SALMON ENHANCEMENT, REHABILITATION, EVALUATION, AND MONITORING EFFORTS CONDUCTED IN THE KODIAK MANAGEMENT AREA THROUGH 2001

by:

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ABSTRACT

Enhancement and rehabilitation of salmon stocks has been ongoing in the Kodiak Island archipelago since the early 1900s, when sockeye salmon *Oncorhynchus nerka* hatcheries were operated at Karluk Lagoon and Afognak Lake. These early programs were not particularly successful. After statehood, the Alaska Department of Fisheries began new programs to rebuild sockeye salmon stocks. Examples of these programs included hatchery stocking at Kitoi Bay, installation of fishways (fish passes or fish ladders) on the Pauls Lake drainage and the Frazer Lake drainage (Dog Salmon Creek), and lake fertilization at Bare Lake. In the 1970s, projects focused on rehabilitating sockeye salmon at Karluk Lake and enhanced pink *O. gorbuscha* and chum *O. keta* salmon production. Fish ladders were also installed at various locations on Afognak Island to increase accessible habitat for sockeye, pink, and coho *O. kisutch* salmon.

In the 1980s, the Alaska Department of Fish and Game along with the newly formed Kodiak Regional Aquaculture Association investigated and implemented various salmon rehabilitation, enhancement, and research programs in the Kodiak Management Area. These programs included limnological and fishery research at Karluk and Frazer Lakes, lake fertilization projects, the construction of Pillar Creek Hatchery to facilitate sockeye salmon outstocking into barren lakes, and fish culture research at Kitoi Bay Hatchery.

In the 1990s, efforts were focused on increasing lake (fertilization and barren lake stocking) and stream (fish passes) habitat, and natural stock rebuilding (stocking). Projects included sockeye salmon broodstock development at Kitoi Bay Hatchery for juvenile stockings at Spiridon Lake. Investigations on lake productivity lead to subsequent lake fertilization and stocking projects, and improvements and maintenance to fish passes on Afognak Island. In addition, coho salmon enhancement was initiated at Kitoi Bay Hatchery, along with expanded pink and chum salmon production. Lastly, comprehensive monitoring and evaluation programs were started at each of the enhancement and rehabilitation projects, which included limnological and fisheries investigations. The projects of the 1990s were carried over into the next decade to provide and maintain supplemental production for the various user groups in the Kodiak Management Area.

This report summarizes enhancement and rehabilitation methods including stocking from Kitoi Bay and Pillar Creek Hatcheries, lake fertilization, the location and operation of barrier bypasses (fish passes), stream clearance activities, and fisheries in special and terminal harvest areas in 2001. The results of enhancement and rehabilitation projects are described in terms of data collected through evaluation and monitoring activities in 2001. Historical data on these projects are summarized in a series of appendices.

In 2001, Kitoi Bay Hatchery personnel released 134,823,670 pink salmon, 20,032,140 chum salmon, and 936,913 coho salmon from saltwater net pens in Big Kitoi Bay. The juvenile outstocking program at Kitoi Bay Hatchery involved the release of 282,089 sockeye salmon into Little Kitoi Lake, 120,000 coho salmon into lower Jennifer Lake, 165,000 coho salmon into Crescent Lake, and 15,000 coho salmon into Katmai Lake.

Releases from Pillar Creek Hatchery typically included remote lake outstockings for the purpose of enhancing sockeye salmon production (stocking in barren lakes) and rebuilding depleted runs (stocking into lakes with natural salmon stocks). Sockeye salmon were released only into barren lakes in 2001 and included 315,500 into Hidden Lake, 310,000 in Little Waterfall Lake, 224,300 into Big Waterfall Lake, 331,500 into Crescent Lake, and 1,700,600 into Spiridon Lake. Juvenile coho salmon were also released into lakes along the Kodiak road system for Sport Fish Division projects.

Sixteen Kodiak and Afognak area lakes were sampled for limnological data from May to September, 2001. Sampling included the collection of light, temperature, dissolved oxygen, pH, and alkalinity levels, and the measurement of dissolved nutrients, algal pigments, and zooplankton abundance and biomass.

Of the lakes sampled, Spiridon Lake was the most transparent or clear lake and Laura Lake was the most turbid lake. Other physical features (temperature, dissolved oxygen) of each lake were within a normal range of readings for the time of year (spring, summer, fall) and the type of lakes (oligotrophic) sampled.

Dissolved nutrients play a key role in the productivity of the lake. Phosphorous and nitrogen, two primary nutrients were tested in various forms for the lakes sampled. Little Kitoi Lake had the highest total phosphorous (13.3 $\mu g\ L^{-1}$) concentration, and Laura Lake had the highest total Kjeldahl nitrogen level at 217 $\mu g\ L^{-1}$ of the lakes sampled. Laura, Little Kitoi, Upper and Lower Malina, and Little Waterfall Lakes were fertilized with a nitrogen-phosphorous solution that artificially elevated these nutrient levels in 2001.

Primary (Chlorophyll *a*, phaeophytin) and secondary (zooplankton) production were measured from most of the lakes. Chlorophyll a (chl *a*) levels were highest in Laura Lake at 5.8 $\mu g\ L^{-1}$ with the lowest level of 0.6 $\mu g\ L^{-1}$ at Spiridon Lake. Phaeophytin (degraded state of chl *a*) levels were highest in the Laura Lake samples (0.9 $\mu g\ L^{-1}$) and lowest at Big Waterfall Lake (0.1 $\mu g\ L^{-1}$). Zooplankton production was measured as density, biomass, and size by genera. Karluk Lake was the most productive by density (242,754 m^2) and biomass (362 mg m^2) levels. Whereas, Saltery Lake had the lowest density levels (9,463 m^2) and Lower Malina Lake had the lowest zooplankton biomass of 9 mg m^2. Copepods were the dominate genera in the Karluk Lake zooplankton community while cladocerans dominated zooplankton communities in Ruth, Big and Little Waterfall Lakes.

Juvenile sockeye salmon populations were estimated at several lakes in 2001. Estimates were made on juveniles in the lake rearing environment and during the smolt migration to the ocean. Rearing juveniles were estimated at four lakes using hydroacoustic techniques. Spiridon Lake had the highest estimate of 2,300,000 million sockeye salmon rearing in the lake, and Hidden Lake had the lowest estimate of 24,444 sockeye. These lakes are stocked annually which provides a variation in abundance based on the stocking strategies for each system. The second method for assessing juvenile production was to determine the smolt population migrating to the ocean. Using mark-recapture techniques, Karluk, Frazer and Malina Lakes sockeye salmon populations were estimated. At Karluk Lake, an estimated 3,740,268 sockeye salmon smolt

migrated to the ocean, while an estimated 941,655 sockeye salmon smolt outmigrated from Frazer Lake and 324,843 outmigrated from Malina Lakes. Total counts of sockeye salmon smolt migrating were also made at Spiridon Lake (1,528,916) and at Little Kitoi Lake (63,537). Age-2 smolt were the predominant age class leaving Karluk, Frazer, and Malina Lakes, whereas age-1 smolt predominated the migrations coming out of Spiridon and Little Kitoi Lakes.

Salmon enhancement and rehabilitation projects provided almost 500,000 sockeye salmon to commercial harvesters in the Kodiak Management Area in 2001, with Frazer and Spiridon Lake projects accounting for 80% of the supplemental sockeye salmon production. Kitoi Bay Hatchery provided 13,000,000 pink salmon, 216,000 chum salmon, 152,000 coho salmon, and 49,000 sockeye salmon to the Kodiak Management Area harvest.

INTRODUCTION

Exploitation, Preservation, and Rebuilding of Kodiak Archipelago Salmon Stocks

Salmon have long been considered an important food source to the indigenous people and other inhabitants of the islands within the Kodiak archipelago. Salmon have been commercially exploited in the Kodiak area for over 150 years, and local people believed it was important to conserve area salmon stocks to provide sustainable harvests (Roppel 1986). Commercial harvests of sockeye salmon were documented as early as 1882. In 1974, a "limited entry system" was adopted by the State of Alaska to regulate participation into the commercial salmon fisheries (Wadle and Brennan 2001). In 2001, 605 commercial salmon permits were available for use in the Kodiak Management Area (KMA); although, only 182 purse seine, and 172 set gillnet permits were actively fished (Wadle 2001; Brennan 2001).

Before Alaska became a state, the federal government was responsible for the management of Alaska's salmon resources. Under federal control Alaska's resources were heavily exploited, as shown by the severe decline in salmon escapements, and the huge volume of salmon exported before statehood by the canned salmon industry. In 1951, the territorial legislature created the Alaska Department of Fisheries (ADF) to preserve and rebuild the salmon runs (ADF 1951). As a way to rebuild depleted runs and protect healthy stocks, the ADF focused on the enhancement of sockeye salmon fisheries (Appendix A). Various strategies including hatchery production, stocking of barren lakes, lake enrichment, and installation of fishways, fish ladders and/or fish passes to circumvent impassable falls were employed to enhance sockeye salmon production and increase harvest opportunities in territorial days.

History of Sockeye Salmon Enhancement, Rehabilitation, and Research

Karluk Lake, located on the southwest side of Kodiak Island (Figure 1), was an important commercial salmon producer during the late 1800s when sockeye salmon were heavily exploited at Karluk Lagoon. According to Roppel (1982), cannery operators built the first hatchery in Alaska at the mouth of the Karluk River in 1896 (Appendix A). The hatchery was operated until 1917, but failed to produce substantial increases in sockeye salmon runs due to poor release strategies (Schmidt et al. 1998).

Estimated sockeye salmon runs at Karluk Lake ranged, on average, from one to two million fish from the 1920s through the 1940s, but declined substantially from the 1950s through the 1970s. The Alaska Department of Fish and Game (ADF&G) implemented a project from 1978-1987 on the Upper Thumb River (UTR) to rehabilitate a portion of the Karluk Lake early sockeye salmon run (Figure 1; Appendix A; White 1986). Between 1979-1981, UTR sockeye salmon fry were 'back stocked' into the river after eggs and fry were cultured at the Kitoi Bay Hatchery (KBH) on Afognak Island (Figure 1). From 1982-1983, eggs were incubated at a remote facility located on the UTR. Eyed eggs were also planted in the gravel on the UTR between 1980-1987. These fry and egg plants increased the UTR sockeye salmon escapement from less than 4,000 fish in 1980, to nearly

50,000 fish in 1988, which represented an increase in the UTR proportion of the total early-run sockeye salmon escapement into the Karluk River from approximately 5% to 20%.

Afognak Lake, located on the southwest portion of Afognak Island, was the site of a large sockeye salmon hatchery operated by the federal government (White et al. 1990; Figure 1; Appendix A). From 1908-1933, the hatchery released sockeye salmon fry into Afognak Lake and shipped eggs to rearing facilities in Alaska and other states. Over 79 million eggs were incubated at the hatchery during the peak years of production. The facility closed after many years of marginal returns and amid controversy over hatchery production (Roppel 1982).

Physical barriers previously blocked fish migrations into the upper reaches of the Pauls Lake system. The system comprises Pauls, Laura, and Gretchen Lakes and is situated in the northeast corner of Perenosa Bay on Afognak Island (Figure 1). Prior to an ADF salmon enhancement project in the early 1950s, sockeye salmon escapement into the Pauls Lake system was limited annually to only a few hundred fish and spawning habitat was underutilized in the upper drainage areas due to the barriers (Honnold and Edmundson 1993; Appendix A). The installation of fishways in 1952 enabled returning adults access around the barriers to the spawning grounds. In addition, eyed sockeye salmon eggs were planted in Gretchen Creek (a Laura Lake tributary) from 1951-1955 to initiate adult returns and to enhance overall sockeye salmon production. By the late 1950s, the sockeye salmon run was well established throughout the Pauls Lake drainage. In 1959, the ADF&G installed a 9 meter steeppass at the original fishway site in Gretchen Creek and a 27 meter steeppass at the highest barrier at Laura Creek in 1964 (Honnold 1991). Modifications and improvements were made at both sites in the 1970s and 1980s by adding more steeppasses, resting pools, and water diversion structures (Honnold and Edmundson 1993).

In 1951, the ADF introduced sockeye salmon into Frazer Lake, which is located on the southwestern end of Kodiak Island (Blackett 1979; Blackett 1987; Kyle et al. 1988; Figure 1; Appendix A). A 10-m waterfall blocked anadromous fish migrations into Frazer Lake. To establish a self-sustaining run, sockeye salmon eggs were planted in tributary streams, and fry and adults were stocked into the lake. In 1962, an Alaska steeppass (Ziemer 1962) was constructed to allow salmon to bypass the barrier falls. The project proved successful in establishing the sockeye salmon run by the late 1970s, and adults from this run are commercially harvested.

Kitoi Bay Research Station, now known as Kitoi Bay Hatchery, was constructed on the southeastern side of Afognak Island in 1953 (Hall et al. 1998; Figure 1; Appendix A). The hatchery facility was built to develop techniques for successfully introducing sockeye salmon into lakes not utilized by anadromous fish (barren), and to evaluate environmental factors related to species competition, predation, and lake production (Meehan 1966). In 1955, the hatchery became operational and research was initiated at Little Kitoi Lake to estimate sockeye salmon smolt emigrations (Figure 1). In 1956, Ruth Lake (a barren lake in the Kitoi Bay area) was studied to examine the effects of predation by resident fish on stocked sockeye salmon fry and how lake production responds to different stocking densities. In the early 1960s, steeppasses and concrete raceways were installed at the outlets of Little Kitoi and Ruth Lakes to provide migration corridors for adults and smolts. The Ruth Lake steeppass was removed and stocking efforts discontinued after the study was completed.

In 1955, Bare Lake on Kodiak Island, which drains into the Ayakulik River (Figure 1) was the first lake in Alaska fertilized with a phosphate and sodium nitrate mixture (Roppel 1986; Honnold et al. 1996; Appendix A). The intent of this project was to determine whether increased nutrient levels in the lake could enhance freshwater growth and survival of juvenile sockeye salmon, and subsequently increase adult production. The resultant fertilizer applications increased zooplankton abundance and produced larger sized smolts (Nelson and Edmondson 1955; Honnold et al. 1996). This project was a precursor to later lake enrichment programs (i.e., Karluk Lake).

Other Salmon Enhancement Projects

In the early 1970s, pink salmon enhancement began at KBH. Annual fry releases were increased dramatically from thousands of fish in the 1980s to hundreds of millions in the 1990s (KRAA 1998). Kitoi Bay Hatchery also began a chum salmon enhancement project in the early 1980s. At first, the project produced mixed results; however, returns to the hatchery have improved in recent years. Pink salmon enhancement on Afognak Island also occurred at Seal Bay and Little Waterfall Creek in the late 1970s (McDaniel 1981; Honnold 1999; Figure 1). Fry plants from KBH, along with the installation of a fish pass did not prove successful at Seal Bay Creek. However, the installation of three fish passes at Little Waterfall Creek allowed for utilization of previously unused spawning habitat. By the early 1980s, increased pink salmon production at Little Waterfall allowed for an annual harvest in Perenosa Bay. A fish pass installed at Portage Creek on Afognak Island in the early 1970s to enhance pink salmon also increased sockeye and coho salmon production (White and Edmundson 1993).

Regional Salmon Production Planning

In accordance with Alaska Statutes 16.10.375-470, the ADF&G Commissioner is responsible for the development of a comprehensive plan for salmon production in the KMA (KRPT 1987; 1992). This responsibility has been delegated to the Kodiak Regional Planning Team (KRPT), consisting of representatives from the ADF&G and the regional aquaculture association. The KRPTs mission is to plan for the long-term future of the salmon resources within the KMA by establishing priorities and examining the region's salmon production potential (KRPT 1992).

In 1983, the Commissioner officially approved the creation of the Kodiak Regional Aquaculture Association (KRAA; KRPT 1992). The purpose of the KRAA was to provide the public and user-groups assistance in the process of enhancing salmon production in the Kodiak Island area in accordance with the KRPT comprehensive plan. In 1983, the results of a questionnaire sent out to commercial, subsistence, and sport fish groups indicated that the preferred salmon species to harvest in descending order were sockeye, pink, coho and chum salmon. Questionnaire results provided the basis for establishing RPT production goals.

In 1984, the Commissioner approved Phase I of the Kodiak Regional Comprehensive Salmon Plan (KRPT 1992). The Phase I plan was categorized into production and harvest goals, research and data gathering goals, and policy and management goals for the next 20 years (1982-2002). In

1992, the KRPT scheduled an interim evaluation (Phase II) to assess the plan's progress. The KRPTs project planning was designed to achieve established goals and objectives, and benefit as many of the fishing user groups as possible (Appendix A). This was accomplished by assessing the needs expressed by the groups during the Phase I planning process. As a result of the planning process, limnological and fishery research were initiated by the ADF&G to achieve the goals and objectives of the KRPT. Schrof et al. (2000) and Honnold and Schrof (2001a) discussed in detail the research projects that were started in the 1980s and 1990s, and the status of these projects to the present (Appendix B).

Evaluation and Monitoring

All salmon enhancement and rehabilitation projects are evaluated and monitored each year through the collection of limnological and fisheries information at each system, including lake primary and secondary production data, juvenile rearing trend data, smolt emigration data, and adult run (catch and escapement) data (ADF&G 2000; 2001; 2002; Figure 2). In addition, rearing hatchery fish are assessed for baseline data and juvenile sockeye salmon are marked at Kitoi Bay Hatchery to assess the success of different stocking strategies.

The purpose of this report is to summarize the methods and results of salmon stockings, lake enrichment, and other enhancement and rehabilitation activities in 2001. Previous years' data are presented in a series of appendices.

Description of the Study Area

The systems studied in this report are located within the KMA, which comprises waters of the western Gulf of Alaska surrounding the Kodiak Archipelago, and along the Alaska Peninsula between Cape Douglas and Kilokak Rocks (Brennan 2001; Wadle and Brennan 2001; Honnold and Schrof 2001a). The archipelago is composed of Kodiak, Afognak, Shuyak, and many smaller islands.

Salmon enhancement and rehabilitation investigations have encompassed an area from Red Fox Lake (58° 26' N lat., 152° 34' W long.) on the northwestern end of Afognak Island to the Olga Lakes (commonly known as Upper Station Lakes) on the southwestern end of Kodiak Island (57° 04' N lat., 154° 15' W long.; Figure 1). Lakes included in the study area are grouped according to island (Kodiak or Afognak) and classified as an enhancement (barren), rehabilitation (anadromous), or monitored system (Table 1; Schrof et al. 2000). The morphology of each lake has been assessed in terms of surface area (SA), mean depth (MD), maximum depth ($M_{ax}D$), and volume. These data can be found in the associated Appendices C.1-C.5, D.1, E.1, F.1, G.1, H.1, I.1-I.2, J.1-J.3, K.1, L.1, M.1, N.1, O.1, P.1, and Q.1-Q.2. Other limnological characteristics such as euphotic zone depth (EZD) and euphotic volume (EV) have also been measured.

Crescent and Spiridon Lakes are enhanced systems on Kodiak Island where continual stocking of juvenile sockeye salmon is required to maintain supplemental returns (Table 1; Figures 1 and 3).

Crescent Lake sockeye salmon (Afognak Lake brood source) return in late May through June. Returning adults are available for 100% harvest in the traditional commercial and subsistence fishing areas (Central Section of the Northwest Kodiak District). The Settler Cove Terminal Harvest Area (SCTHA) was created to harvest adults that escaped the fisheries to the stream terminus (Figure 4). The Spiridon Lake sockeye salmon (Upper Station and Saltery Lake brood sources) project was originally established as a late run stock. Project goals were changed to a stock with an earlier run timing in order to reduce the incidental harvest of local wild pink and chum salmon stocks. Returning adults are harvested in the traditional areas (purse seine and gillnet) of the Northwest Kodiak District. The Spiridon Lake Terminal Harvest Area (SLTHA) was created to harvest excess fish that eluded outside fisheries (Figure 4).

Other lakes without anadromous salmon runs on Kodiak Island that have been investigated for baseline limnology data include Dry Spruce, Goat, and Summit Lakes (Table 1; Figure 1).

Karluk, Frazer, and Bare Lakes are the only lakes on Kodiak Island that have had salmon rehabilitation programs, although many other lakes have been monitored for limnology and fishery data (Table 1; Figure 1). The lakes on the southwestern end of Kodiak Island are the most productive (sockeye salmon escapement and harvest) systems in the Kodiak archipelago. The largest sockeye salmon runs annually averaging more than 500,000 in this area return to Karluk, Red, Frazer, and the Upper Station (Olga) Lakes. Sockeye salmon escapement timing into these systems varies from mid May to late September. Minor systems producing sockeye salmon in this area that have an early to midsummer run timing are Little River, Uganik, Mush, (Northwest Kodiak District) and Horse Marine (Alitak Bay District) Lakes. Karluk, Akalura, and the Upper Station Lakes sockeye salmon runs each contain an early and a late component extending from May to mid September.

Buskin, Saltery, and Rose Tead lakes are considered minor sockeye salmon systems and are located on the northeast end of Kodiak Island near the City of Kodiak (Table 1; Figure 1). The Buskin Lake sockeye escapement returns early, beginning in late May to mid July. Saltery and Rose Tead Lakes sockeye salmon return in late June through early August.

Other anadromous salmon systems on Kodiak Island proper that have been monitored include Barabara, Miam, and Sitkalidak lakes (Table 1; Figure 1).

Hidden, Jennifer, Little Kitoi, Little and Big Waterfall, and Ruth lakes are enhanced systems located on Afognak Island where continual stocking of juvenile sockeye salmon is required to maintain returns (Table 1; Figures 1 and 3). Hidden, Little and Big Waterfall lakes sockeye salmon (Afognak Lake brood source) returns are in late May through June. All adult sockeye salmon that return to Foul Bay (Hidden) and Waterfall Bay (Waterfall) Terminal Harvest Areas are available for 100% harvest (Figure 4). The Little Kitoi Lake sockeye salmon project was originally established as a late-run (Upper Station stock) broodstock development program; however, project goals were changed to an earlier run timing. Using the earlier run timing of the Saltery Lake stock, which was expected to reduce the incidental harvest during the directed pink salmon fishery at Kitoi Bay Hatchery (Schrof et al. 2000; McCullough et al. 2001; Honnold and Schrof 2001a). Early-run sockeye salmon (Afognak Lake stock) stocking into Little Kitoi Lake was discontinued when the

late-run Upper Station stock was changed to the Saltery Lake stock. Jennifer Lake was also stocked with a late-run Upper Station stock, but stocking was discontinued in 1997 when the late-run broodstock was changed at Little Kitoi Lake. Ruth Lake was stocked with Saltery Lake sockeye salmon from 1996 to 2000. The Ruth Lake stocking project was also discontinued when the broodstock was changed at Little Kitoi Lake. Returning adults (both broodstocks) from the Kitoi Lakes (Little Kitoi, Jennifer, and Ruth) were harvested from late June through mid September in the Izhut Bay, Duck Bay and Kitoi Bay statistical fishing areas (Figure 5). Once the returns are strictly Saltery Lake broodstock, the run will end by mid August. The Kitoi Bay Special Harvest Area (KBSHA) is a designated area to collect broodstock and/or open a cost recovery fishery, when either option is determined to be necessary (Figures 2 and 5).

Afognak Island Lakes without anadromous salmon runs that have been monitored for limnology data include Sorg, Big Waterfall, Big Kitoi, and Pillar lakes (Table 1; Figure 1). Sorg Lake was stocked with sockeye salmon in 1997; however, stocking was discontinued because an artificial outlet was not constructed as planned to provide smolt an access from the lake. Big Waterfall Lake was also stocked once in 1992, then stocking was discontinued and re-instituted on an annual basis starting in 1999 and continuing for 2000 and 2001.

Adult returns of Afognak Island sockeye salmon stocks (Afognak, Pauls/Laura, Portage, Thorsheim, Malina, Red Fox, and Little Afognak) start in late May with peak escapements occurring in June (Figure 1). Afognak and the Pauls Lake systems are the largest sockeye salmon producers on Afognak Island. Escapements into Afognak Lake have typically exceeded the current escapement goal range of 40,000 - 60,000 sockeye salmon almost every year prior to 2000. A dramatic drop in the Afognak lake sockeye salmon escapement to 24,271 fish occurred in 2000. The current sockeye salmon escapement goal of 20,000-40,000 fish for the Pauls Lake system was not met from the mid 1980s to the early 1990s. Sockeye salmon escapements to the Pauls Lake system ranged from a high of 50,933 fish in 1980 to a low of 3,237 fish in 1991 with an average escapement of 18,403 between 1980-1992. More recent sockeye salmon escapements (1999-2001) into Pauls Lake have met the current escapement goal (Brodie *in press*). Sockeye salmon escapements into Portage Lake from weir counts have averaged 6,192 from 1990-1993 and 2000-2001, and 8,850 from indexed escapement counts (1978-1989 and 1994-1999). Sockeye salmon escapements into the Malina Lakes system have averaged 14,080 from 1992-2001. Thorsheim and Red Fox Lakes are considered minor sockeye salmon systems with limited escapement information.

Coho salmon enhancement projects have been ongoing at Katmai Lake, near the Village of Ouzinkie on Spruce Island, and Crescent Lake, near the Village of Port Lions on Kodiak Island (Figures 1,2, and 4). Pink salmon enhancement projects at Little Waterfall and Portage Creeks increased spawning habitat availability when the steeppasses became operational (Figures 1 and 6). Returning sockeye and chum salmon adults from projects in the Kitoi Bay area return in June and July, pink salmon return in July and August, and coho salmon return in August and September. Katmai and Crescent Lake coho salmon are primarily harvested in subsistence and sport fisheries near the villages in August and September. Pink salmon returning to Little Waterfall and Portage Creeks are harvested in the Perenosa Bay section during late July and August.

OBJECTIVES

The 2001 objectives for salmon enhancement and rehabilitation projects are described in the Pillar Creek Hatchery (McCullough et al. 2001) and Kitoi Bay Hatchery (McCullough and Aro 2001) Annual Management Plans (AMPs). Similarly, the evaluation and monitoring objectives for 2001 are outlined in individual project operational plans (ADF&G 2001). Objectives established prior to 2001 can be reviewed in the Pillar Creek Hatchery (Honnold et al. 1999; McCullough et al. 2000b; 2001) and Kitoi Bay Hatchery (Hall et al. 1999; McCullough et al. 2000a; McCullough and Aro 2001) AMPs, project operational plans (ADF&G 1999a; 2000; 2001), and Schrof et al. (2000).

METHODS

Hatchery Production

Kitoi Bay Hatchery (KBH)

KBH is a production facility that incubates and raises four species of salmon (Hall et al. 1999; McCullough et al. 2000a; McCullough and Aro 2001). The hatchery program is based on egg takes at Big Kitoi Creek (BKC) and Little Kitoi Creek (LKC), incubation, and rearing of all life stages on-site. Pink and chum salmon are reared in saltwater net pens and released in Big Kitoi Bay (BKB). Depending on release strategies, coho salmon are reared in raceways and short-term reared in net pens before release in BKB. Sockeye salmon presmolt are also reared in raceways before release into Little Kitoi Lake. A small portion of coho are reared in raceways at the hatchery and released into designated lakes in the Kitoi Bay area that do not have anadromous salmon runs.

Saltwater releases in 2001 included 134,823,670 pink salmon (BKC broodstock), 20,032,140 chum salmon (BKC broodstock), and 936,913 coho salmon (BKC broodstock; Table 2; Figures 3 and 5). In addition, Little Kitoi Lake was stocked with 282,089 late-run Saltery Lake (SL) sockeye salmon. In 2001, 120,000 coho salmon (BKC broodstock) were stocked into Jennifer Lakes. Sockeye salmon released into Little Kitoi Lake were marked (fin-clipped) to assess survival and assist with run reconstruction.

KBH also conducted a remote lake out stocking program in 2001. This program entailed incubation and rearing at the hatchery, and then releasing juvenile salmon into lakes located in areas distant from the facility. Remote lakes stocked via KBH in 2001 were Crescent (165,000 BKC coho salmon) and Katmai (15,000 BKC coho salmon) lakes (Table 2; Figures 1 and 3). Historical KBH salmon releases are described, by species, in Appendices C.6-C.12.

Pillar Creek Hatchery (PCH)

The remote lake out stocking program for Kodiak Island has been primarily associated with Pillar Creek Hatchery (PCH; Honnold et al. 1999; McCullough et al. 2000b; 2001; Figure 1). PCH was constructed for the primary purpose of stocking barren lakes and to rehabilitate depressed anadromous systems. In addition, a small number of coho and chinook *O. tshawytscha* salmon are reared at PCH to enhance sport fish opportunities along the Kodiak Island road system. Sockeye salmon egg takes for barren lake stocking projects occur at Afognak and Saltery Lakes (Figure 1). Egg takes were also conducted at Upper Station and Little Kitoi Lakes prior to 2001. Juvenile sockeye salmon were incubated and reared at PCH to the fry, fingerling, and presmolt life stages, prior to release into the selected lakes.

In 2001, early-run sockeye salmon releases of Afognak Lake broodstock from PCH included 315,500 into Hidden Lake, 310,000 into Little Waterfall Lake, 224,300 into Big Waterfall Lake, and 331,500 into Crescent Lake (Table 2; Figure 4). Early-run sockeye salmon releases into Little Kitoi and Sorg Lakes were discontinued after 1997. In 2001, Spiridon Lake was stocked with 1,700,600 sockeye salmon of Saltery Lake stock from PCH (Table 2; Figure 3). Historical releases of sockeye salmon from PCH are listed in Appendices D.2, E.2, F.2, and G.2. Coho salmon juveniles (73,400) were also stocked into Kodiak Island lakes located on the road system in 2001 (McCullough and Clevenger 2002).

As part of the remote outstocking program at PCH, Afognak, Malina, and Laura Lakes sockeye salmon stocks are being rehabilitated. Sockeye salmon eggs are incubated and juveniles are short term reared at PCH. Stockings into these three lakes did not occur in 2001 based on escapement goals being achieved. Previous juvenile sockeye salmon outstockings into lakes being rehabilitated are documented in Appendices H.2, I.3, and J.4.

The egg-take procedures and fish culture methods used to incubate, rear, and release salmon stocked from KBH and PCH are described in the respective hatchery annual management plans (McCullough and Aro 2002 ; McCullough and Clevenger 2002).

Planning Annual Stocking Levels

The primary consideration in developing stocking recommendations is the forage base status of each lake, and secondarily, the rearing limitations (i.e., lack of water, rearing units) at Pillar Creek Hatchery and Kitoi Bay Hatchery. The initial stocking capacity determined for each lake was calculated from bathymetry measurements and two years of light penetration data. These data were applied to a euphotic volume (EV) model as described by Koenings and Burkett (1987). Individual analyses resulted in a recommended range of fry released into a lake, which could produce either threshold (60 millimeter or 2 gram) or optimal (85 millimeter or 5 gram) size sockeye salmon smolt. The lower or optimum level was used as a guide for beginning stocking projects at each barren lake. Stocking levels for anadromous lakes considered for rehabilitation were adjusted based on fry recruitment from the parent-year escapement.

After the first few years of stocking, limnological data provided information used to modify the EV model calculations to adjust stocking capacities for some lakes (Honnold and Schrof 2001b). Consequently, for the last several years, stocking levels have been dynamic, and adjusted in accordance with the zooplankton abundance and biomass trends at each lake. The anadromous systems (Afognak, Malina, and Laura lakes) were evaluated for stocking levels in a similar manner to the barren lakes; however, escapement and lake enrichment were considered significant factors. Lake enrichment has successfully increased the zooplankton abundance and biomass in these lakes and allows more flexibility in stocking. In 1994, a response to declines in the forage base at barren lakes resulted in the implementation of a pre-smolt rearing strategy at the hatcheries. This rearing strategy, in which sockeye salmon are reared until October, was employed to reduce rearing time in the stocked lakes to take advantage of the lower basal metabolism of juveniles in order to lessen the impact on the zooplankton population. Preliminary data indicate that this strategy has worked. Most barren lakes (Hidden, Big and Little Waterfall, and Little Kitoi) are now stocked with pre-smolt. Hidden Lake was stocked for several years with both fry and presmolt; however, reductions in zooplankton indicate that pre-smolt may be the only option to continue production until the forage base rebounds (Honnold and Sagalkin 2001; Honnold and Schrof 2001b). Anadromous lakes appear to be more resilient, and rebound quicker after overgrazing of the zooplankton population. Additionally, fertilization provides a nutrient buffer for anadromous lakes, allowing fry to be stocked at higher levels under the rehabilitation program.

The goal of the planning process is to maintain healthy lake rearing environments while continuing smolt and adult production at cost effective levels. Between 1993-1996, the ADF&G limnology staff advised the ADF&G Kodiak staff and KRAA on the appropriate stocking levels for each lake on an annual basis. Typically, the zooplankton data analysis for a given year was completed by early winter and initial stocking recommendations were provided prior to drafting the AMPs. These recommendations were adjusted slightly to accommodate the rearing capacity and schedule of the hatcheries.

Since 1996, in-season analysis of zooplankton data collected at each stocked lake has assisted with planning current year stocking adjustments when needed, and establishing and planning the following year's goals. In 1997, when limnology support was discontinued, the Kodiak ADF&G staff developed the stocking recommendations (Honnold et al. 1998; 1999) and assumed all limnological processing and analyses responsibilities for the Westward Region in 2000.

Lake Enrichment

Lake enrichment programs have been an integral part of the rehabilitation and enhancement projects in the KMA since 1990. The intent of the lake enrichment projects has been to increase zooplankton biomass, fry growth and survival, and adult returns. Fertilizer applications were continued in 2001 at many lakes on Afognak Island, including upper and lower Malina, Laura, Little Waterfall and Little Kitoi Lakes (Figure 7). Lake enrichment projects were completed prior to 2001 at Karluk (1986-1990), Frazer (1988-1992), Portage (1993-1997), and Afognak (1990-2000) Lakes (Figure 1).

Lakes have been treated with a nutrient addition composed (20 N-5 P-0 K ratio) of an aqueous nitrogen (N), white phosphorus (P), and potassium (K) solution sprayed from a fixed-wing aircraft (Kyle 1994; Koenings and Kyle 1997). The fertilizer type was based on the phosphorus and nitrogen levels in each lake. Phosphorus was added in the form of inorganic phosphate and nitrogen as a mixture of ammonium, nitrate, and urea. A fertilizer N-to-P ratio of 20:1 is the optimal ratio used for non blue-green algal production (Vollenweider 1976). Calculations were based on supplemental phosphorus levels with an annual mean loading rate of 90% according to equations by Vollenweider (1976). The fertilizer was applied to the lake surface on a weekly basis from June through August to minimize rapid flushing of nutrients. The amount of liquid fertilizer applied in 2001 ranged from 2,587 (lower Malina) to 12,106 (Laura) kilograms (Table 3). Historical nutrient applications by lake are described in Appendices C.13, F.3, H.3, I.4, J.5, K.2, L.2, and M.2.

Barrier Bypasses – Increasing Available Habitat

Adult Bypass Systems

Another method used to increase salmon production in the Kodiak Island archipelago has been the installation and operation of barrier bypasses (also referred to as fishways, steeppasses, fish passes, or fish ladders) to allow utilization of previously unavailable spawning and rearing habitat. Currently, there are nine operational bypasses in the Kodiak Island archipelago: Dog Salmon Creek (Frazer River) fish pass is located on Kodiak Island, and Little Kitoi Lake, Portage Creek, Laura Creek, Gretchen Creek, Little Waterfall Creek, and Seal Bay Creek fish passes are located on Afognak Island (Table 4; Figure 6). The history behind the bypasses and the systems where they are utilized is briefly described in Schrof et al. (2000). Photos of the bypasses, except for the Seal Bay Creek bypass, are provided in Appendices C.14, F.4, J.6, K.3, and L.3.

Spiridon Lake Smolt Bypass

A smolt bypass system installed at Telrod Creek (draining Spiridon Lake) to move sockeye salmon smolt downstream around injurious barrier falls has been operated since 1992. Stocked fry utilize the nursery habitat in Spiridon Lake and migrate out as smolt via a pipeline around the falls to the marine environment. Smolt are enumerated and sampled for age and size as they pass through the bypass system. A more detailed description of the design and materials (Appendix D.3) used and other methods are provided in Honnold (1997) and ADF&G (2001).

Stream Clearance

Stream clearance projects have also been used to provide improved access to spawning and rearing habitat (Schrof et al. 2000). In 2001, Jennifer and Ruth creeks in the Kitoi Bay area (Figure 6) were examined periodically to ensure that no obstructions to smolt passage existed.

Harvest Opportunities for Enhanced Salmon

Salmon enhancement projects require methods for harvesting adult salmon returns in an orderly fashion without adversely affecting wild stocks (McCullough et al. 2001a; McCullough and Aro 2001). Harvest strategies for enhanced salmon returns include special openings in the designated THA and, if broodstock collection or cost recovery fishing is required in the Special Harvest Areas (SHA). These harvest areas are included as part of management plans for the KMA that were previously approved by the Alaska Board of Fisheries (BOF; Wadle 2001; Brennan 2001). There is one SHA (Kitoi Bay) and five THAs (Settler Cove, Foul Bay, Waterfall Bay, Malina Creek and Spiridon Lake) in the KMA (Table 5; Figure 4).

Kitoi Bay SHA

The Kitoi Bay harvest strategy is described in the Eastside Afognak Management Plan (5AAC 18.365) for the Duck, Izhut, and Kitoi Bay Sections (ADF&G 1999b; Figure 5). The Kitoi Bay Hatchery provides enhanced salmon fishing opportunities for the Kodiak common property fisheries by increasing returns of sockeye, coho, pink and chum salmon to Kitoi Bay (Hall et. al 1999). The Kitoi Bay SHA was created to harvest all excess salmon after broodstock needs are met (Table 5). Kitoi Bay SHA boundaries include all waters northwest of a line from the regulatory markers located at the entrance to Kitoi Bay commonly known as "the jaws" (Hall et al. 1999; Figure 5).

Settler Cove THA

Juvenile sockeye salmon have been stocked into Crescent Lake annually, since 1992 (Honnold et al. 1998; Figure 3; Appendix G.2). Crescent Lake, a barren lake, empties into Settler Cove, part of Kizhuyak Bay. These areas are managed within the Central Section of the Northwest Kodiak District. Coho salmon have also been stocked into the lake each year since 1988 (Appendix G.2). A management plan was adopted (5AAC 18.364) by the Alaska BOF in 1990 governing the harvest of Crescent Lake coho salmon (Brennan 1998). This plan did not cover a harvest strategy for returning sockeye salmon. However, a terminal harvest area was established in regulation, 5AAC 18.377, to provide for the harvest of returns to Settler Cove (ADF&G 1999b; Figure 4). The Settler Cove Terminal Harvest Area boundaries are all waters of Settler Cove west of 152° 50.80' W long. (Table 5; Appendix G.3).

Foul Bay THA

Juvenile sockeye salmon have been stocked into Hidden Lake annually since 1992, under a cooperative agreement between the United States Fish and Wildlife Service (FWS), ADF&G, and the KRAA (Honnold et al. 1998; Honnold and Schrof 2001b; Figure 3; Appendix E.2). The intent of this project is to enhance the common property fishery in the KMA using an early-run (June to early July) sockeye salmon stock (Afognak Lake) returning to Foul Bay. The Foul Bay Terminal Harvest Area (in regulation 5ACC 18.375; ADF&G 1999b) boundaries encompass all waters of Foul Bay east of 152° 47.20' W long. to the terminus of Hidden Creek (stream #251-406; Table 5;

Figure 4; Appendix E.3). All returning adult sockeye salmon are available for harvest in the commercial fishery by the installation of a barrier weir across Hidden Creek (Appendix E.4).

Waterfall Bay THA

The Waterfall Lake early-run sockeye salmon enhancement project was started in 1992 to increase the fish available for commercial harvest by permit holders in the KMA (Honnold et al. 1998; Figure 3; Appendix F.2). Little Waterfall Lake has been used as a rearing area for juvenile sockeye salmon that eventually migrate to the ocean and return to Waterfall Bay as adults. All returning adult sockeye salmon are made available for commercial harvest by the use of a barrier net blocking salmon migrations into Little Waterfall Creek (Appendix F.5). The Waterfall Bay THA was put into regulation 5AAC 18.376 to provide for an orderly harvest in the commercial fishery (ADF&G 1999b). The THA boundaries include all waters seaward of the stream terminus of streams 251-821 and 251-822 to a straight line extending northwesterly from 58° 24.15' N lat., 152° 28.23 W long. to 56° 25.60' N lat., 152° 30.80' W long. (Table 5; Figure 4; Appendix F.6).

Malina Creek THA

The Malina Lakes rehabilitation project began in 1991 to increase the natural production of sockeye salmon to the system. To increase sockeye salmon production, the ADF&G and the KRAA implemented a lake fertilization project along with supplemental fry stockings, using the sockeye salmon stock of origin (Kyle and Honnold 1991; Figure 3 and 7). In the event that an excess number of sockeye salmon return to Malina Creek, the KMA biologist by emergency order (EO) may open the Malina Creek THA to commercial salmon fishing (Honnold and Schrof 2001a). The THA boundary (5AAC 18.378) consists of all waters within one-half nautical mile of the beach near the terminus of Malina Creek between 58° 10.00' N lat. and 58° 11.00' N lat. (ADF&G 1999b; Table 5). This regulation was approved by the BOF in January, 2002 and went into effect at the beginning of the 2002 commercial salmon season.

Spiridon Lake THA

The Spiridon Lake sockeye salmon enhancement project was initiated in the late 1980s between the ADF&G and the USFWS (Honnold 1997; Honnold et al. 1998; Figure 3; Appendix D.2). The purpose of the project was to provide supplemental sockeye salmon for the commercial harvest in traditional westside Kodiak fishing areas of the KMA. In 1993, the BOF adopted the Spiridon Lake Sockeye Salmon Management Plan (5AAC 18.366) establishing the terminal harvest area at Telrod Cove as a designated area to harvest surplus sockeye salmon (ADF&G 1999b; Figure 4). The Spiridon Lake Terminal Harvest Area (SLTHA) boundaries include all waters of Telrod Cove north of a line extending from Stream Point 57° 39.00' N lat., 153° 38.50' W long. to 57° 38.80' N lat., 153° 37.60' W long. (Table 5; Appendix D.4). The SLTHA boundary had originally encompassed a larger area in Spiridon Bay but was reduced to Telrod Cove in 1995 to limit interception of chum and pink salmon destined for the Spiridon River at the head of Spiridon Bay.

Scale pattern analysis along with visual scale pattern identification was conducted from 1994 through 1997 to estimate the contribution of Spiridon Lake sockeye salmon in the Kodiak's westside commercial catches. Stock separation of sockeye salmon returning to Spiridon Lake was discontinued after 1997. However, the results from the 1994-1997 stock assessment studies, which provide a mechanism to account for Spiridon Lake origin, were applied to the 2001 harvest data from the THA, the SW Afognak Section and NW Kodiak Districts combined.

Evaluation and Monitoring: Limnological Assessment

All lakes were assessed for baseline limnology data for a minimum of two years prior to the initiation of salmon enhancement (stocking) and/or rehabilitation (stocking and/or fertilization) projects (Schrof et al. 2000; Honnold and Schrof 2001a). Once stocking and/or fertilization projects were initiated, monitoring annual limnological trends at each lake were continued throughout the program for a minimum of two post-project years. In 2001, lakes assessed for fertilization included Afognak, Little Waterfall, Malina (lower and upper), Laura, and Little Kitoi Lakes (Table 6; Figure 7). Crescent, Hidden, Little Waterfall, and Spiridon Lakes were assessed for stocking effects. Saltery Lake was also monitored because the sockeye salmon are taken as broodstock for the Spiridon Lake project. Spiridon and Hidden Lakes were monitored more frequently for more limnological parameters to comply with the FWS Environmental Assessment (EA) criteria. Lastly, Karluk, Frazer, Big Waterfall, Upper and Lower Jennifer, and Ruth Lakes were sampled as part of continued monitoring or post-project sockeye salmon stocking assessments.

Lake Sampling Protocol

Limnological surveys were conducted on 16 Kodiak and Afognak Island lakes in 2001 (Table 6). Surveys were conducted at approximately 4-6 week intervals during the ice free season (May-September) for a total of four to five surveys per lake (except for Big Waterfall Lake where only three zooplankton samples were collected). Float-equipped aircraft provided transportation to and from sampling sites. Surveys were conducted after mooring to an anchored buoy (station) at the deepest point in the lake. Because of the relatively large surface area and EA sampling requirements, two sampling stations were established at Spiridon and Frazer lakes. At each station, measurements of temperature, dissolved oxygen, and light penetration were taken, and zooplankton samples collected. In addition, water samples were also collected from Afognak, Hidden, Laura, Little Kitoi, Little and Big Waterfall, Upper and Lower Malina, and Spiridon Lakes. Sampling and laboratory analysis methods are described below in detail and in Schrof et al. (2000).

Lake Morphometry

Equipment and procedures used to chart the bottom profiles of each lake are described in Schrof et al. (2000). Depth profiles were determined for each lake following procedures outlined by Honnold et al. (1996). Once depth profiles were established, the surface area (SA), total volume, maximum depth, and mean or average depth were calculated for each lake (Schrof et al. 2000).

Light and Water Clarity

Underwater light intensity or downward light penetration was measured as foot-candles using a Protomatic© submersible photometer sensitive to the visible spectral range (400-700 nanometers). Measurements were taken at 0.5-m increments from the surface to a depth of 5 m, and at subsequent 1-m increments to the lake bottom or to a depth equivalent to 1% of the subsurface reading. The vertical extinction coefficient for downward light (K_d, m^{-1}) was obtained from the equation:

$$I_z = I_o e^{-Kd} \text{ or } \ln I_z = \ln I_o - K_d z \quad (1)$$

where I_z and I_o are the values of light penetration at z meters (m) and just below the surface, respectively (Wetzel and Likens 1991). The linear regression coefficient of ln I_z against depth (z) gives the value of K_d. Assuming K_d is constant with depth, the euphotic zone depth (EZD) or the depth at which 1% of the subsurface light remains, is given by $4.6/K_d$ (Kirk 1994). Water transparency was measured using a standard 20-cm diameter black and white Secchi disk at the depth averaged when the disk disappeared and reappeared from the observer's view.

Temperature and Dissolved Oxygen

Temperature profiles measured in Centigrade (^oC) and dissolved oxygen (DO) levels measured in milligram per liter (mg l^{-1}) were collected from the lake surface to the bottom or to a maximum depth of 50 meters at 1-m increments using a YSI model 50-B analyzer. Temperature probe accuracy was calibrated against a mercury thermometer in each lake. The meter self-calibrates for DO levels, and samplers verified DO levels against the temperature and altitude conversion table on the back of the meter to ensure the meter was working properly.

General Water Chemistry and Nutrients

Beginning in 2000, the Kodiak ADF&G began operating a limnology laboratory locally because the Statewide Limnology laboratory in Soldotna scaled back on the analysis of water chemistry and nutrient parameters. In 2001, analysis of water chemistry and nutrient parameters were further reduced to testing pH and alkalinity. Historically, Kodiak area lakes have been extensively tested for conductivity, pH, alkalinity, turbidity, color, calcium, magnesium, iron, silicon, and carbon. Water samples for general water chemistry and nutrient analyses that were collected and analyzed prior to 2000 followed procedures outlined in Koenings et al. (1987), and the ADF&G laboratory operational plan (ADF&G 2002).

Hydrogen Sulfide

An anoxic hydrogen sulfide layer was discovered on the bottom of Little Kitoi Lake in 1990 (ADF&G 1998). Testing to quantify the volume of H_2S on the lake bottom was started in 1993. During the winter of 1995-1996, hydrogen sulfide was removed by submerging a 10-cm diameter polyethylene pipe in the lake basin and creating a siphon that partially removed the bottom layer of hydrogen sulfide from the lake.

Water samples were collected and tested from two stations established on Little Kitoi Lake for the presence of hydrogen sulfide in 2001. Samples were collected and prepared for analysis as outlined by Strickland and Parsons (1972) and Cline (1969) and modified by Koenings et al. (1987). The sulfide was converted to a violet-colored compound by its reaction with p-phenylenediamine and ferric chloride. The results of the H_2S sample tested was then multiplied by 0.60 to determine toxic levels of H_2S in the bottom layer (Koenings et al. 1987).

Chlorophyll *a*

Discrete samples for the analysis of the algal pigment chlorophyll *a* (chl *a*) were collected at the 1-m depth and analyzed by methods described by Koenings et al. (1987) and the ADF&G (2002).

Zooplankton

Vertical zooplankton hauls from each site were collected using a 0.2-m diameter, 153-µm mesh, conical net. The net was pulled manually at a constant speed (~0.5 m sec^{-1}) from 2 m off the lake bottom or from a maximum depth of 50 m to the surface. Net contents from each tow were emptied into separate 125-ml polybottles and preserved in 10% neutralized formalin. Cladocerans and copepods were identified according to taxonomic keys in Pennak (1989) and Thorp and Covich (1991). Zooplankton were enumerated and measured in triplicate 1-ml sub-samples taken with a Hansen-Stempel pipette and placed in a Sedgewick-Rafter counting chamber. Lengths of 15 animals of each species were measured to the nearest 0.01 mm and the mean body length for each taxon was calculated. Biomass was estimated from species-specific linear regression equations between length and dry weight derived by Koenings et al. (1987).

Marine Temperature, Salinity, and Plankton Sampling

Temperature (^{o}C) and salinity in parts-per-thousand (0/00) profiles were determined at four sites in Kitoi Bay using a YSI model 33 S-C-T meter. Readings were taken at the surface down to 20 m or just off the bottom at 1-m increments.

Plankton tows were conducted to measure phytoplankton and zooplankton levels at three sites in Kitoi Bay. At each site, two vertical tows were retrieved manually at a constant rate using a 23-cm diameter, 153-µm mesh plankton net. Both plankton samples were poured into a graduated settling cylinder for 24 hours before measuring. Phytoplankton and zooplankton volumes were measured separately to the nearest ml.

Evaluation and Monitoring: Juvenile Assessment

Indices of Juvenile Rearing Abundance

Hydroacoustic surveys were conducted on Hidden, Little Kitoi, Little Waterfall and Spiridon Lakes in 2001 to provide indices of rearing juvenile sockeye salmon populations. Surveys consisted of collecting data along transects perpendicular to the longitudinal axis of each lake. Data were

recorded along each transect at night when juvenile sockeye salmon were more likely to be distributed in the upper to middle part of the water column (Unger and Brandt 1989; Hansson 1993; Appenzeller and Leggett 1995). Specific field methods and instruments used for data acquisition are described by the ADF&G (2001).

The hydroacoustic data for each lake were analyzed by "Echo Counting" techniques using procedures described by ADF&G (2001). The lakes' surface area, strata depths, target counts, and percents-per-stratum were entered into a computer program. Targets (fish) attributable to the estimate were enumerated by zooming to a depth range, working across each depth range in each transect, and counting the number of echoes per fish. The echoes per fish were entered into the computer program. Estimates for each stratum were computer-generated and total population estimates made by summing the strata. The variances and 95% confidence intervals (CI) for the total fish estimates were calculated using formulae from Thorne and Thomas (1982) described by Kyle (1990).

Species Composition, Age, and Size of Rearing Sockeye Salmon

Townet catches are used to estimate the juvenile sockeye salmon population for each survey by multiplying the composition of sockeye in the combined townet catches by the total fish population estimate. Transect and strata variances as well as the 95% CI for juvenile sockeye population estimates were calculated using formulae from Thorne (1983), described by Kyle (1990). Species composition estimates were not made for Hidden, Little Waterfall, and Spiridon Lakes because water clarity complicated the successful capture of sockeye salmon. Few other species reside in these lakes so hydroacoustic estimates were used as indices of rearing sockeye salmon abundance. Estimates of abundance generated by townet data as applied to hydroacoustic data were typically from anadromous lakes (e.g., Saltery Lake) where large populations of sticklebacks occur. These estimates were also considered relative indices of abundance.

Historically, hydroacoustic and townet surveys have been conducted at most project lakes and other lakes previously monitored for fish population trends. Previous surveys occurred at Afognak, Akalura, Crescent, Frazer, Karluk, Laura, Malina, Portage, Red, and Upper Station Lakes (Figure 1).

Sockeye Salmon Smolt Estimates

Frazer, Karluk, and Malina Lakes. Mark-recapture (M/R) dye test programs were re-instituted at Frazer Lake in 1990, at Karluk Lake in 1999, and initiated at Malina Lakes in 1992 to estimate the emigrating sockeye smolt populations. The M/R program has been conducted each year through 2001 at Frazer Lake. The trap on the outlet from Frazer Lake was operated from 8 May to 3 July in 2001. Smolt population studies have been ongoing annually from 1999 to 2001 at Karluk Lake, and the trap was operational from 6 May to 3 July in 2001. At Malina Lake, the smolt project was discontinued in 1992 and then reinitiated in 1997 and continued annually through 2001. In 2001, the trap was operated at Malina Creek from 12 May to 25 June. The methods used at Frazer, Karluk, and Malina Lakes were very similar and described in detail in the 2001 operational plans (ADF&G 2001).

Little Kitoi Lake. Each year since 1995, a fyke net trap (4-mm mesh) was set up in the fish pass compound at the outlet of Little Kitoi Lake to enumerate the sockeye smolt emigrations. The trap was operated from 8 May to 27 July in 2001.

Spiridon Lake. As previously described, a bypass system has been used since 1992 to pass smolt emigrating from Spiridon Lake around the outlet falls (Honnold 1997). In 2001, timed counts of smolt passing through the bypass system were used to estimate the daily sockeye smolt outmigration from 3 May to 3 July. Methods for obtaining smolt counts and a description of their movement through the bypass system are provided in Schrof et al. (2000) and ADF&G (2001).

Prior sockeye salmon smolt emigration estimates were made for other Kodiak Island lakes including Afognak, Akalura (Coggins and Sagalkin 1999), Karluk, Red (Coggins 1997), and the Upper Stations Lakes (Barrett et al. 1993).

Sockeye Salmon Smolt Age and Size

Sockeye salmon smolt were captured to sample for age and size during outmigrations in 2001 from Frazer, Karluk, Malina, Little Kitoi, Spiridon, Afognak, Hidden, Laura, Little Waterfall, Portage, and Saltery Lakes. Smolt were collected using a Canadian fan trap, fyke net, incline trap, dip net or beach seine in the outlet stream or drainage of the respective lake. In addition, raceway-rearing smolt or presmolt were sampled from Pillar Creek Hatchery and Kitoi Bay Hatchery prior to release. Smolt were anesthetized in a tricaine methanesulfonate (MS-222) and water solution and sampled for AWL as previously described for rearing fish.

Assessment and Monitoring: Adult Production

Enhanced Salmon Runs: Early Run

Crescent Lake. Crescent Lake sockeye and coho salmon runs were monitored by tracking catches in the Settler Cove THA (259-35) through the ADF&G database. Prior to July 16, the THA is not open to commercial fishing unless a large number of adults escape the normal fishing periods in the traditional fishing areas in the KMA. A barrier net is not used to block these two species from entering freshwater, due to natural barriers preventing salmon access to the lake, and the villagers of Port Lions utilize all inriver escapement for subsistence purposes. Subsistence catches are tracked through the ADF&G fish ticket database. Field data are not collected from the Crescent Lake sockeye and coho salmon runs.

Hidden Lake. In 1992, a monitoring camp was established in the southeast corner of Foul Bay approximately 500 meters from the creek mouth to monitor the Hidden Lake sockeye salmon run (ADF&G 1998; Honnold et al. 1998; Honnold and Schrof 2001). Returns of sockeye salmon to Foul Bay did not occur until 1994. At that time, age 1.1 fish (jacks) were the only returns documented. Beginning in 1995, the Foul Bay Terminal Harvest Area (statistical area 251-41) was designated for the commercial harvest of early run sockeye salmon returning to Hidden Creek. To prevent adult sockeye salmon from escaping into the creek, a barrier weir (Appendix

E.4) was installed and maintained annually from June 1 to June 30. The weir was located approximately 100 m upstream from the stream terminus. Methods for assembling the barrier weir are summarized by the ADF&G (2002).

Daily surveys were conducted in Foul Bay to assess sockeye salmon run strength with information relayed to the commercial fishery managers at 0800 and 2000 hour radio schedules. During the fishery opening, the date, fishing and tender vessel names, fishing location, and estimated catch by species were recorded. All sockeye salmon harvested in the FBTHA (statistical area 251-41) were attributed to the Hidden Lake enhancement project.

Little Kitoi Lake. Early-run sockeye salmon releases were discontinued at Little Kitoi Lake in 1997. However, returns from previous releases continue to be monitored as in past years. Harvests of all salmon species are estimated by field personnel in the Kitoi Bay Section (statistical area 252-32) by interviewing fishers and tenders operators. The ADF&G fish ticket database is used to estimate catches in the Kitoi, Duck and Izhut Bay sections (statistical areas 252-30 and 252-31).

The sockeye salmon broodstock development program at Little Kitoi Lake was evaluated and the broodstock was changed in 1997 (1998 stocking year) from Upper Station Lake to Saltery Lake for the Spiridon Lake enhancement project. In 2001, the sockeye salmon (Afognak and Upper Station stocks) escapements were prevented from entering Little Kitoi Lake as part of the transition to the new broodstock. Periodically, the fish pass was opened to prevent straying of sockeye salmon holding in the estuary and to check for fin clipped fish during fishery closures. Sockeye salmon collected in the compound were examined for marks, sampled, and returned to salt water, where they became available for commercial harvest. Sockeye salmon returned to salt water were hole punched in the caudal fin for an external mark to identify previously sampled fish that re-entered the compound through the fish pass. The fish pass was opened in September to permit the passage of coho salmon into the lake.

Little Waterfall Lake. A monitoring camp was established at Little Waterfall Creek in the early 1980s to maintain fish passes and monitor pink salmon production (Honnold 1999). Beginning in 1994, the camp has been utilized to monitor the sockeye salmon return to Little Waterfall Creek. Monitoring activities in the Waterfall Bay THA (statistical area 251-84) parallel those at the Foul Bay THA, except that a barrier net (Appendix F.5) rather than a barrier weir was hung in the Little Waterfall Bay estuary to prevent sockeye salmon from escaping into the creek. Modifications and location changes to the barrier net have occurred occasionally since 1995. A thorough description of the installation and type of netting used for the barrier net is provided in the ADF&G operational plans (ADF&G 2002).

Enhanced Salmon Runs: Late Run

Jennifer, Little Kitoi, and Ruth Lakes. Sockeye salmon returning to Jennifer, Little Kitoi, and Ruth Lakes were caught incidentally in the commercial fisheries targeting pink salmon in the Kitoi, Izhut and Duck Bay Sections. System specific run evaluations did not occur for Jennifer and Ruth Lakes because returning adults were harvested in the same statistical areas as Little Kitoi fish.

Spiridon Lake. Spiridon Lake late-run sockeye salmon that escaped the traditional fisheries in the Northwest Kodiak District were targeted for harvest in the Spiridon Lake THA located at Telrod Cove. ADF&G personnel monitored the commercial salmon fishery at Telrod Cove from late-June to mid-September in 2001. Sockeye salmon returns to Telrod Cove started in 1994 and have continued annually to date. During this time, the ADF&G monitored the commercial fishery at Telrod Cove. A barrier net was installed in the intertidal area at the mouth of Telrod creek from 1994-1997 to prevent sockeye salmon from entering the creek. Due to straying concerns expressed by the ADF&G Genetics staff, the net was not installed after 1997 so that any fish escaping the fishery were free to ascend Telrod Creek.

Natural Salmon Runs

Adult production from the rehabilitation projects at these systems was primarily assessed through monitoring of escapement and harvest trends. Escapements were enumerated through weirs at Afognak (1978-2001), Pauls (1984-2001), and Malina (1992-2001) Lakes. Portage Creek escapements were enumerated through a weir for some years (1989-1993 and 2000-2001), but were primarily indexed through tributary foot surveys and aerial surveys. Harvests were primarily tracked through the ADF&G fish ticket database.

Lastly, Saltery Lake sockeye salmon were monitored for escapement as related to broodstock collection. In-season estimates of total escapement were used to determine if egg takes could occur and how many brood fish could be used (Honnold et al. 1998; Hall et al. 1998). Frazer Lake sockeye salmon escapements were also enumerated via the fish pass (Brodie *in press*).

Field camps, weir configurations and operations for escapement monitoring are described in detail by Brodie (2001) and the ADF&G (2001).

Commercial Catch, Escapement and Broodstock Sampling

Sockeye salmon catches were sampled for age, length, and sex (ALS) data at the Foul Bay THA, Waterfall Bay THA, Kitoi Bay, and Spiridon Lake THA. Other catches in the Northwest Kodiak District and the Afognak District were also sampled to identify Spiridon Lake sockeye salmon as part of run reconstruction efforts (Honnold 1997; Nelson 1999).

Afognak, Pauls, Malina and Portage sockeye salmon escapements were sampled for ALS data. Little Kitoi sockeye salmon escapements were also sampled prior to the change in the late-run broodstock.

Frazer, and Saltery Lakes sockeye salmon escapements were also sampled for ALS data. Commercial harvests were also sampled for ALS data as part of the Frazer Lake run reconstruction. Chum salmon broodstock at Kitoi Bay Hatchery were sampled. Sampling procedures for the above collections were followed as described by the ADF&G (2002).

PROJECT EVALUATION AND MONITORING RESULTS

Limnological Assessment

Lake Sampling

Sampling was conducted at 14 systems on Kodiak and Afognak Islands in 2001 (Table 6; Figure 1). Lakes were sampled based upon project category (fertilization, stocking, broodstock, and environmental assessment). Spiridon Lake had two sampling stations and all other lakes had one station. Three seasonal samples were collected from Lower Jennifer and Big Waterfall Lakes. Four seasonal samples were collected from Crescent, Upper Jennifer, Little Waterfall, Ruth and Saltery Lakes. Five seasonal samples were collected at Spiridon, Hidden, Afognak, Laura, Little Kitoi, Upper and Lower Malina Lakes. Sampling occurred from 2 May to 18 September. A total of 47 water samples were obtained from nine lakes and 81 zooplankton tows were pulled from 16 lakes. In the past, more samples were collected annually from Kodiak and Afognak lakes, however, budget constraints have reduced sampling efforts in recent years (Appendix C.14, D.5, E.5, F.7, G.4, H.4, I.5, J.7, K.4, L.4, M.3, N.2, O.2, P.2, and Q.3).

Lake Morphometry

The morphometric characteristics of each lake are summarized in Table 1 and bathymetric maps of each lake, including those surveyed in prior years are presented in Appendices C.1-C.5, D.1, E.1, F.1, G.1, H.1, I.1-I.2, J.1-J.3, K.1, L.1, M.1, N.1, O.1, P.1, and Q.1-Q.2. Karluk Lake has the largest surface area (39.4 km^2) and total volume (1,920 km^3) of the lakes surveyed. Frazer Lake is the second largest in volume (551 km^3), but has only about a third of the volume and less than half the maximum depth of Karluk Lake. Spiridon (318 km^3), Red (208 km^3), and the upper Olga Lake (208 km^3) are the third through fifth in total volume (Table 1). Smaller lakes at the other end of the spectrum in terms of volume are Ruth (1.1 km^3), Gretchen (1.4 km^3), Summit (1.6 km^3), and Big Waterfall (1.6 km^3) Lakes. Lakes that have a smaller basin size (volume) typically have similar morphometric characteristics (surface area, mean depth). These lakes, except for Summit Lake, are located on Afognak Island.

Karluk was the deepest lake surveyed at 126 m with a mean depth of 48.6 m. Lower Olga (Upper Station) Lake was the shallowest lake at 2 m on Kodiak Island. Hidden and Thorsheim Lakes are in similar locations on Afognak Island; however, they differ greatly in basin parameters. Hidden Lake is the deepest lake on Afognak Island with a maximum depth of 42 m and a mean depth of 10.8 m, whereas Thorsheim Lake is the shallowest lake with a maximum depth 12.4 m and a mean depth of 5.1 m.

Light Penetration and Turbidity

The mean vertical extinction coefficient (K_d m^{-1}), or rate of light attenuation, was lowest in Frazer Lake (0.15) and highest in Little Waterfall Lake (1.01) in 2001 (Table 7). Frazer Lake had the greatest euphotic zone depth (EZD) at 29.3 m while Laura Lake had the lowest EZD at 7.3 m.

Average Secchi disk transparency readings ranged from a depth of 10.5 m in Spiridon Lake to a depth of 2.5 m in Laura Lake. Spiridon Lake was considered the most transparent or clear and Laura Lake was the least transparent of the lakes sampled. Frazer Lake was also fairly transparent, however readings were collected only once, thus seasonal variation cannot be determined for comparison.

Other low light attenuated or optically deep lakes included Frazer, Karluk, Crescent, and Saltery Lakes. In these lakes, K_d ranged from 0.15 to 0.30 m^{-1}, EZD from 29.3 to 15.4 m, and SD transparency from 6.4 to 4.4 m. In Schrof et al. (2000), readings from these same lakes in 1998 indicated a smaller seasonal variation within and between each lake than observed in 2001.

Temperature and Dissolved Oxygen

In 2001, spring temperatures varied considerably in many of the lakes from the surface to the bottom indicating temperature stratification (Table 8). Temperature stratification (in the spring) was distinct in all of the lakes, except for Afognak, Crescent, Lower Malina, and Saltery Lakes, where temperatures varied only 1-2° C from the lake surface to the bottom. Maximum lake surface temperatures ranged from 12.6^{o} C to 18° C during the summer sampling period. Lower Malina Lake again showed little or no temperature variation from the surface to the bottom in the summer. Fall temperature profiles varied from lake to lake but were generally stratified except in Little Waterfall and Lower Malina Lakes. Often times, the water column stays well mixed in shallow lakes in the summer due to strong winds. Lakes in this region typically show a fairly complete mixing of the water column in the spring and fall. These mixing events can occur from any number of conditions, including high winds or ice melt (Cole 1983). In the summer as water temperatures warm at the surface, the lake waters stratify creating a cool dense bottom layer (hypolimnion) and a warm upper layer (epilimnion), separated by a temperature gradient (thermocline). Throughout the sampling season changes occurred in the temperature recordings. The 2001 season was different in that, except for lakes listed previously, temperature stratification had been completed before sampling occurred.

Dissolved oxygen (DO) concentrations in the spring (May-June) ranged between 7.2 and 12.9 mg L^{-1} throughout the entire water column for the lakes sampled (Table 9). During the summer (July-August), DO levels decreased approximately 1-2 mg L^{-1} near the surface and varied considerably near the bottom throughout the lakes sampled. Spiridon and Hidden Lakes had DO levels that differed by 2.3 mg L^{-1} from the bottom to the surface. This is quite common in lakes with a large volume of water and deep basins. Low DO levels (3-4 mg L^{-1}) at the bottom of Ruth, Little Kitoi, and Upper Malina Lakes measured in the fall indicated a lack of mixing in the water column.

Major Dissolved Constituents

In 2001, pH and alkalinity levels were measured in nine lakes (Table 10). PH readings were all between 7.2-7.5 units. These readings exhibited little seasonal variation in each lake as indicated by the low standard deviations. Alkalinity levels ranged from 8.1 (Hidden) to 24 mg L^{-1} (L. Kitoi), showing more variability in each lake. Historical summaries of all Kodiak area lakes sampled for pH, alkalinity, and water chemistry parameters that were measured prior to 2000 are

provided in Appendices C.15-17, D.6, E.6, F.8, G.5, H.5, I.6-7, J.8, K.5, L.5, M.4, N.3, O.3, P.3, and Q.4.

Dissolved Nutrients

Mean seasonal total phosphorus (TP) concentrations ranged from 4.9 to 13.3 μg L^{-1} and Kjeldahl (organic nitrogen + ammonia) nitrogen (TKN) concentrations ranged from 81.3 to 217 μg L^{-1} in the 1-m stratum lake samples (Table 10). Little Kitoi Lake had the highest TP level, and Laura Lake had the highest TKN concentration. Hidden and Spiridon Lakes had the lowest levels measured for TP, and Little and Big Waterfall Lakes had the lowest TKN levels of the lakes sampled. Laura, Little Kitoi, Upper and Lower Malina, and Little Waterfall Lakes were fertilized with a nitrogen-phosphorus mixture in 2001. Fertilization of these lakes may have artificially elevated nutrient levels and these fertilizer applications may have contributed to the seasonal variability between the sampling dates.

Inorganic dissolved nitrogen existing as ammonia (NH_3) and nitrate (NO_{3-}) is assimilated by phytoplankton in the lake. Mean seasonal ammonia concentrations in the 1-m stratum ranged from 2.1 to 6.6 μg L^{-1} (Table 10). Nitrate + nitrite levels varied noticeably ranging from a low of 6.7 μg L^{-1} at Big Waterfall Lake to a high of 193.8 μg L^{-1} at Spiridon Lake. Standard deviations of the seasonal mean for nitrate + nitrite levels were also high.

Inorganic phosphorus concentrations varied little among the lakes. Mean seasonal total filterable phosphorus (TFP) levels ranged from 3.1 to 6.4 μg L^{-1}; and filterable reactive phosphorus (FRP) ranged from 1.9 to 8.2 μg L^{-1} (Table 10). Afognak and Upper Malina Lakes had the highest TFP and FRP concentrations among the lakes. Big Waterfall and Spiridon Lakes had the lowest TFP and FRP levels measured of the sampled lakes.

Historical summaries of all Kodiak area lakes sampled for pH, alkalinity, and water chemistry parameters that were measured prior to 2000 are provided in Appendices C.15-17, D.6, E.6, F.8, G.5, H.5, I.6-7, J.8, K.5, L.5, M.4, N.3, O.3, P.3, and Q.4.

Hydrogen Sulfide

In 2001, H_2S testing was completed in two basins in Little Kitoi Lake. The main basin (station 1) had no detectable level of H_2S and the sample at the second station contained 2,122 μg L^{-1} of H_2S. The 2,122 μg L^{-1} H_2S level was multiplied by 0.60 to determine toxic levels of the bottom layer. Toxicity of the H_2S layer was 1,910 μg L^{-1} with 3 μg L^{-1} considered lethal to fish (Koenings et al. 1987). Based on the results from the previous years' sampling, H_2S levels have decreased (Appendix C.18).

Morphometric maps of Little Kitoi Lake show the estimated volume of H_2S prior (Appendix C.19) to the siphoning process and after the H_2S was removed (Appendix C.20).

Chlorophyll *a*

The mean near-surface (1-m) chlorophyll-*a* (chl-*a*) concentration ranged from 0.6 in Spiridon Lake to a high of 5.8 μg L^{-1} in Laura Lake (Table 10). Seasonal fluctuations throughout the growing season were limited in most of the lakes sampled as indicated by the small standard deviations. However, chl-*a* levels in Laura and Little Kitoi Lakes were the exception with standard deviations close to each lakes seasonal mean. Phaeophytin *a* concentrations ranged from 0.10 to 0.94 μg L^{-1} with considerable seasonal variation. Laura Lake had the highest mean phaeophytin concentration (0.94 μg L^{-1}) and Big Waterfall Lake the lowest level at 0.10 μg L^{-1}.

Historical nutrient, and algal pigment concentrations for each lake sampled are summarized in Appendices C.21-C.23, D.7, E.7, F.9, G.6, H.6, I.8-I.9, J.9, K.6, L.6, M.5, N.4, O.4, P.4, and Q.5.

Zooplankton Abundance and Species Composition

The zooplankton community in the Kodiak area lakes are primarily composed of the cladocerans *Bosmina*, *Daphnia*, and *Holopedium* and the copepods *Epischura*, *Diaptomus*, and *Cyclops* (Koenings et al. 1987). Cladocerans dominated the samples taken from many of the Kodiak area lakes in 2001 (Table 11). Afognak (52%), Crescent (52%), and Spiridon (55%) lakes were more evenly split in the cladoceran to copepod ratio with cladocerans still the slight majority of plankton counted. The zooplankton communities in Saltery (82%) Lower Jennifer (79%) and Karluk (79%) lakes were dominated by copepods. Mean zooplankton density, biomass, and body length by taxa for all lakes in 2001 are presented in Table 12. Mean total zooplankton (TMZ) density (animals per m^2) ranged from a low at Saltery Lake of 9,463 m^2 to a high at Karluk Lake of 242,754 m^2, and TMZ biomass (milligram per m^2) ranged from 9 mg m^{-2} at Lower Malina Lake to 465 mg m^{-2} at Upper Jennifer Lake.

In 2001, the barren lakes varied in TMZ densities and biomass. Upper and Lower Jennifer, Little Waterfall, and Ruth Lakes had higher TMZ densities compared to Spiridon, Crescent, Hidden, Little Kitoi, and Big Waterfall Lakes. However, TMZ biomass for these lakes did not follow the same pattern. For example, Spiridon (299), Crescent (188), and Big Waterfall (290) Lakes had higher TMZ biomass levels than Little Waterfall Lake (159). Most of these lakes have ongoing stocking programs, except that sockeye salmon stocking was discontinued in 1997 at Ruth, Upper and Lower Jennifer Lakes as well as the fertilization program at Little Waterfall Lake.

Annual trends in zooplankton density, biomass, and size for Kodiak area lakes are summarized in attached appendices (Appendices C.24-31, D.8-9, E.8-9, F.10-11, G.7-8, H.7-8, I.10-13, J.10-11, K.7-8, L.7-8, M.6-7, N.5-6, O.5-6, P.5-6, and Q.6-9).

Marine Temperature, Salinity, and Plankton Abundance: Kitoi Bay

Three sampling stations were established in Kitoi Bay to measure water temperatures at three different times in 2001. Temperatures ranged from 4.5°C at 20 m on 11 May to 10°C on 4 June at the surface (Table 13). Historical water temperature profiles are summarized in Appendix C.32.

Salinity readings were taken concurrently to temperature measurements (Table 14). Salinity levels ranged from 20 to 30 parts per thousand (ppt). Surface measurements at Stations 1 and 2 had slightly lower salinities. Freshwater flushing into the bays will typically remain in the upper layer of the water column due to the density difference between fresh and salt water. The differences in salinity levels were hardly detectable in 2001. Historical salinity levels are summarized in Appendix C.33.

In 2001, the highest total plankton levels were 340-390 mls measured on 11 May (Table 15). Phytoplankton levels were high in the first sample (11 May) tested and decreased steadily in the next two samples. Zooplankton levels increased after each successive sampling period. Historical zooplankton levels for Kitoi Bay are summarized in Appendix C.34.

Fishery Assessment

Juvenile Rearing Abundance

Sockeye salmon population estimates in 2001 for four Kodiak area lakes are summarized in Table 16. The highest estimated fish population was 2,331,383 +/- 487,738 (95% confidence interval) at Spiridon Lake and the lowest, 24,444 +/- 6,725, estimated at Hidden Lake. Rearing fish populations were also estimated at Little Kitoi Lake (38,952 +/- 8,418) and Little Waterfall Lake (33,128+/- 27,684).

Historical juvenile population estimates for each lake are summarized in Appendices C.35, D.10, E.10, F.12, G.9, H.9, I.14, J.12, K.9, L.9, M.8, N.7, O.7, P.7, and Q.10. Historical townet effort and catch composition are summarized in Appendices C.36, F.13, G.10, H.10, I.15, J.13, K.10, L.10, M.9, N.8, O.8, P.8, and Q.11.

Age and Size of Rearing Juveniles

Tow net surveys were not conducted to estimate sockeye salmon production and age compositions of rearing sockeye salmon in 2001. The lakes surveyed with hydroacoustic equipment in 2001 are clear lakes, producing large juveniles that are able to avoid capture in the townet. Prior AWL data for years townet catches were sampled are summarized in Appendices C.37, F.14, G.11, H.11, I.16, J.14, K.11, L.11, M.10, N.9, O.9, P.9, and Q.12.

Sockeye Salmon Smolt Estimates

Frazer, Karluk, and Malina Lakes. The smolt trap at the outlet to Frazer Lake was operated from 8 May to 3 July with a total sockeye salmon smolt capture of 348,692 (Table 17). A sockeye salmon smolt estimate of 941,655 (95% CI = 866,342 - 1,016,814) were calculated from M/R trials. AWL samples (n=2,600) indicated that smolt ages during the migration were predominantly age 2. smolt (95.7%).

In 2001, the Karluk River smolt project was continued using M/R trials to estimate the population. A smolt trap was operated from 6 May to 3 July and trapped 205,705 sockeye salmon smolt. Using the Carlson estimator (Carlson et al. 1998), a population of 3,740,268 (95% CI = 3,136,398 – 4,344,111) sockeye salmon smolt was estimated. Migrating smolt were predominately age 2. (81.9%; Table 17).

Smolt trapping was conducted at the outlet of lower Malina Lake from 12 May to 25 June in 2001 (Table 17). A total of 58,186 sockeye salmon smolt were trapped and M/R trials resulted in a total emigration estimate of 324,843 (95% CI = 279,835 - 540,812) sockeye salmon smolt. The emigration were 37% age 1. (120,523) and 57% age 2. (183,479) smolt with a small number (20,839) of age 3. fish also represented.

Little Kitoi Lake. A fyke net was set up in the compound Appendix C.13) at the outlet to Little Kitoi Lake from 8 May to 27 July. A total of 63,537 sockeye salmon smolts were trapped at the outlet (Table 17). The age structure was 95% age 1. and 5% age 2.

Spiridon Lake. Sockeye salmon smolt emigrated through the Spiridon Lake bypass system and pipeline from 3 May through 3 July in 2001 (Table 17). Time and actual count estimates indicated that 1,528,916 smolt emigrated. Of these, 71% (1,087,695) were age 1. and 29% (441,221) were age 2.

Other Systems. Sockeye salmon smolt captured at other systems for AWL sampling in 2001 included 62 from Afognak Lake, 447 from Hidden Lake, 198 from Laura Lake, 199 from Little Waterfall Lake, 200 from Portage Lake, and 12 from Saltery Lake (Table 17).

Sockeye salmon smolt trapping and abundance data from Kodiak area lakes for prior years are summarized in Appendices C.38, D.11, H.12-13, I.17, L.12, M.11, O.10, P.10, and Q.13. Smolt population estimates at Akalura, Red and Upper Station Lakes were originally calculated according to Rawson (1984) based on the M/R trials and reported in Schrof et al. (2000). Adjustments to these population estimates were made according to Carlson et al. (1998) and tabulated in Appendices O.10, P.10, and Q.13.

Emigration Timing

Sockeye salmon smolt emigrated from Malina (12 May-25 June), Little Kitoi (8 May-27 July) and Spiridon (3 May-3 July) Lakes from early May through July (Figure 8). Additionally, sockeye salmon smolt emigrated from Frazer and Karluk Lakes in early May through the first week in July. Peak emigrations occurred around the first week in June at Little Kitoi and Karluk Lakes, the last week in May at Malina Lakes, and late May at Spiridon and Frazer Lakes. Timing of sockeye salmon smolt emigrations from Kodiak area systems (prior to 2001) are summarized in Appendices C.39, D.11, H.12-13, I.18, L.13, and O.11.

Smolt Age and Size

Sockeye salmon smolt sampled for AWL information in 2001 were predominantly age 1. juveniles from Afognak, Malina, Hidden, Little Kitoi, Little Waterfall, Portage, and Spiridon Lakes (Table 18). Age 2. smolt were the more predominate age class sampled from Frazer, Karluk and Laura Lakes.

The age 1. sockeye salmon smolt migrating from Little Kitoi Lake were the largest in length with an average of 107 mm and 8.5 g., and the smallest smolt were captured in Saltery Creek (age 1.; 63 mm, 2.1 g; Table 18). Spiridon Lake produced the largest age 2. smolt (136 mm, 20 g) sampled and Saltery Lake age 2. sockeye salmon smolt were the smallest sampled (69 mm and 3.1 g). All sockeye salmon sampled were in good condition, except for Little Kitoi smolt as reflected by their condition factors.

Sockeye salmon AWL data for prior year smolt catches are summarized in Appendices C.40, D.12, E.11, F.15, H.14, I.19, J.15, K.12, L.14, M.12, N.10, O.12, P.11, and Q.14.

Preseason Forecasts, Catches, and Total Enhanced Run Estimates

Crescent Lake (Settler Cove THA). The preseason forecast for the 2001 sockeye salmon run, as a result of the stocking into Crescent Lake, was 14,600 early-run adults (Table 19). Commercial fishing opened 9 June 2001 for a 33-hour opening in the SCTHA (statistical area 259-35) and again on 14 June (Brennan 2001). The latter fishery opening continued until 9 July, and the final fishing period in the THA was from 14 July through 17 July. Throughout this period, 3,722 sockeye salmon, averaging 5.6 pounds (lbs.) were harvested and resulted in an exvessel value of $14,590 (Table 19; Appendix R). The majority of the sockeye salmon catch (2,400) occurred from 9 June through 13 June in the SCTHA. Subsistence fishers harvested an additional 1,524 sockeye salmon in 2001 for a total run to the SCTHA of 5,449 sockeye salmon. Commercial harvests of Crescent Lake sockeye salmon occurred in the Central Section of the Northwest Kodiak District outside of SCTHA.

Coho salmon have been stocked into Crescent Lake annually since 1988. The projected return of coho salmon was 6,500 adults (Table 19). However, the actual harvest was only 160 coho salmon, which were caught in the subsistence fishery. The only other commercially harvested salmon in the SCTHA were 16 chinook and 15 chum salmon (Appendix R).

Hidden Lake (Foul Bay THA). Annual releases of juvenile sockeye salmon into Hidden Lake were projected to produce 34,000 adult sockeye salmon in 2001 (Table 19). The FBTHA (statistical area 251-41) was open to commercial fishing continuously from 9 June through 8 July in 2001 (Brennan 2001; Table 19). Throughout the fishery, 29,822 sockeye salmon were harvested in the FBTHA (Table 20; Appendix R). The average weight was 5 lbs. for an exvessel value of $104,377. In addition, 104 chinook salmon, 1,141 pink salmon and 53 chum salmon were harvested incidentally to sockeye salmon in the FBTHA in 2001. The majority of the sockeye were harvested from early to mid-June, similar to the timing of the broodstock used (Afognak Lake) for stocking Hidden Lake (Figure 9; Appendix R).

Kitoi Bay Area (Kitoi, Duck, and Izhut Bays). The preseason forecast for early-run sockeye salmon returning to Little Kitoi Lake was 8,400 adults (Table 19). The Kitoi Bay (252-32), Duck Bay (252-31), and Izhut Bay (252-30) statistical fishing areas were opened to target the chum salmon returning to Kitoi Bay Hatchery. Commercial catches of sockeye salmon were 5,138 in Kitoi Bay, 14,252 in Duck Bay, and 4,584 in Izhut Bay for a total catch of 23,974 Little Kitoi fish (Tables 20; Appendix R). These sockeye salmon averaged 5.5 lbs. for an exvessel value of $92,300. The majority of early-run sockeye salmon were harvested in late June (Figure 10; Appendix R). Eighty-seven additional early-run sockeye salmon were harvested by sport fishers in the Kitoi Bay area, which increased the Little Kitoi Lake early run to 24,061 adults in 2001 (Table 19).

A late-run sockeye salmon run of 27,800 fish was forecasted as a result of the stocking projects at Jennifer, Little Kitoi, and Ruth Lakes, as well as salt water releases in Little Kitoi Bay (Table 19). The same sections as described above were opened from 16 July through 18 September (Brennan 2001; Table 20). The late-run sockeye salmon harvest was 1,653 from Kitoi Bay, 16,867 from Duck Bay, and 6,022 from Izhut Bay for a total harvest of 24,542 adults (Tables 19 and 20; Appendix R). The late-run sockeye salmon commercial harvest (5.5 lb. fish) was worth $94,487. The majority of this harvest occurred around mid-August (Figure 10; Appendix R). In 2001, the total run (early and late) to the Kitoi Bay area was 48,521 sockeye salmon (Table 19).

Commercial catches of pink, chum, and coho salmon also occurred in the Kitoi Bay area in 2001. Preseason forecasts were for runs of approximately 4.2 million (3.8 million for harvest) pink salmon, 92,000 (62,000 for harvest) chum salmon, and 115,000 (109,000 for harvest) coho salmon (Table 19). Actual commercial harvests were 13,126,761 pink salmon, 216,266 chum salmon, and 151,732 coho salmon (Table 19; Appendix R). The exvessel values of these harvests were $5,198,197 for pink salmon, $519,038 for chum salmon, and $298,609 for coho salmon.

Little Waterfall Lake (Waterfall Bay THA). The Waterfall Bay THA (251-84) was opened to commercial salmon fishing from 9 June through 8 July, 2001. An estimated 23,500 sockeye salmon were forecasted for harvest in 2001 (Table 19). The actual harvest estimate was 16,023 sockeye salmon (Tables 19 and 20; Appendix R). The fish weighed an average of 4.6 lbs. for an exvessel value of $51,594. The timing of harvests in the WBTHA paralleled those in the FBTHA (Figure 9). Additional harvest during the sockeye fishery included 3 chinook, 33 pink, and 3 chum salmon (Appendix R).

The pink salmon run to Little Waterfall Creek was estimated on foot at 37,355 fish in 2001 (Appendix F.17). Only 3,171 pink salmon were harvested at Little Waterfall due to strong returns of pink salmon in the KMA. The exvessel value of the pink salmon harvest was $1,256 (Table 19).

Spiridon Lake (Spiridon Lake THA). The SLTHA (254-50) was open to continuous fishing from 27 June through 10 September (Brennan 2001; Table 20). The forecast for the sockeye salmon run to Spiridon Lake was 201,000. The harvest in the THA was 59,733 sockeye salmon, 70,883 pink salmon, 12,885 chum salmon, and 345 coho salmon (Brennan 2001; Appendix R). The total 2001 Spiridon Lake harvest was estimated at 146,678 sockeye salmon, which averaged

5.2 lbs. each and had an exvessel value of $533,908 (Tables 19). An additional 1,600 sockeye (Telrod Creek escapement) were not harvested; thus, the total run was estimated to be 148,278 adults in 2001. The run timing paralleled the broodstock's escapement timing; Saltery Lake fish returned primarily in July and Upper Station fish returned primarily in August (Figure 11).

Katmai Lake (near the Village of Ouzinkie). The forecast for the coho salmon run to Katmai Lake was 1,500 fish (Table 19). Commercial catch data on coho returns to Katmai Lake were limited and sport and subsistence catch data from Ouzinkie village residents could not be obtained.

Historical preseason forecasts, catches, and total enhanced run estimates for the aforementioned systems are described in Appendices C.41, D.13, E.12, F.16, and G.12.

Preseason Forecasts, Catches, Escapements, and Total Natural Run Estimates

Afognak Lake. Afognak Lake sockeye salmon runs have not been formally forecasted; however, supplemental production is projected each year. Based on stocking numbers, approximately 21,000 supplemental sockeye salmon were projected to return in 2001 (Table 19). A commercial harvest of sockeye salmon from statistical area 252-34 (Afognak Bay) did not occur in 2001 due to low returns to the system. The subsistence harvest was 4,788 and sport fish harvest was 118 sockeye salmon. The sockeye salmon escapement of 24,271 was well below the minimum escapement goal of 40,000 established for this system (Nelson and Lloyd 2001). The total Afognak Lake sockeye salmon run in 2001 was 29,177 adults.

Laura (Pauls) and Portage Lakes (Perenosa Bay Section). Laura and Portage Lakes sockeye, pink, and coho salmon runs have not been formally forecasted. Supplemental sockeye salmon production is projected each year for Laura Lake. Based on stocking numbers, approximately 1,900 supplemental sockeye salmon were projected to return in 2001 (Table 19). The total harvest from statistical area 251-82, 251-83 (Perenosa Bay) was 26 sockeye salmon for an exvessel value of $84 (Table 19; Appendix R). The subsistence fishery harvest was estimated at 96 sockeye salmon, plus an additional 23,221 fish were counted through the weir (Brodie *in press*).

A fish weir was operated upstream of the fish pass on Portage Creek to count sockeye salmon in 2001 (Brodie *in press*). The 2001 sockeye salmon escapement into Portage Lake was 3,147.

The coho salmon harvest from the Perenosa Bay section was 21,518 adults in 2001 (Table 19; Appendix R). The coho salmon averaged 8.4 lbs. for an exvessel value of $36,150. Subsistence and sport fishers harvested another 884 coho and the escapement through the Pauls Bay weir was 25,015 fish (Brodie *in press*), for a total run of 47,417 fish in 2001. Coho salmon typically return to Pauls Bay in late August and early September (Figure 12). Also, 15,404 pink salmon were enumerated through the weir at Pauls Bay in 2001.

Malina Lakes. The preseason forecast for the enhanced portion of the sockeye salmon run to the Malina Lakes was 38,000. Stocking has occurred from 1992-1999 to provide enhanced

production into this system. A formal stock separation analysis was not implemented to assess supplemental fish production. Commercial (4,001) and subsistence (95) fishers harvested 4,096 sockeye salmon in 2001 and the escapement was 22,490 (Brodie *in press*) for a total run of 26,586. The commercial sockeye salmon harvest of 4,001 was valued at $13,723. The run timing of this early-run stock was similar to the average timing of previous years (Figure 12).

Frazer Lake. The sockeye salmon run to Frazer Lake was forecasted to be 487,000 adults with a projected harvest of 347,000 (Table 19). The actual catch was 239,936 sockeye salmon valued at $940,549. The escapement was 163,455 sockeye salmon for a total run of 403,689 in 2001 (Appendix L.15; Honnold and Schrof 2001). The sockeye salmon escapement fell within the escapement goal range of 140,000 to 200,000 fish.

Saltery Lake. Saltery Lake sockeye salmon runs have not been formally forecasted due to the inability to estimate the catch bound for Saltery Lake. Adult escapement levels are monitored as a way to measure production. In 2001, 45,668 sockeye salmon were enumerated through the Saltery Lake weir (Brodie *in press*; Nelson and Lloyd 2001). The escapement was above the upper end of the escapement goal of 40,000 fish. Escapement timing (July) was similar in 2001 to the previous 10-year average (Figure 11).

Age Compositions of Escapements and Harvests

Adult sockeye salmon were sampled for age determination at nine systems that were part of the enhancement, rehabilitation, and monitoring projects in the KMA for 2001 (Table 21). Sample sizes varied between projects based on the sampling objectives (ADF&G 2001). The number of scale samples collected ranged from a high of 1,819 sockeye salmon from Spiridon Lake THA and Spiridon Bay (setnet site) combined to a low of 163 samples from the Malina Creek THA commercial salmon harvest. The predominant age class at each system were identified as follows: Afognak Lake escapement was dominated by age 2.3 fish (45%), Foul Bay THA – age 1.3 (68%), Little Kitoi Lake/Bay harvest – age 2.3 fish (72%), Malina Lake escapement/ harvest – age 1.3 (43%), Pauls Lake escapement – age 2.3 fish (37%), Saltery Lake escapement – age 1.3 (55%), Spiridon Lake THA harvest – age 1.2 fish (59%), and Waterfall Bay THA harvest – age 1.3 fish (57%).

Historical age compositions of escapements, and catches for years prior to 2001 are tabulated in Appendices C.42, D.14, E.13, F.18, H.15, I.20, J.16, K.13, and N.11.

SUMMARY

Salmon rehabilitation, enhancement, and research programs have been conducted in the KMA since the early 1900s. Data collected from more recent investigative projects in the late 1980s through 2001 have been presented in this report.

Lake habitat is critical for rearing juvenile sockeye salmon. To assess sockeye salmon rearing habitat in the systems with rehabilitation and enhancement projects, a limnological sampling program was implemented in the KMA to closely monitor the physical, chemical, and biological parameters of project lakes. In these investigations, the lakes were either classified as anadromous (self-sustaining) or non-anadromous (barren) systems. Anadromous systems such as Karluk, Afognak, and Malina Lakes were considered depressed in terms of sockeye salmon production. Since sockeye salmon escapement goals were not being achieved, these systems are referred to as 'rehabilitation systems'. Non-anadromous systems such as Frazer, Laura, Spiridon, Hidden, Little and Big Waterfall, and Crescent Lakes are considered enhancement projects with the intent to provide supplemental sockeye salmon to commercial fisheries. As a whole, the lakes evaluated exhibited seasonal and annual variations that were within the normal range for parameters measured.

Kitoi Bay Hatchery and Pillar Creek Hatchery produce juvenile salmon to increase supplemental harvest production in the KMA common property fishery. Kitoi Bay Hatchery produces pink, chum, and coho salmon for commercial fishers. Sockeye salmon production at Kitoi Bay Hatchery also provides for broodstock development and supplemental harvest in the commercial fishery through outstocking projects. Pillar Creek Hatchery was built as an outstocking facility to enhance sockeye salmon production through barren lake stockings and to rehabilitate depressed sockeye salmon systems.

To further evaluate and monitor production, juvenile sockeye salmon populations were estimated utilizing hydroacoustic surveys in the lakes or mark-recapture and other techniques in outlet streams as fish were emigrating from their respective lakes. Smolt estimates and AWL information provides some indication on the overall health (condition coefficient) of the migrating smolt. Changes in smolt health provide insight into the zooplankton community and status of other lake parameters by comparing pre-project smolt AWL data to current smolt data. The smolt length-to-weight relationships were evaluated to adjust stocking levels and fertilizer applications.

Adult salmon production was determined by weir escapement counts and foot surveys at systems under evaluation. Enhanced production of sockeye salmon was estimated at terminal harvest areas from on-site ADF&G field personnel and fish ticket harvest data. Age composition of salmon stocks and contributions to the commercial fisheries were made using SPA.

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Table 1. Geographic location and morphometric parameters for Kodiak and Afognak Island area lakes.

Lake	Latitude (N)	Longitude (W)	Surface Area (km^2)	Mean Depth (m)	Maximum Depth (m)	Volume (km^3)
Kodiak Island						
Akalura	57° 11.2'	154° 13.2'	4.9	9.9	22.0	48.0
Barabara	57° 48.8'	152° 57.1'	1.4	3.1	11.6	4.4
Buskin	57° 46.7'	152° 32.9'	1.1	10.4	16.8	11.6
Crescent	**57° 51.7'**	**152° 58.1'**	**0.6**	**10.3**	**35.4**	**6.2**
Dry Spruce	57° 53.7'	152° 59.4'	0.6	8.0	26.0	4.9
Frazer	**57° 15.0'**	**154° 08.0'**	**16.6**	**33.2**	**58.9**	**551**
Goat	57° 27.3'	153° 02.4'	0.7	13.2	25.2	8.9
Horse Marine	57° 07.3'	153° 54.7'	0.9	12.2	28.7	11.0
Karluk	**57° 21.8'**	**154° 02.9'**	**39.4**	**48.6**	**126.0**	**1,920**
Little River	57° 46.4'	153° 39.3'	1.4	12.7	18.2	17.4
Miam	57° 29.8'	152° 34.8'	0.6	3.8	7.0	2.5
Mush	57° 40.8'	153° 26.9'	0.3	10.3	13.4	3.1
Red	57° 14.8'	154° 1.5'	8.4	24.7	45.0	208
Rose Tead	57° 29.1'	152° 27.8'	0.9	2.0	5.2	1.8
Saltery	**57° 32.4'**	**152° 45.8'**	**1.1**	**21.0**	**36.0**	**22.0**
Sitkalidak	57° 07.0'	153° 11.9'	na[a]	na[a]	na[a]	na[a]
Spiridon	**57° 43.3'**	**153° 41.1'**	**9.2**	**34.7**	**82.0**	**318**
Summit	57° 32.5'	152° 32.1'	0.3	6.0	13.4	1.6
Uganik	57° 39.8'	152° 19.4'	0.8	17.2	79.0	13.0
Upper Station - Upper	57° 03.8'	154° 12.2'	7.9	26.2	70.0	208
- Lower	57° 03.3'	154° 18.2'	na[a]	na[a]	2.0	na[a]
Uyak	57° 35.1'	154° 00.1'	0.4	6.6	11.0	2.8

-Continued-

Table 1 (page 2 of 2)

Lake	Latitude (N)	Longitude (W)	Surface Area (km^2)	Mean Depth (m)	Maximum Depth (m)	Volume (km^3)
Afognak Island						
Afognak	**58° 06.4'**	**152° 55.5'**	**5.3**	**8.6**	**23.0**	**46.0**
Big Waterfall	**58° 24.0'**	**152° 35.3'**	**0.3**	**5.8**	**15.0**	**1.6**
Big Kitoi	58° 11.0'	152° 23.4'	na[a]	na[a]	38.1	na[a]
Gretchen	58° 17.9'	152° 14.7'	0.3	4.5	15.2	1.4
Hidden	**58° 22.2'**	**152° 42.5'**	**1.9**	**10.8**	**42.0**	**20.6**
Jennifer - Upper	**58° 11.7'**	**152° 17.8'**	**0.4**	**10.6**	**26.0**	**4.1**
- Lower	**58° 11.3'**	**152° 17.8'**	**0.2**	**9.8**	**26.0**	**1.7**
Little Kitoi	**58° 12.1'**	**152° 22.1'**	**0.4**	**11.1**	**24.4**	**4.8**
Little Afognak	58° 08.9'	152° 24.3'	1.4	5.8	28.0	8.1
Little Waterfall	**58° 21.0'**	**152° 32.5'**	**1.0**	**6.8**	**18.3**	**6.7**
Laura	**58° 21.3'**	**152° 18.2'**	**4.2**	**12.0**	**39.0**	**50.5**
Malina - Upper	**58° 09.5'**	**153° 05.1'**	**1.2**	**15.3**	**33.5**	**18.4**
- Lower	**58° 09.5'**	**153° 08.1'**	**0.7**	**6.9**	**15.0**	**4.6**
Pillar	58° 11.0'	152° 08.7'	0.4	4.8	27.0	2.1
Paul's	58° 22.8'	152° 19.8'	0.6	11.4	21.3	6.9
Portage	**58° 16.3'**	**152° 25.9'**	**1.7**	**7.6**	**22.8**	**13.0**
Red Fox	58° 25.4'	152° 35.5'	0.3	5.8	21.3	1.7
Ruth	**58° 11.7'**	**152° 17.9'**	**0.2**	**7.1**	**17.1**	**1.1**
Sorg	58° 08.2'	152° 20.3'	0.5	7.3	19.0	3.6
Thorsheim	58° 14.6'	152° 49.0'	0.5	5.1	12.4	2.5

Area lakes in bold were enhanced, rehabilitated, or monitored in 2001.
[a] na indicates data are not available.

Table 2. Kodiak Management Area salmon stocking numbers by stocking location, species, life stage, date, and size at stocking, 2001.

