Exxon Valdez Oil Spill
Restoration Project Annual Report

Sockeye Salmon Stocking Solf Lake

Restoration Project 00256B
Annual Report

This annual report has been prepared for peer review as part of the Exxon Valdez Oil Spill Trustee Council restoration program for the purpose of assessing project progress. Peer review comments have not been addressed in the annual report.

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Study History: Subsistence resources and services were injured throughout Prince William Sound as a result of the *Exxon Valdez* Oil Spill. This project is the continuing investigation and enhancement of lost subsistence opportunities through the stocking of sockeye salmon (*Oncorhynchus nerka*) in Solf Lake, Herring Bay, in Prince William Sound (PWS). Solf Lake has been recognized as a site for establishing a self-sustaining sockeye salmon population since the 1960's. The lake now provides an excellent opportunity to establish a replacement fishery to benefit subsistence users in western Prince William Sound

Habitat improvements were made in 1978, 1980 and 1981 to provide access to the lake for anadromous fish. The lake was never stocked and subsequent investigations suggest that it was fishless, but had adequate habitat to support a sockeye salmon population. There are two phases to this project: Phase 1, which began in FY96, verified the ability of Solf Lake to support a sustainable population of sockeye salmon. Phase 2 began in 1998 and included stocking the lake with approximately 100,000 sockeye salmon fry annually over a five year period, and ensuring access to Solf Lake for returning adult sockeye salmon by 2001.

Abstract: During the 2000 field season Forest Service personnel completed construction on the fishway in the eastern outlet of Solf Lake. Personnel from the Main Bay Hatchery successfully collected eggs from Coghill brood stock and reared them at their Main Bay facility. This resulted in the release of 116,500 fry into Solf Lake in the spring of 2000. The Alaska Department of Fish and Game reports that the 2000 stocking levels did not significantly influence the abundance or total biomass of the macrozooplankton population at Solf Lake. It is therefore recommended to continue stocking at the 100,000 fry level. Smolt outmigration was not monitored in 2000 and a hydroacoustic survey of the lake by the Alaska Department of Fish and Game did not observe any sockeye fry in Solf Lake, again possibly suggesting that the fry stocked in 2000 emigrated as age-0 smolt.

Key Words: *Exxon Valdez,* fishways, Limnology, Prince William Sound, sockeye salmon (*Oncorhynchus nerka*), Solf Lake, stocking.

Project Data: *Description of data* - There are three primary sets of digital data developed for this project: (1) The feasibility phase of the study included examination of zooplankton and algal biomass, temperature and light profiles, dissolved oxygen and water chemistry. (2) Modified Hankin and Reeves (1988) stream survey information that incorporates the geophysical and hydrological characteristics of the stream into distinct habitat units. (3) An inventory of fish and macro-invertebrate populations. *Format* - Data sets are in Excel spreadsheets and Word Perfect formats. *Custodian* - Contact Cliff Fox at the Glacier Ranger District Office, USDA Forest Service, POB. 129 Girdwood, Alaska 99587. PH. (907) 783-3242, Fax (907) 783-2094, E-mail: cfox02@fs.fed.us. *Availability* - copies of data sets are available upon written request.

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EXECUTIVE SUMMARY

Subsistence resources and services were injured throughout Prince William Sound because of the *Exxon Valdez* Oil Spill. This project continues to improve subsistence opportunities through the stocking of sockeye salmon (*Oncorhynchus nerka*) and stream improvements to allow adult salmon passage into Solf Lake, Herring Bay in Prince William Sound (PWS). Solf Lake has been recognized as a site for establishing a self-sustaining sockeye salmon population since the 1960's. The lake now provides an excellent opportunity to establish a replacement fishery to benefit subsistence users in western Prince William Sound.

This 1996 project began as a feasibility assessment. In Fiscal Year 1996 (FY96) the Trustee Council-funded project 96256 which was a combined proposal to assess the feasibility of establishing a stocking program at both Columbia and Solf Lakes. Interim reports and a recommendation on the feasibility of these two lakes for stocking were provided to the Trustee Council in the fall of 1996. It was determined that Solf Lake could support stocking levels of as many as 400,000 fry based on the available zooplankton. In April 1995, the proposal for this project was presented to the Prince William Sound Copper River Regional Fisheries Planning Team (RPT) for approval. The Forest Service discussed brood stock source/mixed stock issues and stocking levels with the RPT in 1997 at which time they approved the project but recommended stocking at a lower level. The RPT's recommendation was to stock 100,000 fry to achieve the goal of 10,000 adult fish returning to Solf Lake.