Stocking Location [a]	Species [b]		SMOLT [c] (BY99)	FRY [c] (BY2000)	FINGERLING [c] (BY2000)	PRESMOLT [c] (BY2000)	Totals
Big Kitoi Bay	Chum	Number		20,032,140			20,032,140
		Date / Size		23-May / 1.7 g			
Big Kitoi Bay	Coho	Number	936,913				936,913
		Date / Size	1-June / 20.8 g				
Big Kitoi Bay	Pink	Number		134,823,670			134,823,670
		Date / Size		23-May / 0.7 g			
Crescent Lake	Coho	Number		165,000			165,000
		Date / Size		22-June / 0.9 g			
Crescent Lake	Sockeye	Number			218,000	113,500	331,500
		Date / Size			26-July / 4.5 g	2-Oct / 14 g	
Hidden Lake	Sockeye	Number			66,500	249,000	315,500
		Date / Size			25-May / 0.8 g	5-Oct / 13.5 g	
Jennifer Lake	Coho	Number		120,000			120,000
		Date / Size		22-June / 0.9 g			
Katmai Lake	Coho	Number		15,000			15,000
		Date / Size		1-Nov / 8.4 g			
Little Kitoi Lake	Sockeye	Number				282,089	282,089
		Date / Size				1-5 Oct / 9.5 g	
Little Waterfall Lake	Sockeye	Number			36,000	274,000	310,000
		Date / Size			25-May / 0.8 g	5-Oct / 12 g	
Big Waterfall	Sockeye	Number			50,800	173,500	224,300

-Continued-

Table 2. (page 2 of 2)

Stocking Location [a]	Species [b]		SMOLT [c] (BY99)	FRY [c] (BY2000)	FINGERLING [c] (BY2000)	PRESMOLT [c] (BY2000)	Totals
Lake		Date / Size			25-May / 0.8 g	2-Oct / 15 g	
Spiridon Lake	Sockeye	Number			1,700,600		1,700,600
		Date / Size			16-21 June / 0.8 g		
Pillar Creek	Sockeye	Totals	0	0	2,071,900	810,000	2,881,900
Kitoi Bay	Sockeye	Totals	0	0	0	282,089	282,089
KMA	Sockeye	Totals	0	0	2,071,900	1,092,089	3,163,989
Kitoi Bay	Coho	Totals	936,913	300,000	0	0	1,236,913
KMA	Coho	Totals	936,913	300,000	0	0	1,236,913
Kitoi Bay	Chum	Totals	0	20,032,140	0	0	20,032,140
Kitoi Bay	Pink	Totals	0	134,823,670	0	0	134,823,670
Pillar Creek		Totals	0	0	2,071,900	1,092,089	3,163,989
Kitoi Bay		Totals	936,913	155,155,810	0	0	156,092,723
KMA		Totals	936,913	155,155,810	2,071,900	1,092,089	159,256,712

[a] Incubation and rearing facility: PC Pillar Creek Hatchery; KB Kitoi Bay Hatchery (see [b] above)

[b] Brood stocks (Timing):
Afognak Lake sockeye (June) - Afognak, Crescent, Hidden, Big and Little Waterfall Lakes – PC
Big Kitoi Creek chum (June) - Big Kitoi Bay – KB
Big Kitoi Creek coho (August) - Big Kitoi Bay, Crescent Lake, Jennifer, Katmai, Ruth Lakes – KB
Big Kitoi Creek pink (July/August) - Big Kitoi Bay – KB
Buskin Lake coho (August/September) - Kodiak Road System Lakes – PC
Saltery Lake sockeye (July) - Little Kitoi Lake – KB

[c] Fry are released from April to July at up to 200% of emergent size (normally 0.15 to 0.5 g depending on the stock). Fingerling are released from June to September at a size of >200% to <2100% of emergent size (normally 0.3 to 5.25 g depending on the stock). Pre-smolt are released from August to November at a size of >2100% of emergent size but not yet at the physiological stage of smolting (normally 5 to 13 g).

Table 3. Amount of Phosphorous enriched fertilizer applied and nutrient status of the five study lakes in 2001.

Lake	20-5-0 (kg.)	TP (mg L^{-1})	TP_{eoy} (mg L^{-1})	TN (mg L^{-1})	N:P (molar ratio)	CHL (mg L^{-1})
Laura	12,106.0	5.7	7.7	221.3	86.0	2.6
Little Kitoi	3,182.0	na	na	na	na	na
Malina, Lower	2,587.0	10.2	10.0	327.2	71.0	1.8
Malina, Upper	4,996.0	9.7	6.2	211	48.0	1.7
Waterfall	5,378.0	10.2	6.2	209	45.0	1.8

na - data not available

Note: Values for total phosphorus (TP), end of year TP (TPeoy), total nitrogen (TN), nitrogen to phosphorus ratio (N:P), and chlorophyll (CHL) levels are means derived from the 1-m stratum, May-October, 2001.

Table 4. Barrier height, bypass length, bypass slope, bypass grade, and affected salmon species for Kodiak Island operational barrier bypasses.

System	Geographic Location	Barrier Height (m)	Barrier Bypass			Affected Salmon Species
			Length (m)	Slope [a]	Grade (%)	
Frazer River	57°13' N, 154°04' W	10.0	60.0	6:1	22	Sockeye, Chinook, Pink, Chum
Gretchen Creek	58°23' N, 152°18' W	2.4	9.1	4:1	25	Coho and Sockeye
Laura Creek	58°21' N, 152°18' W	5.5	27.4 [b]	5:1	20	Coho and Sockeye
Little Kitoi Lake	58°12' N, 152°22' W	1.8	12.2	7:1	14	Pink, Coho, Sockeye
Little Waterfall Creek	58°22' N, 152°33' W	1.8	9.1	5:1	20	Pink and Coho
		2.4	12.2	5:1	20	Pink and Coho
		7.3	31.9 [b]	4.4:1	[c]	Pink and Coho
Portage Creek	58°16' N, 152°25' W	1.8	15.2	8:1	13	Pink, Coho, Sockeye
Seal Bay Creek	58° 33' N, 152° 22' W	2.0	9.1	4.6:1	16.5	Pink and Coho

[a] Length to height.
[b] Total length composed of two or three bypasses.
[c] Lower section originally 26%, upper section 28%; modified in 1995 so both sections are 17% and additional lower section added at 20% grade.

Table 5. Description and location of the terminal harvest and special harvest areas in the Kodiak Management Area, 2001.

Project Lake	Harvest Area		Boundaries
	Location	Designation	
Big Kitoi Creek and Little Kitoi Lake	Kitoi Bay	Kitoi Bay SHA	all waters northwest of a line from the regulatory markers located at the entrance to Kitoi Bay commonly known as " The Jaws" to the terminus of Big and Little Kitoi Creeks (streams #252-323 and #252-324).
Crescent	Settler Cove	Settler Cove THA	all waters of Settler Cove west of 152° 50.80' W Long.
Hidden	Foul Bay	Foul Bay THA	all waters of Foul Bay east of 152° 47.20' W Long. to the terminus of Hidden Creek (stream #251-406).
Little & Big Waterfall	Waterfall Bay	Waterfall Bay THA	all waters seaward of the stream terminus of stream nos. 251-821 and 251-822 to a straight line extending northwesterly from 58° 24.15' N lat., 152° 28.23' W long. To 56° 25.60' N lat., 152° 30.80' W long.
Malina	Malina Cove	Malina Creek THA	all marine waters within 0.7 nautical miles of the stream terminus of Malina Creek (stream #251-105) located at 153° 12.95' W Long., 58° 10.42' N Lat.
Spiridon	Telrod Cove	Spiridon Lake THA	all waters of Telrod Cove north of a line extending from Stream Point 57° 39.00' N Lat., 153° 38.50' W Long. to 57° 38.80' N Lat., 153° 37.60' W Long.

THA - Terminal Harvest Area
SHA - Special Harvest Area

Table 6. Kodiak area lakes assessed or monitored for limnology data, by category, 2001.

Lake	Project Category [a]	Sampling [b] Stations	Water	Zooplankton
Afognak	F, BS	1	5	5
Big Waterfall	S	1	3	3
Crescent	S	1	0	4
Frazer	PF	2	0	10
Hidden	S,EA	1	5	5
Jennifer - upper	M	1	0	4
- lower	M	1	0	3
Karluk	M	1	0	5
Laura	F, BS	1	5	5
Little Kitoi	F, BS	1	5	5
Little Waterfall	F, S	1	4	4
Malina - lower	F	1	5	5
- upper	F, S	1	5	5
Ruth	M	1	0	4
Saltery	BS, M	1	0	4
Spiridon	S, EA	2	10	10
Total			47	81

[a] F = Fertilization - sampling scheduled every six weeks
S = Stocking - sampling scheduled every six weeks
BS = Broodstock - sampling scheduled every six weeks
PF = Post fertilization - sampling scheduled every six weeks
EA = Environmental assessment - sampling scheduled every four weeks
M = Monitoring - sampling scheduled every six weeks

[b] Temperature, dissolved oxygen, secchi depth, and light penetration data were collected at each station, except for Frazer Lake.

Table 7. Average light extinction coefficient (K_d), euphotic zone depth (EZD), and secchi disk (SD) transparency for Kodiak and Afognak Island regional lakes, 2001.

Lake	Station Number	Kd (m^{-1})	std. dev.	EZD (m)	std. dev.	SD (m)	std. dev.
Afognak	1	0.460	0.087	10.87	3.24	3.95	1.14
Crescent	1	0.279	0.038	15.42	2.39	5.78	1.02
Frazer	1	0.152	nd	29.31	nd	6.00	nd
Hidden	1	0.400	0.079	11.48	2.75	5.18	0.45
Karluk	3	0.223	0.064	20.42	7.24	6.40	2.16
Upper Jennifer	1	0.506	0.292	10.08	4.25	7.22	1.43
Lower Jennifer	1	0.552	0.147	8.46	2.29	5.58	0.76
Laura	1	0.635	0.211	7.26	1.91	2.45	1.02
Little Kitoi	1	0.730	0.490	7.72	3.24	3.58	0.52
Big Waterfall	1	0.356	0.221	11.29	4.58	5.25	2.22
Little Waterfall	1	1.007	0.152	8.88	2.65	3.85	1.04
Lower Malina	1	0.306	0.024	14.86	1.30	4.85	1.04
Upper Malina	1	0.397	0.066	11.26	1.57	3.60	1.14
Ruth	1	0.561	0.192	8.93	3.20	4.56	1.21
Saltery	1	0.299	0.069	15.43	2.88	4.38	0.32
Spiridon	1	0.162	0.021	26.68	2.70	10.50	3.23
	2	0.166	0.028	26.54	3.11	9.56	2.35

nd - standard deviation was not determined, due to only one sample.

Table 8. Temperatures (°C) measured at the 1-meter and near bottom stratas in the spring (May-June), summer (July-August), and fall (September-October) for Kodiak area lakes, 2001.

		Spring		Summer		Fall	
Lake	Station	Surface	Bottom	Surface	Bottom	Surface	Bottom
Afognak	1	9.1	7.2	17.1	10.7	12.9	12.5
Crescent	1	4.4	4.2	17.6	6.7	11.6	6.8
Frazer	1	nc	nc	nc	nc	11.2	6.7
Hidden	1	9.5	4.6	15.7	5.4	11.8	5.4
L. Jennifer	1	9.6	4.7	17.8	4.7	nc	nc
U. Jennifer	1	9.6	4.5	17.9	4.6	12.4	4.4
Karluk	1	8.2	4.2	12.6	4.7	11.5	4.9
L. Kitoi	1	13.4	5.1	17.4	5.1	12.5	4.7
Laura	1	10.8	4.7	16.7	5.2	12.1	5.1
L. Malina	1	9.2	8	16.1	15.2	11.3	11.2
U. Malina	1	7.2	4.7	15.8	6.0	11.2	6.2
Ruth	1	10.4	5	18.0	5.1	12.5	5.2
Saltery	1	8.2	6.0	13.4	6.5	10.8	6.6
Spiridon	1	6.3	3.1	14.1	4.1	11.1	4.3
	2	5.8	3.3	14.5	4.1	11.3	4.3
B. Waterfall	1	14.0	4.8	17.1	5.6	9.8	5.9
L. Waterfall	1	11.1	6.9	15.7	10.2	10.9	10.4

nc - Temperature was not measured.

Note: If more than one measurement was obtained for a time period, the concentrations were averaged.

Table 9. Dissolved oxygen concentrations (mg L^{-1}) measured at the 1-meter and near bottom strata in the spring (May-June), summer (July-August), and fall (September-October) for the Kodiak area lakes, 2001.

		Spring		Summer		Fall	
Lake	Station	Surface	Bottom	Surface	Bottom	Surface	Bottom
Afognak	1	9.7	7.2	9.3	5.3	9.0	8.1
Crescent	1	9.4	10.1	9.0	10.2	10.5	9.1
Frazer	1	nc	nc	nc	nc	10.4	9.9
Hidden	1	10.5	12.4	9.7	12.0	10.0	10.3
L. Jennifer	1	11.5	10.7	9.3	9.2	nc	nc
U. Jennifer	1	10.4	10.7	9.4	11.0	10.0	8.1
Karluk	1	12.3	12.9	10.1	11.5	9.2	8.1
L. Kitoi	1	10	10.1	9.5	9.0	9.8	4.4
Laura	1	8.6	10.6	8.3	9.9	nc	8.8
L. Malina	1	10.9	11.0	9.7	8.8	9.8	9.1
U. Malina	1	10.3	11.0	9.6	9.0	8.9	3.7
Ruth	1	10.8	10.4	9.4	7.4	10.7	2.8
Saltery	1	10.6	10.6	9.5	7.5	10.3	5.3
Spiridon	1	10.6	12.2	10.1	14.1	9.9	12.2
	2	11.1	12.3	10.2	14.1	10.3	12.7
B. Waterfall	1	9.5	11.2	9.1	9.5	9.9	7.1
L. Waterfall	1	10.6	11.3	9.5	9.2	10.0	9.5

nc - Dissolved oxygen levels were not measured.
Note: If more than one measurement was obtained for a time period, the concentrations were averaged.

Table 10. Summary of seasonal mean water chemistry, nutrient, and algal pigment concentrations by station and depth for lakes sampled in the Kodiak Management Area, 2001.

Lake	Station	Depth (m)	pH (Units)	SD	Alkalinity (mg L^{-1})	SD	Total-P (ug L^{-1})	SD	Total filterable-P (ug L^{-1})	SD	Filterable reactive-P (ug L^{-1})	SD	Total Kjeldahl nitrogen (ug L^{-1})	SD	Ammonia (ug L^{-1})	SD	nitrite (ug L^{-1})	SD	Chlorophyll a (ug L^{-1})	SD	Phaeophytin a (ug L^{-1})	SD
Afognak	1	1	7.2	0.4	10.1	2.3	7.8	5.1	6.4	5.2	8.2	6.7	114.5	22.2	4.6	3.6	60.6	67.2	2.40	0.5	0.30	0.2
B. Waterfall	1	1	7.5	0.1	18.3	6.4	6.8	4.0	3.1	2.5	2.6	1.9	81.3	nc	2.7	1.4	6.7	9.9	0.65	0.53	0.10	0.1
Hidden	1	1	7.2	0.1	8.1	1.5	5.1	1.8	4.1	2.6	3.3	3.7	99.5	19.7	5.5	4.4	35.5	25.5	0.64	0.2	0.30	0.3
Laura	1	1	7.5	0.4	9.6	1.5	10.9	1.1	5.8	2.6	4.4	3.7	217.0	144.0	6.6	6.4	3.8	3.8	5.83	4.9	0.94	0.6
L. Kitoi	1	1	7.7	0.1	24.0	4.4	13.3	4.6	4.6	2.5	3.7	3.4	201.6	67.9	5.3	4.3	7.6	14.8	2.88	1.7	0.53	0.2
L. Malina	1	1	7.4	0.4	17.6	5.5	9.5	5.7	3.9	2.8	3.7	3.6	131.2	75.0	6.6	4.6	130.9	45.1	2.19	0.7	0.36	0.3
L.Waterfall	1	1	7.4	0.1	13.4	3.9	11.5	6.6	4.3	2.1	4.4	5.0	84.5	41.4	4.4	1.6	20.1	24.0	1.15	0.4	0.73	0.4
U. Malina	2	1	7.5	0.6	18.0	3.7	11.9	5.7	6.4	2.8	6.6	6.4	120.2	52.9	3.9	2.9	93.3	93.2	4.00	2.0	0.90	0.6
Spiridon	1	1	7.5	0.4	19.3	4.1	4.9	3.3	3.5	2.1	1.9	2.0	101.2	8.0	4.6	4.7	193.8	6.7	0.60	0.3	0.20	0.2
	2	1	7.5	0.4	19.4	3.8	6.7	5.1	3.5	3.3	2.7	3.5	nc	nc	2.1	1.3	189.2	7.3	0.60	0.1	0.30	0.3

SD - standard deviation
nc - not calculated

Table 11. Summary of the cladoceran and copepod compositions in Kodiak area project lakes, 2001.

		Cladoceran		Copepod		
Lake	Station	density ($no.m^{-2}$)	composition (%)	density ($no.m^{-2}$)	composition (%)	Cladoceran to Copepod ratio
Afognak	1	22,327	52.3	20,396	47.7	1.09
Crescent	1	40,289	51.5	37,960	48.5	1.06
Frazer	1	71,079	84.2	13,288	15.8	5.35
		88,772	82.2	19,238	17.8	4.61
Hidden	1	20,740	68.1	9,710	31.9	2.14
L. Jennifer	1	25,478	21.1	95,364	78.9	0.27
U. Jennifer	1	80,165	48.7	84,395	51.3	0.95
Laura	1	79,843	82.0	17,556	18.0	4.55
L. Kitoi	1	69,209	85.5	11,776	14.5	5.88
Karluk	1	52,096	21.5	190,658	78.5	0.27
L. Waterfall	1	143,748	96.4	5,426	3.6	26.49
B. Waterfall	1	67,338	98.1	1,302	1.9	51.72
Malina - lower	1	10,591	93.9	685	6.1	15.46
Malina - upper	1	40,180	66.9	19,883	33.1	2.02
Ruth	1	132,718	98.9	1,468	1.1	90.41
Saltery	1	1,725	18.2	7,738	81.8	0.22
Spiridon	1	43,649	54.5	36,382	45.5	1.20

Table 12. Weighted mean zooplankton density, biomass, and size by genera for Kodiak area project lakes, 2001.

		Number	Epischura			Diaptomus			Cyclops			Bosmina			Daphnia			Holopedium		
Lake	Station	of Samples	Density (no/m^2)	Biomass (mg/m^2)	Size (mm)	Density (no/m^2)	Biomass (mg/m^2)	Size (mm)	Density (no/m^2)	Biomass (mg/m^2)	Size (mm)	Density (no/m^2)	Biomass (mg/m^2)	Size (mm)	Density (no/m^2)	Biomass (mg/m^2)	Size (mm)	Density (no/m^2)	Biomass (mg/m^2)	Size (mm)
Afognak	1	5	15,061	33.0	1.05	1,274	2.8	0.79	4,061	5.1	0.72	20,382	16.3	0.31	626	0.6	0.57	1,319	2.0	0.46
Crescent	1	4	1,145	5.1	1.00	1,219	6.7	1.09	35,596	77.5	0.91	19,365	27.4	0.44	9,977	22.6	0.73	10,947	48.6	0.77
Frazer	1	5	0	0.0	0.00	0	0.0	0.00	13,288	13.0	0.82	41,961	58.0	0.42	29,118	91.0	0.61	0	0.0	0.00
	3	5	32	0.0	1.28	0	0.0	0.00	19,206	26.0	0.98	69,159	115.0	0.46	19,613	26.0	0.61	0	0.0	0.00
Hidden	1	5	3,510	14.7	0.98	0	0.0	0.00	6,200	19.4	1.01	10,230	22.5	0.48	799	2.3	0.91	9,711	24.4	0.55
L. Jennifer	1	4	2,300	6.6	0.85	12,562	67.5	1.08	80,502	163.8	0.88	16,985	36.6	0.48	6,458	18.7	0.90	2,035	9.1	0.65
U. Jennifer	1	3	1,393	4.1	0.86	10,400	67.8	1.15	72,602	158.6	0.86	55,384	128.9	0.56	17,864	59.0	0.94	6,917	47.0	0.81
Laura	1	5	53	0.0	0.55	0	0.0	0.00	17,503	59.3	1.03	46,749	41.1	0.32	29,717	37.2	0.59	3,377	4.6	0.46
L. Kitoi	1	5	425	1.1	0.85	159	0.6	1.01	11,192	12.6	0.71	23,628	24.5	0.34	45,165	53.8	0.56	416	0.7	0.46
Karluk	3	5	5,281	4.7	0.56	5,706	24.1	0.99	179,671	264.4	0.91	28,238	34.1	0.37	23,646	34.7	0.68	212	0.2	0.35
L. Waterfall	1	5	3,179	10.9	0.91	64	0.3	1.04	2,183	3.5	0.95	113,067	90.1	0.34	14,757	21.5	0.63	15,924	32.7	0.53
B. Waterfall	1	3	914	1.9	0.77	0	0.0	0.00	388	0.9	0.80	4,018	4.6	0.37	2,810	4.3	0.66	60,510	278.4	0.76
Malina (lower)	1	5	583	0.8	0.66	66	0.3	1.01	36	0.1	0.68	10,192	6.9	0.28	346	0.5	0.60	53	0.1	0.44
U. Malina (upper)	1	5	12,585	24.2	0.74	6,274	18.5	0.94	1,024	1.2	0.58	37,532	36.3	0.33	2,468	3.7	0.65	180	0.5	0.54
Ruth	1	4	672	1.1	0.69	0	0.0	0.00	796	0.9	0.59	26,791	37.3	0.40	96,970	148.2	0.64	8,957	18.1	0.51
Saltery	1	4	25	0.1	0.73	133	0.8	1.11	7,580	20.0	0.96	365	0.4	0.40	1,360	2.1	0.69	0	0.0	0.00
Spiridon	1, 2	10	1,122	1.7	0.69	2,368	23.3	1.34	32,893	85.5	1.08	16,577	47.0	0.62	19,717	62.3	0.89	7,355	79.0	1.05

Table 13. Temperature (°C) data collected at three stations in the Kitoi Bay Section (252-32), May 11-June 4, 2001.

Depth	Mid-Bay Kitoi (station 1)			Big Kitoi Bay (station 2)			Little Kitoi Bay (station 3)		
(m)	11-May	21-May	4-Jun	11-May	21-May	4-Jun	11-May	21-May	4-Jun
surface	7.0	8.0	9.0	6.5	8.0	10.0	8.0	8.0	9.5
0.5	7.0	8.0	9.0	6.0	8.0	9.0	7.5	8.0	9.5
1.0	7.0	8.0	9.0	6.0	8.5	9.0	7.5	8.0	9.5
1.5	7.0	8.0	8.5	6.0	8.0	9.0	7.5	8.0	9.5
2.0	7.0	8.0	8.5	6.0	8.0	9.0	7.5	8.0	9.5
2.5	7.0	8.0	8.5	6.0	8.0	9.0	7.5	8.0	9.0
3.0	7.0	8.0	8.5	6.0	8.0	8.5	7.5	8.0	9.0
3.5	7.0	8.0	8.5	6.0	8.0	8.5	7.5	7.5	8.5
4.0	7.0	8.0	8.5	6.0	7.5	8.5	7.5	7.5	8.5
4.5	7.0	8.0	8.5	5.5	7.5	8.5	7.5	7.5	8.5
5.0	6.5	8.0	8.0	5.5	7.5	8.0	7.0	7.5	8.0
6.0	6.5	8.0	8.0	5.5	7.5	8.0	7.0	7.5	8.0
7.0	6.5	8.0	8.0	5.5	7.5	7.5	7.0	7.0	8.0
8.0	6.5	7.5	8.0	5.0	7.0	7.5	7.0	7.0	7.5
9.0	6.0	7.5	8.0	5.0	7.0	7.5	7.0	7.0	7.5
10.0	6.0	7.5	7.5	5.0	7.0	7.0	6.5	7.0	7.5
11.0	6.0	7.0	7.5	5.0	7.0	7.0	6.5	7.0	7.5
12.0	6.0	7.0	7.5	5.0	7.0	7.0	6.0	7.0	7.5
13.0	6.0	7.0	7.5	5.0	7.0	7.0	6.0	7.0	7.5
14.0	5.5	7.0	7.5	5.0	7.0	7.0	6.0	7.0	7.5
15.0	5.5	7.0	7.0	4.5	7.0	7.0	6.0	7.0	7.0
16.0	5.5	7.0	7.0	4.5	7.0	7.0	5.5	7.0	7.0
17.0	5.0	7.0	7.0	4.5	7.0	7.0	5.5	7.0	7.0
18.0	4.5	7.0	7.0	4.5	6.5	6.5	5.5	7.0	7.0
19.0	4.5	7.0	7.0	4.5	6.5	6.5	5.0	7.0	7.0
20.0	4.5	7.0	6.5	4.5	6.5	6.0	5.0	7.0	7.0

Table 14. Salinity data (parts/thousand) collected at three stations in the Kitoi Bay Section (252-32), May 11-June 4, 2001.

Depth	Mid- Bay Kitoi (station 1)			Big Kitoi Bay (station 2)			Little Kitoi Bay (station 3)		
(m)	11-May	21-May	4-Jun	11-May	21-May	4-Jun	11-May	21-May	4-Jun
surface	29.5	25.0	20.0	29.0	21.5	24.5	29.5	23.0	26.0
0.5	29.5	25.0	23.0	29.0	21.5	24.5	29.5	23.0	25.5
1.0	29.5	25.0	24.5	29.0	25.0	24.5	29.5	23.0	25.5
1.5	29.5	25.0	24.5	29.0	25.5	24.5	29.5	23.0	25.5
2.0	29.5	25.0	25.0	29.0	25.5	24.5	29.5	23.0	25.5
2.5	29.5	25.0	25.0	29.0	25.5	24.0	29.5	25.5	25.5
3.0	29.5	25.0	25.5	29.0	25.5	24.0	29.5	25.5	25.5
3.5	29.5	25.0	25.5	29.0	25.0	24.0	29.5	25.5	25.5
4.0	29.5	25.0	25.5	29.0	25.0	24.0	29.5	25.5	25.5
4.5	29.5	25.0	25.5	29.0	25.0	24.0	29.5	24.5	25.5
5.0	29.0	25.0	25.5	29.0	25.0	24.0	29.5	24.5	25.0
6.0	29.0	25.0	26.0	29.0	25.0	24.0	29.5	24.5	25.0
7.0	29.0	25.0	26.0	29.0	24.5	24.0	29.5	24.5	25.0
8.0	29.0	25.0	25.5	29.0	24.5	24.0	29.5	24.5	25.0
9.0	29.0	25.0	25.5	29.0	24.5	24.0	29.5	24.5	25.0
10.0	29.0	25.0	25.5	29.0	24.5	24.0	29.5	24.5	24.5
11.0	29.0	25.0	25.5	29.0	24.5	24.0	29.5	24.5	24.5
12.0	29.0	25.0	25.5	29.0	24.5	24.0	29.5	24.5	24.5
13.0	29.0	25.0	25.5	29.0	24.0	24.0	29.5	24.5	24.5
14.0	29.0	25.0	25.5	29.0	24.0	24.0	29.5	24.5	24.5
15.0	29.0	25.0	25.5	29.0	24.0	24.0	29.5	24.5	24.5
16.0	29.0	25.0	25.5	29.0	24.0	24.0	29.5	24.5	24.5
17.0	29.0	25.0	25.5	29.0	24.5	24.0	29.5	24.5	24.0
18.0	29.0	25.0	25.5	29.0	24.5	24.0	29.5	24.5	24.0
19.0	29.0	25.0	25.0	29.0	24.5	24.0	29.0	24.5	24.0
20.0	29.0	25.0	24.0	29.0	24.5	24.0	29.0	24.5	24.0

Table 15. Results of plankton surveys at three stations in the Kitoi Bay Section (252-32), May 11-June 4, 2001.

Date	Station	zooplankton (ml)	phytoplankton (ml)	total plankton (ml)
May 11	1	3.5	336.5	340.0
May 11	2	3.0	337.0	340.0
May 11	3	4.0	386.0	390.0
May 21	1	4.0	24.0	28.0
May 21	2	3.5	34.5	38.0
May 21	3	4.0	28.0	32.0
June 4	1	7.0	5.0	12.0
June 4	2	8.0	2.0	10.0
June 4	3	3.0	6.0	9.0

station #1: mid-bay
station #2: Big Kitoi Bay
station #3: Little Kitoi Bay

Table 16. Juvenile sockeye salmon estimates based on hydroacoustic fish population estimates for Kodiak area lakes, 2001.

		Sockeye Estimates		
			95% C. I.	
Lake	Date	Number	Low	High
Hidden	9-May	24,444	17,719	31,169
L. Kitoi [a]	18-Aug	38,952	47,370	30,534
L. Waterfall	10-May	33,128	5,444	60,812
Spiridon	1-May	1,754,217	1,469,665	2,038,770
	15-Sep	2,331,383	1,843,645	2,819,122

[a] The sockeye salmon estimate was calculated by removing the first strata's fish estimates from the total fish estimate.

Table 17. Emigrating sockeye salmon smolt captured for age and size data and total population estimatesa by age class from Kodiak area systems, 2001.

System	Trapping Dates	Total Captured	Total Smolt Estimates by Age Class 0	1	2	3	Total Emigration Number	Variance	95% C. I. Lower	Higher
Frazer Lake	8-May	348,692	0	10,833	901,205	29,382	941,655	38,386	866,342	1,016,814
	thru 3-Jul		0.0	1.2	95.7	3.1				
Karluk Lake	6-May	205,705	3,740	239,377	3,063,279	437,611	3,740,268	314,020	3,136,398	4,344,111
	thru 3-Jul		0.1	6.4	81.9	11.7				
Little Kitoi	8-May	63,537	0	60,487	3,050	0	63,537			
	thru 27-Jul		0.0	95.2	4.8	0.0				
Malina Lake	12-May	58,186	0	120,523	183,479	20,839	324,843	22,963	279,835	540,812
	thru 25-Jun		0.0	37.1	56.5	6.4				
Spiridon [b]	3-May	1,528,916	0	1,087,695	441,221	0	1,528,916			
	thru 3-Jul		0.0	71.1	28.9	0.0				
Afognak Lake	11-Jun	62	AGE, LENGTH AND WEIGHT SAMPLING ONLY							
	thru 13-Jun									
Hidden Lake	27-May	447	AGE, LENGTH AND WEIGHT SAMPLING ONLY							
	thru 23-Jun									
Laura Lake	4-Jun	198	AGE, LENGTH AND WEIGHT SAMPLING ONLY							
	thru 20-Jun									
L. Waterfall Lake	24-May	199	AGE, LENGTH AND WEIGHT SAMPLING ONLY							
	thru 27-May									
Portage	29-May	200	AGE, LENGTH AND WEIGHT SAMPLING ONLY							
Saltery	15-Jun	12	AGE, LENGTH AND WEIGHT SAMPLING ONLY							

[a] Little Kitoi Lake, Malina Lake, and Spiridon Lake.

[b] Both live and dead sockeye smolt are trapped; live sockeye smolt, only, are included in total emigration estimates (by actual counts and time estimates).

Table 18. Mean age, length, weight, and condition by age for sockeye salmon smolt sampled at Kodiak area lakes, 2001.

		Age-1				Age-2				Age-3			
System	Sampling Weeks	*n*	Length (mm)	Weight (g)	Condition (K)	*n*	Length (mm)	Weight (g)	Condition (K)	*n*	Length (mm)	Weight (g)	Condition (K)
Afognak Lake	22 (5/24-5/30)	116	66.4	2.6	0.82	46	88.0	6.6	0.90	1	103.0	10.0	0.92
Frazer Lake	19-27 (5/3-7/4)	77	70.3	3.4	0.86	2,444	77.4	3.8	0.82	79	109.2	11.5	0.85
Hidden Lake	22-26 (5/24-6/27)	441	95.5	7.4	0.85	6	97.7	8.1	0.85	0			
Laura Lake	23-25 (5/31-6/20)	36	87.7	5.5	0.81	155	91.0	6.1	0.81	7	109.0	10.0	0.77
Little Kitoi Bay [a]	33 (8/9-8/15)	120	73.8	4.1	1.00	0	0.0	0.0	0.00	0			
Little Kitoi Lake	20-25 (5/10-6/20)	512	107.1	8.5	0.67	104	93.5	5.3	0.63	0			
L.Waterfall Lake	22 (5/24-5/30)	199	81.5	4.3	0.79	0	0.0	0.0	0.00	0			
Malina Lake	20-26 (5/10-6/27)	535	73.9	3.2	0.77	367	91.1	6.0	0.77	74	105.6	10.3	0.83
Portage Lake	22 (5/24-5/30)	170	71.4	3.0	0.81	30	78.7	4.3	0.84	0			
Saltery Lake	25 (6/14-6/20)	6	63.0	2.1	0.81	6	69.0	3.1	0.89	0			
Spiridon Lake	19-27 (5/3-7/4)	2,037	103.8	8.8	0.78	506	136.2	20.2	0.79	0			

[a] Smolt reared at Kitoi Bay Hatchery; sampled prior to release at Little Kitoi Bay.

Table 19. Preseason forecasts, common property salmon harvests, and total runs for systems with salmon enhancement and rehabilitation projects in the Kodiak Management Area, 2001.

Project	Species	Preseason Forecast		Common Property				
		Run	Harvest	Commercial [a]	Stat. Areas	Ave Wt (lbs)	$/lb.	Value [b]
Kitoi Area [e, f]	pink	4.200.000	3.800.000	13.126.761	252-30.31.32	3.3	0.12	$5.198.197
(hatchery stocking)	chum	92,000	62,000	216,266	252-30,31,32	7.5	0.32	$519,038
	coho	115,000	109,000	151,732	252-30,31,32	8.2	0.24	$298,609
	sockeye - E.Run	8,400	8,400	23,974	252-30,31,32	5.5	0.70	$92,300
	sockeye - L.Run	27,800	27,800	24,542	252-30,31,32	5.5	0.70	$94,487
	sockeye - Total Run	36,200	36,200	48,516	252-30,31,32	5.5	0.70	$186,787
Frazer Lake [g] (fishpass; fertilization)	sockeye	487.000	347.000	239.936	assigned catches from 257-10,20 50,60,70, 40,41	5.6	0.70	$940.549
Laura Lake [h]	coho	No Forecast	No Forecast	21.518	251-82.83	8.4	0.24	$43.380
(fishpasses;stocking;fertilization)	sockeye	1,900		26	251-82,83	4.6	0.70	$84
Little Waterfall Creek	pink	No Forecast	No Forecast	3,171	251-82,83,84	3.3	0.12	$1,256
and Lake [e]	sockeye	23.500	23.500	16.023	251-84	4.6	0.70	$51.594
fishpasses; stocking; fertilization)								
Afognak Lake [h] (stocking)	sockeye	21.000		na	252-34			
Malina Lakes [h] (fertilization; stocking)	sockeye	38.000		4.001	251-10	4.9	0.70	$13.723
Hidden Lake [e] (stocking)	sockeye	34.000	34.000	29.822	251-40.41	5.0	0.70	$104.377
Spiridon Lake [e] (stocking)	sockeye	201.000	201.000	146.678	254-50	5.2	0.70	$533.908
Crescent Lake [e]	sockeye	14.600	14.600	3.722	259-35	5.6	0.70	$14.590
(stocking)	coho	6.500	6.500		259-35			$0
Katmai Lake [e] (stocking)	coho	1.500	1.500	na	na	na		$0
Totals:	**pink**			**13,129,932**				**$5,199,453**
	chum			**216,266**				**$519,038**
	sockeye			**488,724**				**$1,845,612**
	coho			**173,250**				**$341,989**
	all species			**14,008,172**				**$7,906,092**

[a] From ADF&G fish ticket summaries for regulatory management units; na=not available-assumed that some level of harvest has occurred in other statistical areas.

[b] Commercial harvest exvessel value = average weight (lb) x price per pound (preseason estimate) x catch.

[c] Estimated based on field staff observations and ADF&G Individual subsistence permittee harvest reports.

[d] Sport harvest data are estimates from field project personnel or Sport Fish Division staff.

[e] Non-anadromous system; total harvest reflects supplemental production; Spiridon Lake estimate using methods as described by Nelson (1999) from 254-50, 251-10-20, 253-11-35,and 254-10-40 statistical areas.

[f] Kitoi Area early and late sockeye run estimates delineated by the July 15 separation date.

[g] System originally non-anadromous; enhanced by fish pass which is operated annually; currently is anadromous and production includes rehabilitation efforts (lake enrichment) from 1988-1992. Indexed harvest estimate; escapement through Dog Salmon weir but not through fish pass included in escapement.

[h] Anadromous system; production soley attributed to fertilization is not available (na); fish pass operation considered essential to any production; forecast only for supplemental production.

Table 20. Sockeye salmon commercial fishing harvest at Foul Bay (251-41), Waterfall Bay (251-84), and Telrod Cove (254-50) terminal harvest areas, and Kitoi (252-32), Duck (252-31), and Izhut (252-30) Bays combined, June 9 - September 10, 2001.

	Foul Bay THA		Waterfall Bay THA		Telrod Cove THA		Kitoi, Duck, Izhut Bays	
Date	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative
9-Jun	12,726	12,726	3,015	3,015	closed		1,165	1,165
10-Jun	5,576	18,302	3,210	6,225	closed		919	2,084
11-Jun	1,309	19,611	359	6,584	closed		218	2,302
12-Jun	1,760	21,371	1,081	7,665	closed		2,068	4,370
13-Jun	0	21,371	1,081	8,746	closed		1,765	6,135
14-Jun	695	22,066	278	9,024	closed		436	6,571
15-Jun	1,615	23,681	1,184	10,208	closed		672	7,243
16-Jun	325	24,006	0	10,208	closed		1,420	8,663
17-Jun	526	24,532	1,290	11,498	closed		986	9,649
18-Jun	426	24,958	0	11,498	closed		764	10,413
19-Jun	458	25,416	588	12,086	closed		1,091	11,504
20-Jun	638	26,054	0	12,086	closed		860	12,364
21-Jun	0	26,054	246	12,332	closed		closed	
22-Jun	636	26,690	0	12,332	closed		closed	
23-Jun	0	26,690	1,303	13,635	closed		closed	
24-Jun	1,716	28,406	347	13,982	closed		closed	
25-Jun	0	28,406	0	13,982	closed		closed	
26-Jun	0	28,406	0	13,982	closed		closed	
27-Jun	0	28,406	660	14,642	0	0	closed	
28-Jun	0	28,406	0	14,642	0	0	closed	
29-Jun	0	28,406	560	15,202	0	0	closed	
30-Jun	688	29,094	254	15,456	0	0	closed	
1-Jul	0	29,094	0	15,456	130	130	1,441	13,805
2-Jul	0	29,094	0	15,456	86	216	640	14,445
3-Jul	0	29,094	0	15,456	108	324	761	15,206
4-Jul	389	29,483	0	15,456	85	409	224	15,430
5-Jul	339	29,822	0	15,456	116	525	0	15,430
6-Jul	0	29,822	0	15,456	194	719	57	15,487
7-Jul	0	29,822	567	16,023	0	719	645	16,132
8-Jul	0	29,822	0	16,023	365	1,084	161	16,293
9-Jul	0	29,822	0	16,023	162	1,246	800	17,093
10-Jul	closed		closed		111	1,357	1,046	18,139
11-Jul	closed		closed		700	2,057	2,141	20,280
12-Jul	closed		closed		780	2,837	261	20,541
13-Jul	closed		closed		1,285	4,122	837	21,378
14-Jul	closed		closed		1,444	5,566	2,372	23,750
15-Jul	closed		closed		651	6,217	224	23,974
16-Jul	closed		closed		608	6,825	361	24,335
17-Jul	closed		closed		647	7,472	188	24,523
18-Jul	closed		closed		511	7,983	527	25,050
19-Jul	closed		closed		1,131	9,114	421	25,471
20-Jul	closed		closed		1,042	10,156	100	25,571
21-Jul	closed		closed		1,527	11,683	157	25,728
22-Jul	closed		closed		1,420	13,103	0	25,728
23-Jul	closed		closed		2,509	15,612	0	25,728

-Continued-

Table 20. (page 2 of 2)

	Foul Bay THA		Waterfall Bay THA		Telrod Cove THA		Kitoi, Duck, Izhut Bays	
Date	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative
24-Jul	closed		closed		1,132	16,744	607	26,335
25-Jul	closed		closed		1,260	18,004	110	26,445
26-Jul	closed		closed		0	18,004	1,080	27,525
27-Jul	closed		closed		0	18,004	41	27,566
28-Jul	closed		closed		0	18,004	0	27,566
29-Jul	closed		closed		0	18,004	48	27,614
30-Jul	closed		closed		3,965	21,969	313	27,927
31-Jul	closed		closed		2,456	24,425	690	28,617
1-Aug	closed		closed		1,321	25,746	987	29,604
2-Aug	closed		closed		960	26,706	1,100	30,704
3-Aug	closed		closed		1,046	27,752	1,504	32,208
4-Aug	closed		closed		1,855	29,607	964	33,172
5-Aug	closed		closed		1,232	30,839	1,241	34,413
6-Aug	closed		closed		2,668	33,507	839	35,252
7-Aug	closed		closed		2,844	36,351	750	36,002
8-Aug	closed		closed		389	36,740	1,907	37,909
9-Aug	closed		closed		1,277	38,017	1,350	39,259
10-Aug	closed		closed		0	38,017	1,295	40,554
11-Aug	closed		closed		4,575	42,592	789	41,343
12-Aug	closed		closed		4,750	47,342	634	41,977
13-Aug	closed		closed		1,388	48,730	387	42,364
14-Aug	closed		closed		803	49,533	675	43,039
15-Aug	closed		closed		524	50,057	555	43,594
16-Aug	closed		closed		402	50,459	503	44,097
17-Aug	closed		closed		0	50,459	666	44,763
18-Aug	closed		closed		0	50,459	206	44,969
19-Aug	closed		closed		0	50,459	253	45,222
20-Aug	closed		closed		3,411	53,870	207	45,429
21-Aug	closed		closed		968	54,838	262	45,691
22-Aug	closed		closed		1,535	56,373	484	46,175
23-Aug	closed		closed		920	57,293	739	46,914
24-Aug	closed		closed		856	58,149	289	47,203
25-Aug	closed		closed		243	58,392	179	47,382
26-Aug	closed		closed		156	58,548	70	47,452
27-Aug	closed		closed		0	58,548	221	47,673
28-Aug	closed		closed		0	58,548	86	47,759
29-Aug	closed		closed		0	58,548	53	47,812
30-Aug	closed		closed		0	58,548	27	47,839
31-Aug	closed		closed		0	58,548	29	47,868
1-Sep	closed		closed		0	58,548	59	47,927
2-Sep	closed		closed		0	58,548	539	48,466
3-Sep	closed		closed		1,185	59,733	13	48,479
4-Sep	closed		closed		0	59,733	10	48,489
5-Sep	closed		closed		0	59,733	0	48,489
6-Sep	closed		closed		0	59,733	4	48,493
7-Sep	closed		closed		0	59,733	5	48,498
8-Sep	closed		closed		0	59,733	0	48,498
9-Sep	closed		closed		0	59,733	5	48,503
10-Sep	closed		closed		0	59,733	13	48,516

Table 21. Estimated age composition of sockeye salmon escapement and harvests from Kodiak Management Area enhancement or rehabilitation systems, 2001.

Location	Sample Weeks	Sample Size		Ages														
				1.1	0.3	1.2	2.1	1.3	2.2	3.1	1.4	2.3	3.2	4.1	2.4	3.3	3.4	Total
Afognak Lake	22-31	790	Percent	0.7	0.0	11.4	4.0	26.2	3.2	9.0	0.0	44.6	0.0	0.3	0	0.7	0.0	100
(escapement)[a]	(5/24-8/01)		Numbers	137	0	2,383	833	5,473	676	1,877	0	9,328	0	63	0	156	0	20,929
Foul Bay THA	24-28	551	Percent	1.7	0.0	28.8	0.0	67.8	0.4	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	100
(harvest)	(6/7-7/11)		Numbers	517	0	8,602	0	20,206	123	0	0	374	0	0	0	0	0	29,822
Little Kitoi Lake/Bay[b]	24-36	570	Percent	0.3	0.0	3.5	1.9	9.5	11.3	0.0	0.0	71.6	0.1	0.0	0.0	1.5	0.0	100
(harvest)	(6/7-9/5)		Numbers	23	0	241	132	648	770	0	0	4,859	5	0	0	102	0	6,791
Little Kitoi fish pass[c]	22-23	80	Percent	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	96.0	0.0	0.0	0.0	1.0	0.0	100
(harvest)	(5/27-6/2)		Numbers	0	0	0	0	2	0	0	0	77	0	0	0	1	0	80[e]
Malina Bay	24	163	Percent	2.5	0.0	22.7	1.8	41.1	14.1	0.6	0.0	16.6	0.6	0.0	0.0	0.0	0.0	100
(harvest)	(6/7-6/13)		Numbers	4	0	37	3	67	23	1	0	27	1	0	0	0	0	163
Malina Lake	21-32	681	Percent	13.6	0.0	15.0	8.0	42.7	3.3	0.2	0.0	16.7	0.2	0.0	0.0	0.3	0.0	100
(escapement)	(5/24-8/8)		Numbers	3,059	0	3,374	1,799	9,603	742	45	0	3,756	45	0	0	67	0	22,490
Pauls Lake	23-35	441	Percent	5.1	0.0	24.9	2.8	26.6	3.9	0.0	0.0	36.6	0.0	0.0	0.0	0.1	0.0	100
(escapement)	(5/31-8/29)		Numbers	1,180	0	5,780	653	6,183	907	0	0	8,506	0	0	0	22	0	23,230
Saltery Lake	28-33	218	Percent	0.7	1.2	2.9	0.0	54.5	18.7	0.0	0.0	20.0	0.0	0.0	1.1	0.0	0.9	100
(escapement)[d]	(7/5-8/15)		Numbers	252	456	1,088	0	20,467	7,035	0	0	7,492	0	0	429	0	328	37,547
Spiridon Lake THA	27-36	1,534	Percent	1.1	0.1	58.5	3.4	17.2	19.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	100
(harvest)	6/28-9/5)		Numbers	674	51	34,921	2,022	10,300	11,334	0	7	391	0	0	7	0	0	59,733
Spiridon Bay (HP)	30-33	285	Percent	0.0	0.0	45.0	0.0	23.0	28.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	100
(harvest)	(7/23-8/14)		Numbers	0	1	127	1	65	79	0	0	12	0	0	0	0	0	285[e]
Waterfall Bay THA	24-28	497	Percent	1.2	0.0	40.8	0.6	56.9	0.2	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0	100
(harvest)	(6/7-7/11)		Numbers	190	0	6,532	90	9,112	34	0	34	30	0	0	0	0	0	16,023

[a] Actual escapement was 24,271; reduced apportionment due to no late season sampling.

[b] Based on age samples and marks observed at Little Kitoi fish pass and Big Kitoi raceways; applied to escapement and harvest from statistical areas 252-30 (Izhut Bay), 252-31 (Duck Bay), and 252-32 (L. Kitoi Bay).

[c] Fish transiting the fishpass were sampled and returned to saltwater.

[d] Actual escapement was 45,608; reduced apportionment due to no late season sampling.

[e] Actual sample size, numbers have not been expanded out for total harvest or escapement.

THA = Terminal harvest area; HP = Hook Point setnet site.

Figure 1. Location of salmon systems where biological data was collected on Kodiak and Afognak Islands, 1951-2001.

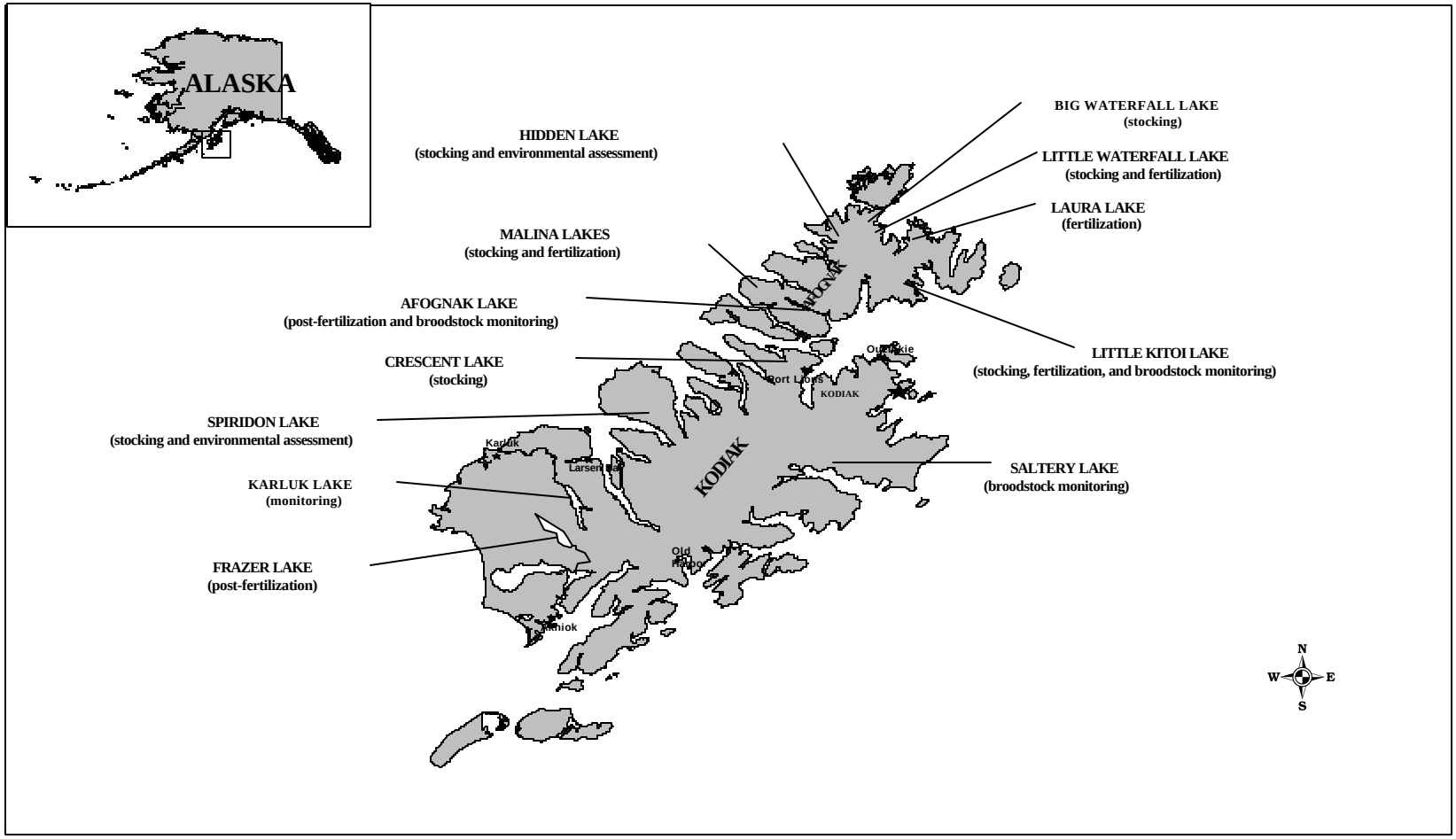


Figure 2. Locations of sockeye salmon stocking, fertilization, broodstock, and environmental assessment monitoring programs on Kodiak and Afognak Islands, 2001.

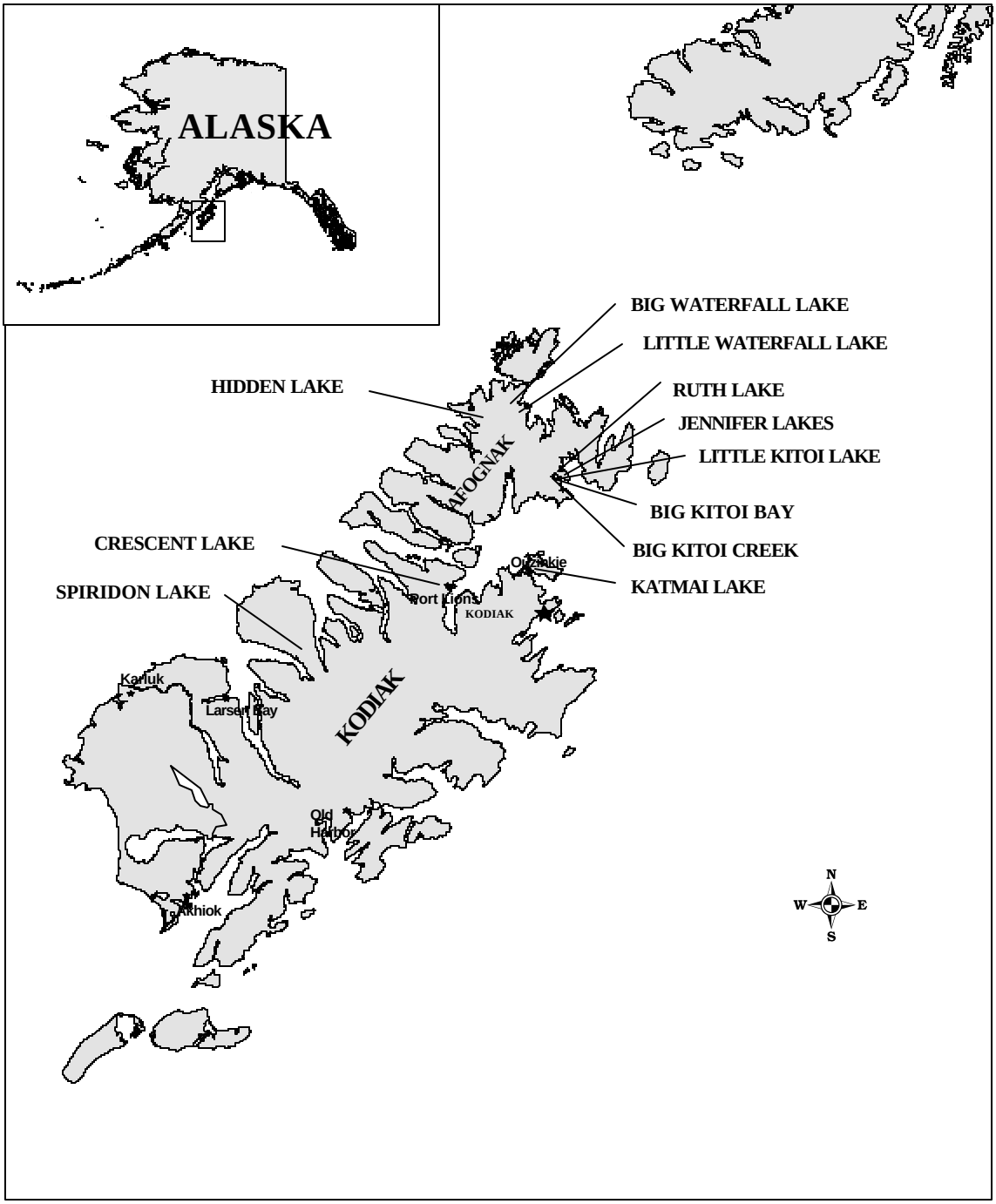


Figure 3. Salmon stocking locations on Kodiak and Afognak Islands, 2001.

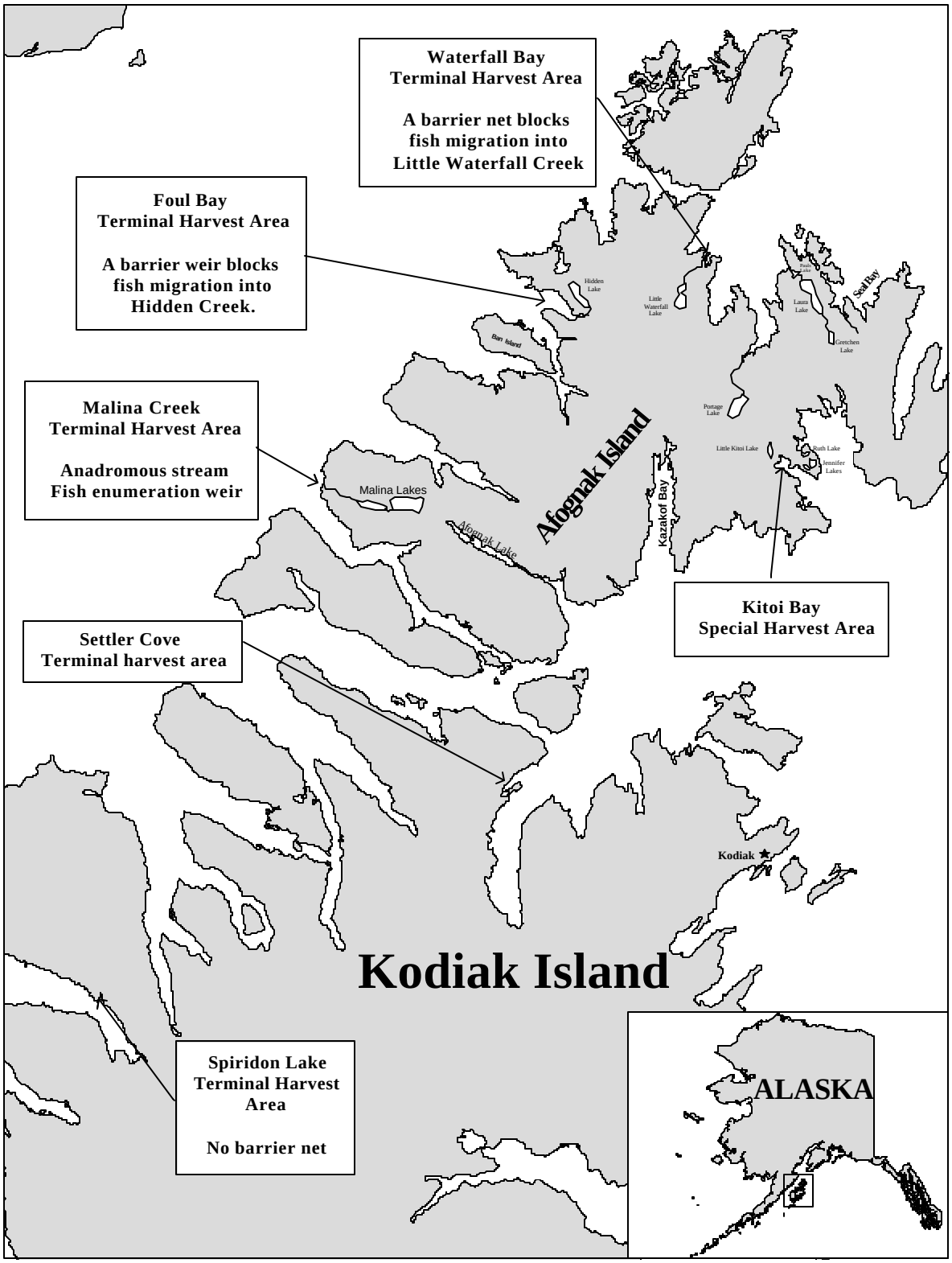


Figure 4. Locations of terminal and special harvest areas with associated barrier weirs/nets or counting weirs at these systems.

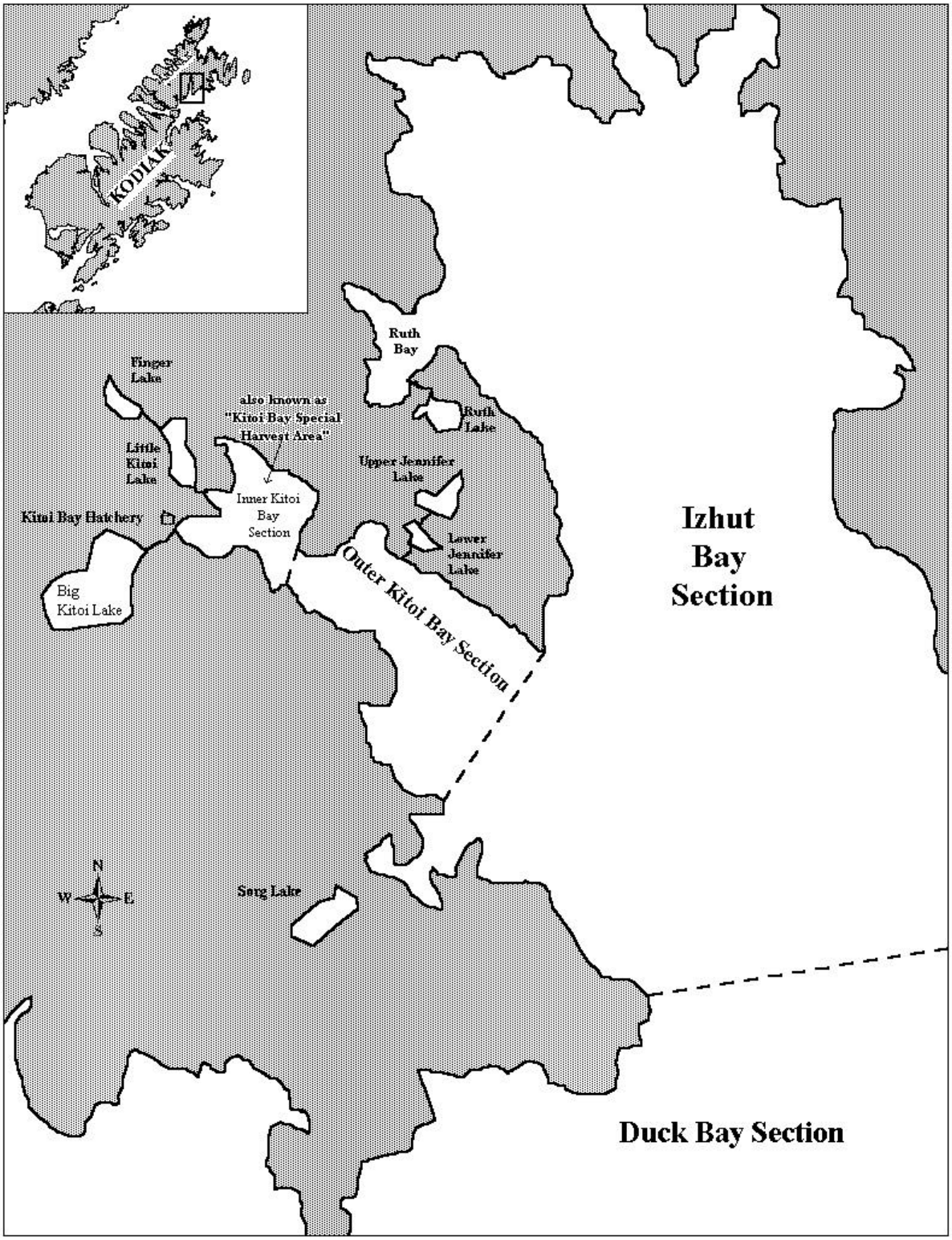


Figure 5. Izhut (252-30), Duck (252-31), and Kitoi (252-32) Bay Sections of the Afognak Commercial Fishing District, 2001.

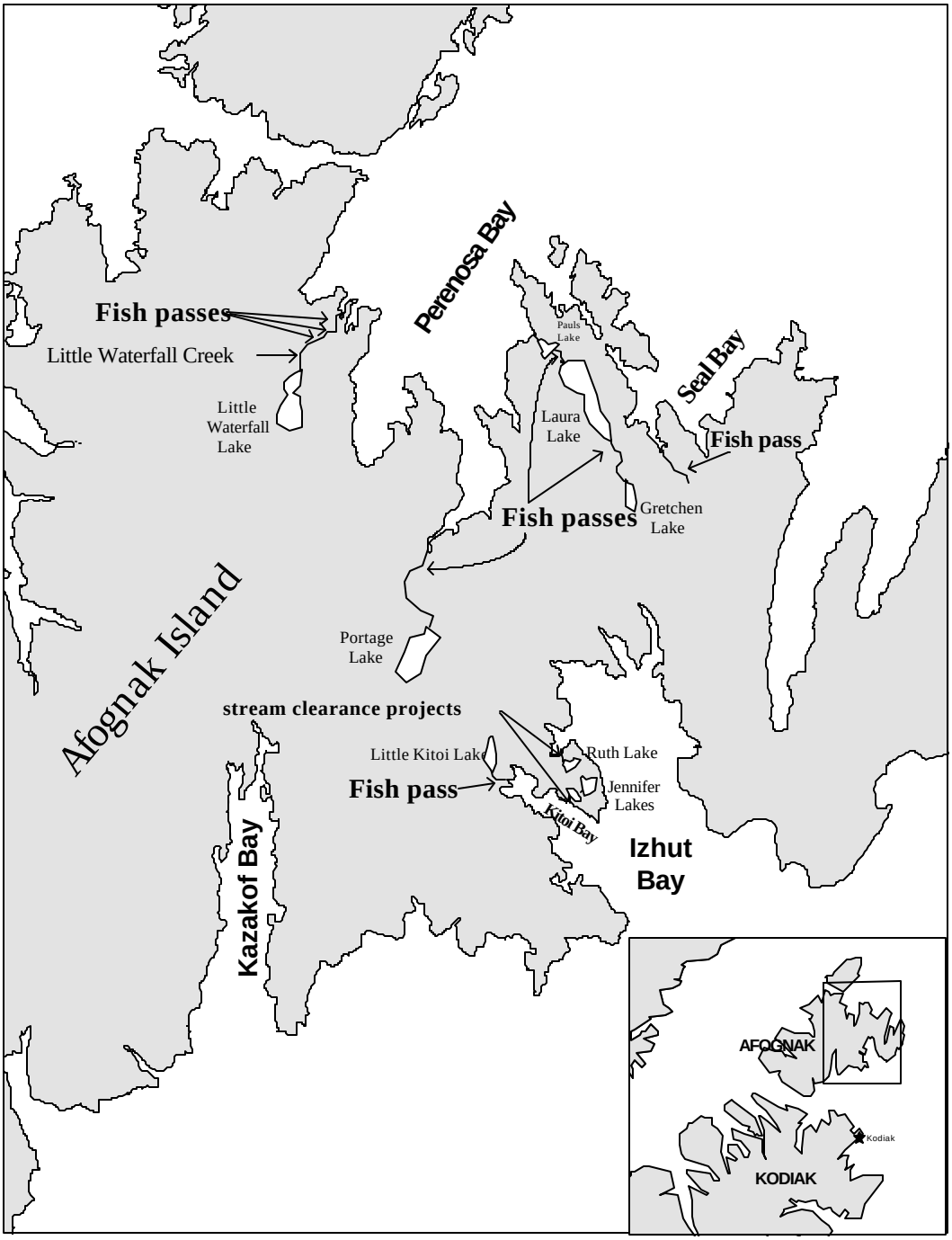


Figure 6. Location of fish passes and stream clearance operations at salmon systems on Afognak Island, 2001.

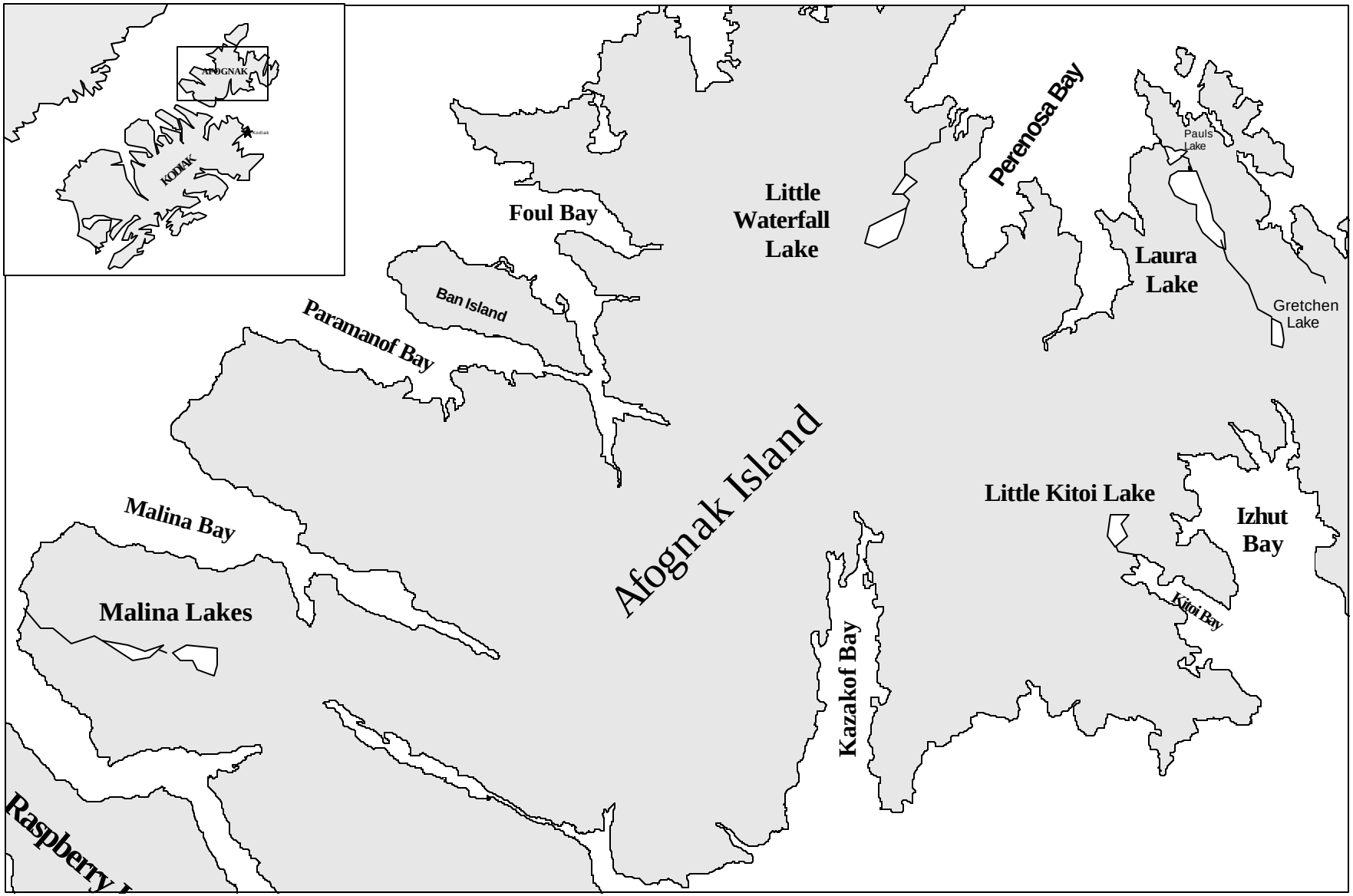


Figure 7. Location of lake enrichment systems on Afognak Island, 2001.

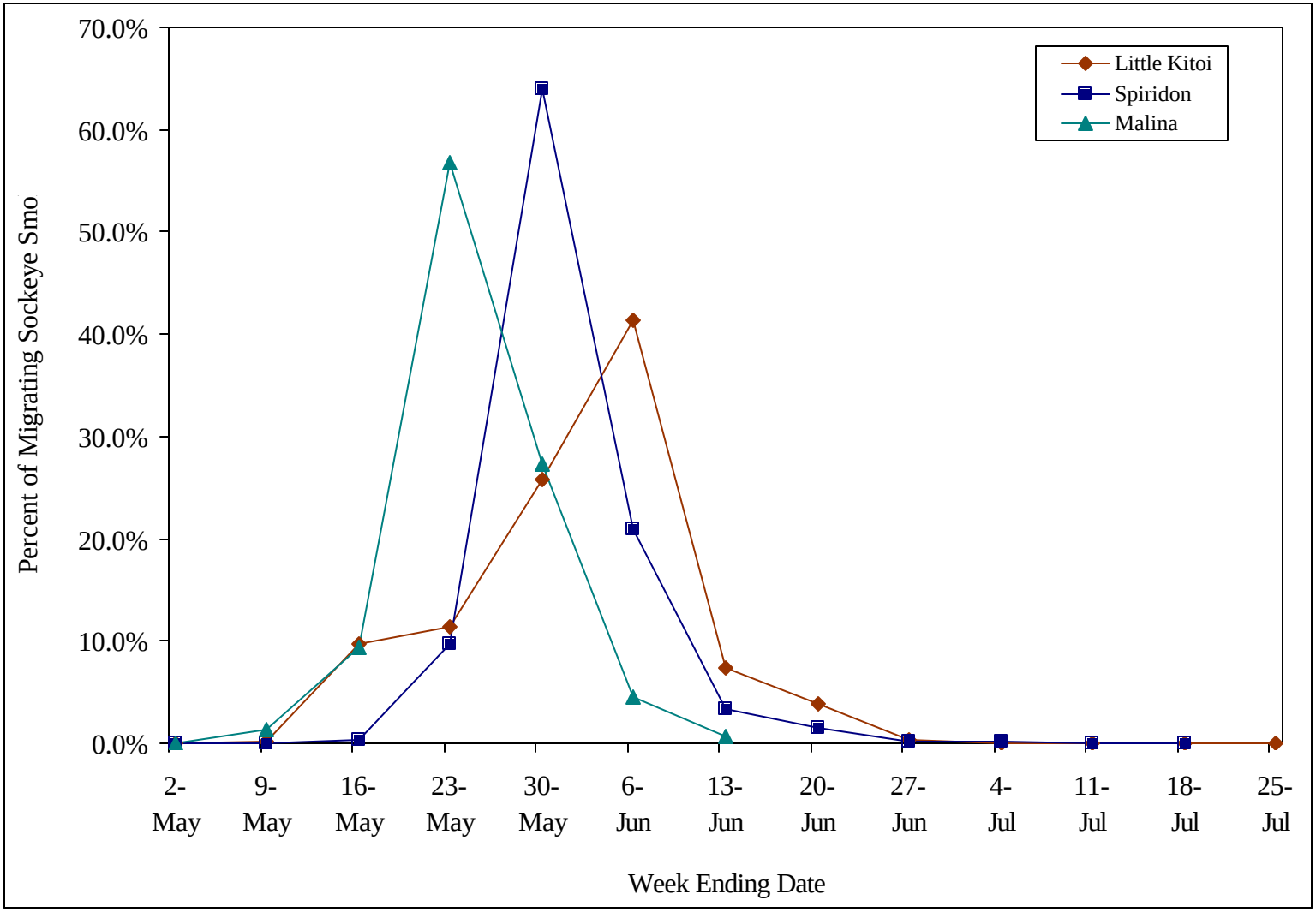


Figure 8. Sockeye salmon smolt emigration timing from Little Kitoi, Spiridon, and Malina Lakes, 2001.

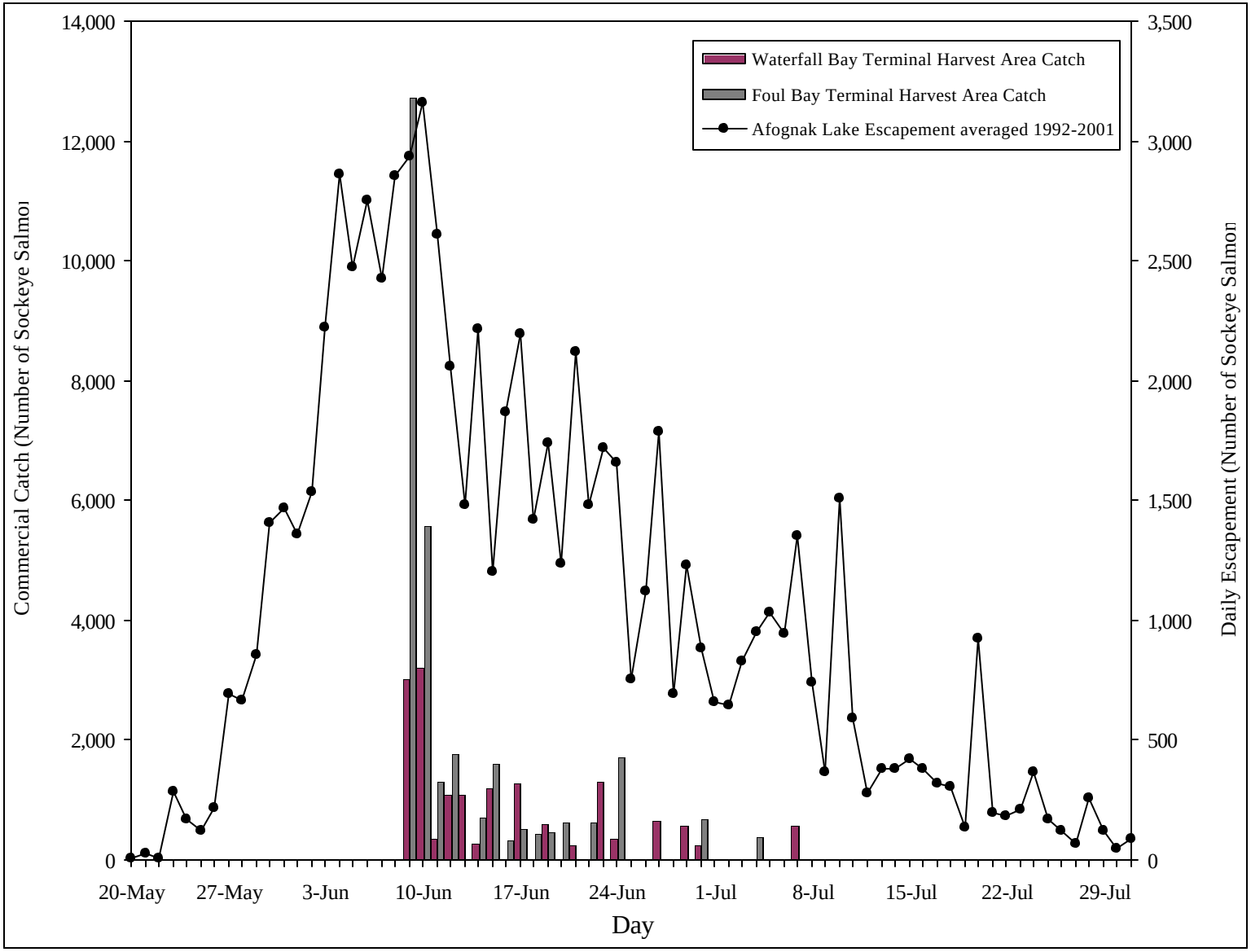


Figure 9. Commercial harvest of sockeye salmon in the Waterfall Bay and Foul Bay terminal harvest areas in 2001 compared to the escapement timing of the Afognak Lake brood source, 1992-2001.

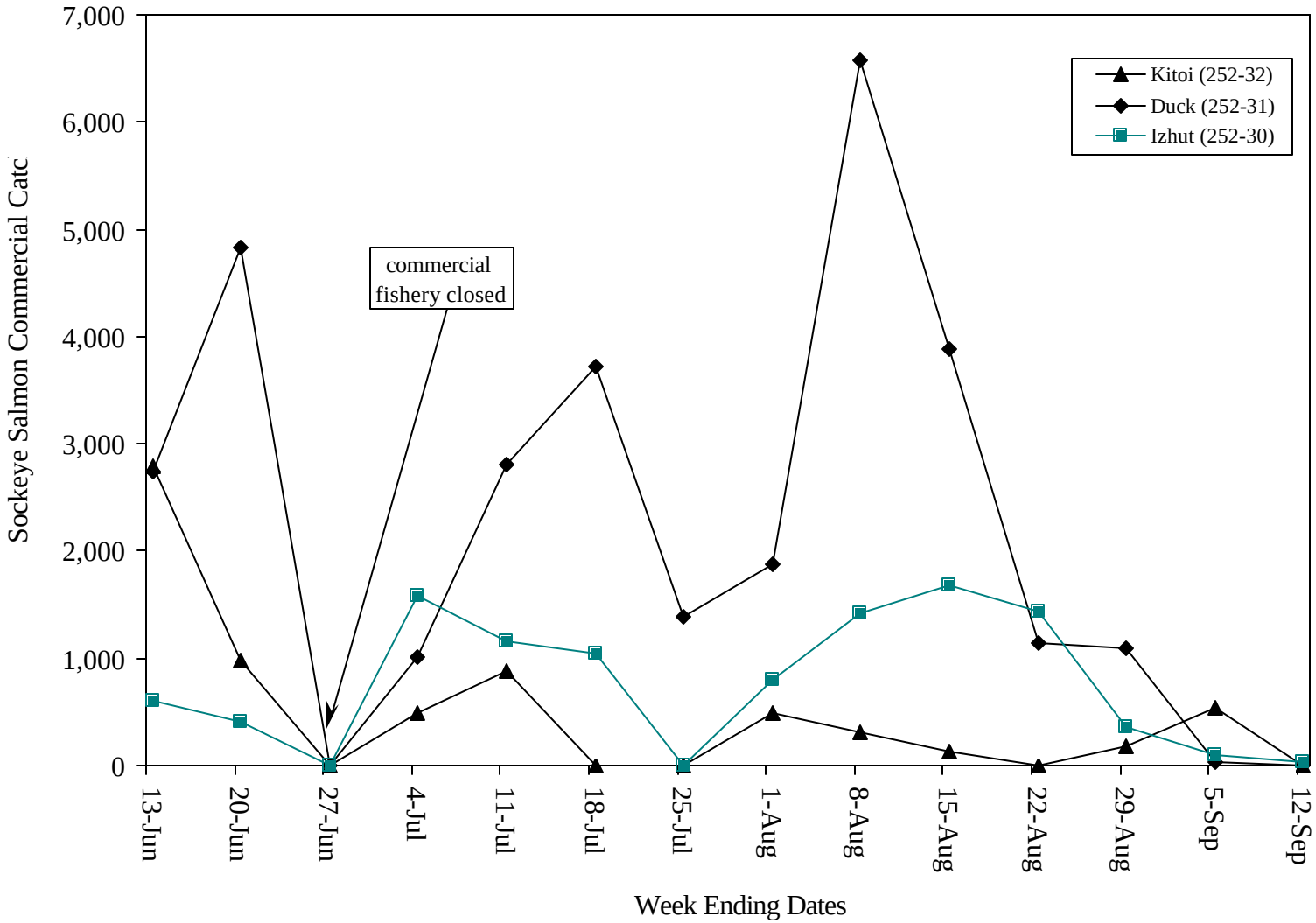


Figure 10. Sockeye salmon commercial catches in the Kitoi (252-32), Duck (252-31), and Izhut (252-30) Bay Sections, 2001.

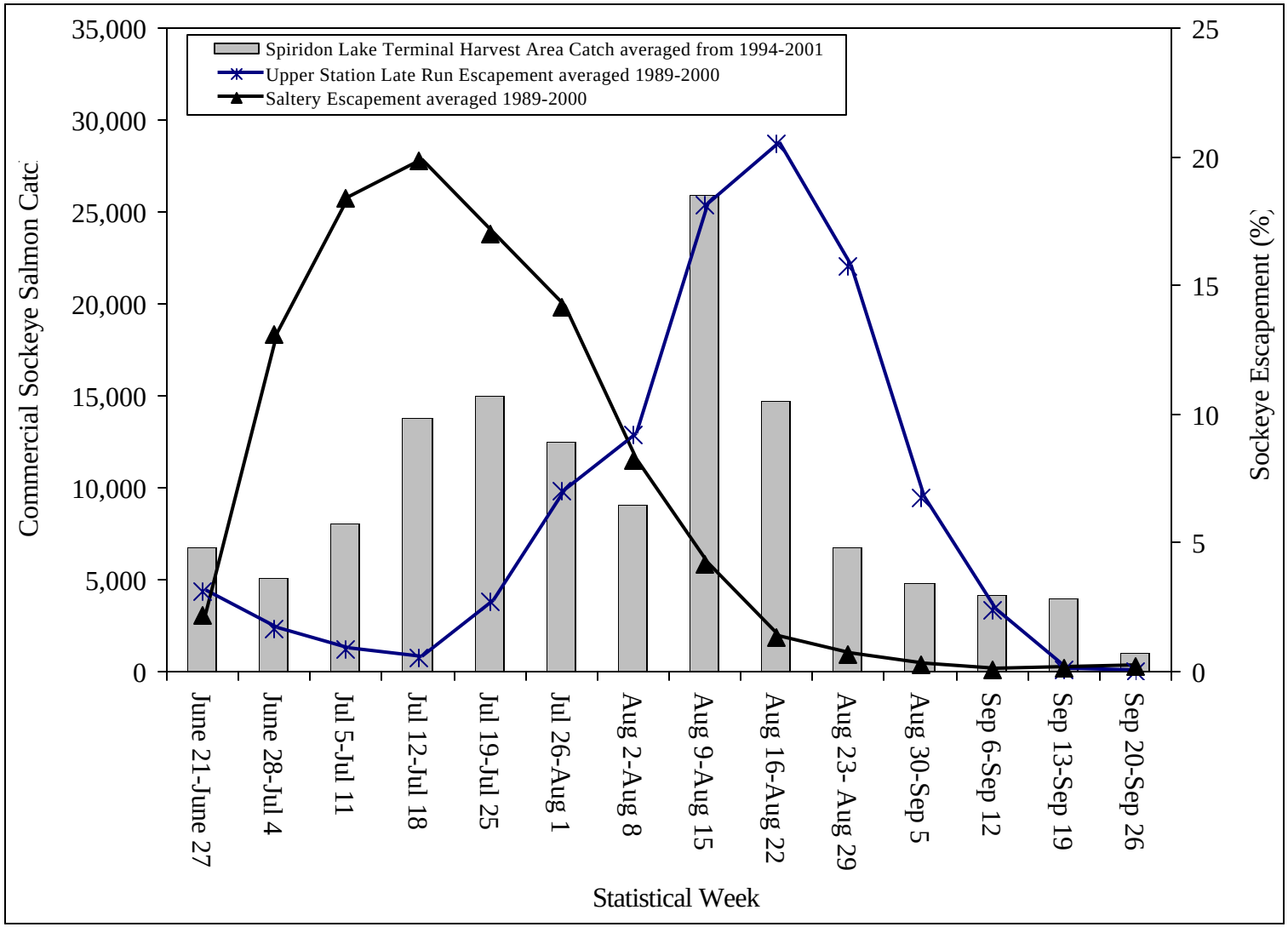


Figure 11. Average commercial sockeye salmon harvest in the Spiridon Lake terminal harvest area from 1994-2001 compared to the average escapement timing of the Upper Station Lake and Saltery Lake brood sources, 1989-2000.

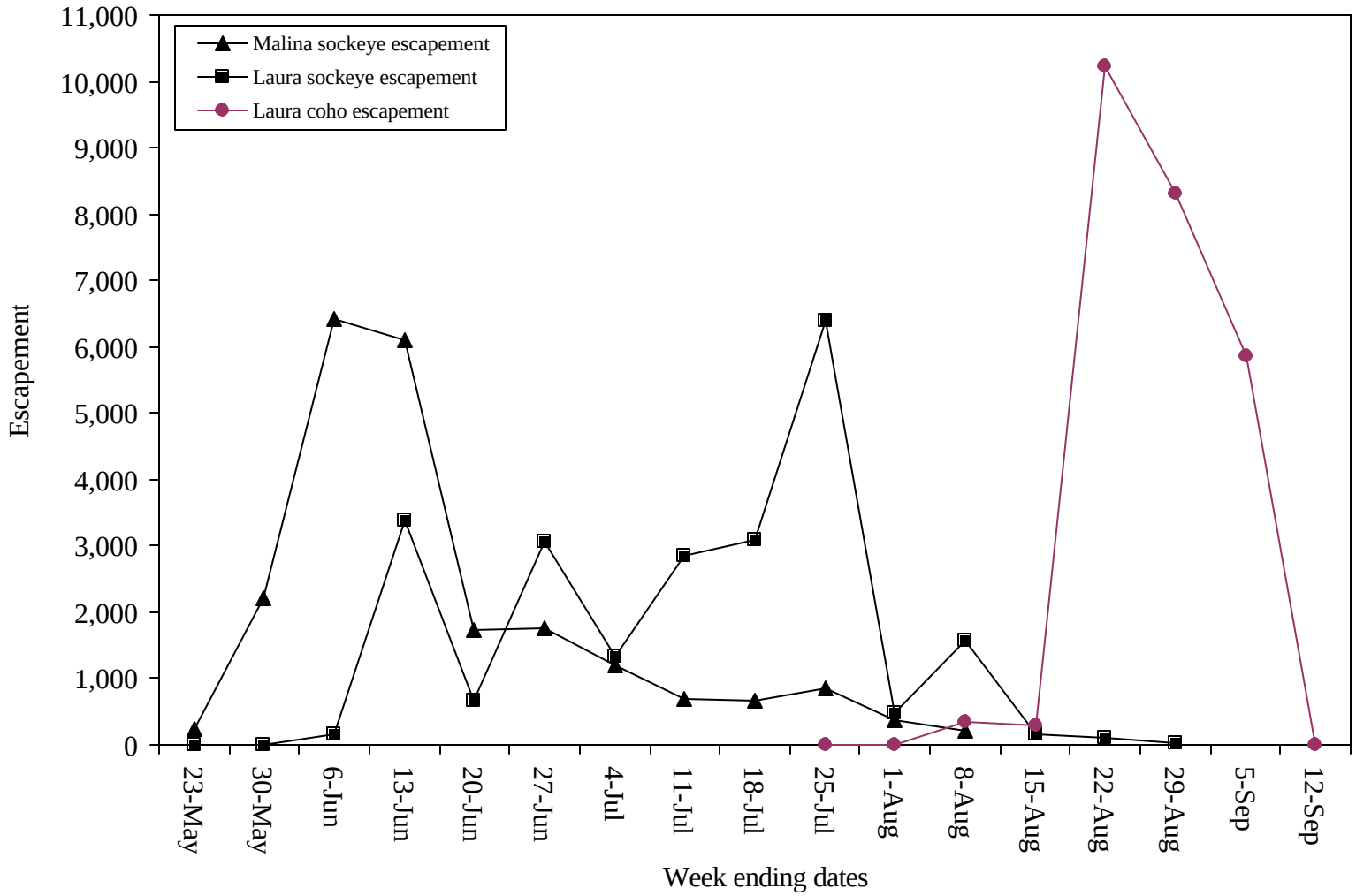


Figure 12. Escapement timing of sockeye and coho salmon into the Pauls/Laura Lake system and sockeye salmon escapement into Malina Lakes, 2001.

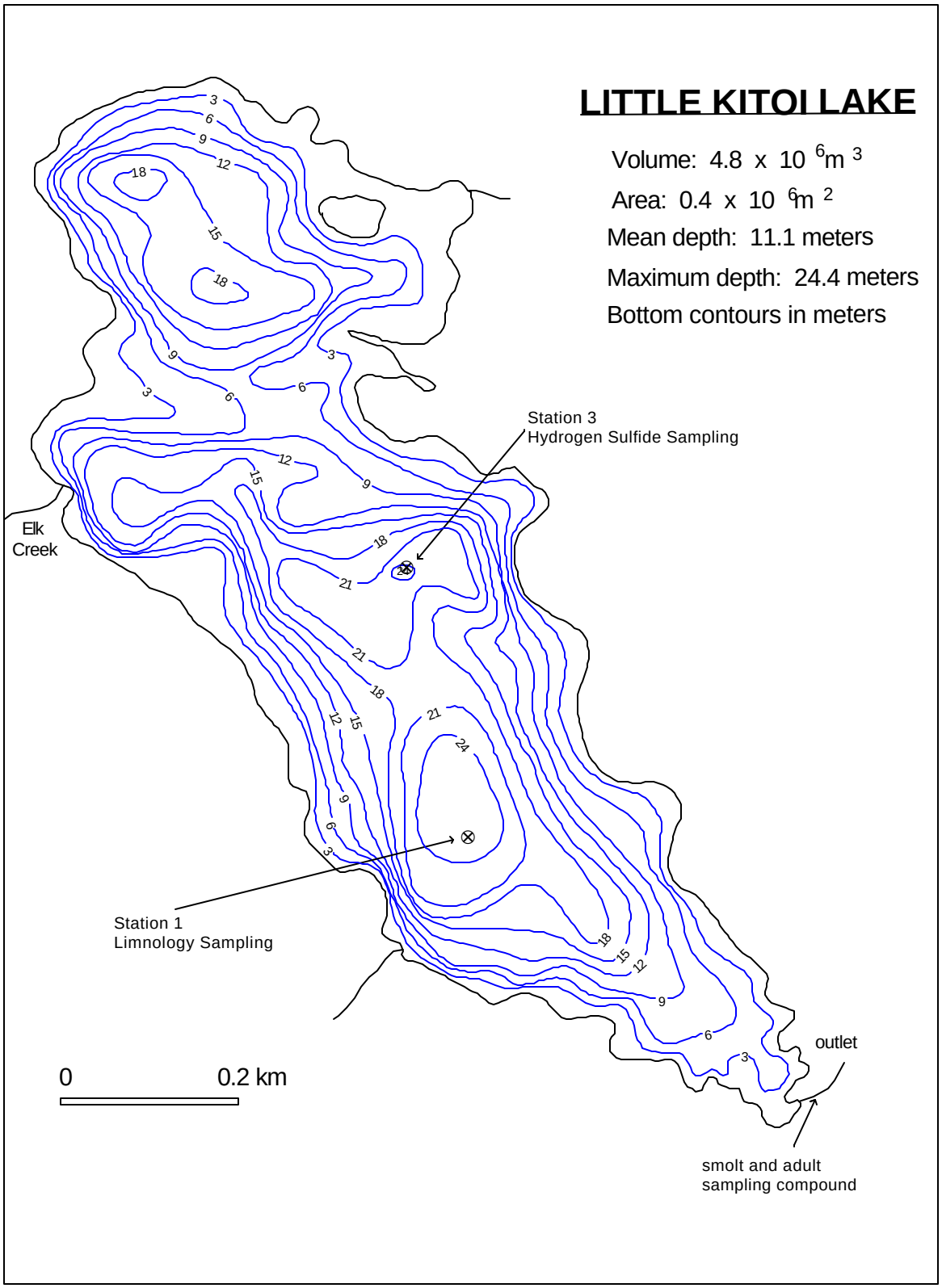
APPENDIX

Appendix A. History of Kodiak Island sockeye salmon enhancement and restoration projects, 1890-2001.

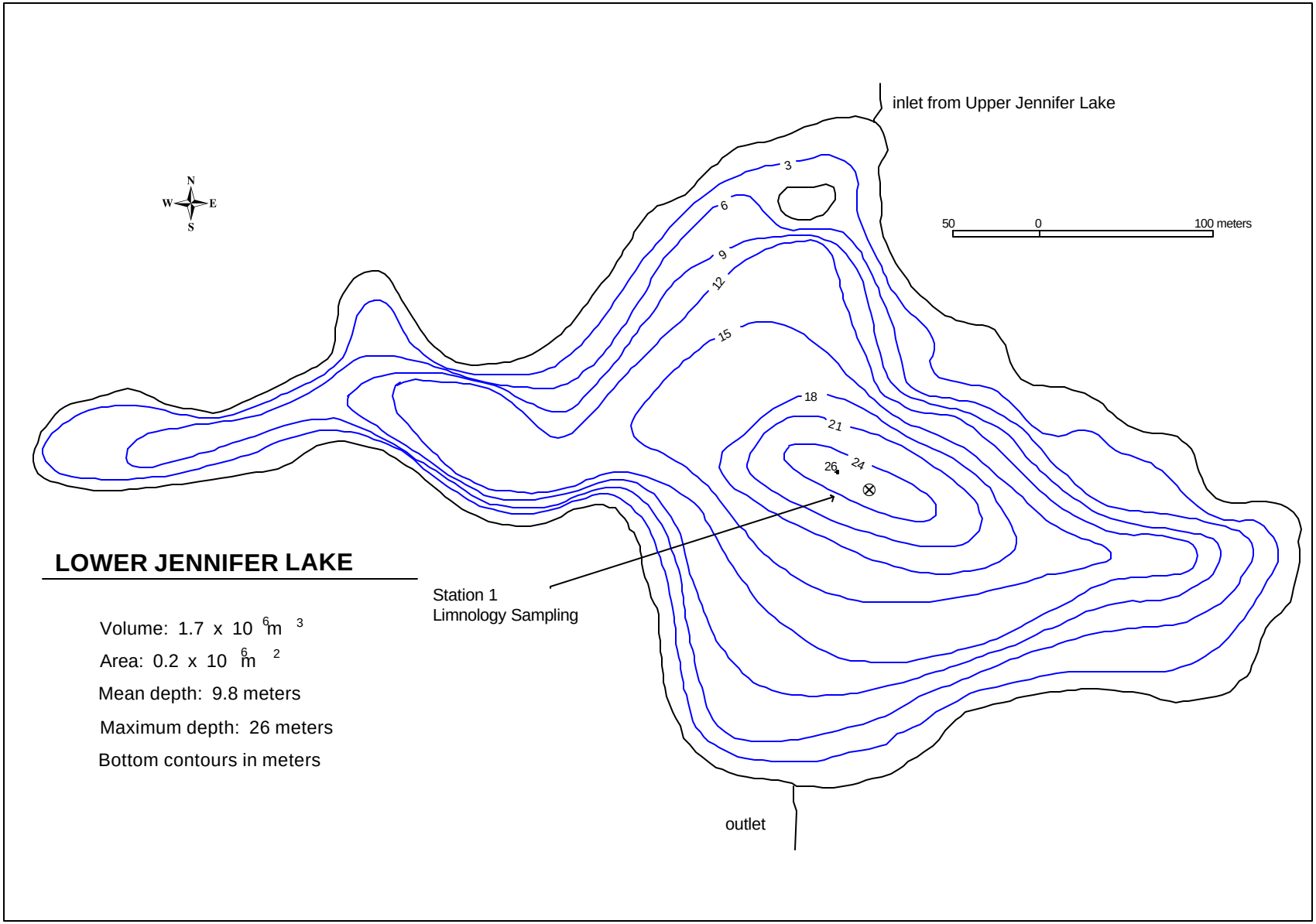
Project	Years	Funding Source
Karluk Voluntary Hatchery	1891, 1896-1917	Cannery Operators
Afognak Lake Federal Hatchery	1908-1932	Bureau of Fisheries
Paul's Lake System Egg Plants and Fishway Development	1951-1955	Territorial Department of Fisheries (TDF)
Frazer Lake Egg Plants, Fry Stocking, Adult Transplants, and Fish Ladder	1951-1971	TDF; Alaska Department of Fish and Game (ADF&G)
Kitoi Bay Research Station/Hatchery	1953-1972	TDF; ADF&G
Bare Lake Enrichment	1955	USF&WS
Karluk Lake Streamside Incubation/ Egg Plants	1979-1986	ADF&G
Kodiak Regional Aquaculture Association (KRAA)	1983-present	Fishery Enhancement Tax
Karluk Lake Enrichment	1986-1990	KRAA; Kodiak Island Borough (KIB)
Frazer Lake Enrichment	1988-1992	KRAA; KIB
Kodiak and Afognak Island Lakes Feasibility Investigations	1990-1992	KRAA
Afognak Lake Enrichment	1990-2000	KRAA
Malina Lakes Enrichment	1991-2001	KRAA
Portage Lake Enrichment	1993-1997	KRAA
Jennifer Lakes Stocking	1993-1997	KRAA
Laura Lake Enrichment	1993-2001	KRAA
Little Waterfall Lake Enrichment	1993-2001	KRAA
Little Kitoi Lake Enrichment	2000-2001	KRAA

Appendix B. Kodiak Comprehensive Salmon Plan 1982-2002, Phase II harvest objectives (natural, supplemental, and total), by species.

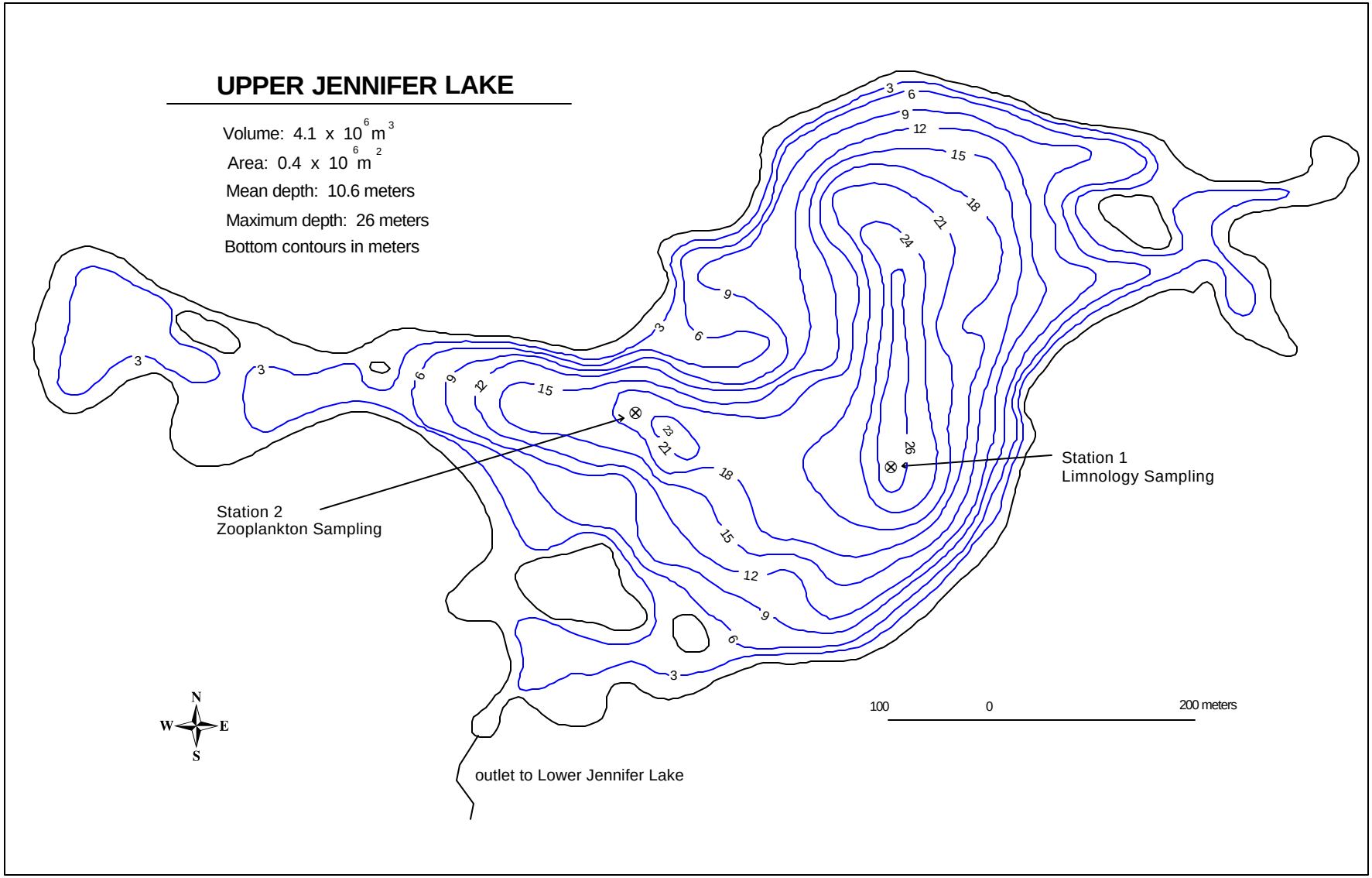
Species	Harvest Objective		
	Natural (wild runs)	Supplemental (enhanced runs)	Total
Pink			
odd year	7,500,000	11,500,000	19,000,000
even year	12,000,000	11,500,000	23,500,000
Sockeye	2,700,000	1,700,000	4,400,000
Chum	900,000	1,100,000	2,000,000
Coho	161,000	382,000	543,000
Chinook	12,000	3,000	15,000
Total Harvest:			
odd year	11,273,000	14,685,000	25,958,000
even year	15,773,000	14,685,000	30,458,000



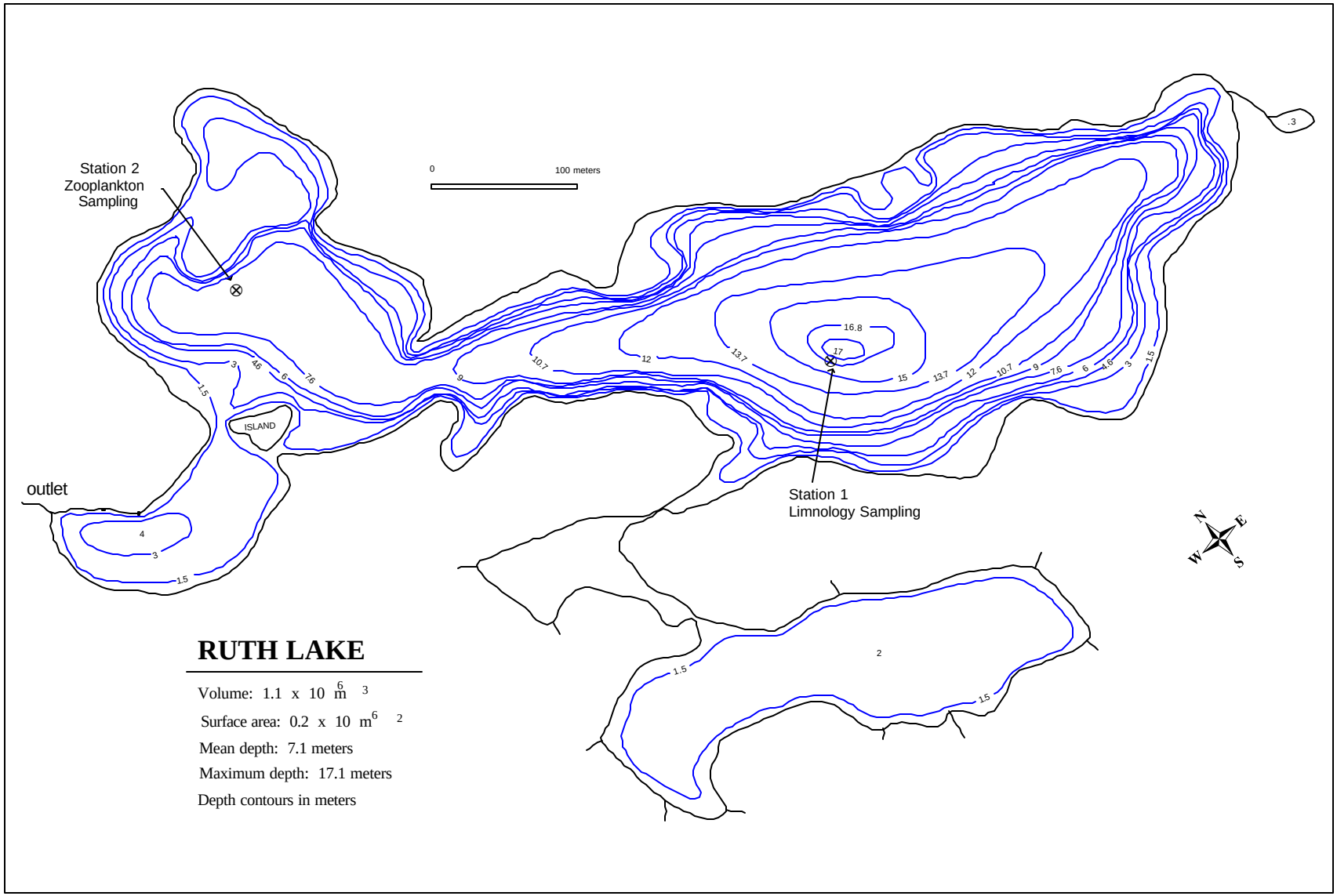
Appendix C.1. Morphometric map showing the limnology and hydrogen sulfide stations, and the smolt and adult sampling compound on Little Kitoi Lake.



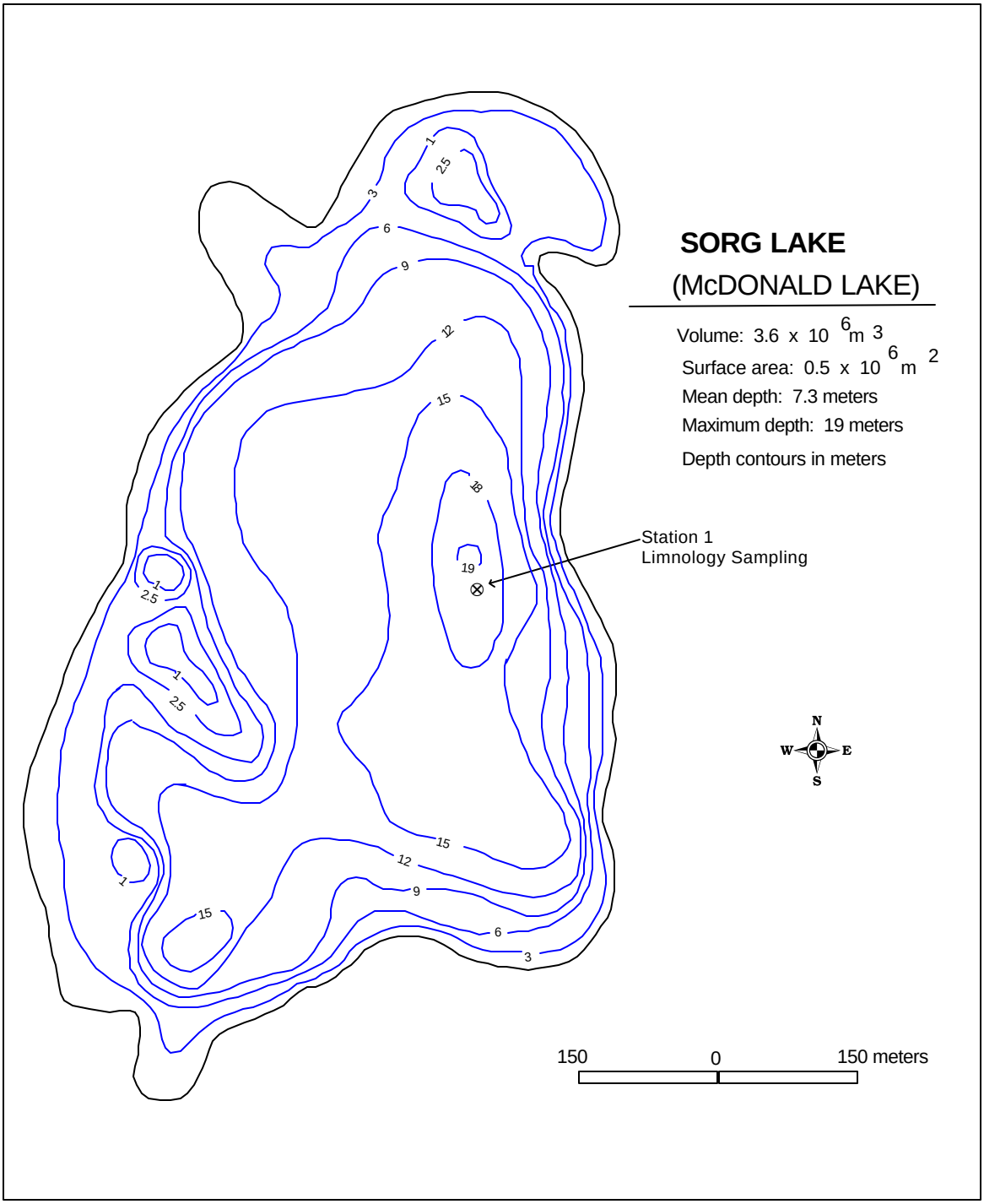
Appendix C.2. Morphometric map showing the limnology station for Lower Jennifer Lake.



Appendix C.3. Morphometric map showing the limnology and zooplankton stations on Upper Jennifer Lake.



Appendix C.4. Morphometric map showing the limnology and zooplankton stations on Ruth Lake.



Appendix C.5. Morphometric map showing the limnology station on Sorg Lake.

Appendix C.6. Historical pink salmon releases from Kitoi Bay Hatchery for release years 1973-2001.

Brood Year	Broodstock	Number of Fry Released	Release Location	Avg. Weight (g)	Release Year
1972	Big Kitoi	493,130	Big Kitoi Bay	[a]	1973
1973	Big Kitoi	447,642	Big Kitoi Bay	[a]	1974
1974	Big Kitoi	1,226,314	Big Kitoi Bay	[a]	1975
1975	Big Kitoi	2,486,410	Big Kitoi Bay	[a]	1976
1976	Big Kitoi	4,722,152	Big Kitoi Bay	0.50	1977
1977	Big Kitoi	17,255,424	Big Kitoi Bay	0.44	1978
1978	Big Kitoi	17,319,537	Big Kitoi Bay	[a]	1979
1979	Big Kitoi	22,458,947	Big Kitoi Bay	0.63	1980
1980	Big Kitoi	26,351,664	Big Kitoi Bay	0.93	1981
1981	Big Kitoi	47,828,701	Big Kitoi Bay	[a]	1982
1982	Big Kitoi	72,054,096	Big Kitoi Bay	0.79	1983
1983	Big Kitoi	87,065,569	Big Kitoi Bay	0.58	1984
1984	Big Kitoi	75,109,442	Big Kitoi Bay	0.29	1985
1985	Big Kitoi	97,773,052	Big Kitoi Bay	0.78	1986
1986	Big Kitoi	90,017,823	Big Kitoi Bay	0.27	1987
1987	Big Kitoi	94,172,516	Big Kitoi Bay	0.73	1988
1988	Big Kitoi	80,502,220	Big Kitoi Bay	0.62	1989
1989	Big Kitoi	84,907,550	Big Kitoi Bay	0.61	1990
1990	Big Kitoi	124,148,019	Big Kitoi Bay	0.60	1991
1991	Big Kitoi	147,145,130	Big Kitoi Bay	0.80	1992
1992	Big Kitoi	169,552,112	Big Kitoi Bay	0.51	1993
1993	Big Kitoi	163,192,575	Big Kitoi Bay	0.45	1994
1994	Big Kitoi	134,104,406	Big Kitoi Bay	0.53	1995
1995	Big Kitoi	144,045,245	Big Kitoi Bay	0.48	1996
1996	Big Kitoi	102,583,724	Big Kitoi Bay	0.50	1997
1997	Big Kitoi	128,101,460	Big Kitoi Bay	0.50	1998
1998	Big Kitoi	127,685,500	Big Kitoi Bay	0.54	1999
1999	Big Kitoi	137,702,154	Big Kitoi Bay	0.61	2000
2000	Big Kitoi	134,823,670	Big Kitoi Bay	0.72	2001

[a] Average release weights were not determined.

Appendix C.7. Historical chum salmon fry releases from Kitoi Bay Hatchery for release years 1982-2001.

Brood Year	Broodstock	Number of Fry Released	Release Location	Avg. Weight (g)	Release Year
1981	Sturgeon R.	36,846	Big Kitoi Creek	0.56	1982
1982	Sturgeon R.	105,058	Big Kitoi Creek	1.05	1983
1983	Sturgeon R.	630,422	Big Kitoi Creek	1.16	1984
1984	Sturgeon R.	784,078	Big Kitoi Creek	0.67	1985
1985	Sturgeon R.	414,233	Big Kitoi Creek	[b]	1986
1986	Big Kitoi	693,166	Big Kitoi Creek	2.00	1987
1987	Big Kitoi	4,737,587	Big Kitoi Creek	2.10	1988
1988	Big Kitoi	3,289,878	Big Kitoi Creek	1.85	1989
1989	Big Kitoi	1,502,501	Big Kitoi Creek	2.44	1990
1990	Big Kitoi	[a]	Big Kitoi Creek	[b]	1991
1991	Big Kitoi	22,214,472	Big Kitoi Creek	1.80	1992
1992	Big Kitoi	10,101,986	Big Kitoi Creek	2.02	1993
1993	Big Kitoi	6,507,497	Big Kitoi Creek	1.52	1994
1994	Big Kitoi	9,738,472	Big Kitoi Creek	1.51	1995
1995	Big Kitoi	20,139,843	Big Kitoi Creek	1.27	1996
1996	Big Kitoi	23,500,000	Big Kitoi Creek	1.50	1997
1997	Big Kitoi	12,310,015	Big Kitoi Creek	1.50	1998
1998	Big Kitoi	6,859,982	Big Kitoi Bay	1.03	1999
1999	Big Kitoi	22,334,640	Big Kitoi Bay	1.70	2000
2000	Big Kitoi	20,032,140	Big Kitoi Bay	1.73	2001

[a] A disease outbreak occurred, all chum fry were destroyed.
[b] Average release weights were not determined.

Appendix C.8. Historical coho salmon releases at Big Kitoi and Little Kitoi systems for release years 1984-2001.

Brood Year	Broodstock	Number Released	Release Location	Avg. Weight (g)	Release Year
1983	L.Kitoi	127,700	Little Kitoi Lake	1.00	1984
1984	L.Kitoi	33,472	Little Kitoi Lake	1.50	1985
1985	L.Kitoi	53,360	Little Kitoi Lake	6.10	1986
1986	L.Kitoi	171,103	Little Kitoi Lake	1.79	1987
1986	L.Kitoi	9,600	Big Kitoi Creek	5.00	1987
1987	L.Kitoi	43,807	Little Kitoi Lake	1.52	1988
1988	L.Kitoi	137,493	Big Kitoi Bay	23.30	1990
1990	L.Kitoi	60,755	Big Kitoi Bay	32.00	1992
1991	L.Kitoi	70,605	Little Kitoi Lake	1.40	1992
1991	L.Kitoi	613,681	Big Kitoi Bay	18.90	1993
1992	L Kitoi	139,147	Little Kitoi Lake	1.30	1993
1992	L Kitoi	5,163	Big Kitoi Creek	14.60	1993
1992	L Kitoi	97,973	Big Kitoi Bay	28.40	1994
1993	Big Kitoi	258,926	Big Kitoi Bay	25.90	1995
1994	Big Kitoi	894,486	Big Kitoi Bay	23.54	1996
1995	Big Kitoi	819,046	Big Kitoi Bay	19.57	1997
1996	Big Kitoi	769,000	Big Kitoi Bay	23.90	1998
1997	Big Kitoi	1,098,338	Big Kitoi Bay	19.30	1999
1998	Big Kitoi	871,448	Big Kitoi Bay	16.92	2000
1999	Big Kitoi	936,913	Big Kitoi Bay	20.76	2001

Appendix C.9. Historical sockeye salmon releases at Big Kitoi and Little Kitoi systems for release years 1989-2001.

Brood Year	Broodstock	Number Released	Release Location	Avg. Weight (g)	Release Year
1988	Upper Station	143,725	Little Kitoi Bay	2.5	1989
1989	Upper Station	578,932	Little Kitoi Lake	0.3	1990
1989	Upper Station	1,312,728	Little Kitoi Bay	3.0	1990
1990	Upper Station	1,250,000	Little Kitoi Bay	2.5	1991
1991	Upper Station	1,463,000	Little Kitoi Bay	1.6	1992
1991	Afognak	182,000	Little Kitoi Bay	1.5	1992
1992	Upper Station	52,418	Little Kitoi Lake	3.1	1993
1992	Upper Station	326,500	Little Kitoi Bay	15.0	1994
1993	Afognak	293,000	Little Kitoi Bay	1.9	1994
1993	Upper Station	1,672,710	Little Kitoi Bay	0.82 - 15.0	1994
1993	Afognak	183,000	Little Kitoi Lake	12.0	1994
1993	Little Kitoi	10,108	Little Kitoi Lake	4.6	1994
1993	Afognak	3,500	Little Kitoi Lake	23.0	1995
1993	Little Kitoi	916,677	Little Kitoi Bay	10.1	1995
1994	Upper Station	266,952	Little Kitoi Lake	1.8	1995
1994	Afognak	112,900	Little Kitoi Lake	10.0	1995
1994	Little Kitoi	84,861	Little Kitoi Lake	5.0	1995
1994	Little Kitoi	573,242	Little Kitoi Bay	12.7	1996
1995	Afognak	50,650	Little Kitoi Lake	10.0	1996
1995	Little Kitoi	155,687	Little Kitoi Lake	3.2	1996
1995	Upper Station	587,435	Little Kitoi Bay	12.1	1997
1996	Afognak	125,800	Little Kitoi Lake	9.5	1997
1996	Little Kitoi	77,039	Little Kitoi Lake	3.3	1997
1996	Little Kitoi	99,085	Little Kitoi Lake	11.7	1998
1996	Little Kitoi	397,000	Little Kitoi Bay	15.1	1998
1997	Saltery	106,658	Little Kitoi Lake	17.7	1999
1998	Saltery	98,737	Little Kitoi Lake	7.2	1999
1998	Saltery	74,463	Little Kitoi Lake	14.7	2000
1998	Saltery	23,756	Little Kitoi Bay	14.7	2000
1999	Saltery	154,039	Little Kitoi Lake	11.3	2000
2000	Saltery	282,089	Little Kitoi Lake	9.5	2001

Appendix C.10. Historical sockeye and coho salmon releases into upper and lower Jennifer Lakes for release years 1992-1995 and 1997-2001, respectively.

Species	Brood Year	Broodstock	Number Released	Release Location	Avg. Weight (g)	Year Released
Sockeye	1992	U. Station	180,000	U. Jennifer Lake	0.5	1993
Sockeye	1993	U. Station	370,000	U. Jennifer Lake	0.2	1994
Sockeye	1994	U. Station	200,000	U. Jennifer Lake	0.2	1995
Sockeye	1996	U. Station	458,000	U. Jennifer Lake	0.5	1997
Coho	1991	Little Kitoi	162,387	U. Jennifer Lake	4.5	1992
Coho	1992	Little Kitoi	135,486	U. Jennifer Lake	1.9	1993
Coho	1994	Big Kitoi	165,000	U. Jennifer Lake	1.5	1995
Coho	1996	Big Kitoi	163,000	U. Jennifer Lake	0.4	1997
Coho	1997	Big Kitoi	165,000	U. Jennifer Lake	0.5	1998
Coho	1998	Big Kitoi	136,000	U. Jennifer Lake	0.6	1999
Coho	1999	Big Kitoi	155,688	U. Jennifer Lake	0.4	2000
Coho	2000	Big Kitoi	120,000	L. Jennifer Lake	0.9	2001

Appendix C.11. Historical sockeye and coho salmon releases into Ruth and Sorg Lakes for release years 1995-2000.

Species	Brood Year	Broodstock	Number Released	Release Location	Avg. Weight (g)	Year Released
Sockeye	1995	Saltery	150,000	Ruth Lake	0.2	1996
Sockeye	1996	Saltery	147,000	Ruth Lake	0.2	1997
Sockeye	1997	Saltery	100,000	Ruth Lake	0.7	1998
Sockeye	1998	Saltery	66,500	Ruth Lake	1.3	1999
Sockeye	1999	Saltery	78,700	Ruth Lake	0.3	2000
Coho	1994	Big Kitoi	59,500	Ruth Lake	1.7	1995
Coho	1996	Big Kitoi	35,000	Ruth Lake	0.4	1997
Coho	1997	Big Kitoi	35,000	Ruth Lake	0.5	1998
Coho	1998	Big Kitoi	35,000	Ruth Lake	0.6	1999
Coho	1999	Big Kitoi	30,695	Ruth Lake	0.7	2000
Sockeye	1995	Afognak	146,000	Sorg Lake	6.3	1996

Appendix C.12. Historical coho salmon releases at Katmai Creek for release years 1987-2001.

Brood Year[a]	Broodstock	Number Released	Release Location	Avg. Weight (g)	Year Released
1986	Little Kitoi	22,349	Katmai Creek	0.5	1987
1987	Little Kitoi	20,000	Katmai Creek	0.7	1988
1991	Little Kitoi	14,973	Katmai Creek	4.5	1992
1992	Little Kitoi	15,052	Katmai Creek	1.9	1993
1993	Little Kitoi	13,178	Katmai Creek	23.3	1994
1994	Little Kitoi	16,489	Katmai Creek	5.9	1995
1995	Little Kitoi	15,246	Katmai Creek	5.0	1996
1996	Little Kitoi	15,735	Katmai Creek	7.3	1997
1997	Little Kitoi	14,000	Katmai Creek	7.2	1998
1998	Little Kitoi	15,000	Katmai Creek	6.0	1999
1999	Little Kitoi	15,000	Katmai Creek	8.2	2000
2000	Little Kitoi	15,000	Katmai Creek	8.4	2001

[a] For brood years 1988-1990, coho salmon were not released into Katmai Creek.

a.

b.

Appendix C.13. Little Kitoi fish pass (a) and smolt/adult sampling compound (b).

Appendix C.14. Limnological sampling stations and total samples collected for Kitoi area lakes, 1990-2001.

Lake	Year	Sampling Stations		Total Samples
Big Kitoi	1991	1		5
	1992	1		5
	1993	1		5
	1994	1		4
Jennifer	1990	1	2	3
	1993	1	2	4
	1994	1	2	4
	1995	1	2	5
	1996	1	2	5
	1997	1	2	4
	1998	1		4
	1999			0
	2000	1		4
	2001	1	2	4
Little Kitoi	1990	1		4
	1991	1		6
	1992	1		5
	1993	1		5
	1994	1	2	4
	1995	1	2	5
	1996	1	2	4
	1997	1	2	4
	1998	1		4
	1999	1		4
	2000	1		4
	2001	1		5
Ruth	1994	1	2	4
	1995	1	2	4
	1996	1	2	4
	1997	1		4
	1998	1		4
	1999	1		4
	2000	1		4
	2001	1		4
Sorg	1995	1		4
	1996	1		4
	1997	1		4

Appendix C.15. Summary of seasonal mean water chemistry parameters by station and depth for Little Kitoi Lake, 1990-2001.

Year	Stations	Depth (m)	Specific Conductance (umhos/cm)	S.D.	pH (Units)	S.D.	Alkalinity (mg/L)	S.D.	Turbidity (NTU)	S.D.	Color (Pt units)	S.D.	Calcium (mg/L)	S.D.	Magnesium (mg/L)	S.D.	Iron (ug/L)	S.D.
1990	1	1	115	7	7	0.2	28	2.5	2	1.9	11	1.3	11	1.6	2	1.0	32	11.4
	1	24	16,215	1,146	7	0.2	337	125.9	68	50.7	77	29.6	142	84.2	235	202.3	279	233.9
1991	1	1	112	31	7	0.1	27	2.0	1	0.3	14	3.4	10	0.6	2	0.7	28	18.3
	1	25	13,494	6,380	8	0.1	387	88.5	39	54.7	88	28.7	218	94.1	371	115.2	142	21.4
1992	1	1	119	5	7	0.4	25	4.1	1	1.3	13	2.6	9	0.3	3	0.6	51	54.0
	1	21	11,348	852	7	0.1	223	20.4	19	25.4	74	11.9	123	20.2	283	41.4	222	130.9
1993	1	1	116	18	7	0.3	28	3.2	0	0.2	11	2.8	11	0.6	2	1.1	26	13.9
	1	22	9,490	2,645	8	0.3	237	65.9	14	27.9	63	16.0	152	116.4	242	147.0	167	56.7
1994	1	1	112	15	7	0.3	27	2.1	1	0.3	19	0.5	10	1.2	2	0.4	33	19.7
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
	1	18	1,672	2,881	7	0.5	61	65.9	1	0.1	38	39.6	30	38.7	38	67.7	82	81.4
	2	1	139	59	7	0.5	30	4.1	1	0.4	21	4.7	11	2.0	2	0.8	40	20.3
	2	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
	2	15	137	16	7	0.2	32	1.9	2	2.5	19	1.4	12	0.7	2	0.1	42	35.1
1995	1	1	112	4	7	0.3	25	1.2	1	0.8	41	33.9	9	0.6	2	0.4	35	23.8
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
	1	22	12,500	2,985	7	0.1	309	64.0	55	98.9	70	28.8	141	32.6	319	64.7	238	46.6
	2	1	125	21	7	0.2	27	1.9	1	0.4	32	9.7	9	0.4	2	0.3	38	19.8
	2	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
	2	18	149	5	7	0.1	31	5.5	2	0.7	20	7.8	12	1.1	2	0.4	82	37.3
1996 [a]	1	1	124	3	7	0.2	28	1.6	1	1.1	14	3.8	9	0.1	2	0.4	30	14.3
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
	1	24	260	128	7	0.1	28	2.2	1	1.0	16	2.1	10	0.8	4	2.0	48	7.1
	2	1	125	3	7	0.2	28	1.6	1	0.7	14	2.9	9	0.1	2	0.1	39	15.7
	2	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
	2	16	139	5	7	0.1	28	1.0	1	0.7	16	2.4	10	0.4	2	0.3	57	20.3
1997	1	1	115	4	8	0.1	30	1.4	1	0.1	17	1.7	9	0.2	2	0.5	28	9.5
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
	1	24	216	117	7	0.2	30	5.0	2	1.5	16	5.4	9	0.5	4	1.8	29	5.3
	2	1	116	5	8	0.0	32	3.0	1	0.1	15	3.6	9	0.2	2	0.1	22	8.7
	2	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
	2	15	147	4	7	0.1	37	3.2	1	0.1	13	0.5	11	0.7	2	0.1	32	12.9
1998	1	1	106	1	7	0.1	30	2.7	1	0.7	23	2.9	10	0.6	2	0.3	18	5.3
1999	1	1	106	2	7	0.2	26	1.5	1	0.6	13	1.8	10	0.2	2	0.2	58	19.7
2000	1	1	na	na	8	1.1	16	4.4	na	na	na	na	na	na	na	na	na	na
2001	1	1	na	na	8	0.1	24	4.4	na	na	na	na	na	na	na	na	na	na

[a] A hydrogen sulfide layer was siphoned from the lake bottom during the winter, 1995-1996.

SD - standard deviation; na - data not available or not collected.

Appendix C.16. Summary of seasonal mean water chemistry parameters by station and depth for Lower and Upper Jennifer Lakes, 1990-1994.

Lake	Year[a]	Stations	Depth (m)	Specific Conductance (umhos/cm)	S.D.	pH (Units)	S.D.	Alkalinity (mg/L)	S.D.	Turbidity (NTU)	S.D.	Color (Pt units)	S.D.	Calcium (mg/L)	S.D.	Magnesium (mg/L)	S.D.	Iron (ug/L)	S.D.
Lower	1990	1	1	117.7	15.0	7.0	0.5	15.0	1.8	1.1	0.5	8.7	0.6	5.7	0.4	3.0	0.7	26.0	15.1
		1	21	137.3	2.5	6.8	0.1	17.2	0.8	0.7	0.5	10.3	2.1	6.9	1.8	1.8	1.5	34.7	6.4
Lower	1993	1	1	132.0	1.4	7.1	0.3	20.9	4.8	0.6	0.3	4.8	2.2	6.6	0.4	2.9	0.7	24.3	12.0
		1	22	133.3	2.5	6.7	0.2	18.0	0.8	0.6	0.3	4.3	0.5	6.9	0.2	2.9	0.3	36.0	11.2
Lower	1994	1	1	130.3	2.1	6.7	0.2	18.0	0.8	0.6	0.2	19.5	7.6	6.1	0.6	2.4	0.8	33.8	9.7
		1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
		1	20	133.3	4.3	6.5	0.2	17.8	1.0	0.6	0.3	17.8	3.0	6.1	0.4	2.6	0.8	41.3	13.7
Upper	1993	1	1	132.8	5.3	7.3	0.5	17.8	1.7	0.6	0.5	3.5	0.6	6.8	0.7	3.1	0.7	15.5	8.7
		1	25	135.0	1.6	6.8	0.3	17.5	1.9	0.4	0.1	3.3	0.5	6.6	0.9	2.9	0.7	15.0	6.8
Upper	1994	1	1	129.3	2.6	6.7	0.3	16.6	0.5	0.4	0.2	9.8	2.2	5.6	0.6	3.0	1.1	7.3	4.4
		1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
		1	21	132.8	0.5	6.5	0.2	17.8	0.9	0.8	0.8	9.8	1.7	6.1	1.0	2.9	0.7	23.5	32.5

[a] Water samples were not collected in 1991-1992, and 1995-1998.
na - data not available.

Appendix C.17. Summary of seasonal mean water chemistry parameters by station and depth for Ruth and Sorg Lakes, 1993-1994.

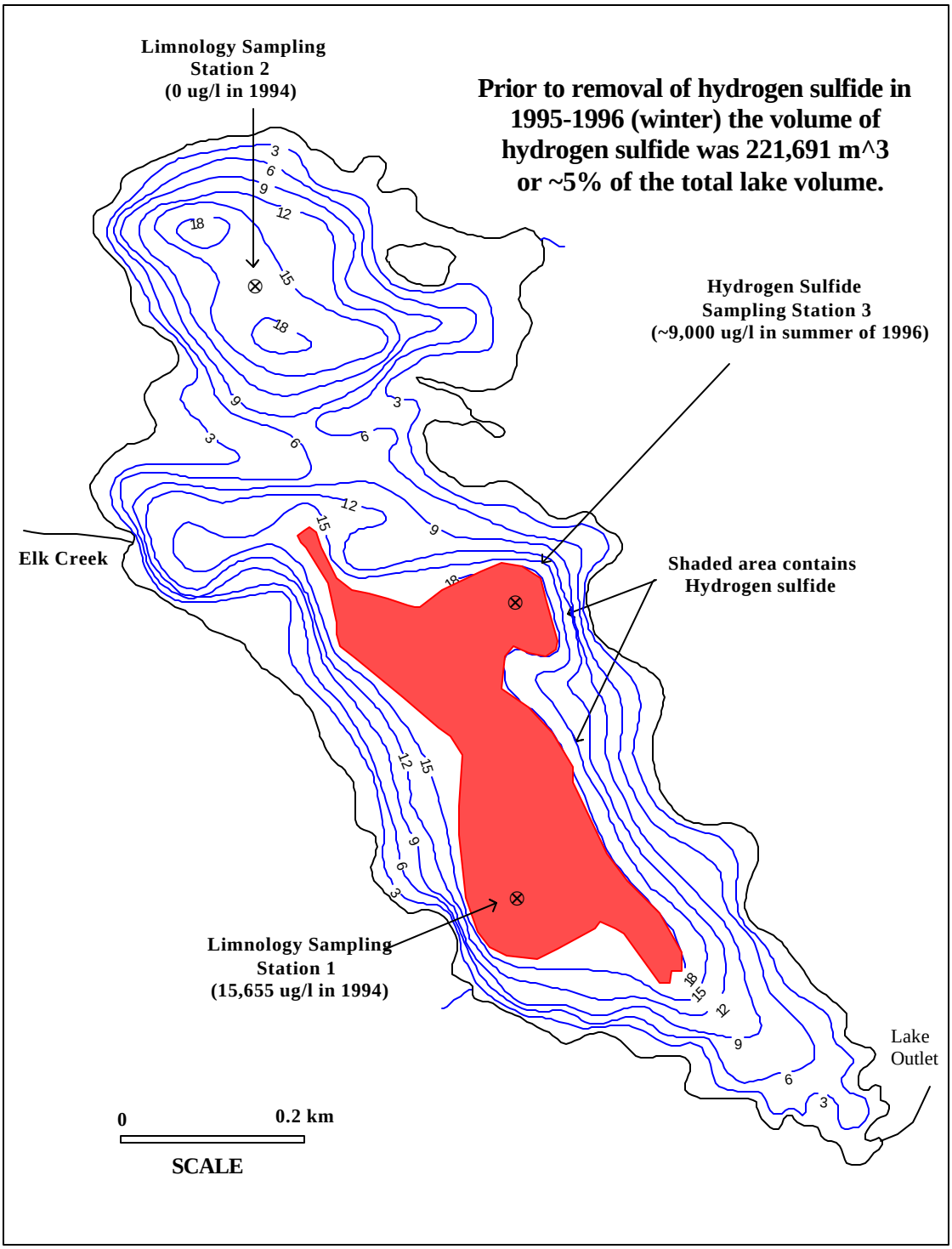
Lake	Year	Stations	Depth (m)	Specific Conductance (umhos/cm)	S.D.	pH (Units)	S.D.	Alkalinity (mg/L)	S.D.	Turbidity (NTU)	S.D.	Color (Pt units)	S.D.	Calcium (mg/L)	S.D.	Magnesium (mg/L)	S.D.	Iron (ug/L)	S.D.
Ruth	1994	1	1	126.8	3.2	6.8	0.3	22.0	2.1	0.8	0.2	8.0	6.0	7.6	0.5	2.4	0.4	94.0	65.9
		1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
		1	12	130.0	5.9	6.5	0.1	22.8	0.9	0.8	0.2	9.3	5.4	7.1	0.9	2.4	0.4	102.0	61.5
Sorg	1993	1	1	106.0	nc	7.1	nc	15.0	nc	0.3	nc	4.0	nc	3.9	nc	3.8	nc	28	nc
		1	17	91.0	nc	6.6	nc	14.0	nc	0.6	nc	9.0	nc	3.9	nc	2.5	nc	100	nc
Sorg	1994	1	1	88.8	8.7	6.8	0.1	13.8	1.5	0.8	0.3	12.5	1.0	4.0	0.1	2.1	0.4	68.3	32.0
		1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
		1	14	90.0	9.0	6.5	0.2	13.5	1.7	0.7	0.2	11.0	0.8	4.0	0.1	2.4	0.3	85.0	29.6

S.D. - standard deviation.
na - data not available.
nc - not calculated, only one sample was collected through out the field season.

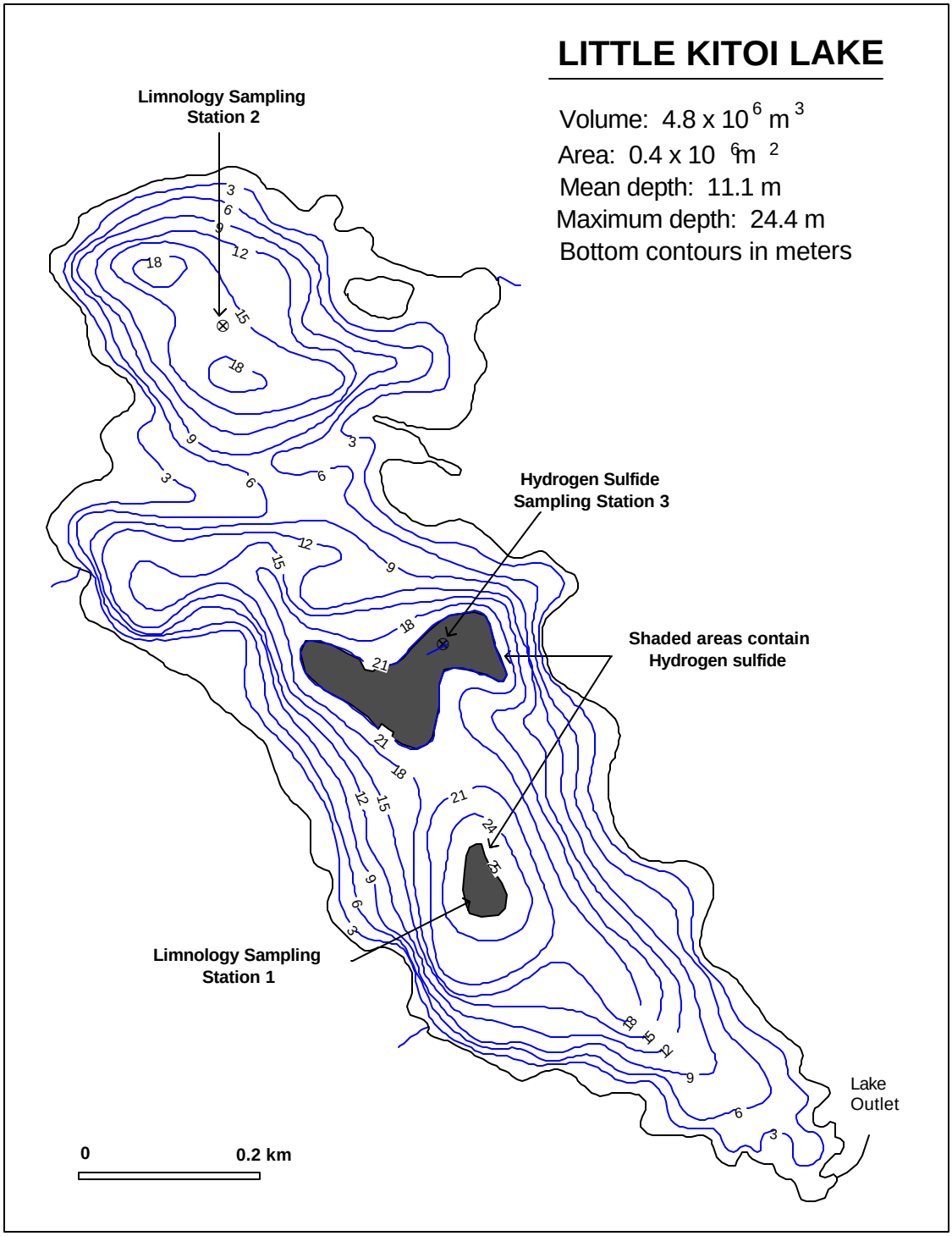
Appendix C.18. Historical hydrogen sulfide (H2S) levels measured at Little Kitoi Lake, 1993-1994, 1996-1998, and 2000-2001.

Year	Month	Depth (m)	Total H_2S (ug/l)	Toxic H_2S Present[a] (ug/l)	Comments
Station 1: Main Basin					
1993	April	21.0	3,023	2,209	
	July	22.5	6,310	909	
1994	August	21.0	52,183	15,655	
1996	August	24.0	88	48	
1997	June	24.0	1	<dl	
	August	24.0	1	<dl	
1998	August	25.0	23	13.7	These are average figures, replicates varied greatly.
1999			No samples collected		
2000	August	25.0	0	0	
2001	August	24.0	<dl	<dl	
Station 2: North Basin					
1993	July	21.0	2	1	
1994	August	18.0	0	0	
1997	June	18.0	0	<dl	
1998			No samples collected		
Station 3: Middle Basin					
1996	August	23.0	29,982	8,995	
1997	June	23.0	5,318	1,861	
	August	23.0	4,455	2,005	
1998			No samples collected		
1999			No samples collected		
2000	August	23.0	4,438	2,219	
2001	August	24.0	2,122	1,910	

[a] Some readings were less than the detectable level (<dl).



Appendix C.19. Morphometric map of Little Kitoi Lake showing the volume of hydrogen sulfide prior to removal in the winter of 1995-1996.



Appendix C.20. Morphometric map of Little Kitoi Lake showing the residual hydrogen sulfide that remained in the two basins after siphoning efforts in the winter of 1995-1996.

Appendix C.21. Summary of seasonal mean nutrient and algal concentrations by station and depth for Little Kitoi Lake, 1990-2001.

Year	Stations	Depth (m)	Total-P (ug/L P)	S.D.	Total Filterable-P (ug/L P)	S.D.	Filterable Reactive-P (ug/L P)	S.D.	Total Kieldahl Nitrogen (ug/L N)	S.D.	Ammonia (ug/L N)	S.D.	Nitrate+nitrite (ug/L N)	S.D.	Reactive Silicon (ug/L Si)	S.D.	Organic carbon (ug/L)	S.D.
1990	1	1	3.7	0.6	2.8	1.7	2.9	1.8	122.7	29.1	9.5	7.7	19.8	29.3	1.649.5	759.8	167.8	39.6
	1	24	752.8	658.8	707.1	738.6	440.6	661.2	10,587.0	4,363.4	7,780.0	3,022.9	2.3	1.8	7,901.3	4,097.4	545.8	22.5
1991	1	1	5.8	1.5	4.2	1.9	2.7	1.6	116.5	22.6	17.3	3.8	36.7	39.9	2,044.7	348.7	191.0	42.0
	1	25	974.4	407.9	878.0	380.1	925.6	409.4	10,358.6	3,087.7	7,331.5	2,656.6	1.9	1.5	12,112.7	4,900.0	554.2	37.7
1992	1	1	4.5	1.1	3.0	1.5	2.3	0.9	131.0	20.9	6.0	3.5	48.1	41.7	2,382.4	442.7	169.0	32.3
	1	21	189.2	34.9	172.6	37.0	175.4	36.4	6,756.3	903.5	5,605.4	1,018.8	3.8	0.4	10,090.4	958.6	913.8	86.3
1993	1	1	4.2	0.5	2.4	0.7	2.2	0.6	143.3	19.8	12.9	7.4	103.9	64.7	2,142.4	348.8	166.4	64.7
	1	22	274.9	176.4	271.6	189.6	282.2	181.8	5,392.9	4,063.9	5,934.6	2,383.0	31.2	36.6	9,468.0	1,953.6	1,088.4	233.8
1994	1	1	4.7	0.7	3.1	0.6	1.7	0.4	159.5	26.5	9.8	7.6	160.7	63.2	2,424.5	354.7	139.0	63.5
	1	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1	18	18.9	29.0	18.6	30.7	16.8	29.6	936.4	1,564.1	578.4	1,096.8	222.4	80.6	4,010.8	1,951.3	208.3	275.7
	2	1	5.6	1.4	3.6	0.8	2.0	0.4	171.8	27.6	11.4	7.3	161.8	62.4	2,452.8	363.8	155.8	55.4
	2	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2	15	4.8	1.3	3.4	0.6	2.0	0.9	143.8	47.9	11.1	7.7	244.5	15.8	3,078.3	148.5	59.5	24.2
1995	1	1	6.8	1.7	4.1	3.0	3.3	2.5	159.8	26.5	13.7	7.1	128.3	49.9	2,483.6	384.9	165.8	43.5
	1	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1	22	404.3	281.1	308.0	145.8	299.9	136.4	8,611.2	2,459.1	7,067.8	1,517.5	7.7	8.4	13,879.0	3,199.7	872.6	41.3
	2	1	5.7	0.9	4.5	2.5	2.8	1.5	162.9	21.4	15.2	6.9	32.5	55.1	2,454.4	388.1	162.6	34.3
	2	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2	18	11.3	8.0	5.3	2.1	2.5	1.2	129.9	4.7	18.9	10.8	55.3	79.2	3,219.0	344.0	105.6	29.5
1996 [a]	1	1	4.6	0.7	2.0	0.5	1.9	0.5	185.1	14.5	3.3	3.2	78.7	36.7	2,241.3	138.7	191.3	57.6
	1	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1	24	4.8	0.7	2.6	0.9	2.0	0.5	170.9	13.6	27.3	20.5	203.8	48.3	3,062.5	443.6	131.3	21.5
	2	1	5.5	1.1	2.1	0.7	1.9	0.5	174.5	24.4	4.9	3.3	75.9	36.4	2,154.8	138.3	176.0	22.6
	2	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2	16	5.8	1.3	2.1	0.2	2.0	0.4	150.4	23.3	8.1	11.8	192.4	18.3	3,033.8	327.9	133.5	17.7
1997	1	1	5.8	1.5	3.7	1.2	3.4	1.5	193.4	51.8	5.7	2.8	46.0	30.1	1,940.3	299.9	183.5	45.6
	1	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1	24	5.4	1.1	4.3	2.3	3.4	2.1	150.5	34.3	12.3	6.7	183.3	36.9	2,883.3	492.5	114.5	28.1
	2	1	5.8	0.7	3.3	0.9	2.6	0.9	165.3	18.3	5.5	3.5	45.6	32.7	1,932.8	305.3	148.0	29.9
	2	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2	15	6.2	1.7	2.9	1.2	2.6	0.9	155.5	13.6	9.7	6.3	148.2	24.3	2,804.0	405.3	150.8	53.2
1998	1	1	8.4	3.7	5.5	0.8	3.7	1.2	216.3	42.8	22.9	20.0	17.5	10.9	2,002.0	319.7	121.7	52.5
1999	1	1	9.8	4.1	4.1	1.7	2.0	0.5	220.5	38.0	37.4	32.0	32.2	24.8	2149.5	127.7	217.5	29.0
2000	1	1	16.4	11.7	4.6	4.9	1.5	1.0	45.4	20.1	9.2	9.0	53.6	86.5	NA	NA	NA	NA
2001	1	1	13.3	4.6	4.6	2.5	3.7	3.4	105.7		5.3	4.3	7.6	14.8	NA	NA	NA	NA

[a] A hydrogen sulfide layer was siphoned from the lake bottom during the winter, 1995-1996.
SD - standard deviation; NA - data not available or not collected.

Appendix C.22. Summary of seasonal mean nutrient and algal concentrations by station and depth for Lower and Upper Jennifer Lakes, 1990-1994.

Lake	Year[a]	Stations	Depth (m)	Total-P (ug/L P)	S.D.	Total Filterable-P (ug/L P)	S.D.	Filterable Reactive-P (ug/L P)	S.D.	Total Kjeldahl Nitrogen (ug/L N)	S.D.	Ammonia (ug/L N)	S.D.	Nitrate+nitrite (ug/L N)	S.D.	Reactive Silicon (ug/L Si)	S.D.	Organic carbon (ug/L)	S.D.	Chlorophl (ug/L)
Lower	1990	1	1	2.3	0.4	2.8	0.6	2.1	1.0	150.6	26.2	2.6	1.6	1.9	1.9	1074.7	35.2	164.0	54.6	0.17
		1	21	13.1	18.3	2.3	0.3	1.8	0.2	211.7	103.1	14.8	6.5	53.4	20.9	1599.0	164.4	134.3	72.9	0.21
Lower	1993	1	1	4.8	0.6	2.8	1.0	1.9	0.5	146.3	4.0	3.7	1.1	15.7	28.3	1878.8	92.5	98.0	16.8	0.40
		1	22	4.6	1.1	2.8	1.3	2.2	1.1	123.5	12.8	10.7	5.7	50.6	25.8	2376.0	166.7	82.5	56.8	0.15
Lower	1994	1	1	4.9	0.7	4.8	4.1	3.4	3.8	178.9	11.6	16.4	8.9	184.8	83.8	1885.8	260.2	152.0	73.0	0.38
		1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	0.31
		1	20	14.8	20.5	3.3	0.6	2.2	0.8	194.3	35.0	26.3	6.9	269.0	22.2	2437.5	209.1	74.5	55.0	0.15
Upper	1993	1	1	3.9	0.5	2.3	0.5	1.8	0.5	148.8	8.2	2.5	1.3	4.2	5.5	1283.3	102.8	127.8	47.3	0.37
		1	25	4.3	1.4	2.2	0.4	1.4	0.2	131.2	7.0	8.4	7.0	29.7	8.9	1638.5	171.9	63.8	5.1	0.32
Upper	1994	1	1	5.1	1.2	2.6	1.0	1.6	1.1	159.7	14.2	9.3	2.7	23.2	17.5	1193.8	177.5	117.0	56.8	0.39
		1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	0.26
		1	21	3.6	1.0	2.4	0.7	1.2	0.3	144.4	12.3	22.4	7.0	84.3	13.6	1588.8	67.0	67.3	23.1	0.13

[a] Water samples were not collected in 1991-1992, and 1995-1998.
na - data not available.

Appendix C.23. Summary of seasonal mean nutrient and algal pigment concentrations by station and depth for Ruth and Sorg Lakes, 1993-1994.

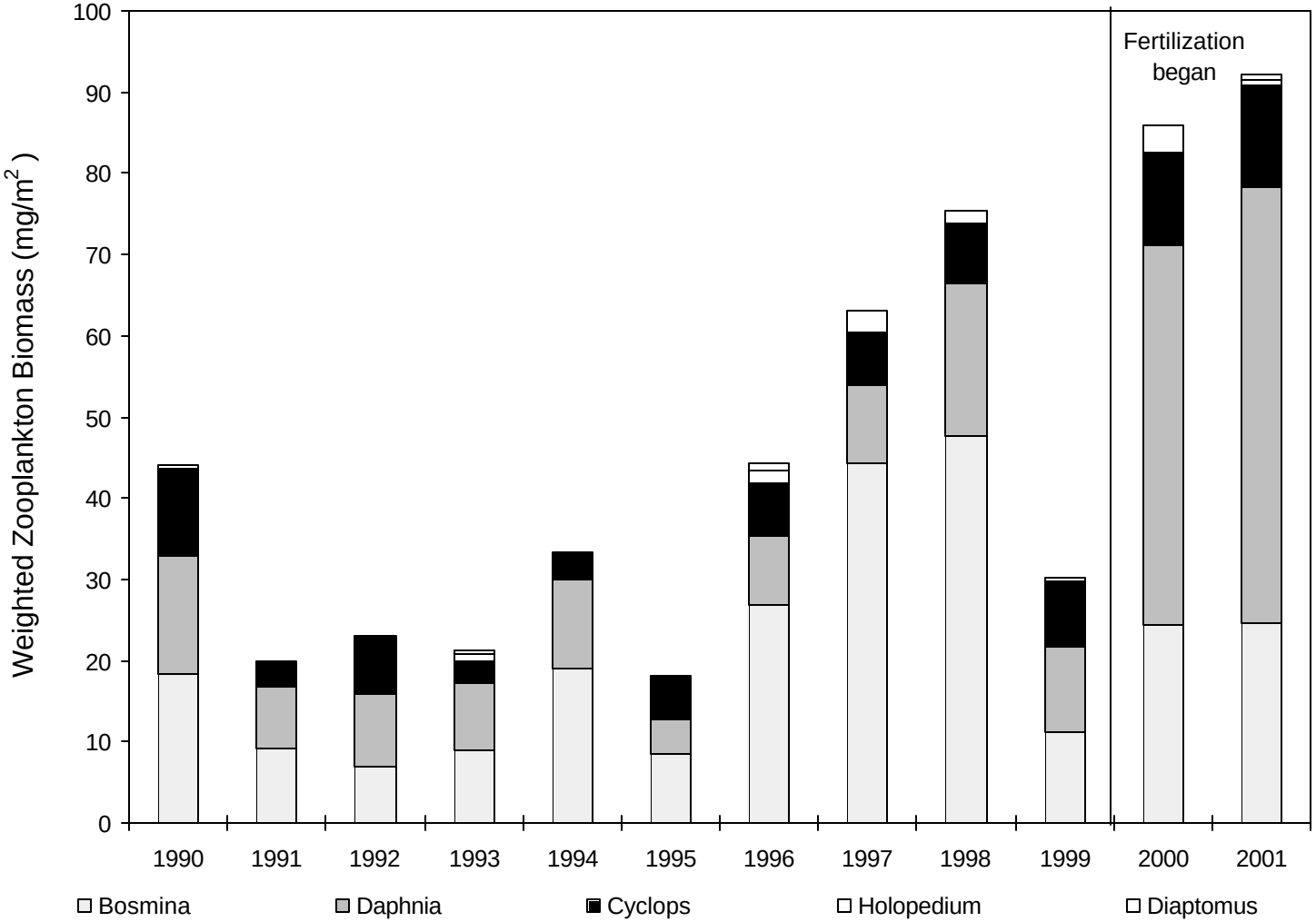
Lake	Year	Stations	Depth (m)	Total-P (ug/L P)	S.D.	Total Filterable-P (ug/L P)	S.D.	Filterable Reactive-P (ug/L P)	S.D.	Total Kjeldahl Nitrogen (ug/L N)	S.D.	Ammonia (ug/L N)	S.D.	Nitrate+nitrite (ug/L N)	S.D.	Reactive Silicon (ug/L Si)	S.D.	Organic carbon (ug/L)	S.D.	Chlorophyll *a* (ug/L)	S.D.	Phaeophy (ug/L)
Ruth	1994	1	1	4.6	2.2	3.3	0.6	1.5	0.5	176.4	10.8	10.4	2.8	42.1	na	1516.8	277.8	127.0	15.1	0.60	0.2	0.19
		1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	0.52	0.1	0.20
		1	12	5.3	2.1	4.7	1.8	2.4	0.6	169.8	17.7	21.9	12.6	77.3	33.0	2173.8	195.4	87.0	28.8	0.33	0.2	0.28
Sorg	1993	1	1	3.0	nc	1.7	nc	0.6	nc	124.4	nc	<1.7	nc	<4.0	nc	2125.0	nc	123.0	nc	0.46	nc	0.31
		1	17	5.6	nc	2.8	nc	1.1	nc	116.6	nc	<1.7	nc	12.5	nc	2864.0	nc	83.0	nc	0.35	nc	0.42
Sorg	1994	1	1	4.8	0.7	4.5	3.4	2.8	1.7	165.4	26.5	5.7	6.0	21.6	27.8	2542.3	327.8	164.5	54.7	0.78	0.1	0.29
		1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	0.74	0.1	0.26
		1	14	7.8	6.9	2.5	1.0	1.8	0.5	144.3	13.2	12.0	9.7	57.2	18.2	2529.0	745.4	117.3	47.3	0.35	0.3	0.24

S.D. - standard deviation.
na - data not available.
nc - not calculated, only one sample was collected through out the field season.

Appendix C.24. Weighted mean zooplankton density, biomass, and size by genera for Little Kitoi Lake, 1990-2001.

	No. of	*Diaptomus*			*Cyclops*			*Bosmina*			*Daphnia*			*Holopedium*			TOT.
	Sample	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density
Year	Dates	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2
1990	4	66	0.45	1.18	8,188	10.8	0.63	24,337	18.4	0.29	12,553	14.4	0.53	199	<1	-	45,343
1991	6	34	0.05	0.70	8	2.8	0.55	0	9.2	0.30	0	7.6	0.49	0	0.22	0.42	42
1992	5	0	0.0	-	6,136	7.1	0.59	9,023	6.9	0.29	7,580	8.9	0.53	42	0.08	0.45	22,781
1993	5	85	0.5	1.10	2,840	2.7	0.54	11,348	8.9	0.30	7,749	8.3	0.51	340	0.8	0.53	22,362
1994	4	27	0.05	0.72	3,179	3.1	0.54	25,818	19.1	0.29	12,327	10.8	0.46	136	0.22	0.44	41,487
1995	5	6	0.04	1.18	4,820	5.1	0.57	11,492	8.4	0.29	4,089	4.3	0.50	151	0.23	0.43	20,558
1996	4	319	0.9	0.88	7,378	6.3	0.51	35,934	26.8	0.29	7,484	8.6	0.53	1,274	1.7	0.41	52,388
1997	4	16	0.0	0.68	7,158	6.5	0.53	54,393	44.2	0.30	10,722	9.8	0.47	1,930	2.5	0.41	74,219
1998	4	0	0.00	-	18,373	15.6	0.31	21,924	0.0	-	1,245	0.0	-	0	0.0	-	41,542
1999[b]	3	0	0.00	-	3,875	3.9	0.33	9,554	0.0	-	371	0.0	-	0	0.0	-	13,800
2000[b]	4	0	0.00	-	12,792	11.4	0.52	27,707	24.3	0.32	36,101	46.8	0.56	853	3.3	0.65	77,453
2001[b]	5	159	0.59	1.01	11,192	12.6	0.71	23,628	24.5	0.34	45,165	53.8	0.56	416	0.7	0.46	80,560

[a] Stocking includes only juvenile sockeye salmon planted in Little Kitoi Lake, and does not include juvenile coho salmon planted in Little Kitoi, Elk, and Finger Lakes.
[b] Only Station 1 was sampled.



Appendix C.25. Weighted mean zooplankton biomass by genera for Little Kitoi Lake, 1990-2001.

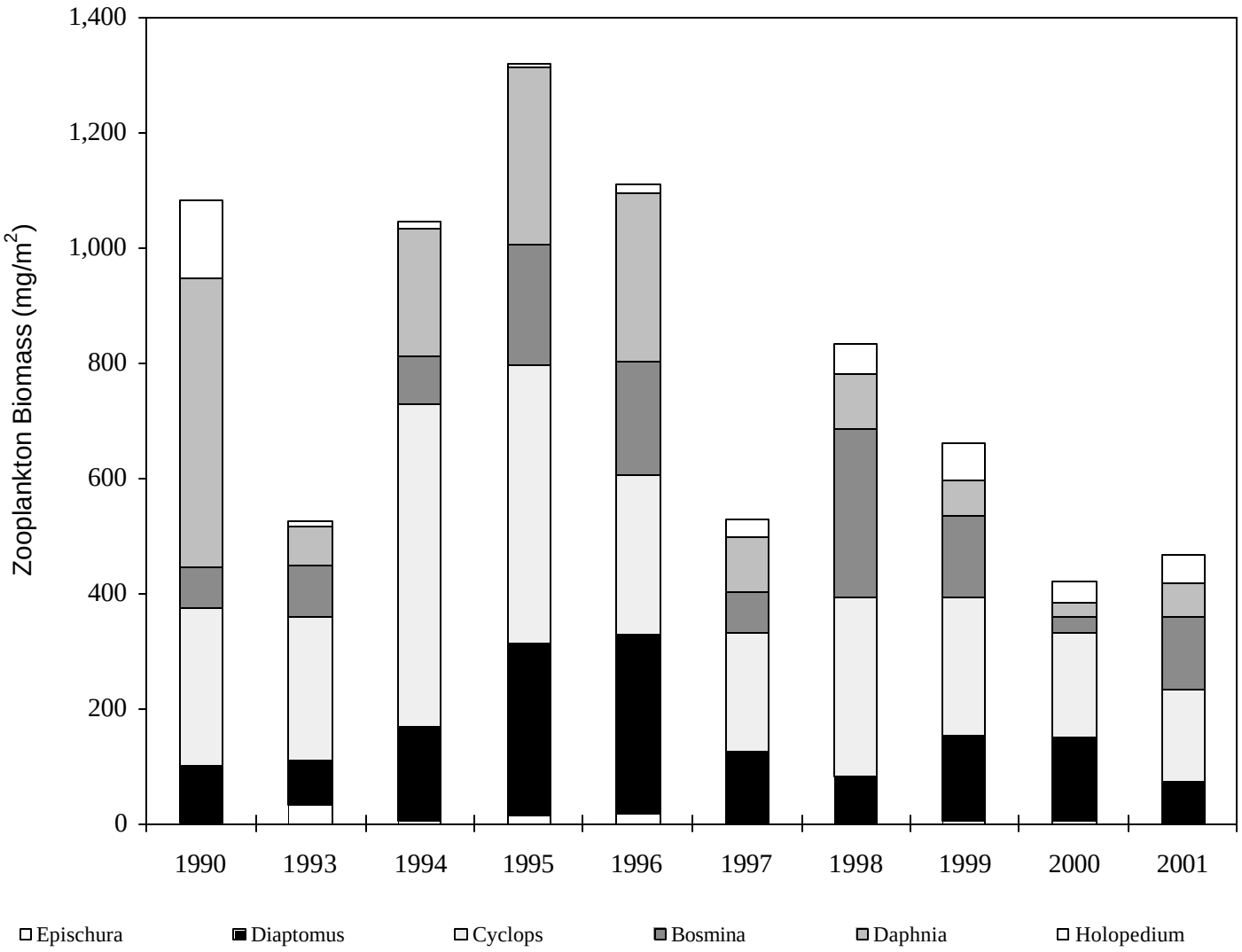
Appendix C.26. Weighted mean zooplankton density, biomass, and size by genera for Lower and Upper Jennifer Lakes, 1990 and 1993-2001.

LOWER JENNIFER LAKE

Station	Number	*Epischura*			*Diaptomus*			*Cyclops*			*Bosmina*			*Daphnia*			*Holopedium*			TOTAl
1	Sample	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density
Year	Dates	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2
1993	4	2,309	22	1.30	29,485	182	1.14	59,475	161	0.87	26,672	42	0.41	20,886	48	0.73	3,901	28	0.83	142,728
1994	4	Data Not Available.																		
1995	5	552	11	1.71	29,703	201	1.18	86,730	277	0.94	22,484	41	0.44	63,778	200	0.84	807	5	0.78	204,054
1996	5	212	3	1.46	26,306	124	1.03	106,773	308	0.90	21,932	34	0.41	67,516	181	0.78	4,756	26	0.74	227,495
1997	4	0	0	0.00	43,471	159	0.94	113,588	293	0.85	15,154	24	0.41	29,579	67	0.72	4,644	26	0.75	206,436
1998		No samples collected.																		
1999		No samples collected.																		
2000		No samples collected.																		
2001	3	2,300	7	0.85	12,562	68	1.08	80,502	164	0.88	16,985	37	0.48	6,458	19	0.90	2,035	9	0.65	120,842

UPPER JENNIFER LAKE

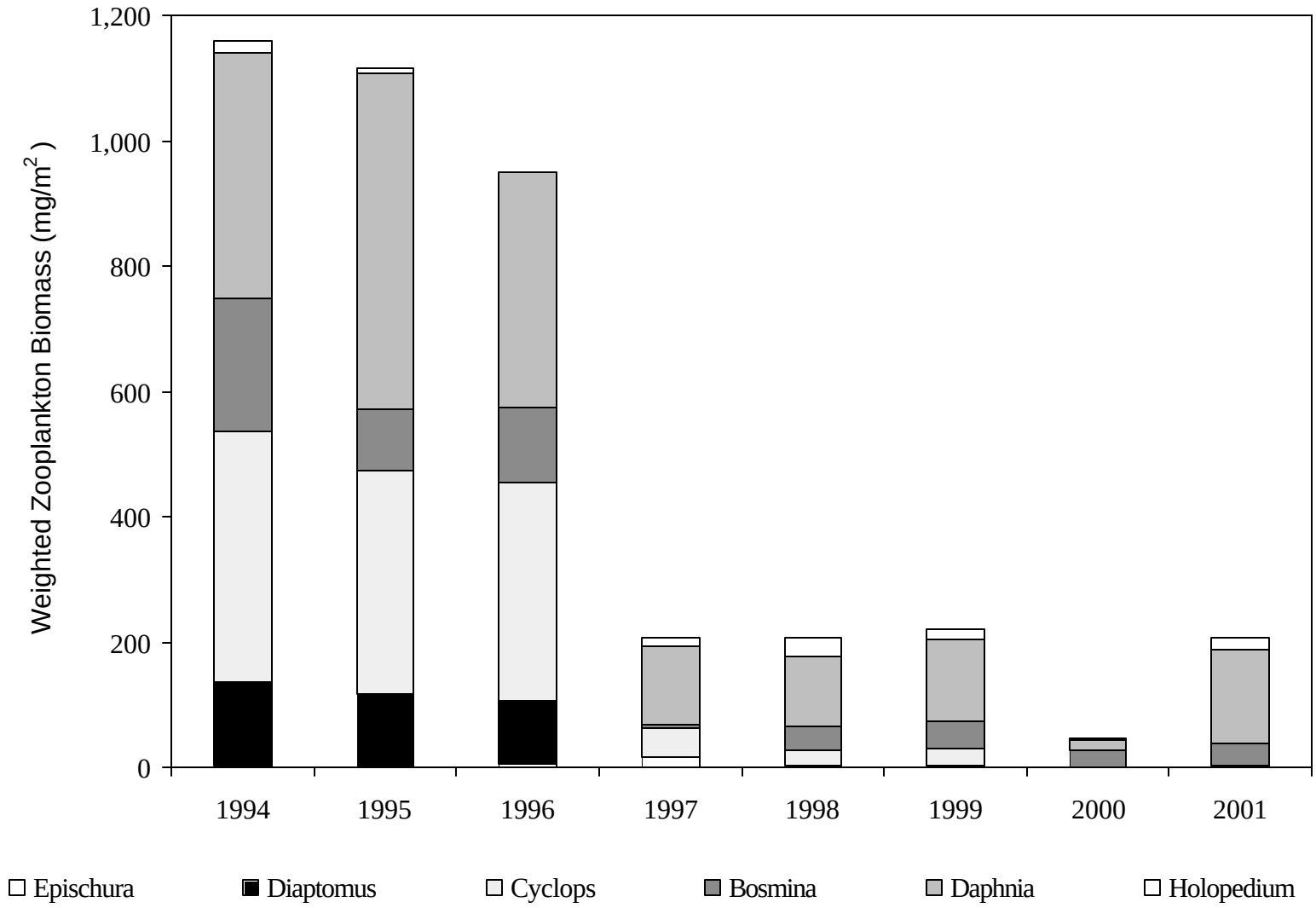
Station	Number	*Epischura*			*Diaptomus*			*Cyclops*			*Bosmina*			*Daphnia*			*Holopedium*			TOT
1	Sample	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density
Year	Dates	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2
1990	3	88	2	1.85	11,854	98	1.26	116,861	275	0.82	28,751	70	0.51	111,465	502	0.99	8,758	135	1.13	277,777
1993	4	4,379	34	1.21	10,032	75	1.22	98,754	250	0.85	51,142	89	0.43	28,131	68	0.74	1,593	10	0.70	194,031
1994	4	398	7	1.65	31,874	163	1.06	208,942	558	0.87	36,386	84	0.49	55,520	221	0.93	1,991	14	0.81	335,111
1995	5	552	13	1.80	35,223	298	1.27	154,819	485	0.94	82,017	209	0.52	72,399	305	0.96	1,147	9	0.87	346,157
1996	5	764	18	1.78	50,573	310	1.13	107,983	278	0.85	84,120	197	0.50	72,824	291	0.94	1,996	14	0.82	318,260
1997	4	0	0	-	21,099	124	1.12	86,279	206	0.82	31,768	71	0.49	32,272	95	0.81	6,688	33	0.71	178,105
1998	4	0	0	-	10,722	83	1.23	141,986	325	0.79	125,903	263	0.47	32,644	94	0.75	8,387	47	0.75	319,642
1999	4	212	5	1.82	19,506	150	1.23	86,438	238	0.88	64,927	141	0.48	19,506	62	0.83	8,652	64	0.83	199,241
2000	2	4,379	7	0.69	26,274	141	1.08	98,726	184	0.73	16,122	29	0.44	8,460	23	0.78	6,170	36	0.76	160,131
2001	4	1,393	4	0.86	10,400	68	1.15	72,602	159	0.86	55,384	129	0.56	17,864	59	0.94	6,917	47	0.81	164,560



Appendix C.27. Weighted mean zooplankton biomass by genera for Upper Jennifer Lake, 1990, 1993-2001.

Appendix C.28. Weighted mean zooplankton density, biomass, and size by genera for Ruth Lake, 1994-2001.

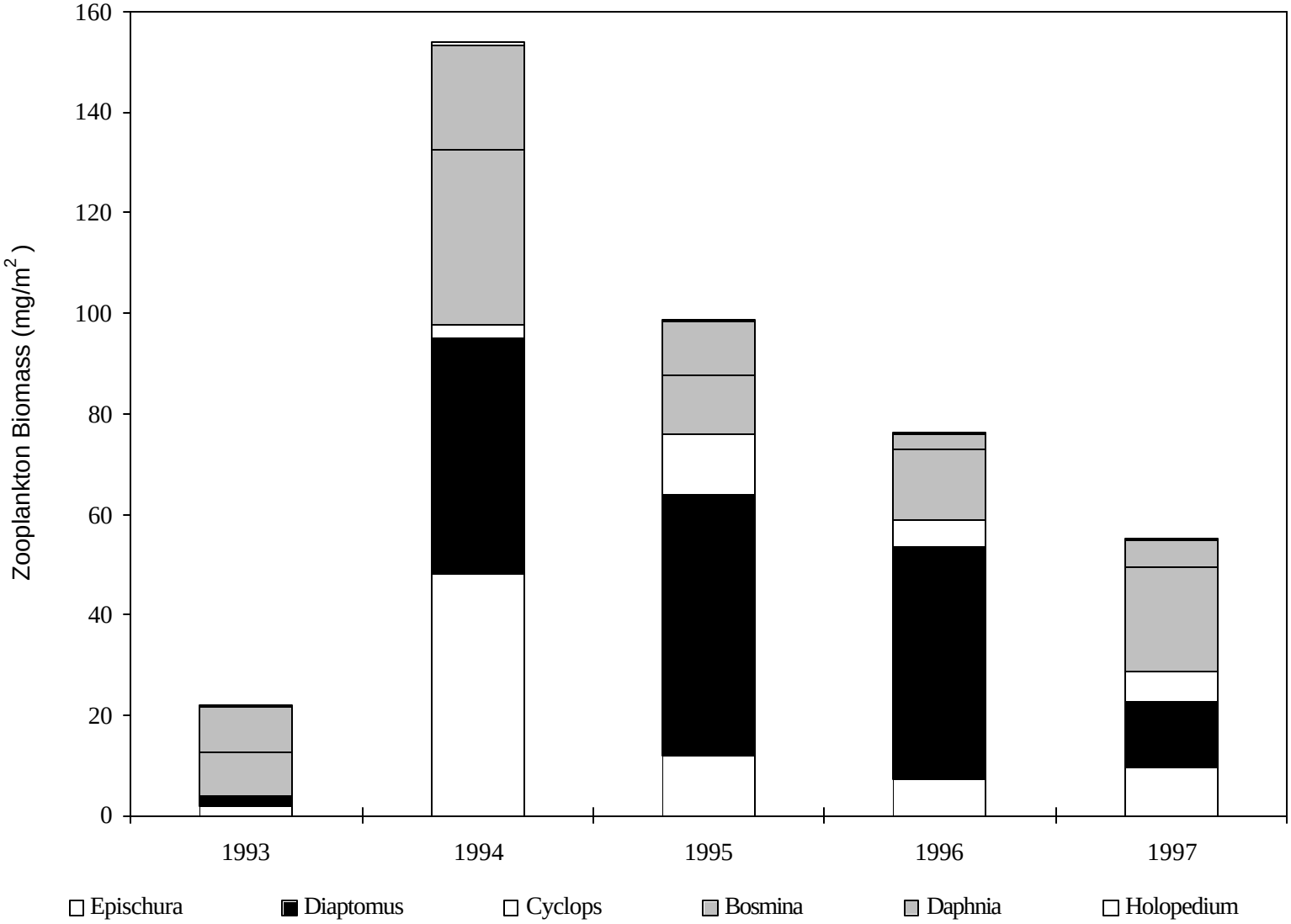
Station	Number	*Epischura*			*Diaptomus*			*Cyclops*			*Bosmina*			*Daphnia*			*Holopediun*	
1	Sample	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass
Year	Dates	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2
1994	4	133	2.4	1.64	24,045	134	1.09	165,767	399	0.83	87,500	212	0.51	102,601	392	0.92	2,866	20
1995	4	106	0	0.68	21,656	117	1.08	119,268	358	0.92	39,013	98	0.51	120,595	535	1.00	1,009	8
1996	4	1,964	6	0.85	12,872	100	1.23	160,059	348	0.79	51,035	120	0.50	88,535	375	0.98	239	1.0
1997	4	4,644	15	0.89	372	1	0.82	16,508	48	0.90	3,569	4	0.35	69,228	124	0.65	4,087	14
1998	4	1,088	4	0.93	239	1	0.93	10,497	20	0.71	44,879	39	0.30	79,446	116	0.76	9,236	23
1999	4	531	1	0.73	106	1	1.11	9,023	28	0.92	54,379	43	0.30	91,574	133	0.58	7,776	14
2000	2	0	0	-	0	0	-	995	1	0.54	35,364	27	0.29	12,487	14	0.52	1,633	3
2001	4	672	1	0.69	0	0	-	796	1	0.59	26,791	37	0.40	96,970	148	0.64	8,957	18



Appendix C.29. Weighted mean zooplankton biomass by genera for Ruth Lake, 1994-2001.

Appendix C.30. Weighted mean zooplankton density, biomass, and size by genera for Sorg Lake, 1993-1997.

	Number	*Epischura*			*Diaptomus*			*Cyclops*			*Bosmina*			*Daphnia*			*Ho*
	Sample	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density
Year	Dates	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2
1993	1	1,062	1.7	0.70	318	1.5	1.04	1,433	0.6	0.37	13,748	8.9	0.27	7,060	8.9	0.55	212
1994	4	11,346	48.3	0.98	12,261	46.6	0.96	2,773	2.6	0.53	43,591	35.1	0.30	14,239	20.7	0.59	159
1995	4	4,671	12.0	0.82	10,510	51.8	1.05	10,576	11.9	0.58	15,035	11.9	0.30	8,705	10.7	0.54	53
1996	4	3,002	7.4	0.81	10,467	46.2	1.01	5,083	5.2	0.55	15,802	14.2	0.32	2,919	3.1	0.50	101
1997	4	3,766	9.7	0.82	3,302	13.0	0.97	8,116	5.9	0.47	27,076	20.8	0.29	4,537	5.1	0.52	486



Appendix C.31. Weighted mean zooplankton biomass by genera for Sorg Lake, 1993-1997.

Appendix C.32. Historical mean water temperatures measured at four stations in Kitoi Bay from mid-May to mid-August, 1990-2001.

	Big Kitoi - outer Bay (station 1) - Depth (m)					Big Kitoi - inner Bay (station 2) - Depth (m)				
Year	0.0	0.5	1.0	2.0	3.0	0.0	0.5	1.0	2.0	3.0
1990										
1991										
1992						13.1	13.1	12.7	11.8	11.2
1993						11.3	11.2	11.1	10.5	9.8
1994						8.9	8.5	8.1	7.8	7.1
1995	10.7	10.4	9.5	8.8	8.2	9.8	10.1	9.3	8.8	8.4
1996	11.3	11.1	10.8	10.4	10.1	10.1	10.0	10.0	9.9	9.7
1997	10.3	10.0	9.6	9.3	9.1	11.2	11.0	10.4	9.7	9.1
1998	8.6	8.5	8.7	8.7	8.5	8.5	8.5	8.5	8.5	8.4
1999	8.2	8.2	8.2	7.3	7.2	8.2	7.8	8.0	7.3	6.8
2000	7.8	7.5	7.5	7.5	7.5	9.0	8.6	8.3	8.1	7.8
2001	8.0	8.0	8.0	7.8	7.8	8.2	7.7	7.8	7.7	7.5

	Little Kitoi - outer Bay (station 3) - Depth (m)					Little Kitoi - inner Bay (station 4) - Depth (m)				
Year	0.0	0.5	1.0	2.0	3.0	0.0	0.5	1.0	2.0	3.0
1990	13.5	12.9	12.6	12.4	11.7					
1991	12.6	12.0	11.1	10.4	9.8	13.7	12.1	11.3	10.5	9.9
1992	13.3	13.5	12.7	12.1	11.3	14.4	14.5	12.8	12.3	11.4
1993	9.7	10.3	10.0	9.9	9.5	11.3	10.9	10.6	10.1	9.6
1994	8.3	9.4	8.8	8.6	8.3	9.6	9.0	8.5	8.2	8.0
1995	10.8	10.6	9.5	9.0	8.6	11.3	9.6	9.3	8.9	8.5
1996	10.7	10.5	10.3	10.1	10.0	11.6	10.6	10.4	10.3	10.1
1997	11.3	10.6	10.2	9.6	9.5	12.7	9.9	9.4	8.6	8.3
1998	8.5	8.4	8.5	8.4	8.5	8.8	8.4	8.5	8.5	8.5
1999	7.5	7.3	7.0	7.0	6.8					
2000	8.8	8.7	8.5	7.8	7.7					
2001	8.5	8.3	8.3	8.3	8.2					

Appendix C.33. Historical mean salinity levels measured at four stations in Kitoi Bay from mid-May to mid-August, 1990-2001.

	Big Kitoi - outer Bay (station 1) - Depth (m)					Big Kitoi - inner Bay (station 2) - Depth (m)				
Year	0.0	0.5	1.0	2.0	3.0	0.0	0.5	1.0	2.0	3.0
1990										
1991										
1992						28.2	28.6	28.9	29.7	29.7
1993						27.5	27.5	27.5	28.3	29.0
1994						23.3	26.6	27.9	28.2	28.1
1995	19.8	26.1	28.3	29.8	30.3	27.4	28.2	28.7	29.2	29.4
1996	25.3	27.6	28.6	29.2	29.4	29.2	29.4	29.5	29.6	29.9
1997	25.6	26.5	26.7	27.1	27.1	21.8	24.8	25.5	26.1	26.4
1998	14.6	20.0	22.3	23.5	23.7	21.6	21.7	23.2	23.6	23.5
1999	24.8	25.0	25.2	25.5	25.3	21.0	23.0	23.0	24.0	24.0
2000	25.8	26.5	26.0	26.2	26.2	22.9	24.1	24.6	24.8	25.0
2001	26.7	26.7	26.7	26.7	26.7	25.0	25.0	26.2	26.3	26.2

	Little Kitoi - outer Bay (station 3) - Depth (m)					Little Kitoi - inner Bay (station 4) - Depth (m)				
Year	0.0	0.5	1.0	2.0	3.0	0.0	0.5	1.0	2.0	3.0
1990	26.9	30.6	31.2	31.5	31.7					
1991	16.6	29.0	30.7	31.7	31.9	5.0	23.5	29.8	31.0	31.9
1992	22.4	27.2	28.3	29.2	29.9	6.2	13.9	28.3	29.1	29.8
1993	15.7	27.1	28.4	28.8	29.2	3.5	19.8	28.0	29.1	29.8
1994	16.5	24.2	26.7	27.5	27.5	5.3	15.4	27.2	28.4	28.9
1995	21.2	26.7	28.4	29.2	29.4	9.2	26.8	27.7	28.4	28.7
1996	26.7	27.3	28.3	28.8	28.6	20.8	25.7	27.5	27.8	28.6
1997	25.7	25.5	26.4	26.6	26.6	6.6	24.9	25.3	26.4	26.3
1998	14.6	19.6	22.1	23.6	24.1	7.5	17.4	22.2	23.8	23.8
1999	25.3	25.3	25.8	25.8	25.9					
2000	25.2	25.3	25.3	25.3	25.3					
2001	25.8	25.7	26.0	26.0	26.0					

Appendix C.34. Mean zooplankton densities measured in milliliters at three sites in Kitoi Bay, 1991-2001.

	Week	statistical	Sampling Years										
Station	ending	week	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
mid-	16-May	20				12.0			3.6	1.2		2.5	3.5
Kitoi	23-May	21			0.1				12.0	1.5		2.0	4.0
1	30-May	22			0.6		0.1	1.8				5.5	
	6-Jun	23			0.1		0.1	1.8	4.8	2.4	50.0		7.0
	13-Jun	24			1.2		0.1	6.6	16.8	3.0		3.0	
	20-Jun	25			1.2		0.1	19.3					
	27-Jun	26		10.8							4.0		
	4-Jul	27		6.0									
	11-Jul	28		48.1									
	18-Jul	29	16.9										
	25-Jul	30	96.3	101.1									
	1-Aug	31											
	8-Aug	32		45.7									
	15-Aug	33											
	22-Aug	34											
	29-Aug	35											
	5-Sep	36											
	12-Sep	37		4.8									
Big	16-May	20							2.4	0.9		1.6	3.0
Kitoi	23-May	21							12.0	1.8		2.5	3.5
2	30-May	22					1.1	1.8					
	6-Jun	23					0.1	11.4	5.4	3.0	30.0	3.0	8.0
	13-Jun	24					4.8	10.2	12.0	7.2			
	20-Jun	25					1.6	20.5				1.5	
	27-Jun	26									65.0		
Little	16-May	20				14.4			1.2	0.9		2.0	4.0
Kitoi	23-May	21			0.1				12.0	2.4		1.5	4.0
3	30-May	22			0.6		0.1	2.4				2.5	
	6-Jun	23			0.1		0.1	9.0	3.6	2.1	5.0		3.0
	13-Jun	24			3.6		0.1	5.4	19.3	16.8		3.0	
	20-Jun	25			1.2		0.6	14.4					
	27-Jun	26		7.2							30.0		
	4-Jul	27		14.4									
	11-Jul	28		60.2									
	18-Jul	29	7.2										
	25-Jul	30	91.5	63.8									
	1-Aug	31											
	8-Aug	32		26.5									
	15-Aug	33											
	22-Aug	34											
	29-Aug	35											
	5-Sep	36											
	12-Sep	37		6.0									

[a] Weeks with multiple samples were averaged.

Appendix C.35. Juvenile sockeye salmon estimates based on townet catches and hydroacoustic fish population estimates for Little Kitoi Lake, 1994-1995, 1998, and 2000-2001.

	Total Fish Estimates			Sockeye Estimates			Sockeye
		95% C. I.			95% C. I.		Composition
Date	Number	Low	High	Number	Low	High	(%)
10/31/94	407,708	239,508	575,908	46,886	27,543	66,229	11.5
05/14/95	50,258	32,406	68,110	46,086	29,716	62,456	91.7
07/15/95[a]	55,205	42,418	67,992	nc	nc	nc	nc
08/18/98	81,261	68,609	93,913	6,176	5,214	7,138	7.6
08/14/00	104,701	91,752	117,650	63,586	56,089	71,083	60.7
08/12/01	80,817	60,178	101,456	38,952	30,534	47,366	48.2

[a] nc - sockeye salmon estimates were not calculated.

Appendix C.36. Townet catches from Little Kitoi Lake, 1994-1995 and 1998.

	Tow		Catch by Species					
			Sockeye			Stickleback		
Date	No.	Minutes	No.	%	CPUE	No.	%	CPUE
10/31/94	5	38	39	11.5	1.0	300	88.5	7.9
05/14/95	4	26	11	91.7	0.4	1	8.3	0.0
08/18/98	6	31	14	7.6	0.5	170	92.4	5.5

Appendix C.37. Mean length, weight, and condition coefficient of juvenile sockeye salmon captured by townet at Little Kitoi Lake, 1995 and 1998.

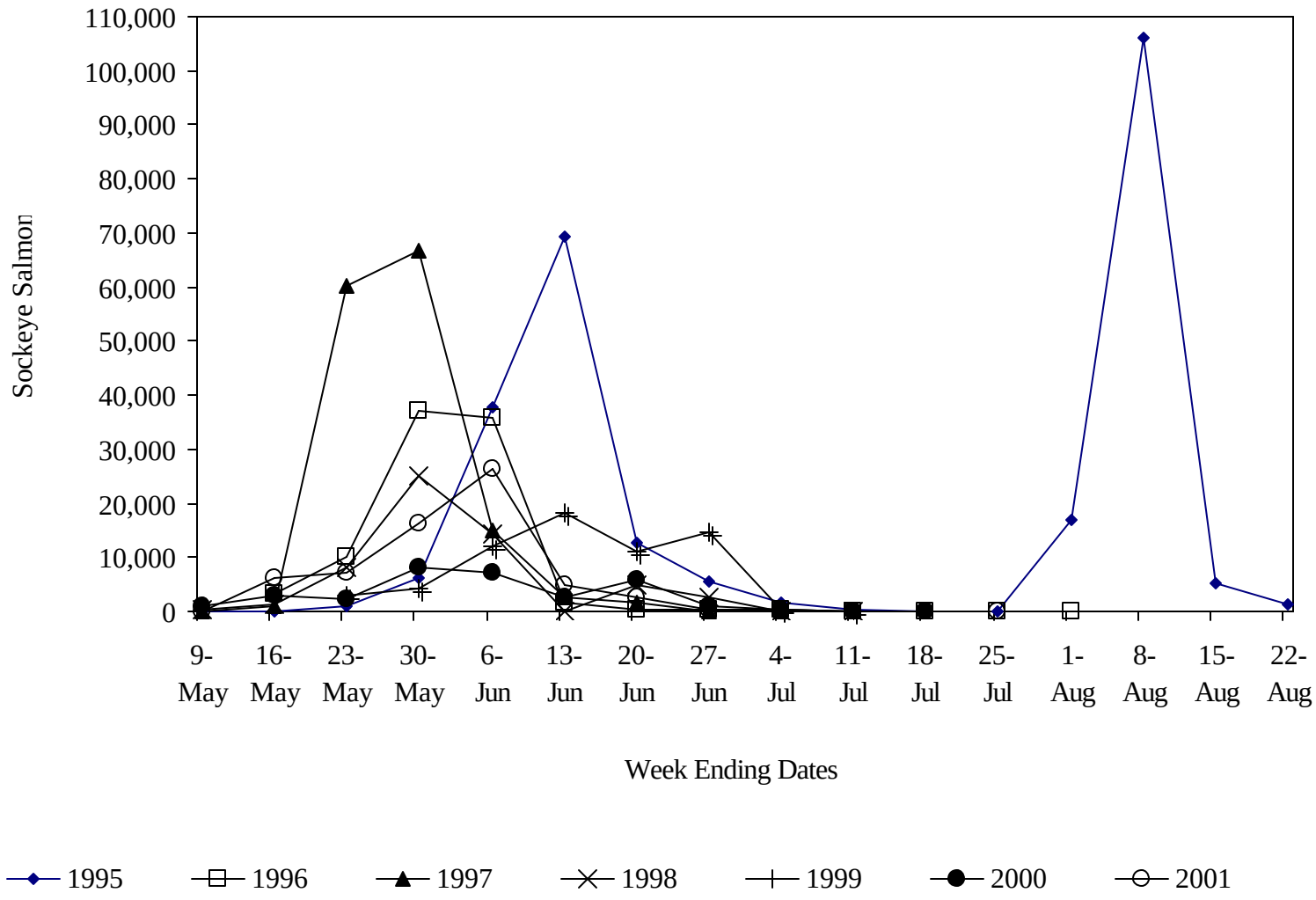
	Age-0					Age-1					Age-2				
Year	n	%	Length (mm)	Weight (g)	Condition (K)	n	%	Length (mm)	Weight (g)	Condition (K)	n	%	Length (mm)	Weight (g)	Condition (K)
1995	8	80.0	48.3	1.3	1.15	2	20.0	103.5	13.4	0.95	0	0	0.0	0.0	0.00
1998	9	64.3	57.8	2.1	1.07	4	28.6	72.5	4.3	1.68	1	7.1	64.0	3.0	1.14

Note: Tow net samples collected in 1994 were lost before size information was obtained .

Appendix C.38. Estimated sockeye salmon smolt outmigration from Little Kitoi Lake by week, 1995-1998.

Stat Week	Week Ending Date	Weekly Totals[a]						
		1995	1996	1997	1998	1999	2000	2001
17	25-Apr				221			
18	2-May			10	60			
19	9-May	91		96	352		1,100	69
20	16-May	97	3,396	1,049	1,272		2,991	6,150
21	23-May	851	10,007	60,358	8,120	2,978	2,118	7,230
22	30-May	6,240	37,177	66,557	25,192	4,137	8,134	16,387
23	6-Jun	37,629	35,816	15,118	14,417	11,962	7,158	26,312
24	13-Jun	69,478	1,722	2,488	65	18,316	2,737	4,722
25	20-Jun	12,655	174	1,690	4,825	10,980	5,987	2,447
26	27-Jun	5,540	257	136	2,722	14,505	889	206
27	4-Jul	1,771	367	7	68	483	488	5
28	11-Jul	407	13		56	0	1	0
29	18-Jul	93	1				0	5
30	25-Jul	69	2					4
31	1-Aug	17,043	1					
32	8-Aug	106,199						
33	15-Aug	5,231						
34	22-Aug	1,220						
35	29-Aug	450						
36	5-Sep	41						
Total[a]		134,922	88,933	147,509	57,370	63,361	31,603	63,537

[a] Excludes zero checks planted in July 1995, which outmigrated the same year (130,184 zero checks).



Appendix C.39. Sockeye salmon smolt outmigration timing from Little Kitoi Lake, 1995-2001.

Appendix C.40. Mean length, weight, and condition coefficient of Little Kitoi, Jennifer, and Ruth Lake sockeye salmon smolt sampled, by age, 1993-2001.

		Age-1					Age-2					Age-3				
Lake	Sampling Year	n	%	Length (mm)	Weight (g)	Condition (K)	n	%	Length (mm)	Weight (g)	Condition (K)	n	%	Length (mm)	Weight (g)	Condition (K)
Little Kitoi	1993	38	10.5	63.6	2.0	0.77	306	85.1	70.8	2.8	0.86	16	4.4	82.4	4.7	0.79
	1994	115	33.9	65.9	2.2	0.78	224	66.1	69.7	2.7	0.79	0				
	1995	917	94.3	110.6	11.1	0.77	55	5.7	76.1	3.9	0.75	0				
	1996	1,011	90.8	92.7	5.8	0.70	102	9.1	66.9	2.1	0.70	1	0.1	92.0	4.9	0.63
	1997	1,032	81.6	91.2	6.0	0.73	226	17.9	71.6	2.9	0.74	6	0.5	72.7	2.9	0.74
	1998	1,125	83.1	91.1	5.8	0.72	207	15.3	69.4	2.4	0.72	22	1.6	72.7	2.9	0.74
	1999	260	26.3	120.2	14.7	0.81	620	62.7	84.8	4.5	0.72	109	11.0	83.9	4.6	0.76
	2000	1,311	90.5	114.7	10.3	0.65	122	8.4	105.3	8.1	0.67	15	1.0	91.8	5.6	0.72
	2001	512	83.1	107.1	8.5	0.67	104	16.9	93.5	5.3	0.63					
Jennifer	1996	181	87.4	116.7	15.2	0.92	26	12.6	146.8	33.1	0.93	0				
	1997	0					2	66.7	178.0	46.3	0.82	1	33.3	209.0	77.2	0.85
Ruth	1997	128	100.0	123.5	15.9	0.84	0					0				
	1999	197	100.0	103.3	10.5	0.93	0					0				
	2000	150	78.5	91.0	6.0	0.79	40	21.0	97.6	7.5	0.80	1	0.5	98.0	7.2	0.76
	2001	1	9.1	88.0	5.8	0.85	8	72.7	114.5	12.1	0.80	2	18.2	119.0	12.6	0.75

Appendix C.41. Kitoi Bay area commercial salmon harvest, by species, 1974-2001.

	Commercial Salmon Harvest [a,b,c]			
Year	Pink	Chum	Coho	Sockeye
1974	8,794			
1975	13,012			
1976	53,783			
1977	49,682			
1978	234,409			
1979	417,505			
1980	886,837			
1981	880,276			
1982	321,989			
1983	192,281			
1984	401,178	3,301		
1985	3,582,973	5,840		
1986	317,753	1,670	3,477	
1987	1,050,911	5,749	9,889	
1988	693,750	4,001	16,075	
1989	0	0	0	
1990	619,518	6,322	7,227	
1991	1,390,681	31,719	9,359	
1992	845,395	9,868	7,681	25,407
1993	12,076,738	11,886	32,517	31,221
1994	2,051,375	10,799	45,884	14,134
1995	4,519,885	215,351	42,235	31,326
1996	979,143	14,189	57,200	21,981
1997	1,213,615	11,029	110,344	50,115
1998	6,272,029	38,118	148,333	75,506
1999	4,057,093	140,896	116,513	63,342
2000	3,659,698	303,783	133,238	50,749
2001	13,126,761	216,266	151,732	48,516
1992-2001 avg.	4,880,173	97,219	84,568	41,230
1997-2001 avg.	5,665,839	142,018	132,032	57,646

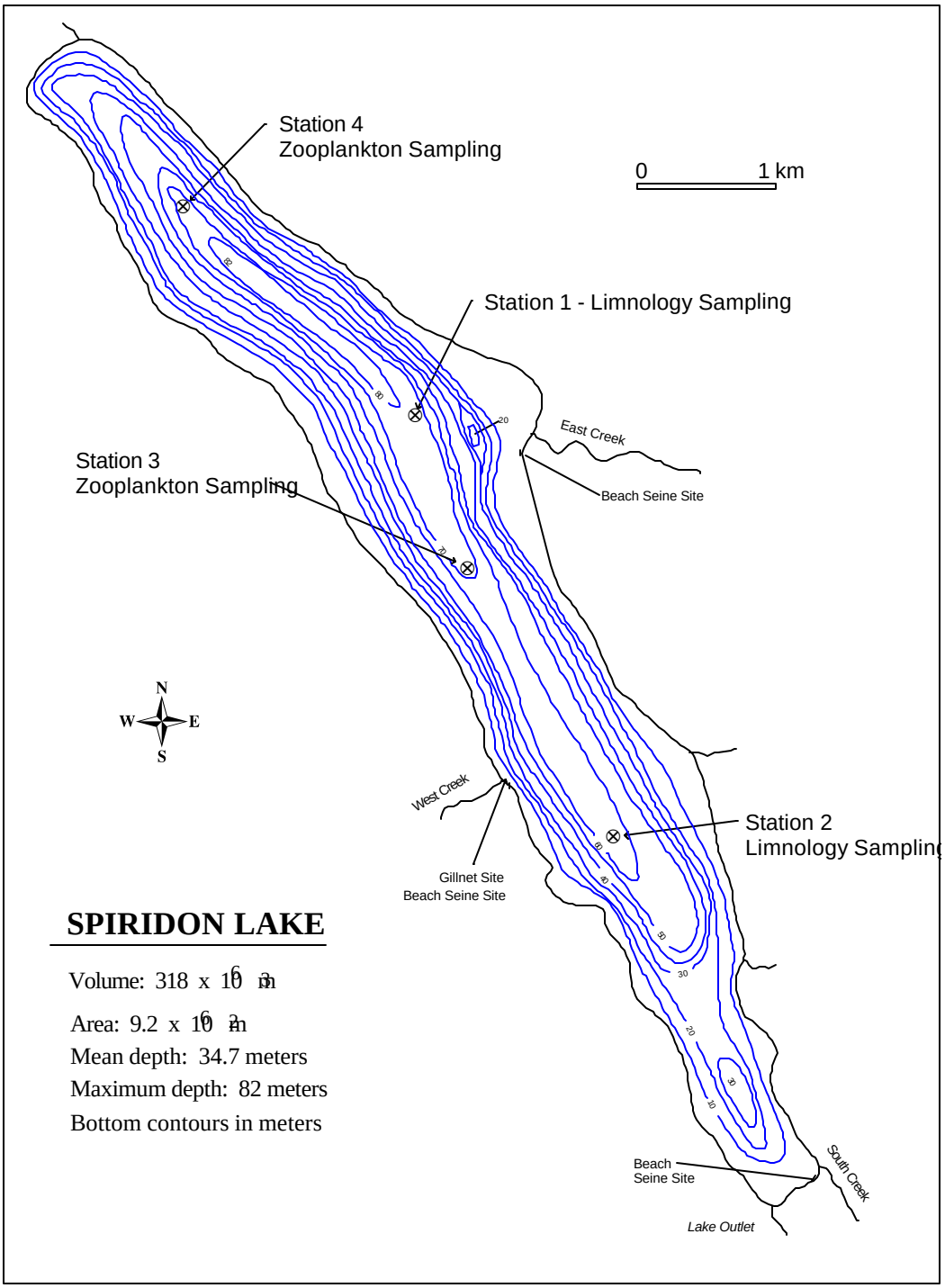
[a] Harvests are a result of stocking projects at Big Kitoi Bay, Little Kitoi Bay, Little Kitoi Lake, Jennifer, and Ruth Lakes.

[b] Cost recovery harvest occurred for pinks in 1987-1989 (165,773 - 1987; 298,439 - 1988; 6,641,889 - 1989).

[c] Total harvest from ADF&G Kodiak statistical areas 252-30 (Izhut Bay), 252-31 (Duck Bay), and 252-32 (Kitoi Bay) are considered an index of total harvest.

Appendix C.42. Estimated age composition of Little Kitoi Lake sockeye salmon caught in Kitoi Bay (252-32), 1992-2001.

		Ages														
Year		0.1	0.2	0.3	1.1	1.2	1.3	1.4	2.1	2.2	2.3	2.4	3.1	3.2	3.3	Total
1992	Number	0	3	2	17	283	101	1	18	199	62	0	0	20	0	706
	Percent	0.0	0.4	0.3	2.4	40.1	14.3	0.1	2.5	28.2	8.8	0.0	0.0	2.8	0.0	100
1993	Number	0	0	0	8	328	448	0	60	882	816	4	8	24	118	2,696
	Percent	0.0	0.0	0.0	0.3	12.2	16.6	0.0	2.2	32.7	30.3	0.1	0.3	0.9	4.4	100
1994	Number	0	4	0	4	151	165	0	7	301	114	0	0	15	0	760
	Percent	0.0	0.5	0.0	0.5	19.8	21.7	0.0	1.0	39.6	15.0	0.0	0.0	1.9	0.0	100
1995	Number	7	0	7	79	137	733	7	52	340	609	0	0	7	0	1,976
	Percent	0.3	0.0	0.3	4.0	7.0	37.1	0.3	2.6	17.2	30.8	0.0	0.0	0.3	0.0	100
1996	Number	0	6	0	4,005	1,994	260	0	130	1,680	154	0	0	0	0	8,229
	Percent	0.0	0.1	0.0	48.7	24.2	3.2	0.0	1.6	20.4	1.9	0.0	0.0	0.0	0.0	100
1997	Number	46	617	15	3,350	21,334	2,254	31	31	278	278	0	0	0	0	28,235
	Percent	0.2	2.2	0.1	11.9	75.6	8.0	0.1	0.1	1.0	1.0	0.0	0.0	0.0	0.0	100
1998	Number	0	72	0	1,739	22,677	8,477	36	72	290	507	0	0	0	0	33,871
	Percent	0.0	0.2	0.0	5.1	67.0	25.0	0.1	0.2	0.9	1.5	0.0	0.0	0.0	0.0	100
1999	Number	0	0	0	274	7,061	2,227	11	0	380	42	0	0	11	11	10,016
	Percent	0.0	0.0	0.0	2.7	70.5	22.2	0.1	0.0	3.8	0.4	0.0	0.0	0.1	0.1	100
2000	Number	759	5	75	45	8,498	910	0	0	131	139	0	0	33	99	10,694
	Percent	7.1	0.0	0.7	0.4	79.5	8.5	0.0	0.0	1.2	1.3	0.0	0.0	0.3	0.9	100
2001	Number	10	2	0	23	242	652	0	132	772	5,009	1	0	5	103	6,951
	Percent	0.1	0.0	0.0	0.3	3.5	9.4	0.0	1.9	11.1	72.1	0.0	0.0	0.1	1.5	100



Appendix D.1. Morphometric map showing limnology and zooplankton stations (1-4), and beach seine and gillnet sites on Spiridon Lake.

Appendix D.2. Juvenile sockeye salmon stocked into Spiridon Lake, 1990-2001.