Solf Lake has two outlets. The western outlet historically provided anadromous fish access to the lake until an earthquake uplifted it and created an impassable barrier. At the same time a new outlet on the eastern side of the lake was created, but was blocked by debris from a landslide due to the earthquake. For many years, Dolly Varden (Salvelinus malma) was the only recorded species of fish in Solf Lake and it was determined that neither outlet was passable for anadromous salmon. In 1978, the Forest Service removed the barriers from the east channel and created a dam at the western outlet to provide adequate stream flows to the eastern channel, which was intended to provide access for sockeye salmon to the lake. Additional improvements to the eastern outlet and dam were made in 1980 and 1981, but the system was never stocked with salmon. The old structures at the two outlets of the lake were evaluated in 1997. It was determined that the structures at both outlets required extensive reconstruction. A new diversion weir was completed at the western outlet in 1998 and a design for the fishway in the eastern outlet was completed in August of 1999 and approved by the Forest Service Regional Engineers. Forest Service Crews in 2000 successfully installed the fishway, consisting of two Alaska steep passes each with concrete headwalls and supports; three intermittent weirs; and a 60-foot long bedrock trench.

Additionally the third stocking of 116,500 Coghill sockeye salmon fry was successfully completed in the spring of 2000. Forest Service biologist reviewed the macrozooplankton results for 2000, which did not differ significantly from the pre-stocking densities, and determined that current stocking levels are still supported at Solf Lake. A hydroacoustic survey of the lake conducted shortly after stocking along with fyke net sampling in the fall did not observe any sockeye fry in Solf Lake. It is possible that fry were missed during the hydroacoustic survey and emigrated as age-0 smolt prior to the fyke netting.

INTRODUCTION

Subsistence use of resources in the *Exxon Valdez* oil spill area declined following the spill. Although restoration studies have shown that harvest levels have since returned to pre-spill levels in most oil spill communities, Chenega Bay and Tatitlek are exceptions (Seitz and Fall, 1995; Seitz and Miraglia, 1995). These communities showed reduced harvest levels in 1993/94 and an increased reliance on salmon harvests (Seitz and Fall, 1995; Seitz and Miraglia, 1995). Solf Lake provides an opportunity to establish a large replacement fishery that is easily accessible, approximately 40 miles from Chenega Bay (Figure 1).

Solf Lake is located off Herring Bay on Knight Island. The lake is approximately 40 miles by boat from Chenega Bay and 46 miles from Whittier. The lake is unnamed on USGS maps; however, Nickerson (1978), PWSRPT (1983), Barto and Nelson (1982) all refer to the lake as Solf Lake (ADF&G Stream 690). The lake is described in the Anadromous Waters Catalog as number 226-10-16900-0010 (ADF&G, 1992).

Solf Lake is a clear water lake with a mean depth of 42.5 m and a surface area of approximately 0.61 km^2 (Barto and Nelson, 1982). Based on historical limnological data from the 1980's; stream survey information collected in 1996; and analysis of current limnological data; it is reasonable to expect that the lake is capable of supporting a sustainable sockeye population with an adult return of approximately 10,000 fish. Establishing this fishery would directly benefit subsistence users in western Prince William Sound.

Solf Lake has long been recognized as an opportunity to reestablish a sockeye salmon run in Prince William Sound. According to Nickerson (1978), "This system had historic runs of sockeye salmon. An earthquake in the 1930's caused blockages of the natural outlet resulting in water flowing over an impassable fall." Starting in the early 1970's, various attempts have been made to reestablish sockeye salmon in Solf Lake. For two years in this same period, ADF&G personnel transported adult sockeye salmon from Eshamy River to Solf Lake. Unfortunately, necessary stream improvements had not been completed when the offspring from the transplanted fish returned. In 1978, 1980 and 1981, the USFS implemented improvements to the outlet streams. The work consisted of improving the eastern outlet and partially damming the western outlet. The diversion weir was designed to raise the level of the lake to provide adequate water flow for fish passage at the eastern outlet. The improved eastern outlet channel is less than 100 m in length, with an average gradient of 23 percent (Figure 2). Stocking of the lake never occurred after the improvements due to higher priority projects for both the USFS and ADF&G.

ADF&G surveyed Solf Lake in 1985/1986 as part of a lake investigation study. The results of this survey, which included attempts to capture fish, suggest that the lake may be fishless (Pellissier and Somerville, 1987). However 1996 minnow trapping by USFS crews indicated a larger population of Dolly Varden than has been previously observed, but still not significant. These results are also supported by the composition and biomass of the zooplankton populations, which were sampled in 1986. The Pellissier and Somerville (1987) survey also documented that water was flowing through the western outlet due to an incomplete seal by the diversion weir. Three minor barriers to fish passage were identified in the eastern channel. The report also suggested that if all the water passing under the dam at the western outlet was stopped these barriers might disappear.