Release Year	Broodstock	Life Stage[a] fry	Life Stage[a] fingerling	Total Stocked
1990	Upper Station	249,346		249,346
1991	Upper Station	3,300,000		3,300,000
1992	Upper Station	2,200,000		2,200,000
1993	Upper Station	4,246,000		4,246,000
1994	Upper Station	5,676,000		5,676,000
1995	Saltery	2,813,000	1,786,000	4,599,000
1996	Upper Station	1,100,000	3,744,000	4,844,000
1997	Upper Station	5,500,000	1,200,000	6,700,000
1998	Saltery	784,000	2,556,000	3,340,000
1999	Saltery	600,000	2,964,000	3,564,000
2000	Saltery	3,890,000	507,100	4,397,100
2001	Saltery		1,700,600	1,700,600

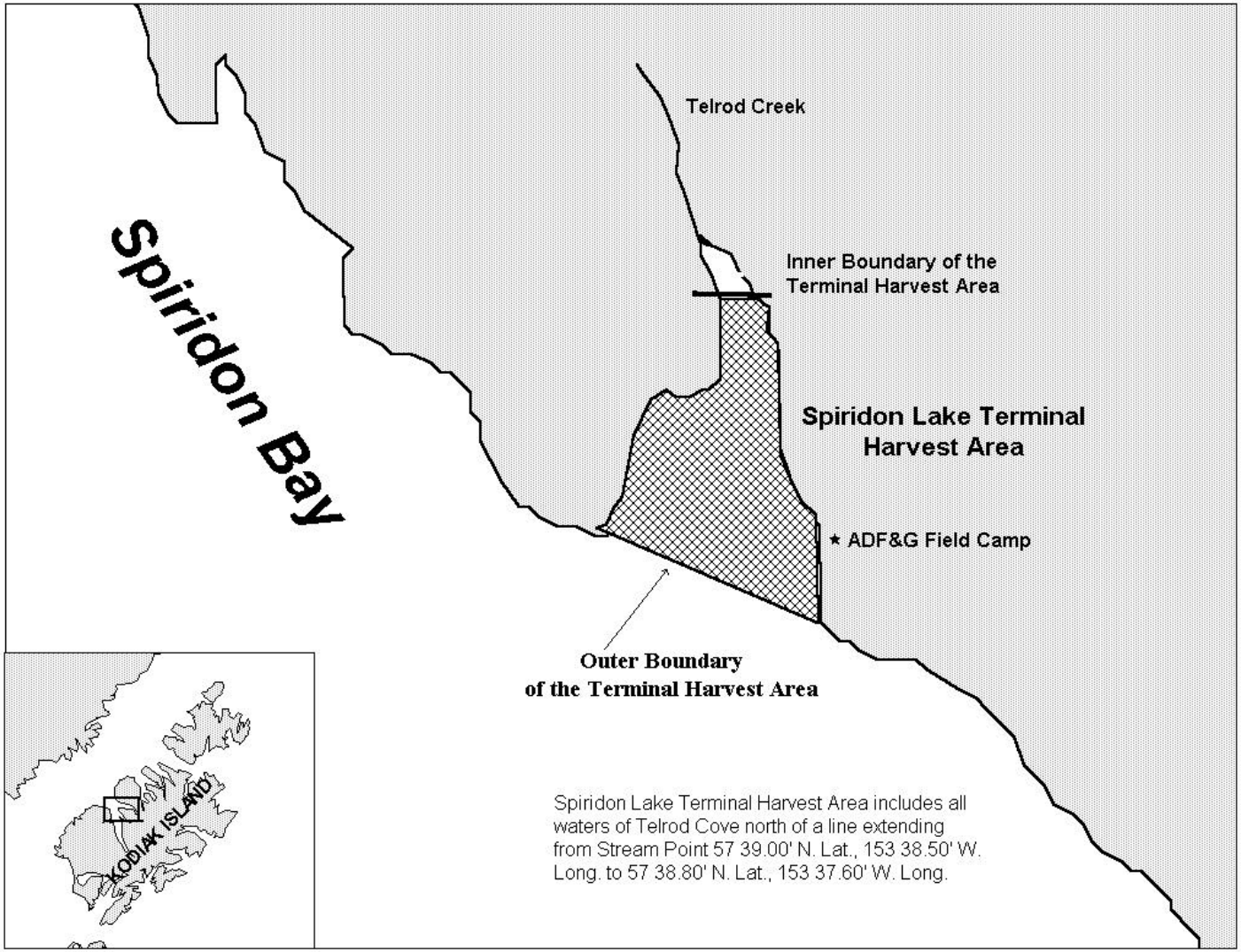
[a] Fry are released from April to July at up to 200% of emergent size (normally 0.15 to 0.5 g depending on the stock). Fingerling are released from June to September at a size of >200% to <2100% of emergent size (normally 0.3 to 5.25 g depending on the stock).

a.

b.

c.

Appendix D.3. Spiridon Lake smolt bypass system including the trap and de-watering tanks (a); pipeline from de-watering tanks to counting tank (b); and smolt counting tank (c).



Appendix D.4. Spiridon Lake (Telrod Cove) Terminal Harvest Area (SLTHA) boundaries and ADF&G camp location in Telrod Cove.

Appendix D.5. Limnological sampling stations and total samples collected for Spiridon Lake, 1988-2001.

Year	Sampling Stations	Total Samples
1988	1, 2	4
1989	1, 2	5
1990	1, 2	5
1991	1, 2	7
1992	1, 2	6
1993	1, 2	6
1994	1-4	6
1995	1-4	6
1996	1-4	6
1997	1-4	6
1998	1, 2	5
1999	1, 2	6
2000	1, 2	5
2001	1, 2	5

Appendix D.6. Summary of seasonal mean water chemistry parameters by station and depth for Spiridon Lake, 1988-2001.

Year	Station	Depth (m)	Sp. Cond. (μ mhos/cm)	S.D.	pH (Units)	S.D.	Alkalinity (μ g L^{-1})	S.D.	Turbidity (NTU)	S.D.	Color (Pt units)	S.D.	Calcium (μ g L^{-1})	S.D.	Magnesium (μ g L^{-1})	S.D.	Iron (μ g L^{-1})	S.D.
1988	1	1	71.5	1.0	7.1	0.2	20.8	1.7	0.6	0.3	7.0	2.3	6.1	1.0	2.3	0.5	16.5	3.0
	1	50	71.5	0.6	7.0	0.1	20.5	1.3	0.6	0.4	5.8	0.5	6.1	0.8	2.2	0.7	12.0	3.3
	2	1	71.7	0.6	7.1	0.2	20.0	1.0	0.4	0.1	8.0	0.0	7.7	2.8	1.3	1.6	16.3	5.9
	2	50	71.6	0.5	7.0	0.1	19.4	0.9	0.7	0.5	7.4	2.8	5.4	0.2	3.2	1.0	15.0	6.7
1989	1	1	75.0	6.2	7.3	0.2	22.2	2.8	0.3	0.1	13.8	6.4	5.7	1.0	2.0	0.3	8.6	3.6
	1	50	76.8	8.6	7.3	0.2	22.8	3.5	0.3	0.1	12.4	3.8	6.3	0.6	2.3	0.7	12.0	9.0
	2	1	73.6	1.5	7.3	0.2	21.4	0.9	0.7	0.6	12.0	3.9	5.9	0.4	2.4	0.4	25.2	35.4
	2	50	72.6	1.7	7.3	0.1	20.2	4.1	0.8	0.9	14.4	6.2	5.8	0.6	2.4	0.7	84.4	144.4
1990	1	1	76.2	7.2	7.4	0.2	23.7	2.6	0.5	0.4	5.0	1.9	5.7	0.9	2.2	0.6	14.0	8.8
	1	50	73.2	1.9	7.3	0.2	23.4	1.5	0.5	0.4	4.8	0.8	6.1	0.6	2.3	0.6	16.4	8.3
	2	1	73.0	1.2	7.4	0.1	23.2	1.3	0.5	0.3	6.0	2.8	6.3	0.5	2.0	0.5	19.4	7.3
	2	50	73.2	0.8	7.3	0.2	23.0	1.6	0.5	0.4	5.8	2.9	5.7	0.8	2.5	0.6	15.8	12.0
1991	1	1	83.7	23.5	7.3	0.1	21.1	3.6	0.7	0.4	6.6	2.2	6.1	0.4	2.4	0.8	23.0	23.9
	1	50	75.4	4.0	7.3	0.1	22.1	2.0	1.5	2.1	7.4	3.9	6.2	0.7	2.4	0.5	113.9	232.1
	2	1	74.3	4.4	7.4	0.1	23.0	0.6	0.7	0.5	8.4	5.9	6.4	0.4	2.3	0.3	22.4	13.8
	2	50	75.0	1.7	7.3	0.2	25.9	8.0	0.8	0.4	6.1	4.1	6.1	0.6	2.2	0.4	29.4	25.3
1992	1	1	72.8	1.3	7.1	0.1	20.4	0.8	0.7	0.3	4.2	0.4	5.9	0.7	2.5	0.8	20.5	9.2
	1	50	74.3	0.5	7.1	0.1	20.8	0.4	0.5	0.1	8.0	4.8	6.2	0.5	2.3	0.5	19.7	9.3
	2	1	74.2	0.8	7.2	0.1	21.0	0.0	0.6	0.3	8.2	4.3	6.2	0.7	2.5	1.0	18.2	7.6
	2	50	73.8	0.4	7.0	0.1	20.7	0.4	0.7	0.5	4.2	2.5	6.0	0.9	2.2	0.4	14.6	4.4
1993	1	1	80.3	5.2	7.3	0.6	23.1	2.5	1.1	1.3	3.5	0.8	6.7	1.6	2.2	0.6	15.8	9.7
	1	50	89.2	28.0	7.0	0.4	22.3	2.3	1.0	0.6	3.5	0.8	6.2	0.7	2.8	1.0	23.0	15.1
	2	1	79.8	5.6	7.3	0.6	23.6	2.8	0.8	0.6	4.8	2.4	6.5	1.2	2.5	0.4	15.0	7.6
	2	50	78.3	2.4	7.0	0.1	21.8	0.8	0.4	0.1	4.5	2.1	6.1	0.6	2.5	0.4	13.7	7.3
1994	1	1	77.3	0.8	6.9	0.4	21.8	1.3	0.4	0.1	8.5	1.5	6.3	0.5	2.2	0.3	7.7	9.1
	1	50	78.7	2.3	6.9	0.3	21.9	0.9	0.3	0.1	8.0	1.5	6.3	0.5	2.4	0.7	5.3	4.4
	2	1	77.3	1.0	7.0	0.3	22.1	0.8	0.4	0.1	9.2	2.3	6.1	0.4	2.5	0.7	18.2	25.2
	2	50	77.7	0.8	6.9	0.3	22.3	0.9	0.7	0.9	7.8	3.3	6.1	0.4	2.3	0.3	31.2	48.1

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Year	Station	Depth (m)	Sp. Cond. (μ mhos/cm)	S.D.	pH (Units)	S.D.	Alkalinity (μ g L^{-1})	S.D.	Turbidity (NTU)	S.D.	Color (Pt units)	S.D.	Calcium (μ g L^{-1})	S.D.	Magnesium (μ g L^{-1})	S.D.	Iron (μ g L^{-1})	S.D.
1995	1	1	76.0	3.1	6.8	0.1	21.7	0.5	1.0	0.7	4.2	1.5	5.6	0.2	2.4	0.3	10.8	4.6
	1	50	75.4	1.5	6.9	0.1	22.5	2.0	0.7	0.5	5.5	2.3	5.8	0.5	2.8	0.8	9.0	6.0
	2	1	76.3	2.8	7.0	0.1	22.3	0.7	0.7	0.6	3.7	1.2	5.8	0.3	2.3	0.5	11.3	6.3
	2	50	76.0	2.0	6.9	0.2	22.8	1.2	0.7	0.6	6.3	4.6	5.8	0.3	2.3	0.5	11.3	5.4
1996	1	1	77.0	2.8	7.0	0.2	22.4	0.6	0.6	0.2	4.2	0.8	5.5	0.1	2.6	0.2	10.7	4.5
	1	50	77.3	3.0	7.0	0.1	22.6	1.1	0.6	0.3	4.8	1.8	5.5	0.1	2.6	0.2	8.8	4.0
	2	1	76.8	1.5	7.2	0.1	22.0	0.4	0.6	0.4	4.0	0.6	5.5	0.1	2.6	0.2	13.5	9.6
	2	50	77.7	2.4	7.0	0.1	22.0	0.5	0.6	0.2	5.8	3.5	5.5	0.1	2.6	0.2	7.7	1.4
1997	1	1	75.7	3.3	7.6	0.3	24.8	2.6	0.5	0.1	7.8	5.6	5.8	0.9	2.5	0.4	13.8	3.9
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
	1	50	75.2	0.4	7.4	0.1	23.6	0.6	0.5	0.1	5.7	1.4	5.4	0.2	2.4	0.5	11.5	5.3
	2	1	75.3	0.5	7.5	0.0	24.1	1.0	0.5	0.1	5.3	2.2	5.5	0.2	2.5	0.4	12.5	5.5
	2	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
	2	50	75.0	0.6	7.4	0.1	23.7	0.6	0.4	0.1	7.5	2.1	5.4	0.3	2.7	0.4	10.8	5.0
1998	1	1	72.3	0.5	7.4	0.1	24.5	2.0	1.0	0.4	7.5	3.4	5.8	0.2	2.4	0.1	11.5	5.7
	1	50	73.8	0.5	7.3	0.1	22.9	0.7	0.7	0.4	5.5	0.6	5.7	0.1	2.5	0.0	9.3	4.6
	2	1	74.0	0.8	7.4	0.1	24.6	1.9	1.0	0.7	5.8	2.9	5.7	0.1	2.5	0.1	10.8	5.9
	2	50	72.0	3.4	7.3	0.0	23.7	1.5	0.6	0.4	5.0	0.8	5.7	0.1	2.5	0.1	9.3	5.3
1999	1	1	70.3	1.7	7.2	0.3	22.3	0.7	0.4	0.1	4.0	0.8	5.7	0.1	2.6	0.1	28.3	16.0
	1	50	71.5	1.7	7.2	0.2	22.4	0.5	0.6	0.5	3.5	1.3	5.9	0.1	2.4	0.0	29.0	16.8
	2	1	71.2	1.3	7.1	0.2	22.4	0.8	0.6	0.4	4.2	0.8	5.7	0.1	2.5	0.2	25.8	15.3
	2	50	72.0	0.7	7.1	0.2	22.1	0.4	0.6	0.4	3.2	0.4	5.7	0.1	2.5	0.1	24.4	10.6
2000	1	1	na	na	7.6	0.2	13.3	1.3	na	na	na	na	na	na	na	na	na	na
	2	1	na	na	7.6	0.2	13.7	1.3	na	na	na	na	na	na	na	na	na	na
2001	1	1	na	na	7.5	0.4	19.3	4.1	na	na	na	na	na	na	na	na	na	na
	2	1	na	na	7.5	0.4	19.4	3.8	na	na	na	na	na	na	na	na	na	na

Note: Table revised from S.G. Honnold. 1997. The results of sockeye salmon stocking into Spiridon Lake on the Kodiak National Wildlife Refuge: juvenile and adult production, commercial harvest, and ecosystem effects, 1987-2001.

SD-standard deviation; na-not available.

Appendix D.7. Summary of seasonal mean nutrient and algal pigment concentrations by station and depth for Spiridon Lake, 1988-2001.

Year	Station	Depth (m)	Total - P (μ g L^{-1})	S.D.	Total filterable - P (μ g L^{-1})	S.D.	Filterable reactive - P (μ g L^{-1})	S.D.	Total Kjeldahl - N (μ g L^{-1})	S.D.	Ammonia (μ g L^{-1})	S.D.	Nitrate + nitrite (μ g L^{-1})	S.D.	Reactive silicon (μ g L^{-1})	S.D.	Chlorophyll *a* (μ g L^{-1})	S.D.
1988	1	1	3.8	1.4	3.0	1.1	2.5	1.2	102.8	11.4	9.9	2.7	220.5	26.0	2,171	160	0.45	0.1
	1	50	3.8	0.6	2.2	0.6	1.7	0.5	94.9	9.0	11.2	5.5	256.9	9.6	2,279	172	0.16	0.1
	2	1	3.5	0.1	2.0	0.6	1.8	0.3	100.5	11.3	7.8	6.6	221.3	11.1	2,283	170	0.40	0.1
	2	50	4.0	0.6	1.9	0.6	1.8	0.5	91.4	9.9	8.6	4.4	236.2	27.5	2,237	157	0.29	0.1
1989	1	1	3.6	0.7	3.7	1.9	3.0	2.2	103.4	7.6	8.5	2.5	207.1	35.4	2,162	214	0.19	0.1
	1	50	4.2	1.0	3.2	1.2	2.4	0.4	97.9	18.6	11.5	7.3	242.8	54.9	2,277	353	0.32	0.2
	2	1	6.1	3.7	2.7	1.0	2.5	0.4	114.8	45.7	9.5	5.2	197.9	61.9	2,129	119	0.18	0.1
	2	50	7.3	7.8	2.7	0.7	2.7	0.7	104.0	40.1	12.5	11.0	209.8	50.4	2,173	109	0.37	0.3
1990	1	1	3.5	1.8	2.4	0.6	2.0	0.8	92.5	16.5	4.9	2.0	203.4	36.8	2,114	93	0.23	0.1
	1	50	3.0	0.7	2.8	0.5	2.0	0.6	85.3	10.9	6.3	2.5	228.5	24.8	2,171	96	0.34	0.2
	2	1	2.4	0.6	4.1	3.2	3.3	2.4	83.2	6.4	4.7	1.7	185.0	79.4	2,127	80	0.24	0.1
	2	50	2.5	0.8	2.8	1.1	2.9	1.9	87.7	12.3	6.6	2.8	187.3	80.1	2,205	109	0.24	0.1
1991	1	1	4.9	5.9	2.8	0.8	2.6	0.9	93.7	7.3	7.6	4.4	234.0	38.1	2,082	57	0.38	0.1
	1	50	5.2	3.7	3.3	2.0	2.8	1.4	87.5	12.9	9.4	4.8	265.1	20.9	2,131	54	0.20	0.1
	2	1	3.6	0.8	4.8	3.3	4.6	3.3	91.8	8.6	8.2	4.5	237.0	29.6	2,081	66	0.35	0.1
	2	50	3.8	1.5	3.6	3.3	3.4	3.2	88.6	7.4	11.3	5.8	267.7	7.7	2,137	46	0.25	0.1
1992	1	1	3.7	0.6	2.1	0.7	1.5	0.5	89.6	10.1	1.5	0.8	239.5	12.3	2,082	131	0.27	0.1
	1	50	4.9	1.4	4.2	3.1	3.7	3.0	87.0	8.0	4.6	3.3	258.7	16.9	2,111	102	0.22	0.1
	2	1	3.6	0.3	2.6	1.4	2.4	1.4	98.4	18.2	1.7	0.6	235.2	25.9	2,025	90	0.27	0.2
	2	50	4.5	0.8	3.1	2.8	2.0	1.1	83.2	24.8	5.3	3.7	273.4	7.7	2,112	46	0.23	0.1
1993	1	1	2.7	0.9	2.2	1.1	1.6	0.8	93.6	11.2	2.4	1.5	231.6	37.6	2,023	164	0.75	0.2
	1	50	3.0	0.9	3.0	4.0	1.8	1.8	90.7	10.8	5.2	3.4	240.2	22.8	2,122	94	0.42	0.2
	2	1	2.9	1.0	3.2	3.5	2.6	3.3	97.0	12.0	1.8	0.5	230.3	41.5	2,026	163	0.77	0.3
	2	50	2.5	0.1	3.2	2.5	2.8	2.5	85.4	3.8	5.4	3.7	247.7	30.6	2,128	96	0.40	0.2
1994	1	1	3.2	1.3	1.9	1.5	1.5	1.1	101.8	3.9	3.2	4.7	204.3	22.1	2,092	131	0.26	0.2
	1	50	3.9	2.0	1.2	0.2	1.1	0.4	97.5	16.1	6.7	3.6	218.1	18.3	2,184	95	0.21	0.1
	2	1	2.8	0.7	2.2	1.5	1.4	0.9	105.7	12.8	1.6	1.3	202.1	17.2	2,144	77	0.31	0.1
	2	50	3.3	1.2	2.2	1.3	1.9	1.1	105.6	13.2	5.8	2.5	225.7	20.6	2,190	85	0.20	0.1

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Year	Station	Depth (m)	Total - P (μg L^{-1})	S.D.	Total filterable - P (μg L^{-1})	S.D.	Filterable reactive - P (μg L^{-1})	S.D.	Total Kjeldahl - N (μg L^{-1})	S.D.	Ammonia (μg L^{-1})	S.D.	Nitrate + nitrite (μg L^{-1})	S.D.	Reactive silicon (μg L^{-1})	S.D.	Chlorophyll *a* (μg L^{-1})	S.D.
1995	1	1	3.4	2.2	0.9	0.1	0.9	0.2	108.8	12.3	2.2	1.6	203.1	26.8	2,300	95	0.95	0.49
	1	50	3.4	1.3	1.5	0.3	1.4	0.4	105.6	20.4	3.5	2.4	241.6	6.6	2,340	105	0.58	0.44
	2	1	3.9	2.0	1.2	0.4	1.1	0.2	125.2	24.1	2.2	1.0	213.4	19.8	2,297	75	1.02	0.41
	2	50	3.2	0.9	0.9	0.2	0.9	0.1	108.2	18.6	4.5	3.0	243.1	9.1	2,329	102	0.58	0.45
1996	1	1	2.7	0.6	1.5	0.9	1.0	0.5	113.4	34.1	5.1	2.8	183.6	18.5	2,042	93	0.49	0.16
	1	50	3.0	1.1	1.3	0.7	1.0	0.4	90.5	18.5	9.3	5.0	210.8	9.0	2,148	51	0.51	0.23
	2	1	2.7	0.7	1.4	0.7	1.1	0.3	105.5	20.7	5.6	1.6	180.2	14.4	2,083	82	0.47	0.14
	2	50	4.4	1.7	1.5	0.7	1.5	1.3	101.1	16.9	10.2	4.1	217.9	2.4	2,179	82	0.57	0.33
1997	1	1	3.0	0.6	3.4	3.5	3.5	4.1	103.6	12.0	11.2	5.8	147.4	31.1	2154.8	63.8	0.57	0.3
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	0.58	0.4
	1	50	2.8	0.7	1.8	0.4	1.8	0.5	90.5	5.2	11.1	6.3	191.0	19.7	2222.7	98.3	0.38	0.2
	2	1	3.1	0.9	3.2	3.3	3.1	3.2	106.1	11.3	11.2	6.4	168.2	25.2	2138.7	102.6	0.59	0.3
	2	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	0.57	0.3
	2	50	3.8	1.5	3.1	1.0	3.2	1.0	107.4	30.3	10.7	6.2	188.3	17.5	2205.2	82.6	0.44	0.2
1998	1	1	4.8	1.6	2.7	1.8	1.7	1.0	138.3	20.5	8.4	6.1	121.5	24.7	2239.3	174.3	0.43	0.3
	1	50	4.0	0.4	1.6	0.8	1.3	0.5	118.4	10.1	10.2	5.4	174.4	19.6	2355.3	42.4	0.14	0.0
	2	1	3.9	1.2	1.5	1.1	1.4	0.6	124.6	10.1	4.9	1.4	148.3	12.2	2262.3	105.2	0.38	0.3
	2	50	4.0	1.7	1.5	0.9	1.5	0.7	122.9	12.0	9.6	4.5	171.9	26.4	2296.5	93.3	0.21	0.1
1999	1	1	4.0	2.5	1.9	0.5	1.5	0.5	93.0	4.8	6.4	2.9	188.0	33.8	2,432.0	141.1	0.49	0.3
	1	50	3.2	0.4	1.7	0.7	1.2	0.5	92.0	2.7	6.9	3.8	211.4	6.1	2,478.0	207.9	0.15	0.0
	2	1	2.7	0.3	2.3	0.7	1.7	0.4	103.5	14.3	6.2	4.1	193.4	24.0	2,465.2	152.0	0.30	0.2
	2	50	3.0	0.6	2.3	1.6	1.7	1.4	87.9	15.3	11.2	6.0	208.1	10.1	2,524.6	157.1	0.25	0.1
2000	1	1	7.0	4.5	3.4	3.8	2.3	2.2	na	na	8.7	8.6	195.5	1.8	na	na	0.58	0.1
	2	1	6.1	8.7	3.3	4.6	2.0	2.0	na	na	7.5	8.0	184.0	15.7	na	na	0.77	0.2
2001	1	1	4.9	3.3	3.5	2.1	1.9	2.0	na	na	4.6	4.7	193.8	6.7	na	na	0.60	0.3
	2	1	6.7	5.1	3.5	3.3	2.7	3.5	na	na	2.1	1.3	189.2	7.3	na	na	0.60	0.1

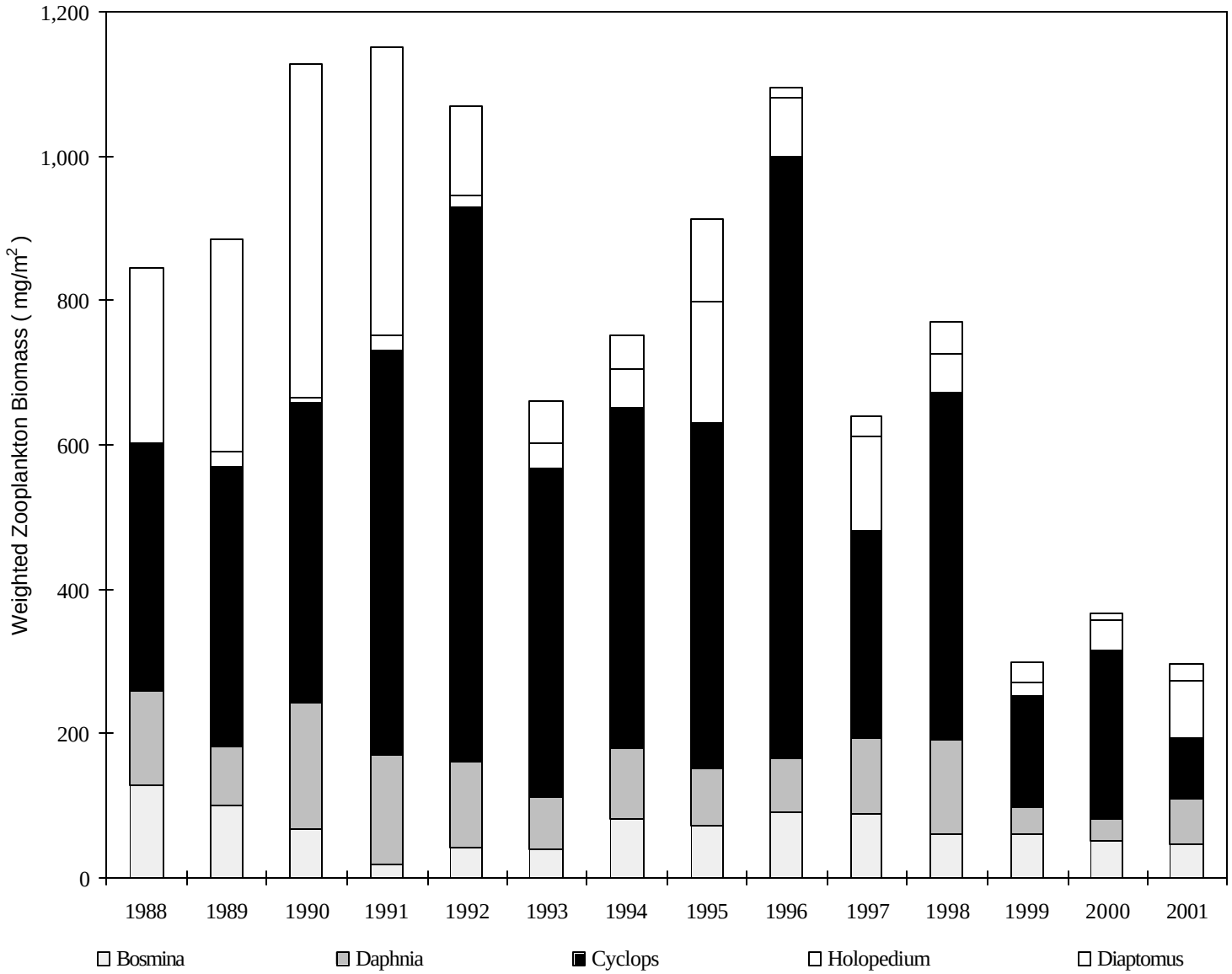
Note: Table revised from S.G. Honnold. 1997. The results of sockeye salmon stocking into Spiridon Lake on the Kodiak National Wildlife Refuge: juvenile and adult production, commercial harvest, and ecosystem effects, 1987-2001.

SD - standard deviation; na - not available.

Appendix D.8. Weighted mean zooplankton density, biomass, and size by genera for Spiridon Lake, 1987-2001.

	No. of	*Diaptomus*			*Cyclops*			*Bosmina*			*Daphnia* [a]			*Holopedium*			TOTALS	
	Sample	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass
Year	Dates	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2
1987	1	131,369	503	0.96	225,318	426	0.74	65,287	203	0.57	54,140	133	0.75	5,573	93	1.17	481,687	1,359
1988	4	53,344	243	1.02	146,961	341	0.81	38,694	129	0.61	19,043	130	1.20	763	4	0.73	258,806	847
1989	5	95,435	293	0.89	317,795	386	0.60	33,559	101	0.56	18,949	83	0.96	3,344	23	0.82	469,081	886
1990	5	111,385	460	0.99	206,688	415	0.76	21,178	69	0.59	30,069	175	1.10	1,486	8	0.69	370,806	1,127
1991	7	113,778	401	0.94	329,343	562	0.70	6,786	20	0.55	32,956	151	0.99	824	18	0.76	483,688	1,151
1992	5	20,328	125	1.13	261,093	768	0.91	11,825	41	0.60	24,893	121	1.01	1,780	16	0.91	319,919	1,072
1993	6	11,047	59	1.06	269,740	455	0.70	16,211	40	0.51	23,932	72	0.80	3,738	35	0.83	324,668	662
1994	6	8,090	45	1.09	240,942	471	0.75	27,941	82	0.55	39,411	98	0.75	7,754	55	0.85	324,139	751
1995	6	12,816	117	1.30	213,531	479	0.81	29,839	74	0.51	28,966	77	0.78	19,836	167	0.83	304,987	915
1996	6	3,096	14	0.99	384,605	832	0.78	28,268	91	0.58	20,846	77	0.92	8,873	83	0.91	445,689	1,096
1997	6	3,176	26	1.26	119,126	287	0.82	31,962	89	0.54	25,177	105	1.00	17,551	132	0.84	196,993	640
1998	5	8,153	63	1.23	354,953	448	0.80	23,652	59	0.55	37,601	120	1.06	16,256	78	0.85	440,615	767
1999	5	5,488	27	1.06	73,291	156	0.78	18,420	60	0.58	10,929	38	0.92	6,900	18	0.35	115,028	299
2000	5	1,430	8	1.13	184,661	233	0.61	21,549	51	0.51	11,225	30	0.78	7,076	43	0.76	225,940	366
2001	5	2,368	23	1.34	32,893	86	1.08	16,577	47	0.62	19,717	62	0.89	7,355	79	1.05	78,910	297

[a] Daphnia data are a combination of both species, *Daphnia l.* and *Daphnia r.*



Appendix D.9. Weighted mean zooplankton biomass by genera for Spiridon Lake, 1987-2001.

Appendix D.10. Juvenile sockeye salmon estimates based on hydroacoustic fish population surveys in Spiridon Lake, 1992, and 1994-2001.

		Total Fish Estimates [a]		
			95% Confidence Interval	
Year	Date	Number	Low	High
1992	13-Sep	470,587	263,248	677,926
1994	25-Apr	701,521	586,692	816,350
	24-Jun	132,793	85,712	179,874
	26-Sep	562,029	406,414	717,644
1995	2-May	770,610	624,763	916,457
	27-Jun	166,412	136,694	196,130
	29-Sep	1,463,235	970,958	1,955,512
1996	4-May	775,092	480,683	1,069,501
	1-Jul	119,466	98,065	140,867
	19-Sep	658,871	40,670	1,277,072
1997	28-Apr	719,530	520,732	918,328
	7-Jul	592,241	360,022	824,460
	11-Sep	1,577,625	1,203,260	1,951,990
1998	25-Apr	1,341,645	1,226,528	1,456,762
	15-Sep	2,041,377	1,664,655	2,418,099
1999	6-Oct	2,064,419	1,687,922	2,440,916
2000	13-May	1,681,691	1,449,089	1,914,293
2001	1-May	1,754,217	1,469,665	2,038,769
	23-Aug	2,331,383	1,843,645	2,819,122

[a] Total fish population estimates include all species residing in the lake. Townet sampling to determine species composition in the lake was attempted in 1992 and 1994, however, no rearing juvenile sockeye were captured. Juvenile sockeye grow quickly in size to avoid capture by townet.

Appendix D.11. Daily sockeye salmon smolt emigration estimates from Spiridon Lake, 1992-2001.

	Total Smolt Emigration									
Date	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
23 Apr	0	0	0	0	0	0	16		0	
24 Apr	0	0	0	0	0	0	106		0	
25 Apr	0	0	0	0	1	1	302		0	
26 Apr	0	0	0	1	0	1	201		0	
27 Apr	0	0	0	0	1	0	140		0	
28 Apr	0	0	1	0	0	0	693		0	
29 Apr	0	0	1	9	0	1	3,265		0	
30 Apr	0	0	7	20	0	79	3,815		0	
1 May	0	0	9	52	0	44	1,560	0	0	
2 May	0	0	16	68	0	457	502	0	11	
3 May	0	0	37	337	10	1,202	2,141	0	9	1
4 May	0	0	11	973	35	2,819	3,799	0	12	0
5 May	0	0	97	300	181	20,378	7,302	0	15	0
6 May	353	15,659	49	1,182	2,184	10,123	27,033	0	25	5
7 May	5,000	4,561	889	1,485	188	5,578	20,765	0	107	2
8 May	466	13,746	542	3,673	169	16,018	5,057	0	47	6
9 May	47	6,253	8,740	2,056	228	108,639	12,243	0	182	4
10 May	6,513	3,953	3,026	4,300	5,196	29,773	78,222	0	90	29
11 May	8,442	709	426	19,021	3,801	6,011	14,998	0	48	27
12 May	73,695	31,664	20,666	3,403	7,800	2,638	60,438	0	36	19
13 May	149,523	50,853	25,627	25,733	3,837	9,926	47,142	2	34	186
14 May	7,768	91,670	27,718	11,061	14,801	163,534	5,291	296	199	319
15 May	184,299	89,746	21,212	30,641	3,422	24,775	4,478	6,835	314	2,037
16 May	101,401	7,280	10,633	51,470	100,606	9,516	43,312	13,396	812	1,243
17 May	37,735	1,136	19,456	27,961	259,686	56,220	4,046	11,231	1,052	9,385
18 May	58,892	1,474	67,357	11,441	116,622	41,144	1,713	39,484	6,544	13,919
19 May	141,103	2,089	33,371	12,812	25,951	45,624	50,534	1,871	20,641	2,685
20 May	96,785	664	13,375	13,322	72,497	58,592	5,968	1,927	8,908	36,752
21 May	62,408	401	58,559	21,205	21,480	67,029	42,070	1,312	32,823	58,067
22 May	87,527	6,675	32,340	27,913	4,585	35,836	60,768	366	73,736	17,773
23 May	20,501	10,568	31,763	71,338	21,288	78,103	22,817	1,147	19,966	10,407
24 May	201,062	950	58,745	39,606	63,983	15,154	9,059	228	54,811	194,029
25 May	159,082	3,124	142,295	35,022	7,083	11,291	24,201	1,660	24,604	49,581

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Date	1992	1993	1994	1995 `		1997	1998	1999	2000	2001
26 May	2,257	1,876	40,920	26,843	26,474	19,253	14,968	1,671	43,324	168,398
27 May	6,164	98	67,604	7,657	75,210	6,545	6,384	17,217	54,719	252,675
28 May	24,587	71	22,861	26,127	22,810	22,831	32,078	516	48,296	155,436
29 May	12,150	60	18,634	25,385	7,464	6,206	15,118	394	38,355	124,346
30 May	12,350	49	19,779	12,888	21,601	2,323	2,669	31,324	7,098	37,509
31 May	16,862	71	15,585	9,552	19,121	1,695	8,621	21,618	13,817	51,019
1 Jun	1,380	35	11,830	4,828	18,324	2,891	14,473	19,580	5,820	80,592
2 Jun	444	123	12,038	4,918	14,474	3,206	6,472	365,272	28,697	16,084
3 Jun	535	0	4,358	8,476	28,804	1,303	7,579	258,733	20,676	39,065
4 Jun	885	0	4,193	15,749	15,744	1,750	2,853	53,796	16,956	90,013
5 Jun	494	0	2,582	7,148	17,808	980	3,751	13,901	5,844	33,543
6 Jun	793	0	4,223	8,674	8,903	1,430	2,361	5,781	1,069	12,078
7 Jun	890	0	875	4,562	7,135	458	3,359	10,811	493	15,817
8 Jun	476	0	3,825	9,336	8,221	517	489	11,644	9,783	2,259
9 Jun	371	0	1,707	2,885	5,584	379	6,065	3,549	21,043	10,420
10 Jun	103	0	2,601	1,862	2,985	361	2,265	56	42,662	3,758
11 Jun	183	0	5,681	1,191	2,449	263	2,366	5,953	7,966	6,332
12 Jun	73	0	1,765	2,561	2,307	336	2,514	16,825	3,059	7,484
13 Jun	169	0	2,697	1,368	1,895	500	4,766	7,022	1,254	5,604
14 Jun	185	0	2,603	1,527	1,580	191	14,213	3,508	214	5,346
15 Jun	868	0	2,269	1,483	553	795	8,065	318	781	3,043
16 Jun	0	0	1,793	2,508	181	0	5,332	421	6,269	3,052
17 Jun	0	0	2,431	1,825	748	0	2,935	375	4,681	2,616
18 Jun	0	0	1,671	2,066	586	0	195	593	22,647	523
19 Jun	0	0	988	981	695	0	1,491	160	10,207	6,424
20 Jun	0	0	1,580	853	532	0	181	310	5,410	1,286
21 Jun	0	0	1,011	1,077	253	0	414	828	23,022	807
22 Jun	0	0	2,013	1,319	878	0	2,272	336	5,624	543
23 Jun	0	0	1,076	989	1,689	0	216	582	5,344	444
24 Jun	0	0	1,338	374	592	0	172	33	10,447	649
25 Jun	0	0	1,764	748	334	0	73	40	10,385	338
26 Jun	0	0	2,010	478	771	0	1,239	24	15,874	632
27 Jun	0	0	1,218	350	1,379	0	370	530	3,096	319
28 Jun	0	0	979	0	746	0	2,048	373	2,730	418
29 Jun	0	0	1,757	0	430	0	1,344	462	3,034	750

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Date	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
30 Jun	0	0	764	0	291	0	806	565	5,495	7
1 Jul	0	0	435	0	0	0	483	0	1,818	99
2 Jul	0	0	782	0	0	0	385	394	1,814	17
3 Jul	0	0	442	0	0	0	287	52	1,336	
4 Jul	0	0	698	0	0	0	160	92	2,340	
5 Jul	0	0	0	0	0	0	125	70	365	
6 Jul	0	0	0	0	0	0	174	39	2,120	
7 Jul	0	0	0	0	0	0	211	90	1,232	
8 Jul	0	0	0	0	0	0	103	24	0	
9 Jul	0	0	0	0	0	0	109	29	1,252	
10 Jul	0	0	0	0	0	0	77	0	0	
11 Jul	0	0	0	0	0	0	141	273	3,985	
12 Jul	0	0	0	0	0	0	181	0	0	
13 Jul								64	4,000	
14 Jul								0	804	
15 Jul								52	0	
16 Jul								0	0	
17 Jul								0	1,000	
18 Jul								0	0	
19 Jul								0	1,000	
20 Jul								63	0	
21 Jul									718	
22 Jul									0	
23 Jul									3,409	
24 Jul									0	
25 Jul									6,000	
26 Jul									0	
27 Jul									0	
28 Jul									1,500	
29 Jul									0	
30 Jul									0	
31 Jul									0	
1 Aug									3,000	
Totals	1,484,821	345,558	850,348	614,993	1,055,186	894,719	750,946	940,116	792,909	1,540,223

Appendix D.12. Mean age, length, weight, and condition coefficient for sockeye salmon smolt captured by trapping at Spiridon Lake, 1991-2001.

	Age-1				Age-2				Age-3			
Year	N [a]	Length (mm)	Weight (g)	Condition (K)	N [a]	Length (mm)	Weight (g)	Condition (K)	N [a]	Length (mm)	Weight (g)	Condition (K)
1991	596	127	19.3	1.08	0				0			
1992	1393/1389	115	12.7	0.81	16/14	183	58.9	0.80	0			
1993	817/493	116	13.4	0.83	404/240	155	33.8	0.88	2/2	178	50.7	0.90
1994	1477/929	106	9.3	0.78	526/344	152	28.5	0.79	6/4	254	145.8	0.88
1995	1697/999	104	9.2	0.81	1081/667	138	25.1	0.95	6/5	244	102.8	0.84
1996	2224/1573	109	10.3	0.79	694/513	141	20.7	0.73	6/5	221	85.6	0.77
1997	1428/876	102	8.6	0.80	720/441	137	20.6	0.80	11/6	169	41.9	0.81
1998	2205/1496	93	6.3	0.76	727/414	127	15.4	0.75	3/0			
1999[b]	1452/799	95	7.0	0.80	518/336	122	14.1	0.78	2/1	126	15.0	0.75
2000	2263/1700	94	6.8	0.79	507/325	132	18.5	0.8	22/8	142	22.4	0.77
2001	2037/2037	104	8.8	0.78	506/506	136	20.2	0.79	0/0			

[a] N for age/ N for length, weight, and condition.
[b] one smolt sampled was age 0. - 96 mm; 6.6 g; 0.75 K

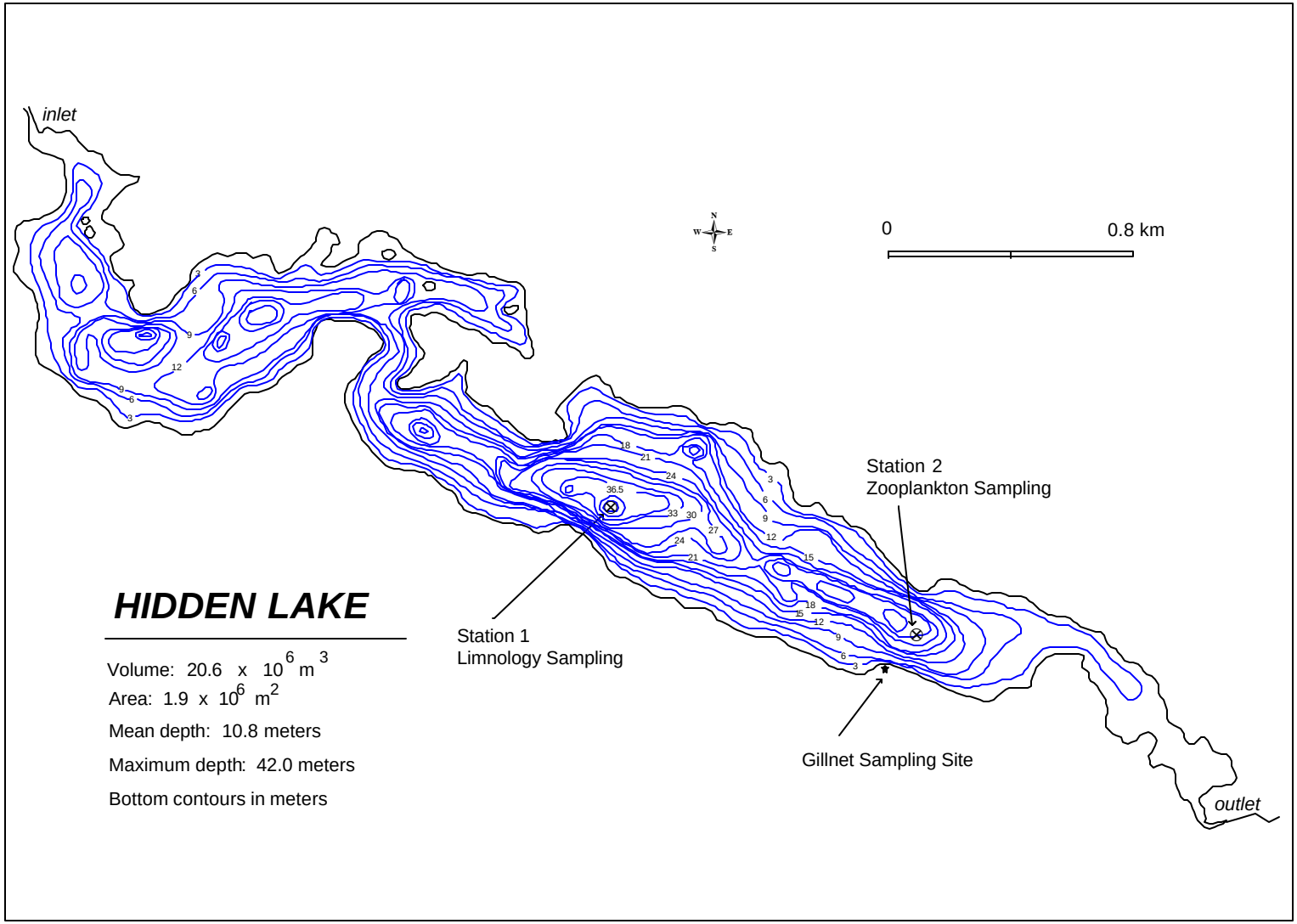
Appendix D.13. Commercial harvest of sockeye salmon in the Spiridon Lake Terminal Harvest Area (254-50) by statistical week, 1994-2001.

	Statistical	Year							
Period	Week	1994	1995	1996	1997	1998	1999	2000	2001
26	June 21-June 27						13,046	411	
27	June 28-Jul 4					6,700	11,796	1,617	409
28	Jul 5-Jul 11					14,500	13,894	2,108	1,648
29	Jul 12-Jul 18					19,000	23,205	6,998	5,926
30	Jul 19-Jul 25		1,757			16,653	20,280	13,109	10,021
31	Jul 26-Aug 1		3,178	27,066	2,247	11,040	22,892	15,838	7,742
32	Aug 2-Aug 8	312	2,663	34,309	879	2,300	13,921	9,243	10,994
33	Aug 9-Aug 15	77,789	10,600	42,586	4,404	11,000	42,293	13,309	13,317
34	Aug 16-Aug 22	13,890	6,914	45,242	13,067	6,716	13,743	14,192	6,316
35	Aug 23- Aug 29	9,997	3,970	9,923	10,939	2,750	11,555	4,772	2,175
36	Aug 30-Sep 5	13,200	2,461	2,648	15,882	1,000	3,638	334	1,185
37	Sep 6-Sep 12		149	344	13,792		155	0	
38	Sep 13-Sep 19				3,174		0	0	
Total:		115,188	31,692	162,118	64,384	91,659	190,418	81,931	59,733

Appendix D.14. Estimated age composition of the adult sockeye salmon harvested in the Spiridon Lake Terminal Harvest Area, 1994-2001.

Year	Sample Size		Ages 0.2	1.1	0.3	1.2	2.1	1.3	0.4	2.2	2.3	3.1	3.2	1.4	2.4	Total [a]
1994	1,329	Percent	0	0	0	100	0	0	0	0	0	0	0	0	0	100
		Numbers	0	267	0	266,013	1,069	0	0	0	0	0	0	0	0	267,350
1995	1,313	Percent	0	20	0	60	2	5	0	12	1	0	0	0	0	100
		Numbers	97	19,247	97	58,224	1,838	4,739	0	11,219	1,257	0	0	0	0	96,717
1996	1,875	Percent	0	2	0	79	5	0		14	0	0	0	0	0	100
		Numbers	0	6,965	0	305,703	17,800	774	0	55,336	0	387	0	0	0	386,966
1997	1,703	Percent	0	3	0	63	3	2		29	0	0	0	0	0	100
		Numbers	0	4,123	0	92,175	4,123	3,534	0	43,143	147	0	0	0	0	147,245
1998	1,943	Percent	0	4	0	82	2	1	0	11	1	0	0	0	0	100
		Numbers	0	9,061	0	176,466	4,315	1,294	0	23,083	1,079	0	216	216	216	215,729
1999	2,345	Percent	0	0	0	48	0	33	0	17	2	0	0	0	0	100
		Numbers	0	1,871	0	223,585	936	152,955	0	81,389	7,016	0	468	468	468	467,752
2000	1,997	Percent	0	0	0	72	0	3	0	18	7	0	0	0	0	100
		Numbers	0	202	202	144,769	405	6,074	0	37,053	13,363	0	202	202	202	202,474
2001	1,534	Percent	0	1	0	59	3	17	0	19	1	0	0	0	0	100
		Numbers	0	1,620	147	86,168	5,008	25,335	0	27,986	1,031	0	0	0	0	147,295
Mean	1,755	Percent	0	2	0	70	2	10	0	14	1	0	0	0	0	100
		Numbers	12	5,420	56	169,138	4,437	24,338	0	34,901	2,987	48	111	111	111	241,441

[a] total run = harvest plus escapement into Telrod Creek.



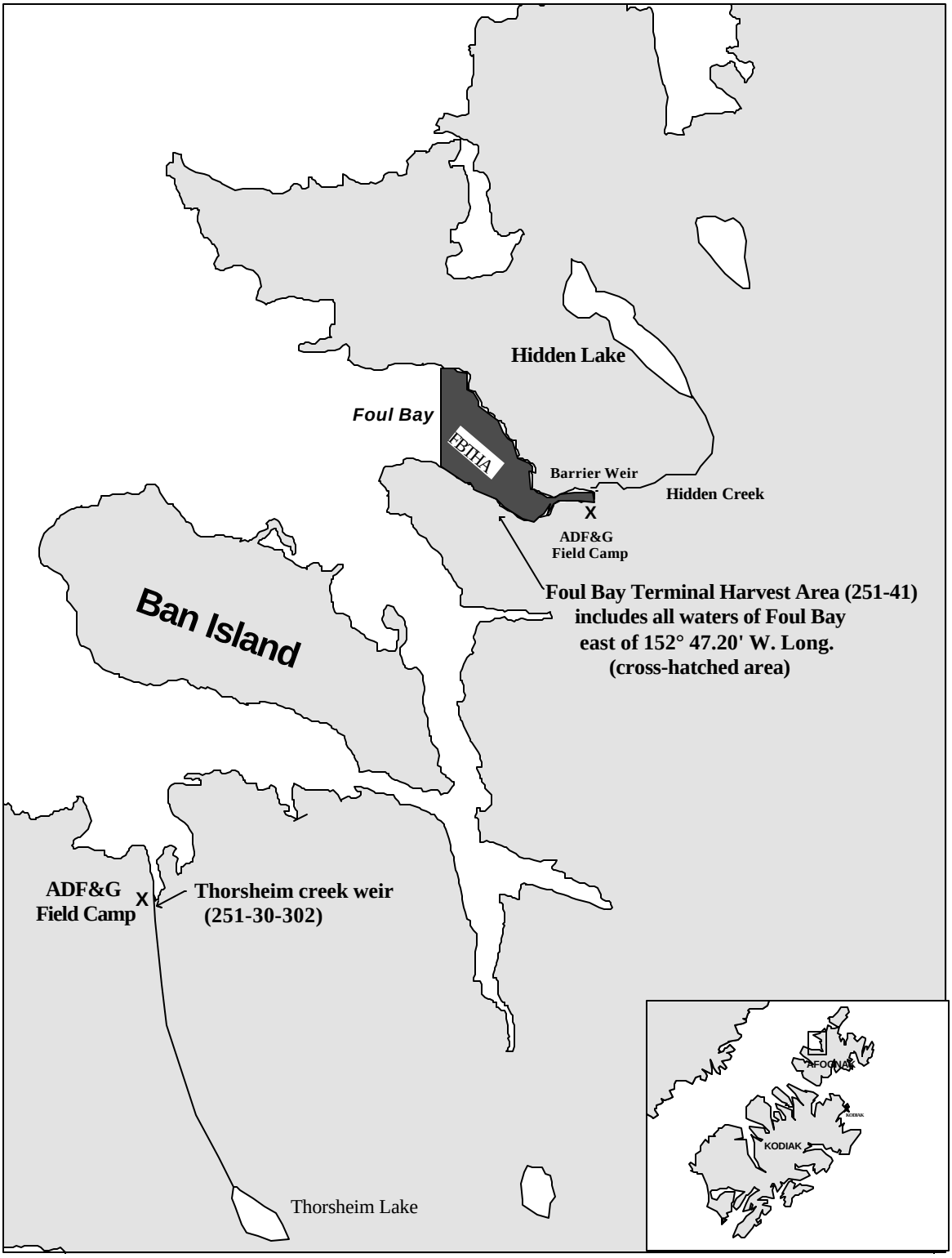
Appendix E.1. Morphometric map showing the limnology and zooplankton stations on Hidden Lake.

Appendix E.2. Juvenile coho and sockeye salmon releases into Hidden Lake, 1988-1989, and 1991-2001.

Release Year	Broodstock	Species Stocked	Life Stage[a] fry	fingerling	presmolt	Total Stocked
1988	Big Kitoi	Coho		137,585		137,585
1989	Big Kitoi	Coho		239,817		239,817
1991	Big Kitoi	Coho		250,889		250,889
1992	Afognak	Sockeye			260,000	260,000
1993	Afognak	Sockeye	554,600			554,600
1994	Afognak	Sockeye	250,000			250,000
1995	Afognak	Sockeye			98,650	98,650
1996	Afognak	Sockeye	252,000		138,800[b]	390,800
1997	Afognak	Sockeye	287,700		167,500[b]	455,200
1998	Afognak	Sockeye			340,400[b]	340,400
1999	Afognak	Sockeye			310,000[b]	310,000
2000	Afognak	Sockeye	172,000		332,400[b]	504,400
2001	Afognak	Sockeye		66,500	249,000[b]	315,500

[a] Fry are released from April to July at up to 200% of emergent size (normally 0.15 to 0.5 g depending on the stock). Fingerling are released from June to September at a size of >200% to <2100% of emergent size (normally 0.3 to 5.25 g depending on the stock). Pre-smolt are released from August to November at a size of >2100% of emergent size but not yet at the physiological stage of smolting (normally 5 to 13 g.

[b] Pre smolt releases were air dropped from a fixed wing aircraft.



Appendix E.3. Location of the Foul Bay Terminal Harvest Area, ADF&G field camps, and fish weirs at Hidden Creek and Thorsheim Creek.

Appendix E.4. Hidden Creek barrier weir.

Appendix E.5. Limnological sampling stations and total samples collected at Hidden Lake, 1987-2001.

Year	Sampling Stations	Total Samples
1987	1	3
1989	1	1
1990	1	4
1991	1	5
1992	1	6
1993	1	6
1994	1, 2	7
1995	1, 2	7
1996	1, 2	6
1997	1, 2	6
1998	1	5
1999	1	5
2000	1	5
2001	1	5

Appendix E.6. Summary of seasonal mean water chemistry parameters by station and depth for Hidden Lake, 1987 and 1990-2001.

Year	Station	Depth (m)	Specific Conductivity (umhos/cm)	SD	pH (Units)	SD	Alkalinity (mg/L)	SD	Turbidity (NTU)	SD	Color (Pt units)	SD	Calcium (mg/L)	SD	Magnesium (mg/L)	SD	Iron (ug/L)	SD
1987	1	1	41.3	1.2	6.7	0.2	7.5	1.5	0.5	0.4	9.7	2.1	2.7	0.1	0.4	0.2	83.3	98.5
	1	25	42.0	1.7	6.7	0.2	6.7	1.5	0.6	0.4	11.7	2.5	2.8	0.2	0.6	0.2	94.3	86.6
1990	1	1	62.8	2.0	6.9	0.2	8.2	1.3	0.7	0.3	17.0	7.6	3.7	0.6	1.1	0.6	52.0	16.0
	1	29	66.3	3.1	6.7	0.2	8.5	0.9	0.5	0.1	13.0	2.0	3.9	0.5	1.1	0.3	39.8	9.3
1991	1	1	45.0	8.2	6.8	0.1	9.0	1.0	0.7	0.4	17.4	6.3	3.3	0.6	0.8	0.1	33.8	14.6
	1	30	46.2	8.3	6.8	0.2	10.3	1.9	0.5	0.2	15.6	3.0	3.3	0.5	0.9	0.3	37.8	10.7
1992	1	1	47.0	1.4	6.6	0.1	8.5	1.5	0.7	0.5	10.7	0.8	4.0	0.4	0.8	0.5	33.2	10.4
	1	27	47.3	1.0	6.5	0.2	10.6	5.3	0.8	0.7	12.0	1.1	3.5	0.8	1.0	0.6	68.7	88.7
1993	1	1	50.5	3.9	6.6	0.2	9.1	1.4	0.8	0.4	10.2	1.6	3.8	0.4	0.9	0.3	34.8	9.3
	1	42	50.3	3.1	6.5	0.2	8.8	1.0	0.6	0.5	10.7	2.3	4.0	0.2	0.9	0.3	54.0	27.2
1994	1	1	47.9	2.9	6.5	0.2	7.2	0.6	0.7	0.3	11.6	1.5	3.2	0.5	1.0	0.3	56.2	22.7
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
	1	40	46.6	1.3	6.3	0.3	7.1	0.7	0.5	0.3	12.6	1.0	3.0	0.1	0.9	0.3	46.8	17.5
1995	1	1	50.0	4.2	6.4	0.1	8.7	1.5	0.9	0.9	15.3	5.7	3.0	0.5	1.0	0.6	78.6	104.4
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
	1	43	50.3	1.4	6.2	0.1	7.3	0.2	0.4	0.2	12.3	1.8	2.8	0.3	0.8	0.5	38.9	7.4
1996	1	1	50.3	1.6	6.6	0.2	8.2	0.7	0.8	0.7	14.8	1.9	2.9	0.3	0.9	0.4	36.8	9.5
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
	1	42	51.5	1.6	6.3	0.1	7.4	0.3	0.5	0.3	16.5	2.1	2.7	0.1	0.9	0.4	22.8	7.5
1997	1	1	49.2	1.2	6.9	0.1	9.9	1.5	0.4	0.1	12.0	1.7	2.9	0.2	0.8	0.3	29.3	9.3
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
	1	43	50.5	0.8	6.7	0.1	9.6	0.7	0.4	0.1	14.3	1.9	2.8	0.1	0.8	0.3	28.3	8.4
1998	1	1	43.3	1.0	6.9	0.0	9.8	1.7	0.9	0.5	13.3	1.0	3.0	0.5	0.7	0.2	24.5	6.6
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
	1	42	44.8	1.5	6.8	0.1	9.3	0.5	0.9	0.4	13.8	0.4	3.0	0.5	0.7	0.2	26.1	3.5
1999	1	1	49.4	1.5	6.8	0.3	8.9	0.7	0.6	0.6	11.6	1.1	3.3	0.3	1.0	0.2	41.8	12.5
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
	1	42	50.2	0.8	6.6	0.2	8.4	0.5	0.5	0.3	11.4	0.5	3.4	0.1	1.0	0.2	40.4	8.0
2000	1	1	na	na	7.3	0.2	7.2	1.1	na	na	na	na	na	na	na	na	na	na
2001	1	1	na	na	7.2	0.1	8.1	1.5	na	na	na	na	na	na	na	na	na	na

SD - standard deviation
na - not analyzed

Appendix E.7. Summary of seasonal mean nutrient and algal pigment concentrations by station and depth for Hidden Lake, 1987 and 1990-2001.

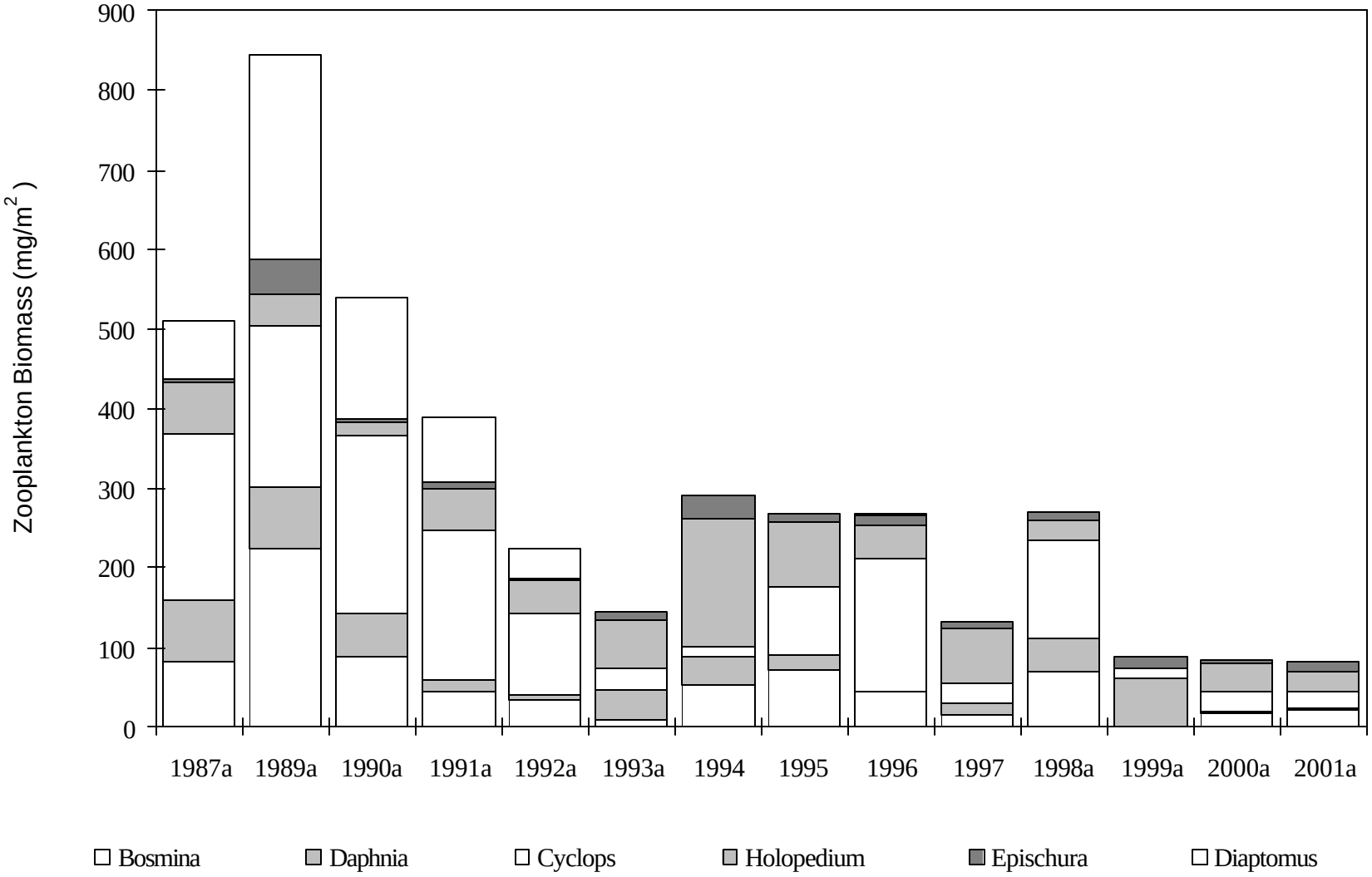
Year	Station	Depth (m)	Total-P (ug/L P)	SD	Total filterable-P (ug/L P)	SD	Filterable reactive-P (ug/L P)	SD	Total Kjeldahl nitrogen (ug/L N)	SD	Ammonia (ug/L N)	SD	Nitrate+nitrite (ug/L N)	SD	Reactive silicon (ug/L Si)	SD	Organic carbon (ug/L)	SD	Chlorophyll *a* (ug/L)	SD
1987	1	1	4.2	0.4	2.2	0.7	0.9	0.1	90.1	2.4	4.3	3.1	82.0	11.7	1840.0	436.6	49.3	14.5	0.15	0.0
	1	25	4.0	1.6	2.9	0.9	1.1	0.2	80.7	11.4	4.6	3.2	90.9	5.7	1875.0	454.7	78.3	38.0	0.06	0.1
1990	1	1	3.9	2.2	3.6	3.8	2.1	1.1	101.3	48.7	3.8	4.3	65.9	11.3	1906.8	318.5	151.5	71.3	0.29	0.0
	1	29	2.1	1.2	1.4	0.3	1.2	0.2	79.2	34.0	6.1	2.3	88.7	16.4	1956.5	172.9	120.5	67.2	0.11	0.0
1991	1	1	4.1	1.9	4.0	3.1	3.4	2.6	75.2	44.5	12.0	4.1	53.4	25.1	1727.4	83.1	na	na	0.18	0.1
	1	30	3.1	0.7	2.5	0.7	1.9	0.8	82.9	19.1	13.6	3.4	70.4	13.7	1733.8	205.8	na	na	0.07	0.1
1992	1	1	4.0	0.4	2.0	0.4	1.8	0.2	93.7	41.0	4.1	2.9	64.9	15.8	1746.5	74.0	87.0	29.8	0.22	0.1
	1	27	5.1	3.8	2.5	0.9	2.4	1.1	98.8	34.3	3.7	2.5	74.3	16.0	1806.0	99.2	130.2	155.1	0.11	0.1
1993	1	1	3.7	2.6	5.1	6.3	3.0	3.3	102.0	30.9	12.6	11.4	45.7	22.1	1721.7	133.1	na	na	0.79	0.4
	1	42	3.1	1.6	2.4	1.1	1.9	1.1	84.2	23.4	16.2	9.0	90.4	16.1	1896.0	82.5	na	na	0.20	0.2
1994	1	1	4.6	1.7	1.7	0.5	1.2	0.5	120.3	33.3	4.3	2.5	19.7	19.9	1651.6	101.5	178.3	91.0	1.11	0.3
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	0.87	0.9
	1	40	4.3	2.3	1.5	0.5	1.2	0.4	88.2	17.7	7.4	3.8	54.9	3.4	1813.9	82.5	66.0	47.2	0.08	0.1
1995	1	1	3.8	2.2	2.2	1.6	1.7	1.2	108.6	24.6	9.7	3.0	39.4	15.8	1893.9	248.5	na	na	0.77	0.3
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	0.70	0.3
	1	43	3.6	2.2	2.0	0.8	1.3	0.7	91.7	12.9	10.2	1.9	64.2	3.6	1934.7	112.9	na	na	0.22	0.2
1996	1	1	3.4	0.9	3.6	0.4	1.9	0.2	92.6	8.0	3.8	4.6	38.9	13.8	1650.3	85.1	na	na	0.51	0.1
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	0.46	0.1
	1	42	3.7	1.5	3.6	0.8	1.9	0.4	80.4	7.1	7.2	3.7	72.5	5.1	1754.7	30.3	na	na	0.14	0.1
1997	1	1	3.1	1.4	1.9	0.4	1.6	0.3	93.0	8.8	7.8	8.3	20.1	13.2	1792.5	136.3	84.3	16.4	0.39	0.1
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	0.41	0.1
	1	43	3.3	1.2	2.7	1.1	2.2	1.1	87.7	14.2	15.1	9.5	47.7	3.0	1908.8	136.2	56.3	9.7	0.12	0.1
1998	1	1	3.1	1.0	2.4	0.8	1.7	0.9	100.5	11.5	5.5	4.5	13.3	4.8	1651.0	227.2	80.0	27.4	0.45	0.2
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	0.18	0.2
	1	42	3.2	0.5	2.5	0.8	1.8	0.8	98.2	16.6	6.4	3.8	17.2	5.8	1627.5	214.0	113.8	51.8	0.38	0.2
1999	1	1	3.1	0.4	1.7	0.3	1.2	0.3	92.8	8.9	10.7	1.6	51.3	20.7	1857.0	46.3	126.8	23.1	0.17	0.10
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
	1	42	3.2	0.3	1.9	0.2	1.3	0.3	81.0	7.3	15.1	4.4	73.0	10.3	1997.6	83.8	100.4	28.6	0.09	0.08
2000	1	1	4.9	4.0	2.8	1.3	1.4	1.1	<60	na	11.9	10.3	83.1	31.2	na	na	na	na	1.03	1.24
2001	1	1	5.1	1.8	4.1	2.6	3.3	3.7	94.7	na	3.4	3.2	35.5	25.5	na	na	na	na	0.64	0.23

SD - standard deviation
na - not analyzed

Appendix E.8. Weighted mean zooplankton density, biomass, and size by genera for Hidden Lake, 1987, and 1989-2001.

	Number	*Epischura*			*Diaptomus*			*Cyclops*			*Bosmina*			*Daphnia*			*Holopedium*	
Year	of Samples	Density no/m^2	Biomass mg/m^2	Size mm	Density no/m^2	Biomass mg/m^2	Size mm	Density no/m^2	Biomass mg/m^2	Size mm	Density no/m^2	Biomass mg/m^2	Size mm	Density no/m^2	Biomass mg/m^2	Size mm	Density no/m^2	Biomass mg/m^2
1987[a]	3	204	4	1.74	24,080	72	0.88	90,499	208	0.81	31,766	82	0.52	23,629	78	0.86	6,281	66
1989[a]	1	2,654	44	1.58	91,826	259	0.98	107,219	203	0.74	91,826	226	0.51	16,985	76	0.99	4,246	38
1990[a]	4	133	4	1.92	33,174	152	1.02	92,622	226	0.83	30,852	90	0.55	15,061	51	0.87	1,526	16
1991[a]	5	411	7	1.60	23,447	81	0.93	82,307	190	0.81	15,864	44	0.54	5,320	14	0.77	3,372	53
1992[a]	6	288	3	1.37	17,693	37	0.77	51,177	101	0.76	13,498	35	0.52	1,894	5	0.81	3,813	43
1993[a]	6	1,561	11	1.17	0	0	-	12,062	26	0.79	3,463	8	0.50	20,510	39	0.66	8,364	60
1994	7	4,589	32	1.22	0	0	-	4,384	13	0.89	25,239	52	0.47	13,835	37	0.77	19,193	159
1995	7	1,892	9	1.02	76	0.6	1.23	34,141	85	0.85	30,965	71	0.49	8,245	20	0.74	9,851	81
1996	6	3,185	12	0.95	35	0.2	1.10	70,897	166	0.82	21,447	45	0.46	650	1	0.62	6,420	42
1997	6	1,018	8	1.16	47	0.1	0.70	12,515	26	0.76	9,205	14	0.40	7,774	16	0.67	8,887	67
1998[a]	5	1,316	11	1.25	0	0	-	45,527	123	0.85	29,667	68	0.49	18,605	44	0.73	4,242	24
1999[a]	5	1,656	17	1.33	0	0	-	8,630	13	0.40	0	0	-	6,136	60	0.93	0	0
2000[a]	5	955	6	1.15	0	0	-	13,142	23	0.71	8,099	19	0.50	1,142	2	0.59	6,594	35
2001[a]	5	3,510	15	0.98	0	0	-	6,200	19	1.01	10,230	23	0.48	799	2	0.91	9,711	24

[a] Samples taken from station 1 only.



Appendix E.9. Weighted mean zooplankton biomass by genera for Hidden Lake, 1987 and 1989-2001.

[a] Samples taken from one station only.

Appendix E.10. Juvenile sockeye salmon estimates based on hydroacoustic fish population surveys of Hidden Lake, 1994-1998 and 2000-2001.

Sample		Sockeye Salmon Estimates[a]		
			95% Confidence Interval	
Year	Month	Number	Low	High
1994	October	91,181	63,700	118,662
1995	November	75,149	35,690	114,608
1996	May	34,347	8,084	60,610
	July	21,241	12,264	30,218
	October	175,154	111,678	238,630
1997	May	103,310	51,157	155,463
	June	25,659	4,603	46,715
1998	April	115,768	90,556	140,980
1999		No surveys were conducted		
2000	May	107,390	84,335	130,445
2001	May	24,444	17,719	31,169

[a] Townet surveys were discontinued due to sockeye avoidance of the trawl net.

Appendix E.11. Mean age, length, weight, and condition coefficient sockeye salmon smolt collected from Hidden Creek, 1993-2001.

			Age-1				Age-2			
Year	Statistical Week	Date	Sample Size	Mean Length (mm)	Mean Weight (g)	Condition Factor (K)	Sample Size	Mean Length (mm)	Mean Weight (g)	Condition Factor (K)
1993	21	May 17-23	324	100.5	8.5	0.83	0	0.0	0.0	0.00
1994	24-27	June 7-July 4	214	122.9	16.2	0.87	4	145.0	29.1	0.92
1995	23-26	May 31-June 27	148	124.5	20.5	1.00	5	164.3	45.8	1.02
1996	23-25	May 31-June 20	426	125.3	18.4	0.94	14	159.5	41.6	0.95
1997	23-26	May 31-June 27	439	109.2	11.4	0.87	3	120.0	14.7	0.78
1998	22-26	May 24-June 27	455	111.1	12.3	0.89	7	140.0	24.1	0.87
1999	23-26	May 31-June 27	262	96.6	7.4	0.81	0	0.0	0.0	0.00
2000	23-25	May 31-June 20	509	113.4	12.5	0.85	12	146.8	28.6	0.88
2001	22-26	May 27-June 23	441	95.5	7.4	0.85	6	97.7	8.1	0.85

Appendix E.12. Daily harvest of sockeye, pink and chum salmon in the Foul Bay Terminal Harvest Area (statistical area 251-41) and outer Foul Bay (statistical area 251-40), 1995-2001.

	SOCKEYE							PINK							CHUM						
DATE	1995	1996	1997	1998	1999	2000	2001	1995	1996	1997	1998	1999	2000	2001	1995	1996	1997	1998	1999	2000	2001
9-Jun	0	14,890	0	567	3,720	10,037	12,726	0	0	0	0	0	0	0	0	0	0	0	1	0	0
10-Jun	5,357	2,962	0	1,770	5,617	2,340	5,576	0	0	0	0	0	1	0	0	20	0	0	0	6	29
11-Jun	4,460	4,816	0	1,431	0	590	0	0	0	0	0	0	0	0	0	0	0	43	0	17	0
12-Jun	2,208	2,173	0	958	2,612	2,424	1,760	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13-Jun	0		0	425	1,825	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
14-Jun	5,832	0	0	0	0	1,867	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15-Jun	1,691	0	0	661	0	0	1,615	0	0	0	0	0	0	0	3	0	0	0	0	0	0
16-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Jun	3,378	70	0	362	0	1,101	526	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18-Jun	0	668	0	682	1,500	0	426	0	0	0	0	0	0	0	0	9	0	0	0	0	0
19-Jun	3,093	0	0	235	0	0	458	20	0	0	0	0	0	0	5	0	0	0	0	0	0
20-Jun	654	0	0	0	0	1,429	638	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Jun	153	0	1,484	712	1,368	884	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22-Jun	1,625	1,397	2,388	0	1,751	225	636	0	7	0	0	0	0	0	0	34	0	0	0	0	0
23-Jun	733	0	5,256	0	1,356	48	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
24-Jun	0	250	3,030	0	2,315	0	1,716	0	0	5	0	0	0	0	0	0	2	0	1	0	0
25-Jun	0	568	867	0	1,031	1,498	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26-Jun	0	122	580	0	768	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27-Jun	1,360	122	0	421	561	408	0	0	0	0	47	0	0	0	0	0	0	12	0	0	0
28-Jun	0	0	0	0	211	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29-Jun	646	392	146	0	1,246	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-Jun	0	0	0	46	874	0	688	0	0	0	8	0	0	0	0	0	0	2	0	0	0
1-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2-Jul	0	0	0	0	237	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4-Jul	0	0	0	0	0	0	389	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5-Jul	0	0	0	0	0	0	339	0	0	0	0	0	0	1,141	0	0	0	0	0	0	24
6-Jul	0	0	0	0	0	2,321	0	0	0	0	0	0	442	0	0	0	0	0	0	225	0
7-Jul	0	0	0	0	310	110	160	0	0	0	0	39	0	1,054	0	0	0	0	9	0	22
8-Jul	0	0	0	0	0	483	0	0	0	0	0	0	127	0	0	0	0	0	0	103	0
9-Jul	0	0	0	0	0	272	0	0	0	0	0	0	10	0	0	0	0	0	0	25	0

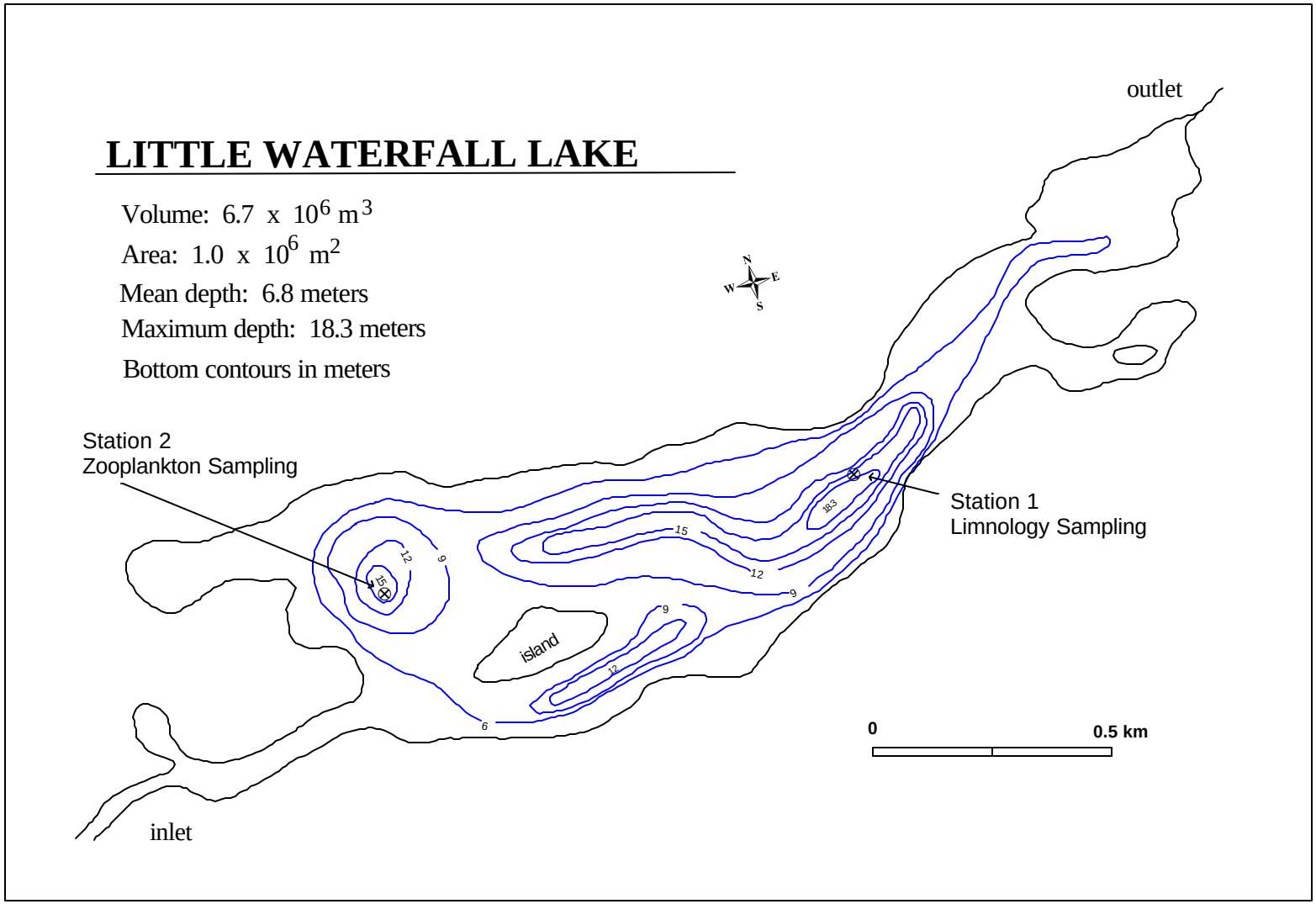
-Continued-

Appendix E.12. (Page 2 of 2)

DATE	SOCKEYE							PINK							CHUM						
	1995	1996	1997	1998	1999	2000	2001	1995	1996	1997	1998	1999	2000	2001	1995	1996	1997	1998	1999	2000	2001
10-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13-Jul	0	0	0	0	0	805	0	0	0	0	0	0	961	0	0	0	0	0	0	28	0
14-Jul	0	0	0	0	0	581	0	0	0	0	0	0	853	0	0	0	0	0	0	113	0
15-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20-Jul	0	0	0	0	0	70	0	0	0	0	0	0	1,440	0	0	0	0	0	0	201	0
21-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28-Jul	0	0	0	0	0	282	0	0	0	0	0	0	7,952	0	0	0	0	0	0	397	0
29-Jul	0	0	0	0	0	455	0	0	0	0	0	0	5,995	0	0	0	0	0	0	640	0
Total	31,190	29,189	13,751	8,270	27,302	29,022	29,982	20	7	5	55	39	17,781	2,195	8	63	2	57	13	1,755	75

Appendix E.13. Estimated age composition of Foul Bay Terminal Harvest Area commercial sockeye salmon catch, 1994-2001.

Year	Sample Size		Ages 1.1	0.3	1.2	2.1	1.3	2.2	3.1	1.4	2.3	3.2	2.4	Total
1994	50	Numbers	49	0	1	0	0	0	0	0	0	0	0	50
		Percent	98.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100
1995	485	Numbers	749	31	29,443	0	530	31	0	0	405	0	0	31,190
		Percent	2.4	0.1	94.4	0.0	1.7	0.1	0.0	0.0	1.3	0.0	0.0	100
1996	537	Numbers	289	0	9,160	108	18,050	1,454	0	0	127	0	0	29,189
		Percent	1.0	0.0	31.4	0.4	61.8	5.0	0.0	0.0	0.4	0.0	0.0	100
1997	562	Numbers	788	0	8,288	19	8,344	656	19	38	469	56	38	18,751
		Percent	4.2	0.0	44.2	0.1	44.5	3.5	0.1	0.2	2.5	0.3	0.2	100
1998	646	Numbers	2,447	0	3,949	365	1,054	397	0	0	58	0	0	8,270
		Percent	29.6	0.0	47.8	4.4	12.7	4.8	0.0	0.0	0.7	0.0	0.0	100
1999	603	Numbers	70	0	36,414	0	1,906	2,450	0	0	204	0	0	41,042
		Percent	0.2	0.0	88.7	0.0	4.6	6.0	0.0	0.0	0.5	0.0	0.0	100
2000	733	Numbers	376	0	16,768	0	8,022	1,100	0	27	536	0	0	26,829
		Percent	1.4	0.0	62.5	0.0	29.9	4.1	0.0	0.1	2.0	0.0	0.0	100
2001	551	Numbers	517	0	8,602	0	20,206	123	0	0	374	0	0	29,822
		Percent	1.7	0.0	28.8	0.0	67.8	0.4	0.0	0.0	1.3	0.0	0.0	100



Appendix F.1. Morphometric map showing the limnology and zooplankton stations on Little Waterfall Lake.

Appendix F.2. Juvenile sockeye salmon stocked into Little Waterfall Lake, 1992-2001.

Release Year	Broodstock	Species Stocked	Life Stage[a] fry	fingerling	presmolt	smolt	Total Stocked
1992	Afognak	Sockeye	493,000	96,000			589,000
1993	Afognak	Sockeye		205,000			205,000
1994	Afognak	Sockeye			150,000		150,000
1995	Afognak	Sockeye			100,000	97,800	197,800
1996	Afognak	Sockeye			82,300		82,300
1997	Afognak	Sockeye			246,800		246,800
1998	Afognak	Sockeye			237,300		237,300
1999	Afognak	Sockeye			273,000		273,000
2000	Afognak	Sockeye	106,000		252,800		358,800
2001	Afognak	Sockeye		36,000	274,000		310,000

[a] Fry are released from April to July at up to 200% of emergent size (normally 0.15 to 0.5 g depending on the stock). Fingerling are released from June to September at a size of >200% to <2100% of emergent size (normally 0.3 to 5.25 g depending on the stock). Pre-smolt are released from August to November at a size of >2100% of emergent size but not yet at the physiological stage of smolting (normally 5 to 13 g.

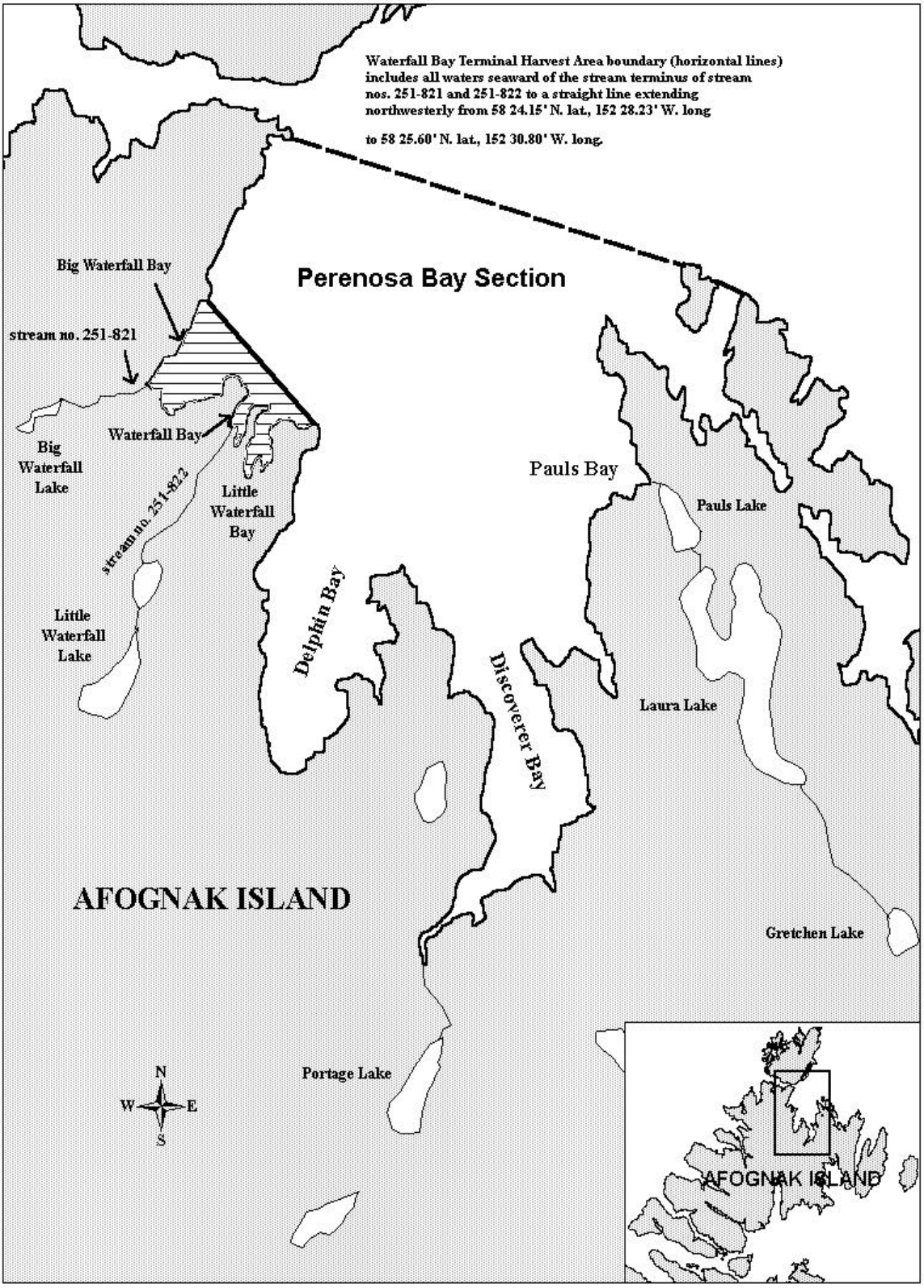
Appendix F.3. Nutrient addition ratio and enrichment amounts into Little Waterfall Lake, 1993-2001.

Year	Fertilizer ratio [a]	Amount (kg)
1993	20-5-0	2,836
1994	20-5-0	3,628
1995	20-5-0	4,536
1996	20-5-0	5,080
1997	20-5-0	5,080
1998	20-5-0	5,080
1999	20-5-1	7,330
2000	20-5-0	5,107
2001	20-5-0	5,426

[a] Nitrogen-Phosphorus-Potassium

Appendix F.4. The lower (a), middle (b), and upper (c) fish passes on Little Waterfall Creek.

Appendix F.5. Little Waterfall Creek barrier net.



Appendix F.6. Waterfall Bay (Little and Big Waterfall Lakes) Terminal Harvest Area and rehabilitation project sites in Perenosa Bay.

Appendix F.7. Limnological sampling stations and total samples collected at Little Waterfall Lake, 1990-2001.

Year	Sampling Stations	Total Samples
1990	1	4
1991[a]	nc	nc
1992	1	5
1993	1	5
1994	1, 2	7
1995	1, 2	7
1996	1, 2	6
1997	1, 2	6
1998	1	4
1999	1	4
2000	1	4
2001	1	5

Appendix F.8. Summary of seasonal mean water chemistry parameters by station and depth from Little Waterfall Lake, 1990 - 2001.

	Sta	Depth	Sp. Conductivity		pH		Alkalinity		Turbidity		Color		Calcium		Magnesium		Iron	
Year	tion	(m)	(umhos cm^{-1})	SD	(Units)	SD	(mg L^{-1})	SD	(NTU)	SD	(Pt units)	SD	(mg L^{-1})	SD	(mg L^{-1})	SD	(ug L^{-1})	SD
1990	1	1	57.3	1.9	7.2	0.1	12.8	2.2	0.5	0.2	13.5	5.3	4.8	1.0	1.5	0.1	120.3	15.6
	1	12	54.5	2.4	7.1	0.2	13.3	0.5	1.7	1.9	15.8	6.2	4.8	0.9	1.1	0.3	125.7	43.5
1992	1	1	55.0	5.8	6.9	0.1	14.8	2.4	0.7	0.3	13.2	2.4	4.9	1.0	1.2	0.3	163.4	36.0
	1	15	49.5	8.6	6.8	0.3	13.4	3.3	1.3	1.4	13.2	1.4	5.3	1.0	0.9	0.4	141.5	78.1
1993	1	1	58.8	7.3	6.9	0.2	15.4	3.2	1.4	1.8	13.4	3.2	6.1	1.0	1.6	0.6	104.8	20.7
	1	12	55.4	4.8	6.6	0.2	13.5	2.4	0.7	0.1	15.4	2.6	5.4	1.2	1.1	0.6	110.6	49.7
1994	1	1	56.4	5.3	6.8	0.2	13.4	2.9	1.0	0.6	15.6	5.0	5.1	1.0	1.1	0.3	117.1	29.0
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
	1	15	51.9	3.7	6.5	0.2	10.6	1.2	1.1	0.7	15.6	4.1	4.3	0.5	0.9	0.3	87.1	41.6
1995	1	1	52.3	5.0	6.6	0.2	11.7	2.6	1.2	0.6	13.1	2.7	4.2	0.8	1.2	0.6	130.1	43.6
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
	1	15	50.0	4.5	6.3	0.1	10.4	1.9	1.4	0.6	12.0	4.6	3.7	0.6	1.1	0.7	148.9	82.7
1996	1	1	60.5	2.4	6.8	0.1	13.9	1.8	1.1	0.6	16.0	4.0	4.9	1.0	1.1	0.2	109.8	28.3
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
	1	14	66.7	16.5	6.5	0.3	12.4	1.9	1.0	0.5	15.0	4.4	4.3	0.5	1.2	0.5	89.8	47.5
1997	1	1	59.5	5.5	7.2	0.2	16.1	3.8	0.8	0.1	13.0	4.8	5.1	1.0	0.7	0.4	59.8	28.9
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
	1	14	57.8	6.0	6.8	0.2	12.5	1.9	0.8	0.3	14.7	3.9	3.9	0.4	0.9	0.3	59.3	25.8
1998	1	1	57.3	2.5	7.2	0.1	17.2	3.3	0.9	0.3	19.3	0.6	4.6	0.6	1.0	0.1	58.7	10.1
1999	1	1	62.0	3.9	6.6	0.3	13.2	2.0	1.5	0.9	16.0	5.4	4.6	0.4	1.4	0.2	133.5	22.6
2000	1	1	na	na	7.3	0.1	10.6	2.8	na	na	na	na	na	na	na	na	na	na
2001	1	1	na	na	7.4	0.1	13.4	3.9	na	na	na	na	na	na	na	na	na	na

SD - standard deviation
na - parameters were not analyzed.

Appendix F.9. Summary of seasonal mean nutrient and algal pigment concentrations by station and depth from Little Waterfall Lake, 1990 - 2001.

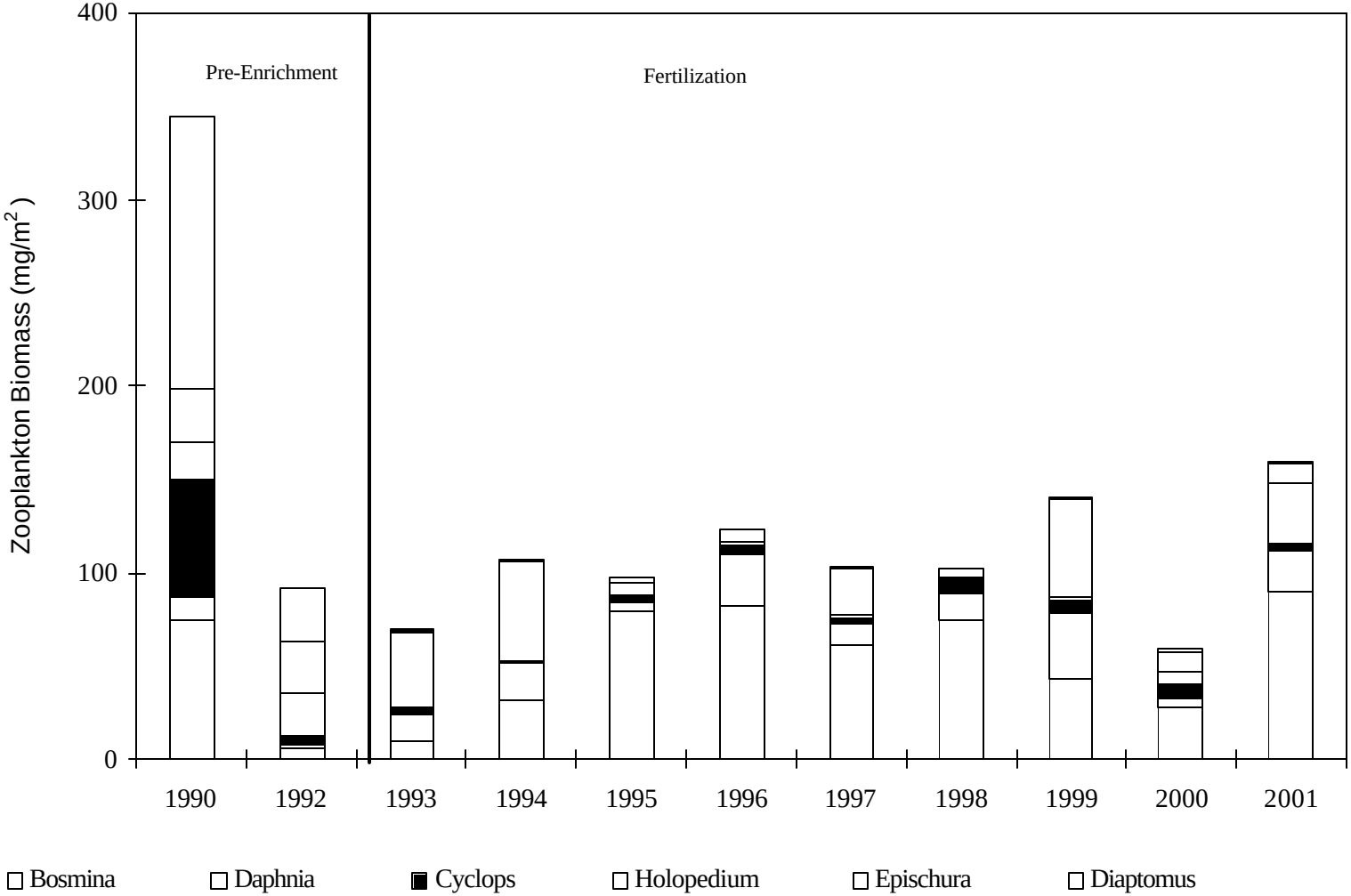
Year	Station	Depth (m)	Total-P (ug L^{-1})	SD	Total filterable-P (ug L^{-1})	SD	Filterable reactive-P (ug L^{-1})	SD	Total Kjeldahl nitrogen (ug L^{-1})	SD	Ammonia (ug L^{-1})	SD	Nitrate+ nitrite (ug L^{-1})	SD	Reactive silicon (ug L^{-1})	SD	Organic carbon (ug L^{-1})	SD	Chlorophyll a (ug L^{-1})	SD	Phaeophytin a (ug L^{-1})	SD
1990	1	1	3.1	0.7	2.5	0.7	1.7	0.4	160.5	27.7	4.7	2.7	35.6	21.8	1765.3	329.1	na	na	0.52	0.17	0.29	0.07
	1	12	4.6	2.4	3.5	2.4	1.8	0.6	152.3	19.2	5.8	3.8	49.0	9.1	1835.8	208.7	na	na	0.24	0.09	0.33	0.06
1992	1	1	5.4	2.1	3.6	0.9	2.7	0.6	132.1	37.4	2.2	0.9	52.9	54.7	1734.8	266.5	247.0	47.4	0.60	0.58	0.38	0.14
	1	15	5.1	0.9	5.4	1.1	4.1	0.4	96.3	41.6	4.3	3.8	88.7	36.6	1683.5	137.5	232.0	140.9	0.29	0.48	0.26	0.19
1993	1	1	6.7	3.0	3.5	0.9	1.9	0.6	148.7	58.4	5.1	3.4	35.1	31.3	1450.8	350.5	233.8	88.5	1.27	1.06	0.61	0.38
	1	12	6.1	1.2	3.9	1.3	2.6	1.1	133.2	39.6	7.0	6.5	54.2	21.7	1714.8	79.0	176.8	36.0	0.72	0.03	0.52	0.12
1994	1	1	5.9	2.1	2.7	1.3	1.9	1.4	133.8	35.3	2.7	2.8	11.9	15.1	1492.4	233.5	166.1	83.6	1.46	1.21	0.44	0.28
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	1.75	1.23	0.35	0.15
	1	15	4.0	1.0	2.5	1.7	1.9	1.6	103.4	23.7	7.4	7.1	37.3	11.2	1740.1	139.0	152.4	132.9	0.53	0.76	0.24	0.15
1995	1	1	7.1	4.3	2.7	1.0	2.4	0.7	145.4	44.2	11.5	14.3	35.7	15.7	1636.3	300.2	na	na	2.48	3.54	0.77	0.70
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	2.44	3.38	0.75	0.54
	1	15	5.0	1.7	2.2	0.8	1.7	1.0	120.5	39.3	19.3	17.4	40.7	10.5	1877.0	256.7	na	na	0.44	0.27	0.37	0.15
1996	1	1	7.0	2.1	2.9	0.8	2.1	0.7	124.9	31.3	8.9	7.2	17.8	16.8	1553.5	328.1	132.8	78.2	1.47	1.16	0.44	0.28
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	1.34	0.96	0.34	0.23
	1	14	5.9	1.3	3.6	2.3	2.8	1.4	114.6	29.8	19.7	17.3	49.7	15.3	1896.0	122.3	50.0	23.0	0.32	0.13	0.26	0.09
1997	1	1	8.3	3.2	2.3	1.0	1.5	0.3	153.3	46.3	3.2	1.9	13.2	13.4	1478.0	451.3	172.8	66.3	1.28	0.97	0.72	0.39
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	1.24	0.90	0.80	0.54
	1	14	6.4	2.9	2.8	0.9	2.3	1.1	99.1	25.5	7.1	6.0	39.6	7.8	1827.7	252.4	103.3	32.8	0.38	0.17	0.45	0.18
1998	1	1	10.2	3.5	3.3	1.0	2.4	0.4	183.6	29.0	9.2	8.4	24.9	21.5	1520.0	110.4	183.7	92.8	1.79	1.32	0.62	0.58
1999	1	1	8.4	2.3	3.8	1.2	2.5	1.6	160.2	38.1	11.8	3.5	69.5	70.5	1609.0	388.6	197.8	77.5	1.31	1.39	0.32	0.29
2000	1	1	5.2	2.3	3.9	2.5	2.2	2.7	66.4	na	10.2	11.3	74.9	81.8	na	na	na	na	1.21	1.22	0.47	0.41
2001	1	1	11.5	6.6	4.3	2.1	4.4	5.0	84.5	na	4.0	1.4	20.1	24.0	na	na	na	na	1.15	0.43	0.73	0.37

SD - standard deviation
na - parameters were not analyzed.

Appendix F.10. Weighted mean zooplankton density, biomass, and size by genera from Little Waterfall Lake, 1990 and 1992 -2001.

	Number	*Epischura*			*Diaptomus*			*Cyclops*			*Bosmina*			*Daphnia*			*Holopedium*			TOTALS	
Year [a]	Sample Dates	Density no/m^2	Biomass mg/m^2	Size mm	Density no/m^2	Biomass mg/m^2	Size mm	Density no/m^2	Biomass mg/m^2	Size mm	Density no/m^2	Biomass mg/m^2	Size mm	Density no/m^2	Biomass mg/m^2	Size mm	Density no/m^2	Biomass mg/m^2	Size mm	Density no/m^2	Biomass mg/m^2
1990	4	1,194	28	1.79	26,341	146	1.09	27,468	63	0.81	35,762	74	0.47	8,227	13	0.62	7,099	20	0.57	106,091	344
1992	5	6,582	27	0.97	18,471	30	0.71	2,442	5	0.74	2,873	6	0.46	1,435	2	0.54	3,322	23	0.80	35,124	92
1993	5	61	0	0.71	326	1	0.90	1,844	4	0.79	9,646	9	0.33	11,194	14	0.55	8,017	41	0.72	31,088	69
1994	7	82	0	0.85	109	0	0.96	805	2	0.79	38,086	32	0.31	18,079	19	0.50	8,257	53	0.73	65,418	106
1995	7	447	2	1.10	144	0	0.81	1,959	4	0.82	99,655	79	0.30	2,410	5	0.65	5,064	6	0.39	109,680	97
1996	5	1,140	7	1.10	165	1	0.92	2,502	5	0.74	102,053	82	0.30	18,272	28	0.59	1,129	1	0.40	125,262	124
1997	5	7,023	25	0.92	132	1	1.13	1,123	3	0.84	89,931	61	0.27	6,708	11	0.63	1,480	3	0.46	106,396	103
1998	4	3,026	5	0.72	85	0	0.52	3,681	7	0.73	75,457	74	0.31	12,997	15	0.58	610	1	0.42	95,856	102
1999	4	6,423	52	1.23	319	1	0.95	3,166	6	0.72	44,337	43	0.33	18,636	35	0.65	1,404	3	0.49	74,284	140
2000	4	2,415	11	1.00	171	1	1.25	3,341	7	0.75	34,891	27	0.29	6,796	6	0.50	2,373	7	0.55	49,987	59
2001	5	3,179	11	0.91	64	0	1.04	2,183	3	0.95	113,067	90	0.34	14,757	22	0.63	15,924	33	0.53	149,174	159

[a] Samples were not collected in 1991.



Appendix F.11. Weighted mean zooplankton biomass by genera and lake enrichment time period for Little Waterfall Lake, 1990 and 1992-2001.

Appendix F.12. Juvenile sockeye salmon estimates based on fall townet catch species composition and hydroacoustic fish population estimates for Little Waterfall Lake, 1992 and 1994-2001.

	Total Fish Estimates			Sockeye Estimates			Sockeye
		95% Confidence Interval			95% Confidence Interval		Composition
Date	No.	Low	High	No.	Low	High	(%)
9/29/92	89,869	58,052	121,686	89,869	58,052	121,686	100.0
10/26/94	353,462	278,963	427,961	26,407	8,974	43,840	23.4
5/11/95[a]	120,000	80,430	159,570	120,000	80,430	159,570	
7/13/95[a]	42,445	28,652	56,238	42,445	28,652	56,238	
11/1/95	89,408	64,622	114,194	626	452	800	0.8
5/9/96[a]	50,197	17,412	82,982	50,197	17,412	82,982	
7/11/96[a]	30,474	4,951	55,997	30,474	4,951	55,997	
10/24/96	311,773	195,585	427,961	10,912	6,845	14,979	3.5
5/5/97[a]	125,905	71,886	179,924	125,905	71,886	179,924	
6/23/97[a]	83,492	40,075	126,909	83,492	40,075	126,909	
4/23/98[a]	114,107	93,427	134,787	114,107	93,427	134,787	
1999	No surveys were conducted this season.						
5/10/00[a]	56,793	41,384	72,202	56,793	41,384	72,202	
5/10/01[a]	33,128	5,444	60,812	33,128	5,444	60,812	

[a] Townet surveys were not conducted to determine species composition.

Appendix F.13. Townet catches from Little Waterfall Lake, 1992-1996.

	Tow		Catch by Species					
			Sockeye			Stickleback		
Date	Number	Minutes	Number	%	CPUE[a]	Number	%	CPUE[a]
9/29/92	5	36	17	100.0	0.5	0	0.0	0.0
9/20/93	5	50	100	90.9	2.0	10	9.1	0.2
10/26/94	3	29	43	23.4	1.5	141	76.6	4.9
11/1/95	4	31	1	0.8	0.0	150	99.2	4.8
10/24/96	6	37	2	3.5	0.1	55	96.5	1.5

[a] CPUE - Catch per Unit Effort

Appendix F.14. Mean length, weight, and condition coefficient by age of juvenile sockeye salmon captured by tow net from Little Waterfall Lake, 1992-1996.

	Age-0				Age-1			
Sampling Date	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)
9/29/92	17	69.0	4.0	1.20	0			
9/20/93	57	65.8	3.5	1.23	20	89.7	8.0	1.11
10/1/94	29	95.4	10.7	1.22	3	95.3	10.8	1.25
11/1/95	1	na[a]	na[a]	na[a]	0			
10/24/96	0				2	91.5	10.1	1.31

[a] na - information is not available.

Appendix F.15. Mean length, weight, and condition coefficient by age of sockeye salmon smolt migrating from Little Waterfall Lake, 1993-2001.

	Age-1				Age-2			
Sampling Date	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)
5/24-25/93	197	77.6	3.5	0.73	0			
5/17-23/94	5	86.6	5.4	0.83	10	98.4	7.5	0.79
6/1-15/95	176	110.0	12.4	0.89	0			
6/4-12/96	232	105.2	9.7	0.83	3	104.3	10.1	0.88
6/2-20/97	201	97.7	8.0	0.85	4	111.5	13.1	0.88
5/30-6/11/98	194	99.7	8.3	0.83	5	111.8	13.1	0.85
5/31-6/27/99	197	84.6	4.7	0.76	0			
6/14-27/00	164	101.6	9.7	0.87	0			
5/24-27/01	199	81.5	4.3	0.79	0			

Appendix F.16. Commercial catch by species in the Perenosa Bay Section (251-82 and 251-83) and Waterfall Bay terminal harvest area (251-84), 1998-2001.

	Perenosa Bay Section			Perenosa Bay Section			Waterfall Terminal Harvest Area [b]		
Year	sockeye	pink	coho	sockeye	pink	coho	sockeye	pink	coho
1988	648	198,256	14,338	740	145,130	6,527			
1989	*Exxon Valdez* oil spill, no commercial fishing.								
1990	145	43,214	2,494	290	18,605	1,788			
1991	1	6,505	237	34	3,532	14			
1992				4	2,349	336			
1993	27	89,297	95	55	48,203	371			
1994	37	11,214	1,925	102	12,154	591			
1995	3,930	277,560	4,659	783	73,387	1,356	13,684	141,043	284
1996	64	32	125	4,921	287	1,483	41,481	319	1,608
1997	17	10,729	8,940	15	2,165	12,823	27,873	915	1,308
1998	72	3,168	10,132	6	62	2,396	11,057	144	0
1999	1,617	4,220	435	14,669	1,041	2,285	9,359	12,108	32
2000	125	858	6,016	268	11,106	6,286	8,623	0	0
2001	0	321	4,303	26	5,127	17,215	16,023	33	0

[a] Commercial catch data obtained from the ADF&G fish ticket database.

[b] The Waterfall Bay Terminal Harvest Area was created in 1994 to harvest the enhanced sockeye salmon stocked into Little Waterfall Lake.

Appendix F.17. Pink and coho salmon peak survey counts, bypass counts, and escapement estimates for Little Waterfall Creek, 1981-2001.

	Pink Total System			Coho Total System		
Year [a]	Peak Count	Bypass Count [b]	Escapement Estimate	Peak Count	Bypass Count [b]	Escapement Estimate
1981	nd	55,447	61,247	10	3	24
1982	40,000	47,829	47,829	nd	16	16
1983	11,000	21,560	21,560	40	5	96
1984	40,000	36,016	40,016	65	15	156
1985	80,000	119,211	119,211	2	0	5
1986	25,000	50,884	50,884	200	2	480
1987	26,000	29,093	29,093	1	1	2
1988	14,500	nd	27,550	nd	nd	nd
1989	96,301	nd	147,016	16	nd	38
1990	14,165	42,060	47,000	18	18	43
1991	63,483	99,136	115,000	31	31	74
1992	26,109	35,763	43,000	34	3	82
1993	109,023	nd	166,391	0	nd	0
1994	22,724	nd	50,937	142	nd	341
1995	36,690	nd	100,223	0	nd	0
1996	5,509	nd	13,624	91	nd	218
1997	14,920	nd	24,339	0	nd	0
1998	94,668	nd	151,655	106	nd	254
1999	48,940	nd	115,322	174	nd	418
2000	20,586	nd	36,006	46	nd	110
2001	16,346	nd	34,184	19	nd	46
Mean 81-01:	40,298	54,352	71,932	52	9	126
Mean 81-01 (OY):	50,270	64,889	84,871	27	8	64
Mean 81-01 (EY):	30,326	42,510	53,439	88	11	189

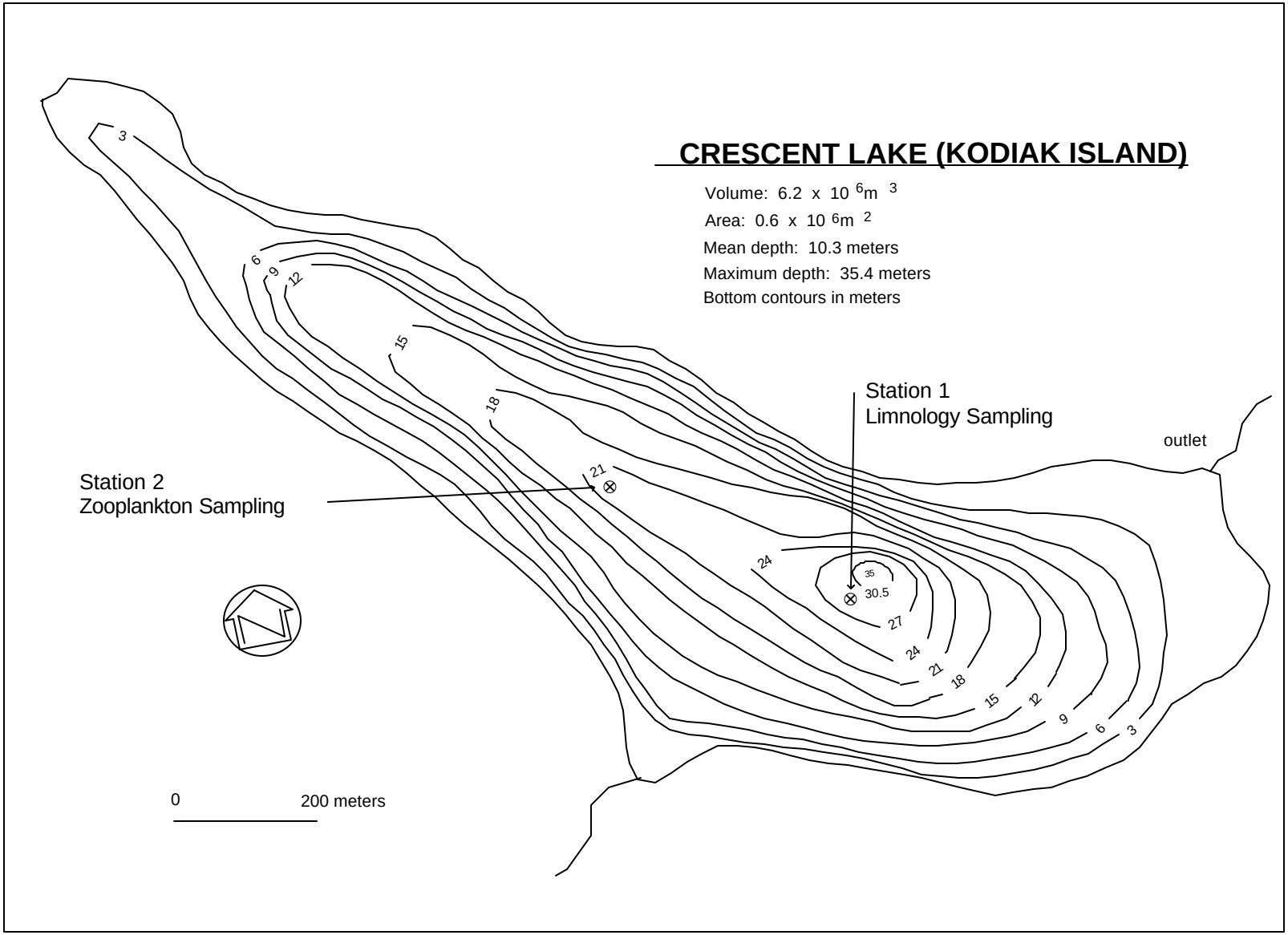
OY - Odd Year; EY - Even Year; nd - no data.

[a] First two barriers bypassed with fish passes in 1979; third bypassed in 1980 ; 1981-1998 escapements were enhanced as a result.

[b] Salmon counted as they exit most downstream bypass.

Appendix F.18. Estimated age composition of the sockeye salmon commercial catch in the Little Waterfall Bay terminal harvest area, 1994-2001.

		Ages									
Year		0.2	0.3	1.1	1.2	1.3	2.1	2.2	2.3	3.2	Total
1994	Number	1	0	49	0	0	0	0	0	0	50
	Percent	2.0	0.0	98.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
1995	Number	29	57	891	11,585	230	259	632	0	0	13,684
	Percent	0.2	0.4	6.5	84.7	1.7	1.9	4.6	0.0	0.0	100.0
1996	Number	0	0	836	8,949	22,497	669	6,272	2,007	251	41,481
	Percent	0.0	0.0	2.0	21.6	54.2	1.6	15.1	4.8	0.6	100.0
1997	Number	124	0	993	11,422	10,739	0	2,669	1,924	0	27,873
	Percent	0.4	0.0	3.6	41.0	38.5	0.0	9.6	6.9	0.0	100.0
1998	Number	23	203	653	6,125	3,468	113	158	293	23	11,057
	Percent	0.2	1.8	5.9	55.4	31.4	1.0	1.4	2.6	0.2	100.0
1999	Number	0	0	56	7,353	1,810	0	139	0	0	9,359
	Percent	0.0	0.0	0.6	78.6	19.3	0.0	1.5	0.0	0.0	100.0
2000	Number	0	0	71	4,614	3,061	0	398	480	0	8,624
	Percent	0.0	0.0	0.8	53.5	35.5	0.0	4.6	5.6	0.0	100.0
2001	Number	0	0	190	6,532	9,112	90	34	30	0	16,023
	Percent	0.0	0.0	1.2	40.8	56.9	0.6	0.2	0.2	0.0	99.9



Appendix G.1. Morphometric map showing the limnology and zooplankton stations on Crescent Lake.

Appendix G.2. Juvenile coho and sockeye salmon releases into Crescent Lake, 1988-1989 and 1991-2001.

Release Year	Broodstock	Species Stocked	Life Stage[a] fry	fingerling	presmolt	Total Stocked
1988	Big Kitoi	Coho		241,373		241,373
1989	Big Kitoi	Coho		202,955		202,955
1991	Big Kitoi	Coho		191,416		191,416
1992	Big Kitoi	Coho			69,100	69,100
1993	Big Kitoi	Coho			66,420	66,420
1994	Big Kitoi	Coho		163,680		163,680
1995	Big Kitoi	Coho		167,778		167,778
1996	Big Kitoi	Coho	163,200			163,200
1997	Big Kitoi	Coho	165,000			165,000
1998	Big Kitoi	Coho	163,000			163,000
1999	Big Kitoi	Coho	165,000			165,000
2000	Big Kitoi	Coho	165,837			165,837
2001	Big Kitoi	Coho	165,000			165,000
1992	Afognak	Sockeye		399,000		399,000
1993	Afognak	Sockeye		202,000		202,000
1994	Afognak	Sockeye	314,000			314,000
1995	Afognak	Sockeye			90,200	90,200
1996	Afognak	Sockeye	427,000			427,000
1997	Afognak	Sockeye	432,000			432,000
1998	Afognak	Sockeye	463,000	108,000		571,000
1999	Afognak	Sockeye		371,700		371,700
2000	Afognak	Sockeye	206,000			206,000
2001	Afognak	Sockeye		331,500		331,500

[a] Fry are released from April to July at up to 200% of emergent size (normally 0.15 to 0.5 g depending on the stock). Fingerling are released from June to September at a size of >200% to <2100% of emergent size (normally 0.3 to 5.25 g depending on the stock). Pre-smolt are released from August to November at a size of >2100% of emergent size but not yet at the physiological stage of smolting (normally 5 to 13 g.).

Appendix G.3. Settler Cove (Crescent Lake) Terminal Harvest Area boundaries in Kizhuyak Bay.

Appendix G.4. Limnological sampling stations and total samples collected for Crescent Lake, 1987 and 1990-2001.

Year	Sampling Stations	Total Samples
1987	1	3
1990	1	4
1991	1	3
1992	1	5
1993	1	5
1994	1,2	6
1995	1,2	6
1996	1,2	5
1997	1,2	5
1998	1	4
1999	1	4
2000	1	4
2001	1	4

Appendix G.5. Summary of seasonal mean water chemistry parameters by station and depth from Crescent Lake, 1990-1994.

	Sta	Depth	Sp. Cond.		pH		Alkalinity		Turbidity		Color		Calcium		Magnesium		Iron	
Year	tion	(m)	(umhos cm^{-1})	SD	(Units)	SD	(mg L^{-1})	SD	(NTU)	SD	(Pt units)	SD	(mg L^{-1})	SD	(mg L^{-1})	SD	(ug L^{-1})	SD
1990	1	1	40.5	1.7	6.8	0.1	6.3	0.5	0.8	0.4	13.5	3.4	2.9	1.4	0.4	0.3	120.8	24.3
	1	16	41.3	1.0	6.7	0.2	6.1	0.6	0.7	0.4	11.0	2.2	3.2	1.8	0.4	0.3	128.3	38.7
1991	1	1	38.0	0.8	6.7	0.1	10.4	7.8	0.9	0.3	13.0	0.8	2.1	0.3	0.8	0.5	210.0	31.1
	1	14	38.3	1.0	6.6	0.2	6.9	0.3	0.9	0.2	15.8	3.9	1.9	0.1	0.8	0.5	190.3	45.0
1992	1	1	34.5	1.2	6.6	0.2	5.8	1.0	0.9	0.5	11.5	3.4	2.5	0.9	0.6	0.3	156.5	9.3
	1	24	34.5	0.5	6.3	0.1	4.9	1.0	0.8	0.6	10.7	1.5	2.5	1.2	0.6	0.3	162.3	56.9
1993	1	1	36.5	1.0	6.6	0.1	7.5	2.7	0.5	0.1	6.6	7.5	2.2	0.4	1.3	1.1	103.6	34.9
	1	25	39.0	4.0	6.4	0.4	7.8	2.1	0.5	0.2	10.0	10.7	2.6	0.9	0.8	0.1	134.2	52.0
1994	1	1	39.0	6.5	6.6	0.2	6.2	2.0	1.1	0.8	5.0	3.2	2.2	0.9	0.6	0.2	140.7	44.0
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
	1	26	36.0	0.9	6.3	0.3	6.5	2.5	0.7	0.3	5.5	4.7	2.2	0.5	0.6	0.2	197.2	87.7

na - not analyzed; SD - standard deviation

Appendix G.6. Summary of seasonal mean nutrient and algal pigment concentrations by station and depth from Crescent Lake, 1990-1994.

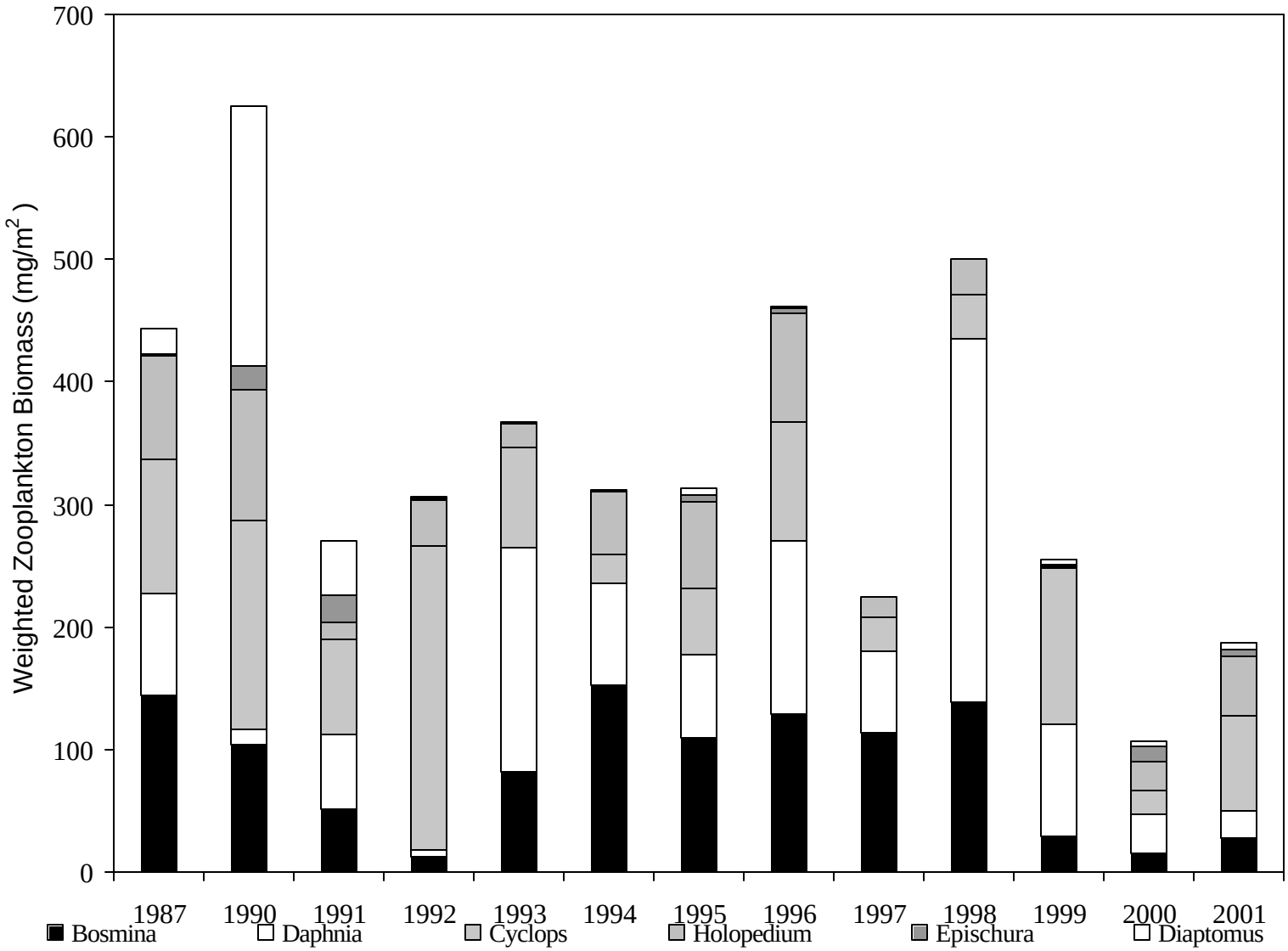
Year	Station	Depth (m)	Total-P (ug L^{-1})	SD	Total filterable-P (ug L^{-1})	SD	Filterable reactive-P (ug L^{-1})	SD	Total Kjeldahl nitrogen (ug L^{-1})	SD	Ammonia (ug L^{-1})	SD	Nitrate+ nitrite (ug L^{-1})	SD	Reactive silicon (ug L^{-1})	SD	Organic carbon (ug L^{-1})	SD	Chlorophyll a (ug L^{-1})	SD	Phaeophytin a (ug L^{-1})	SD
1990	1	1	4.5	1.5	2.9	4.2	3.7	1.7	128.0	16.5	8.0	3.0	40.3	29.1	3249.8	247.5	144.5	13.0	0.34	0.2	0.17	0.0
	1	16	5.1	2.3	1.3	1.3	2.8	1.1	117.7	22.7	9.7	4.2	65.0	29.1	3389.8	154.5	144.0	30.6	0.21	0.0	0.28	0.1
1991	1	1	5.0	2.8	3.2	0.6	2.3	0.4	150.6	22.6	11.5	1.8	56.8	21.3	2865.0	108.6	na	na	0.31	0.2	0.27	0.1
	1	14	4.6	1.5	6.0	3.5	4.5	3.2	138.3	12.3	13.6	5.0	69.7	23.2	2966.0	156.3	na	na	0.22	0.1	0.22	0.1
1992	1	1	3.8	0.5	4.1	2.5	3.1	2.4	135.0	13.9	3.3	1.7	61.7	26.1	3162.8	158.9	198.8	64.1	0.44	0.3	0.28	0.1
	1	24	3.9	1.7	4.0	3.2	2.6	1.7	127.4	12.8	9.6	4.1	92.8	23.1	3181.7	198.0	162.6	52.9	0.31	0.2	0.28	0.1
1993	1	1	4.5	0.8	3.7	1.3	2.8	0.5	148.0	18.5	5.0	2.2	49.1	30.4	3132.2	220.6	146.8	53.3	1.01	0.3	0.36	0.0
	1	25	4.9	1.3	8.5	11.7	6.8	9.9	136.2	17.3	19.4	10.1	98.4	31.7	3379.6	244.0	120.6	47.5	0.52	0.2	0.45	0.1
1994	1	1	5.7	0.7	4.5	3.3	3.6	2.3	159.8	23.8	3.2	1.7	39.8	21.4	2843.3	122.4	114.3	33.0	0.56	0.3	0.28	0.1
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	0.56	0.3	0.34	0.1
	1	26	5.3	1.1	4.8	3.9	4.2	3.2	160.4	17.7	15.2	9.7	74.3	23.8	3176.7	285.5	128.2	52.1	0.36	0.2	0.27	0.1

SD - standard deviation
na - not analyzed

Appendix G.7. Weighted mean zooplankton density, biomass, and size by genera for Crescent Lake, 1987 and 1990-2001.

	Number	*Epischura*			*Bosmina*			*Daphnia*			*Cyclops*			*Diaptomus*			*Holopedium*			TOTAL	
	of	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass
Year	Samples	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2
1987	3	133	2	1.41	65,154	144	0.48	32,599	84	0.77	41,401	110	0.87	4,423	21	1.04	9,466	83	0.90	153,043	442
1990	4	1,194	20	1.59	46,178	104	0.49	7,166	13	0.65	88,110	170	0.75	54,472	213	0.97	10,881	107	0.94	206,807	606
1991	3	1,340	22	1.59	21,139	51	0.51	20,807	60	0.81	28,052	79	0.89	10,218	44	1.00	889	14	1.13	81,104	248
1992	5	329	1	0.96	6,454	12	0.45	4,055	6	0.57	128,482	249	0.75	531	1	0.82	4,384	38	0.89	143,907	305
1993	5	53	0	0.73	50,095	82	0.42	90,774	183	0.68	31,083	81	0.86	191	1	1.23	4,140	20	0.71	176,284	368
1994[a]	6	566	1	0.78	113,490	175	0.41	47,217	95	0.68	12,173	17	0.65	473	2	0.95	32,900	398	1.02	206,253	687
1995[a]	6	1,929	13	1.14	76,574	127	0.42	32,015	80	0.75	19,471	53	0.87	1,415	7	1.02	24,372	124	0.71	153,847	391
1996[a]	5	3,397	13	0.92	108,189	117	0.34	84,113	132	0.61	33,524	92	0.88	764	1	0.58	17,654	87	0.71	244,245	429
1997[a]	5	541	4	1.13	177,861	191	0.34	56,214	68	0.54	6,511	21	0.95	102	0	0.60	19,807	53	0.54	260,495	333
1998	4	53	0	0.62	88,562	139	0.41	220,993	297	0.57	11,996	36	0.91	0	0	0.00	9,607	29	0.58	331,157	500
1999	4	1,383	7	1.00	80,113	104	0.38	61,750	95	0.60	33,604	84	0.84	986	4	0.90	18,538	139	0.74	194,991	425
2000	4	2,140	12	1.07	34,211	15	0.44	15,625	32	0.93	15,128	19	0.62	597	5	1.20	10,375	24	0.78	78,076	107
2001	4	1,145	5	1.00	19,365	27	0.44	9,977	23	0.73	35,596	77	0.91	1,219	7	1.09	10,947	49	0.77	78,249	188

[a] Stations 1 and 2 samples were averaged for the years, 1994 to 1997.



Appendix G.8. Weighted mean zooplankton biomass by genera for Crescent Lake, 1987 and 1990-2001.

Appendix G.9. Juvenile sockeye salmon estimates based on townet catches and hydroacoustic fish population estimates from Crescent Lake, 1992 and 1994.

	Total Fish Estimates			Sockeye Estimates			Sockeye
		95% C. I.			95% C. I.		Composition
Date	Number	Low	High	Number	Low	High	(%)
9/28/92	84,705	68,049	101,361	75,557	60,700	90,414	89.2
10/14/94	149,254	85,187	213,321	0[a]			

[a] Sockeye salmon estimates are based on townet catches to determine species composition in the lake environment. Four tows were conducted, capturing 0 sockeye and 21 sticklebacks. Juvenile sockeye salmon have been stocked into the lake, annually, since 1992.

Appendix G.10. Townet catches from Crescent Lake, 1992 and 1994.

			Catch by Species					
	Tow		Sockeye			Stickleback		
Year	Number	Minutes	Number	%	CPUE	Number	%	CPUE
9/28/92	3	39	83	91.1	2.1	10	8.9	0.3
10/14/94	4	52	0			21	100.0	0.4

Appendix G.11. Mean length, weight, and condition coefficient by age for juvenile sockeye salmon captured by townet at Crescent Lake, 1992 and 1994.

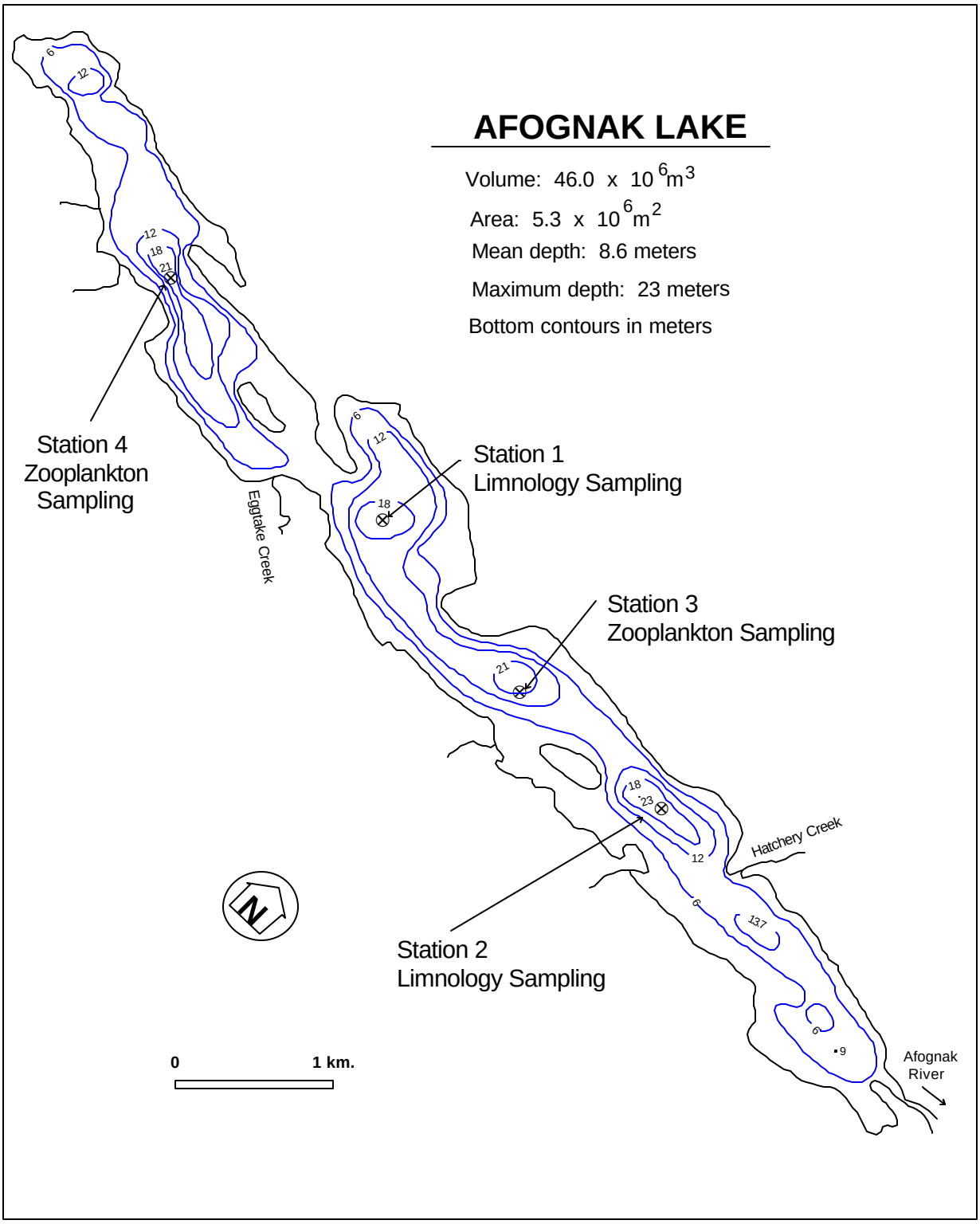
	Age-0				Age-1			
Year	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)
9/28/92	83	67.2	3.5	1.13	0			
10/14/94	0				0			

Appendix G.12. Common property salmon harvest in Settler Cove Terminal Harvest Area from the Crescent Lake enhancement project, 1990-2001.

	Sockeye		Coho	
Year	Commercial	Subsistence	Commercial	Subsistence
1990	0	0	0	1,158
1991	0	0	0	1,505
1992	0	0	0	1,391
1993	0	15	0	1,271
1994 [a]	0	287	1,100	897
1995	253	1,263	79	1,184
1996	12,777	1,205	0	263
1997	6,356	1,620	0	372
1998	3,085	888	0	293
1999	25	905	30	129
2000	0	1,237	0	254
2001	3,722	1,524	0	160

[a] Sockeye salmon returns to the terminal harvest area did not occur until 1994.

Data was obtained from the ADF&G fish ticket and subsistence harvest data base, 1990-2001.



Appendix H.1. Morphometric map showing the limnology and zooplankton stations on Afognak Lake.

Appendix H.2. Juvenile sockeye salmon releases into Afognak Lake, 1992-2001.

Release Year	Broodstock	Species Stocked	Life Stage[a] fry	fingerling	presmolt	Total Stocked
1992	Afognak	Sockeye		160,000	304,000	464,000
1993	Afognak	Sockeye				0
1994	Afognak	Sockeye		311,000		311,000
1995	Afognak	Sockeye				0
1996	Afognak	Sockeye		528,000		528,000
1997	Afognak	Sockeye		197,300	131,000	328,300
1998	Afognak	Sockeye		334,200	88,500	422,700
1999	Afognak	Sockeye				0
2000	Afognak	Sockeye				0
2001	Afognak	Sockeye				0

[a] Fry are released from April to July at up to 200% of emergent size (normally 0.15 to 0.5 g depending on the stock). Fingerling are released from June to September at a size of >200% to <2100% of emergent size (normally 0.3 to 5.25 g depending on the stock). Pre-smolt are released from August to November at a size of >2100% of emergent size but not yet at the physiological stage of smolting (normally 5 to 13 g).

Appendix H.3. The amount of nutrient enrichment additions and ratios into Afognak Lake, 1990-2000.

Year	Fertilizer ratioa	Amount (kg)
1990	20-5-0	11,818
1990	32-0-0	18,181
1991	20-5-0	13,636
1991	32-0-0	19,364
1992	20-5-0	13,636
1992	32-0-0	19,363
1993	20-5-0	21,818
1994	20-5-0	27,216
1995	20-5-0	27,216
1996	20-5-0	25,400
1997	20-5-0	25,400
1998	20-5-0	25,400
1999	20-5-1	27,964
2000	20-5-0	26,425

[a] Nitrogen-Phosphorus-Potassium

Appendix H.4. Limnological sampling stations and total samples collected for Afognak Lake, 1987-2001.

Year	Sampling Stations	Total Samples
1987	1, 2	4
1988	1, 2	4
1989	1, 2	5
1990	1, 2	7
1991	1, 2	6
1992	1, 2	7
1993	1, 2	7
1994	1 - 4	8
1995	1 - 4	7
1996	1 - 4	5
1997	1 - 4	6
1998	1	4
1999	1	4
2000	1	4
2001	1	4

Appendix H.5. Summary of seasonal mean water chemistry parameters by station and depth for Afognak Lake, 1990 - 1998.

	Sta	Depth	Sp. Conductivity		pH		Alkalinity		Turbidity		Color		Calcium		Magnesium		Iron	
Year	tion	(m)	(umhos cm^{-1})	SD	(Units)	SD	(mg L^{-1})	SD	(NTU)	SD	(Pt units)	SD	(mg L^{-1})	SD	(mg L^{-1})	SD	(ug L^{-1})	SD
1990	1	1	40.5	1.7	6.8	0.1	6.3	0.5	0.8	0.4	13.5	3.4	2.9	1.4	0.4	0.3	120.8	24.3
	1	16	41.3	1.0	6.7	0.2	6.1	0.6	0.7	0.4	11.0	2.2	3.2	1.8	0.4	0.3	128.3	38.7
1991	1	1	38.0	0.8	6.7	0.1	10.4	7.8	0.9	0.3	13.0	0.8	2.1	0.3	0.8	0.5	210.0	31.1
	1	14	38.3	1.0	6.6	0.2	6.9	0.3	0.9	0.2	15.8	3.9	1.9	0.1	0.8	0.5	190.3	45.0
1992	1	1	34.5	1.2	6.6	0.2	5.8	1.0	0.9	0.5	11.5	3.4	2.5	0.9	0.6	0.3	156.5	9.3
	1	24	34.5	0.5	6.3	0.1	4.9	1.0	0.8	0.6	10.7	1.5	2.5	1.2	0.6	0.3	162.3	56.9
1993	1	1	36.5	1.0	6.6	0.1	7.5	2.7	0.5	0.1	6.6	7.5	2.2	0.4	1.3	1.1	103.6	34.9
1993	1	25	39.0	4.0	6.4	0.4	7.8	2.1	0.5	0.2	10.0	10.7	2.6	0.9	0.8	0.1	134.2	52.0
1994	1	1	39.0	6.5	6.6	0.2	6.2	2.0	1.1	0.8	5.0	3.2	2.2	0.9	0.6	0.2	140.7	44.0
	1	26	36.0	0.9	6.3	0.3	6.5	2.5	0.7	0.3	5.5	4.7	2.2	0.5	0.6	0.2	197.2	87.7
1995	1	1	59.7	5.6	6.6	0.2	9.8	1.0	2.0	0.8	10.9	2.6	3.7	1.4	1.3	0.4	85.0	45.6
	1	17	59.6	5.4	6.5	0.2	10.0	1.3	2.3	1.2	9.1	2.0	3.4	0.5	1.6	0.5	101.4	33.0
	2	1	57.9	4.9	6.6	0.2	9.7	1.1	1.9	0.9	10.9	4.3	3.2	0.3	1.1	0.3	87.4	55.9
	2	11	58.4	4.3	6.5	0.2	9.6	1.1	2.0	0.8	10.0	5.5	3.5	0.4	1.3	0.3	100.9	53.9
1996	1	1	56.4	1.5	6.7	0.2	10.5	0.7	1.4	1.0	9.8	2.5	3.2	0.5	1.3	0.2	54.0	25.9
	1	18	56.8	2.7	6.6	0.1	11.2	1.9	1.5	0.7	9.4	0.5	3.1	0.5	1.1	0.3	72.2	33.2
	2	1	56.0	1.4	6.7	0.1	10.7	1.0	1.2	0.6	9.2	1.3	3.1	0.5	1.1	0.3	53.6	25.7
	2	11	56.6	1.1	6.7	0.1	10.7	1.0	1.5	0.6	10.8	2.6	2.9	0.5	1.5	0.3	89.4	43.4
1997	1	1	53.0	0.6	7.1	0.2	12.1	1.6	1.1	0.1	9.2	1.9	3.1	0.4	1.1	0.3	27.7	16.6
	1	18	57.7	6.7	6.8	0.2	13.9	3.5	1.7	0.4	10.3	0.8	2.9	0.5	1.7	1.1	68.2	37.7
	2	1	53.2	0.8	7.1	0.1	11.7	0.5	1.0	0.2	10.8	3.8	3.0	0.3	1.0	0.3	33.8	17.3
	2	13	53.4	0.5	7.0	0.1	11.9	0.3	1.3	0.5	9.6	3.0	2.9	0.3	1.0	0.3	44.4	25.8
1998	1	1	48.7	0.6	7.0	0.1	12.6	1.3	1.7	1.2	17.7	10.7	3.2	0.5	0.8	0.2	25.7	15.0
	1	18	48.0	na	7.0	na	11.8	na	2.0	na	11.0	na	3.3	na	1.0	na	48.0	na

SD - standard deviation
na - parameters were not analyzed.

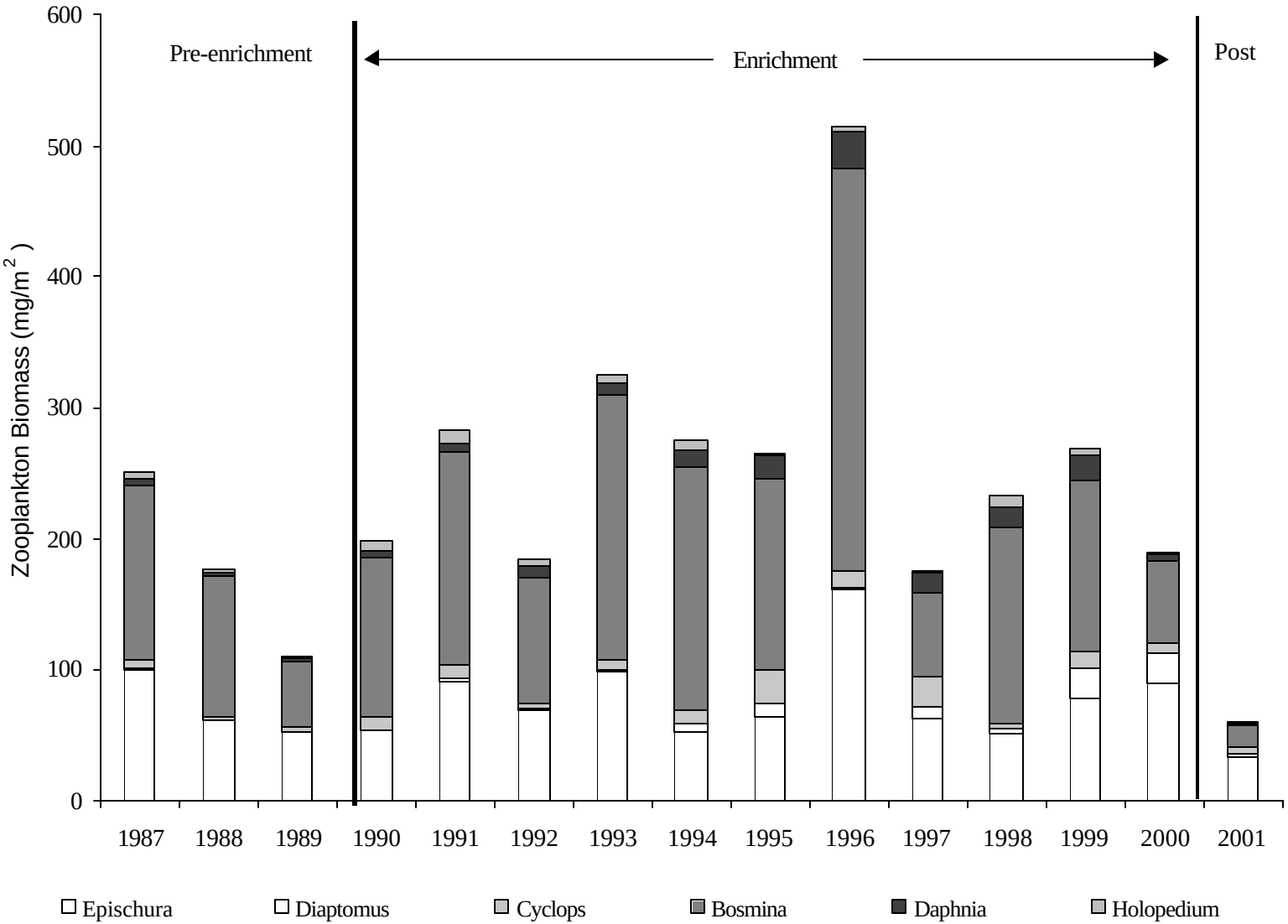
Appendix H.6. Summary of seasonal mean nutrient and algal pigment concentrations by station and depth for Afognak Lake, 1990 - 1998.

Year	Station	Depth (m)	Total Phosphorus (ug L^{-1})	SD	Total filterable-P (ug L^{-1})	SD	Filterable reactive-P (ug L^{-1})	SD	Total Kjeldahl nitrogen (ug L^{-1})	SD	Ammonia (ug L^{-1})	SD	Nitrate+nitrite (ug L^{-1})	SD	Reactive silicon (ug L^{-1})	SD	Organic carbon (ug L^{-1})	SD	Chlorophyll *a* (ug L^{-1})	SD	Phaeophytin *a* (ug L^{-1})	SD
1990	1	1	4.5	1.5	2.9	4.2	3.7	1.7	128.0	16.5	8.0	3.0	40.3	29.1	3249.8	247.5	144.5	13.0	0.34	0.2	0.17	0.0
	1	16	5.1	2.3	1.3	1.3	2.8	1.1	117.7	22.7	9.7	4.2	65.0	29.1	3389.8	154.5	144.0	30.6	0.21	0.0	0.28	0.1
1991	1	1	5.0	2.8	3.2	0.6	2.3	0.4	150.6	22.6	11.5	1.8	56.8	21.3	2865.0	108.6	NA	NA	0.31	0.2	0.27	0.1
	1	14	4.6	1.5	6.0	3.5	4.5	3.2	138.3	12.3	13.6	5.0	69.7	23.2	2966.0	156.3	NA	NA	0.22	0.1	0.22	0.1
1992	1	1	3.8	0.5	4.1	2.5	3.1	2.4	135.0	13.9	3.3	1.7	61.7	26.1	3162.8	158.9	198.8	64.1	0.44	0.3	0.28	0.1
	1	24	3.9	1.7	4.0	3.2	2.6	1.7	127.4	12.8	9.6	4.1	92.8	23.1	3181.7	198.0	162.6	52.9	0.31	0.2	0.28	0.1
1993	1	1	4.5	0.8	3.7	1.3	2.8	0.5	148.0	18.5	5.0	2.2	49.1	30.4	3132.2	220.6	146.8	53.3	1.01	0.3	0.36	0.0
	1	25	4.9	1.3	8.5	11.7	6.8	9.9	136.2	17.3	19.4	10.1	98.4	31.7	3379.6	244.0	120.6	47.5	0.52	0.2	0.45	0.1
1994	1	1	5.7	0.7	4.5	3.3	3.6	2.3	159.8	23.8	3.2	1.7	39.8	21.4	2843.3	122.4	114.3	33.0	0.56	0.3	0.28	0.1
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	0.56	0.3	0.34	0.1
	1	26	5.3	1.1	4.8	3.9	4.2	3.2	160.4	17.7	15.2	9.7	74.3	23.8	3176.7	285.5	128.2	52.1	0.36	0.2	0.27	0.1
1995	1	1	8.7	2.7	3.0	1.5	2.0	1.1	168.3	21.6	9.5	14.1	65.9	22.1	1873.1	735.0	na	na	3.92	2.4	1.13	0.6
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	4.42	3.0	1.15	0.7
	1	17	8.1	2.0	1.9	1.1	1.1	0.4	186.8	47.1	34.7	44.3	45.1	35.0	2045.9	618.4	na	na	3.13	1.7	1.10	0.5
	2	1	7.4	2.1	2.1	1.2	1.7	1.0	168.7	31.0	9.4	14.0	54.4	33.2	1941.9	753.9	na	na	4.20	2.9	1.05	0.7
	2	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	3.71	2.2	1.06	0.6
	2	11	7.2	1.7	2.2	2.0	1.6	1.1	157.0	26.0	16.4	17.4	51.9	34.1	2142.6	805.6	na	na	3.27	2.2	1.05	0.6
1996	1	1	9.2	2.6	3.4	0.7	2.8	0.3	161.4	34.0	17.5	13.9	39.6	29.2	2465.0	297.2	224.8	80.3	2.39	1.2	0.82	0.4
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	2.16	1.0	1.08	0.5
	1	18	8.2	2.7	2.4	0.7	2.2	0.3	161.4	56.5	36.3	37.6	50.9	27.8	2662.6	176.1	190.4	73.1	1.40	0.6	0.81	0.4
	2	1	8.8	2.6	2.7	0.8	2.2	0.4	160.3	37.3	8.2	14.6	40.7	25.9	2466.0	275.0	225.6	52.5	1.77	0.5	0.85	0.4
	2	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	1.72	0.3	0.83	0.4
	2	11	8.4	2.8	3.4	1.6	2.9	1.3	147.2	41.3	28.7	24.5	49.7	25.9	2629.8	220.7	168.6	55.7	1.07	0.3	0.77	0.3
1997	1	1	7.3	1.9	2.7	1.0	2.6	0.9	155.2	33.9	14.0	14.2	21.9	23.9	2346.7	354.4	273.3	63.8	2.56	1.4	1.51	0.7
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	2.59	1.5	1.58	0.8
	1	18	7.2	1.5	2.6	0.5	2.3	0.4	193.7	68.6	63.6	53.3	55.3	14.5	2994.5	503.5	196.8	28.8	1.12	0.5	1.08	0.4
	2	1	6.9	1.7	3.6	1.8	3.1	1.5	155.8	37.8	13.3	15.8	16.9	21.8	2435.2	351.3	252.2	62.8	1.68	1.3	1.19	0.8
	2	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	1.78	1.3	1.23	0.8
	2	13	6.5	1.4	2.8	1.9	2.3	0.8	148.1	38.7	20.9	12.4	29.6	20.1	2584.0	433.5	155.8	50.6	1.33	1.2	1.06	0.8
1998	1	1	9.0	1.7	3.3	0.8	1.9	0.0	192.9	7.7	21.2	13.9	38.1	15.9	2387.0	73.0	151.7	118.8	0.10	0.0	0.04	0.0
	1	18	7.5	na	3.7	na	1.9	na	182.2	na	24.5	na	62.6	na	2311.0	na	36.0	na	0.09	na	0.03	na

SD - standard deviation
na - parameters were not analyzed.

Appendix H.7. Weighted mean zooplankton density, biomass, and size by genera from Afognak Lake, 1987-2001.

		Epischura			*Diaptomus*			*Cyclops*			*Bosmina*			*Daphnia*			*Holopedium*			TOTALS	
	No.	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass
Year	Samples	(no/m^2)	(mg/m^2)	(mm)	(no/m^2)	(mg/m^2)	(mm)	(no/m^2)	(mg/m^2)	(mm)	(no/m^2)	(mg/m^2)	(mm)	(no/m^2)	(mg/m^2)	(mm)	(no/m^2)	(mg/m^2)	(mm)	(no/m^2)	(mg/m^2)
1987	4	28,835	100	0.91	173	1	0.91	4,127	6	0.65	138,370	134	0.33	3,218	4	0.54	2,574	6	0.52	177,297	251
1988	4	16,508	61	0.95	20	0	1.44	1,997	3	0.70	107,650	107	0.33	1,184	3	0.68	1,085	3	0.54	128,444	177
1989	5	13,314	53	0.95	0	0	0.00	2,462	4	0.66	58,937	50	0.31	1,099	2	0.64	950	2	0.47	76,762	110
1990	7	13,994	54	0.95	4	0	0.90	6,724	11	0.67	141,664	121	0.31	2,871	5	0.63	4,485	8	0.47	169,741	198
1991	6	20,282	91	1.00	770	3	0.84	5,442	10	0.74	181,458	163	0.32	3,718	8	0.69	4,554	9	0.50	216,222	283
1992	7	16,208	69	0.97	315	1	0.94	3,122	5	0.68	94,856	96	0.33	4,017	9	0.72	2,443	5	0.45	120,959	185
1993	7	26,463	99	0.94	425	1	0.76	4,921	8	0.67	207,962	202	0.33	5,130	10	0.67	3,852	8	0.49	248,751	326
1994	8	17,360	53	0.89	1,314	5	0.95	6,484	11	0.67	191,551	186	0.33	6,971	13	0.65	4,870	9	0.47	228,548	276
1995	7	14,476	64	0.98	3,382	10	0.91	16,993	25	0.65	162,147	148	0.32	11,321	17	0.60	1,281	2	0.43	209,599	265
1996	5	31,502	161	1.04	223	1	0.83	7,272	13	0.73	285,276	309	0.35	10,202	27	0.77	2,240	4	0.47	336,715	515
1997	6	14,022	63	1.00	4,494	9	0.75	14,194	23	0.66	83,825	65	0.29	10,686	15	0.57	919	1	0.42	128,140	175
1998	4	15,672	51	0.90	1,088	4.0	0.96	2,070	3	0.64	169,971	151	0.29	10,881	15	0.54	5,441	9	0.39	205,123	233
1999	4	18,737	78	0.97	5,945	24.0	0.97	6,688	12	0.71	133,175	130	0.33	9,449	20	0.68	2,495	5	0.46	176,489	269
2000	5	28,822	90	0.88	4,061	22.0	1.09	5,372	8	0.66	57,150	63	0.35	2,521	5	0.64	704	1	0.46	98,630	189
2001	5	15,061	33	1.05	1,274	2.8	0.79	4,061	5	0.72	20,382	16	0.31	626	1	0.57	1,319	2	0.46	42,723	60



Appendix H.8. Weighted mean zooplankton biomass by genera and lake enrichment time period for Afognak Lake, 1987-2001.

Appendix H.9. Juvenile sockeye salmon estimates based on townet catches and hydroacoustic fish population estimates for Afognak Lake, 1990 and 1992-1995.

	Total Fish Estimates			Sockeye Estimates			Sockeye
		95% Confidence Interval			95% Confidence Interval		Composition
Date	Number	Low	High	Number	Low	High	(%)
9/4/90	3,605,299	1,842,657	5,367,941	30,051	19,848	40,254	0.6
9/10/92	2,582,981	2,120,870	3,045,092	135,462	111,748	159,176	5.5
10/9/93	3,002,179	2,675,902	3,328,456	172,461	127,629	217,293	4.5
10/12/94	3,439,596	2,441,089	4,438,103	1,996,715	1,477,661	2,515,769	52.1
9/12/95	2,097,152	1,479,667	2,714,637	23,069	16,277	29,861	1.1

Appendix H.10. Townet catches from Afognak Lake, 1990 and 1992-1995.

			Catch by Species					
			Sockeye			Stickleback		
Date	Number of Tows	Total Minutes	Number	%	CPUE[a]	Number	%	CPUE[a]
9/5/90	2	60	6	0.7	0.1	927	99.3	15.5
9/11/92	3	52	132	13.8	2.5	2,253	86.2	43.3
10/10/93	3	60	32	6.7	0.5	673	93.4	11.2
10/12/94	1	19	114	52.1	6.0	105	47.9	5.5
9/12/95	5	na[b]	37	1.1	na[b]	3,396	98.9	na[b]

[a] CPUE - Catch per unit of effort
[b] na - data were not available.

Appendix H.11. Mean length, weight, and condition coefficient by age for juvenile sockeye salmon captured by townet from Afognak Lake, 1990 and 1992-1995.

	Age-0					Age-1				
Date	n	%	Length (mm)	Weight (g)	Condition (K)	n	%	Length (mm)	Weight (g)	Condition (K)
9/5/90	5	83.3	56.0	2.3	1.31	1	16.7	71.0	4.5	1.26
9/10/92	62	93.9	63.5	3.4	1.31	4	6.1	68.8	4.1	1.24
10/10/93	25	83.3	59.0	2.7	1.28	5	16.7	77.6	5.5	1.17
10/13/94	50	98.0	59.6	2.6	1.20	1	2.0	76.0	5.6	1.28
9/13/95	1	3.6	53.2	1.9	1.25	27	96.4	67.4	3.7	1.21

Appendix H.12. Population estimate of the sockeye salmon smolt emigration from Afognak Lake, 1990.

	Trap Catch					Dye Test			
	Sockeye	Sockeye	Estimated	95% C.I.		Dyed	Dyed	Cum.	Trap
Date	Daily	Cumulative	Migration	lower	upper	Released	Recovered	Recovered	Efficiency
23-May	52	52	723	432	1,013				7.4% [a]
24-May	216	268	3,003	1,997	4,008				7.4% [a]
25-May	228	496	3,169	2,112	4,227	474	35	35	7.4%
26-May	84	580	1,168	736	1,599		0	35	7.4%
27-May	115	695	1,599	1,032	2,166		0	35	7.4%
28-May	45	740	626	366	885		0	35	7.4%
29-May	72	812	1,001	622	1,380		0	35	7.4%
30-May	72	884	1,440	752	2,128	342	18	18	5.3%
31-May	38	922	760	366	1,154		0	18	5.3%
1-Jun	90	1,012	1,800	958	2,642		0	18	5.3%
2-Jun	71	1,083	1,420	741	2,099		0	18	5.3%
3-Jun	100	1,183	2,000	1,072	2,928		0	18	5.3%
4-Jun	215	1,398	4,300	2,388	6,212		0	18	5.3%
5-Jun	260	1,658	5,200	2,903	7,497		0	18	5.3%
6-Jun	226	1,884	4,520	2,514	6,526		0	18	5.3%
7-Jun	202	2,086	2,359	1,626	3,092	480	42	42	8.8%
8-Jun	275	2,361	3,211	2,236	4,186		0	42	8.8%
9-Jun	226	2,587	2,639	1,828	3,452		0	42	8.8%
10-Jun	169	2,756	1,973	1,350	2,597		0	42	8.8%
11-Jun	107	2,863	1,249	833	1,666		0	42	8.8%
12-Jun	198	3,061	2,312	1,592	3,032		0	42	8.8%
13-Jun	49	3,110	572	352	793		0	42	8.8%
14-Jun	40	3,150	467	278	656		0	42	8.8%
15-Jun	64	3,214	747	475	1,019		0	42	8.8%
16-Jun	24	3,238	280	149	412		0	42	8.8%
17-Jun	5	3,243	58	8	109		0	42	8.8%
18-Jun	29	3,272	339	189	488		0	42	8.8%
19-Jun	22	3,294	257	133	381		0	42	8.8%
20-Jun	13	3,307	152	64	240		0	42	8.8%
21-Jun	21	3,328	245	125	365		0	42	8.8%
22-Jun	4	3,332	47	2	91		0	42	8.8%
23-Jun	10	3,342	117	41	192		0	42	8.8%
24-Jun	4	3,346	47	2	91		0	42	8.8%
Total:	3,346	3,346	49,800	30,274	69,326	1,296		95	7.1%

[a] The first mark/recapture test strata calculation on May 25 was expanded to the daily catches from May 23-24.

Appendix H.13. Population estimate of the sockeye salmon smolt emigration from Afognak Lake, 1991.

	Trap Catch					Dye Test			
	Sockeye	Sockeye	Estimated	95% C.I.		Dyed	Dyed	Cum.	Trap
Date	Daily	Cumulative	Migration	lower	upper	Released	Recovered	Recovered	Efficiency
13-May	1	1	12	0	34				8.6%[a]
14-May	7	8	84	21	147				8.6%[a]
15-May	8	16	95	27	164				8.6%[a]
16-May	5	21	60	8	112				8.6%[a]
17-May	5	26	60	8	112				8.6%[a]
18-May	31	57	370	205	535				8.6%[a]
19-May	15	72	179	79	279				8.6%[a]
20-May	44	116	525	311	739				8.6%[a]
21-May	125	241	1,492	981	2,003				8.6%[a]
22-May	54	295	645	393	896				8.6%[a]
23-May	77	372	919	583	1,255				8.6%[a]
24-May	1,184	1,556	14,133	9,818	18,448				8.6%[a]
25-May	571	2,127	6,816	4,701	8,930	431	34	34	7.9%
26-May	169	2,296	2,017	1,348	2,687		3	37	8.6%
27-May	289	2,585	3,450	2,348	4,551		0	37	8.6%
28-May	565	3,150	18,875	10,173	27,576		0	37	8.6%
29-May	154	3,304	5,145	2,687	7,602		0	37	8.6%
30-May	132	3,436	4,410	2,287	6,532		0	37	8.6%
31-May	616	4,052	20,578	11,102	30,055		0	37	8.6%
1-Jun	540	4,592	18,039	9,717	26,362	504	14	14	2.8%
2-Jun	187	4,779	6,247	3,288	9,206		1	15	3.0%
3-Jun	474	5,253	15,835	8,515	23,154		1	16	3.2%
4-Jun	173	5,426	3,187	1,991	4,383		0	16	3.2%
5-Jun	63	5,489	1,161	675	1,646		0	16	3.2%
6-Jun	490	5,979	9,027	5,796	12,258		0	16	3.2%
7-Jun	375	6,354	6,908	4,415	9,401		0	16	3.2%
8-Jun	91	6,445	1,676	1,009	2,344	499	25	25	5.0%
9-Jun	403	6,848	7,424	4,751	10,097		2	27	5.4%
10-Jun	257	7,105	4,735	2,999	6,470		1	28	5.6%
11-Jun	307	7,412	3,918	2,708	5,128		0	28	5.6%
12-Jun	177	7,589	2,259	1,532	2,986		0	28	5.6%
13-Jun	275	7,864	3,510	2,418	4,601		0	28	5.6%
14-Jun	210	8,074	2,680	1,830	3,530		0	28	5.6%
15-Jun	305	8,379	3,892	2,690	5,095	499	6	6	1.2%
16-Jun	246	8,625	3,139	2,156	4,123		32	38	7.6%
17-Jun	236	8,861	3,012	2,065	3,958		2	40	8.0%
18-Jun	425	9,286	5,776	3,934	7,618		0	40	8.0%
19-Jun	256	9,542	3,479	2,341	4,617		0	40	8.0%
20-Jun	132	9,674	1,794	1,174	2,414		0	40	8.0%

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	Trap Catch					Dye Test			
	Sockeye	Sockeye	Estimated	95% C.I.		Dyed	Dyed	Cum.	Trap
Date	Daily	Cumulative	Migration	lower	upper	Released	Recovered	Recovered	Efficiency
21-Jun	194	9,868	2,637	1,757	3,516		0	40	8.0%
22-Jun	146	10,014	1,984	1,306	2,663		0	40	8.0%
23-Jun	99	10,113	1,345	864	1,827	477	34	34	7.1%
24-Jun	80	10,193	1,087	686	1,488		2	36	7.5%
25-Jun	87	10,280	1,182	752	1,613		0	36	7.5%
26-Jun	53	10,333	720	434	1,006		0	36	7.5%
Total:	10,333	228,108	196,516	118,873	274,159	2,410		157	6.6%

a The first mark/recapture test strata calculation on May 25 was expanded to the daily catches from May 13-24.

Appendix H.14. Mean length, weight, and condition coefficient by age for sockeye salmon smolt sampled at Afognak Lake, 1987-2001.

		Age-1				Age-2				Age-3			
Year	Sampling Period	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)
1987	8-Jun	36	74.9	3.6	0.85	186	79.3	3.6	0.86	0			
1988	15-Jun	202	77.9	4.1	0.90	0				0			
1989	15-Jun	208	76.8	4.1	0.91	2	78.0	5.2	1.10	0			
1990	May23-June 24	544	68.8	2.5	0.76	21	77.3	3.4	0.73	0			
1991	May 13-June 26	1,895	72.9	3.1	0.78	176	78.3	3.9	0.81	0			
1992	June 7-20	268	77.0	3.8	0.82	37	76.9	3.8	0.83	0			
1993	May 24-30	274	72.7	3.0	0.78	21	74.8	3.3	0.79	0			
1994	May 17-23	138	72.0	3.0	0.81	142	84.3	4.7	0.79	0			
1995	May 31-June 13	394	69.4	2.8	0.84	5	78.8	3.6	0.74	0			
1996	June 5-11	54	80.9	4.6	0.87	339	81.6	4.8	0.88	0			
1997	May 24-30	76	81.7	4.3	0.78	122	82.1	4.4	0.79	1	90.0	5.6	0.77
1998	May 24-30	116	66.4	2.6	0.82	46	88.0	6.6	0.90	1	103.0	10.0	0.92
1999	May 31-June 6	96	74.6	2.8	0.66	98	66.6	2.1	0.69	0			
2000	May 31-June 13	84	81.5	4.9	0.89	100	85.3	5.6	0.89	16	88.0	6.0	0.88
2001	June 11-13	44	90.1	7	0.93	17	85.6	5.8	0.92	1	136	23.1	0.92

Appendix H.15. Estimated age composition of the Afognak Lake sockeye salmon escapement, 1987-2001.

Year	Sample Size		Ages 0.2	0.3	1.1	1.2	2.1	1.3	2.2	3.1	1.4	2.3	3.2	2.4	3.3	Total
1987	281	Percent	0.0	0.0	6.4	37.0	1.1	36.3	4.3	0.0	0.0	14.6	0.0	0.0	0.0	100
		Numbers	0	0	1,695	9,797	284	9,609	1,131	0	0	3,863	0	0	0	26,474
1988	933	Numbers	51	55	263	23,059	824	9,773	4,488	0	0	429	0	0	0	39,012
		Percent	0.1	0.1	0.7	59.1	2.1	25.1	11.5	0.0	0.0	1.1	0.0	0.0	0.0	100
1989	1,088	Numbers	0	0	13,288	13,404	3,135	35,165	16,314	0	0	7,519	0	0	0	88,825
		Percent	0.0	0.0	15.0	15.1	3.5	39.6	18.4	0.0	0.0	8.5	0.0	0.0	0.0	100
1990	1,053	Numbers	0	26	597	42,314	553	20,518	7,754	0	261	18,613	0	26	0	90,662
		Percent	0.0	0.0	0.7	46.7	0.6	22.6	8.6	0.0	0.3	20.5	0.0	0.0	0.0	100
1991	1,062	Numbers	0	0	295	13,054	196	67,805	3,101	0	0	4,106	0	0	0	88,557
		Percent	0.0	0.0	0.3	14.7	0.2	76.6	3.5	0.0	0.0	4.6	0.0	0.0	0.0	100
1992	1,025	Numbers	0	0	16,362	17,115	7,681	23,096	2,938	90	394	9,526	61	0	0	77,263
		Percent	0.0	0.0	21.2	22.2	9.9	29.9	3.8	0.1	0.5	12.3	0.0	0.0	0.0	100
1993	852	Numbers	0	0	11,837	7,634	12,318	21,667	8,818	53	0	8,965	163	0	0	71,455
		Percent	0.0	0.0	16.6	10.7	17.2	30.3	12.3	0.1	0.0	12.5	0.2	0.0	0.0	100
1994	840	Numbers	222	0	7,703	24,648	3,337	28,385	8,316	125	61	7,708	64	0	0	80,569
		Percent	0.3	0.0	9.6	30.6	4.1	35.2	10.3	0.2	0.1	9.6	0.1	0.0	0.0	100
1995	848	Numbers	0	161	2,281	21,788	837	56,367	10,773	0	149	7,776	0	0	0	100,132
		Percent	0.0	0.2	2.3	21.8	0.8	56.3	10.8	0.0	0.1	7.8	0.0	0.0	0.0	100
1996	1,119	Numbers	0	80	16,340	9,398	2,184	44,744	2,095	0	185	26,427	80	185	0	101,718
		Percent	0.0	0.1	16.0	9.2	2.1	44.0	2.1	0.0	0.2	26.0	0.1	0.2	0.0	100
1997	1,168	Numbers	0	0	5,234	29,004	7,330	47,888	2,351	0	41	14,840	0	0	170	106,858
		Percent	0.0	0.0	4.9	27.1	6.9	44.8	2.2	0.0	0.0	13.9	0.0	0.0	0.2	100
1998	1,240	Numbers	0	0	13,039	5,483	5,082	31,763	7,289	134	267	3,812	0	0	0	66,869
		Percent	0.0	0.0	19.5	8.2	7.6	47.5	10.9	0.2	0.4	5.7	0.0	0.0	0.0	100

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Year	Sample Size		Ages													Total
			0.2	0.3	1.1	1.2	2.1	1.3	2.2	3.1	1.4	2.3	3.2	2.4	3.3	
1999[a]	1,195	Numbers	0	0	661	30,350	427	6,911	30,943	72	202	5,466	456	0	0	75,488
		Percent	0.0	0.0	0.9	40.2	0.6	9.1	41.0	0.1	0.3	7.2	0.6	0.0	0.0	100
2000	1,161	Numbers	21	0	887	1,276	171	8,302	3,084	0	0	37,238	1,753	0	485	53,217
		Percent	0.0	0.0	1.7	2.4	0.3	15.6	5.8	0.0	0.0	70.0	3.3	0.0	0.9	100
2001	790	Numbers	0	0	137	2,393	833	5,473	676	1,877	0	9,328	0	0	156	20,873
		Percent	0.0	0.0	0.7	11.4	4.0	26.2	3.2	9.0	0.0	44.6	0.0	0.0	0.7	100

[a] In 1999, 72 (0.1%) sockeye salmon were aged 0.4.

Source:

1987-1989 age compositions from White et al. Limnological and Fisheries Assessment of Sockeye Salmon Production in Afognak Lake. 1990.

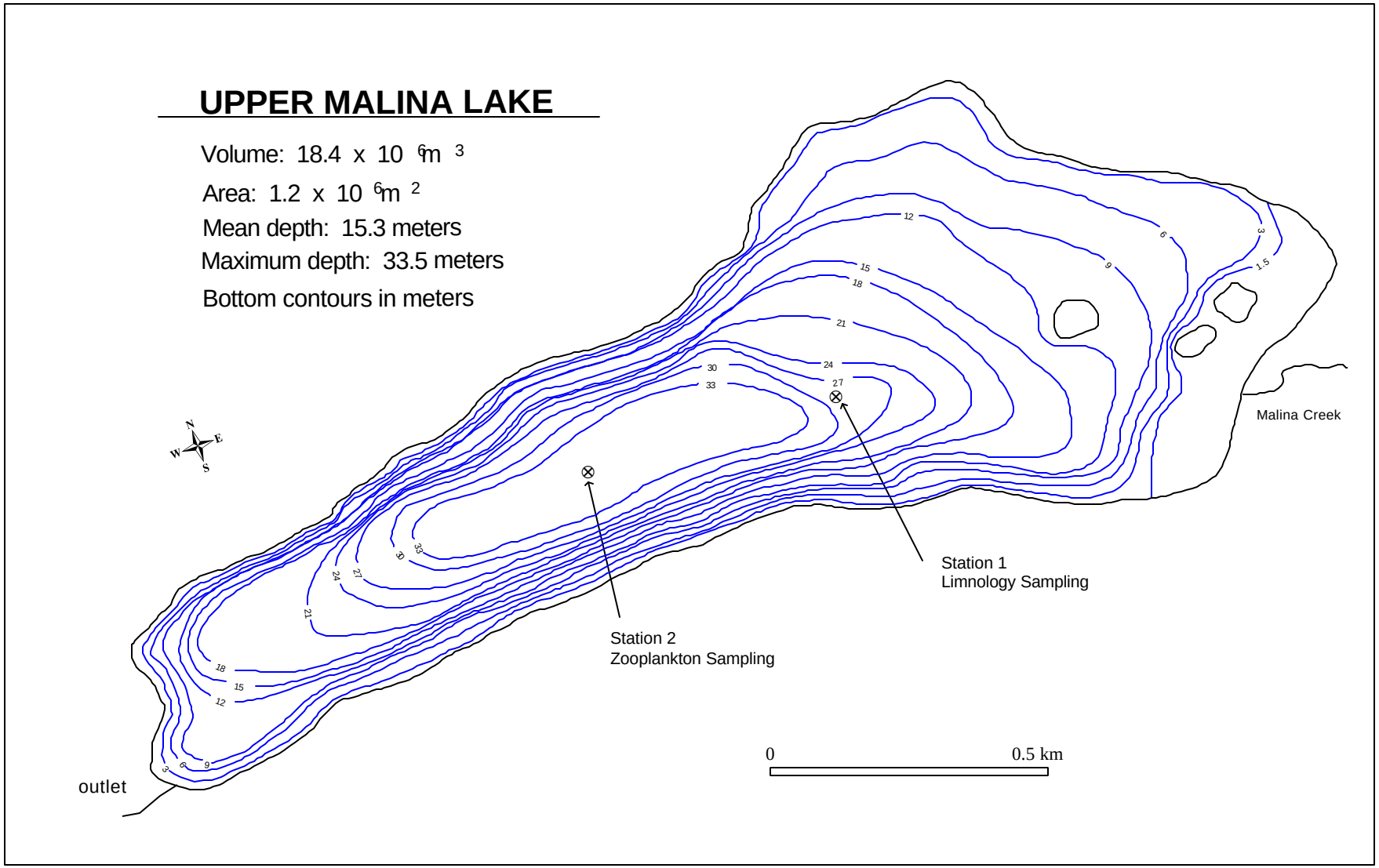
1990-1993,1996-1997 age composition from ADF&G Database, unpublished.

1998 age compositions from Nelson, P.A. 1999. Kodiak Management Area Salmon Escapement and Catch Sampling Results, 1998.

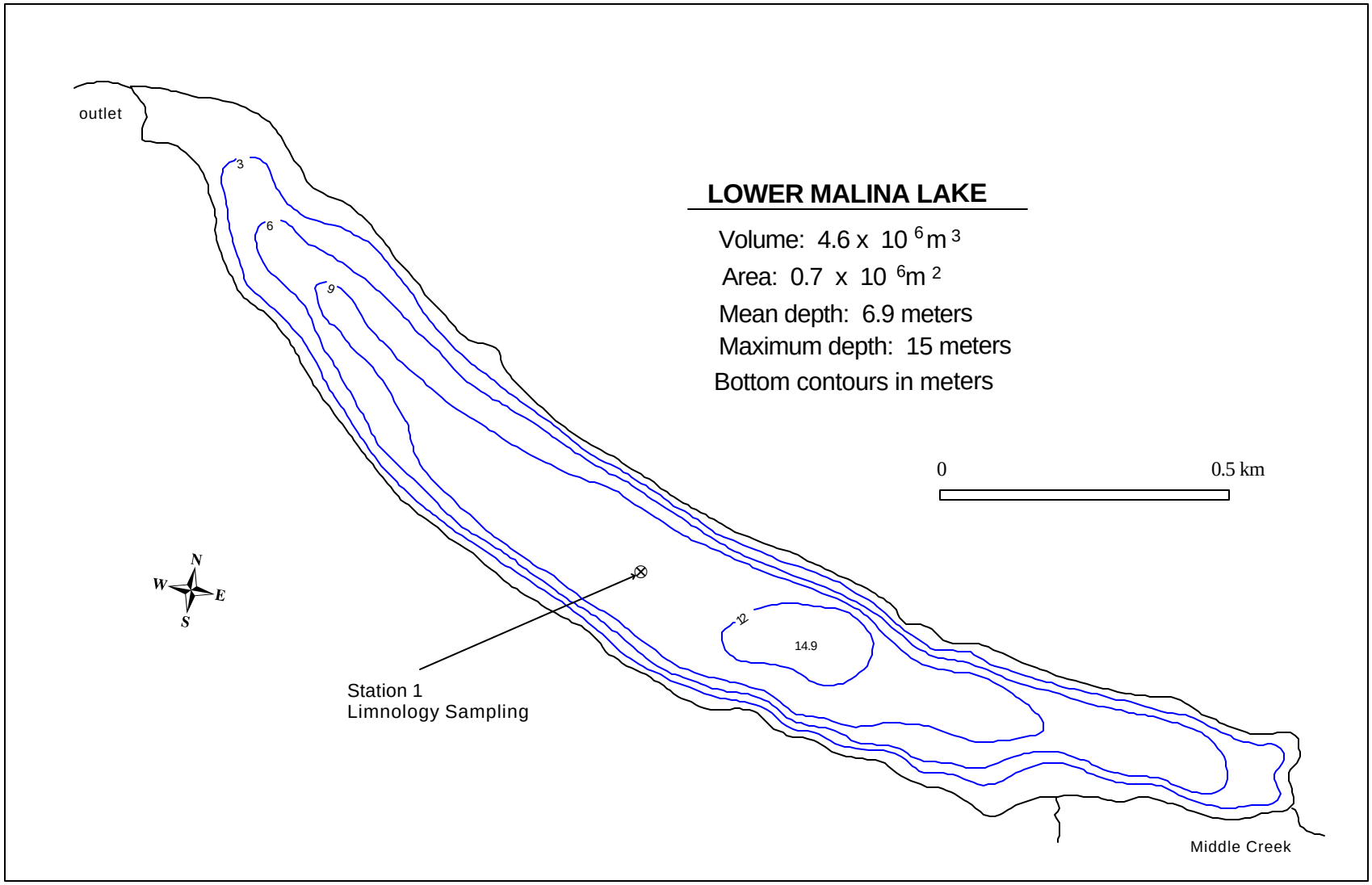
1999 age compositions from Nelson, P.A. and M.B.Foster. 2000. Kodiak Management Area Salmon Escapement and Catch Sampling Results, 1999.

2000 age compositions from Witteveen, M.J. and M.B.Foster. 2000. Kodiak Management Area Salmon Escapement and Catch Sampling Results, 2000.

2001 age compositions from Witteveen, M.J. and M.B.Foster. 2002. Kodiak Management Area Salmon Escapement and Catch Sampling Results, 2001.



Appendix I.1. Morphometric map showing the limnology and zooplankton stations on Upper Malina Lake.



Appendix I.2. Morphometric map showing the limnology station on Lower Malina Lake.

Appendix I.3. Juvenile sockeye salmon releases into Malina Lake, 1992-1999.

Release		Life Stage[a]			Total
Year	Broodstock	fry	fingerling	presmolt	Stocked
1992	Malina		85,000		85,000
1993	Malina	201,000	11,700		212,700
1994	Malina	547,000			547,000
1995	Malina			53,500	53,500
1996	Malina		182,000	229,300	411,300
1997	Malina		166,000	224,400	390,400
1998	Malina		93,300	257,200	350,500
1999	Malina		285,000	121,000	406,000

[a] Fry are released from April to July at up to 200% of emergent size (normally 0.15 to 0.5 g depending on the stock). Fingerling are released from June to September at a size of >200% to <2100% of emergent size (normally 0.3 to 5.25 g depending on the stock). Pre-smolt are released from August to November at a size of >2100% of emergent size but not yet at the physiological stage of smolting (normally 5 to 13 g.).

Appendix I.4. The amount of nutrient enrichment additions and ratios into Upper and Lower Malina Lakes, 1991-2001.

Lake	Year	Fertilizer ratio [a]	Amount (kg)
Upper Malina	1991	20-5-0	3,636
	1991	32-0-0	1,636
	1992	20-5-0	3,636
	1992	32-0-0	1,636
	1993	20-5-0	5,454
	1994	20-5-0	5,454
	1995	20-5-0	5,454
	1996	20-5-0	6,096
	1997	20-5-0	5,080
	1998	20-5-0	8,618
	1999	20-5-1	11,765
	2000	20-5-0	8,710
	2001	20-5-1	4,977
Lower Malina	1996	20-5-0	2,032
	1997	20-5-0	2,540
	1998	20-5-0	2,901
	1999	20-5-1	4,706
	2000	20-5-0	3,023
	2001	20-5-1	1,511

[a] Nitrogen-Phosphorus-Potassium

Appendix I.5. Limnological sampling stations and total samples collected for Upper and Lower Malina Lakes, 1989-2001.

Year	Sampling Stations	Total Samples
1989	1, 2	3
1990	1, 2	5
1991	1, 2	6
1992	1, 2	7
1993	1, 2	7
1994	1-3	8
1995	1-3	7
1996	1-3	5
1997	1-3	6
1998	1, 2	4
1999	1, 2	4
2000	1, 2	4
2001	1, 2	4

Appendix I.6. Summary of seasonal mean water chemistry parameters for Lower Malina Lake, 1989-2001.

Year	Station	Depth (m)	Sp. Conductivity (umhos/cm)	S.D.	pH (Units)	S.D.	Alkalinity (mg/L)	S.D.	Turbidity (NTU)	S.D.	Color (Pt units)	S.D.	Calcium (mg/L)	S.D.	Magnesium (mg/L)	S.D.	Iron (ug/L)	S.D.
1989	1	1	82.0	0.0	7.5	0.1	21.0	1.0	0.4	0.1	8.7	2.0	7.6	0.5	1.6	0.1	38.3	11.2
	1	11	81.0	1.0	7.4	0.2	21.7	1.2	0.5	0.1	8.3	0.7	7.4	0.5	1.6	0.1	41.7	11.5
1990	1	1	80.8	1.1	7.3	0.1	22.8	1.9	0.7	0.2	5.0	0.7	7.1	0.9	1.5	0.2	27.4	17.1
	1	10	81.0	1.2	7.3	0.1	22.1	1.5	0.6	0.2	5.0	0.0	7.3	1.2	1.7	0.5	22.6	17.4
1991	1	1	77.1	2.3	7.3	0.2	21.6	1.8	1.0	0.8	7.7	4.0	6.9	0.3	1.7	0.5	69.9	88.3
	1	10	77.0	2.3	7.3	0.2	21.3	3.7	0.8	0.2	13.6	10.2	7.2	0.9	1.5	0.3	58.4	53.0
1992	1	1	76.1	2.4	7.2	0.3	21.6	1.4	0.7	0.2	8.9	4.8	7.7	1.0	1.7	0.4	22.3	10.7
	1	9	75.3	2.0	7.2	0.2	21.7	1.6	0.7	0.4	5.9	1.2	7.5	0.9	1.6	0.8	23.7	27.6
1993	1	1	77.0	2.5	7.1	0.3	20.6	1.5	0.7	0.3	7.0	3.4	7.2	0.5	1.5	0.4	34.7	11.0
	1	10	77.6	2.4	7.0	0.4	20.1	2.4	0.9	0.5	6.4	2.0	7.4	0.6	1.8	0.5	59.4	45.9
1994	1	1	75.3	2.6	6.9	0.1	21.1	0.9	0.7	0.2	15.8	14.1	8.0	1.9	1.7	0.4	40.1	18.9
	1	9	76.8	5.3	6.9	0.2	20.9	1.1	0.8	0.3	9.4	6.2	7.9	1.9	1.5	0.3	40.9	16.2
1995	1	1	80.4	3.5	6.9	0.1	20.5	1.1	1.0	0.3	5.3	1.8	7.0	0.3	2.0	0.2	42.9	18.3
	1	9	81.6	2.8	7.0	0.2	20.3	0.1	1.2	0.5	4.4	2.7	6.9	0.3	1.9	0.2	64.4	33.3
1996	1	1	80.6	2.2	7.2	0.1	21.7	0.8	0.8	0.4	11.8	1.9	7.3	0.2	1.9	0.4	21.8	10.1
	1	9	82.3	1.3	7.3	0.2	22.3	0.7	0.5	0.0	12.5	6.9	6.9	0.5	1.6	0.6	34.8	8.4
1997	1	1	78.7	1.2	7.5	0.2	23.3	0.8	0.7	0.3	7.5	1.8	6.7	0.6	1.7	0.6	23.7	16.2
	1	9	79.8	1.3	7.5	0.1	23.3	1.3	0.7	0.4	12.5	8.9	6.9	0.5	1.6	0.5	20.3	8.8
1998	1	1	71.7	1.5	7.3	0.1	25.4	4.0	1.2	0.7	9.3	4.0	6.6	0.1	1.6	0.2	17.3	7.5
	1	11	71.0	na	7.3	na	22.5	na	1.1	na	5.0	na	6.9	na	1.6	na	24.0	na
1999	1	1	78.3	0.5	6.9	0.3	20.9	1.1	1.0	0.7	11.5	7.8	7.4	0.2	1.6	0.2	46.8	14.6
2000	1	1	na	na	7.4	0.3	13.9	0.7	na	na	na	na	na	na	na	na	na	na
2001	1	1	na	na	7.4	0.4	17.6	5.5	na	na	na	na	na	na	na	na	na	na

SD - standard deviation
na - parameters were not analyzed.

Appendix I.7. Summary of seasonal mean water chemistry parameters for Upper Malina Lake, 1989-2001.

	Sta	Depth	Sp. Conductivity		pH		Alkalinity		Turbidity		Color		Calcium		Magnesium		Iron	
Year	tion	(m)	(umhos/cm)	S.D.	(Units)	S.D.	(mg/L)	S.D.	(NTU)	S.D.	(Pt units)	S.D.	(mg/L)	S.D.	(mg/L)	S.D.	(ug/L)	S.D.
1989	2	1	80.0	1.0	7.5	0.1	19.7	1.5	0.8	0.2	8.1	0.8	7.0	0.4	1.5	1.3	48.7	11.6
	2	19	87.3	13.6	7.8	0.6	23.7	8.1	0.6	0.1	7.9	0.7	6.9	0.4	2.8	2.4	45.7	28.7
1990	2	1	78.2	1.6	6.7	1.4	21.0	1.4	0.9	0.2	6.4	1.5	7.1	0.9	1.5	0.2	38.6	19.9
	2	25	79.0	1.4	7.2	0.3	21.1	1.2	0.7	0.3	8.4	3.3	6.9	0.9	1.4	0.4	43.0	26.3
1991	2	1	74.0	4.2	7.2	0.2	19.5	4.2	1.0	0.5	10.4	3.8	7.4	1.0	1.5	1.0	60.6	30.6
	2	27	74.1	4.4	7.1	0.3	20.1	3.2	0.7	0.2	10.7	4.0	7.2	0.5	1.5	0.7	58.6	37.9
1992	2	1	72.9	1.5	7.2	0.2	20.4	1.2	0.8	0.3	5.7	2.4	7.1	1.1	1.6	0.7	29.0	13.5
	2	26	73.6	1.6	7.0	0.2	19.9	0.8	0.7	0.3	5.6	1.6	7.3	1.1	1.6	0.7	38.6	15.3
1993	2	1	75.6	1.5	7.0	0.4	21.5	2.7	0.9	0.6	7.3	2.1	7.3	0.6	1.7	0.4	46.6	8.0
	2	27	76.0	2.3	6.9	0.3	20.5	2.4	0.9	0.5	7.3	2.8	7.0	0.3	1.8	0.4	51.7	15.6
1994	2	1	71.1	2.0	6.9	0.2	19.1	1.0	1.0	0.2	6.9	1.6	6.8	0.3	1.4	0.2	52.6	27.8
	2	27	72.1	2.0	6.7	0.1	18.9	0.8	1.0	0.4	8.9	4.5	6.9	0.2	1.5	0.3	60.5	22.1
1995	2	1	79.0	3.2	7.0	0.2	18.6	1.2	1.0	0.2	6.9	3.3	6.3	0.3	2.0	0.5	57.0	28.9
	2	27	80.4	4.6	6.8	0.3	18.6	1.5	1.0	0.4	5.8	3.2	6.7	0.5	1.7	0.4	68.3	26.3
1996	2	1	87.8	0.8	7.2	0.2	19.8	0.7	1.0	0.5	12.2	3.5	6.4	0.1	1.7	0.4	30.6	9.2
	2	27	79.2	2.2	6.9	0.2	19.4	1.0	0.9	0.5	13.2	4.9	6.6	0.4	1.7	0.4	46.6	13.3
1997	2	1	76.7	0.8	7.4	0.1	21.7	1.2	0.8	0.3	9.7	2.9	6.3	0.2	1.6	0.4	24.0	13.5
	2	27	77.5	1.2	7.1	0.3	20.2	0.7	1.2	0.4	8.0	2.3	6.3	0.3	1.6	0.4	31.8	15.8
1998	2	1	69.0	1.0	7.3	0.1	23.8	2.8	1.3	1.0	10.3	1.2	6.6	0.5	1.3	0.2	23.0	3.6
	2	26	69.0	na	7.2	na	21.4	na	2.0	na	6.0	na	6.8	na	1.3	na	28.0	na
1999	2	1	76.0	1.6	6.9	0.2	19.7	0.9	1.5	0.7	8.8	1.0	6.7	0.2	1.7	0.2	70.5	28.7
2000	2	1	na	na	7.4	0.3	14.3	2.3	na	na	0.2	0.0	na	na	na	na	na	na
2001	2	1	na	na	7.5	0.6	18.0	3.7	na	na	na	na	na	na	na	na	na	na

SD - standard deviation
na - parameters were not analyzed.

Appendix I.8. Summary of seasonal mean nutrient and algal pigment concentrations for Lower Malina Lakes, 1989-2001.

Year	Station	Depth (m)	Total-P (ug/L P)	SD	Total Filterable P (ug/L P)	SD	Filterable Reactive P (ug/L P)	SD	Total Kjeldahl N (ug/L N)	SD	Ammonia (ug/L N)	SD	Nitrate+Nitrite (ug/L N)	SD	Reactive Silicon (ug/L Si)	SD	Organic Carbon (ug/L)	SD	Chlorophyll *a* (ug/L)	SD	Phaeophytin *a* (ug/L)	SD
1989	1	1	5.7	0.3	3.7	0.7	4.3	0.6	139.2	1.7	7.5	5.8	85.1	21.3	2499.3	125.7	na	na	0.61	0.2	0.37	0.1
	1	11	5.7	0.8	3.2	0.4	3.8	0.4	131.6	8.5	12.2	8.2	84.3	18.8	2559.3	84.6	na	na	0.47	0.3	0.38	0.1
1990	1	1	5.0	0.5	3.2	0.6	2.4	0.4	84.9	26.8	9.2	5.5	75.2	31.3	2964.4	536.6	190.4	106.3	1.15	0.5	0.52	0.2
	1	10	5.6	1.2	3.5	0.9	2.5	0.3	87.5	26.6	10.4	7.0	74.5	30.9	2883.0	619.9	187.4	76.4	1.03	0.5	0.52	0.1
1991	1	1	4.9	1.2	3.2	2.2	3.1	2.1	121.1	26.5	10.0	7.2	90.6	50.7	2559.9	207.1	na	na	1.40	0.7	0.59	0.1
	1	10	5.6	1.9	6.9	10.0	6.1	9.0	121.1	30.2	13.9	6.5	101.1	33.2	2552.7	207.8	na	na	1.10	0.8	0.57	0.2
1992	1	1	5.8	1.5	4.9	4.0	3.6	2.9	137.5	8.3	8.3	4.9	119.3	45.1	2766.6	247.1	168.1	48.2	0.83	0.2	0.46	0.1
	1	9	5.0	0.7	2.3	0.7	1.8	0.3	125.6	21.4	9.9	5.1	131.0	51.5	2707.9	176.0	149.3	55.9	0.81	0.2	0.45	0.1
1993	1	1	5.6	1.4	3.0	0.7	2.5	0.5	141.8	14.8	6.1	4.7	97.8	51.1	2644.6	142.1	148.5	56.8	1.57	0.9	0.47	0.2
	1	10	5.3	1.7	2.7	1.5	2.5	1.2	134.4	15.4	8.7	5.7	100.3	52.1	2758.6	212.1	188.8	55.9	1.27	0.8	0.48	0.2
1994	1	1	6.0	1.2	10.2	12.9	8.9	11.3	153.7	10.3	7.7	4.6	111.4	48.0	2541.4	135.9	176.3	73.1	1.22	0.4	0.31	0.1
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	1.18	0.4	0.31	0.1
	1	9	5.3	1.0	4.5	2.0	4.0	1.7	139.5	10.4	10.6	5.8	112.3	47.2	2558.5	153.7	156.1	54.9	0.88	0.4	0.30	0.0
1995	1	1	7.3	6.4	4.5	5.3	2.1	1.2	151.8	17.2	11.2	8.4	82.8	41.3	2880.4	169.8	241.9	75.8	3.10	1.5	0.60	0.3
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	2.89	1.1	0.64	0.2
	1	9	6.6	2.1	2.3	0.5	1.7	0.3	149.9	14.2	13.2	9.9	84.8	36.7	2894.9	208.6	281.6	124.1	2.84	1.6	0.71	0.2
1996	1	1	6.0	1.3	5.5	1.2	3.1	2.6	110.7	23.1	9.0	6.9	75.6	39.4	2655.6	210.6	145.8	35.7	1.67	0.4	0.48	0.2
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	1.48	0.3	0.46	0.3
	1	9	7.4	3.8	5.9	2.1	2.9	1.0	95.4	24.2	12.2	15.1	84.4	41.0	2669.0	231.3	128.8	26.9	1.45	0.5	0.51	0.2
1997	1	1	6.8	2.5	2.6	1.1	2.0	1.0	126.9	28.1	6.2	4.0	43.5	37.9	2599.3	281.4	147.2	41.0	1.15	0.3	0.83	0.4
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	1.13	0.3	0.78	0.3
	1	9	5.2	1.2	5.2	6.3	4.3	5.3	115.8	20.0	13.6	10.9	48.6	40.3	2568.2	271.9	125.8	34.7	0.96	0.3	0.72	0.2
1998	1	1	9.5	1.5	5.0	2.7	3.5	1.7	168.3	15.1	27.0	8.6	69.0	7.6	2479.3	493.5	91.3	40.4	0.50	0.0	0.60	0.1
	1	11	9.6	na	2.6	na	1.4	na	175.0	na	37.6	na	64.6	na	1955.0	na	80.0	na	0.73	na	0.89	na
1999	1	1	8.9	5.8	4.6	3.1	3.6	3.7	159.0	57.3	15.8	9.6	164.0	30.2	2606.0	430.8	229.3	49.1	1.01	0.47	0.27	0.10
2000	1	1	13.0	6.3	6.2	4.1	1.7	0.9	189.0	0.0	23.9	13.1	168.2	33.2	na	na	na	na	1.79	1.17	0.54	0.39
2001	1	1	9.5	5.7	3.9	2.8	3.7	3.6	21.4	na	6.6	4.6	130.9	45.1	na	na	na	na	2.19	0.65	0.36	0.25

SD - standard deviation
na - parameters were not analyzed.

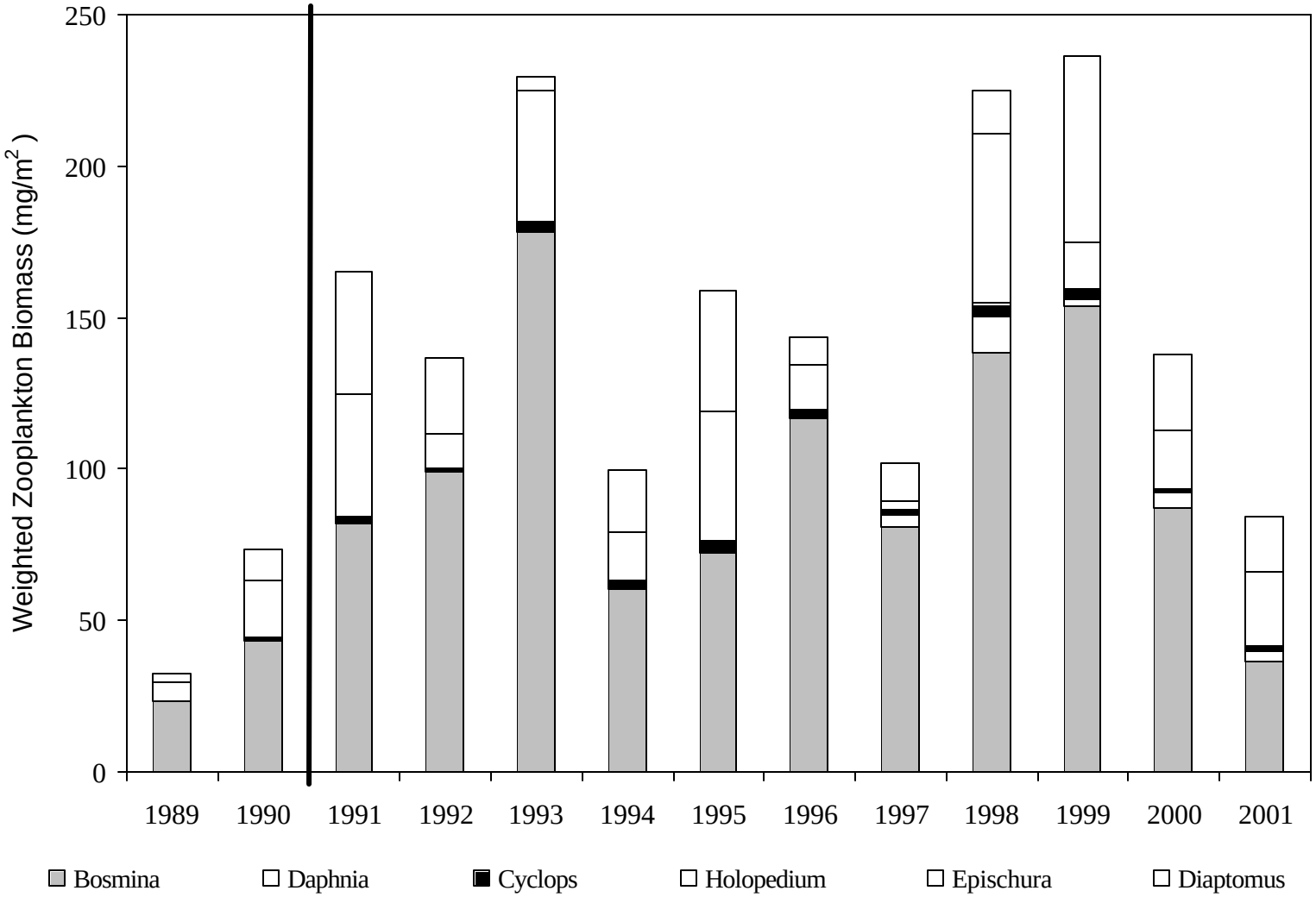
Appendix I.9. Summary of seasonal mean nutrient and algal pigment concentrations for Upper Malina Lake, 1989-2001.