ADF&G recommends stocking based on their zooplankton studies and added that the instability of the macrozooplankton community in barren lakes when faced with predation necessitates stocking programs based on a conservative approach. Close evaluation and experimenting with stocking strategies will ameliorate significant impacts to the macrozooplankton community. Major reasons for the disparity of response to stocking barren lakes include; inherent low productivity of these lakes; macrozooplankton abundance, composition, and ability to adapt to predation; stocking density; lake morphology and variability in the indirect effects of predation in individual lakes. Based on limnological information the stocking levels at Solf Lake could be as high as 400,000 fry. While Solf Lake is most likely capable of supporting stocking at this level, it was decided to take a more conservative approach to stocking.

Based on the available spawning area, it was estimated that Solf Lake could sustain a run of approximately 10,000 sockeye salmon. An escapement goal of approximately 4,500 fish would be required to fully seed the system without depleting the zooplankton populations, leaving 5,500 sockeye available for harvest. Consequently, we recommended stocking at the 100,000 fry level to meet the objective of the stated desired return, with the assumption that there will be a high fry to adult survival during the stocking phase of the project.

The eastern outlet, to the lake required reconstruction of the "irrigation type" control dam; this work was completed in 1997. An engineered survey of the western outlet and suitable dam design was also completed in 1997, and in 1998 installation of the new diversion weir at the western outlet was completed. In 1999 Forest Service Engineers surveyed the eastern outlet and designed a fishway that that would provide sockeye salmon passage into Solf Lake, the Regional Office approved the design in January of 2000.

OBJECTIVES

Phase 1. Feasibility phase. The four objectives to this phase are:

1. Determine if Solf Lake can sustain a population of sockeye salmon (completed).
2. Determine appropriate stocking levels (completed).
3. Coordinate with PWSAC and Main Bay Hatchery to establish an appropriate brood stock and the necessary logistics to begin a stocking program (completed).
4. Evaluate existing habitat improvement structures to ensure adequate conditions for adult migration (completed).

Phase 2. Implementation phase. There are three objectives to this phase:

1. Design and construct necessary improvements to the outlet channel and dam to ensure adequate passage for adult salmon migration (completed).
2. Stock Solf Lake with sockeye salmon to produce a self-sustaining population that can provide an adequate subsistence harvest (ongoing).
3. Monitor zooplankton and smolt out-migration to ensure appropriate stocking levels (ongoing).

METHODS

In general, project 00256B involved the installation of a fishway at the eastern outlet, continuation of sockeye salmon stocking, limnological and water quality sampling.

Part 1. Types of improvements needed to provide access for returning salmon:

ADF&G personnel visited Solf Lake as part of a PWS lake investigation project in 1985 (Pellissier and Somerville, 1987). Three minor barriers to fish migration were identified in the outlet channel. These barriers were height and velocity barriers that ranged in size from 1.5 to 2.5 meters. The barriers may potentially be removed through the creation of plunge pools or by installing steep passes. The report also suggested that the barriers might not exist if more water were in the eastern outlet channel, which could be achieved by repairing the diversion weir at the western outlet.

The eastern outlet to the lake required reconstruction of the "irrigation type" control weir; this work was completed in 1997. During the 1998 field season Forest Service personnel completed the installation of the diversion weir at the lake's western outlet, EVOS Project 98256b.
The fishway in the eastern outlet was completed in the summer of 2000 and was designed to provide sockeye salmon passage into Solf Lake. The design called for two Alaska steep passes one 30 feet, another 40 feet in length, installed at a 22% slope. Each steep pass requires a concrete head wall and support piers. The upper pass spills into an excavated section of bedrock forming a watertight trench. Additionally, step pools will be created by the installation of intermittent notched concrete weirs, to further facilitate fish passage.

Part 2. Methods to implement a stocking program at Solf Lake:

Interagency Coordination (1997 to Present): Close coordination between the USFS, ADF&G, PWSAC and the PWS/CR RPT are mandatory for the success of this project. Prince William Sound is a complex ecosystem and the potential stocking of Solf Lake needs to be considered in perspective with the overall management of the Sound. Interagency coordination has occurred in 1996 through 2000 to identify appropriate brood stocks, determine appropriate stocking levels, meet hatchery-related requirements, and to address mixed-stock fisheries issues.

Stocking Program (1998 to 2002): Appropriate stocking levels and strategies will be determined in coordination with ADF&G, PWS/CR RPT and PWSAC using all available data. Sockeye fry will be short-term reared at the Main Bay Hatchery and transported to the lake for release. The Eyak and Coghill stocks are identified in the PWS/CR Phase 3 Comprehensive Salmon Plan (PWSRPT, 1993) as potential stocks for Solf Lake. Stocking began in 1998 and is planned to continue until the year 2002.