Year	Station	Depth (m)	Total-P (ug/L P)	SD	Total Filterable P (ug/L P)	SD	Filterable Reactive P (ug/L P)	SD	Total Kjeldahl N (ug/L N)	SD	Ammonia (ug/L N)	SD	Nitrate+Nitrite (ug/L N)	SD	Reactive Silicon (ug/L Si)	SD	Organic Carbon (ug/L)	SD	Chlorophyll *a* (ug/L)	SD	Phaeophytin *a* (ug/L)	SD
1989	2	1	6.0	0.3	4.1	0.5	5.1	0.8	136.4	21.3	6.5	3.3	128.5	44.8	2,741	149.4	0.0	0.0	0.80	0.3	1.27	0.1
	2	19	6.1	1.0	3.2	0.5	4.3	0.2	133.5	16.9	10.6	10.3	136.5	35.4	2,789	152.9	0.0	0.0	0.31	0.1	0.52	0.0
1990	2	1	5.4	1.2	4.0	1.1	2.9	0.9	84.9	40.7	6.3	0.7	79.5	36.5	3,165	481.9	229.0	38.1	1.37	0.7	0.63	0.2
	2	25	4.8	1.2	4.5	2.7	3.8	2.2	71.4	39.5	17.2	14.8	103.5	13.3	3,244	425.8	133.0	55.7	0.50	0.3	0.40	0.1
1991	2	1	9.7	6.3	4.2	2.9	3.7	2.9	167.2	67.0	14.0	8.8	82.0	62.2	2,642	218.9	0.0	0.0	2.72	2.8	0.64	0.2
	2	27	7.0	2.5	3.8	2.7	3.4	2.2	137.4	22.9	23.4	14.3	131.7	49.4	2,876	127.5	0.0	0.0	0.97	0.6	0.40	0.1
1992	2	1	6.7	2.5	3.0	2.6	2.1	2.2	139.8	40.3	8.1	4.1	119.8	48.1	2,867	160.6	321.3	99.2	2.61	1.6	1.04	0.6
	2	26	5.0	1.6	2.5	1.3	1.4	0.9	99.5	20.6	15.6	11.7	162.0	49.7	3,078	170.8	168.1	108.7	0.74	0.6	0.55	0.4
1993	2	1	8.1	3.0	3.3	1.2	3.1	1.1	175.4	42.9	6.5	6.3	92.7	78.2	2,688	212.7	322.5	98.8	3.36	1.9	0.72	0.6
	2	27	5.0	1.0	3.1	1.3	2.9	0.9	122.1	24.1	19.9	20.0	189.8	54.0	3,037	229.1	121.5	36.5	0.84	0.4	0.44	0.2
1994	2	1	6.9	2.7	2.8	0.7	3.0	0.7	161.7	24.0	6.5	2.9	125.8	67.7	2,632	201.6	251.8	84.4	2.36	0.8	0.52	0.4
	2	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	2.38	0.8	0.45	0.3
	2	27	6.4	1.2	3.9	1.4	3.8	1.9	140.5	9.3	19.0	13.6	135.1	62.0	2,926	243.7	152.4	49.6	0.98	0.7	0.29	0.1
1995	2	1	7.7	2.4	3.2	1.5	2.3	0.9	162.3	36.7	6.9	5.2	105.7	53.1	2,940	174.8	325.5	117.5	4.68	2.5	1.01	0.7
	2	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	4.28	2.6	0.86	0.6
	2	27	5.9	1.0	2.1	0.8	1.7	0.6	128.6	21.6	24.8	15.0	147.4	22.7	3,112	204.0	155.6	25.5	1.23	0.6	0.56	0.2
1996	2	1	7.7	1.9	5.1	0.8	2.4	0.6	134.0	39.1	3.0	2.0	70.9	55.8	2,704	246.0	281.0	172.7	3.40	1.9	0.82	0.5
	2	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	3.06	1.5	0.66	0.4
	2	27	6.3	1.6	4.6	1.1	3.2	1.4	99.0	32.2	10.6	14.2	136.2	53.8	3,053	304.0	136.2	49.3	1.23	0.7	0.53	0.2
1997	2	1	6.6	1.9	3.3	1.6	2.8	1.5	131.6	24.8	11.1	1.4	58.3	42.0	2,726	242.3	222.8	75.9	1.92	0.8	1.07	0.5
	2	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	2.01	0.8	1.14	0.5
	2	27	7.0	1.8	2.3	0.7	1.9	0.6	120.3	35.7	14.7	7.5	121.5	40.7	3,074	467.2	116.0	33.7	0.89	0.2	0.70	0.2
1998	2	1	7.5	1.8	3.1	0.1	2.6	0.6	171.8	19.7	12.6	7.9	39.2	24.3	2,396	279.8	232.3	42.3	1.70	1.1	1.20	0.5
	2	26	7.0	na	2.7	na	2.1	na	145.0	na	26.4	na	39.1	na	2,416	na	144.0	na	0.92	na	0.80	na
1999	2	1	10.0	4.0	2.7	0.7	1.9	0.7	172.9	52.6	10.9	9.5	139.5	57.2	2,490	565.1	303.8	110.7	2.65	2.17	0.24	0.17
2000	2	1	14.1	3.5	6.6	4.2	2.8	2.4	38.7	0.0	16.1	6.5	121.4	74.5	na	na	na	na	2.24	1.30	1.03	0.75
2001	2	1	11.9	5.7	6.4	2.8	6.6	6.4	52.4	na	3.9	2.9	93.3	93.2	na	na	na	na	4.00	2.00	0.90	0.60

SD - standard deviation
na - parameters were not analyzed.

Appendix I.10. Weighted mean zooplankton density, biomass, and size by genera from Upper Malina Lake, 1989-1998.

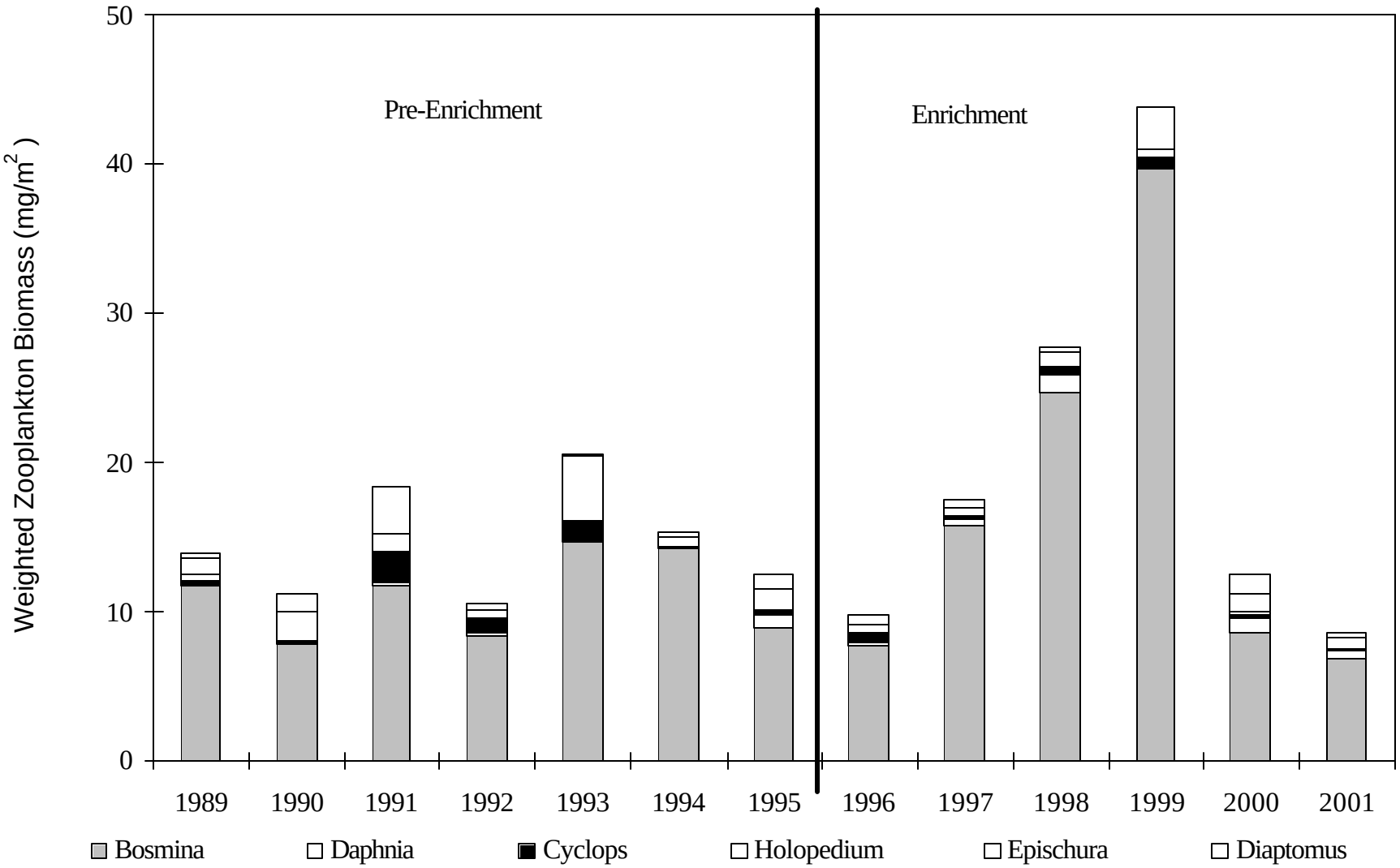
	No. of	*Epischura*			*Diaptomus*			*Cyclops*			*Bosmina*			*Daphnia sp.*			*Holopedium*			TOTALS	
Year	Sample Dates	Density no/m^2	Biomass mg/m^2	Size mm	Density no/m^2	Biomass mg/m^2	Size mm	Density no/m^2	Biomass mg/m^2	Size mm	Density no/m^2	Biomass mg/m^2	Size mm	Density no/m^2	Biomass mg/m^2	Size mm	Density no/m^2	Biomass mg/m^2	Size mm	Density no/m^2	Biomass mg/m^2
1989	3	2,566	6.1	0.8	1,194	2.7	0.8	442	0.4	0.5	32,245	23.2	0.3	0	0.0	0.0	44	<1	0.6	36,492	32
1990	5	2,229	18.9	1.3	4,910	10.1	0.8	929	0.9	0.5	42,251	43.1	0.3	0	0.0	0.5	212	0.6	0.5	50,531	74
1991	6	7,042	40.3	1.1	8,935	40.5	1.0	1,292	1.8	0.6	92,286	82.2	0.3	0	0.0	0.0	168	0.4	0.5	109,722	165
1992	7	2,828	11.3	1.0	13,467	25.1	0.7	1,130	1.3	0.6	112,307	99.1	0.3	243	0.0	0.0	0	0.0	0.0	129,974	137
1993	7	8,492	43.0	1.0	1,251	5.0	1.0	2,844	3.6	0.6	219,025	178.2	0.3	0	0.0	0.0	0	0.0	0.4	231,612	230
1994	8	3,689	16.0	1.0	6,940	20.3	0.9	2,036	2.2	0.6	75,241	60.4	0.3	80	0.2	0.7	146	0.4	0.6	88,131	99
1995	7	5,241	42.9	1.2	11,970	39.6	0.9	2,555	3.9	0.7	78,455	72.3	0.3	9	0.0	0.8	60	0.2	0.6	98,290	159
1996	5	3,091	15.0	1.0	2,255	9.0	1.0	2,335	2.3	0.5	147,427	116.8	0.3	244	0.4	0.6	0	0.0	0.6	155,353	143
1997	6	1,062	3.1	0.9	6,131	12.2	0.8	1,373	1.5	0.6	103,263	80.6	0.3	3,593	4.3	0.5	35	0.1	0.5	115,456	102
1998	4	6,714	55.9	1.2	4,432	14.0	0.9	3,503	3.6	0.6	144,666	138.3	0.3	8,626	11.9	0.6	637	1.2	0.5	168,578	225
1999	4	3,583	15.7	1.0	15,128	61.6	1.0	2,479	3.1	0.6	159,562	154.0	0.3	1,218	1.9	0.6	88	0.2	0.5	182,057	236
2000	5	5,434	19.4	0.9	5,454	24.7	1.0	1,347	1.4	0.6	91,169	87.1	0.3	3,337	5.0	0.6	0	0.0	0.0	106,741	138
2001	5	12,585	24.2	0.7	6,274	18.5	0.9	1,024	1.2	0.6	37,532	36.3	0.3	2,468	3.7	0.7	180	0.5	0.5	60,063	84



Appendix I.11. Weighted mean zooplankton biomass by genera and lake enrichment period for Upper Malina Lake, 1989-2001.

Appendix I.12. Weighted mean zooplankton density, biomass, and size by genera for Lower Malina Lake, 1989-2001.

	No. of	*Epischura*			*Diaptomus*			*Cyclops*			*Bosmina*			*Daphnia sp.*			TOTALS	
	Sample	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass
Year	Dates	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2
1989	3	0	0.0	0.00	486	1.0	0.77	133	0.3	0.84	177	0.4	0.81	16,808	11.7	0.28	17,604	13
1990	5	22	0.0	0.60	338	1.9	1.09	879	1.2	0.66	166	0.2	0.58	9,207	7.8	0.31	10,611	11
1991	6	0	0.0	0.00	318	1.2	0.93	513	3.2	1.14	1,420	2.1	0.67	15,823	11.7	0.29	18,074	18
1992	7	7	0.0	0.42	547	0.6	0.61	243	0.4	0.70	369	0.9	0.85	10,344	8.4	0.30	11,510	10
1993	7	38	0.0	0.47	1,797	4.4	0.81	15	0.1	1.11	432	1.1	0.86	19,305	14.7	0.29	21,588	20
1994	8	384	0.4	0.54	238	0.7	0.86	292	0.4	0.67	109	0.1	0.56	13,779	8.8	0.27	14,801	10
1995	7	295	0.3	0.56	531	1.3	0.81	819	1.0	0.64	223	0.3	0.63	9,616	6.3	0.27	11,484	9
1996	4	366	0.3	0.52	175	0.7	0.94	350	0.5	0.66	454	0.6	0.63	9,395	6.1	0.27	10,740	8
1997	6	371	0.3	0.53	186	0.6	0.90	276	0.6	0.77	75	0.1	0.71	24,676	15.7	0.27	25,584	17
1998	4	406	0.4	0.55	263	1.1	0.97	231	0.3	0.66	311	0.3	0.00	0	24.7	0.00	1,210	27
1999	4	146	0.1	0.41	215	0.4	0.72	526	2.9	1.09	398	0.6	0.00	0	39.7	0.00	1,285	44
2000	5	741	1.2	0.69	345	1.3	0.95	330	0.3	0.55	9,533	8.6	0.32	652	0.9	0.56	11,601	12
2001	6	583	0.8	0.66	66	0.3	1.01	36	0.1	0.68	10,192	6.9	0.28	346	0.5	0.60	11,223	8



Appendix I.13. Weighted mean zooplankton biomass by genera and lake enrichment period for Lower Malina Lake, 1989-2001.

Appendix I.14. Juvenile sockeye salmon estimates based on townet catch species composition and hydroacoustic fish population estimates for Upper and Lower Malina Lakes, 1990 and 1992-1995.

	Total Fish Estimates			Sockeye Estimates			Sockeye
		95% Confidence Interval			95% Confidence Interval		Composition
Date	Number	Low	High	Number	Low	High	(%)
1-Oct-90	481,725	377,207	586,243	78,039	61,107	94,971	16.2
11-Sep-92	1,607,325	1,125,782	2,088,868	170,620	112,213	229,027	11.4
4-Oct-93	1,308,928	1,188,320	1,429,536	123,095	110,681	135,509	9.7
9-Oct-94 [a]	2,110,452	1,583,000	2,637,904	39,709	32,326	47,092	1.7
11-Oct-94 [b]	335,565	197,413	473,717	27,351	17,469	37,233	6.0
14-Sep-95	1,657,937	1,290,806	2,025,068	243,903	186,938	300,868	14.9

[a] hydroacoustic survey conducted on the upper lake.
[b] hydroacoustic survey conducted on the lower lake.

Appendix I.15. Townet catches from Upper and Lower Malina Lakes, 1990 and 1992-1995.

	Tow		Catch by Species					
			Sockeye			Stickleback		
Date	No.	Minutes	No.	%	CPUE	No.	%	CPUE
2-Oct-90	3	60	97	17.9	1.6	503	82.1	8.4
12-Sep-92	3	51	49	11.4	1.0	379	88.6	7.4
5-Oct-93	3	48	50	9.7	1.0	466	90.3	9.7
10-Oct-94 [a]	4	67	35	1.7	0.5	1,987	98.3	29.7
11-Oct-94 [b]	4	69	35	6.0	0.5	547	94.0	7.9
15-Sep-95	4	na[c]	30	14.9	na	172	85.1	na

[a] townet surveys conducted on the upper lake.
[b] townet surveys conducted on the lower lake.
[c] The times for each tow were not available.

Appendix I.16. Mean length, weight, and condition coefficient by age of juvenile sockeye salmon captured by townet from Upper and Lower Malina Lakes, 1990 and 1992-1995.

	Age-0				Age-1				Age-2			
Date	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)
10/2/90	43	46.1	0.8	0.83	11	62.4	2.3	0.91	0			
9/12/92	22	44.0	1.1	1.25	11	65.6	3.4	1.18	0			
10/5/93	47	50.4	1.5	1.18	11	70.6	4.2	1.17	0			
10/10/94 [a]	12	48.7	1.4	1.09	9	65.6	3.1	1.10	0			
10/11/94 [b]	31	49.8	1.3	0.99	1	57.0	1.8	0.97	0			
9/15/95	7	43.0	1.0	1.28	15	64.2	3.2	1.11	1	74	4.3	1.07

[a] samples collected from the upper lake.
[b] samples collected from the lower lake.

Appendix I.17. Estimated number of sockeye salmon smolt outmigrating from Malina Lake by year and age class, 1992 and 1997-2001.

	Number and Relative Percent of Smolt by Age Class			Total Population		95% CI	
Year	1.	2.	3.	Estimate	SE	Lower	Upper
1992	4.9%	94.6%	0.5%				
	49,842	962,262	5,086	1,017,190	177,609	660,252	1,374,129
1997	37.1%	61.8%	1.1%				
	187,506	311,664	5,607	504,777	18,260	468,988	540,566
1998	65.2%	34.1%	0.7%				
	318,438	166,449	3,290	488,180	24,042	441,041	535,318
1999	81.0%	17.3%	1.7%				
	409,345	87,392	8,477	505,214	20,711	464,620	545,807
2000	68.9%	30.9%	0.2%				
	319,832	175,978	815	496,625	22,925	451,691	541,559
2001	37.1%	56.5%	6.4%				
	120,514	183,437	20,891	324,842	22,963	279,835	369,851

Appendix I.18. Upper and Lower Malina Lakes sockeye salmon emigration timing and estimatesa by age class, 1992 and 1997-2001.

	Statistical		Ages			Population
Year	Period	Week	1	2	3	Estimate
1992	20	5/10-5/16	37	2,603	0	2,640
	21	5/17-5/23	2,157	70,724	1,487	74,368
	22	5/24-5/30	42,084	537,159	5,261	584,504
	23	5/31-6/06	8,610	187,062	0	195,672
	24	6/07-6/13	5,657	98,900	314	104,767
	25	6/14-6/20	2,769	45,806	0	48,575
	26	6/21-6/27	0	6,482	0	6,482
			61,314	948,737	7,062	1,017,113
1997	20 & 21	5/10-5/16	19,579	21,245	208	27,662
	22	5/24-5/30	7,085	8,097	156	179,306
	23	5/31-6/06	98,533	254,160	4,604	175,412
	24	6/07-6/13	19,432	12,045	482	34,837
	25	6/14-6/20	42,877	16,118	156	40,993
			187,506	311,665	5,606	504,777
1998	20 & 21	5/10-5/16	4,108	8,415	279	12,802
	22	5/24-5/30	99,187	65,277	848	165,312
	23	5/31-6/06	154,722	36,977	973	192,672
	24	6/07-6/13	25,846	3,735	149	29,730
	25	6/14-6/20	17,406	11,554	600	29,560
	26	6/21-6/27	11,093	25,438	191	36,722
	27	6/28-7/04	5,292	14,112	252	19,656
	28	7/05-7/11	783	939	0	1,722
			318,437	166,447	3,292	488,176

	Statistical		Ages			Population
Year	Period	Week	1	2	3	Estimate
1999	20 & 21	5/10-5/16	120,647	5,623	2,556	128,826
	22	5/24-5/30	170,130	29,194	2,013	201,337
	23	5/31-6/06	90,371	24,217	2,953	117,541
	24	6/07-6/13	18,872	19,658	786	39,316
	25	6/14-6/20	6,866	6,363	167	13,396
	26	6/21-6/27	2,459	2,337	0	4,796
			409,345	87,392	8,475	505,212
2000	20	5/10-5/16	16,083	7,257	196	23,536
	21	5/17-5/23	90,336	32,174	619	123,129
	22	5/24-5/30	122,590	81,727	0	204,317
	23	5/31-6/06	57,941	43,202	0	101,143
	24	6/07-6/13	24,327	9,936	0	34,263
	25	6/14-6/20	8,556	1,682	0	10,238
			319,833	175,978	815	496,626
2001	19	5/03-5/09	1,108	2,630	415	4,153
	20	5/10-5/16	1,712	18,407	10,274	30,393
	21	5/17-5/23	33,389	140,976	10,202	184,567
	22	5/24-5/30	67,854	20,844	0	88,698
	23	5/31-6/06	14,375	521	0	14,896
	24	6/07-6/13	2,077	58	0	2,135
			120,515	183,436	20,891	324,842

[a] Estimates based on seasonal mean age compositions.

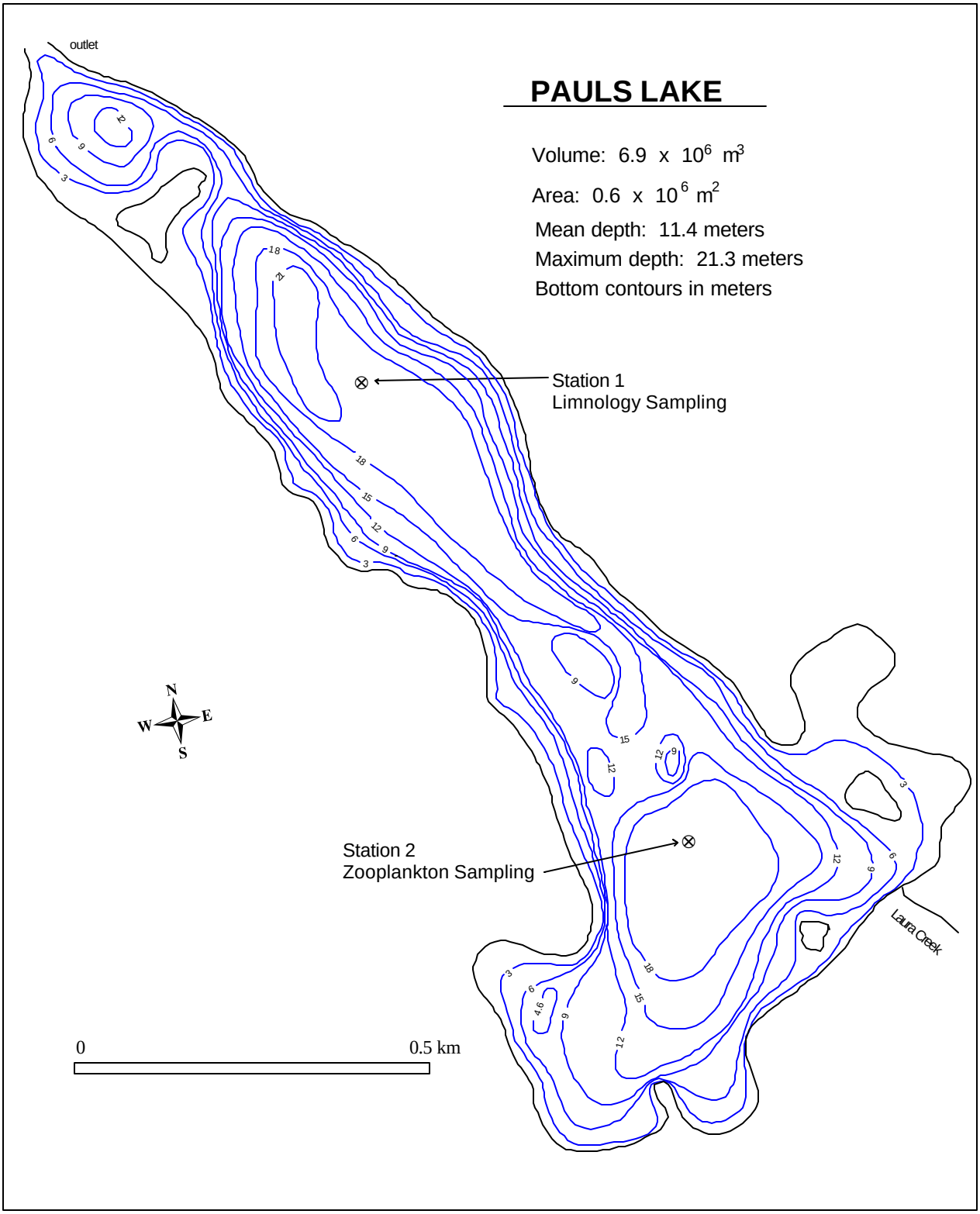
Appendix I.19. Upper and Lower Malina Lakes sockeye salmon smolt age and size composition by year, 1991-2001.

		Age-1				Age-2				Age-3			
Year	Date	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)
1991	May 24-June 6	74	74.5	2.9	0.70	90	77.4	3.2	0.69	1	72.0	2.7	0.72
1992	May 10-June 27	84	71.5	2.3	0.64	1,614	73.0	2.6	0.66	8	77.8	3.6	0.75
1993	May 24-June 6	24	76.1	3.4	0.76	876	78.5	3.7	0.76	79	82.0	4.2	0.76
1994	May 17-June 6 [a]	33	75.8	3.0	0.69	350	78.0	3.3	0.69	8	84.5	4.5	0.71
1995	May 31-June 27	639	70.5	2.5	0.70	45	89.8	6.5	0.78	0			
1996	May 3-June 20	249	99.0	7.3	0.73	965	79.9	4.0	0.75	4	83.3	4.2	0.72
1997	May 10-July 4	687	81.1	3.8	0.70	660	85.5	4.6	0.71	12	85.3	4.7	0.73
1998	May 3-July 18	818	92.8	6.3	0.75	733	77.5	3.7	0.78	17	89.4	6.0	0.81
1999	May 24-July 4	756	83.4	4.2	0.71	276	76.6	3.3	0.72	18	90.8	6.6	0.79
2000	May 10-June 20	721	81.3	4.0	0.72	335	79.1	3.7	0.73	2	97.0	6.9	0.73
2001	May 12-June 25	551	73.9	3.2	0.77	391	91.1	6.0	0.77	74	105.6	10.3	0.83

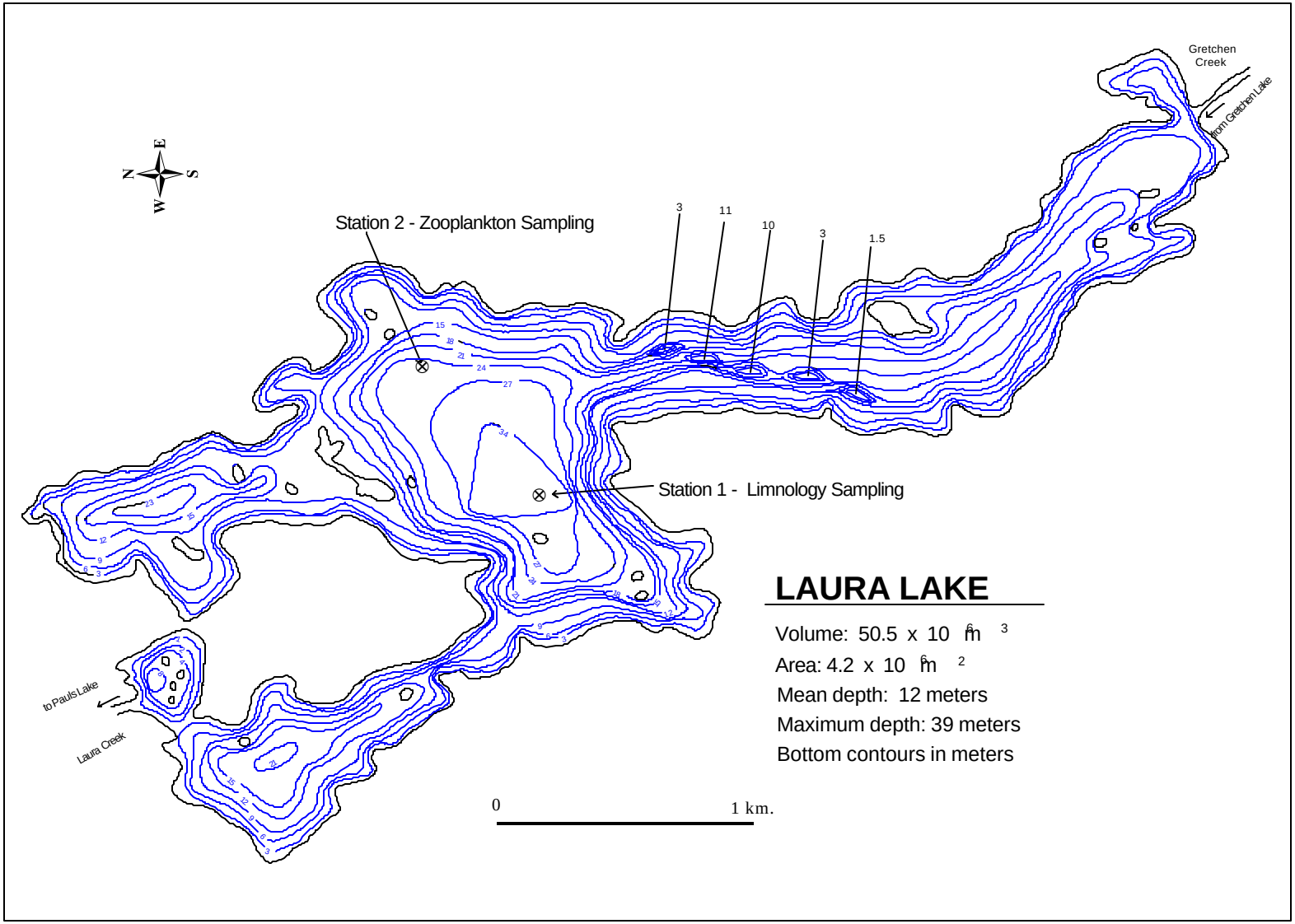
[a] In 1994, one age-0 smolt captured was 79.0 mm, 3.4 g, and a condition of 0.7.

Appendix I.20. Estimated age composition of Upper and Lower Malina Lakes sockeye salmon escapement, 1990 and 1992-2001.

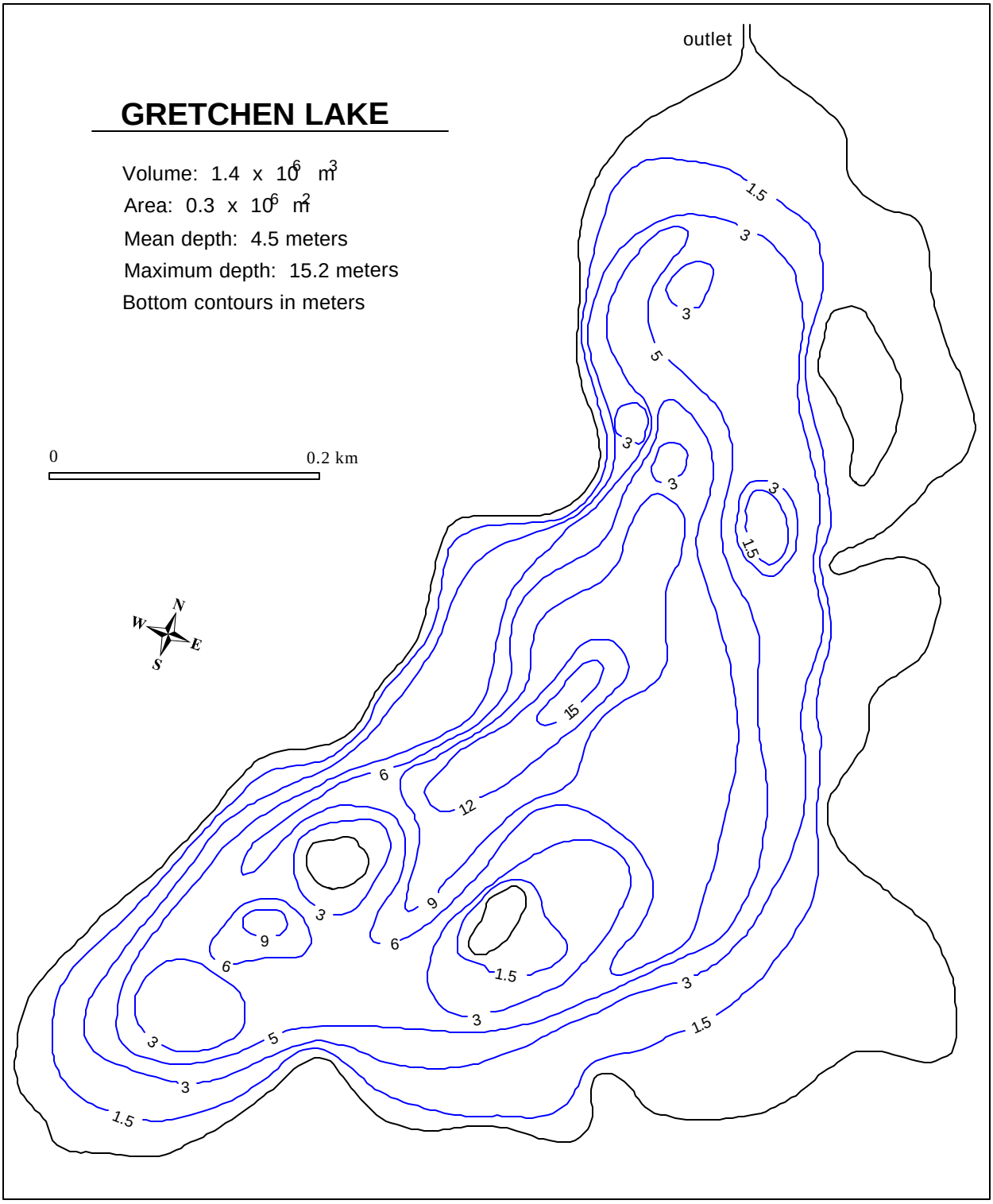
		Ages										
Year		1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	Total
1990	Number	0	109	0	12	381	1	1	0	4	0	508
	Percent	0.0	21.5	0.0	2.4	75.0	0.2	0.2	0.0	0.8	0.0	100
1992	Number	67	247	517	547	3,812	1,468	7.5	232	644	67	7,610
	Percent	0.9	3.2	6.8	7.2	50.1	19.3	0.1	3.1	8.5	0.9	749
1993	Number	206	321	183	2,022	2,450	2,503	0	84	374	130	8,273
	Percent	2.5	3.9	2.2	24.4	29.6	30.3	0.0	1.0	4.5	1.6	100
1994	Number	388	765	607	1,893	4,005	1,299	0	24	49	12	9,042
	Percent	4.3	8.5	6.7	20.9	44.3	14.4	0.0	0.3	0.5	0.1	100
1995	Number	48	167	502	1,028	4,756	4,206	0	24	72	0	10,803
	Percent	0.4	1.5	4.6	9.5	44.0	38.9	0.0	0.2	0.7	0.0	100
1996	Number	44	192	209	113	3,127	4,163	0	26	122	35	8,030
	Percent	0.5	2.4	2.6	1.4	38.9	51.8	0.0	0.3	1.5	0.4	100
1997	Number	2,837	832	879	558	946	3,262	0	47	85	9	9,455
	Percent	30.0	8.8	9.3	5.9	10.0	34.5	0.0	0.5	0.9	0.1	100
1998	Number	5,757	2,553	275	350	3,204	2,428	25	100	150	75	14,917
	Percent	38.6	17.1	1.8	2.3	21.5	16.3	0.2	0.7	1.0	0.5	100
1999	Number	2,197	19,537	1,183	135	2,265	3,245	0	68	372	169	29,171
	Percent	7.5	67.0	4.1	0.5	7.8	11.1	0.0	0.2	1.3	0.6	100
2000[a]	Number	714	6,554	11,049	147	1,113	1,092	0	42	231	63	21,006
	Percent	3.4	31.2	52.6	0.7	5.3	5.2	0.0	0.2	1.1	0.3	100
2001	Number	3,059	3,374	9,603	1,799	742	3,756	0	45	45	67	22,490
	Percent	13.6	15.0	42.7	8.0	3.3	16.7	0.0	0.2	0.2	0.3	100



Appendix J.1. Morphometric map showing the limnology and zooplankton stations on Pauls Lake.



Appendix J.2. Morphometric map showing the limnology and zooplankton stations on Laura Lake.



Appendix J.3. Morphometric map of Gretchen Lake.

Appendix J.4. Juvenile sockeye salmon releases into Laura Lake, 1994-2001.

Release Year	Broodstock	Species Stocked	Life Stage[a] fry	fingerling	presmolt	Total Stocked
1992						0
1993						0
1994	Laura	Sockeye	117,000			117,000
1995	Laura	Sockeye	16,000			16,000
1996	Laura	Sockeye		52,000	130,000	182,000
1997						0
1998						0
1999	Laura	Sockeye		28,000	144,000	172,000
2000						0
2001						0

[a] Fry are released from April to July at up to 200% of emergent size (normally 0.15 to 0.5 g depending on the stock). Fingerling are released from June to September at a size of >200% to <2100% of emergent size (normally 0.3 to 5.25 g depending on the stock). Pre-smolt are released from August to November at a size of >2100% of emergent size but not yet at the physiological stage of smolting (normally 5 to 13 g).

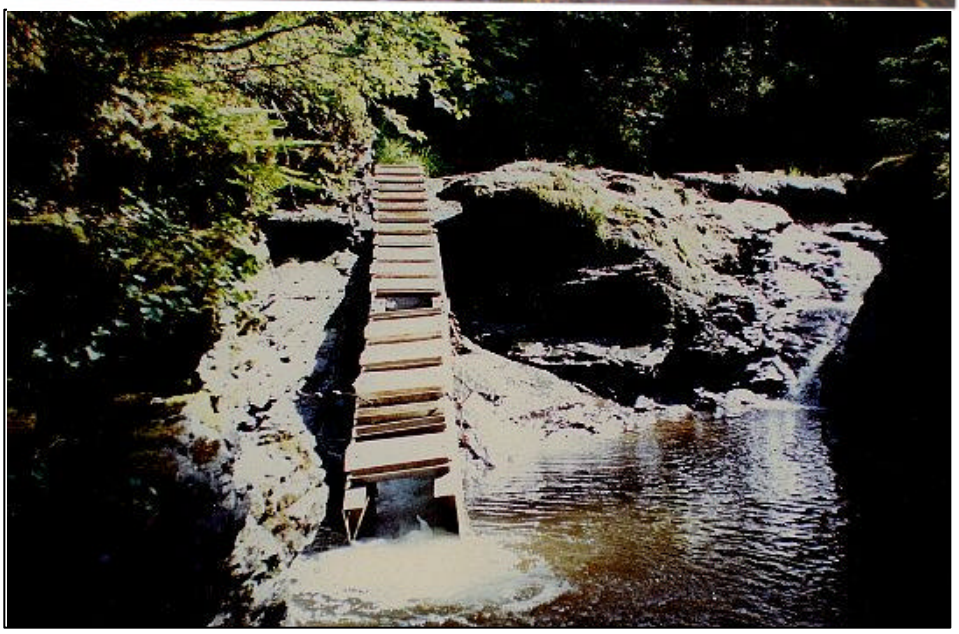
Appendix J.5. The amount of nutrient enrichment additions and ratios into Laura Lake, 1993-2000.

Year	Fertilizer Ratio[a]	Amount (kg)
1993	20-5-0	20,000
1994	20-5-0	18,144
1994	32-0-0	3,629
1995	20-5-0	18,144
1995	32-0-0	3,629
1996	20-5-0	17,272
1996	32-0-0	3,048
1997	20-5-0	8,128
1998	20-5-0	8,000
1999	20-5-1	9,770
2000	20-5-0	9,276

[a] Nitrogen-Phosphorus-Potassium

a.

b.



Appendix J.6. Laura Creek (a) and Gretchen Creek (b) fish passes.

Appendix J.7. Limnological sampling stations and total samples collected for Laura and Pauls Lakes, 1990-2001.

Lake	Year	Sampling Stations	Total Samples
Laura	1990	1	3
	1991	1	5
	1992	1	4
	1993	1	7
	1994	1,2	7
	1995	1,2	7
	1996	1,2	6
	1997	1,2	6
	1998	1	4
	1999	1	4
	2000	1	4
	2001	1	4
Pauls	1994	1,2	4

Appendix J.8. Summary of seasonal mean water chemistry parameters by station and depth for Laura and Pauls Lakes, 1990-2001.

Lake	Year	Station	Depth (m)	Sp. Cond. (umhos cm^{-1})	SD	pH (Units)	SD	Alkalinity (mg L^{-1})	SD	Turbidity (NTU)	SD	Color (Pt units)	SD	Calcium (mg L^{-1})	SD	Magnesium (mg L^{-1})	SD	Iron (ug L^{-1})	SD
Laura	1990	1	1	72.0	1.7	7.0	0.2	11.0	1.0	0.7	0.3	14.3	2.3	4.4	2.4	1.0	0.8	56.7	22.3
		1	29	74.7	1.2	6.8	0.2	11.5	0.9	0.4	0.2	15.3	2.5	4.8	1.4	1.3	1.1	62.7	24.1
	1991	1	1	68.8	1.6	7.0	0.0	11.5	2.2	0.9	0.4	17.6	3.5	3.8	0.1	1.1	0.6	77.4	37.7
		1	32	70.4	1.1	6.8	0.1	11.0	1.7	0.6	0.2	20.8	7.6	4.1	0.4	1.4	0.3	69.0	24.8
	1992	1	1	60.8	1.0	6.8	0.2	8.8	2.1	0.5	0.2	15.0	2.9	4.1	0.5	1.3	0.5	56.3	16.0
		1	35	63.8	1.0	6.4	0.2	10.1	0.6	0.7	0.3	13.8	1.3	3.8	0.6	1.4	0.5	58.3	25.6
	1993	1	1	65.9	1.5	6.8	0.1	11.1	1.5	1.2	1.6	13.1	1.8	4.2	0.5	1.7	0.4	53.1	36.2
		1	34	67.9	5.4	6.8	0.7	12.9	3.6	0.6	0.3	15.1	2.3	4.6	1.4	1.7	0.4	85.4	68.8
	1994	1	1	66.0	1.7	6.5	0.2	10.3	2.1	0.9	0.5	13.6	3.5	4.1	0.4	1.1	0.3	57.6	23.9
		1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
		1	36	70.0	5.4	6.4	0.3	10.5	1.7	0.9	0.2	14.1	1.6	4.2	0.8	1.9	0.5	75.3	24.9
	1995	1	1	67.3	3.8	6.4	0.2	9.1	0.5	1.5	0.5	20.6	9.4	3.6	0.4	1.3	0.0	73.0	31.6
		1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
		1	36	71.0	1.3	6.2	0.1	8.9	0.6	0.8	0.2	16.0	2.8	3.7	0.2	1.3	0.0	70.4	31.1
	1996	1	1	69.5	1.0	6.6	0.2	10.5	0.5	0.8	0.4	17.2	3.7	3.6	0.1	1.2	0.1	60.2	36.0
		1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
		1	33	70.8	1.9	6.3	0.1	9.9	0.5	0.8	0.5	18.2	1.2	3.6	0.1	1.2	0.1	81.8	34.1
	1997	1	1	70.5	1.0	7.0	0.2	12.2	1.2	0.8	0.2	14.0	2.5	3.5	0.2	1.3	0.1	37.5	22.9
		1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
		1	34	71.0	0.9	6.6	0.1	11.8	0.7	0.7	0.1	16.0	1.5	3.7	0.5	1.2	0.1	54.0	17.2
	1998	1	1	63.7	0.6	7.1	0.2	12.7	2.0	1.0	0.6	15.3	2.5	3.5	0.2	1.2	0.2	20.3	4.0
	1999	1	1	72.0	1.2	6.6	0.3	11.6	1.9	1.4	0.5	14.3	2.9	4.0	0.2	1.7	0.2	78.8	30.3
	2000	1	1	na	na	7.3	0.2	8.4	1.7	na	na	na	na	na	na	na	na	na	na
	2001	1	1	na	na	7.5	0.4	9.6	1.5	na	na	na	na	na	na	na	na	na	na
Pauls	1994	1	1	1,453.5	1,892.3	7.1	0.3	16.3	5.2	0.7	0.2	10.5	3.1	15.6	15.8	29.1	40.6	31.8	14.5
		1	12	31,575.0	2,642.4	7.5	0.6	215.3	91.9	2.1	1.0	35.3	22.4	322.0	50.2	767.0	27.4	103.5	63.8

SD - standard deviation
na - not analyzed

Appendix J.9. Summary of seasonal mean nutrient and algal pigment concentrations by station and depth for Laura and Pauls Lakes, 1990-2001.

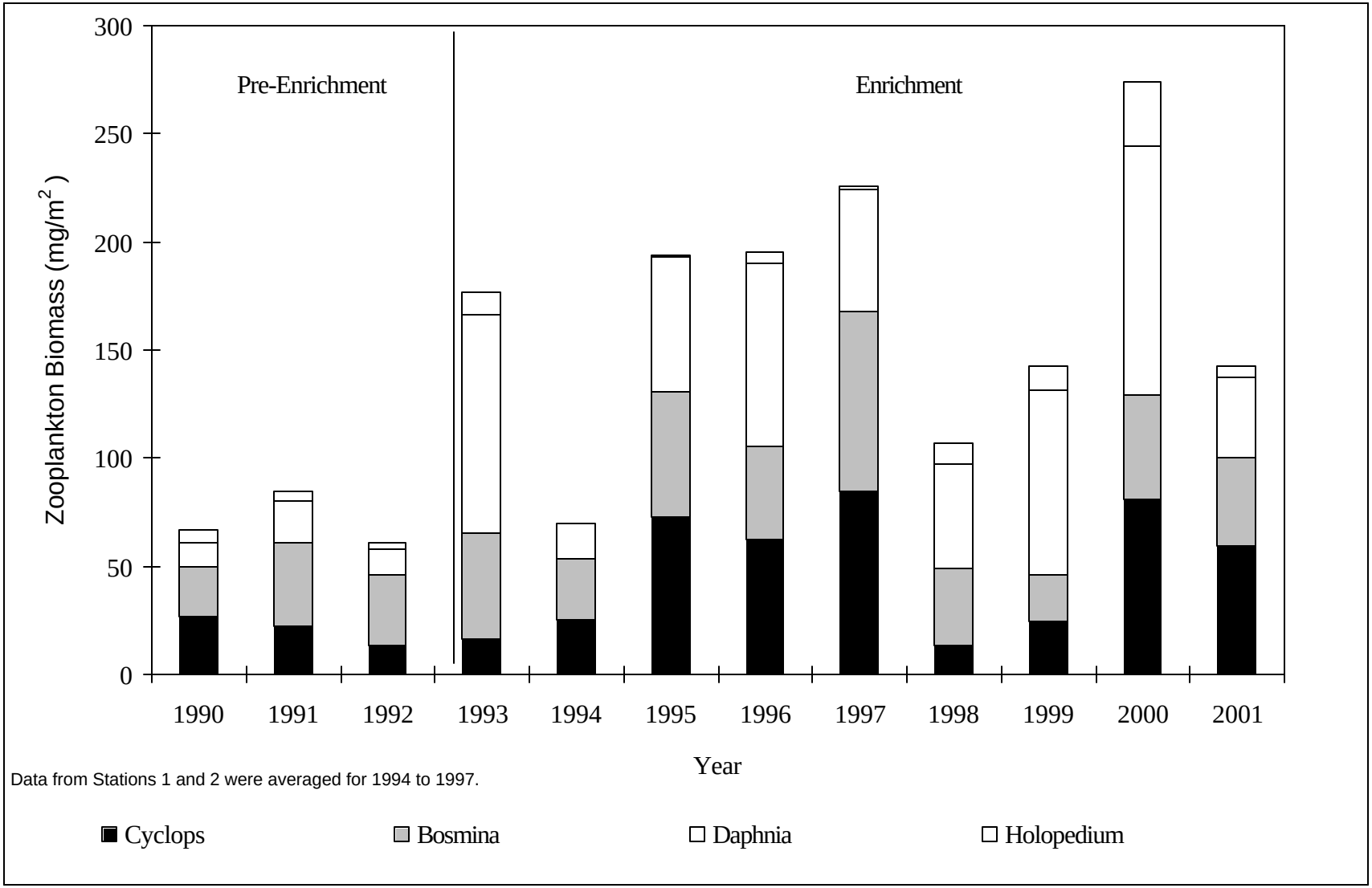
Lake	Year	Station	Depth (m)	Total-P (ug L^{-1})	SD	Total filter-able-P (ug L^{-1})	SD	Filterable reactive-P (ug L^{-1})	SD	Total Kjel-dahl nitrogen (ug L^{-1})	SD	Ammonia (ug L^{-1})	SD	Nitrate+ nitrite (ug L^{-1})	SD	Reactive silicon (ug L^{-1})	SD	Organic carbon (ug L^{-1})	SD	Chloro-phyll a (ug L^{-1})	SD	Phaeo-phytin a (ug L^{-1})	SD
Laura	1990	1	1	3.9	0.9	2.4	0.2	1.6	0.3	125.1	10.2	4.6	0.8	6.0	7.4	1836.0	112.3	251.3	45.0	0.80	0.4	0.37	0.07
		1	29	2.3	0.4	2.9	1.9	2.1	0.9	101.4	6.8	11.5	4.0	30.2	5.4	1983.3	132.1	137.0	44.2	0.27	0.0	0.20	0.03
	1991	1	1	4.1	0.6	2.8	1.3	1.9	0.8	82.6	23.8	10.0	3.3	10.2	12.4	1696.2	136.7	NA	NA	0.79	0.2	0.32	0.06
		1	32	4.0	0.6	3.5	2.0	2.6	2.3	82.9	24.9	15.6	6.8	27.6	6.1	1824.6	57.3	NA	NA	0.35	0.4	0.17	0.10
	1992	1	1	6.0	3.2	3.7	1.6	3.4	1.2	100.3	11.0	5.4	2.5	10.0	3.3	1707.0	198.4	186.5	45.8	0.58	0.4	0.36	0.11
		1	35	6.1	2.6	2.2	0.4	1.9	0.3	91.9	19.0	9.0	2.7	30.8	8.1	1954.8	9.6	99.3	33.4	0.48	0.3	0.34	0.12
	1993	1	1	12.1	3.9	3.9	1.0	1.8	0.4	189.0	37.2	6.6	3.6	8.2	0.0	984.8	512.1	242.1	64.0	2.65	0.8	0.83	0.41
		1	34	8.3	4.1	4.8	4.2	3.1	2.8	139.2	23.4	14.9	8.6	26.2	11.5	1861.0	221.1	125.3	86.2	0.72	0.9	0.37	0.20
	1994	1	1	10.0	4.2	2.8	0.9	1.5	0.2	184.0	47.6	9.4	8.9	31.7	40.5	953.6	550.1	166.3	81.1	2.59	1.6	0.54	0.35
		1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	2.67	1.6	0.60	0.28
		1	36	4.5	0.8	2.3	0.6	1.5	0.4	151.9	37.2	42.2	34.9	29.1	28.5	1784.3	87.8	90.7	25.6	0.39	0.1	0.25	0.03
	1995	1	1	8.9	4.1	4.3	3.9	3.3	3.9	176.0	46.6	10.1	4.5	25.1	18.6	1417.9	367.7	na	na	3.90	3.0	1.00	0.72
		1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	4.11	3.5	1.18	0.83
		1	36	6.1	2.0	2.4	1.1	1.5	0.7	138.2	41.5	26.0	17.6	55.5	15.4	1870.4	107.5	na	na	0.54	0.5	0.33	0.04
	1996	1	1	11.9	4.1	5.2	3.1	3.2	1.8	192.5	71.9	9.9	7.1	17.0	12.0	1435.2	270.5	261.8	101.2	5.31	3.9	0.98	0.42
		1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	4.88	4.4	0.88	0.65
		1	33	6.7	2.3	3.9	2.1	2.7	1.7	125.6	23.7	18.6	15.5	57.7	16.2	1836.6	27.2	73.8	24.1	1.77	1.7	0.55	0.28
	1997	1	1	7.8	1.8	3.5	1.9	2.1	1.4	169.1	40.4	6.7	4.4	9.7	17.2	1059.0	615.4	229.7	53.7	1.76	1.2	1.00	0.46
		1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	1.72	0.9	1.17	0.73
		1	34	6.1	1.3	3.1	0.7	1.9	0.6	124.1	12.9	13.8	9.9	53.7	10.0	1911.2	264.8	89.8	31.3	0.36	0.1	0.43	0.06
	1998	1	1	11.5	4.2	3.7	2.3	0.9	0.5	174.6	17.9	4.1	2.5	11.0	5.1	1127.7	296.1	188.7	91.5	1.38	0.4	3.06	2.97
	1999	1	1	10.2	3.4	3.5	0.5	1.6	0.3	187.6	32.0	6.7	2.7	11.9	17.4	1304.5	358.5	293.5	139.6	2.55	1.5	0.43	0.28
	2000	1	1	5.7	2.6	3.4	2.9	2.8	2.2	40.4	27.7	13.2	10.7	33.7	52.0	na	na	na	na	2.56	1.8	1.03	1.08
	2001	1	1	10.9	1.1	5.8	2.6	4.4	3.7	29.1		4.2	3.8	3.8	3.8	na	na	na	na	5.83	4.90	0.94	0.61
Pauls	1994	1	1	355.2	691	2.675	1.4	1.775	0.5	1,758	3,015	15.05	17.29	19.4	na	1,232	499	264.8	112.3	1.828	1.11	0.483	0.53
		1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	2.26	0.71	0.453	0.23
		1	12	677	707	876.3	581	991.5	660	3,017	3,189	4,292	2,864	2.4	2.54	8,347	4,197	964.8	192.1	4.81	na	25.71	16.64

SD - standard deviation
na - not analyzed

Appendix J.10. Weighted mean zooplankton density, biomass, and size by genera from Laura Lake, 1990-2001.

	No. of	***Cyclops***			***Bosmina***			***Daphnia***			***Holopedium***			TOTALS	
	Sample	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass
Year [a]	Days	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2
1990	3	12,900	27	0.78	27,816	23	0.30	10,218	11	0.50	2,553	6	0.51	53,487	67
1991	5	47,054	22	0.89	47,054	39	0.31	14,293	19	0.56	2,532	5	0.50	110,933	85
1992	4	4,624	13	0.91	33,852	33	0.33	8,920	12	0.56	1,778	3	0.47	49,174	61
1993	7	7,037	16	0.80	49,924	49	0.33	70,951	101	0.58	4,838	11	0.52	132,750	177
1994	7	7,804	25	0.93	31,628	29	0.31	12,323	16	0.56	309	0.7	0.43	52,064	70
1995	7	23,358	73	0.93	65,347	58	0.31	50,174	63	0.55	133	0.4	0.49	139,012	194
1996	6	24,058	62	0.80	53,494	43	0.30	79,937	85	0.51	2,813	5.6	0.49	160,302	196
1997	6	25,035	84	0.95	95,101	83	0.31	41,712	57	0.57	1,083	1.9	0.47	162,931	226
1998	4	5,531	14	0.83	38,687	36	0.31	43,904	53	0.49	5,387	5	0.43	93,509	108
1999	4	10,064	24	0.83	20,685	21	0.34	82,551	86	0.50	6,643	11	0.45	119,942	143
2000	4	27,734	81	0.90	39,636	48	0.36	102,481	115	0.52	11,040	30	0.55	180,891	274
2001	5	17,503	59	1.03	46,749	41	0.32	29,717	37	0.59	3,377	5	0.46	97,346	142

[a] Data from 1994 - 1997 was averaged from two stations, and the remaining years, only samples from station 1 were obtained.



Appendix J.11. Weighted mean zooplankton biomass by genera and lake enrichment time period for Laura Lake, 1990-2001.

Appendix J.12. Juvenile sockeye salmon estimates based on fall townet catch species composition and hydroacoustic fish population estimates for Laura Lake, 1991-1997.

	Total Fish Estimates			Sockeye Estimates			Sockeye
		95% C. I.			95% C. I.		Composition
Date	Number	Low	High	Number	Low	High	(%)
27-Aug-91	1,111,608	734,342	1,488,874	170,076	112,354	227,798	15.3
2-Oct-92	1,837,604	1,310,334	2,364,874	183,760	131,033	236,487	10.0
16-Sep-93	897,732	862,637	932,827	104,137	100,066	108,208	11.6
3-Oct-94	1,089,645	870,045	1,309,245	64,289	51,333	77,245	5.9
30-Aug-95	2,729,625	1,969,959	3,489,291	414,903	299,434	530,372	15.2
16-Sep-96	1,932,933	1,604,064	2,261,802	71,519	59,351	83,687	3.7
17-Sep-97	4,218,356	3,783,430	4,653,282	21,092	18,917	23,267	0.5

Appendix J.13. Townet catches from Laura Lake, 1991-1997.

			Catch by Species					
	Tow		Sockeye			Stickleback		
Date	Number	Minutes	Number	%	CPUE [a]	Number	%	CPUE [a]
28-Aug-91	5	58	83	15.3	1.4	459	84.7	7.9
03-Oct-92	6	69	78	10.0	1.1	702	90.0	10.2
17-Sep-93	5	68	106	11.6	1.6	811	88.4	11.9
04-Oct-94	7	86	29	5.9	0.3	461	94.1	5.4
31-Aug-95	6	46	78	15.2	1.7	435	84.8	9.5
17-Sep-96	6	60	47	3.7	0.8	1,236	96.3	20.6
17-Sep-97	6	43	1	0.5	0.0	208	99.5	4.8

[a] CPUE - Catch per unit of effort

Appendix J.14. Mean length, weight, and condition coefficient by age for juvenile sockeye salmon captured by townet at Laura Lake, 1991-1997.

	Age-0				Age-1				Age-2			
Date	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)
28-Aug-91	39	52.8	1.6	1.07	18	63.7	2.8	1.05	0			
3-Oct-92	56	53.3	1.8	1.14	12	66.6	3.2	1.07	1	71.1	3.9	1.09
17-Sep-93	69	53.2	1.9	1.24	2	65.5	3.5	1.26	0			
4-Oct-94	19	51.2	1.7	1.20	1	63.0	3.1	1.24	1	74.0	5.1	1.26
31-Aug-95	63	55.9	1.9	1.04	17	67.7	3.4	1.08	0			
17-Sep-96	6	50.7	1.5	1.16	40	59.9	2.6	1.21	1	76.0	4.2	0.96
17-Sep-97	0				1	46.0	0.9	0.92	0			

Appendix J.15. Mean length, weight, and condition coefficient by age for sockeye salmon smolt outmigrating from Laura Lake, 1953-1957 and 1992-2001.

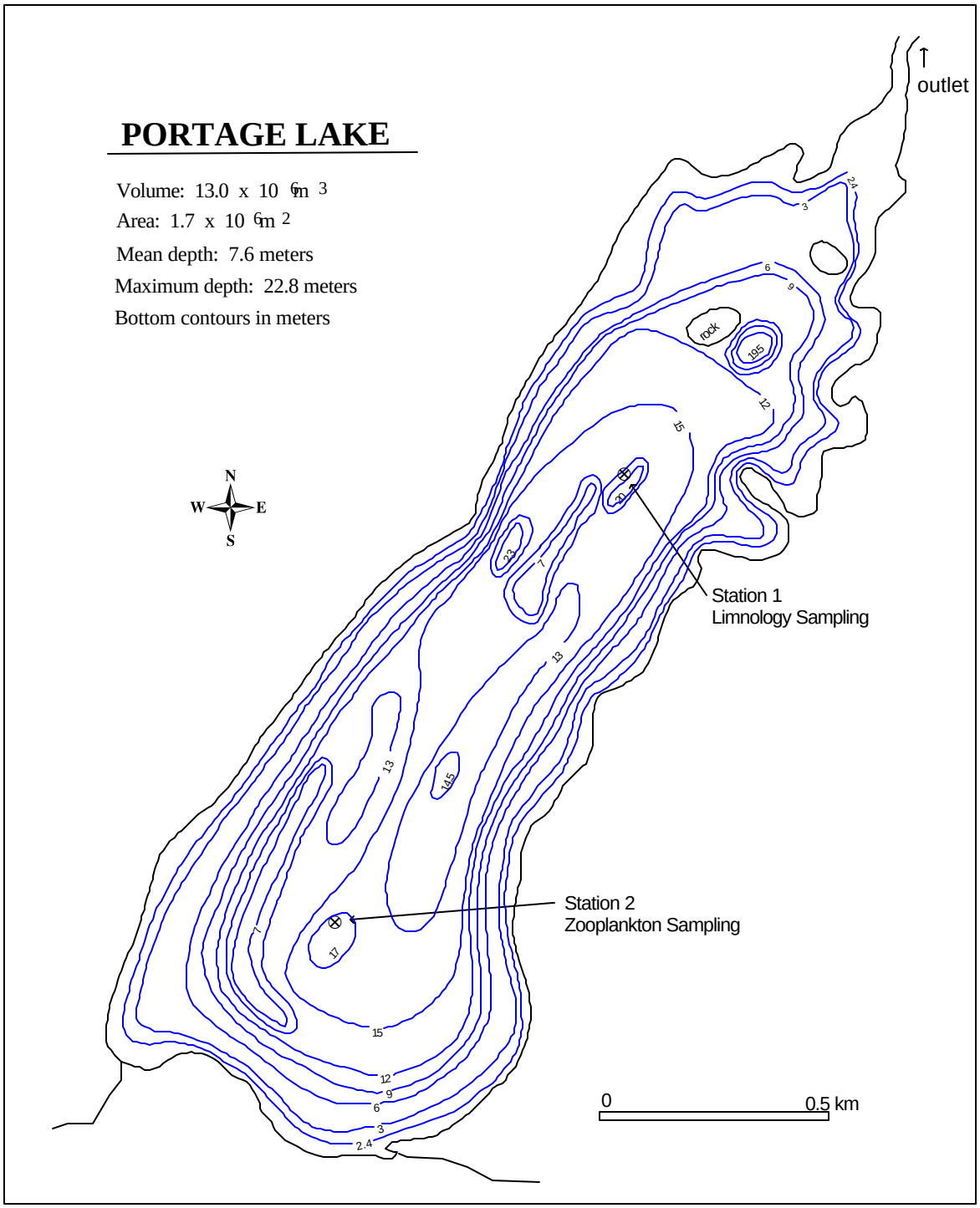
	Age-1				Age-2				Age-3			
Date	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)
1953[a]	1,238	133	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1954[a]	8,702	nd	nd	nd	1,842	nd	nd	nd	nd	nd	nd	nd
1955[a]	936	nd	nd	nd	1,853	nd	nd	nd	184	nd	nd	nd
1956[a]	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1957[a]	226	nd	nd	nd	66	nd	nd	nd	32	nd	nd	nd
June 10-12, 1992	189	69.9	2.6	0.75	64	76.3	3.3	0.75	0			
June 14-15, 1993	124	72.5	3.1	0.80	16	78.0	3.8	0.79	0			
Jun 7-13, 1994	221	70.8	2.8	0.80	19	80.8	4.0	0.75	0			
May 31-June 13, 1995	114	67.4	2.4	0.79	20	74.7	3.0	0.72	0			
Jun 13-18, 1996	132	76.9	3.6	0.79	63	83.1	5.0	0.84	1	85.0	5	0.82
May 31-June 13, 1997	54	82.5	4	0.69	144	77.0	3.3	0.72	0			
May 31-June 20, 1998	10	85.6	5.6	0.84	239	79.4	4.3	0.86	0			
June 14-20, 1999	215	68.3	2.5	0.79	21	74.6	3.2	0.77	0			
May 31-June 27, 2000	148	85.1	4.9	0.78	54	85.2	4.9	0.79	3	84.7	5.0	0.82
May 31-June 20, 2001	36	87.7	5.5	0.81	155	91.0	6.1	0.81	7	109.0	10.0	0.77

[a] 1953-1957, date of capture and length-weight-condition information are unknown; data presented are total smolt trapped.

nd - no data available

Appendix J.16. Estimated age composition of Pauls Bay sockeye salmon escapements, 1955-1957, 1990-1991, and 1993-2001.

	Sample		Ages										
Year	Size		1.1	1.2	2.1	1.3	2.2	1.4	2.3	2.4	3.2	3.3	Totals
1955	58	Number	7	42	8	0	0	0	1	0	0	0	58
		Percent	12.1	72.4	13.8	0.0	0.0	0.0	1.7	0.0	0.0	0.0	100
1956	87	Number	2	68	1	4	12	0	0	0	0	0	87
		Percent	2.3	78.2	1.1	4.6	13.8	0.0	0.0	0.0	0.0	0.0	100
1957	230	Number	64	71	5	64	19	0	7	0	0	0	230
		Percent	27.8	30.9	2.2	27.8	8.3	0.0	3.0	0.0	0.0	0.0	100
1990	423	Number	69	3,431	34	4,700	1,543	137	4,494	69	0	34	14,510
		Percent	0.5	23.6	0.2	32.4	10.6	0.9	31.0	0.5	0.0	0.2	100
1991	457	Number	262	234	85	1,062	460	14	1,105	14	0	0	3,237
		Percent	8.1	7.2	2.6	32.8	14.2	0.4	34.1	0.4	0.0	0.0	100
1993	406	Number	31	3,065	306	3,892	3,739	61	1,195	0	0	31	12,442
		Percent	0.2	24.6	2.5	31.3	30.0	0.5	9.6	0.0	0.0	0.2	100
1994	546	Number	324	2,708	59	8,889	1,825	59	2,178	29	29	0	16,100
		Percent	2.0	16.8	0.4	55.2	11.3	0.4	13.5	0.2	0.2	0.0	100
1995	460	Number	3,073	907	673	1,639	1,522	0	5,648	0	0	0	13,461
		Percent	22.8	6.7	5.0	12.2	11.3	0.0	42.0	0.0	0.0	0.0	100
1996	469	Number	351	22,625	351	1,315	11,663	0	4,823	0	0	0	41,128
		Percent	0.9	55.0	0.9	3.2	28.4	0.0	11.7	0.0	0.0	0.0	100
1997	418	Number	151	5,569	6,622	8,880	4,139	0	6,096	0	0	0	31,456
		Percent	0.5	17.7	21.1	28.2	13.2	0.0	19.4	0.0	0.0	0.0	100
1998	535	Number	2,323	287	3,642	574	6,825	0	1,663	0	29	0	15,343
		Percent	15.1	1.9	23.7	3.7	44.5	0.0	10.8	0.0	0.2	0.0	100
1999	449	Number	3,341	16,381	1,927	4,047	1,542	0	1,606	0	0	0	28,844
		Percent	11.6	56.8	6.7	14.0	5.3	0.0	5.6	0.0	0.0	0.0	100
2000	447	Number	1,021	8,312	152	8,531	4,251	0	4,408	0	0	0	26,675
		Percent	3.8	31.2	0.6	32.0	15.9	0.0	16.5	0.0	0.0	0.0	100
2001	441	Number	1,185	5,784	650	6,179	906	0	8,502	0	0	23	23,230
		Percent	5.1	24.9	2.8	26.6	3.9	0.0	36.6	0.0	0.0	0.1	100



Appendix K.1. Morphometric map showing the limnology and zooplankton stations on Portage Lake.

Appendix K.2. The amount of nutrient enrichment additions and ratios into Portage Lake, 1993-1997.

Year	Fertilizer ratio[a]	Amount (kg)
1993	20-5-0	18,181
1994	20-5-0	15,422
1995	20-5-0	13,608
1996	20-5-0	15,240
1996	32-0-0	2,032
1997	20-5-0	12,192

[a] Nitrogen-Phosphorus-Potassium

a.

b.

Appendix K.3. Portage Creek fish pass, looking upstream (a) and downstream (b).

Appendix K.4. Limnological sampling stations and total samples collected for Portage Lake, 1990-2000.

Year	Sampling Stations	Total Samples
1990	1	4
1991	1	4
1992	1	4
1993	1	7
1994	1,2	7
1995	1,2	7
1996	1,2	6
1997	1,2	6
1998	1	4
1999	1	4
2000	1	4

Appendix K.5. Summary of seasonal mean water chemistry parameters by station and depth for Portage Lake, 1990-1998.

Year	Station	Depth (m)	Sp. Conductivity (umhos cm^{-1})	SD	pH (Units)	SD	Alkalinity (mg L^{-1})	SD	Turbidity (NTU)	SD	Color (Pt units)	SD	Calcium (mg L^{-1})	SD	Magnesium (mg L^{-1})	SD	Iron (ug L^{-1})	SD
1990	1	1	52.0	2.9	7.0	0.2	11.5	1.0	0.8	0.3	20.8	5.6	3.9	0.5	0.9	0.2	219.0	77.1
	1	16	53.5	2.4	6.9	0.1	11.5	1.0	0.7	0.5	20.3	5.9	4.3	0.5	0.9	0.2	189.3	57.6
1991	1	1	47.8	2.1	6.9	0.1	11.0	2.2	0.9	0.3	19.5	3.7	4.3	1.2	1.1	0.4	148.0	45.3
	1	14	47.3	1.5	6.7	0.3	10.3	2.5	1.0	0.4	22.5	3.0	3.9	0.8	1.0	0.3	160.8	52.3
1992	1	1	49.5	1.3	6.7	0.2	12.8	2.3	1.0	0.5	18.0	2.9	4.8	0.8	1.8	1.6	206.5	87.5
	1	15	48.5	1.7	6.6	0.3	11.5	1.6	0.7	0.3	26.3	10.9	4.3	0.5	1.2	1.1	171.0	40.0
1993	1	1	52.9	1.2	6.8	0.2	11.4	1.0	1.7	1.2	23.4	9.4	4.6	0.4	1.0	0.3	147.4	51.5
	1	16	51.7	1.5	6.5	0.2	10.4	0.8	1.0	0.4	21.7	8.3	4.4	0.5	0.9	0.3	142.3	49.4
1994	1	1	47.3	1.9	6.6	0.2	9.9	0.9	1.5	0.6	22.4	3.0	3.9	0.1	1.0	0.3	172.7	68.3
	1	16	49.5	3.1	6.3	0.3	9.6	0.9	1.6	1.0	22.1	2.8	4.0	0.1	0.9	0.3	189.9	83.2
1995	1	1	50.9	3.2	6.5	0.1	10.3	1.2	1.4	0.4	20.3	7.3	3.6	0.3	0.9	0.4	198.7	85.6
	1	15	50.7	3.6	6.3	0.2	9.1	1.1	1.4	1.0	19.6	8.9	3.5	0.5	0.9	0.4	181.0	108.0
1996	1	1	56.0	2.5	6.7	0.1	11.9	1.4	1.2	0.6	16.2	4.7	3.8	0.7	1.0	0.4	122.7	65.2
	1	18	54.3	2.6	6.4	0.4	10.9	1.9	1.3	0.6	19.8	6.2	3.6	0.1	1.0	0.4	138.7	73.8
1997	1	1	53.7	1.0	7.0	0.2	12.4	1.3	1.0	0.4	17.0	8.7	4.0	0.6	0.8	0.3	80.5	37.1
	1	15	53.0	1.9	6.7	0.2	11.7	1.2	1.1	0.5	17.8	4.4	3.8	0.4	0.9	0.3	89.8	36.3
1998	1	1	53.3	0.5	6.8	0.2	12.1	0.4	1.1	0.1	17.4	0.6	3.9	0.1	0.8	0.1	85.2	6.6

SD - standard deviation

Appendix K.6. Summary of seasonal mean nutrient and algal pigment concentrations by station and depth for Portage Lake, 1990-1998.

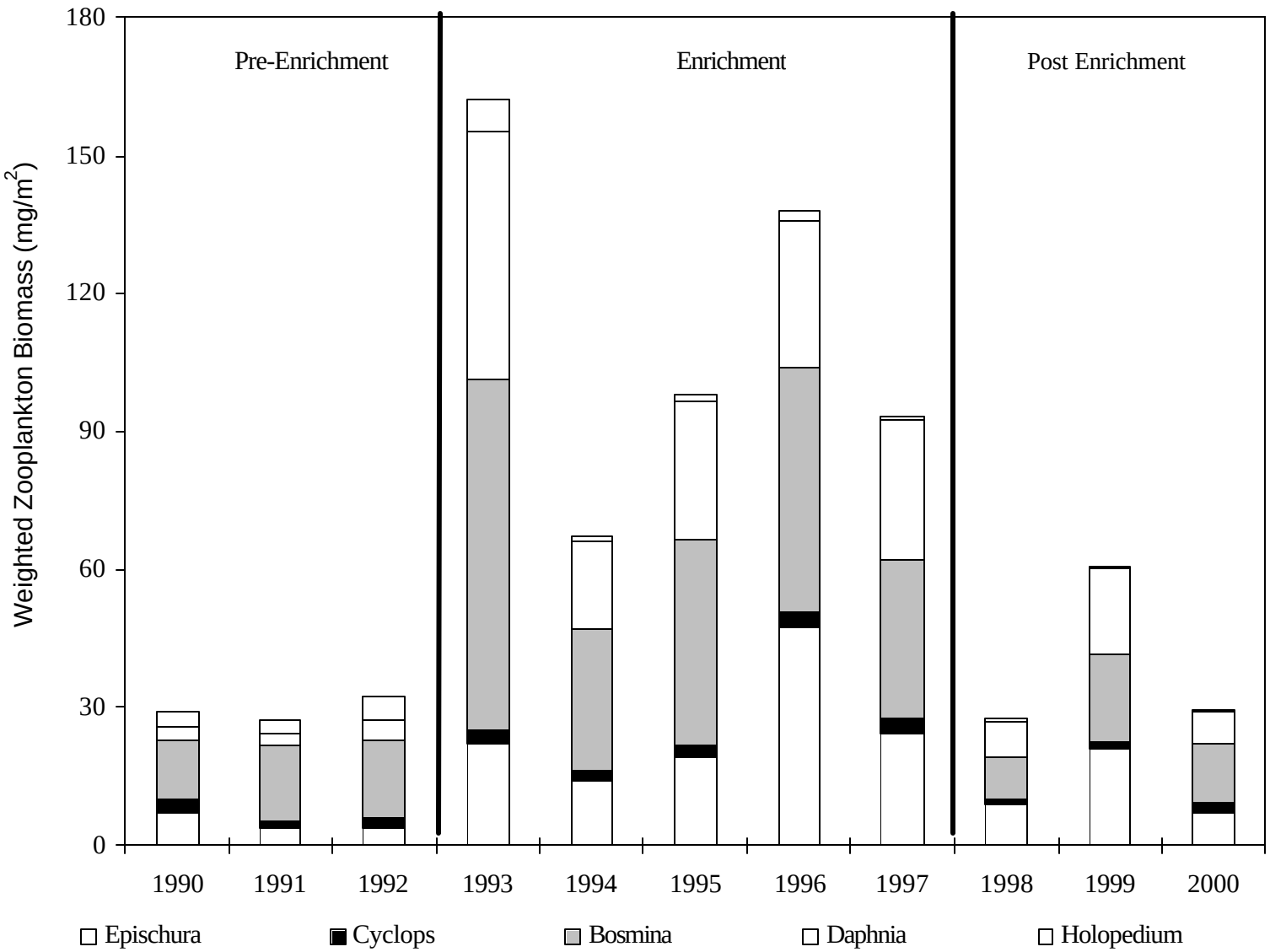
Year	Station	Depth (m)	Total-P (ug L^{-1})	SD	Total filterable-P (ug L^{-1})	SD	Filterable reactive-P (ug L^{-1})	SD	Total Kjeldahl nitrogen (ug L^{-1})	SD	Ammonia (ug L^{-1})	SD	Nitrate+nitrite (ug L^{-1})	SD	Reactive silicon (ug L^{-1})	SD	Organic carbon (ug L^{-1})	SD	Chlorophyll *a* (ug L^{-1})	SD	Phaeophytin *a* (ug L^{-1})	SD
1990	1	1	6.1	2.7	3.0	1.0	1.8	0.4	112.4	44.7	3.8	5.4	20.9	23.7	2160.5	343.3	202.0	81.1	0.50	0.1	0.50	0.4
	1	16	6.1	2.4	2.3	0.3	2.0	0.2	113.6	45.2	7.1	5.6	45.2	21.0	2262.8	353.0	166.3	86.0	0.16	0.1	0.25	0.1
1991	1	1	7.1	2.0	3.3	0.6	2.8	0.5	na	na	5.5	2.5	35.2	19.4	1888.0	142.7	na	na	0.55	0.2	0.33	0.2
	1	14	7.0	1.4	3.6	0.4	2.8	0.5	na	na	7.3	2.9	43.8	15.3	1924.8	96.2	na	na	0.29	0.3	0.26	0.1
1992	1	1	5.2	1.1	5.5	3.2	4.1	2.6	143.6	15.0	2.2	1.1	35.4	39.8	2015.5	213.5	255.8	63.2	0.58	0.5	0.35	0.2
	1	15	6.0	0.9	6.7	4.0	6.2	5.4	100.0	66.8	3.9	4.5	75.0	13.0	2163.3	158.6	186.8	25.9	0.32	0.3	0.31	0.1
1993	1	1	17.6	11.2	10.1	14.7	6.1	9.3	250.3	76.7	5.8	5.8	19.7	12.5	1852.1	337.1	343.4	144.1	6.35	6.2	0.72	0.4
	1	16	7.1	2.4	6.6	5.9	4.2	3.4	159.3	51.1	9.9	5.8	46.0	13.2	2198.6	92.4	123.3	105.9	0.62	0.5	0.49	0.2
1994	1	1	10.5	5.0	3.4	1.0	2.1	0.5	176.8	68.7	6.9	3.6	18.0	8.7	1695.3	519.9	276.1	208.0	1.90	1.3	0.59	0.3
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	1.41	1.0	0.55	0.3
	1	16	5.9	1.3	2.7	0.4	2.2	0.5	164.8	39.2	20.7	22.6	30.6	8.0	2143.6	154.1	116.9	50.7	0.24	0.2	0.34	0.2
1995	1	1	7.7	1.9	3.6	0.7	1.7	0.7	184.3	43.0	12.3	4.6	23.3	10.4	2022.4	501.6	na	na	2.05	1.5	0.85	0.5
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	2.06	1.6	0.82	0.5
	1	15	6.3	1.6	3.0	1.0	1.8	0.9	169.9	33.5	24.4	20.2	37.3	10.6	2295.6	360.2	na	na	0.52	0.3	0.38	0.1
1996	1	1	6.8	1.6	4.6	2.4	3.6	1.9	150.9	56.5	8.0	8.0	64.6	90.3	1810.8	303.7	145.3	71.0	1.81	1.3	0.67	0.4
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	1.68	1.1	0.68	0.4
	1	18	6.1	2.5	5.1	5.5	5.0	5.4	110.9	29.2	17.5	9.8	52.5	8.6	2190.0	110.4	51.3	29.1	0.39	0.2	0.30	0.1
1997	1	1	9.3	4.9	4.1	2.0	2.9	2.2	185.0	54.7	15.7	13.1	14.1	10.2	2007.3	619.8	276.3	213.3	1.94	1.8	1.27	0.9
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	1.92	1.7	1.37	1.0
	1	15	5.2	2.0	2.9	0.6	1.9	0.4	148.5	53.4	29.8	19.6	30.9	6.4	2121.7	274.9	98.2	35.3	0.44	0.1	0.61	0.2
1998	1	1	7.3	2.9	3.5	0.9	2.4	0.7	166.7	25.8	22.7	10.0	22.5	11.9	2064.5	80.8	187.3	126.0	1.43	0.9	1.08	0.4

SD - standard deviation
na - parameters were not analyzed.

Appendix K.7. Weighted mean zooplankton density, biomass, and size by genera for Portage Lake, 1990-2000.

	No. of	*Epischura*			*Cyclops*			*Bosmina*			*Daphnia*			*Holopedium*			TOTALS	
	Sample	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass
Year	Dates	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2
1990	4	3,463	6	0.76	1,573	3.0	0.70	15,347	13	0.31	2,456	3	0.56	1,473	3.0	0.48	24,312	28
1991	4	2,305	4	0.73	1,007	1.0	0.65	19,308	16	0.31	2,308	3	0.53	1,372	3.0	0.53	26,300	27
1992	4	1,513	4	0.81	1,770	2.0	0.60	20,993	17	0.30	3,702	4	0.53	2,672	5.0	0.46	30,650	32
1993	7	5,909	22	0.93	2,397	3.0	0.64	93,807	76	0.30	42,815	54	0.55	3,146	7.0	0.52	148,074	162
1994	7	4,597	12	0.83	1,336	1.6	0.60	43,916	30	0.28	19,801	21	0.50	241	0.4	0.46	69,891	64
1995	7	5,335	19	0.92	1,249	1.9	0.67	61,231	49	0.30	18,778	26	0.60	1,154	2.0	0.46	87,745	97
1996	6	16,885	77	0.99	1,725	2.9	0.69	86,303	66	0.29	20,176	26	0.55	11	0	0.38	125,100	171
1997	6	8,894	31	0.91	1,622	3.7	0.82	47,403	35	0.29	21,645	23	0.51	521	0.8	0.43	80,085	94
1998	4	4,331	9	0.77	1,051	1	0.64	10,065	9	0.30	7,509	8	0.52	558	0.5	0.35	23,514	28
1999	4	0	0	0.00	22,983	11	0.28	17,166	19	0.51	0	0	0.00	0	0	0.00	40,148	30
2000	4	2,229	7	0.91	931	2	0.84	15,934	13	0.30	5,867	7	0.54	422	0	0.50	29,836	29

Data collection began at station 2 in 1994. Average of stations 1 and 2 was used for years 1994 to 1997.



Appendix K.8. Weighted mean zooplankton biomass by genera and lake enrichment time period for Portage Lake, 1990-2000.

Appendix K.9. Juvenile sockeye salmon estimates based on fall townet catch species composition and hydroacoustic fish population estimates for Portage Lake, 1994-1997.

	Total Fish Estimates			Sockeye Estimates			Sockeye
		95% Confidence Interval			95% Confidence Interval		Composition
Date	Number	Low	High	Number	Low	High	(%)
5-Oct-94	1,951,212	1,629,680	2,272,744	54,634	45,631	63,637	2.8
17-Oct-95	755,236	662,504	847,968	68,726	60,287	77,165	9.1
18-Sep-96	311,773	195,585	427,961	6,859	0	9,415	2.2
18-Sep-97	767,747	677,359	858,135	36,084	31,836	40,332	4.7

[a] The hydroacoustic survey was not conducted, however, a townet survey was completed.

Appendix K.10. Townet catches from Portage Lake, 1993-1997.

			Catch by Species					
	Number	Total	Sockeye			Stickleback		
Date	of Tows	Minutes	No.	%	CPUE[a]	No.	%	CPUE[a]
21-Sep-93	5	42	53	10.7	1.3	444	89.3	10.6
5-Oct-94	4	69	140	2.8	2.0	4,910	97.2	71.2
17-Oct-95	2	18	14	9.5	0.8	140	90.5	7.8
18-Sep-96	6	60	10	2.2	0.2	453	97.8	7.6
18-Sep-97	7	52	29	4.7	0.6	591	95.3	11.4

[a] CPUE - Catch per unit effort

Appendix K.11. Mean length, weight, and condition coefficient by age for juvenile sockeye salmon captured by townet at Portage Lake, 1993-1997.

	Age-0				Age-1				Age-2			
Date	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)
21-Sep-93	8	58.6	2.6	1.27	13	74.2	5.3	1.25	1	81.0	7.2	1.35
5-Oct-94	133	47.6	1.3	1.12	3	66.0	3.4	1.16	0			
17-Oct-95	6	61.5	2.3	0.98	4	66.5	3.8	1.33	0			
18-Sep-96	0				10	67.5	3.7	1.20	0			
18-Sep-97	0				21	53.9	1.8	1.12	2	57.0	2.1	1.09

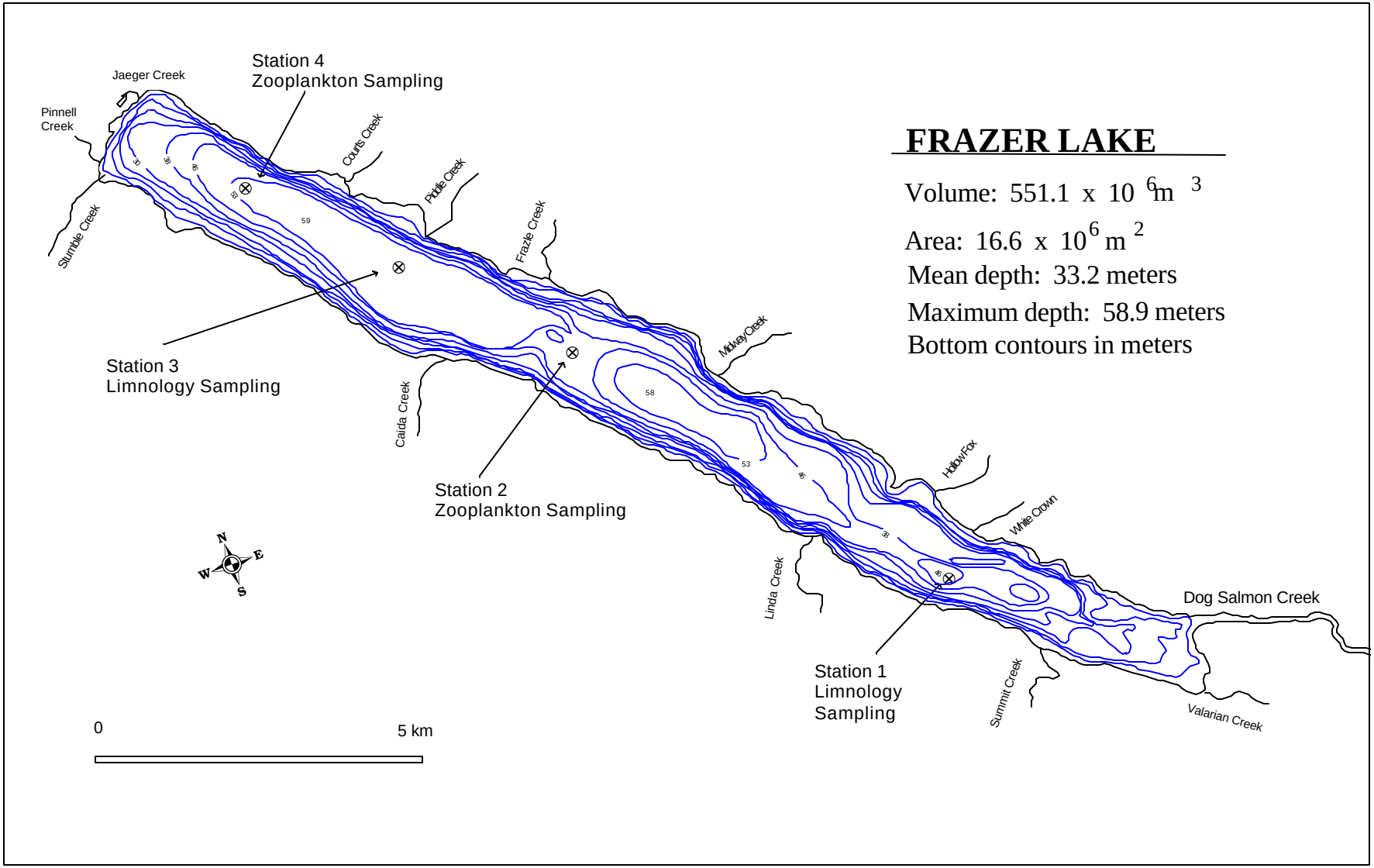
Appendix K.12. Mean length, weight, and condition coefficient, by age of sockeye salmon smolt collected from Portage Creek, 1994-1996 and 1998-2001.

	Age-1				Age-2			
Date	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)
June 7-13, 1994	176	74.6	3.3	0.80	17	79.7	4.2	0.81
June 7-13, 1995	45	61.5	2.0	0.80	0			
June 7-13, 1996	6	76.5	4.0	0.88	5	74.2	3.3	0.82
May 31-June 17, 1998	134	75.4	3.9	0.89	47	80.3	4.9	0.90
June 21-27, 1999	145	77.9	4.7	0.99	57	82.9	8.8	0.88
June 14-July 4, 2000	184	82.8	5.3	0.93	10	86.7	6.1	0.93
May 29, 2001	170	71.4	3.0	0.81	30	78.7	4.3	0.84

Appendix K. 13. Estimated age composition of Portage Lake sockeye salmon escapement samples, 1993 and 1998-2001.

Year	Sample Size		Ages 1.1	1.2	1.3	1.4	2.1	2.2	2.3	2.4	3.2	3.3	Total
1993	5,363	Number	134	670	536	134	402	2,413	1,073	0	0	0	5,363
		Percent	2.5	12.5	10.0	2.5	7.5	45.0	20.0	0.0	0.0	0.0	100
1998 [a]	283	Number	37	19	45	1	92	83	5	0	1	0	283
		Percent	13.1	6.7	15.9	0.4	32.5	29.3	1.8	0.0	0.4	0.0	100
1999	510	Number	2	253	77	0	0	77	92	0	6	3	507
		Percent	0.0	50.0	15.3	0.0	0.0	15.3	18.2	0.0	1.2		100.0
2000	1,026	Number	33	2,514	7,799	0	0	594	2,508	7	0	0	13,455
		Percent	0.2	18.7	58.0	0.0	0.0	4.4	18.6	0.1	0.0	0.0	100.0
2001	986	Number	9	53	2,691	22	6	3	359	6	0	0	3,147
		Percent	0.3	1.7	85.5	0.7	0.2	0.1	11.4	0.2	0.0	0.0	100

[a] The total was the amount sampled not an escapement count. An adult weir was not operated in 1998.

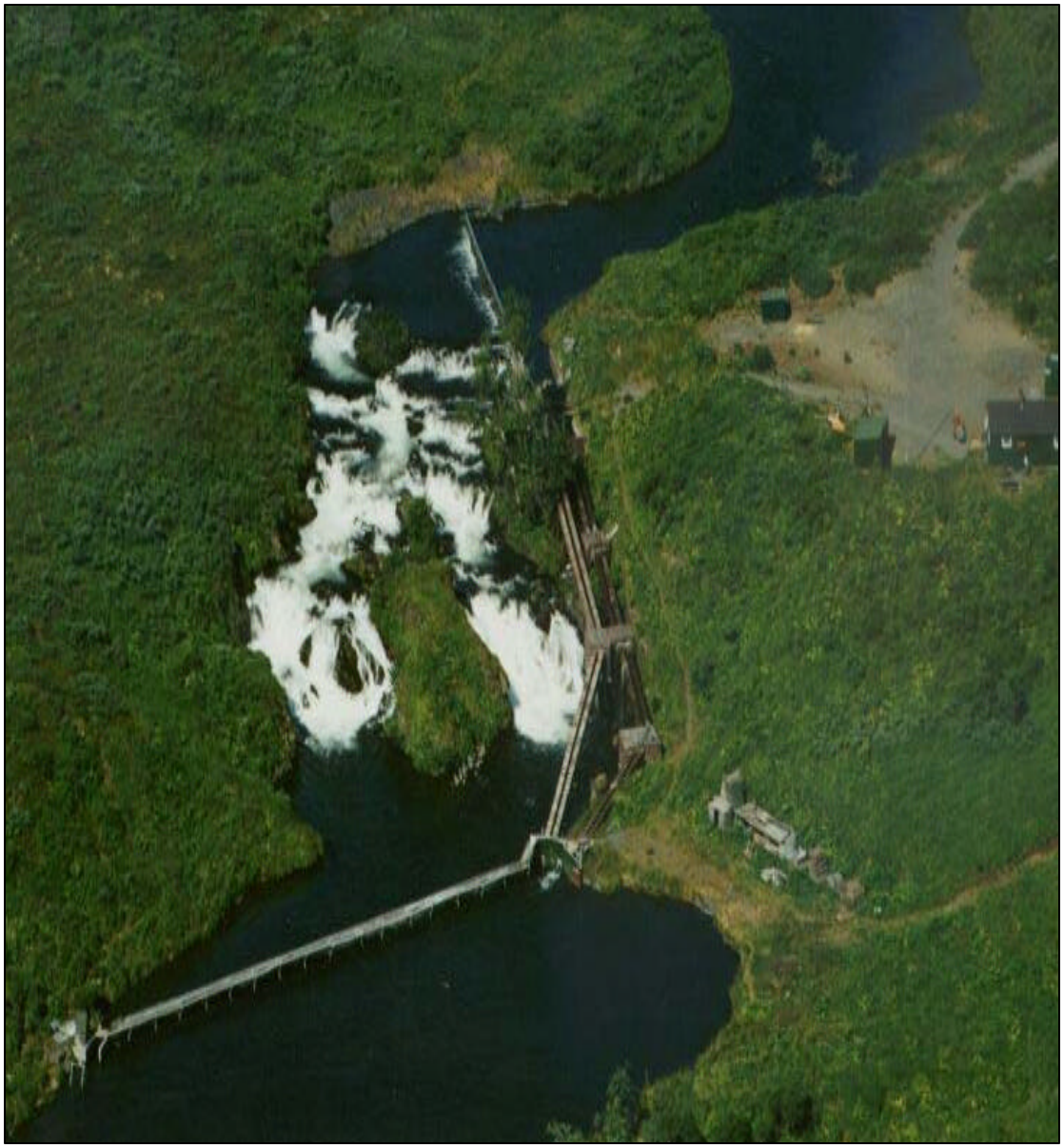


Appendix L.1. Morphometric map showing the limnology and zooplankton stations on Frazer Lake.

Appendix L.2. The amount of nutrient enrichment additions and ratios into Frazer Lake, 1988-1992.

Year	Fertilizer type	Amount (kg)
1988	27-7-0	60,960
1989	20-5-0	66,040
1990	20-5-0	76,200
1991	20-5-0	76,200
1992	20-5-0	76,200

[a] Nitrogen-Phosphorus-Potassium



Appendix L.3. Frazer Lake fish passes, diversion weir, and ADF&G complex.

Appendix L.4. Limnological sampling stations and total samples collected for Frazer Lake, 1986-2001.

Year	Sampling Stations	Total Samples
1986	1, 2	6
1987	1, 2	6
1988	1, 2	9
1989	1, 2	9
1990	1, 2	9
1991	1, 2	7
1992	1, 2	6
1993	1, 2	5
1994	1-4	4
1995	1-4	4
1996	1-4	4
1997	1, 2	4
1998	1	3
1999	1	4
2000	1	4
2001	1, 3	4

Appendix L.5. Summary of seasonal mean water chemistry parameters by station and depth for Frazer Lake, 1990-1996.

		Depth	Sp. Conductivity		pH		Alkalinity		Turbidity		Color		Calcium		Magnesium		Iron	
Year	Stn.	(m)	(umhos cm^{-1})	SD	(Units)	SD	(mg L^{-1})	SD	(NTU)	SD	(Pt units)	SD	(mg L^{-1})	SD	(mg L^{-1})	SD	(ug L^{-1})	SD
1990	1	1	50.6	0.9	7.1	0.2	13.9	1.2	0.8	0.3	6.0	2.4	4.4	1.2	0.9	0.3	31	23.7
	1	23	50.3	0.7	7.1	0.1	13.9	0.7	0.9	0.4	5.3	1.3	4.6	1.0	0.9	0.5	29	14.1
	3	1	50.7	0.9	7.1	0.1	14.3	0.8	0.8	0.3	4.7	0.9	4.4	0.7	0.8	0.4	48	76.4
	3	50	50.6	0.7	7.1	0.2	14.6	0.7	0.8	0.3	5.0	2.4	4.5	0.9	0.8	0.4	37	35.5
1991	1	1	52.6	0.8	7.2	0.2	13.1	2.0	0.8	0.5	6.0	2.6	4.7	0.3	0.9	0.6	21	20.3
	1	23	52.9	0.9	7.1	0.1	13.2	2.3	1.0	0.5	6.9	2.6	4.6	0.3	1.1	0.4	32	21.0
	3	1	52.6	1.1	7.0	0.2	13.1	2.3	1.0	0.5	7.9	3.3	4.5	0.6	0.9	0.6	28	23.6
	3	45	52.6	1.0	7.0	0.1	13.4	2.6	1.2	0.4	5.0	1.2	4.6	0.3	0.9	0.4	47	22.8
1992	1	1	52.9	6.0	7.0	0.1	12.9	1.0	0.6	0.2	6.1	2.5	5.1	0.4	1.2	0.6	17	5.3
	1	20	51.7	2.7	7.0	0.2	13.1	1.1	0.7	0.4	6.0	1.8	5.0	0.8	1.4	0.5	52	46.7
	3	1	51.7	0.8	7.1	0.2	13.3	0.4	0.8	0.3	6.5	1.8	5.0	0.7	1.4	0.9	20	5.0
	3	50	51.2	0.8	7.0	0.3	13.3	0.9	0.6	0.3	6.0	1.7	4.7	0.5	1.5	0.4	17	3.2
1993	1	1	53.4	2.6	6.8	0.1	13.1	0.7	0.8	0.4	6.4	4.7	4.7	0.4	1.5	0.6	20	10.6
	1	25	54.8	4.8	6.8	0.3	13.9	1.6	0.7	0.5	3.8	1.3	5.3	1.0	1.5	0.6	17	4.6
	3	1	53.8	2.6	6.8	0.2	12.8	0.8	0.7	0.4	3.6	0.9	4.9	0.2	1.5	0.6	21	9.9
	3	50	70.0	28.8	7.0	0.7	14.8	2.5	1.2	1.2	3.8	1.6	5.6	1.3	1.4	0.7	23	1.0
1994	1	1	55.5	1.3	7.0	0.4	14.0	1.2	0.6	0.5	5.3	1.0	4.9	0.1	1.3	0.1	23	13.4
	1	23	54.8	1.9	6.9	0.3	13.5	1.0	0.4	0.1	5.0	2.2	4.9	0.1	1.3	0.1	22	11.3
	3	1	55.0	0.8	6.8	0.2	13.1	0.6	0.6	0.3	5.5	1.9	4.9	0.1	1.3	0.1	26	12.5
	3	48	54.3	0.5	6.7	0.2	12.6	0.5	0.4	0.0	3.8	0.5	4.9	0.1	1.3	0.1	24	17.0
1995	1	1	50.0	2.6	6.8	0.2	12.9	0.9	1.3	0.8	7.8	2.1	4.5	0.2	1.0	0.4	28	21.8
	1	44	50.7	4.2	6.6	0.1	13.1	1.6	1.1	0.9	6.3	2.9	4.4	0.1	0.8	0.3	21	14.2
	3	1	50.8	3.2	6.6	0.3	13.8	1.1	1.1	0.5	6.8	2.2	4.5	0.2	1.0	0.4	22	11.3
	3	52	50.8	3.2	6.6	0.2	12.4	1.3	1.0	0.6	7.0	2.9	4.7	0.4	1.1	0.3	22	8.5
1996	1	1	53.3	1.5	6.8	0.2	13.9	0.4	0.5	0.1	7.0	2.4	4.6	0.1	0.7	0.3	13	10.4
	1	44	54.8	2.2	6.9	0.2	14.1	0.9	0.8	0.3	7.3	3.0	4.6	0.1	0.9	0.4	17	11.8
	3	1	53.7	1.2	6.9	0.2	14.0	0.3	0.5	0.1	6.3	1.3	4.6	0.1	0.7	0.3	18	9.6
	3	50	54.0	1.4	6.7	0.0	14.0	0.3	1.1	0.6	6.3	1.3	4.6	0.1	0.9	0.4	15	10.4

SD - standard deviation
na - parameters were not analyzed.

Appendix L.6. Summary of seasonal mean nutrient and algal pigment concentrations by station and depth for Frazer Lake, 1990-1996.

Year	Station	Depth (m)	Total-P (ug L^{-1})	SD	Total filterable-P (ug L^{-1})	SD	Filterable reactive-P (ug L^{-1})	SD	Total Kjel-dahl nitrogen (ug L^{-1})	SD	Ammonia (ug L^{-1})	SD	Nitrate + nitrite (ug L^{-1})	SD	Reactive silicon (ug L^{-1})	SD	Organic carbon (ug L^{-1})	SD	Chlorophyll *a* (ug L^{-1})	SD	Phaeophytin *a* (ug L^{-1})	SD
1990	1	1	5.5	1.2	2.9	0.5	1.2	0.5	63.8	20.4	6.4	4.3	46.8	24.9	1673	492.7	224	123.9	1.80	1.1	0.71	0.5
	1	23	5.7	1.8	2.7	0.4	1.3	0.5	68.9	17.5	6.5	3.6	47.4	20.3	1719	481.7	255	151.4	1.74	1.2	0.88	0.7
	3	1	6.3	1.9	3.1	0.6	1.2	0.4	69.0	26.7	6.1	5.1	40.7	21.1	1656	542.4	172	118.8	1.60	1.7	0.67	0.5
	3	50	5.5	1.5	2.7	0.1	1.3	0.5	70.4	24.7	12.7	12.6	48.8	14.9	1803	480.4	217	156.0	1.74	1.3	0.84	0.5
1991	1	1	5.2	0.8	3.4	0.6	2.1	0.8	93.6	29.1	6.5	10.6	43.9	24.6	970	55.6	0	0.0	1.35	0.4	0.70	0.5
	1	23	5.4	0.9	5.3	3.8	3.0	1.9	100.4	23.9	10.1	10.2	55.1	14.6	1008	53.2	0	0.0	1.77	0.9	0.59	0.5
	3	1	5.6	1.1	3.7	0.9	2.3	0.9	104.6	26.1	7.2	11.4	46.2	23.4	1014	67.3	0	0.0	1.65	0.8	0.68	0.4
	3	45	6.4	0.6	4.0	0.4	2.2	0.5	96.6	22.2	13.6	15.9	61.7	7.5	1005	100.5	0	0.0	2.14	1.4	0.67	0.2
1992	1	1	5.1	2.2	2.6	1.3	1.4	0.6	107.6	40.7	5.4	3.0	64.1	24.7	1409	89.6	166	54.8	1.41	1.0	0.79	0.4
	1	20	5.7	3.2	2.8	1.2	1.3	0.6	105.2	25.1	9.4	8.0	75.6	19.0	1239	484.3	154	126.7	1.14	0.7	0.71	0.4
	3	1	5.2	2.2	2.6	1.0	1.2	0.4	119.1	48.0	5.8	2.6	56.7	17.8	1436	73.1	174	57.7	1.47	0.5	0.95	0.3
	3	50	4.7	4.2	2.7	1.4	1.4	0.7	86.3	25.1	13.3	7.3	85.3	12.4	1493	130.1	90	37.1	0.75	0.5	0.52	0.2
1993	1	1	5.1	1.0	3.7	1.0	2.1	0.7	97.2	12.4	5.6	1.6	55.5	32.4	1780	119.8	151	69.4	1.70	0.6	0.45	0.2
	1	25	5.4	0.8	3.1	0.7	1.9	0.5	99.5	17.2	10.7	8.7	79.6	12.1	1819	100.2	162	60.5	1.82	0.9	0.54	0.2
	3	1	5.3	0.7	3.1	1.3	2.1	0.5	104.3	19.9	7.0	0.0	58.1	28.5	1803	134.8	150	49.2	1.69	0.5	0.48	0.2
	3	50	5.4	1.1	3.2	1.1	1.7	0.3	97.4	15.5	10.5	6.8	80.3	21.8	1870	114.9	102	20.1	1.19	0.5	0.51	0.2
1994	1	1	6.3	2.7	1.8	0.2	1.4	0.3	94.9	7.7	6.2	3.5	61.1	16.0	1900	41.2	136	27.4	0.65	0.1	0.14	0.0
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	0.66	0.1	0.16	0.0
	1	23	3.8	0.6	2.0	0.4	1.4	0.3	91.9	7.0	10.9	10.4	71.4	12.2	1961	62.6	142	20.4	0.63	0.2	0.13	0.1
	3	1	6.4	3.2	2.4	0.9	1.6	0.6	108.7	22.2	4.4	1.1	57.1	22.0	1957	76.8	137	37.5	0.70	0.1	0.17	0.0
	3	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	0.69	0.1	0.17	0.0
	3	48	6.3	4.9	1.8	0.5	1.4	0.4	97.8	8.1	16.1	12.8	79.3	8.6	2013	93.1	76	32.9	0.46	0.2	0.16	0.1
1995	1	1	5.2	0.6	2.1	0.3	1.5	0.2	94.4	14.7	3.4	2.3	70.4	20.9	2192	68.6	162	31.9	1.98	0.7	0.59	0.2
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	2.01	0.9	0.61	0.1
	1	44	4.0	0.4	1.9	0.5	1.5	0.3	80.5	8.6	10.4	6.2	95.1	8.2	2320	104.1	89	21.5	1.55	0.4	0.49	0.1
	3	1	5.2	0.8	2.0	0.5	1.4	0.3	96.2	11.7	3.2	2.2	71.4	20.1	2239	66.5	164	80.1	1.86	1.1	0.51	0.2
	3	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	1.95	0.8	0.58	0.3
	3	52	4.7	0.8	2.0	0.1	1.5	0.3	79.7	13.3	11.1	6.3	104.8	6.6	2331	96.6	56	20.2	1.01	0.4	0.43	0.1
1996	1	1	4.8	1.7	2.5	1.0	1.9	1.2	114.7	24.8	4.5	3.6	30.4	26.9	2104	127.0	141	19.5	0.55	0.1	0.24	0.0
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	0.39	0.4	0.20	0.2
	1	44	5.4	2.2	1.8	0.5	1.4	0.4	103.8	9.0	9.1	7.1	58.9	3.5	2165	160.0	129	66.2	0.57	0.1	0.27	0.0
	3	1	5.3	0.7	2.1	1.0	1.3	0.6	117.9	24.3	3.0	1.7	28.2	22.2	2204	174.5	128	14.4	0.55	0.2	0.24	0.0
	3	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	0.53	0.5	0.26	0.3
	3	50	4.4	0.9	1.9	1.0	1.7	1.1	98.1	4.9	9.6	8.3	70.1	13.8	2176	166.5	91	56.8	0.40	0.1	0.23	0.1

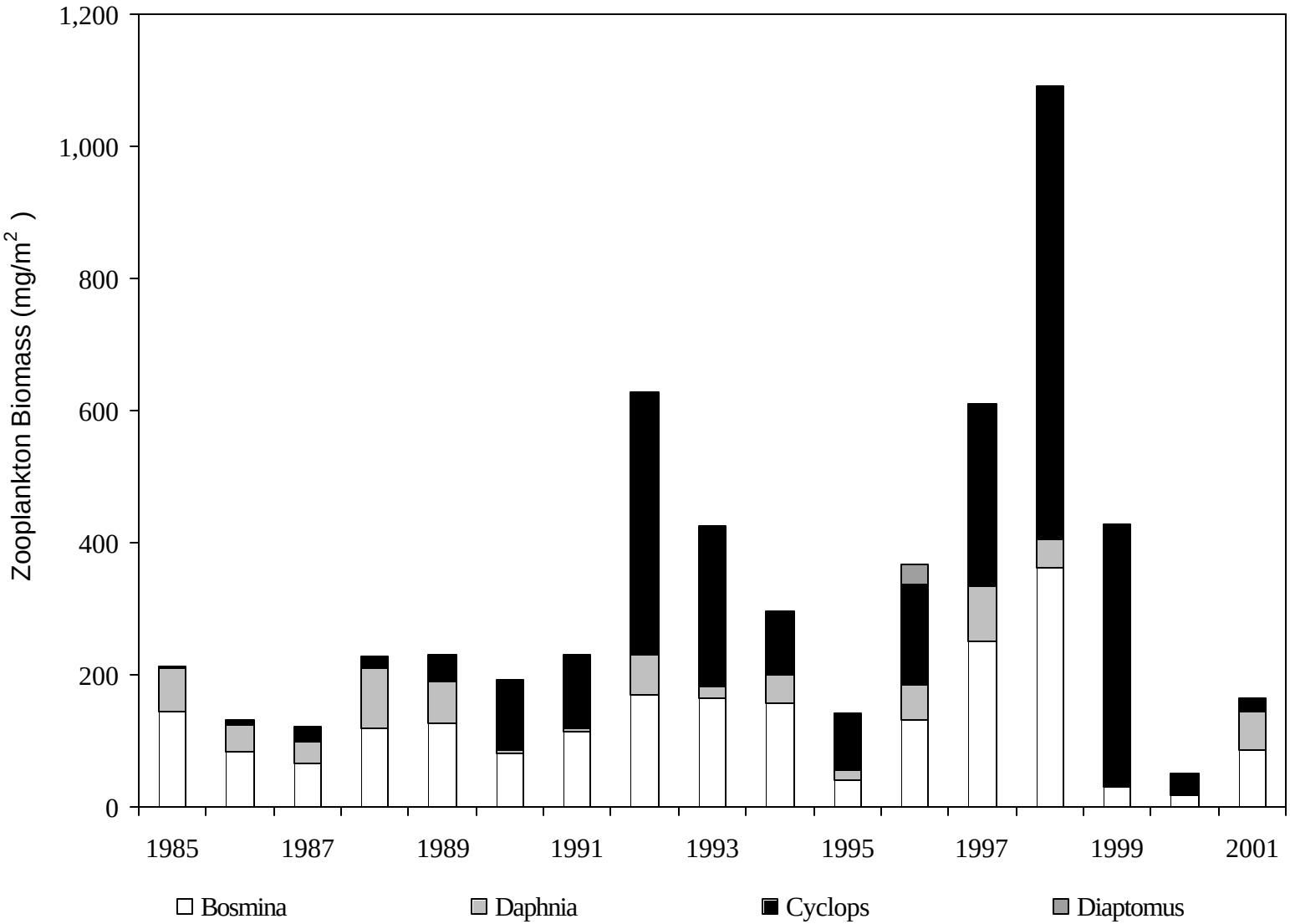
SD - standard deviation
na - parameters were not analyzed.

Appendix L.7. Weighted mean zooplankton density, biomass, and size by genera for Frazer Lake, 1985-2001.

	No. of	***Diaptomus***				***Cyclops***				***Bosmina***				***Daphnia***			
Year	Sample Dates[a]	Density (no/m^2)	Density (no/m^3)	Biomass (mg/m^2)	Size (mm)	Density (no/m^2)	Density (no/m^3)	Biomass (mg/m^2)	Size (mm)	Density (no/m^2)	Density (no/m^3)	Biomass (mg/m^2)	Size (mm)	Density (no/m^2)	Density (no/m^3)	Biomass (mg/m^2)	Size (mm)
1985	5	40	1	0	0.70	1,512	37	3	0.78	121,746	3,682	145	0.36	42,255	1,092	65	0.60
1986	7	38	1	0	0.00	3,431	90	7	0.73	66,766	2,063	83	0.37	27,516	777	42	0.60
1987	8	95	2	1	0.96	13,175	378	23	0.70	47,676	1,453	67	0.39	18,028	489	31	0.64
1988	7	0	0	0	0.00	5,725	153	19	0.94	92,281	3,410	118	0.37	59,256	1,912	92	0.61
1989	6	0	0	0	0.45	15,731	448	40	0.84	94,708	3,286	128	0.38	42,142	1,258	62	0.59
1990	9	74	3	0	0.82	50,756	1,498	106	0.77	58,587	1,461	82	0.39	2,136	51	4	0.65
1991	7	228	10	0	0.64	55,012	1,341	112	0.76	111,598	3,720	114	0.34	2,969	109	5	0.62
1992	7	8	0	0	1.24	133,548	3,416	395	0.91	117,044	3,756	169	0.39	28,677	717	63	0.71
1993	5	213	4	1	0.95	120,295	3,035	242	0.76	161,651	5,079	164	0.33	12,654	345	18	0.59
1994	4	93	4	1	1.04	49,801	1,183	94	0.73	114,400	2,954	156	0.38	28,145	779	45	0.61
1995	4	0	0	0		59,089	1,270	85	0.65	39,823	866	41	0.34	10,403	218	16	0.60
1996	4	10,483	210	30	0.87	103,485	2,144	150	0.64	118,218	2,521	133	0.35	33,685	728	53	0.61
1997	4	0	0	0		88,137	1,916	276	0.93	181,369	3,981	250	0.39	59,554	1,297	84	0.58
1998[b]	3	302	7	0	0.02	319,083	7,446	686	62.85 1	246,200	5,838	363	33.29	20,059	470	42	3.83
1999	4	0	0	0	0.00	226,991	5,315	394	92.13 #	28,026	656	31	7.32	1,062	25	2	0.54
2000	4	0	0	0	0.00	23,065	526	32	63.24 #	16,919	384	18	35.57	299	7	1	1.19
2001	5	16	1	0	0.08	16,247	349	20	11.90 #	55,560	1,164	87	52.60	24,366	540	58	35.42
Avg=	5	964	20	3	0.64	75,593	1,797	158	14.13	98,386	2,722	126	7.86	24,306	636	40	2.88

[a] From 1985-1993 stations 1 and 2 were sampled, from 1994-1996 stations 1-4 were sampled, in 1997 stations 1 and 2 were sampled, from 1998-2000 station 1 was sampled, and in 2001 stations 1 and 3 were sampled.

[b] The high density and biomass levels could be skewed high due to only three samples collected in 1998.



Appendix L.8. Weighted mean zooplankton biomass by genera and lake enrichment time period for Frazer Lake, 1985-2001.

Appendix L.9. Juvenile sockeye salmon estimates based on fall townet catch species composition and hydroacoustic fish population estimates for Frazer Lake, 1990-1997.

	Total Fish Estimates			Sockeye Estimates			Sockeye
		95% C. I.			95% C. I.		Composition
Date	Number	Low	High	Number	Low	High	(%)
6-Sep-90	7,434,331	5,892,227	8,976,435	5,709,566	4,524,308	6,894,825	76.8
19-Sep-91	8,320,947	7,038,830	9,603,064	6,265,673	5,297,874	7,233,472	75.3
16-Sep-92	8,340,877	5,709,471	10,972,283	1,501,358	1,028,027	1,974,689	18.0
1-Oct-93	12,519,826	11,699,503	13,340,149	788,749	736,361	841,137	6.3
10-Sep-94	9,069,751	8,150,824	9,988,678	36,279	32,602	39,956	0.4
2-Oct-95	3,927,893	3,244,987	4,610,799	15,712	12,996	18,427	0.4
5-Sep-96	1,948,829	1,850,215	2,047,443	327,403	310,939	343,867	16.8
4-Sep-97	2,411,638	1,865,126	2,958,150	1,285,403	1,283,181	1,287,625	53.3

Appendix L.10. Townet catches from Frazer Lake, 1990-1996.

			Catch by Species					
	Number	Total Tow	Sockeye			Stickleback		
Date	of Tows	Minutes	No.	%	CPUE[a]	No.	%	CPUE[a]
7-Sep-90	3	60	106	76.8	1.8	32	23.2	0.5
20-Sep-91	3	60	174	75.3	2.9	57	24.7	1.0
17-Sep-92	3	90	328	18.0	3.6	1,496	82.0	16.6
2-Oct-93	3	60	16	6.3	0.3	238	93.7	4.0
11-Sep-94	3	60	2	0.4	0.0	513	99.6	8.6
3-Oct-95	8	121	3	0.4	0.1	828	99.6	6.8
6-Sep-96	5	75	113	16.8	1.5	558	83.2	7.4

[a] CPUE - Catch per unit effort

Appendix L.11. Mean age, length, weight, and condition coefficient by age for juvenile sockeye salmon captured by townet at Frazer Lake, 1990-1996.

	Age-0				Age-1				Age-2			
Date	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)
7-Sep-90	64	50	1.5	1.19	40	77	5.2	1.15	0			
20-Sep-91	54	50	1.2	0.92	47	70	3.4	0.95	0			
17-Sep-92	51	64	2.9	1.05	132	87	6.5	1.00	23	91	7.5	0.99
2-Oct-93	22	66	1.6	0.58	2	97	5.0	0.55	0			
11-Sep-94	2	68	1.7	0.54	0				0			
3-Oct-95	2	53	1.6	1.07	0				0			
6-Sep-96	6	44	1.0	1.17	95	58	2.2	1.08	3	80	5.4	1.05

Appendix L.12. Estimated number of sockeye salmon smolt emigrating from Frazer Lake by year and age class, 1991-2001.

Smolt Outmigration Year	Number and Relative Percent of Smolt by Age Class 1.	2.	3.	4.	Total Population Estimate	SE	95% CI Lower	Upper
1991	1,940,906	2,870,690	6,905	0	4,818,501	1,077,978	2,705,664	6,931,337
	40.3%	59.6%	0.1%	0.0%				
1992	82,415	4,978,109	305,253	0	5,365,777	624,657	4,141,448	6,590,106
	1.5%	92.8%	5.7%	0.0%				
1993	22,221	4,046,434	3,364,676	966	7,434,298	1,397,839	4,694,534	10,174,062
	0.3%	54.4%	45.3%	0.0%				
1994	673,765	4,450,246	537,478	0	5,661,489	344,992	4,985,306	6,337,672
	11.9%	78.6%	9.5%	0.0%				
1995	53,410	8,684,874	85,492	0	8,823,777	551,775	7,742,298	9,905,256
	0.6%	98.4%	1.0%	0.0%				
1996	57,487	3,480,272	282,845	0	3,820,604	268,297	3,294,742	4,346,466
	1.5%	91.1%	7.4%	0.0%				
1997	244,298	2,196,609	628,446	0	3,069,352	295,134	2,490,891	3,647,814
	8.0%	71.6%	20.5%	0.0%				
1998[a]	33.6%	65.5%	1.0%	0.0%				
1999	744,710	1,274,565	433,687		2,452,962	219,262	2,023,209	2,882,715
	30.4%	52.0%	17.7%	0.0%				
2000	10,105	4,659,190	55,939	9,413	4,734,647	227,527	4,289,578	5,181,484
	0.2%	98.4%	1.2%	0.2%				
2001	10,833	901,205	29,382	216	941,655	38,386	866,342	1,016,814
	1.2%	95.7%	3.1%	0.0%				
1991-2001 Average	378,674	2,885,732	564,461	1,177	4,255,476	499,341	3,276,857	5,234,274

[a] Due to high water, smolt emigration estimates are not available
[b] 19 Age 0. Smolt were also estimated in 2001.

Appendix L.13. Frazer Lake sockeye salmon smolt emigration by age class, 1991-1995.

Year	Statistical Week	Dates	Age Class 1	2	3	4	Population Estimate
1991	19	5/03-5/09	0	0	0	0	0
	20	5/10-5/16	2,172	2,498	0	0	4,670
	21	5/17-5/23	873,195	1,004,644	0	0	1,877,839
	22	5/24-5/30	93,892	118,123	0	0	212,015
	23	5/31-6/06	1,058,220	1,791,367	0	0	2,849,587
	24	6/07-6/13	399,064	492,833	2,181	0	894,078
	25	6/14-6/20	61,525	131,956	0	0	193,481
	26	6/21-6/27	53,327	185,212	1,147	0	239,686
	27	6/28-7/04	10,577	46,961	423	0	57,961
	28	7/05-7/11	863	3,832	35	0	4,730
	Total		2,552,835	3,777,426	3,786	0	6,334,047
1992	19	5/03-5/09	470	3,287	2,348	0	6,105
	20	5/10-5/16	11,406	840,207	315,553	0	1,167,165
	21	5/17-5/23	17,968	752,402	137,004	0	907,374
	22	5/24-5/30	7,724	613,311	23,173	0	644,208
	23	5/31-6/06	13,356	1,073,806	13,356	0	1,100,518
	24	6/07-6/13	46,927	1,578,459	59,725	0	1,685,112
	25	6/14-6/20	2,938	369,217	5,876	0	378,031
	26	6/21-6/27	3,841	216,723	549	0	221,112
	27	6/28-7/04	3,859	267,035	0	0	270,894
	28	7/05-7/11	0	24,703	0	0	24,703
	Total		108,489	5,739,150	557,584	0	6,405,222
1993	19	5/03-5/09	0	16	756	0	772
	20	5/10-5/16	0	4,081	45,508	612	50,202
	21	5/17-5/23	0	356,218	944,914	0	1,301,132
	22	5/24-5/30	0	1,129,985	1,761,446	0	2,891,431
	23	5/31-6/06	0	2,024,932	1,471,534	0	3,496,466
	24	6/07-6/13	0	1,204,317	433,554	0	1,637,871
	25	6/14-6/20	23,496	358,317	29,370	0	411,183
	26	6/21-6/27	0	0	0	0	0
	27	6/28-7/04	0	0	0	0	0
	Total		23,496	5,077,866	4,687,082	612	9,789,057

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Year	Statistical Week	Dates	Age Class 1	2	3	4	Population Estimate
1994	19	5/03-5/09	0	0	0	0	0
	20	5/10-5/16	875	85,197	59,813	0	145,886
	21	5/17-5/23	11,726	439,417	166,016	0	617,158
	22	5/24-5/30	6,345	1,895,113	213,623	0	2,115,082
	23	5/31-6/06	110,768	1,398,245	96,320	0	1,605,333
	24	6/07-6/13	181,603	680,122	28,487	0	890,212
	25	6/14-6/20	271,445	80,336	2,123	0	353,905
	26	6/21-6/27	121,944	25,067	442	0	147,454
	27	6/28-7/04	23,073	4,759	0	0	27,833
	28	7/05-7/11	0	0	0	0	0
	Total		727,779	4,608,256	566,824	0	5,902,863
1995	19	5/03-5/09	0	0	0	0	0
	20	5/10-5/16	0	1,747,768	30,573	0	1,778,341
	21	5/17-5/23	3,789	1,314,676	3,789	0	1,322,253
	22	5/24-5/30	13,581	2,349,522	6,791	0	2,369,893
	23	5/31-6/06	22,857	1,908,587	28,572	0	1,960,016
	24	6/07-6/13	13,261	751,479	4,420	0	769,161
	25	6/14-6/20	3,483	154,989	2,322	0	160,794
	26	6/21-6/27	2,589	22,911	129	0	25,629
	27	6/28-7/04	0	0	0	0	0
	28	7/05-7/11	0	0	0	0	0
	Total		59,560	8,249,932	76,596	0	8,386,087

Appendix L.14. Summary of mean length, weight, and condition coefficient by age class of Frazer Lake sockeye salmon smolt, 1989-2001.

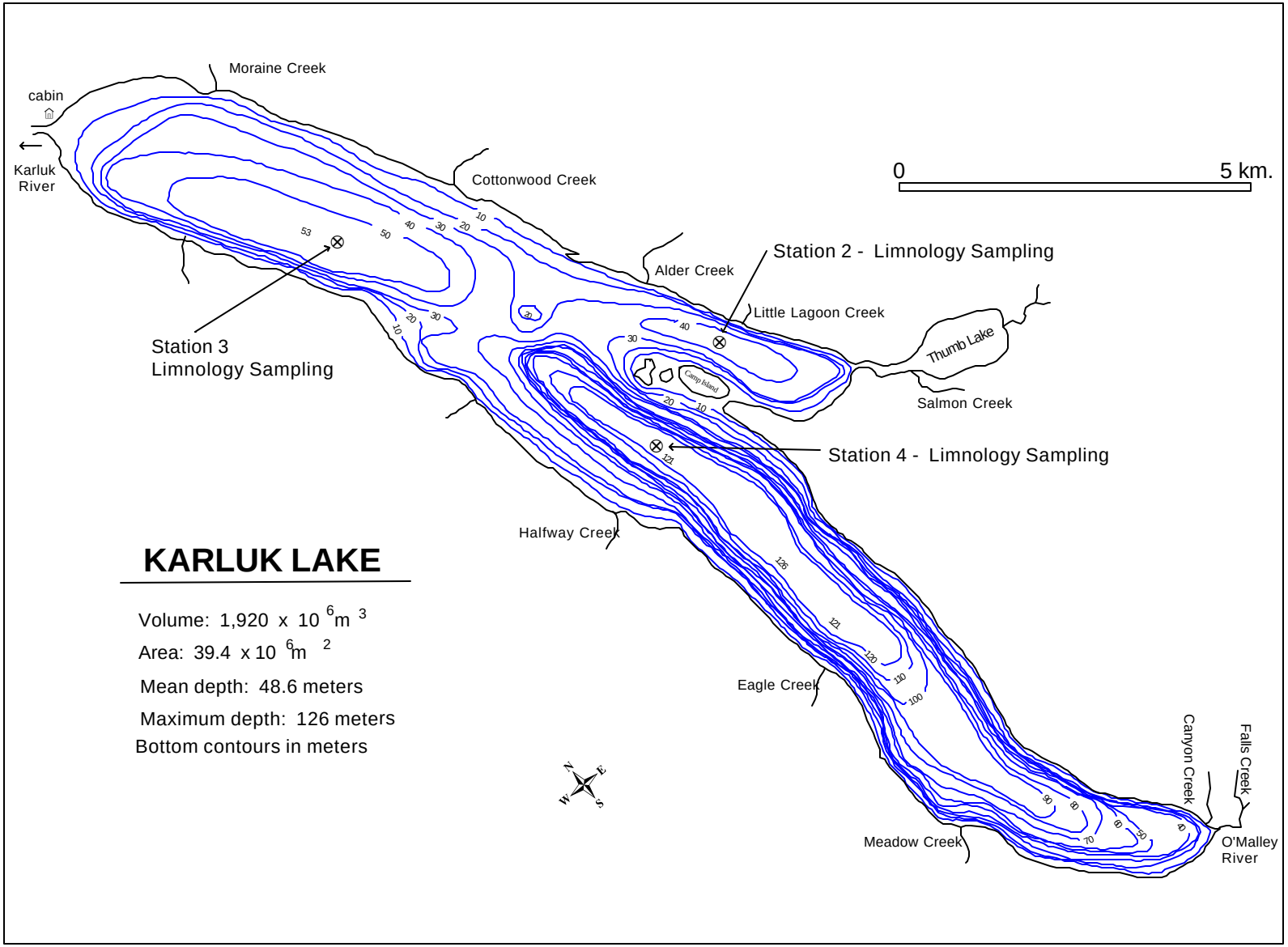
	Age-1				Age-2				Age-3				Age-4			
Year	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)
1989	22	87.0	5.5	0.84	620	100.5	8.0	0.78	0				0			
1990	573	84.3	4.5	0.74	553	104.3	9.0	0.79	43	112.0	11.7	0.82	0			
1991	746	89.7	5.4	0.74	1,344	89.5	5.6	0.77	4	120.8	15.7	0.85	0			
1992	49	86.4	6.1	0.94	2,951	83.9	5.5	0.92	191	91.1	7.2	0.93	0			
1993	8	89.9	6.1	0.83	682	100.3	8.3	0.82	913	104.2	17.7	0.85	3	121.3	17.7	0.85
1994	713	86.3	5.2	0.81	1,456	102.6	8.1	0.75	302	112.8	10.7	0.74	0			
1995	39	86.7	5.3	0.74	2,154	91.2	5.6	0.73	20	115.2	13.6	0.79	0			
1996	42	91.3	6.2	0.78	1,718	87.2	5.2	0.78	116	103.6	9.7	0.81	0			
1997	544	88.8	5.5	0.78	1,385	93.5	6.4	0.77	638	106.1	9.5	0.79	9	112.6	11.9	0.81
1998	618	97.5	8.1	0.86	1,205	109.6	10.4	0.79	18	114.4	11.8	0.78	0			
1999	1,357	88.8	5.5	0.78	792	120.9	13.7	0.77	196	125.7	15.3	0.77	0			
2000	29	52.1	1.3	1.07	3,382	85.8	4.3	0.67	90	112.6	11.7	0.80	13	138.3	24.3	0.90
2001	77	70.3	3.4	0.86	2,444	77.4	3.8	0.82	79	109.2	11.5	0.85	1	155	33.5	0.90

Appendix L.15. Frazer Lake sockeye salmon escapement, catch, run, and exploitation rate, 1970-2001.

	Escapement					Exploitation
Year	DS Weir [a]	Fish Ladder	River [b]	Catch [c]	Run	Rate (%)
1970		24,039		3,904	27,943	14
1971		55,366		10,549	65,915	16
1972		66,419		2,761	69,180	4
1973		56,255		1,210	57,465	2
1974		82,609		2,765	85,374	3
1975		64,199		3,300	67,499	5
1976		119,321		8,770	128,091	7
1977		139,548		1,366	140,914	1
1978		141,981		30,336	172,317	18
1979		126,742		26,805	153,547	17
1980		405,535		55,173	460,708	12
1981		377,716		110,210	487,926	23
1982		430,423		76,232	506,655	15
1983	166,655	158,340	8,315	29,668	196,323	15
1984 [d]	48,844	53,524	-4,680	13,853	62,697	22
1985	506,336	485,835	20,501	131,535	637,871	21
1986	136,553	126,529	10,024	41,652	178,205	23
1987	48,956	40,544	8,412	8,626	57,582	15
1988	248,055 [e]	246,704	1,351	210,406	458,461	46
1989	362,007	360,373	1,634	708,864	1,070,871	66
1990	254,540	226,707	27,833	725,293	979,833	74
1991	288,013	190,358	97,655	980,132	1,268,145	77
1992	206,406	185,825	20,581	212,367	418,773	51
1993	198,412	178,391	20,021	552,993	751,405	74
1994	240,913	206,071	34,842	409,132	650,045	63
1995	222,170	196,323	25,847	730,207	952,377	77
1996	208,638	198,695	9,943	492,275	700,913	70
1997	268,328	205,264	63,064	148,091	416,419	36
1998	245,409	233,755	11,654	360,949	606,358	60
1999	222,964	216,565	6,399	134,115	357,079	38
2000	222,965	158,044	64,921	236,661	459,626	60
2001	163,309	154,349	8,960	249,023	412,332	62
Avg. 1983-2001	221,579	201,168	20,410	334,287	555,866	50
10 year Avg.	215,004	193,328	21,675	350,143	565,147	58

[a] Prior to 1983 the Dog Salmon weir was not in operation.
[b] Dog Salmon weir count minus Frazer fish ladder count.
[b] Dog Salmon weir count minus Frazer fish ladder count.
[c] Although Frazer Lake sockeye catch occurred prior to 1983, numbers are unreliable.
[d] In 1984, the Dog Salmon weir count is inaccurate due to high water; Alitak catch based upon Frazer count.
[e] Estimated value, weir was inoperable for part of season actual count was 241,970 sockeye.

Sagalkin, N. *In Press*.1999. Frazer Lake Fish Pass Sockeye Salmon Smolt and Adult Research, 1997 and 1998. Alaska Dept. of Fish and Game, Division of Commercial Fisheries, RIR No. 4K99-59, Kodiak.



Appendix M.1. Morphometric map showing the limnology stations (2-4) on Karluk Lake.

Appendix M.2. The amount of nitrient enrichment additions and ratios into Karluk Lake, 1986-1990.

Year	Fertilizer Ratio[a]	Amount (kg)
1986	27-7-0	87,272
1987	27-7-0	87,272
1988	27-7-0	87,272
1989	20-5-0	77,272
1990	20-5-0	27,272
1990	32-0-0	59,091

[a] Nitrogen-Phosporus-Potassium

Appendix M.3. Limnological sampling stations and total samples collected for Karluk Lake, 1990-2001.

Year	Sampling Stations	Total Samples
1990	3	9
1991	3	6
1992	3	5
1993	1	5
1994	1	4
1995	2	4
1996	1	4
1997	2	4
1998	No sampling conducted	
1999	1	3
2000	1	4
2001	1	5

Appendix M.4. Summary of seasonal mean water chemistry parameters by station and depth for Karluk Lake, 1985-1994.

Year	Station	Depth (m)	Sp. Conductivity (umhos cm^{-1})	SD	pH (Units)	SD	Alkalinity (mg L^{-1})	SD	Turbidity (NTU)	SD	Color (Pt units)	SD	Calcium (mg L^{-1})	SD	Magnesium (mg L^{-1})	SD	Iron (ug L^{-1})	SD
1985	2	1	63.0	na	7.3	na	22.0	na	1.0	na	4.0	na	8.3	na	1.6	na	10.0	na
	2	35	63.0	na	7.2	na	23.0	na	2.0	na	na	na	8.6	na	1.5	na	10.0	na
	3	1	64.0	na	7.0	na	22.0	na	0.7	na	4.3	na	8.3	na	1.3	na	7.0	na
	3	50	65.0	na	7.1	na	22.0	na	0.6	na	na	na	8.0	na	1.6	na	10.0	na
	4	1	62.0	na	7.3	na	21.0	na	0.8	na	5.0	na	7.5	na	1.8	na	10.0	na
	4	50	60.0	na	7.1	na	21.0	na	2.1	na	na	na	8.2	na	1.2	na	13.0	na
1986	2	1	64.0	na	7.2	na	24.0	na	0.5	na	3.2	na	na	na	na	na	14.0	na
	2	35	62.0	na	7.1	na	24.0	na	1.0	na	3.7	na	na	na	na	na	8.0	na
	3	1	64.0	na	7.2	na	24.0	na	0.8	na	4.3	na	na	na	na	na	26.0	na
	3	50	63.0	na	7.1	na	23.0	na	0.5	na	4.0	na	na	na	na	na	8.0	na
	4	1	64.0	na	7.2	na	23.0	na	0.5	na	4.8	na	na	na	na	na	8.0	na
	4	50	64.0	na	7.1	na	24.0	na	0.7	na	4.2	na	na	na	na	na	17.0	na
1987	2	1	63.0	na	7.0	na	22.0	na	0.5	na	2.9	na	6.5	na	1.4	na	22.0	na
	2	35	64.0	na	7.0	na	22.0	na	0.5	na	2.7	na	6.5	na	1.3	na	16.0	na
	3	1	64.0	na	7.0	na	22.0	na	0.5	na	3.6	na	6.5	na	1.6	na	15.0	na
	3	50	64.0	na	7.0	na	22.0	na	0.5	na	4.0	na	6.5	na	1.3	na	27.0	na
	4	1	64.0	na	7.0	na	22.0	na	0.4	na	2.9	na	6.5	na	1.5	na	26.0	na
	4	50	62.0	na	7.0	na	21.0	na	0.4	na	3.3	na	6.5	na	1.6	na	33.0	na
1988	2	1	63.4	3.0	7.4	0.5	20.3	1.3	0.6	0.4	8.5	3.4	na	na	na	na	17.8	11.3
	2	30	63.8	1.0	7.0	0.2	20.6	1.4	0.6	0.3	7.4	1.5	na	na	na	na	14.4	9.4
	3	1	63.3	0.7	7.2	0.4	20.1	1.0	0.6	0.4	8.8	3.5	na	na	na	na	17.4	11.9
	3	40	64.4	1.7	7.1	0.3	19.8	1.2	0.5	0.1	11.9	10.8	na	na	na	na	16.0	10.7
	4	1	63.0	1.1	7.2	0.2	20.3	1.0	0.6	0.2	9.1	4.2	na	na	na	na	13.6	10.4
	4	80	63.9	0.4	7.1	0.2	20.0	0.8	0.5	0.2	7.4	2.1	na	na	na	na	19.3	13.4
1989	2	1	64.0	1.0	7.2	0.2	21.4	1.7	0.4	0.1	5.3	1.1	7.5	0.3	1.0	0.7	7.9	4.9
	2	30	64.7	1.3	7.1	0.2	21.4	2.0	0.4	0.2	5.0	1.7	7.2	0.3	1.2	0.5	11.0	6.1
	3	1	64.1	0.6	7.1	0.2	20.8	1.8	0.4	0.2	5.2	2.0	7.4	0.5	1.4	0.2	5.8	4.9
	3	40	64.8	0.9	7.1	0.2	21.3	1.9	0.4	0.1	5.0	2.0	7.4	0.5	1.4	0.2	12.1	4.3
	4	1	63.9	0.4	7.2	0.2	21.0	2.2	0.3	0.1	5.9	2.9	7.1	0.5	1.5	0.4	7.4	5.1
	4	80	64.0	0.5	7.1	0.2	21.1	2.6	0.4	0.2	5.7	2.0	7.0	0.3	1.3	0.2	8.0	5.2

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Appendix M.4. (page 2 of 2)

Year	Station	Depth (m)	Sp. Conductivity (umhos cm^{-1})	SD	pH (Units)	SD	Alkalinity (mg L^{-1})	SD	Turbidity (NTU)	SD	Color (Pt units)	SD	Calcium (mg L^{-1})	SD	Magnesium (mg L^{-1})	SD	Iron (ug L^{-1})	SD
1990	2	1	64.4	2.0	7.5	0.3	22.3	0.8	0.5	0.4	4.9	2.4	7.2	0.7	1.4	0.3	10.7	9.4
	2	30	64.6	0.8	7.2	0.3	22.3	1.1	0.7	1.0	4.7	1.2	6.8	0.6	1.4	0.6	24.4	47.5
	3	1	64.0	0.9	7.4	0.3	22.4	0.8	0.5	0.2	4.0	1.1	6.8	0.7	1.5	0.4	10.3	5.4
	3	40	65.3	1.7	7.3	0.2	22.8	1.3	0.5	0.3	4.6	1.6	7.2	0.5	1.4	0.3	10.8	10.8
	4	1	63.4	2.3	7.4	0.2	22.3	0.9	0.5	0.2	5.4	1.4	7.2	0.5	1.4	0.3	16.9	14.1
	4	80	64.8	0.5	7.3	0.1	21.7	2.6	0.5	0.3	3.7	1.3	7.2	0.3	1.4	0.3	16.2	22.2
1991	2	1	66.6	2.5	7.5	0.4	23.4	2.3	0.9	0.4	4.0	1.2	7.8	1.0	1.5	0.8	49.7	85.1
	2	30	67.0	1.4	7.2	0.1	22.6	2.3	1.1	1.4	10.4	5.8	8.0	0.8	1.1	0.9	17.4	12.0
	3	1	67.3	1.3	7.4	0.1	23.2	1.7	1.7	0.3	5.6	1.7	8.0	0.4	2.4	0.7	21.2	19.9
	3	40	67.0	1.9	7.2	0.3	22.4	3.0	0.8	0.7	5.6	1.7	7.8	0.6	1.4	0.7	23.2	19.8
	4	1	68.0	2.9	7.5	0.4	23.8	2.0	1.1	0.7	7.2	4.7	8.0	0.8	1.6	0.4	71.7	19.5
	4	80	66.6	0.5	7.3	0.1	23.0	1.7	0.8	0.5	8.4	3.6	8.2	0.8	2.7	4.0	16.7	18.9
1992	2	1	65.4	0.5	7.0	0.2	20.5	1.1	0.6	0.2	3.6	0.9	7.4	1.0	2.2	0.7	14.0	6.7
	2	30	65.6	1.1	6.9	0.1	20.3	0.7	0.4	0.1	4.0	0.7	8.4	2.7	1.8	1.0	11.0	0.0
	3	1	64.8	0.8	7.1	0.2	20.5	0.7	0.5	0.1	5.0	0.7	7.4	1.1	1.3	0.9	11.0	0.0
	3	40	65.2	0.8	7.0	0.2	21.1	1.7	0.4	0.2	5.2	2.3	8.1	1.3	1.1	0.8	11.0	0.0
	4	1	65.0	0.7	7.1	0.2	21.1	1.3	0.5	0.1	4.4	0.9	8.5	2.0	1.5	0.8	11.0	0.0
	4	80	65.0	1.0	7.0	0.1	20.6	0.7	1.2	1.7	4.6	2.4	7.7	1.5	1.8	1.1	11.0	0.0
1993	3	1	69.0	3.5	7.0	0.2	22.2	1.3	0.7	0.6	4.0	2.2	8.1	1.3	1.9	0.8	13.4	3.9
	3	40	70.4	1.7	6.9	0.1	21.4	0.5	0.8	0.8	3.8	1.3	8.1	1.2	1.9	0.8	12.6	2.3
1994	3	1	71.3	1.3	7.1	0.2	21.1	1.0	0.8	0.6	9.0	1.2	7.3	0.4	1.4	0.4	29.8	27.9
	3	50	71.3	1.5	6.8	0.2	21.1	1.0	1.8	1.9	9.5	1.0	7.8	0.1	1.4	0.4	177.8	181.9

SD - Standard Deviation
na - parameters were not analyzed.
Limnology results from 1985-1987 were obtained from Koenings, J.P., and R.D. Burkett. 1988.

Appendix M.5. Summary of seasonal mean nutrient and algal pigment concentrations by station and depth for Karluk Lake, 1985-1994.

Year	Station	Depth (m)	Total -P (ug L^{-1})	SD	Total filterable - P (ug L^{-1})	SD	Filterable reactive - P (ug L^{-1})	SD	Total Kjeldahl - N (ug L^{-1})	SD	Ammonia (ug L^{-1})	SD	Nitrate+ nitrite (ug L^{-1})	SD	Reactive silicon (ug L^{-1})	SD	Carbon (ug L^{-1})	SD	Chlorophyll *a* (ug L^{-1})	SD	Phaeophytin *a* (ug L^{-1})	SD
1985	2	1	7.7	na	2.5	na	1.1	na	119.0	na	8.2	na	40.9	na	138.0	na	190.0	na	1.92	na	1.05	na
	2	35	6.2	na	2.5	na	1.4	na	104.0	na	18.7	na	60.4	na	61.0	na	211.0	na	1.78	na	1.09	na
	3	1	5.9	na	1.0	na	1.0	na	105.0	na	24.3	na	42.6	na	54.0	na	256.0	na	1.88	na	0.96	na
	3	50	6.3	na	1.5	na	1.5	na	107.0	na	14.3	na	69.5	na	58.0	na	228.0	na	1.58	na	0.91	na
	4	1	6.6	na	1.0	na	1.0	na	109.0	na	6.8	na	45.9	na	62.0	na	244.0	na	1.87	na	1.02	na
	4	50	6.9	na	1.6	na	1.6	na	102.0	na	17.1	na	70.0	na	63.0	na	213.0	na	1.30	na	0.90	na
1986	2	1	8.4	na	5.3	na	0.9	na	95.0	na	3.1	na	69.1	na	132.0	na	229.0	na	1.67	na	0.57	na
	2	35	8.1	na	5.0	na	1.0	na	94.0	na	9.2	na	70.9	na	128.0	na	218.0	na	1.72	na	0.57	na
	3	1	8.7	na	5.6	na	1.1	na	107.0	na	2.3	na	65.2	na	67.0	na	209.0	na	1.48	na	0.64	na
	3	50	6.9	na	3.7	na	0.9	na	80.0	na	8.2	na	80.9	na	78.0	na	178.0	na	1.37	na	0.52	na
	4	1	8.9	na	6.2	na	1.4	na	102.0	na	3.9	na	60.3	na	67.0	na	227.0	na	1.51	na	0.57	na
	4	50	8.0	na	4.5	na	1.2	na	83.0	na	8.7	na	71.9	na	61.0	na	176.0	na	1.92	na	0.68	na
1987	2	1	9.3	na	4.0	na	0.9	na	133.0	na	8.8	na	68.6	na	184.0	na	NA	na	2.29	na	0.55	na
	2	35	8.1	na	3.8	na	0.8	na	110.0	na	12.8	na	93.6	na	147.0	na	NA	na	2.28	na	0.55	na
	3	1	8.2	na	3.7	na	1.1	na	117.0	na	12.9	na	61.5	na	89.0	na	NA	na	2.36	na	0.62	na
	3	50	7.8	na	3.5	na	0.8	na	104.0	na	15.7	na	90.2	na	53.0	na	NA	na	2.64	na	0.55	na
	4	1	9.1	na	4.1	na	0.9	na	118.0	na	11.5	na	68.3	na	68.0	na	NA	na	2.15	na	0.51	na
	4	50	8.4	na	3.7	na	0.8	na	98.0	na	17.2	na	113.6	na	63.0	na	NA	na	2.12	na	0.59	na
1988	2	1	8.2	1.0	3.6	1.0	1.4	0.4	100.7	32.7	6.2	3.1	106.4	46.2	168.3	68.9	355.4	191.8	2.44	0.8	0.70	0.3
	2	30	8.2	0.6	3.0	0.8	1.7	0.9	85.9	33.2	11.5	9.7	118.3	16.7	95.9	53.2	311.0	245.4	2.35	1.5	0.68	0.2
	3	1	9.0	2.6	4.2	1.6	2.0	0.9	102.1	37.6	4.9	2.6	92.6	39.5	68.5	27.4	399.1	262.2	3.26	3.3	0.83	0.7
	3	40	8.5	0.9	4.8	4.1	1.5	0.4	80.4	22.8	10.3	7.9	121.2	31.7	57.3	37.5	275.6	167.4	2.16	0.7	0.63	0.2
	4	1	8.5	1.2	4.0	1.2	1.6	0.6	94.4	16.7	4.7	2.0	89.5	36.5	57.0	33.2	343.1	151.0	2.50	1.3	0.87	0.5
	4	80	9.2	0.7	3.9	0.8	1.8	0.3	77.1	25.5	7.7	4.9	130.5	17.0	56.8	48.8	321.3	286.2	1.92	0.7	0.59	0.2
1989	2	1	8.0	1.2	4.7	1.4	1.5	0.6	121.3	30.3	3.5	3.0	90.3	46.5	162.6	74.5	na	na	1.37	0.4	0.63	0.3
	2	30	7.4	1.1	4.8	3.5	1.3	0.6	108.1	14.1	11.0	10.8	122.1	16.3	156.9	70.2	na	na	1.44	0.8	0.43	0.1
	3	1	7.1	3.1	4.7	1.7	1.4	0.3	111.0	48.1	2.8	2.4	93.3	41.3	73.3	53.6	na	na	1.64	0.6	0.64	0.2
	3	40	9.1	6.7	3.9	0.6	1.4	0.4	110.6	35.0	6.3	7.2	134.6	24.3	62.0	43.0	na	na	1.06	0.6	0.49	0.2
	4	1	8.3	1.2	5.7	2.6	2.0	1.5	113.8	18.3	3.6	3.9	93.6	48.9	69.3	37.8	na	na	1.22	0.5	0.68	0.2
	4	80	8.2	2.2	6.4	3.3	2.5	2.0	99.6	21.5	5.5	3.9	141.4	25.3	57.4	40.1	na	na	0.89	0.5	0.42	0.1

-Continued-

Appendix M.5. (page 2 of 2)

Year	Station	Depth (m)	Total -P (ug L^{-1})	SD	Total filterable - P (ug L^{-1})	SD	Filterable reactive - P (ug L^{-1})	SD	Total Kjeldahl - N (ug L^{-1})	SD	Ammonia (ug L^{-1})	SD	Nitrate+ nitrite (ug L^{-1})	SD	Reactive silicon (ug L^{-1})	SD	Carbon (ug L^{-1})	SD	Chlorophyll *a* (ug L^{-1})	SD	Phaeophytin *a* (ug L^{-1})	SD
1990	2	1	7.7	3.2	4.0	0.8	1.5	0.5	103.3	22.6	6.2	2.9	67.6	22.9	228.1	161.9	47.7	86.4	1.33	1.3	0.56	0.4
	2	30	8.2	3.6	5.1	1.8	1.9	0.4	96.0	16.0	14.9	16.2	96.7	34.8	205.6	131.9	40.4	45.7	1.20	0.8	0.53	0.3
	3	1	8.8	4.2	3.9	0.6	1.4	0.7	108.0	26.6	6.3	3.2	76.7	47.4	153.6	91.7	26.2	33.8	1.07	1.0	0.51	0.3
	3	40	7.9	3.2	4.0	1.5	1.7	1.2	98.6	21.4	12.7	11.3	95.5	37.0	148.1	105.1	42.6	80.2	1.06	1.1	0.48	0.3
	4	1	8.0	3.0	4.4	1.5	1.8	0.9	98.3	30.4	6.6	2.8	80.6	26.7	134.2	108.6	36.8	71.3	0.94	0.7	0.52	0.4
	4	80	7.5	3.2	4.6	1.3	2.3	1.4	81.4	10.5	13.0	10.8	106.7	43.7	141.8	78.6	19.2	11.7	0.77	0.6	0.42	0.2
1991	2	1	6.1	0.9	3.7	0.6	1.3	0.6	96.7	61.9	4.8	5.0	101.4	36.9	158.0	63.8	0.0	0.0	1.65	0.9	0.94	0.5
	2	30	9.2	5.4	8.0	5.6	3.2	3.1	67.3	66.3	4.7	2.7	155.2	31.8	115.4	117.9	0.0	0.0	1.47	0.6	0.63	0.3
	3	1	8.1	2.3	3.4	0.5	1.1	0.4	78.9	69.5	5.5	5.8	90.0	46.7	107.0	74.9	0.0	0.0	1.54	0.4	0.85	0.2
	3	40	6.0	1.0	3.1	0.6	0.9	0.7	65.4	62.1	3.8	1.8	159.2	23.7	83.6	59.5	0.0	0.0	1.26	0.7	0.52	0.1
	4	1	7.7	2.3	3.5	1.1	1.2	1.2	69.3	66.8	4.4	4.1	107.3	46.1	96.0	48.0	0.0	0.0	1.58	0.4	0.82	0.3
	4	80	7.7	2.6	4.0	1.5	1.8	1.4	68.6	63.0	3.7	3.9	186.4	25.4	82.4	60.5	0.0	0.0	1.14	1.1	0.39	0.2
1992	2	1	8.0	2.8	3.7	1.2	1.0	1.1	138.0	37.2	5.2	2.1	67.5	57.9	220.0	58.5	275.3	78.5	2.28	1.3	0.71	0.6
	2	30	6.7	1.8	3.9	1.3	1.4	1.0	125.9	13.9	13.7	13.1	110.8	18.2	214.0	60.8	196.0	57.2	1.35	0.3	0.74	0.1
	3	1	8.3	2.4	5.4	2.0	2.5	2.6	154.0	37.4	5.5	1.2	66.6	52.2	143.6	62.7	241.6	67.5	2.40	0.9	0.80	0.1
	3	40	6.2	1.8	4.3	2.3	1.7	1.9	113.4	26.7	12.2	9.4	145.1	24.2	190.2	31.9	204.8	72.6	1.07	0.6	0.59	0.2
	4	1	7.5	1.3	4.1	0.5	1.1	0.9	131.8	19.2	5.5	2.8	74.9	54.7	146.2	64.0	291.0	88.6	1.73	0.6	0.78	0.2
	4	80	6.6	2.5	3.6	0.6	0.9	0.7	103.5	16.0	10.3	10.3	136.4	38.9	203.2	48.4	133.0	74.1	0.68	0.4	0.47	0.2
1993	3	1	6.1	1.2	3.3	0.7	1.3	0.9	105.7	22.0	4.1	1.5	91.9	54.9	145.0	83.1	215.2	39.2	2.76	1.3	1.51	1.7
	3	40	8.5	2.8	3.5	0.5	1.3	0.5	111.4	16.7	5.4	4.6	141.1	33.3	127.2	64.0	189.8	56.8	2.69	1.2	0.53	0.4
1994	3	1	5.5	1.6	2.9	1.1	0.9	0.4	114.4	15.0	3.2	1.1	79.6	45.4	139.0	83.5	290.5	158.6	0.97	0.3	0.20	0.1
	3	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	0.92	0.3	0.23	0.1
	3	50	22.1	2.3	7.3	8.1	5.2	7.9	117.1	45.2	21.1	22.8	138.2	14.8	218.8	93.5	267.5	115.5	0.93	0.3	0.27	0.1

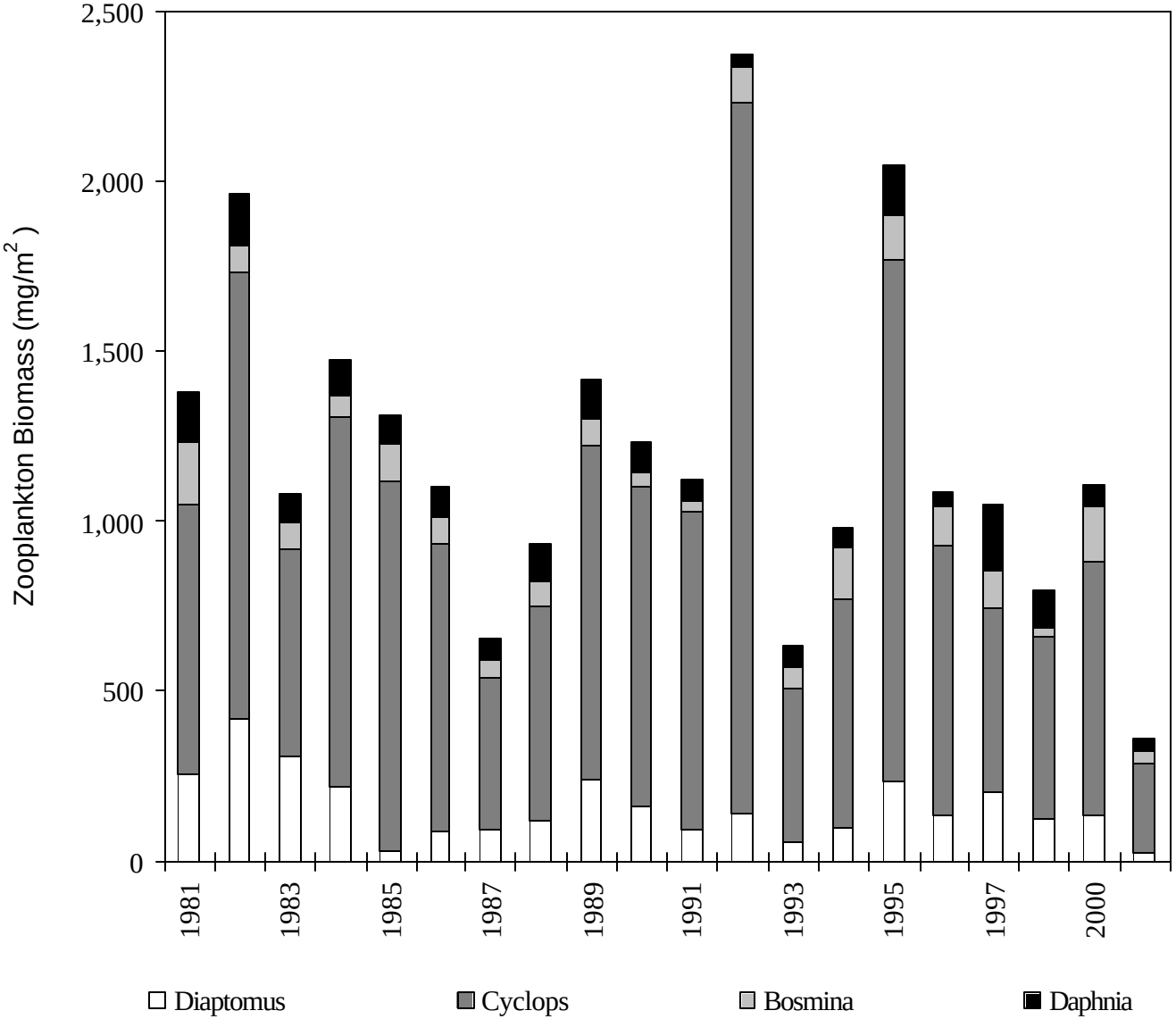
SD - Standard Deviation

na - parameters were not analyzed.

Limnology results from 1985-1987 were obtained from Koenings, J.P., and R.D. Burkett. 1988.

Appendix M.6. Weighted mean zooplankton density, biomass, and size by genera for Karluk Lake, 1981-1997 and 1999-2001.

		Diaptomus			Cyclops			Bosmina			Daphnia			Total	
Year	Samples (n)	Density (no/m^2)	Biomass (mg/m^2)	Size (mm)	Density (no/m^2)	Biomass (mg/m^2)	Size (mm)	Density (no/m^2)	Biomass (mg/m^2)	Size (mm)	Density (no/m^2)	Biomass (mg/m^2)	Size (mm)	Density (no/m^2)	Biomass (mg/m^2)
1981	8	76,845	257	0.91	422,695	792	0.74	97,570	183	0.45	66,501	146	0.71	663,610	1,379
1982	6	145,134	421	0.88	647,203	1,313	0.76	41,727	75	0.44	66,620	152	0.72	900,685	1,960
1983	5	91,131	305	0.91	474,953	613	0.62	49,687	76	0.41	47,033	89	0.66	662,804	1,083
1984	7	43,047	220	1.07	354,271	1,086	0.93	27,518	61	0.48	40,977	108	0.78	465,813	1,476
1985	6	9,333	29	0.88	457,216	1,089	0.82	48,910	111	0.50	37,233	84	0.75	552,691	1,313
1986	8	36,950	86	0.80	509,587	849	0.70	45,283	82	0.44	36,558	87	0.74	628,378	1,103
1987	10	29,605	90	0.89	289,251	448	0.68	30,215	50	0.42	36,584	70	0.67	347,001	612
1988	8	33,307	119	0.94	408,027	630	0.67	38,897	74	0.45	41,833	107	0.77	522,063	931
1989	7	73,978	242	0.90	531,781	978	0.73	54,074	82	0.41	56,396	109	0.67	716,229	1,411
1990	9	40,440	157	0.97	488,625	944	0.75	30,682	43	0.39	40,548	92	0.72	600,295	1,236
1991	6	34,368	90	0.84	528,662	940	0.72	23,543	32	0.39	31,913	57	0.64	618,487	1,120
1992	5	25,833	137	1.08	674,148	2,094	0.93	50,218	108	0.48	11,165	31	0.79	761,364	2,370
1993	6	19,259	56	0.87	311,452	453	0.65	48,823	62	0.37	37,650	65	0.64	417,184	636
1994	4	27,037	96	0.95	481,358	673	0.64	103,968	155	0.40	30,288	53	0.64	642,651	977
1995	4	55,904	236	0.99	676,997	1,533	0.80	71,430	131	0.44	68,897	145	0.70	873,229	2,045
1996	4	31,476	133	0.98	452,020	793	0.71	81,516	117	0.40	29,624	45	0.60	594,636	1,088
1997	2	97,306	207	0.78	277,680	537	0.75	79,174	112	0.39	103,914	192	0.64	558,075	1,048
1999	3	45,648	125	0.85	280,786	536	0.74	20,711	26	0.37	52,725	108	0.68	399,870	795
2000	4	37,686	135	1.00	457,272	745	0.69	89,106	167	0.45	34,501	57	0.62	618,565	1,104
2001	5	5,706	24	0.99	179,671	264	0.91	28,238	34	0.37	23,646	35	0.68	237,261	357



Appendix M.7. Weighted mean zooplankton biomass by genera for Karluk Lake, 1981-1997 and 1999-2001.

Appendix M.8. Juvenile sockeye salmon estimates based on fall townet catch species composition and hydroacoustic fish populations estimates from Karluk Lake, 1983-1991 and 1994-1997.

	Total Fish Estimates			Sockeye Estimates			Sockeye
		95% C. I.			95% C. I.		Composition
Date	Number	Low	High	Number	Low	High	(%)
12-Jul-83	10,204,000	9,261,000	11,147,000	1,418,000	1,286,000	1,550,000	14.0
18-Sep-84	42,705,000	17,074,000	68,336,000	1,989,000	885,000	3,093,000	5.0
2-Oct-85	65,020,000	49,743,000	80,297,000	11,336,000	10,232,000	12,440,000	17.0
7-Jul-86	9,571,000	7,715,000	11,427,000	1,367,000	1,119,000	1,615,000	14.0
15-Sep-86	48,066,000	43,382,000	52,750,000	6,037,000	5,443,000	6,631,000	13.0
19-Sep-87	81,278,000	63,073,000	99,483,000	18,205,000	15,005,000	21,405,000	20.0
Sep-88	81,350,000	na[a]	na[a]	10,924,500	na[a]	na[a]	13.4
Sep-89	80,077,000	na[a]	na[a]	3,989,000	na[a]	na[a]	5.0
10-Sep-90	87,299,500	73,045,681	101,553,319	48,363,923	40,467,307	56,260,539	55.4
25-Sep-91	36,146,550	21,306,133	50,986,967	7,952,241	4,687,349	11,217,133	22.0
20-Apr-94	31,522,425	20,618,469	42,426,381	3,467,467	2,268,032	4,666,902	11.0
15-Sep-94	42,001,613	32,295,370	51,707,856	1,176,045	904,270	1,447,820	2.8
27-Apr-95	36,474,225	27,905,810	45,042,640	9,920,989	7,590,380	12,251,598	27.2
17-Jun-95	6,468,308	5,750,950	7,185,666	556,274	494,581	617,967	8.6
27-Sep-95	51,569,925	33,921,070	69,218,780	1,443,958	949,790	1,938,126	2.8
28-Apr-96	11,564,550	8,102,485	15,026,615	0	na	na	0.0
30-Jun-96	4,210,133	2,882,943	5,537,323	711,512	487,217	935,807	16.9
10-Sep-96	14,820,315	11,434,607	18,206,023	2,178,586	1,680,887	2,676,285	14.7
30-Apr-97	19,504,558	16,806,230	22,202,886	7,957,859	6,856,941	9,058,777	13.6
8-Jul-97	16,849,178	14,799,353	18,899,003	606,570	532,776	680,364	1.2
9-Sep-97	23,649,328	18,448,773	28,849,883	2,057,491	1,605,043	2,509,939	2.9

[a] na - Raw data not available to calculate confidence intervals.

Appendix M. 9. Townet catches from Karluk Lake, 1983-1988, 1990-1991, and 1994-1997.

			Catch by Species					
	Number	Total	Sockeye			Stickleback		
Date	of Tows	Minutes	No.	%	CPUE	No.	%	CPUE
12-Apr-83	5	140	16	10.7	0.11	134	89.3	0.96
20-Sep-84	4	100	88	6.3	0.88	1,316	93.7	13.16
2-Oct-85	4	175	28	11.0	0.16	228	89.0	1.30
7-Jul-86	11	330	1,332	17.0	4.04	6,503	83.0	19.71
15-Sep-86	23	690	930	9.0	1.35	9,403	91.0	13.63
19-Sep-87	14	420	120	13.0	0.29	803	87.0	1.91
15-Sep-88	9	270	219	14.0	0.81	1,345	86.0	4.98
10-Sep-90	3	60	90	0.3	1.50	188	0.7	3.13
25-Sep-91	8	160	83	21.3	0.52	307	78.7	1.92
20-Apr-94	11	204	4	11.0	0.02	32	89.0	0.16
15-Sep-94	8	130	169	2.8	1.30	5,968	97.2	45.91
27-Apr-95	11	165	25	27.2	0.15	67	72.8	0.41
21-Jun-95	11	165	13	8.6	0.08	139	91.4	0.84
28-Sep-95	9	139	127	2.8	0.91	4,389	97.2	31.58
28-Apr-96	10	130	0			27	100.0	0.21
28-Jun-96	9	135	33	16.9	0.24	162	83.1	1.20
10-Sep-96	7	105	81	14.7	0.77	470	85.3	4.48
30-Apr-97	10	115	6	13.6	0.05	38	86.4	0.33
8-Jul-97	9	135	4	1.2	0.03	334	98.8	2.47
9-Sep-97	10	130	19	2.9	0.15	644	97.1	4.95

[a] Catch per unit effort

Appendix M.10. Mean age, length, weight, and condition coefficient by age for juvenile sockeye salmon captured by townet at Karluk Lake, 1990-1991 and 1994-1997.

	Age-0				Age-1				Age-2			
Date	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)
10-Sep-90	86	44	0.8	0.95	3	80	4.6	0.90	0			
25-Sep-91	17	44	0.9	1.06	5	71	3.8	1.03	2	96	9.4	1.01
25-Sep-94	110	60	2.0	0.89	28	82	5.4	0.90	7	81	4.9	0.88
27-Apr-95	0				3	90	7.3	0.98	19	100	10.7	1.06
28-Sep-95	33	67	3.3	1.03	78	99	9.6	0.99	1	113	14.4	1.00
10-Sep-96	23	40	0.9	1.28	35	63	2.8	1.11	7	77	5.3	1.09
30-Apr-97	0				3	90	7.9	1.07	3	100	11.9	1.11
8-Jul-97	0				1	93	8.6	1.07	2	85	7.5	1.23
9-Sep-97	6	43	0.8	0.98	3	65	3.2	1.09	0			

Appendix M.11. Age compositions and population estimates of sockeye salmon smolt emigrating from Karluk Lake, 1961-1968, 1980-1984, 1991-1992, and 1999-2001.

		Age					Total #	95% C.I.	
Year		0	1	2	3	4	of Smolt	Low	High
1961	Percent	0.4	8.0	85.2	6.4	0.0			
	Number	6,419	134,811	1,444,399	109,132	0	1,694,761	na	na
1962	Percent	0	1.3	70.4	28.3	0.0			
	Number	0	18,653	1,010,144	406,067	0	1,434,864	na	na
1963	Percent	0.0	0.2	46.1	53.7	0.0			
	Number	0	3,079	709,755	826,765	0	1,539,599	na	na
1964	Percent	0.0	0.0	24.7	73.8	1.5			
	Number	0	0	385,593	1,152,095	23,417	1,561,105	na	na
1965	Percent	0.0	0.0	48.8	49.9	1.3			
	Number	0	0	717,022	733,184	19,101	1,469,307	na	na
1966	Percent	0.0	0.0	61.2	36.9	1.9			
	Number	0	0	661,593	398,519	20,838	1,080,950	na	na
1967	Percent	0.0	15.0	83.5	1.5	0.0			
	Number	0	203,736	1,134,127	20,374	0	1,358,237	na	na
1968	Percent	0.0	4.7	61.8	33.5	0.0			
	Number	0	171,158	2,250,549	1,219,958	0	3,641,665	na	na
1980	Percent	0.0	29.3	62.9	7.8	0.0			
	Number	0	494,500	1,060,800	131,200	0	1,686,500	na	na
1981	Percent	0.0	10.8	76.5	12.8	0.0			
	Number	0	219,500	1,561,300	260,900	0	2,041,700	na	na
1982	Percent	0.0	1.7	85.1	13.2	0.0			
	Number	0	14,000	698,800	108,400	0	821,200	na	na
1983	Percent	0.0	1.4	83.0	15.6	0.0			
	Number	0	13,000	781,000	147,000	0	941,000	na	na
1984	Percent	0.0	6.9	79.8	13.3	0.0			
	Number	0	74,000	857,000	143,000	0	1,074,000	na	na
1991	Percent	0.0	2.6	57.8	39.6	0.0			
	Number	0	108,123	2,392,324	1,640,374	0	4,140,821	2,809,914	5,471,727
1992	Percent	0.0	0.8	58.4	40.5	0.3			
	Number	0	28,189	2,039,222	1,415,788	10,797	3,493,996	2,780,674	4,207,319
1999	Percent	0.0	3.3	49.8	45.7	1.2			
	Number	0	35,196	531,134	487,406	12,798	1,066,534	717,152	1,415,915
2000	Percent	0.0	13.0	77.2	21.5	0.0			
	Number	0	9,441	1,263,785	402,919	0	1,676,502	1,328,451	2,024,553
2001	Percent	0.1	6.4	81.9	11.7	0.0			
	Number	2,835	238,338	3,062,548	436,468	80	3,740,268	3,136,398	4,344,111

[a] na - data was not available to determine confidence intervals.

Appendix M.12. Summary of mean length and weight by age class of Karluk Lake sockeye salmon smolt samples, 1925-1936, 1961-1968, and 1979-2001.

	Age-1				Age-2				Age-3				Age-4			
Year	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)
1925	3	113	na	na	563	136	22.8	0.91	84	145	28.5	0.93	0			
1926	5	100	na	na	445	136	22.9	0.91	156	144	28.5	0.95	3	164	na	na
1927	5	116	na	na	212	134	21.2	0.88	144	147	27.3	0.86	0			
1928	6	111	na	na	494	128	19.9	0.95	225	141	28.4	1.01	4	151	na	na
1929	0				418	130	20.0	0.91	603	143	25.2	0.86	12	155	na	na
1930	24	110	na	na	1,145	127	18.5	0.90	625	137	25.0	0.97	20	143	na	na
1931	16	111	na	na	1,795	130	20.0	0.91	247	138	26.8	1.02	14	145	na	na
1932	16	105	na	na	1,358	133	20.9	0.89	634	139	29.5	1.10	20	146	na	na
1933	43	114	na	na	685	136	23.9	0.95	521	144	29.6	0.99	23	147	na	na
1934	7	123	na	na	822	140	24.8	0.90	75	148	33.3	1.03	6	161	na	na
1935	16	113	na	na	1,520	142	26.3	0.92	286	152	26.6	0.76	2	146	na	na
1936	60	111	na	na	744	133	21.3	0.91	233	143	18.2	0.62	9	151	na	na
1961	na	110	13.1	0.98	na	115	13.7	0.90	na	124	16.6	0.87	0			
1962	na	108	11.3	0.90	na	113	12.4	0.86	na	123	15.8	0.85	0			
1963	na	110	14.5	1.09	na	119	14.6	0.87	na	129	18.5	0.86	0			
1964	0				na	128	21.0	1.00	na	136	24.1	0.96	na	149	33.7	1.02
1965	0				na	127	19.1	0.93	na	142	26.7	0.93	na	145	28.7	0.94
1966	0				na	115	13.2	0.87	na	131	18.9	0.84	na	137	21.4	0.83
1967	na	102	10.7	1.01	na	113	13.8	0.96	na	133	23.1	0.98	0			
1968	na	104	9.9	0.88	na	113	12.4	0.86	na	124	15.3	0.80	0			
1979	66	112	14.8	1.07	201	120	18.5	1.07	11	147	29.1	0.91	0			
1980	300	97	8.3	0.90	496	103	9.4	0.87	80	113	11.7	0.80	0			
1981	77	96	9.4	1.05	600	111	13.4	0.97	83	119	16.2	0.95	0			
1982	8	104	10.8	0.96	413	119	15.1	0.90	64	132	20.2	0.88	0			
1983	17	101	9.5	0.92	1,014	117	14.2	0.89	149	132	19.9	0.87	0			
1984	165	108	11.5	0.91	670	117	13.9	0.87	63	130	19.3	0.88	0			
1985	227	103	10.1	0.92	541	111	12.1	0.87	37	123	16.4	0.87	0			

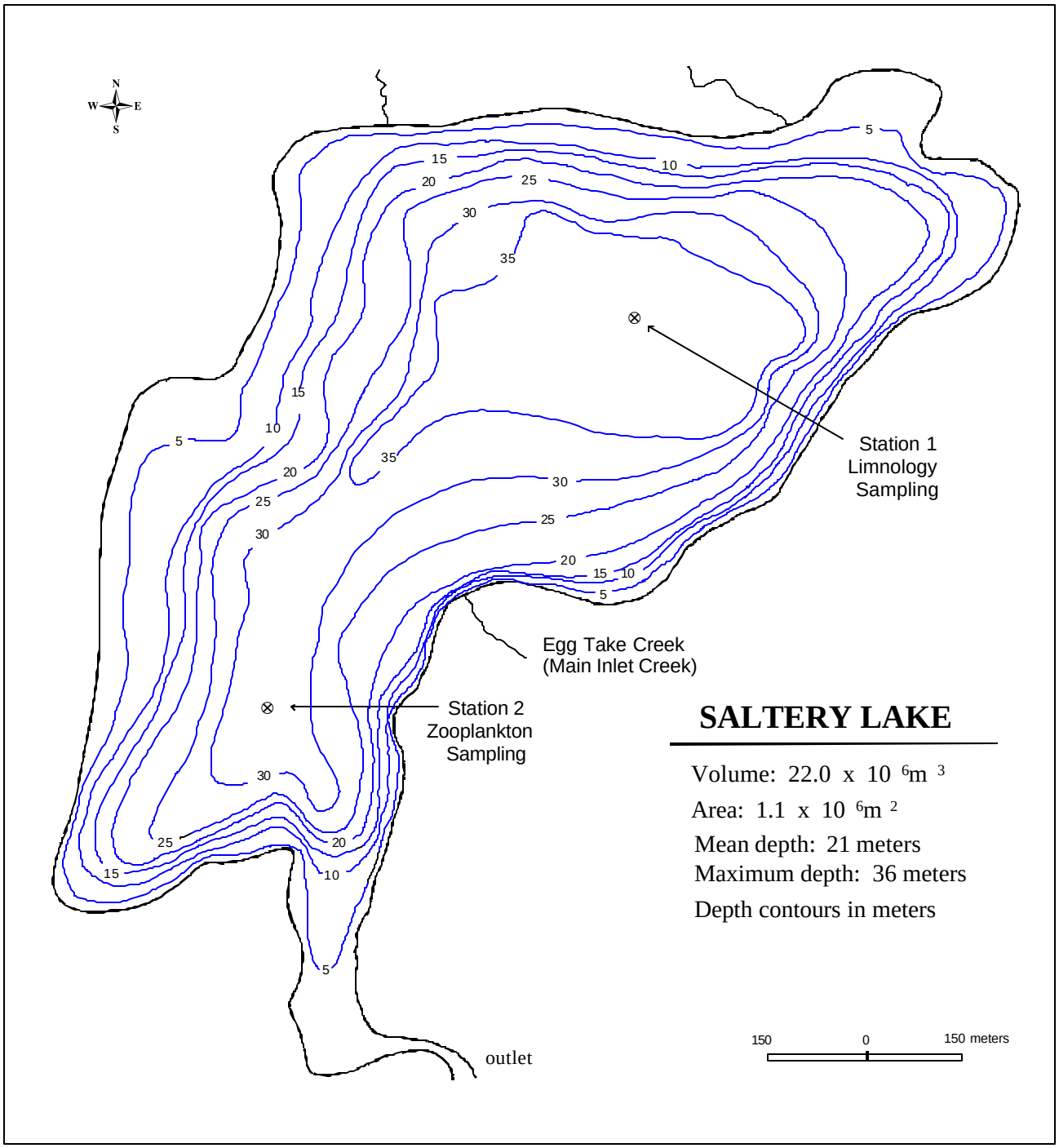
-Continued-

Appendix M.12 (page 2 of 2)

	Age-1				Age-2				Age-3				Age-4			
Year	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)
1986	426	85	6.2	1.01	1,184	111	13.0	0.95	28	118	14.7	0.90	0			
1987	43	95	7.4	0.82	1,776	106	10.4	0.86	316	121	15.6	0.86	0			
1988	8	82	4.9	0.84	800	103	9.4	0.86	10	118	11.9	0.82	0			
1989	5	92	6.7	0.84	828	103	9.6	0.86	149	116	13.4	0.85	0			
1990	30	96	7.8	0.85	270	101	8.7	0.82	709	114	12.2	0.82	1	121	14.4	0.81
1991	166	100	8.7	0.84	1,584	110	11.3	0.84	654	121	15.0	0.84	0			
1992	59	101	8.8	0.83	1,340	106	9.8	0.82	565	117	13.4	0.83	4	127	18.0	0.87
1993																
1994	1	110	12.0	0.90	167	112	11.1	0.79	129	119	13.4	0.79	0			
1995	7	105	9.5	0.82	79	113	12.3	0.83	2	122	16.1	0.89	0			
1996																
1997	0				157	112	13.0	0.92	83	114	13.4	0.91	1	109	12.3	0.95
1998																
1999	40	90	6.2	0.78	598	116	13.2	0.84	549	125	16.5	0.83	15	132	18.9	0.81
2000	16	98.0	8.5	0.87	963	120	15.0	0.86	268	131	19.7	0.86	0			
2001[a]	459	103.0	9.6	0.86	1,565	118	14.4	0.86	313	139	23.4	0.87	1	140	23.7	0.86

na - not available

[a] In addition to the 2001 listed ages, there were 12 Age 0.0 smolt samples which made up 0.5% of the total sample size.



Appendix N.1. Morphometric map showing the limnology and zooplankton stations on Saltery Lake.

Appendix N.2. Limnological sampling stations and total samples collected for Saltery Lake, 1994-2001.

Year	Sampling Stations	Total Samples
1994	1,2	4
1995	1,2	4
1996	1,2	4
1997	1,2	5
1998	1	4
1999	1	4
2000	1	4
2001	1	4

Appendix N.3. Summary of seasonal mean water chemistry parameters by station and depth for Saltery Lake, 1994 and 1997.

	Sta	Depth	Sp. Conductivity		pH		Alkalinity		Turbidity		Color		Calcium		Magnesium		Iron	
Year	tion	(m)	(umhos cm^{-1})	SD	(Units)	SD	(mg L^{-1})	SD	(NTU)	SD	(Pt units)	SD	(mg L^{-1})	SD	(mg L^{-1})	SD	(ug L^{-1})	SD
1994	1	1	64.3	20.6	6.7	0.3	18.0	2.0	2.3	1.6	8.0	6.1	6.3	3.0	0.6	0.2	94.8	54.7
	1	33	65.3	18.0	6.6	0.3	18.0	0.8	5.0	1.8	5.0	2.7	8.0	0.1	0.7	0.5	185.0	32.2
1997	1	1	52.8	3.3	7.2	0.1	19.6	0.6	3.5	2.3	7.2	5.0	6.3	0.2	0.7	0.3	52.4	17.2
	1	34	60.4	2.1	6.8	0.2	22.4	1.4	5.4	2.7	4.2	0.4	7.2	0.5	0.5	0.2	41.0	21.9

SD - standard deviation
na - parameters were not analyzed.

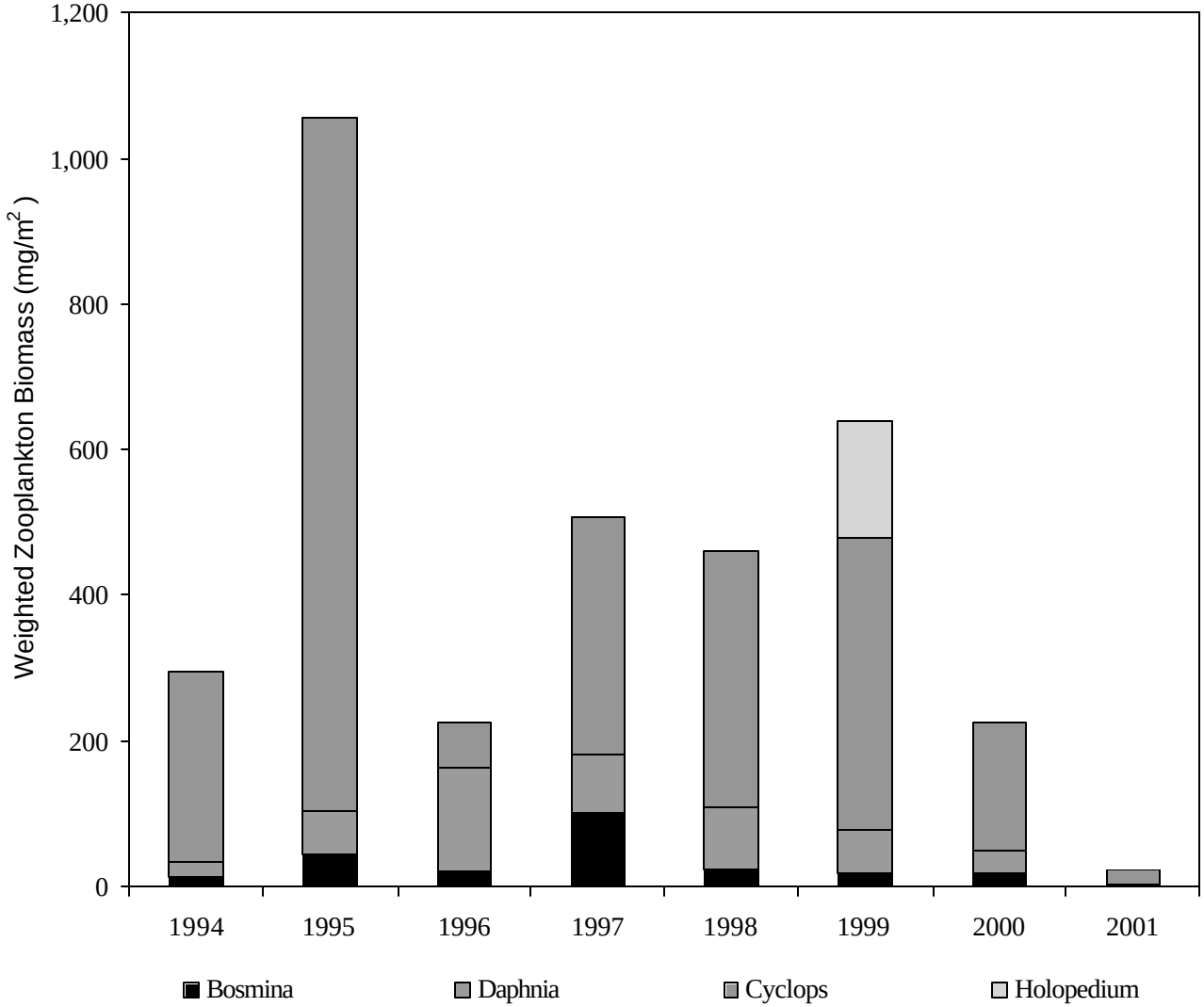
Appendix N.4. Summary of seasonal mean nutrient and algal pigment concentrations by station and depth for Saltery Lake, 1994 and 1997.

Year	Station	Depth (m)	Total Phosphorus (ug L^{-1})	SD	Total filterable-P (ug L^{-1})	SD	Filterable reactive-P (ug L^{-1})	SD	Total Kjeldahl-N (ug L^{-1})	SD	Ammonia (ug L^{-1})	SD	Nitrate + nitrite (ug L^{-1})	SD	Reactive silicon (ug L^{-1})	SD	Organic carbon (ug L^{-1})	SD	Chloro-phyll *a* (ug L^{-1})	SD	Phaeo-phytin *a* (ug L^{-1})	SD
1994	1	1	7	1.3	4	3.2	3	3.4	100	45	5	4.6	124	91.5	2,104	661.4	151	78.6	1.38	1.3	0.33	0.0
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	1.67	1.3	0.35	0.2
	1	33	11	2.7	4	2.2	3	1.7	70	9	9	3.1	221	22.6	2,075	92.7	149	40.7	1.00	0.1	0.44	0.1
1997	1	1	9	4.6	4	2.2	4	2.3	75	22	3	2.7	71	56.5	1,767	190.9	195	68.4	1.65	0.8	0.90	0.4
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	1.59	0.8	0.98	0.5
	1	34	10	1.4	3	1.3	2	0.8	90	32	12	16.3	192	36.3	2,161	270.9	207	132.3	0.97	1.0	0.60	0.3

SD - standard deviation
na - parameters were not analyzed.

Appendix N.5. Weighted mean zooplankton density, biomass, and size by genera for Saltery Lake, 1994-2001.

	No. of	*Diaptomus*			*Cyclops*			*Bosmina*			*Daphnia*			*Holopedium*			TOTALS	
Year	Sample Dates	Density (no/m^2)	Biomass (mg/m^2)	Size mm	Density (no/m^2)	Biomass (mg/m^2)	Size mm	Density (no/m^2)	Biomass (mg/m^2)	Size mm	Density (no/m^2)	Biomass (mg/m^2)	Size mm	Density (no/m^2)	Biomass (mg/m^2)	Size mm	Density (no/m^2)	Biomass (mg/m^2)
1994	4	53	0.0	0.85	119,169	261.6	0.79	9,329	13.7	0.40	6,469	20.0	0.81	106	0.0		135,126	295.3
1995	4				358,887	950.0	0.86	23,620	44.2	0.45	27,535	58.3	0.70				410,041	1,052.6
1996	4				29,578	64.2	0.79	17,436	21.1	0.36	97,213	141.4	0.59				144,228	226.7
1997	5	64	0.5	1.20	124,140	327.0	0.86	61,083	100.3	0.42	44,289	79.9	0.64	21	0.1	0.52	229,596	507.7
1998	4				157,135	350.2	0.79	14,993	23.1	0.39	40,896	85.8	0.72				213,024	459.1
1999	4	929	8.2	1.29	203,291	400.0	0.75	11,385	17.6	0.40	27,442	60.9	0.71	29,591	160.5	0.73	272,638	647.2
2000	4	149	1.1	1.40	127,488	175.5	0.64	11,395	17.7	0.42	20,203	31.7	0.61	0			159,235	226.0
2001	4	133	0.8	1.11	7,580	20.0	0.96	365	0.4	0.40	1,360	2.1	0.69	0			9,438	23.2



Appendix N.6. Weighted mean zooplankton biomass by genera for Saltery Lake, 1994-2001.

Appendix N.7. Juvenile sockeye salmon estimates based on fall townet catch species composition and hydroacoustic fish population estimates for Saltery Lake, 1997-1999.

	Total Fish Estimates			Sockeye Estimates			Sockeye
		95% Confidence Interval			95% Confidence Interval		Composition
Date	Number	Low	High	Number	Low	High	(%)
16-Sep-97	458,696	382,513	534,879	456,403	380,601	532,205	99.5
16-Sep-98	686,598	611,227	761,969	680,419	609,690	751,148	99.1
07-Oct-99	532,642	407,292	657,992	0[a]			

[a] Tow net surveys were not conducted to determine sockeye estimates.

Appendix N.8. Townet catches from Saltery Lake, 1997-1998.

			Catch by Species					
	Number	Total	Sockeye			Stickleback		
Date	of Tows	Minutes	Number	%	CPUE	Number	%	CPUE
16-Sep-97	4	43	215	99.5	5.00	1	0.5	0.02
16-Sep-98	2	27	229	99.1	8.50	2	0.9	0.07

Appendix N.9. Mean length, weight, and condition coefficient by age of juvenile sockeye salmon captured by townet at Saltery Lake, 1997-1999.

	Age-0				Age-1				Age-2			
Date	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)
16-Sep-97	25	39.0	0.6	1.04	131	42.6	0.9	1.04	10	67.4	3.5	1.12
16-Sep-98	10	49.7	1.4	1.09	198	56.8	2.0	1.08	2	56.0	1.9	1.07
7-Oct-99	13	44.0	1.0	1.14	0				0			

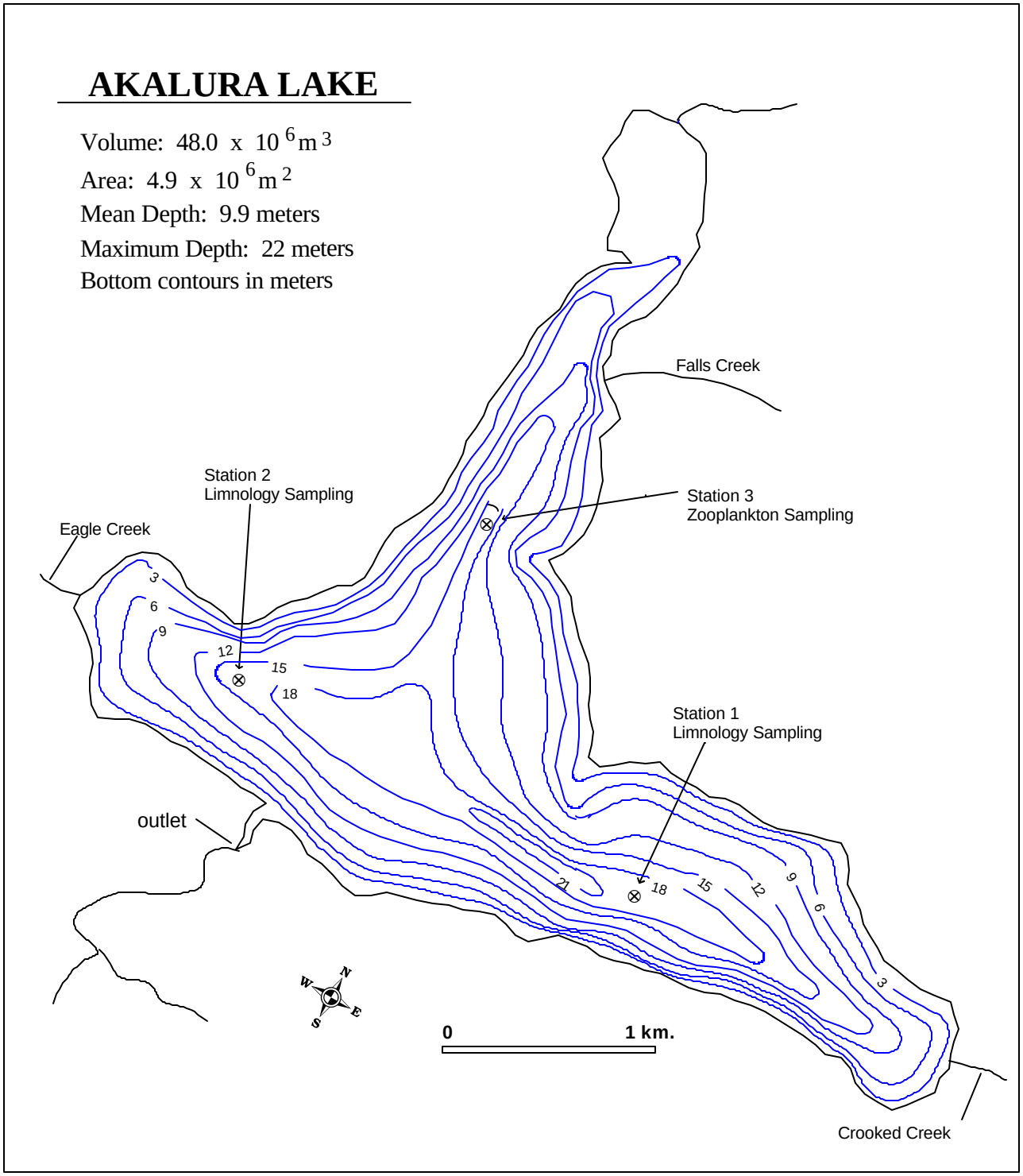
Appendix N.10. Mean length, weight, and condition coefficient of Saltery Lake sockeye salmon smolt samples by age, 1997 and 2000-2001.

	Age-0				Age-1				Age-2				Age-3			
Sampling		Length	Weight	Condition		Length	Weight	Condition		Length	Weight	Condition		Length	Weight	Condition
Time Period	n	(mm)	(g)	(K)	n	(mm)	(g)	(K)	n	(mm)	(g)	(K)	n	(mm)	(g)	(K)
May 17-23, 1997	0				0				2	83.0	4.1	0.71	4	87.5	5.2	0.77
May 24- June 13, 2000	2	70.5	3.5	1.00	31	70.5	3.3	0.94	2	71.0	3.3	0.93	0			
June 14-20, 2001	0				6	63.0	2.1	0.81	6	69.0	3.1	0.89	0			

Appendix N.11. Estimated age composition of the Saltery Lake sockeye salmon escapement, 1995-2001.

Year	Sample Size		Ages													Total
			0.2	0.3	1.1	1.2	1.3	2.1	2.2	1.4	2.3	2.4	3.1	3.2	3.3	
1995	437	Numbers	0	300	0	702	36,027	0	3,212	300	3,311	0	0	0	0	43,856
		Percent	0.0	0.7	0.0	1.6	82.1	0.0	7.3	0.7	7.5	0.0	0.0	0.0	0.0	100.0
1996	418	Numbers	0	0	0	1,020	10,699	0	1,530	254	21,989	0	0	0	0	35,488
		Percent	0.0	0.0	0.0	2.9	30.1	0.0	4.3	0.7	62.0	0.0	0.0	0.0	0.0	100.0
1997	316	Numbers	0	68	68	608	4,596	203	3,378	135	11,962	0	0	203	135	21,355
		Percent	0.0	0.3	0.3	2.8	21.5	1.0	15.8	0.6	56.0	0.0	0.0	1.0	0.6	100.0
1998	337	Numbers	158	79	394	8,877	4,832	1,182	5,384	0	4,754	0	473	263	158	26,263
		Percent	0.6	0.3	1.5	33.8	18.4	4.5	20.5	0.0	18.1	0.0	1.8	1.0	0.6	100.0
1999	362	Numbers	0	66	0	1,233	4,131	0	11,180	0	3,039	0	0	3,832	0	23,481
		Percent	0.0	0.3	0.0	5.3	17.6	0.0	47.6	0.0	12.9	0.0	0.0	16.3	0.0	100.0
2000	294	Numbers	0	0	0	2,827	3,238	0	5,883	0	15,186	0	0	0	18,105	45,604
		Percent	0.0	0.0	0.0	6.2	7.1	0.0	12.9	0.0	33.3	0.0	0.0	0.0	39.7	99.2
2001[a]	218	Numbers	0	451	263	1,089	20,463	0	7,021	0	7,509	413	0	0	0	37,547
		Percent	0.0	1.2	0.7	2.9	54.5	0.0	18.7	0.0	20.0	1.1	0.0	0.0	0.0	99.1

Note: Age composition estimates are collected from a portion of the escapement and do not represent ages for the total run.
[a] In 2001, 328 (0.9%) of the escapement were aged 3.4.



Appendix O.1. Morphometric map showing the limnology and zooplankton stations on Akalura Lake.

Appendix O.2. Limnological sampling stations and total samples collected for Akalura Lake, 1986-1996.

Year	Sampling Stations	Total Samples
1986	3	2
1987	1	5
1988	1	3
1989	1	4
1990	2	6
1991	2	6
1992	2	6
1993	2	5
1994	3	5
1995	3	6
1996	2	4

Appendix O.3. Summary of seasonal mean water chemistry parameters by station and depth for Akalura Lake, 1990-1991 and 1993-1996.

		Depth	Sp. Conductivity		pH		Alkalinity		Turbidity		Color		Calcium		Magnesium		Iron	
Year	Station	(m)	(umhos cm^{-1})	SD	(Units)	SD	(mg L^{-1})	SD	(NTU)	SD	(Pt units)	SD	(mg L^{-1})	SD	(mg L^{-1})	SD	(ug L^{-1})	SD
1990	1	1	60	2.0	7.2	0.2	14.8	1.1	1.0	0.3	7.0	2.1	4.9	0.5	1.5	0.5	136.2	53.0
	1	16	60	2.8	6.9	0.3	16.0	1.5	2.2	1.2	8.5	2.4	5.1	0.9	1.5	0.9	381.8	449.6
	2	1	59	1.6	7.1	0.2	15.0	0.8	1.0	0.4	6.6	2.4	5.6	2.7	1.2	0.6	435.4	757.8
	2	15	58	4.1	6.8	0.2	15.8	1.5	1.6	0.3	7.0	2.9	4.8	0.5	1.5	0.2	288.2	338.5
1991	1	1	58	1.8	7.1	0.1	13.9	2.2	1.7	1.4	5.5	1.4	4.8	0.7	1.5	0.7	66.7	33.4
	1	16	59	2.2	6.9	0.2	14.3	2.1	1.4	0.5	6.8	2.8	5.1	0.8	1.1	0.7	102.6	172.6
	2	1	58	1.3	7.1	0.1	14.2	1.9	1.3	0.5	8.7	3.4	5.0	0.8	1.2	0.6	61.0	34.6
	2	15	58	2.8	6.9	0.2	14.4	2.0	1.3	0.5	6.7	2.9	4.6	0.5	1.6	0.4	91.6	216.4
1993	1	1	59	0.0	6.8	0.1	14.9	0.2	1.2	0.5	7.4	7.4	4.8	0.1	1.6	0.2	52.4	15.8
	1	16	61	2.3	6.6	0.2	15.7	1.2	1.8	0.8	5.0	2.7	4.6	0.5	1.6	0.2	300.8	289.9
	2	1	60	2.3	6.9	0.1	15.0	0.4	1.5	0.4	5.6	3.6	4.7	0.6	1.5	0.2	90.4	45.5
	2	13	61	2.3	6.6	0.2	15.0	0.7	1.6	0.3	4.4	2.2	4.9	0.1	1.5	0.2	244.6	241.3
1994	1	1	59	2.3	6.9	0.1	14.3	0.5	3.5	2.9	5.5	1.0	5.0	0.1	1.3	0.4	77.0	15.1
	1	16	61	2.3	6.8	0.3	14.8	0.8	2.2	0.8	7.6	3.6	5.0	0.1	1.3	0.4	470.0	461.7
	2	1	59	2.3	7.0	0.1	14.3	0.7	4.5	4.8	5.0	2.2	4.8	0.4	1.3	0.4	109.0	69.1
	2	14	60	2.3	6.7	0.3	14.4	0.9	2.2	0.9	6.6	1.8	5.0	0.1	1.3	0.4	225.0	147.3
1995	1	1	59	2.3	6.9	0.2	15.2	0.6	1.6	0.6	4.3	1.2	4.7	0.3	1.4	0.6	113.0	36.2
	1	15	60	2.3	6.8	0.3	15.6	0.8	1.5	0.5	6.5	3.7	4.4	0.4	1.4	0.6	185.7	103.5
	2	1	60	2.3	6.8	0.3	15.0	0.9	1.8	0.7	6.0	2.6	4.6	0.2	1.4	0.6	240.2	311.6
	2	15	60	2.3	6.7	0.3	15.2	0.8	1.8	0.9	6.2	2.5	4.6	0.2	1.2	0.3	277.7	197.8
1996	1	1	59	2.3	7.2	0.4	16.9	1.2	0.9	0.2	5.3	0.6	na	na	1.5	0.4	53.7	26.5
	1	15	59	2.3	6.9	0.4	16.7	1.1	1.3	0.3	7.7	1.5	4.5	0.1	1.5	0.4	232.7	50.8
	2	1	60	2.3	7.0	0.2	16.5	0.7	1.0	0.4	9.3	4.7	4.5	0.1	1.4	0.3	93.5	21.1
	2	14	59	2.3	6.9	0.2	16.5	1.2	1.3	0.3	6.7	1.0	4.5	0.1	1.5	0.3	150.7	42.6

SD - standard deviation
na - parameters were not analyzed.

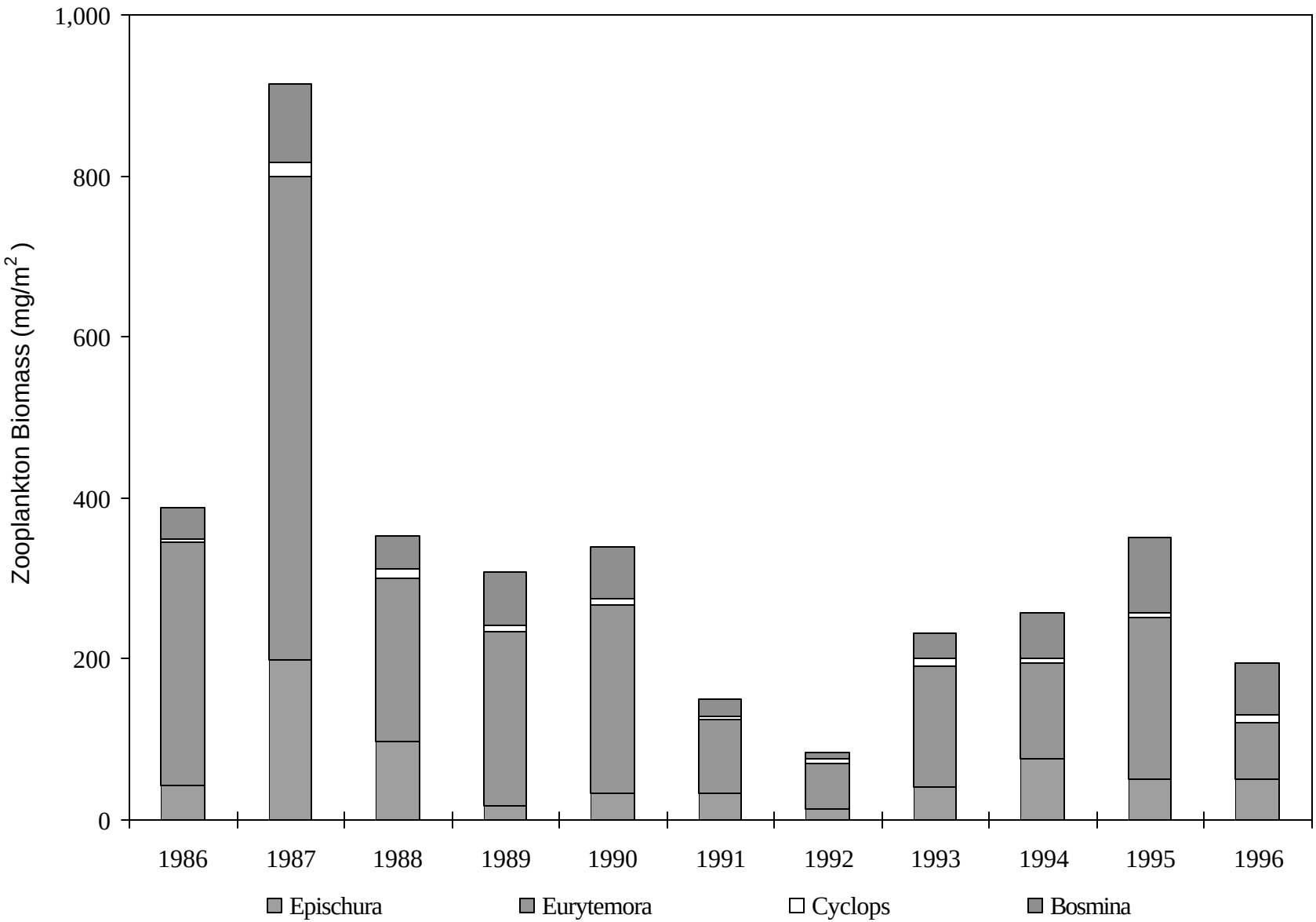
Appendix O.4. Summary of seasonal mean nutrient and algal pigment concentrations by station and depth for Akalura Lake, 1990-1991 and 1993-1996.