The success of the stocking program is being monitored through sampling of the fish population using hydroacoustic surveys and observing adult returns. Previous fry stocked at Solf Lake were marked with half-length coded wire tags; the fry released in 2000 were thermally marked with a specific otolith sequence. Returning adults will be enumerated at a weir on the eastern outlet stream, scales, tags and otolith will be collected along with sex ratio information for analysis.

Part 3. Collection methods of biological, physical and morphological information at Solf Lake:

Limnological Sampling (2000): Data collection and analysis included: Algal biomass (chlorophyll a), zooplankton populations (biomass, body-sizes, species composition etc.), temperature and light profiles, dissolved oxygen, and water quality (nutrients) to estimate the potential productivity of the lake. Procedures for the collection of these samples are detailed in Koenings et. al. (1987). Samples were collected from a minimum of two permanent collection sites every three to four weeks May - September to assess seasonal variation.

Sustainable Sockeye Returns: Future estimates of adult returns to Solf Lake are based on the available spawning area times a redd density of one redd per 6.7 m^2 and a fecundity of 2,000 eggs / gravid female, and a 1:1 sex ratio. Survival rates assume a 10% egg to fry survival, a 15% fry to smolt survival and a 15% smolt to adult return.

Smolt out-migration: Smolt counts were not conducted by ADF&G in 2000. The previous years hydroacoustic survey in the fall of 1999 indicated that no sockeye fry remained in Solf Lake. Therefore it was decided that a smolt weir would provide little if any information, as was the case in the previous years sampling.

RESULTS

With the exception of 1986 prior to stocking activity, *Diaptomus* have accounted for more than 50% of the total biomass followed by *Cyclops*, which generally comprises about 30 % of the total. The remainder of the total macrozooplankton (TMZ) consisted primarily of the cladoceran form *Bosmina* and very small numbers of *Daphnia*. The 2000 stocking level of 116,500, 0.42g sockeye fry did not appear to have a significant influence on (TMZ) and the abundance as indicated by an increase in *Diaptomus* density by 22% and a 4.5% increase in biomass. Results indicate *Bosmina* decline in density by 39% and in biomass by 45% from pre-stocking means. Similarly a decline in *Cyclops* by 57% and 63% respectively were also observed. All of the observations in 2000 fall within the range of pre-stocking observations and are therefore not considered to be significant see Figures 3 and 4.

On June 16 personnel from ADF&G conducted a hydroacoustic survey of Solf Lake; surveying several transects perpendicular to the longitudinal axis of the lake. There were essentially no targets (fish) recorded during the entire survey. In September Forest Service crewmembers fished a floating fyke net overnight near the inlet streams of the lake and captured 27 Dolly Varden but no sockeye. Additionally ADF&G collected water chemistry information monthly between June and September at one and 50 m depths in Solf Lake see Figure 5 for results.

Personnel from the Main Bay Hatchery successfully collected 121,000 green eggs from Coghill brood stock and reared them at their Main Bay facility. Overall, survival of green eggs to released fry was 96.3%. This resulted in the release of 116,500, 0.42 g fry into Solf Lake on June 15, 2000. Of the total number of fry released into Solf Lake all were marked with a thermal otolith mark sequence of 1:1.3,2.2.

The expected return from the release of the BY99 Coghill stock sockeye to Solf Lake is expected to be 4,400. Approximately 60% of these should return as four-year-olds in 2003. The remaining 40% may return as five-year-old in 2004.

Forest Service Engineers completed and approved a fishway design in January of 2000. The design provides sockeye salmon moderately difficult passage into Solf Lake during anticipated low flow periods of 10 cfs and at any tide stage. The design called for two Alaska steep passes, one 30 feet, the other 40 feet in length installed at a 22% slope. Each steep pass required a concrete head wall and support piers anchored into bedrock. The upper steep pass spills into an excavated section of bedrock that forms a 60-foot long watertight trench. Installation of three notched concrete weirs anchored into bedrock creates intermittent step pools; facilitating fish passage during periods of low stream flow, see figure 6.

Site preparation at Solf Lake began the week of May 9th with the removal of hazardous trees to allow sling loading; by helicopter of materials and equipment to the staging areas. The following week nearly 40 tons of materials were sling loaded off a landing craft anchored in Herring Bay to the project site. Construction began in earnest in June with the removal of overburden and laying out the fishway as designed. Drilling, blasting and mucking continued all month to bring the stream channel to grade for steep pass installation and forming of the trench. In July steep pass sections were assembled then headwalls and foundations for support piers constructed. The assembled steep passes were set in place, anchored and concrete work completed near the end of July. August work involved the backfilling of steep passes, intermittent weir construction, site preparation and project area cleanup. The construction of these weirs is 80% complete and will be finished in May of 2001 by Forest Service personnel.

DISCUSSION and CONCLUSIONS

Fishless lakes are susceptible to overgrazing by large numbers of obligate planktivores, i.e. sockeye fry, resulting in steep declines in macrozooplankton numbers and biomass. Diet selectivity studies for rearing sockeye fry have shown that fry presented with a wide choice of food items tend to select for cladoceran and large calanoid forms. Although sockeye fry do graze on *Cyclops*, it is not actively selected. Thus, in Solf Lake, we would expect the large, red pigmented, and therefore, highly visible *Diaptomus*, to be an indicator species of excessive grazing pressure and a guide to gauge stocking levels.

In April the Project Investigator reviewed the macrozooplankton results from 2000 and determined that current stocking levels are still supported at Solf Lake. There was no observed significant difference between macrozooplankton biomass and density from pre-stocking and post-stocking means.

The reason for the lack of fish targets during the hydroacoustic survey and fyke net sampling remains unknown. The hydroacoustic survey was conducted within a few days of stocking, during this time a barrier net was in place at the diversion weir to prevent any outmigration, and the eastern outlet was closed for construction purposes. Both ADF&G and Forest Service Crews observed several small groups of fry, usually numbering less than 50 swimming around the margins of the lake. However, no large groups, at least not enough to account for 116,500 fry

were seen exiting the lake or as mortalities. It is possible, that no fry were observed during the hydroacoustic survey due to the gregarious nature of recently stocked fry and the survey being conducted so shortly after the time of stocking. The survey may have missed a few large groups of fish not yet dispersed throughout the lake or fry aggregating very near the shoreline. Additionally, fyke netting in the fall may not have captured any sockeye fry because they may have emigrated as age-0 smolt, as has been proposed in previous reports. Starting in 2001 stocking procedures will include retention of sockeye fry in temporary holding pens near the lake's inlet streams for two weeks to allow time for fry to acclimate and for observation of possible mortalities.

Cook Inlet Aquaculture Association (CIAA) has documented age-0 sockeye salmon smolts emigrating from their lake stocking programs; from 1990-1995, estimates of age-0 smolt emigrating Chelatna Lake (Susitna River basin) have ranged from less than 1% to 62% of the total outmigration (Fandrei 1995), and in Bear Lake (Seward) age-0 smolt estimates for 1990-1994 have ranged from less than 1%, up to 98% in one year (Hetrick and Prochazka 1998). At this time it is uncertain what the effects of this early emigration will have on ocean survival and consequently the number of returning adults to Solf Lake.

This early outmigration is expected to discontinue as the available zooplankton is reduced and fry growth rates decrease and stabilize, however given the results from the macrozooplankton sampling this situation has not yet occurred. Increasing future stocking levels to decrease growth rates will have to be discussed with ADF&G and the RPT if returning adult in 2001 indicate low ocean survival rates.

In 2000 the Regional Forest Service Engineer and the Trustee Council approved the final design for the fishway to be installed in the spring of the same year. The constructed fishway varied only slightly from the approved design in location and orientation of the steep passes and concrete headwalls. Construction specifications detailed in the final design were adhered to the greatest extent possible. Excavation of the 60-foot trench through bedrock went extremely well, primarily due to the expertise of the Forest Service Blasters and construction crew. Because the integrity of the bedrock was maintained during trench construction and a watertight seal created, a concrete liner was not required. Time did not allow for an as-built survey but will be planned for in 2001 and should be available for inclusion in the final report.

Both the diversion weir at the western outlet and the control structure on the eastern outlet have been successfully completed and are working properly. During the 2000 field season both structures were inspected for serviceability. After a full 3 years of exposure to the rigorous weather of Prince William Sound the structures remain operational showing little sign of wear.

LITERATURE CITED

ADF&G.1992.An atlas to the catalog of waters important for spawning, rearing or migration of anadromous fishes, Southcentral Region, Resource Management Region II. Alaska Dept. of Fish & Game. Anchorage.

Barto, D.L. and V.L. Nelson. 1982. Field data summary for Copper River and Prince William Sound lake investigations, 1982. Prince William Sound Aqua. Corp. Cordova. 268 pp.

Blanchet, D. 1983. Chugach National Forest Environmental Atlas. USDA Forest Service, Alaska Region. Report number 124.

Fandrei, G. 1995. Chelatna Lake sockeye salmon progress report 1995. Cook Inlet Aquaculture Association, Kenai.

Hankin, D.G and G.H. Reeves. 1988. Estimating total fish abundance and total habitat area in small streams based on visual estimation methods. Can. J. Fish. Aquat. Sci., Vol. 45: 834-844.

Hetrick, J., and T. Prochazka. 1998. Bear Lake sockeye and coho enhancement progress report 1996. Cook Inlet Aquaculture Association, Kenai.

Koenings, J.P.; J.A. Edmundson; G.B. Kyle and J.M. Edmundson. 1987. Limnology field and laboratory manual: Methods for assessing aquatic production. Alaska Dept. of Fish & Game. FRED Division Report number 71. 212 pp.