Year	Station	Depth (m)	Total-P (ug L^{-1})	SD	Total filterable-P (ug L^{-1})	SD	Filterable reactive-P (ug L^{-1})	SD	Total Kjel--dahl nitrogen (ug L^{-1})	SD	Ammonia (ug L^{-1})	SD	Nitrate + nitrite (ug L^{-1})	SD	Reactive silicon (ug L^{-1})	SD	Organic Carbon (ug L^{-1})	SD	Chlorophyll *a* (ug L^{-1})	SD	Phaeophytin *a* (ug L^{-1})	SD
1990	1	1	11.4	3.2	3.2	1.5	1.5	0.4	173.7	28.9	15.6	21.4	29.7	26.8	441	244.7	469	43.9	3.93	1.8	1.40	0.5
	1	16	15.0	3.9	4.5	1.1	2.1	0.9	278.7	106.1	86.8	109.4	35.3	15.5	576	433.6	647	289.5	3.01	2.4	1.50	0.5
	2	1	11.3	2.2	3.6	2.3	1.4	1.1	159.1	19.7	15.9	20.1	21.3	19.6	316	198.0	401	83.7	4.32	1.7	1.41	0.5
	2	15	13.7	3.3	3.6	2.8	1.6	0.6	261.6	93.0	101.1	96.4	29.3	4.1	535	291.5	456	167.9	3.56	3.8	1.38	0.4
1991	1	1	11.8	1.6	3.9	0.7	1.5	0.7	160.8	23.2	11.5	12.2	19.8	26.8	285	252.3	na	na	5.07	5.1	1.32	1.5
	1	16	13.2	3.1	4.3	1.2	1.9	1.2	166.1	32.4	38.5	27.3	36.6	29.0	427	311.3	na	na	4.35	3.3	1.50	0.8
	2	1	11.9	3.1	5.7	6.8	3.2	3.7	157.9	16.7	12.6	12.4	18.6	26.5	284	244.4	na	na	3.61	2.2	1.54	0.9
	2	15	13.7	4.5	4.5	1.3	2.0	1.3	165.5	38.6	26.9	37.4	36.0	30.0	426	351.3	na	na	4.19	3.3	1.26	0.4
1993	1	1	14.1	3.0	7.1	4.0	4.8	4.3	195.0	16.2	9.9	14.0	8.6	13.1	656	400.9	365	80.3	5.18	2.5	0.80	0.5
	1	16	20.0	7.6	5.9	2.2	3.2	1.3	235.2	56.7	51.3	46.9	16.7	17.2	880	581.6	367	107.9	4.41	4.1	1.13	0.5
	2	1	14.1	3.5	6.2	3.4	3.3	2.1	196.7	20.7	9.0	13.9	8.1	12.0	615	429.4	377	87.9	4.67	1.9	1.10	0.7
	2	13	17.7	6.3	5.0	1.8	2.7	1.4	214.2	49.3	42.2	41.0	17.4	16.9	984	525.3	336	134.5	4.07	3.4	0.92	0.6
1994	1	1	15.5	6.9	3.9	1.9	2.9	1.4	294.0	123.3	25.8	43.7	14.8	21.6	911	360.2	601	426.4	6.18	5.8	0.61	0.4
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	5.72	4.7	0.57	0.4
	1	16	24.2	15.4	6.5	4.4	4.2	2.8	285.8	109.9	95.1	69.9	37.2	27.4	1234	381.5	390	157.3	2.74	2.7	0.95	0.4
	2	1	12.5	3.5	6.0	4.7	4.0	2.9	245.4	92.5	21.3	38.5	17.6	18.3	875	332.5	546	306.1	5.78	4.8	0.51	0.3
	2	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	5.54	4.1	0.58	0.4
	2	14	16.1	4.2	4.7	1.8	3.5	1.2	238.5	38.6	55.4	34.2	42.7	49.0	1085	373.8	335	148.0	3.09	2.1	0.88	0.5
1995	1	1	11.9	3.2	4.1	0.6	1.4	0.5	165.4	16.4	13.4	8.9	38.6	35.3	525	334.3	312	111.7	5.15	3.1	1.41	0.7
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	5.56	3.8	1.71	0.9
	1	15	13.5	5.8	4.7	1.5	2.2	1.2	176.0	26.9	37.4	44.7	37.8	31.5	653	403.9	281	105.1	4.74	3.6	1.76	0.7
	2	1	12.6	4.7	4.2	0.6	1.7	0.6	201.2	69.2	51.2	71.1	28.7	28.5	621	341.2	344	94.3	4.75	3.2	1.57	0.7
	2	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	5.42	3.6	1.59	0.8
	2	15	11.4	2.8	4.5	1.2	2.1	0.7	180.2	28.6	59.2	31.5	35.5	30.2	688	334.9	274	94.7	4.62	3.4	1.46	0.4
1996	1	1	11.0	0.9	3.6	1.7	1.4	0.9	163.3	23.9	8.8	3.6	4.1	0.0	160	105.0	303	27.6	1.01	0.4	0.36	0.2
	1	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	0.73	0.2	0.30	0.1
	1	15	14.6	7.2	3.6	1.6	1.4	1.7	197.4	65.5	53.4	50.6	2.8	2.3	408	310.3	279	64.2	0.98	0.3	0.54	0.1
	2	1	10.0	3.6	6.0	3.5	2.9	2.7	167.9	23.5	19.3	8.8	4.1	0.6	305	241.9	281	64.6	0.82	1.1	0.32	0.1
	2	2	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	1.37	1.1	0.35	0.2
	2	14	11.7	2.2	2.8	0.7	0.3	0.3	171.2	24.7	25.2	13.9	4.1	0.6	298	265.8	288	130.3	1.62	1.0	0.57	0.2

SD - standard deviation
na - parameters were not analyzed.

Appendix O.5. Weighted mean zooplankton density, biomass, and size by genera (stations 1, 2, & 3 averaged) for Akalura Lake, 1986-1996.

	No. of	*Epischura*			*Eurytemora*			*Cyclops*			*Bosmina*			*Chydorinae*			TOTALS	
Year	Sample Dates	Density no/m^2	Biomass mg/m^2	Size mm	Density no/m^2	Biomass mg/m^2	Size mm	Density no/m^2	Biomass mg/m^2	Size mm	Density no/m^2	Biomass mg/m^2	Size mm	Density no/m^2	Biomass mg/m^2	Size mm	Density no/m^2	Biomass mg/m^2
1986	2	7,528	43	1.11	73,470	302	0.84	2,505	3	0.60	48,424	39	0.30	0	0	0.00	131,927	387
1987	5	41,242	198	0.99	108,386	601	0.97	16,242	18	0.57	122,452	98	0.30	743	1	0.00	289,065	916
1988	3	25,035	97	0.95	45,471	204	0.85	7,741	10	0.63	59,934	42	0.28	0	0	0.00	138,181	353
1989	4	10,152	18	0.71	49,662	216	0.84	6,403	7	0.56	80,912	67	0.30	266	0	0.00	147,395	308
1990	6	4,282	33	1.21	51,522	235	0.87	6,847	8	0.59	79,977	65	0.30	792	1	0.26	143,419	341
1991	6	6,675	33	1.03	18,728	91	0.60	3,776	4	0.39	27,757	21	0.20	354	0.2	0.13	57,290	150
1992	6	4,472	13	0.92	10,642	57	0.94	4,370	7	0.67	8,338	7	0.31	314	1	0.36	28,136	84
1993	5	11,720	40	0.90	33,737	152	0.86	8,658	10	0.59	38,265	30	0.30	1,451	1	0.25	93,829	232
1994	5	16,723	75	1.00	23,298	119	0.92	6,702	6	0.53	76,037	57	0.29	0	0	0.00	122,760	257
1995	6	15,010	51	0.91	45,023	201	0.85	4,895	5	0.61	124,546	92	0.29	514	0	0.25	189,988	350
1996	3	15,444	52	0.93	13,483	70	0.95	7,774	10	0.61	82,523	64	0.29	743	0.6	0.29	119,967	195



Appendix O.6. Weighted mean zooplankton biomass by genera for Akalura Lake, 1986-1996.

Appendix O.7. Juvenile sockeye salmon estimates based on fall townet catch species composition and hydroacoustic total fish population estimates for Akalura Lake, 1990-1991 and 1995.

	Total Fish Estimates			Sockeye Estimates			Sockeye
		95% C. I.			95% C. I.		Composition
Date	Number	Low	High	Number	Low	High	(%)
29-Sep-90	3,950,101	3,155,384	4,744,818	209,355	167,287	251,424	5.3
5-Oct-91	3,171,881	2,631,498	3,712,264	41,234	39,013	43,456	1.3
14-Oct-95	3,637,001	2,834,510	4,439,492	461,899	359,267	564,531	12.7

Appendix O.8. Townet catches from Akalura Lake, 1990, 1991, and 1995.

	Tow		Catch by Species					
		Total	Sockeye			Stickleback		
Date	No.	Minutes	No.	%	CPUE[a]	No.	%	CPUE[a]
29-Sep-90	3	70	237	5.3	3.4	4,252	94.7	60.7
11-May-91	3	72	54	12.2	0.8	387	87.8	5.4
5-Oct-91	3	70	147	1.3	2.1	10,765	98.7	153.8
14-Oct-95	4	40	87	12.7	2.2	590	87.3	14.8

[a] CPUE - Catch per unit effort

Appendix O.9. Mean age, length, weight, and condition coefficient by age for juvenile sockeye salmon captured by townet at Akalura Lake, 1991 and 1995.

	Age-0				Age-1				Age-2			
Date[a]	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)
11-May-91	3	29.0	0.2	0.79	24	50.0	1.0	0.78	17	68	2.4	0.74
5-Oct-91	54	52.0	1.4	0.95	93	74.0	3.8	0.93	0			
14-Oct-95	43	61.0	2.7	1.14	44	82.0	6.0	1.10	0			

[a] Preserved sockeye salmon captured 29 September 1990 spoiled prior to sampling for AWL.

Appendix O.10. Age compositions and population estimates of sockeye salmon smolt emigrating from Akalura Lake, 1990-1997.

Year		Age 0	1	2	3	4	Population Estimate	95% Confidence Interval Low	High
1990	Percent	0.0	13.2	86.8	0.0	0.0			
	Number	0	60,107	394,652	0	0	454,759	343,243	566,275
1991	Percent	0.0	2.9	96.3	0.8	0.0			
	Number	0	8,172	270,867	2,181	0	281,220	234,688	327,752
1992	Percent	0.0	1.1	94.4	4.5	0.0			
	Number	21	2,173	180,557	8,561	0	191,313	169,560	213,066
1993	Percent	0.0	3.3	88.0	8.6	0.1			
	Number	0	2,150	57,512	5,624	80	65,366	51,443	79,289
1994	Percent	0.1	41.6	53.1	5.2	0.0			
	Number	128	71,495	91,296	8,996	0	171,915	153,159	190,671
1995	Percent	0.0	45.9	53.9	0.2	0.0			
	Number	0	60,654	71,187	268	0	132,110	113,806	150,414
1996	Percent	0.0	6.4	93.1	0.5	0.0			
	Number	0	15,639	228,766	1,416	0	245,821	na[a]	na[a]
1997	Percent	0.1	7.8	92.1	0.0	0.0			
	Number	196	14,874	178,680	0	0	193,750	na[a]	na[a]

[a] Estimates of precision are not available.

Data obtained from Coggins and Sagalkin. 1999. Akalura Lake sockeye smolt restoration. RIR 4K99-64.

Appendix O.11. Akalura Lake sockeye salmon smolt emigration by age class, 1990-1997.

Statistical			Age Class				Statistical			Age Class				
Year	Week	Dates	0	1	2	3	Year	Week	Dates	0	1	2	3	4
1990	18	4/26-5/02	0	0	0	0	1991	18	4/26-5/02	0	0	0	0	0
	19	5/03-5/09	0	0	0	0		19	5/08-5/09	0	491	9,281	0	0
	20	5/13-5/16	0	1,951	230,326	0		20	5/10-5/16	0	7,461	205,521	0	0
	21	5/17-5/23	0	1,822	137,769	0		21	5/17-5/23	0	509	64,210	663	0
	22	5/24-5/30	0	9,473	18,837	0		22	5/24-5/30	0	22	794	11	0
	23	5/31-6/06	0	38,072	19,431	0		23	5/31-6/06	0	12	1,399	65	0
	24	6/07-6/13	0	7,540	3,258	0		24	6/07-6/13	0	415	13,170	400	0
	25	6/14-6/20	0	8,877	1,230	0		25	6/14-6/20	0	64	1,254	0	0
	26	6/21-6/27	0	2,253	0	0		26	6/21-6/27	0	74	3,640	98	0
								27	6/28-7/01	0	39	324	13	0
	Total		0	69,988	410,851	0		Total		0	9,087	299,593	1,250	0
1992	18	5/01-5/02	0	0	49	0	1993	18	4/26-5/02	0	0	0	0	0
	19	5/03-5/09	0	0	48,780	3,157		19	5/03-5/09	0	0	2,516	968	0
	20	5/10-5/16	0	1,378	93,065	4,512		20	5/10-5/16	0	0	3,848	2,633	0
	21	5/17-5/23	0	313	9,865	303		21	5/17-5/23	0	2,384	20,387	6,796	238
	22	5/24-5/30	0	74	16,786	239		22	5/24-5/30	0	143	31,988	1,865	0
	23	5/31-6/06	0	74	12,175	103		23	5/31-6/06	0	301	11,601	43	0
	24	6/07-6/13	0	49	2,387	0		24	6/07-6/13	0	283	2,287	10	0
	25	6/14-6/20	0	34	170	0		25	6/14-6/20	0	148	435	0	0
	26	6/21-6/27	0	0	21	0								
	27	6/28-7/01	0	0	7	0								
	Total		0	1,922	183,305	8,314		Total		0	3,259	73,062	12,315	238

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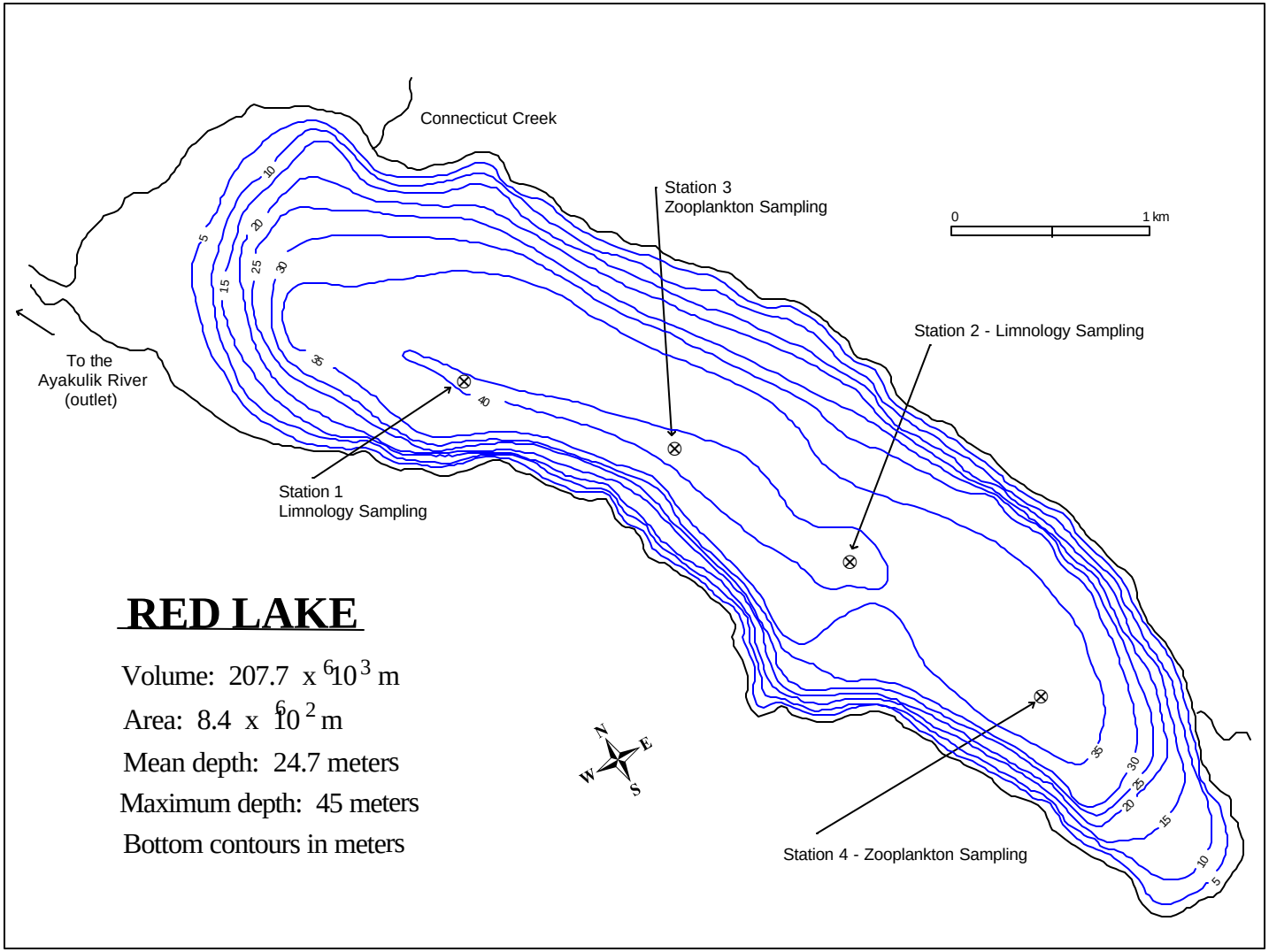
Statistical			Age Class				Statistical			Age Class				
Year	Week	Dates	0	1	2	3	Year	Week	Dates	0	1	2	3	4
1994	18	4/26-5/02	0	0	0	0	1995	18	4/26-5/02	0	0	0	0	0
	19	5/03-5/09	0	7	583	292		19	5/03-5/09	0	100	4,577	66	0
	20	5/10-5/16	0	13	567	278		20	5/10-5/16	0	795	19,820	199	0
	21	5/17-5/23	0	13	457	137		21	5/17-5/23	0	1,078	10,280	0	0
	22	5/24-5/30	0	221	14,377	2,436		22	5/24-5/30	0	2,426	12,524	0	0
	23	5/31-6/06	0	12,529	57,339	3,832		23	5/31-6/06	0	6,607	17,110	0	0
	24	6/07-6/13	0	39,051	16,253	166		24	6/07-6/13	0	38,896	6,184	0	0
	25	6/14-6/20	90	14,065	776	0		25	6/14-6/20	0	12,499	0	0	0
	26	6/21-6/27	0	6,573	114	0		26	6/21-6/27	0	957	0	0	0
	Total		90	72,472	90,466	7,141		Total		0	63,358	70,495	265	0
1996	18	4/26-5/02	0	0	5	0	1997	18	4/26-5/02	0	0	21	0	0
	19	5/03-5/09	0	895	43,356	128		19	5/03-5/09	0	238	53,536		0
	20	5/10-5/16	0	4,294	114,231	1,288		20	5/10-5/16	0	1,681	71,003		0
	21	5/17-5/23	0	624	20,657	0		21	5/17-5/23	0	656	26,352	0	0
	22	5/24-5/30	0	3,468	34,214	0		22	5/24-5/30	0	7,648	26,572	0	0
	23	5/31-6/06	0	2,842	15,810	0		23	5/31-6/06	151	2,918	981	0	0
	24	6/07-6/13	0	3,017	487	0		24	6/07-6/13	32	1,223	202	0	0
	25	6/14-6/20	0	498	6	0		25	6/14-6/20	11	434	11	0	0
								26	6/21-6/27	2	76	2	0	0
	Total		0	15,638	228,766	1,416		Total		196	14,874	178,680	0	0

Appendix O.12. Summary of mean length, weight, and condition coefficient by age class of Akalura Lake sockeye salmon smolt samples, 1969-1977 and 1990-1997.

	Age-0				Age-1				Age-2				Age-3			
		Length	Weight	Condition		Length	Weight	Condition		Length	Weight	Condition		Length	Weight	Condition
Year	n	(mm)	(g)	(K)	n	(mm)	(g)	(K)	n	(mm)	(g)	(K)	n	(mm)	(g)	(K)
1969					575	80.0	4.2	0.82								
1970					78	94.0	7.6	0.92	845	99.0	8.4	0.87				
1971					541	77.0	3.8	0.83	82	96.0	7.3	0.83				
1972					835	83.0	4.8	0.84	25	95.0	7.2	0.84				
1973					485	90.0	6.7	0.92	466	98.0	8.6	0.91				
1974					53	88.0	6.2	0.91	890	96.0	8.2	0.93				
1975					106	78.0	3.9	0.82	611	92.0	6.4	0.82				
1976					10	81.0	5.2	0.98	297	92.0	7.7	0.99				
1977					2	75.0	4.2	1.00	462	94.0	7.3	0.88				
1990					577	73.9	3.6	0.89	748	85.9	5.3	0.84				
1991					41	77.2	4.3	0.93	1,382	77.5	4	0.86	22	97.3	8.9	0.97
1992	1	59.0	1.5	0.73	25	75.7	3.7	0.85	2,014	78.8	3.9	0.80	61	86.4	4.9	0.76
1993[a]					74	61.8	2.2	0.93	992	85.8	5.7	0.90	94	90.8	6.8	0.91
1994	2	73.0	3.4	0.87	721	87.5	6.1	0.91	763	93.1	7.3	0.90	146	95.8	7.7	0.88
1995					644	81.7	4.8	0.88	1,216	92.1	6.6	0.84	6	99	7.6	0.78
1996					400	82.6	4.8	0.85	1,451	91.0	6.2	0.82	4	97.5	7.5	0.81
1997	10	58.0	1.7	0.87	361	81.9	4.7	0.86	1,094	91.9	6.3	0.81				

[a] In 1993, two sockeye salmon smolt age-4 averaged 101.5 mm., weighed 10.1 g., and a condition factor of 0.97.



Appendix P.1. Morphometric map showing the limnology and zooplankton stations on Red Lake.

Appendix P.2. Limnological sampling stations and total samples collected for Red Lake, 1990-1996.

Year	Sampling Stations	Total Samples
1990	1,2	5
1991	1,2	6
1992	1,2	6
1993	1,2	6
1994	1-4	6
1995	1-4	6
1996	1-4	4

Appendix P.3. Summary of seasonal mean water chemistry parameters by station and depth for Red Lake, 1990-1996.

Year	Station	Depth (m)	Specific Conductivity (umhos cm^{-1})	SD	pH (Units)	SD	Alkalinity (mg L^{-1})	SD	Turbidity (NTU)	SD	Color (Pt units)	SD	Calcium (mg L^{-1})	SD	Magnesium (mg L^{-1})	SD	Iron (ug L^{-1})	SD
1990	1	1	56.0	9.1	7.2	0.3	14.7	2.8	0.7	0.6	7.6	5.9	7.9	5.8	3.7	5.3	18.7	7.2
	1	32	60.4	7.3	7.0	0.4	15.9	0.9	0.7	0.4	4.0	1.4	8.1	7.2	1.6	0.6	60.6	64.1
	2	1	54.2	15.3	7.3	0.2	16.3	1.1	0.6	0.4	3.8	1.8	6.8	4.2	1.6	0.6	36.3	24.1
	2	34	60.8	1.1	7.0	0.1	15.9	1.2	1.3	1.6	4.8	2.3	7.9	5.4	1.5	0.5	75.0	72.6
1991	1	1	60.7	0.8	7.2	0.1	15.3	2.6	1.0	0.5	5.2	2.2	5.2	0.6	1.3	0.3	45.8	38.1
	1	32	61.3	1.0	7.1	0.1	15.5	2.3	1.4	0.9	7.0	1.5	5.2	0.6	1.2	0.4	95.0	80.9
	2	1	61.0	0.6	7.1	0.1	15.4	1.8	1.0	0.5	4.8	1.6	5.3	0.5	1.0	0.3	47.0	17.2
	2	32	61.0	0.6	7.0	0.1	15.6	2.3	1.1	0.3	7.2	4.1	5.4	0.5	1.1	0.4	75.3	35.8
1992	1	1	60.0	0.6	7.0	0.1	15.0	0.3	0.7	0.4	4.2	0.8	5.2	0.7	1.3	0.6	22.0	5.7
	1	35	60.0	1.8	6.8	0.3	14.8	0.4	0.8	0.4	3.8	0.8	5.2	0.8	1.5	0.6	68.8	79.3
	2	1	58.8	1.8	7.0	0.1	14.9	0.2	0.9	0.7	4.2	0.8	5.3	0.8	1.7	0.5	18.0	5.7
	2	34	60.0	2.5	6.8	0.3	14.9	0.5	0.7	0.3	5.0	3.1	4.9	1.0	1.7	0.7	117.8	149.9
1993	1	1	63.2	3.6	7.0	0.7	15.9	2.0	1.4	0.7	5.5	3.2	5.8	1.6	1.4	0.3	114.2	211.8
	1	38	65.3	5.3	6.9	0.9	16.3	2.4	1.7	1.0	6.2	3.9	6.3	3.3	1.4	0.3	259.0	331.0
	2	1	64.3	7.3	6.9	0.1	15.4	0.4	0.9	0.4	6.8	4.8	5.0	0.5	1.4	0.3	43.5	33.2
	2	38	67.2	8.0	6.6	0.2	17.0	3.9	2.3	0.9	4.8	1.8	5.8	1.6	1.2	0.3	474.2	405.7
1994	1	1	62.2	2.1	6.9	0.3	15.0	1.5	0.8	0.3	5.0	3.6	5.3	0.5	1.1	0.3	37.8	22.9
	1	38	63.0	1.7	6.6	0.4	15.7	0.8	1.7	0.6	5.3	2.1	5.1	0.4	1.6	0.6	388.3	336.7
	2	1	62.3	0.8	6.8	0.3	15.8	0.8	1.0	0.6	3.8	1.2	5.3	0.5	1.2	0.3	43.5	22.0
	2	37	66.5	5.0	6.7	0.5	16.8	2.2	2.0	0.7	3.7	1.4	5.3	0.5	1.4	0.6	481.3	477.6
1995	1	1	59.2	9.7	7.0	0.2	16.8	1.6	0.8	0.3	3.6	1.3	5.3	1.5	1.3	0.2	35.5	10.9
	1	37	64.0	3.4	6.5	0.4	16.3	2.1	1.7	0.6	4.8	3.6	4.9	0.6	1.6	0.5	397.2	314.0
	2	1	61.2	0.8	7.0	0.1	16.0	0.3	0.9	0.4	6.0	4.6	4.9	0.5	1.4	0.6	31.8	22.9
	2	37	62.6	0.5	6.5	0.3	15.8	0.8	1.9	0.9	4.8	2.4	4.9	0.3	1.8	0.6	540.6	493.1
1996	1	1	60.3	4.7	7.1	0.5	17.0	0.9	0.6	0.1	4.7	1.5	4.5	0.1	1.6	1.3	22.0	11.8
	1	37	61.0	3.6	6.9	0.6	16.9	0.6	0.8	0.2	4.5	2.1	4.5	0.1	1.1	0.3	107.3	109.3
	2	1	48.0	21.9	7.2	0.6	13.2	5.5	0.9	0.5	5.0	2.6	3.9	1.0	0.9	0.6	23.3	23.4
	2	34	61.3	4.0	6.8	0.6	16.2	0.6	1.1	0.3	5.0	1.0	4.5	0.1	1.1	0.3	157.7	139.0

SD - standard deviation

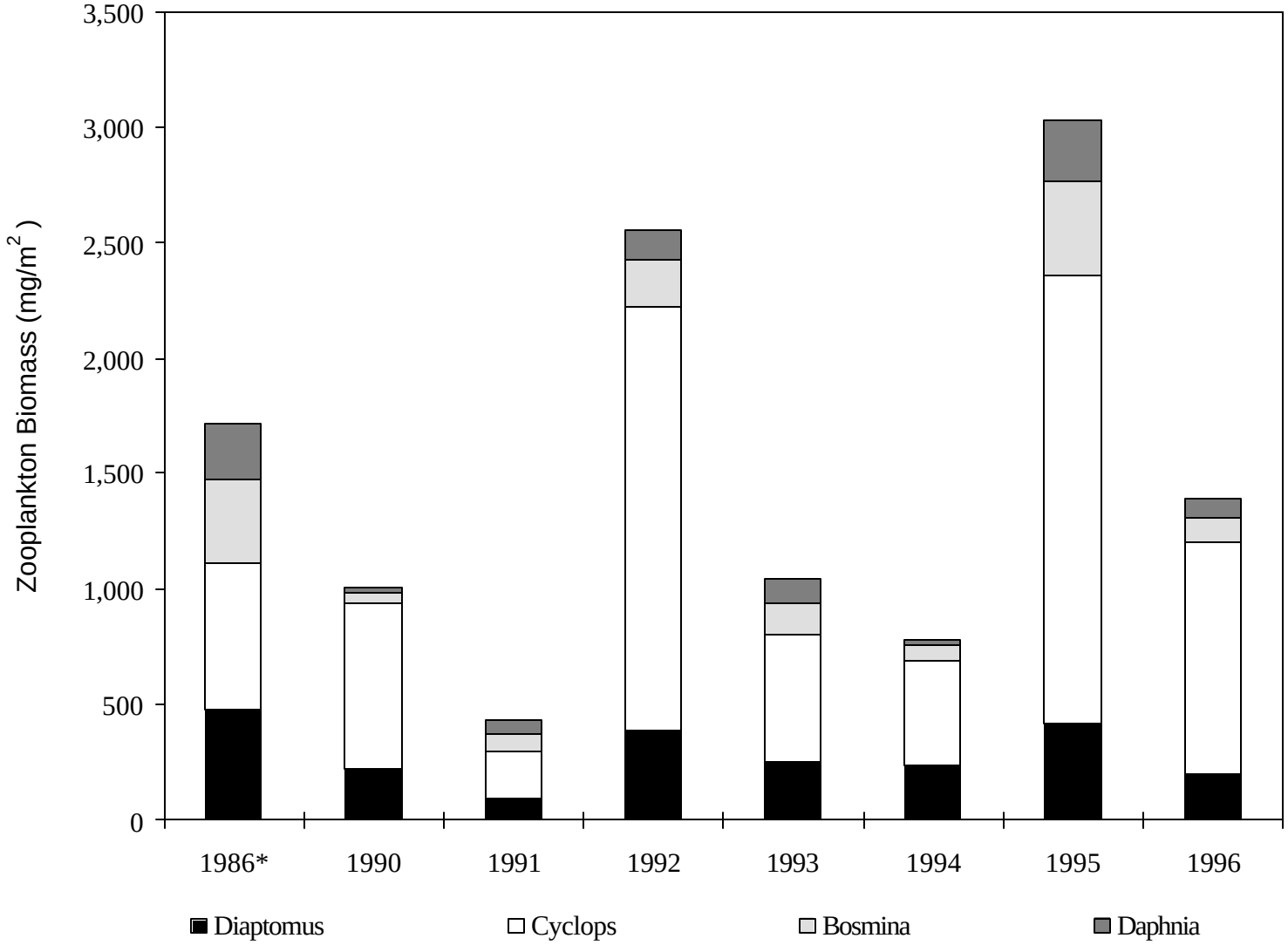
Appendix P.4. Summary of seasonal mean nutrient and algal pigment concentrations by station and depth for Red Lake, 1990-1996.

Year	Station	Depth (m)	Total-P (ug L^{-1})	SD	Total filterable-P (ug L^{-1})	SD	Filterable reactive-P (ug L^{-1})	SD	Total Kjeldahl nitrogen (ug L^{-1})	SD	Ammonia (ug L^{-1})	SD	Nitrate+ nitrite (ug L^{-1})	SD	Reactive silicon (ug L^{-1})	SD	Organic carbon (ug L^{-1})	SD	Chlorophyll *a* (ug L^{-1})	SD	Phaeophytin *a* (ug L^{-1})	SD
1990	1	1	10.1	4.2	6.0	2.9	3.3	3.7	129.8	28.4	4.0	0.7	50.9	18.2	227.3	146.8	265.4	117.3	1.77	1.0	2.59	4.2
	1	32	16.6	2.6	7.7	5.9	3.5	5.2	148.8	49.6	25.5	25.1	102.4	70.8	314.3	342.4	213.2	130.3	1.76	1.6	1.07	0.4
	2	1	10.6	4.3	4.0	0.7	0.8	0.1	132.8	26.9	4.2	1.9	55.2	12.2	167.0	147.9	243.6	92.8	2.74	1.6	1.18	0.7
	2	34	26.1	15.9	6.6	3.1	1.6	1.0	180.7	72.1	29.1	30.1	82.4	53.5	323.8	242.1	247.2	171.8	2.06	2.5	1.81	2.0
1991	1	1	13.8	11.4	8.0	7.6	4.7	8.2	112.7	28.5	13.3	5.1	21.0	27.1	122.8	141.7	169.8	96.3	2.06	1.3	1.18	1.0
	1	32	32.2	25.6	13.7	11.0	10.4	11.1	152.6	55.7	22.2	14.0	50.5	62.6	196.6	210.2	253.2	177.5	3.70	3.1	3.17	5.8
	2	1	12.8	3.7	7.5	7.2	4.3	7.2	116.5	6.2	11.3	3.7	25.8	29.6	96.2	113.6	223.5	110.2	2.57	1.0	0.97	0.7
	2	32	18.2	12.1	11.1	8.2	8.3	7.7	114.1	17.5	20.2	13.2	45.9	45.8	413.4	460.7	203.2	102.3	2.59	1.7	1.40	1.2
1992	1	1	14.1	5.0	6.4	4.3	3.2	4.5	130.9	19.3	7.4	3.0	24.6	16.3	208.6	67.8	1.6	1.0	1.17	0.6	1.17	0.6
	1	35	33.4	26.7	17.1	15.1	14.0	14.9	138.0	29.5	17.0	15.3	80.3	65.7	338.0	225.8	1.0	0.9	1.06	0.5	1.06	0.5
	2	1	15.7	6.3	6.1	4.8	2.9	4.5	134.8	28.7	6.8	2.4	20.0	23.2	214.8	94.9	2.1	1.0	1.22	0.8	1.22	0.8
	2	34	43.1	39.7	23.1	22.8	19.1	21.1	159.6	33.3	31.0	35.0	69.2	73.7	394.6	275.5	1.1	1.2	1.25	0.6	1.25	0.6
1993	1	1	23.5	14.0	12.9	8.7	8.4	7.7	160.9	32.6	21.7	26.4	71.2	81.5	274.2	214.1	282.3	121.1	3.38	1.0	1.51	0.9
	1	38	49.3	45.7	22.9	17.5	19.8	18.8	157.7	43.6	25.9	27.9	84.6	83.0	492.0	451.5	231.8	51.3	1.99	1.5	1.13	0.8
	2	1	15.2	8.6	11.5	7.4	8.2	8.3	136.7	32.9	8.5	5.1	87.5	84.4	229.5	197.4	210.8	66.8	2.48	1.1	1.26	0.7
	2	38	68.7	53.7	25.2	16.7	22.2	16.7	184.2	64.9	41.3	49.1	58.4	51.8	589.5	415.0	325.7	82.7	3.36	3.2	2.46	1.6
1994	1	1	17.8	9.3	8.4	4.7	4.7	4.8	167.3	47.1	6.3	6.0	15.8	18.4	151.0	97.5	279.7	110.3	3.43	2.0	0.53	0.4
	1	38	66.9	44.9	27.9	20.9	24.4	21.2	224.2	98.3	46.9	54.3	64.0	70.4	394.3	329.9	319.0	139.9	2.53	3.0	0.47	0.3
	2	1	15.7	9.6	8.1	5.5	4.3	5.3	157.2	31.8	6.4	6.6	17.0	19.3	142.5	92.8	266.8	58.0	3.94	2.7	0.61	0.5
	2	37	72.4	55.1	24.9	17.4	23.0	18.5	228.5	72.6	53.8	62.4	61.2	70.2	399.0	360.8	364.7	97.5	3.29	3.5	0.76	0.4
1995	1	1	9.3	5.0	5.7	2.2	2.4	2.5	139.6	25.1	2.0	0.8	13.3	14.4	212.6	164.4	249.8	26.5	3.52	1.5	0.89	0.3
	1	37	106.9	106.1	42.4	34.4	37.5	34.0	171.6	69.7	64.6	60.8	110.4	106.2	718.0	574.0	270.0	na	0.95	1.1	1.16	0.2
	2	1	9.7	2.8	5.6	2.6	2.3	2.3	127.8	11.6	3.9	3.0	12.8	17.5	173.2	160.1	245.2	52.9	3.30	1.6	0.86	0.3
	2	37	136.7	134.8	53.2	49.7	48.3	47.8	209.4	90.0	78.0	72.3	105.7	99.6	738.0	580.8	248.0	na	1.04	1.1	1.31	0.4
1996	1	1	13.2	1.2	6.4	0.4	2.0	0.3	159.0	23.4	8.6	7.0	4.1	0.0	128.3	55.8	262.7	42.8	0.71	0.1	0.30	0.1
	1	37	36.0	21.9	22.5	13.6	20.1	13.4	158.5	24.1	29.6	20.9	72.0	100.2	293.7	300.7	238.7	108.3	0.44	0.3	0.38	0.0
	2	1	14.2	1.3	5.5	1.7	1.8	1.3	162.7	43.0	7.8	3.6	4.1	0.0	80.3	72.6	268.3	88.7	0.70	0.3	0.34	0.2
	2	34	50.4	37.0	16.5	12.8	14.7	13.5	191.5	41.8	33.7	13.3	53.3	85.7	355.7	414.0	344.7	129.5	0.51	0.3	0.43	0.1

SD - standard deviation

Appendix P.5. Weighted mean zooplankton density, biomass, and size by genera for Red Lake, 1986 and 1990-1996.

Stations	Number	*Diaptomus*			*Cyclops*			*Bosmina*			*Daphnia*			*Epischura*			TOTALS	
1-4	Sample	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass
Year	Dates	(no/m^2)	(mg/m^2)	(mm)	(no/m^2)	(mg/m^2)	(mm)	(no/m^2)	(mg/m^2)	(mm)	(no/m^2)	(mg/m^2)	(mm)	(no/m^2)	(mg/m^2)	(mm)	(no/m^2)	(mg/m^2)
1986	1	70,470	483	1.20	151,979	628	1.06	140,941	361	0.54	64,528	244	0.93				427,917	1,715
1990	5	70,674	222	0.91	303,026	715	0.79	55,573	54	0.34	11,519	19	0.63				440,791	1,010
1991	6	23,587	98	1.00	115,139	198	0.83	57,946	80	0.42	40,364	59	0.64	646	1	0.59	237,681	435
1992	6	85,612	393	1.09	516,432	1,828	1.00	113,279	202	0.46	57,281	132	0.79				772,603	2,554
1993	6	74,642	247	0.90	256,878	558	0.78	92,954	129	0.41	68,471	117	0.70				492,945	1,050
1994	6	60,548	235	0.98	218,190	461	0.73	51,818	63	0.41	15,303	25	0.62				345,857	784
1995	6	124,513	421	0.96	609,950	1,941	0.88	239,584	404	0.45	128,517	265	0.68				1,102,564	3,030
1996	4	48,636	197	0.97	289,777	1,001	0.92	61,837	115	0.46	36,986	78	0.69				437,237	1,392



Appendix P.6. Weighted mean zooplankton biomass by genera for Red Lake, 1986 and 1990-1996.

Appendix P.7. Juvenile sockeye salmon estimates based on fall tow net catch species composition and hydroacoustic fish population estimates for Red Lake, 1990-1991.

	Total Fish Estimates			Sockeye Estimates			Sockeye
		95% Confidence Interval			95% Confidence Interval		Composition
Date	Number	Low	High	Number	Low	High	(%)
30-Sep-90	7,227,742	6,079,520	8,375,964	101,188	85,188	117,189	1.4
5-Oct-91	9,430,782	10,131,244	12,334,284	631,862	437,083	826,641	6.7

Source: (Honnold 1993)

Appendix P.8. Townet catches from Red Lake, 1990-1994.

	Tow		Catch by Species					
			Sockeye			Stickleback		
Date	No.	Min.	No.	%	CPUE	No.	%	CPUE
1-Oct-90	3	90	20	1.4	0.2	1,452	98.6	16.1
12-May-91	3	82	34	2.7	0.4	1,228	97.3	15.0
6-Oct-91	3	90	91	6.7	1.0	1,277	93.3	14.2
23-Sep-92	3	92	62	1.9	0.7	3,190	98.1	34.7
24-Sep-92	3	120	149	nd	1.2	nd	nd	nd
26-Sep-93	3	62	41	8.8	0.7	425	91.2	6.9
23-Oct-94	3	60	86	4.3	1.4	1,909	95.7	31.8

nd - no data
Source: (Honnold 1993)

Appendix P.9. Mean age, length, weight, and condition coefficient by age for juvenile sockeye salmon captured by townet at Red Lake, 1991-1994.

	Age-0				Age-1				Age-2			
Year	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)
12-May-91	12	29.0	0.2	0.83	6	69.0	2.4	0.74	16	95.0	6.0	0.69
6-Oct-91	27	51.0	1.2	0.85	64	81.0	4.4	0.81				
23-Sep-92	137	68.5	2.6	0.79	74	97.0	8.2	0.84				
24-Sep-92												
26-Sep-93	1	63.0	2.3	0.92	3	79.3	5.1	1.01				
23-Oct-94	6	60.0	1.4	0.65	74	85	4.4	0.72	1	103.0	7.7	0.70

Source: (Honnold 1993)

Appendix P.10. Age compositions and population estimates of sockeye salmon smolt emigrating from Red Lake, 1990-1996.

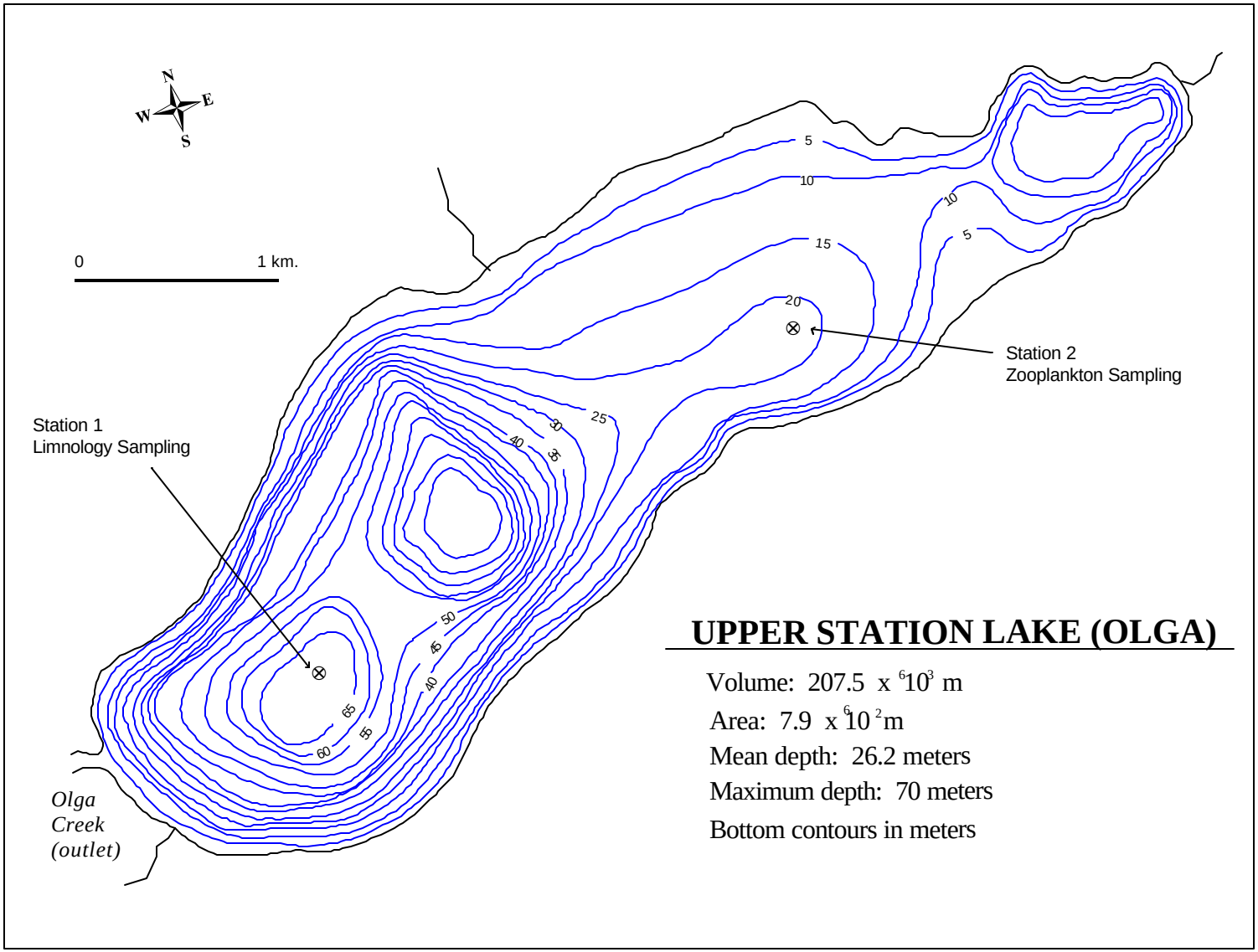
Year		Age 1.	Age 2.	Age 3.	Population Estimate	95% Confidence Interval Low	95% Confidence Interval High
1990	Percent	41.1	58.3	0.6			
	Number	274,435	389,338	4,244	668,017	535,431	800,591
1991	Percent	45.8	40.5	13.7			
	Number	123,920	109,633	37,147	270,700	230,701	310,699
1992	Percent	2.3	96.5	1.2			
	Number	31,915	1,343,862	17,243	1,393,020	1,228,639	1,557,401
1993	Percent	58.5	30.4	11.1			
	Number	328,698	170,907	62,514	562,118	495,554	628,682
1994	Percent	13.2	86.6	0.2			
	Number	73,215	478,912	901	553,029	510,604	595,454
1995	Percent	4.9	92.2	2.8			
	Number	17,361	324,299	9,943	351,603	287,810	415,396
1996	Percent	74.5	23.7	1.8			
	Number	735,953	233,991	17,669	987,612	867,565	1,107,659

Note: These estimates are slightly different than those reported in RIRs 4K93-1, 4K96-16, and 4K00-57 because previous estimates were based upon the Rawson estimator. The estimates presented here are based upon Carlson et al. 1998.

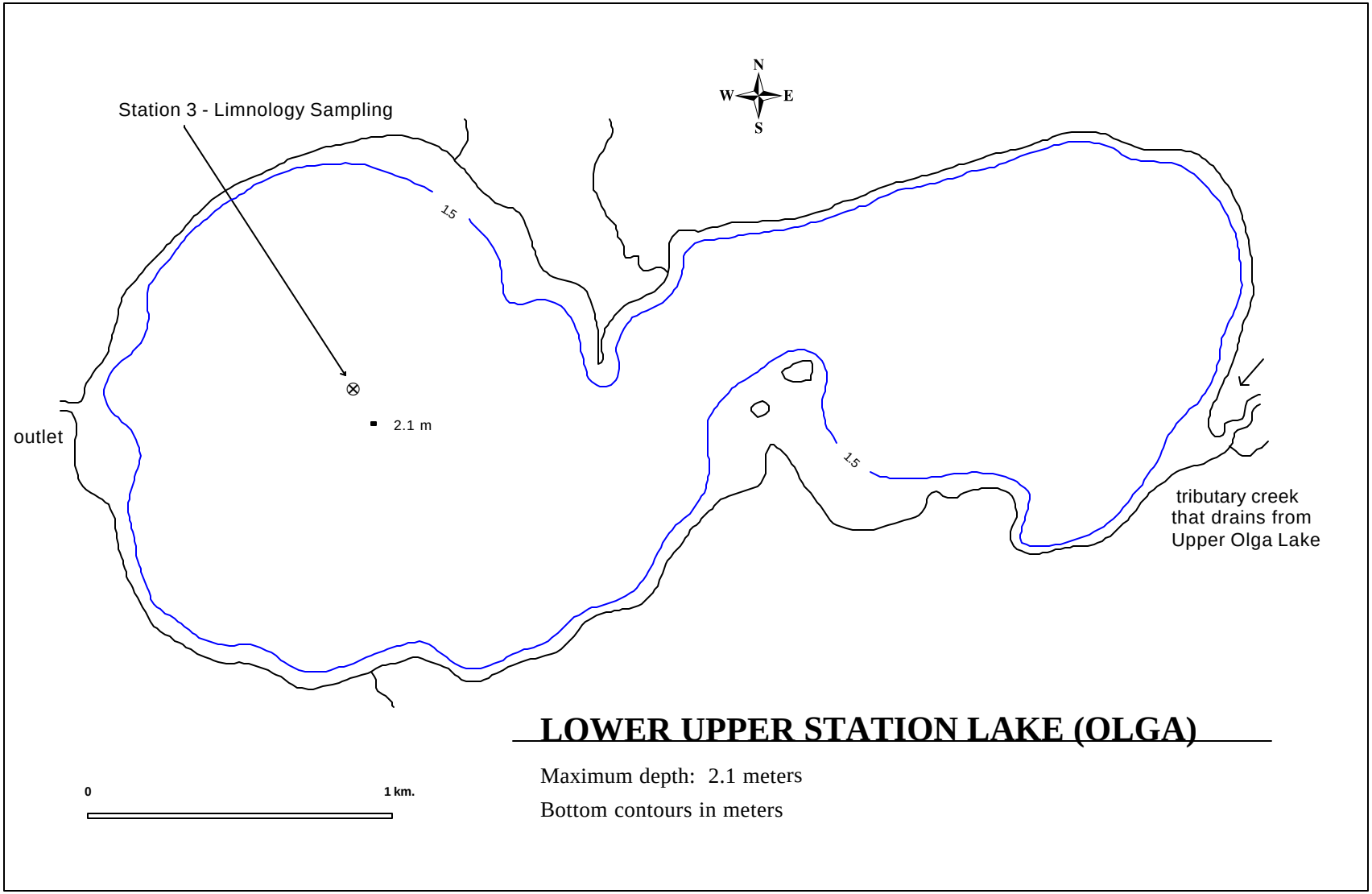
Appendix P.11. Mean length, weight, and condition coefficient by age for sockeye salmon smolt emigrating from Red Lake, 1990-1996.

	Age-1				Age-2				Age-3			
Sampling Year	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)
1990	342	106.5	10.0	0.83	1,052	111.8	11.0	0.79	20	117.9	13.0	0.79
1991	1,135	88.2	5.0	0.73	977	106.7	9.5	0.78	407	113.0	11.3	0.78
1992	85	99.5	8.8	0.89	1,667	110.2	11.8	0.88	63	119.7	15.2	0.89
1993	1,409	91.7	7.3	0.94	516	108.6	11.0	0.84	397	120.1	14.5	0.82
1994	225	86.2	5.1	0.79	1,718	98.7	7.6	0.79	7	104.9	9.0	0.78
1995	151	92.1	6.4	0.80	1592	103.2	9.3	0.80	97	115.7	13.3	0.80
1996	1,027	103.0	8.9	0.80	601	113.0	12.1	0.82	112	122.0	15.4	0.83

Data obtained from: (Barrett et al. 1993a; Barrett et al. 1993b; Swanton et al. 1995; Swanton et al. 1996; and Coggins 1997)



Appendix Q.1. Morphometric map showing the limnology and zooplankton stations on Upper Station (Olga) Lake.



Appendix Q.2. Morphometric map showing the limnology and zooplankton stations on Lower Upper Station (Olga) Lake.

Appendix Q.3. Limnological sampling stations and total samples collected for the Upper Station Lakes, 1986, 1990-1995, 1999 and 2000.

Year	Sampling Stations[a]	Total Samples
1986	1	1
1990	1, 2, 3	5
1991	1, 2, 3	5
1992	1, 2, 3	6
1993	1, 2, 3	6
1995	1, 1	4
1999	1, 2	4
2000	1, 2	4

[a] Stations 1 and 2 are located on the upper lake, and station 3 is located on the lower lake.

Appendix Q.4. Summary of seasonal mean water chemistry parameters by station and depth for the Upper Station Lakes, 1990-1991, and 1993.

Year	Station	Depth (m)	Specific Conductivity (umhos cm^{-1})	SD	pH (Units)	SD	Alkalinity (mg L^{-1})	SD	Turbidity (NTU)	SD	Color (Pt units)	SD	Calcium (mg L^{-1})	SD	Magnesium (mg L^{-1})	SD	Iron (ug L^{-1})	SD
1990	1	1	46.0	0.9	6.9	0.1	9.0	0.7	0.5	0.1	9.4	3.4	3.8	1.1	0.6	0.7	23.0	16.6
	1	60	46.0	1.1	6.8	0.2	8.7	0.8	0.5	0.1	8.8	0.8	3.5	0.5	1.1	1.3	36.0	23.0
	2	1	46.0	0.9	6.9	0.1	9.0	0.6	0.5	0.1	7.8	3.3	3.6	0.7	1.0	1.1	24.0	11.1
	2	14	46.0	0.9	6.9	0.1	8.5	1.1	0.6	0.2	6.8	2.2	3.1	0.7	1.1	1.4	31.0	11.1
1991	1	1	46.0	2.6	6.9	0.1	9.0	1.8	0.8	0.3	7.8	3.3	3.2	0.6	0.4	0.2	23.8	22.8
	1	60	46.0	3.2	6.8	0.1	8.7	1.2	0.8	0.3	9.3	5.5	3.0	0.6	0.5	0.4	19.3	17.9
	2	1	46.0	2.5	6.9	0.2	8.7	1.8	0.7	0.2	8.0	2.8	3.3	0.9	0.7	0.5	14.0	15.4
	2	20	46.0	2.2	6.9	0.1	8.9	1.5	0.8	0.4	8.7	3.7	3.4	0.6	0.4	0.2	19.3	16.9
	3	1	48.0	3.5	7.0	0.1	9.5	1.1	1.5	0.6	9.8	2.6	3.0	0.4	0.9	0.4	49.2	27.0
	3	2	48.0	4.1	6.9	0.1	9.4	1.5	1.3	0.5	10.2	3.0	3.3	0.5	0.7	0.3	46.4	20.3
1993	1	1	46.0	2.9	6.8	0.3	9.6	3.4	1	0.7	2.8	0.8	2.9	13.8	0.7	39.0	21.0	9.1
	1	50	49.0	2.7	6.5	0.2	8.4	0.8	0.7	0.3	3.8	2.3	3.2	0.5	1.2	0.8	18.0	8.4
	2	1	49.0	4.9	7.0	0.9	9.3	2.8	0.7	0.2	3.2	0.8	3.6	1.2	0.9	0.4	15.0	3.9
	2	24	49.0	4.4	6.8	0.4	9.3	1.6	0.7	0.3	3.2	1.2	3.6	0.8	0.9	0.4	17.0	11.3
	3	1	49.0	1.9	6.7	0.2	8.7	1.0	1.8	1.0	3.7	1.2	3.1	0.4	0.8	0.1	41.0	43.7

SD - standard deviation

Appendix Q.5. Summary of seasonal mean nutrient and algal pigment concentrations by station and depth for Upper Station Lakes, 1990, 1991, and 1993.

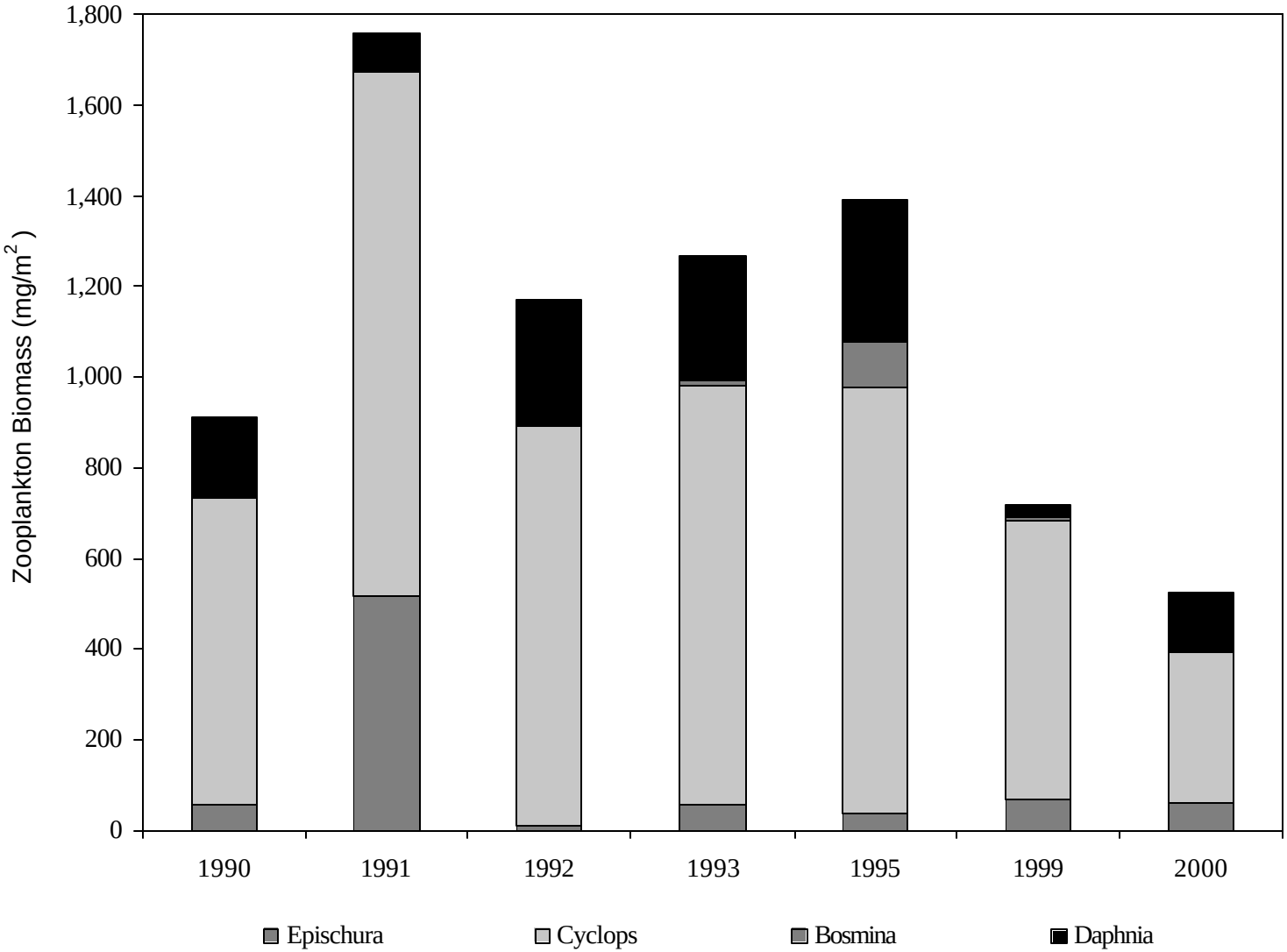
Year	Station	Depth (m)	Total Phosphorus (ug L^{-1})	SD	Total filterable Phosphorus (ug L^{-1})	SD	Filterable reactive Phosphorus (ug L^{-1})	SD	Total Kjel-dahl nitrogen (ug L^{-1})	SD	Ammonia (ug L^{-1})	SD	Nitrate + nitrite (ug L^{-1})	SD	Reactive silicon (ug L^{-1})	SD	Organic Carbon (ug L^{-1})	SD	Chloro-phyll *a* (ug L^{-1})	SD	Phaeo-phytin *a* (ug L^{-1})	SD
1990	1	1	6.7	0.7	5.9	3.6	3	2.8	91	11.6	5	1.0	26	32.1	107	108.2	260	107.4	1.68	0.7	0.85	0.3
	1	60	8.4	3.2	3.6	1.1	2	1.0	99	21.3	27	26.0	33	14.6	100	98.0	174	81.7	1.68	1.1	1.09	0.6
	2	1	7.0	1.1	3.6	0.8	2	1.0	95	7.8	4	0.9	10	8.3	101	102.5	267	89.9	1.74	0.8	0.86	0.3
	2	14	8.2	2.6	3.3	0.6	1	0.5	99	10.2	5	1.2	11	7.8	97	111.6	273	92.7	1.92	0.7	1.12	0.3
1991	1	1	8.7	2.5	3.6	1.0	2	1.2	108	57.3	6	4.2	5	3.4	94	50.0	na	na	2.00	1.0	0.43	0.2
	1	60	9.3	2.4	4.1	1.9	2	1.7	103	54.5	11	17.4	21	21.1	120	39.2	na	na	1.98	0.8	0.42	0.2
	2	1	7.5	3.4	3.4	0.5	1	0.5	94	51.0	5	3.2	5	4.5	86	37.1	na	na	1.79	1.2	0.48	0.2
	2	20	8.2	1.5	4.7	2.1	2	1.1	96	52.2	9	7.7	9	8.1	92	27.9	na	na	2.17	1.0	0.61	0.2
	3	1	17.5	3.8	5.5	1.4	2	0.8	170	38.1	7	4.9	3	1.2	544	291.6	na	na	1.56	0.8	0.56	0.2
	3	2	14	2.5	6.4	1.9	3	0.9	171	39.0	8	6.4	3	1.2	543	293.6	na	na	1.78	0.5	0.67	0.2
1993	1	1	6.6	11.5	2.9	4.5	1	3.3	132	29.3	3	1.7	10	6.9	166	102.1	299	100.7	2.42	1.0	0.66	0.3
	1	50	7.7	2.4	3.5	1.1	1	1.0	118	21.3	6	7.0	29	18.2	90	58.8	338	52.4	3.64	0.8	1.07	0.4
	2	1	6.9	1.9	3.7	0.8	1	0.4	121	12.5	3	2.2	9	7.3	128	87.6	286	97.6	2.74	1.5	0.81	0.5
	2	24	7.7	1.8	3.5	1.0	1	0.5	120	7.9	6	3.4	16	5.3	131	114.5	278	107.8	3.96	1.1	1.12	0.7
	3	1	14.9	5.2	5.4	1.3	2	0.4	199	53.1	4	1.9	6	0.0	472	310.7	475	172.8	2.96	3.5	1.41	1.4

SD - standard deviation
na - not analyzed

Appendix Q.6. Weighted mean zooplankton density, biomass, and size by genera for the upper lake of the Upper Station Lakes, 1986 and 1990-1995.

	Number	*Epischura*			*Cyclops*			*Bosmina*			*Daphnia*			TOTALS	
	Sample	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass
Year	Days	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2
1986[a]	1	5,943	6	0.60	161,742	202	0.61	30,990	51	0.42				198,675	259
1990	5	3,318	57	1.39	321,577	676	0.72	95,329	178	0.44	186	1	0.61	420,409	911
1991	6	77,820	517	1.09	376,849	1,154	0.93	62,799	88	0.40				517,467	1,759
1992	6	819	11	1.45	410,753	884	0.77	137,208	275	0.45				548,780	1,169
1993	6	7,095	56	1.19	575,871	923	0.68	173,554	274	0.41	7,418	15	0.68	763,938	1,267
1995	4	6,668	37	1.07	490,751	937	0.71	144,871	316	0.48	44,818	100	0.69	687,108	1,390
1999	4	12,938	70	1.01	302,495	613	0.74	12,169	25	0.46	10,828	11	0.70	338,430	718
2000	4	9,758	61	1.12	223,618	334	0.68	64,789	131	0.47	174	<1	0.26	298,338	525

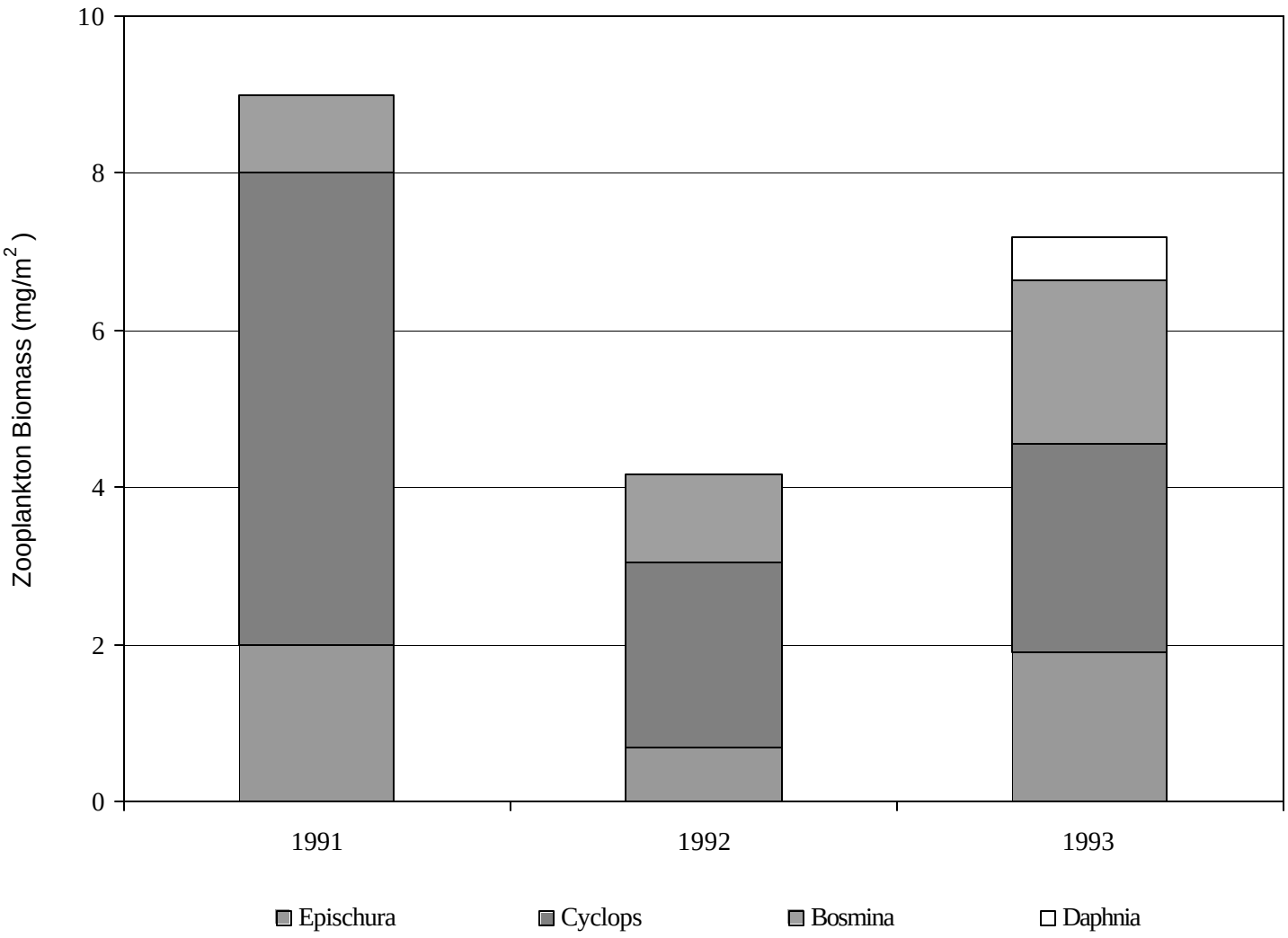
[a] Only one sample (July) was taken in 1986.



Appendix Q.7. Weighted mean zooplanton biomass by genera for the upper lake of the Upper Station Lakes, 1990-1993, 1995, 1999 and 2000.

Appendix Q.8. Weighted mean zooplankton density, biomass, and size by genera for the Lower Upper Station Lake, 1991-1993.

Station 3	Number of Sample	*Epischura*			*Cyclops*			*Bosmina*			*Daphnia*			TOTALS	
		Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass	Size	Density	Biomass
Year	Dates	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2	mm	no/m^2	mg/m^2
1991	6	411	2.0	0.96	3,285	6.0	0.76	603	1.0	0.32	19	<1	0.58	4,318	9.0
1992	6	398	0.7	0.72	1,208	2.3	2.34	536	1.1	0.47	8	<1		2,150	4.2
1993	6	866	1.9	0.77	2,214	2.7	2.66	1,987	2.1	0.34	377	0.6	0.59	5,444	7.2



Appendix Q.9. Weighted mean zooplankton biomass by genera for the Lower Upper Station Lake, 1991-1993.

Appendix Q.10. Juvenile sockeye salmon estimates based on fall townet catch species composition and hydroacoustic fish population estimates for Upper Station (upper lake) Lake, 1990-1991.

	Total Fish Estimates			Sockeye Estimates			Sockeye
		95% Confidence Interval			95% Confidence Interval		Composition
Date	Number	Low	High	Number	Low	High	(%)
28-Sep-90	3,843,823	3,376,317	4,311,329	1,172,366	1,029,643	1,315,089	30.5
4-Oct-91	3,987,459	3,431,754	4,543,164	386,784	333,009	440,558	9.7

Source: (Honnold 1993)

Appendix Q.11. Townet catches from the Upper Station (upper lake) Lake, 1990-1992.

	Tow		Catch by Species					
			Sockeye			Stickleback		
Date	Number	Minutes	Number	%	CPUE	Number	%	CPUE
28-Sep-90	3	91	174	30.5	1.9	397	69.5	4.4
8-May-91	3	90	14	1.0	0.2	1,353	99.0	15.0
4-Oct-91	3	94	160	9.8	1.7	1,480	90.2	15.7
21-Sep-92	3	93	275	33.6	3.0	543	66.4	5.8

Source: (Honnold 1993)

Appendix Q.12. Mean age, length, weight, and condition coefficient by age for juvenile sockeye salmon captured by tow net at Upper Station (upper lake) Lake, 1991-1992.

	Age-0					Age-1					Age-2				
Date	n	%	Length (mm)	Weight (g)	Condition (K)	n	%	Length (mm)	Weight (g)	Condition (K)	n	%	Length (mm)	Weight (g)	Condition (K)
8-May-91	4	31	31	0.3	0.87	2	15	73	3.3	0.87	7	53.8	109	10.4	0.79
4-Oct-91	116	73	56	1.7	0.85	44	28	91	7.0	0.91					
21-Sep-92	213	78	67	2.9	0.89	62	23	90	8.4	1.03					

Source: (Honnold 1993)

Appendix Q.13. Estimated number of sockeye salmon smolt emigrating from the Upper Station Lakes by year and age class, 1990-1993[a].

Smolt Outmigration Year	Number and Relative Percent of Smolt by Age Class 0.	1.	2.	3.	Total Population Estimate	SE	95% Confidence Interval Lower	Upper
1990	79%	2%	18%	1%				
	5,188,222	156,344	1,171,183	54,581	6,570,331	881,065	4,843,443	8,297,219
1991	80%	9%	10%	1%				
	1,730,763	200,531	222,037	15,637	2,168,968	263,019	1,653,451	2,684,485
1992	87%	2%	10%	0%				
	1,870,009	43,823	222,668	1,065	2,137,565	193,335	1,758,628	2,516,502
1993	74%	14%	12%	0%				
	3,187,854	620,651	502,347	13,163	4,324,015	294,599	3,746,601	4,901,429

[a] These estimates are slightly different than those reported in RIRs 4K93-1, 4K93-32, and 4K00-57 because previous estimates were based upon the Rawson estimator. The estimates presented here are based upon Carlson et al. 1998.

Appendix Q.14. Mean length, weight, and condition coefficient by age for sockeye salmon smolt emigrating from the Upper Station Lakes, 1990-1993.

	Age-0				Age-1				Age-2				Age-3			
Sampling Year	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)	n	Length (mm)	Weight (g)	Condition (K)
1990	939	55	1.5	0.93	325	81.4	4.9	0.91	1,539	100	8.3	0.84	74	110	11.1	0.84
1991	1,622	59	2.0	0.96	658	94.0	7.1	0.85	947	102	9.3	0.87	72	115	12.8	0.84
1992	1,813	58	1.8	0.95	477	93.7	7.9	0.96	1,841	103	10.1	0.92	8	113	13.6	0.95
1993	2,311	61	2.1	0.91	1,113	92.0	6.3	0.80	853	111	11.7	0.82	27	120	14.9	0.84

Source: (Barrett et al. 1993a; Barrett et al. 1993b)

Appendix R. Kodiak area commercial salmon harvest by statistical area from enhanced and rehabilitated systems, 2001.

Stat.			CHINOOK		SOCKEYE		COHO		PINK		CHUM	
Area	Date	Landings	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds
251-10	10-Jun	3	121	1,610	1,882	9,364	0	0	0	0	21	194
SW	11-Jun	2	205	1,471	596	2,802	0	0	0	0	44	375
Afognak	12-Jun	7	183	1,338	794	4,416	0	0	0	0	727	8,591
Malina	13-Jun	4	335	3,380	2,242	11,102	0	0	0	0	362	2,805
	14-Jun	2	97	918	1,004	4,857	0	0	0	0	72	635
	Total	18	941	8,717	6,518	32,541	0	0	0	0	1,226	12,600
251-40	7-Jul	1	0	0	160	801	0	0	1,054	3,164	22	179
Outer	Total	1	0	0	160	801	0	0	1,054	3,164	22	179
Foul Bay	Avg. Wt.					5.0				3.0		8.1
251-41	9-Jun	9	0	0	12,726	63,348	0	0	0	0	0	0
Foul Bay	10-Jun	7	93	539	5,576	27,748	0	0	0	0	29	200
THA	11-Jun	2	0	0	1,309	6,420	0	0	0	0	0	0
	12-Jun	4	0	0	1,760	8,792	0	0	0	0	0	0
	14-Jun	2	0	0	695	3,632	0	0	0	0	0	0
	15-Jun	4	11	88	1,615	8,106	0	0	0	0	0	0
	16-Jun	2	0	0	325	1,443	0	0	0	0	0	0
	17-Jun	1	0	0	526	2,630	0	0	0	0	0	0
	18-Jun	2	0	0	426	2,036	0	0	0	0	0	0
	19-Jun	1	0	0	458	2,149	0	0	0	0	0	0
	20-Jun	1	0	0	638	3,191	0	0	0	0	0	0
	22-Jun	1	0	0	636	3,179	0	0	0	0	0	0
	24-Jun	2	0	0	1,716	8,580	0	0	0	0	0	0
	30-Jun	1	0	0	688	4,127	0	0	0	0	0	0
	4-Jul	1	0	0	389	1,945	0	0	0	0	0	0
	5-Jul	2	0	0	339	1,699	0	0	1,141	3,424	24	185
	Total	42	104	627	29,822	149,025	0	0	1,141	3,424	53	385
	Avg. Wt.			6.0		5.0				3.0		7.3
251-82	1-Sep	1	0	0	0	0	2,695	24,259	169	509	0	0
Inner	5-Sep	1	0	0	0	0	1,608	14,474	152	562	0	0
Perenosa	Total	2	0	0	0	0	4,303	38,733	321	1,071	0	0
	Avg. Wt.							9.0		3.3		0
251-83	8-Aug	1	0	0	26	143	492	3,418	1,596	5,314	13	92
Outer	23-Aug	1	0	0	0	0	900	9,093	468	1,405	0	0
Perenosa	25-Aug	1	0	0	0	0	4,879	39,906	582	2,329	0	0
	27-Aug	1	0	0	0	0	2,287	20,585	603	1,810	0	0
	28-Aug	2	0	0	0	0	5,013	40,509	899	3,019	9	82
	30-Aug	1	0	0	0	0	2,551	22,963	792	2,377	0	0
	1-Sep	1	0	0	0	0	179	1,616	156	468	0	0
	4-Sep	1	0	0	0	0	914	6,395	31	113	0	0
	Total	9	0	0	26	143	17,215	144,485	5,127	16,835	22	174
	Avg. Wt.					5.5		8.4		3.3		7.9

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Stat.			CHINOOK		SOCKEYE		COHO		PINK		CHUM	
Area	Date	Landings	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds
251-84	9-Jun	3	0	0	3,015	14,455	0	0	0	0	0	0
Waterfall	10-Jun	3	0	0	3,210	15,258	0	0	0	0	0	0
THA	11-Jun	1	0	0	359	1,687	0	0	7	15	0	0
	12-Jun	1	0	0	1,081	5,087	0	0	0	0	0	0
	13-Jun	1	0	0	1,081	5,087	0	0	0	0	0	0
	14-Jun	2	0	0	278	1,326	0	0	0	0	0	0
	15-Jun	2	0	0	1,184	5,584	0	0	0	0	0	0
	17-Jun	2	2	18	1,290	5,796	0	0	0	0	0	0
	19-Jun	3	0	0	588	2,647	0	0	0	0	0	0
	21-Jun	1	0	0	246	977	0	0	0	0	0	0
	23-Jun	1	0	0	1,303	5,078	0	0	0	0	0	0
	24-Jun	1	0	0	347	1,735	0	0	0	0	0	0
	27-Jun	1	0	0	660	2,439	0	0	0	0	0	0
	29-Jun	1	0	0	560	2,802	0	0	0	0	0	0
	30-Jun	1	0	0	254	1,018	0	0	0	0	0	0
	7-Jul	1	1	8	567	2,838	0	0	26	86	3	23
	Total	25	3	26	16,023	73,814	0	0	33	101	3	23
	Avg. Wt.			8.7		4.6				3.1		7.7
252-30	9-Jun	4	3	45	286	1,508	0	0	2	5	1,944	16,458
Izhut	10-Jun	4	38	333	270	1,161	0	0	0	0	4,907	35,169
Bay	13-Jun	2	18	222	45	222	0	0	0	0	1,711	13,472
	15-Jun	1	0	0	12	60	0	0	0	0	1,076	7,530
	16-Jun	3	11	46	102	514	0	0	19	71	2,190	18,598
	17-Jun	3	21	204	297	1,530	1	6	59	182	1,897	15,226
	1-Jul	11	48	150	807	4,050	25	150	625	2,188	11,049	89,683
	2-Jul	9	7	78	407	2,054	8	48	274	1,019	9,745	68,622
	3-Jul	5	0	0	138	811	3	14	137	407	4,102	35,283
	4-Jul	1	0	0	224	1,119	0	0	163	490	609	5,485
	5-Jul	1	0	0	0	0	0	0	0	0	438	3,285
	7-Jul	2	1	6	108	578	25	154	325	1,001	1,220	9,424
	9-Jul	1	0	0	65	387	22	145	215	744	61	440
	10-Jul	2	1	9	328	1,477	81	449	503	1,607	2,511	16,323
	11-Jul	1	2	37	658	3,289	324	1,943	1,215	4,860	454	4,086
	13-Jul	4	6	72	837	4,121	429	2,562	1,903	7,184	4,227	28,385
	17-Jul	1	7	38	188	849	114	629	875	2,801	118	764
	18-Jul	1	0	0	20	109	8	79	335	1,019	30	295
	26-Jul	1	0	0	68	405	54	379	3,462	12,462	116	927
	29-Jul	2	0	0	48	267	8	54	11,053	35,371	26	210
	30-Jul	8	0	0	148	746	11	73	87,313	298,726	161	1,145
	31-Jul	9	2	42	104	562	18	131	51,630	183,610	170	1,489
	1-Aug	22	0	0	434	2,259	132	879	137,326	488,700	291	2,122
	2-Aug	10	0	0	123	614	83	616	49,249	162,794	98	718
	3-Aug	12	1	21	160	912	113	783	61,902	220,528	104	698
	4-Aug	12	0	0	124	650	108	754	61,498	207,233	107	884
	5-Aug	20	7	13	319	1,675	409	2,846	113,237	387,837	214	1,510
	6-Aug	12	0	0	93	535	83	651	54,121	181,289	48	340
	7-Aug	25	1	2	198	1,178	387	2,963	156,208	512,753	95	742
	8-Aug	15	4	64	404	2,376	392	2,855	121,222	401,447	300	2,429
	9-Aug	24	3	70	514	2,835	753	5,905	200,144	647,191	148	1,285
	10-Aug	31	0	0	107	519	354	2,853	177,152	567,699	73	552

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Stat.			CHINOOK		SOCKEYE		COHO		PINK		CHUM	
Area	Date	Landings	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds
Cont.	11-Aug	35	3	40	169	916	621	4,558	196,580	699,994	109	844
252-30	12-Aug	45	0	0	90	482	502	3,806	257,432	901,673	70	566
Izhut	13-Aug	32	0	0	83	439	557	4,063	187,494	677,831	41	281
Bay	14-Aug	61	1	9	356	2,032	2,397	18,546	471,557	1,632,604	173	1,270
	15-Aug	58	8	129	361	1,999	2,125	16,784	388,856	1,327,564	215	1,590
	16-Aug	67	0	0	390	2,140	3,026	23,318	369,324	1,270,801	162	1,249
	17-Aug	51	0	0	544	2,936	2,949	22,442	283,362	984,730	158	1,234
	18-Aug	47	0	0	125	674	2,744	20,139	249,850	864,081	54	360
	19-Aug	47	2	26	110	586	2,246	17,300	256,003	883,476	54	407
	20-Aug	27	0	0	89	451	1,393	11,464	211,918	642,822	26	195
	21-Aug	24	1	11	40	234	2,315	20,288	152,857	526,321	11	77
	22-Aug	35	5	81	131	697	3,057	24,909	259,289	901,064	38	311
	23-Aug	35	3	24	101	534	2,867	23,985	227,709	770,925	39	272
	24-Aug	21	0	0	32	166	2,121	16,467	142,305	477,152	5	38
	25-Aug	23	0	0	51	251	3,194	23,234	156,533	566,896	31	250
	26-Aug	17	0	0	34	189	2,153	16,471	127,183	428,809	11	102
	27-Aug	26	0	0	57	340	3,569	27,806	200,238	693,383	10	78
	28-Aug	30	0	0	62	338	5,091	39,624	217,316	756,961	13	114
	29-Aug	22	0	0	25	131	2,120	16,674	75,787	269,312	15	122
	30-Aug	6	0	0	16	92	1,654	11,586	35,273	130,496	12	102
	31-Aug	3	0	0	12	59	1,243	8,847	22,862	83,933	13	103
	1-Sep	5	0	0	42	223	4,768	33,378	37,120	137,348	23	185
	2-Sep	1	0	0	6	33	354	2,475	7,297	26,999	5	41
	3-Sep	2	0	0	9	48	1,581	11,066	22,212	82,185	1	6
	4-Sep	1	0	0	8	42	979	6,851	6,334	23,437	5	38
	5-Sep	1	0	0	0	0	0	0	4,529	15,899	0	0
	6-Sep	1	0	0	4	21	1,587	11,109	8,256	30,549	2	18
	7-Sep	2	0	0	5	31	3,126	21,884	11,401	42,186	0	0
	8-Sep	1	0	0	0	0	0	0	1,941	7,183	0	0
	9-Sep	1	0	0	5	28	1,661	11,632	6,035	22,331	3	22
	10-Sep	2	0	0	13	68	2,943	20,693	6,223	23,027	3	28
	14-Sep	1	0	0	0	0	261	1,825	0	0	0	0
	16-Sep	2	0	0	0	0	2,318	16,225	152	562	0	0
	17-Sep	1	0	0	0	0	1,766	12,365	129	478	0	0
	18-Sep	1	0	0	0	0	1,936	13,553	0	0	0	0
	Total	993	204	1,772	10,606	55,552	75,169	563,288	5,893,524	20,234,230	51,542	393,482
	Avg. Wt.			8.7		5.2		7.5		3.4		7.6
252-31	9-Jun	1	0	0	264	1,402	0	0	0	0	173	1,725
Duck	12-Jun	4	46	568	1,722	8,529	0	0	7	12	3,453	24,224
Bay	13-Jun	1	23	234	750	3,941	0	0	24	65	1,320	10,381
	14-Jun	1	6	23	133	669	0	0	0	0	728	5,098
	15-Jun	3	6	132	564	2,820	0	0	48	188	2,355	16,701
	16-Jun	4	19	191	844	4,466	0	0	37	111	3,954	28,930
	17-Jun	2	11	191	581	2,904	0	0	124	435	1,812	15,247
	18-Jun	3	33	317	764	3,833	0	0	88	322	2,799	23,689
	19-Jun	6	14	166	1,091	5,416	0	0	108	361	3,992	32,300
	20-Jun	4	21	102	860	4,892	1	4	112	383	2,590	21,697
	1-Jul	2	1	6	634	3,202	5	27	218	843	1,071	8,407
	2-Jul	1	0	0	233	1,168	5	31	106	426	1,065	9,584
	3-Jul	1	1	24	141	704	18	108	82	329	925	8,323

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Stat.			CHINOOK		SOCKEYE		COHO		PINK		CHUM	
Area	Date	Landings	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds
Cont.	6-Jul	1	0	0	57	399	2	15	56	178	203	1,852
252-31	7-Jul	2	12	32	396	2,108	95	565	631	2,339	349	2,677
Duck	8-Jul	1	0	0	161	1,127	21	149	156	502	310	2,796
Bay	9-Jul	2	1	19	600	3,169	73	591	509	1,632	803	6,174
	10-Jul	2	5	17	328	1,546	107	587	879	3,132	502	3,340
	11-Jul	2	0	0	1,272	7,429	401	3,583	2,830	9,035	104	921
	12-Jul	1	2	12	261	1,548	248	1,488	481	1,905	62	473
	14-Jul	3	7	26	2,372	11,497	1,285	8,318	5,514	19,952	995	7,068
	15-Jul	1	6	74	224	1,122	172	1,031	1,047	4,186	130	1,170
	16-Jul	1	0	0	361	1,808	110	995	2,811	9,278	40	325
	18-Jul	5	4	74	507	3,003	519	3,742	3,997	13,839	280	2,147
	19-Jul	2	2	12	421	2,977	394	3,771	3,863	12,271	175	1,508
	20-Jul	2	14	29	100	523	49	402	1,123	3,621	148	1,289
	21-Jul	4	4	21	157	1,101	158	1,385	2,681	8,220	221	2,089
	24-Jul	8	10	201	607	3,309	258	1,861	30,016	94,285	862	7,125
	25-Jul	4	1	30	110	527	58	327	6,315	21,012	299	2,043
	26-Jul	6	11	379	1,012	2,029	172	1,316	18,729	65,595	356	2,869
	27-Jul	1	0	0	41	205	47	282	4,039	16,154	46	411
	30-Jul	2	0	0	60	315	37	275	7,450	26,467	105	822
	31-Jul	5	2	47	374	1,957	257	1,796	41,031	150,261	433	3,531
	1-Aug	24	3	32	383	1,975	383	2,596	103,255	356,515	276	2,021
	2-Aug	27	6	125	874	4,144	638	4,308	208,895	672,688	657	4,807
	3-Aug	37	9	117	1,335	7,047	960	6,819	233,640	787,687	1,164	8,845
	4-Aug	48	8	110	815	4,360	1,289	9,634	395,414	1,251,991	611	4,726
	5-Aug	47	3	42	866	4,602	1,274	9,384	287,678	1,032,713	592	3,924
	6-Aug	51	10	125	725	3,746	1,095	7,874	357,266	1,184,659	514	3,973
	7-Aug	37	13	216	552	2,937	1,168	8,599	320,734	1,070,042	360	2,798
	8-Aug	71	4	89	1,408	7,285	2,629	19,426	575,403	1,936,240	664	5,132
	9-Aug	56	6	144	832	4,345	1,505	10,840	307,939	1,063,295	501	3,874
	10-Aug	53	2	23	1,096	5,752	2,684	19,577	310,996	1,059,556	572	4,352
	11-Aug	41	0	0	605	3,401	1,260	10,058	255,895	861,224	235	1,900
	12-Aug	32	5	65	544	2,996	1,524	10,901	147,446	502,980	236	1,948
	13-Aug	40	2	69	290	1,688	1,130	8,832	227,673	803,348	108	836
	14-Aug	27	2	34	319	1,669	1,429	10,371	180,466	603,204	130	1,047
	15-Aug	19	1	23	194	886	1,041	7,709	121,525	408,885	170	1,375
	16-Aug	23	0	0	113	624	1,598	12,631	132,538	444,103	62	475
	17-Aug	16	2	69	122	665	1,533	11,605	89,850	302,586	34	250
	18-Aug	15	0	0	80	445	2,002	15,421	92,438	299,052	34	276
	19-Aug	27	0	0	143	849	2,664	19,974	203,260	688,026	35	266
	20-Aug	21	0	0	118	667	3,049	25,011	239,170	832,724	19	137
	21-Aug	31	1	12	222	1,192	5,718	42,901	257,456	903,357	157	1,156
	22-Aug	34	2	33	352	1,890	4,724	35,340	251,755	885,662	75	545
	23-Aug	37	2	51	600	3,286	4,761	40,222	251,293	873,842	109	800
	24-Aug	25	0	0	235	1,101	2,886	23,446	190,294	622,340	42	245
	25-Aug	19	0	0	128	700	2,843	21,224	132,641	450,621	60	432
	26-Aug	10	2	16	33	185	1,014	7,881	47,903	173,191	9	72
	27-Aug	12	0	0	43	239	2,365	18,145	47,512	162,107	15	117
	28-Aug	6	2	32	24	122	1,513	12,481	29,647	95,818	16	126
	29-Aug	4	0	0	26	136	809	6,415	26,739	85,233	22	187
	30-Aug	4	0	0	11	58	1,190	8,615	39,698	137,083	3	25
	31-Aug	3	0	0	15	80	2,935	20,543	31,771	117,551	14	106

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Stat.			CHINOOK		SOCKEYE		COHO		PINK		CHUM	
Area	Date	Landings	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds
Cont.	1-Sep	2	0	0	14	75	1,626	11,381	12,263	45,372	2	23
252-31	2-Sep	1	0	0	0	0	567	3,404	2,009	7,432	0	0
Duck	Total	988	347	4,354	31,119	160,792	68,298	516,217	6,247,574	21,188,466	40,158	313,732
Bay	Avg. Wt.			12.5		5.2		7.6		3.4		7.8
252-32	9-Jun	4	63	560	615	3,622	0	0	0	0	2,589	21,680
Kitoi	10-Jun	2	5	63	649	3,247	0	0	0	0	3,522	27,535
Bay	11-Jun	2	24	281	218	1,219	0	0	0	0	2,597	21,825
	12-Jun	3	31	267	346	1,732	0	0	0	0	3,920	33,225
	13-Jun	5	32	447	970	5,145	0	0	0	0	5,215	46,069
	14-Jun	6	41	490	303	1,487	0	0	0	0	6,440	48,288
	15-Jun	3	12	208	96	470	0	0	0	0	3,281	26,532
	16-Jun	6	36	553	474	2,371	0	0	0	0	8,953	71,603
	17-Jun	2	0	0	108	542	0	0	0	0	1,368	10,874
	3-Jul	42	2	22	482	2,446	4	22	427	1,316	71,354	511,719
	4-Jul	2	0	0	0	0	0	0	0	0	2,555	20,449
	7-Jul	3	6	80	141	746	4	22	238	884	2,151	18,153
	9-Jul	2	3	24	135	790	89	562	257	1,013	3,486	26,130
	10-Jul	3	19	131	390	1,768	50	277	668	2,241	4,373	28,369
	11-Jul	1	1	7	211	1,081	51	422	750	2,103	709	5,830
	14-Jul	1	0	0	0	0	0	0	0	0	1,411	11,365
	30-Jul	9	0	0	105	561	8	46	68,250	208,628	104	762
	31-Jul	8	0	0	212	1,055	34	236	52,868	194,041	61	432
	1-Aug	7	2	88	170	945	52	359	57,552	207,149	122	840
	2-Aug	6	0	0	103	509	77	545	38,040	129,131	107	740
	3-Aug	2	0	0	9	49	5	33	7,916	27,517	24	168
	4-Aug	5	0	0	25	125	20	176	35,795	112,079	32	226
	5-Aug	4	1	22	56	321	105	733	31,628	117,225	66	464
	6-Aug	3	0	0	21	111	14	121	19,384	64,620	14	106
	8-Aug	10	1	5	95	487	116	823	52,868	188,641	37	266
	9-Aug	4	0	0	4	27	10	79	24,486	83,264	13	88
	10-Aug	20	0	0	92	548	285	1,863	96,931	322,629	30	243
	11-Aug	9	0	0	15	77	33	257	38,798	128,848	8	61
	13-Aug	1	0	0	14	74	82	577	18,517	68,513	5	40
	18-Aug	2	0	0	1	7	108	807	18,090	54,274	6	50
	22-Aug	8	0	0	1	9	240	1,989	60,769	164,767	0	0
	23-Aug	7	0	0	38	231	580	4,098	33,763	118,992	0	0
	24-Aug	5	0	0	22	160	48	338	41,450	128,965	0	0
	26-Aug	1	0	0	3	16	194	1,555	9,711	34,960	5	28
	27-Aug	2	0	0	121	691	713	5,882	21,621	71,366	8	56
	28-Aug	3	0	0	0	0	40	427	19,634	64,362	0	0
	29-Aug	7	0	0	2	7	138	807	49,668	160,403	0	0
	31-Aug	2	0	0	2	9	277	2,488	27,718	90,087	0	0
	1-Sep	2	0	0	3	10	2,063	18,344	31,244	102,795	0	0
	2-Sep	2	0	0	533	4,715	526	4,680	31,249	101,558	0	0
	3-Sep	6	0	0	4	20	1,372	12,165	33,576	110,856	0	0
	4-Sep	4	0	0	2	17	747	5,226	57,269	199,498	0	0
	6-Sep	2	0	0	0	0	180	1,495	4,528	15,839	0	0
	Total	228	279	3,248	6,791	37,447	8,265	67,454	985,663	3,278,564	124,566	934,216
	Avg. Wt.			11.6		5.5		8.2		3.3		7.5

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Stat.			CHINOOK		SOCKEYE		COHO		PINK		CHUM	
Area	Date	Landings	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds
254-50	1-Jul	1	0	0	130	720	0	0	0	0	0	0
Spiridon	2-Jul	2	0	0	86	546	0	0	34	145	97	865
Lake	3-Jul	1	0	0	108	595	0	0	0	0	0	0
THA	4-Jul	1	0	0	85	463	0	0	11	35	0	0
Telrod	5-Jul	1	0	0	116	615	0	0	44	155	6	49
Cove	6-Jul	2	0	0	194	1,058	0	0	167	589	17	158
	8-Jul	3	0	0	365	1,977	0	0	233	732	34	326
	9-Jul	1	1	6	162	814	0	0	45	136	5	47
	10-Jul	1	0	0	111	610	0	0	103	309	25	175
	11-Jul	4	0	0	700	3,656	0	0	678	2,455	138	1,554
	12-Jul	4	0	0	780	3,941	0	0	608	1,831	83	798
	13-Jul	6	0	0	1,285	6,486	0	0	849	2,795	443	4,028
	14-Jul	5	0	0	1,444	7,420	0	0	1,545	4,818	624	5,895
	15-Jul	3	0	0	651	3,334	0	0	751	2,414	171	1,583
	16-Jul	4	0	0	608	3,311	0	0	1,045	4,126	385	3,792
	17-Jul	4	0	0	647	3,492	0	0	2,200	7,721	784	7,528
	18-Jul	3	0	0	511	2,560	0	0	979	3,135	209	2,103
	19-Jul	4	0	0	1,131	5,668	0	0	1,496	4,791	210	2,076
	20-Jul	6	0	0	1,042	5,267	0	0	2,235	7,240	3,435	33,234
	21-Jul	6	0	0	1,527	7,726	0	0	3,415	10,919	2,655	27,185
	22-Jul	3	0	0	1,420	7,350	0	0	1,449	5,270	401	3,993
	23-Jul	6	0	0	2,509	13,123	0	0	3,501	12,973	1,000	10,004
	24-Jul	6	0	0	1,132	5,740	0	0	1,342	4,346	189	1,923
	25-Jul	4	0	0	1,260	6,372	0	0	1,788	5,778	220	2,147
	30-Jul	4	0	0	3,965	23,459	0	0	3,340	11,193	114	996
	31-Jul	4	0	0	2,456	12,757	0	0	6,557	22,428	464	4,056
	1-Aug	3	0	0	1,321	6,746	0	0	3,819	14,429	114	1,038
	2-Aug	3	0	0	960	5,004	0	0	3,159	12,486	90	825
	3-Aug	5	0	0	1,046	5,463	0	0	2,544	9,440	55	527
	4-Aug	6	0	0	1,855	8,775	0	0	3,539	12,825	119	979
	5-Aug	6	0	0	1,232	6,245	1	9	2,246	7,768	107	960
	6-Aug	3	0	0	2,668	14,964	0	0	2,337	9,289	189	1,544
	7-Aug	4	0	0	2,844	13,640	1	9	2,273	8,416	71	684
	8-Aug	3	0	0	389	1,905	0	0	243	944	6	59
	9-Aug	3	0	0	1,277	6,527	3	24	650	2,601	15	131
	11-Aug	6	0	0	4,575	23,408	0	0	2,500	9,712	113	966
	12-Aug	7	0	0	4,750	24,037	4	41	1,827	6,903	202	1,865
	13-Aug	2	0	0	1,388	7,420	0	0	507	1,948	7	79
	14-Aug	3	0	0	803	4,464	8	69	1,382	5,277	16	156
	15-Aug	3	0	0	524	2,843	0	0	456	1,676	3	15
	16-Aug	1	0	0	402	2,174	0	0	574	2,080	0	0
	20-Aug	4	0	0	3,411	17,819	24	236	1,788	7,164	22	182
	21-Aug	3	0	0	968	5,037	5	48	1,015	4,070	16	157
	22-Aug	4	0	0	1,535	7,982	24	226	1,293	5,350	13	101
	23-Aug	4	0	0	920	4,608	27	293	932	3,731	7	57
	24-Aug	4	0	0	856	5,084	200	2,020	1,651	8,309	11	109
	25-Aug	2	0	0	243	1,326	9	94	173	637	0	0
	26-Aug	1	0	0	156	805	28	283	454	1,721	0	0
	3-Sep	1	0	0	1,185	5,925	11	107	1,106	3,319	0	0
	Total	170	1	6	59,733	311,261	345	3,459	70,883	256,429	12,885	124,949
	Avg. Wt.			6.0		5.2		10.0		3.6		9.7

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Stat.			CHINOOK		SOCKEYE		COHO		PINK		CHUM	
Area	Date	Landings	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds
259-35	9-Jun	4	16	110	913	4,569	0	0	0	0	14	113
Settler	10-Jun	3	0	0	754	3,938	0	0	0	0	1	8
Cove	12-Jun	1	0	0	629	3,765	0	0	0	0	0	0
THA	13-Jun	1	0	0	119	711	0	0	0	0	0	0
	17-Jun	1	0	0	66	395	0	0	0	0	0	0
	18-Jun	1	0	0	269	1,346	0	0	0	0	0	0
	19-Jun	1	0	0	379	3,088	0	0	0	0	0	0
	21-Jun	1	0	0	294	1,471	0	0	0	0	0	0
	22-Jun	1	0	0	171	859	0	0	0	0	0	0
	24-Jun	1	0	0	88	485	0	0	0	0	0	0
	25-Jun	1	0	0	40	211	0	0	0	0	0	0
	Total	16	16	110	3,722	20,838	0	0	0	0	15	121
	Avg. Wt.			6.9		5.6		0.0		0.0		8.1

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