Nickerson, R. 1978. Identification of fish hatcheries, aquiculture sites, habitat & species enhancement projects in Prince William Sound. Alaska Dept. of Fish and Game. Cordova.

Pellissier, R.F. and M.A. Somerville. 1987. Field data summary for Copper River and Prince William Sound lake investigations, 1985. ADF&G contract no. 85-0159. 149p

PWS/CR RPT. 1994. Prince William Sound -- Copper River phase 3 comprehensive salmon plan. Prince William Sound – Copper River Regional Planning Team. Cordova.

Seitz, J. and J.A. Fall. 1995. Tatitlek. In: Fall, J.A and C.J. Utermohle, (eds). An investigation of the sociocultural consequences of outer Continental Shelf development in Alaska; II. Prince William Sound. MMS 95-011; Technical Report No. 160.

Seitz, J. and R. Miraglia. 1995. Chenega Bay. In: Fall, J.A and C.J. Utermohle, (eds). An investigation of the sociocultural consequences of outer Continental Shelf development in Alaska; II. Prince William Sound. MMS 95-011; Technical Report No. 160.

Todd, G. L. 1994. A lightweight, inclined plane trap for sampling salmon smolts in rivers. Alaska Fishery Research Bulletin 1(2): 168-175.

Figure 1. Location Map.

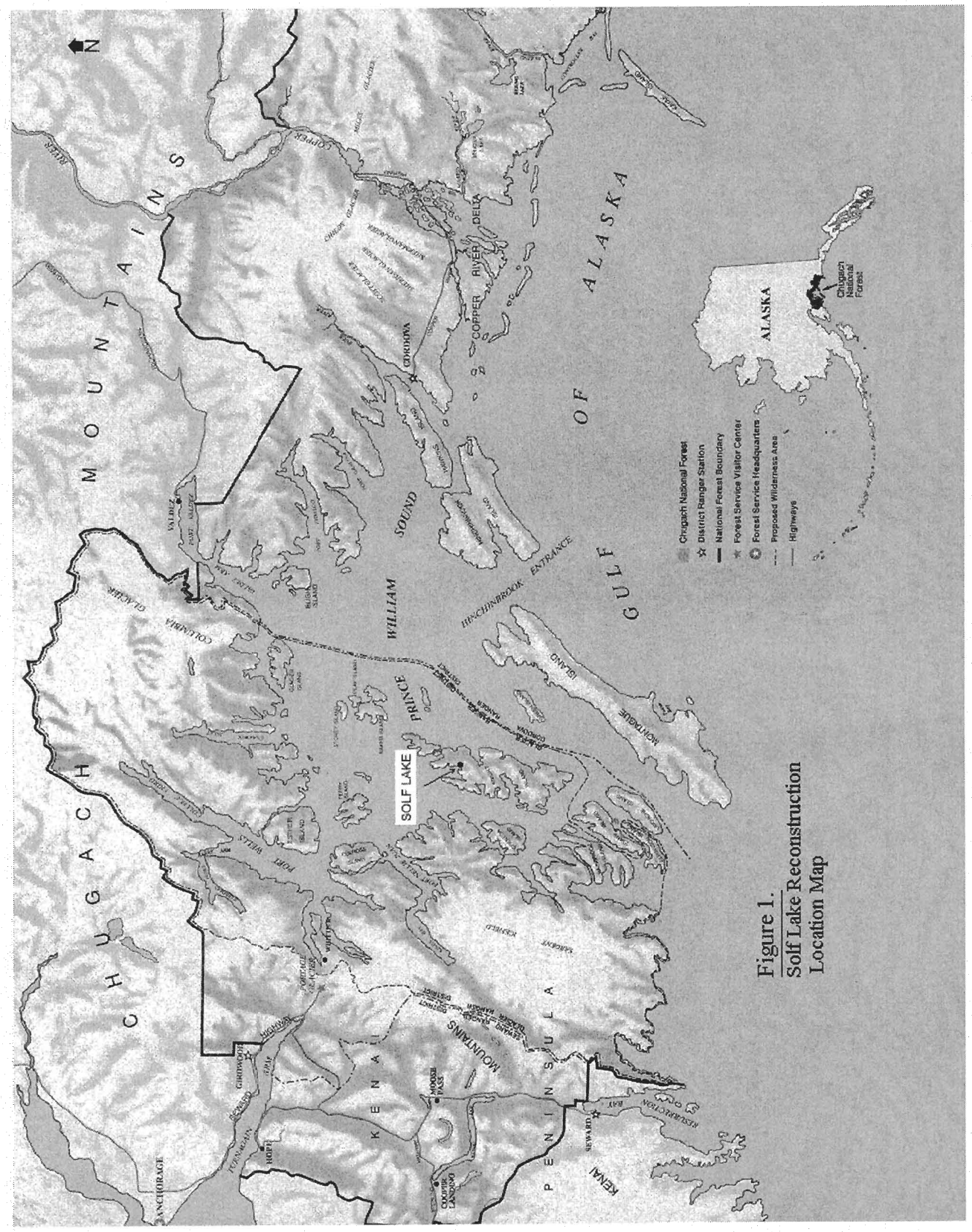

Figure 1.
Solf Lake Reconstruction
Location Map

Figure 2. Site Plan

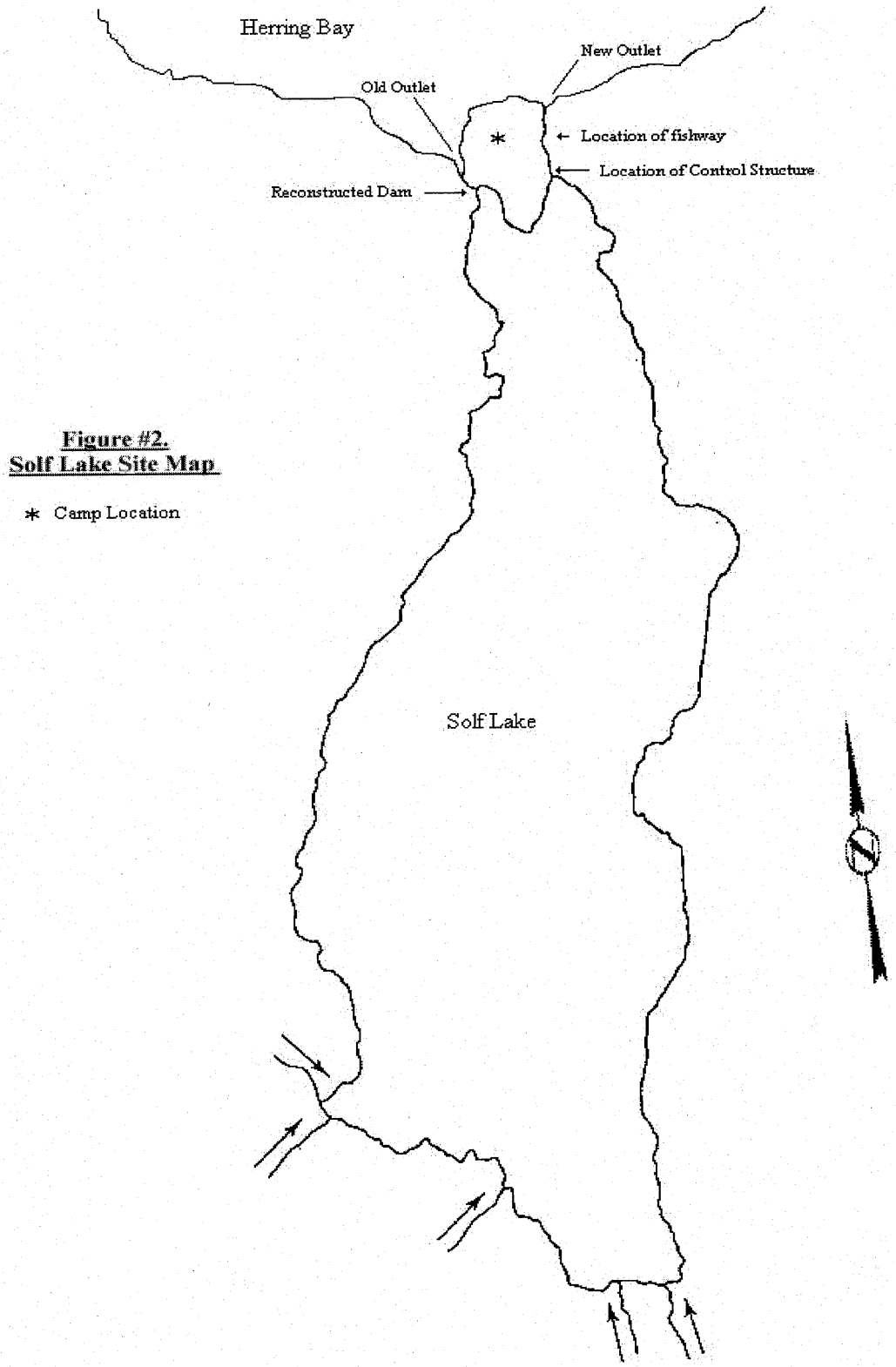

Figure 3. Macrozooplankton Composition by Density (no/m^2).

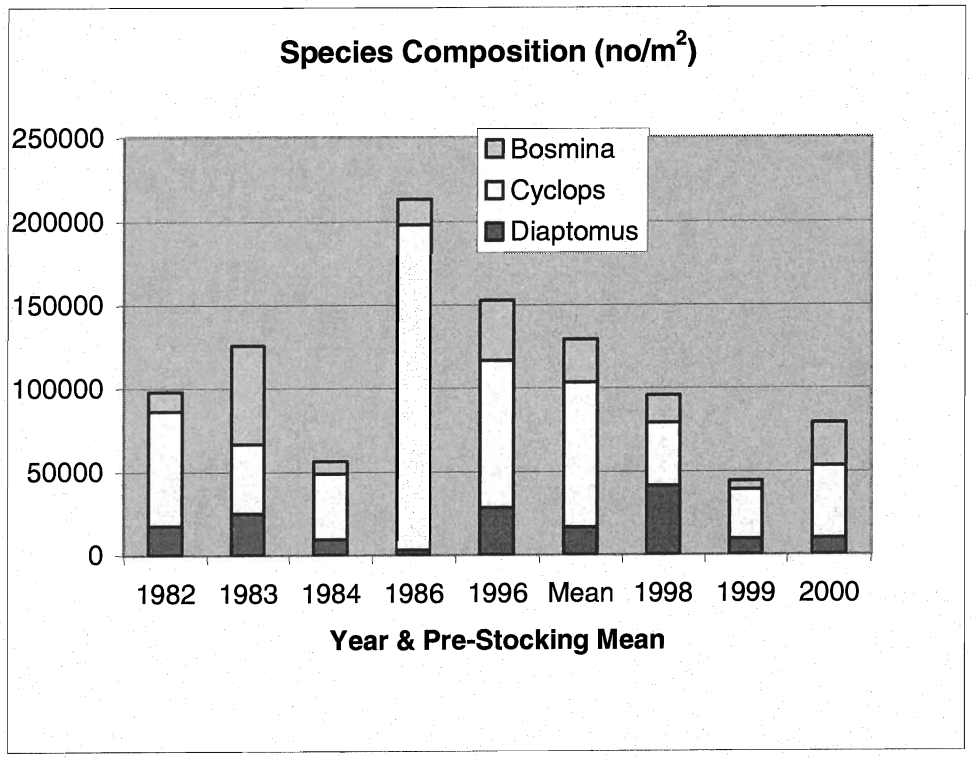

Figure 4. Macrozooplankton Biomass (mg/m^2).

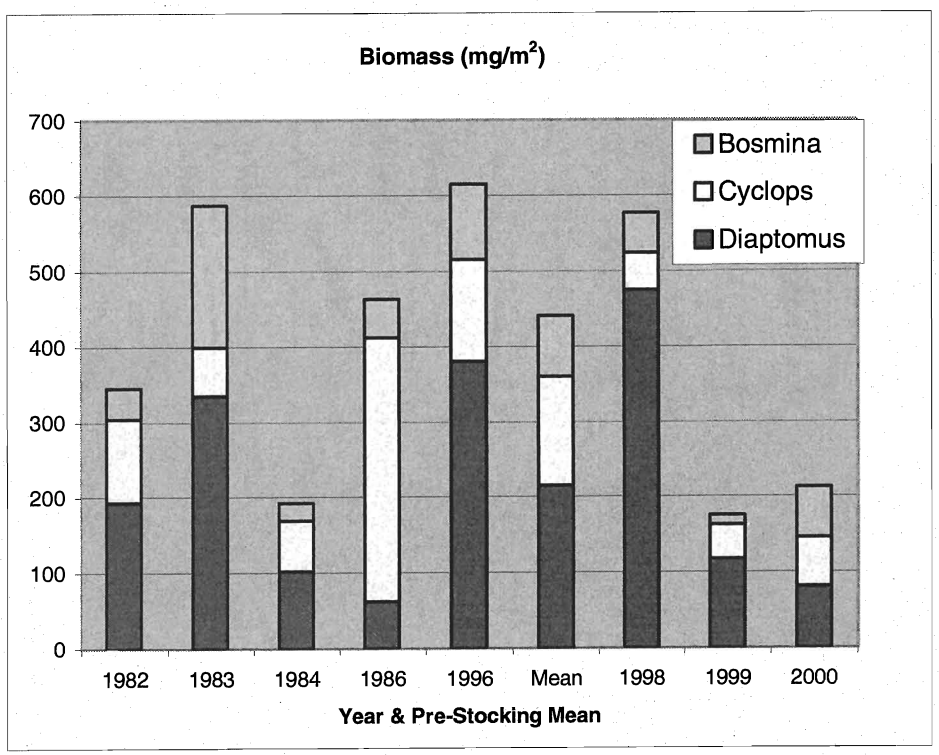

Figure 5. Water Chemistry Results Solf Lake.

Date	Depth	pH	Alkalinity (mg/l)	Turbidity (NTU)	Total-P (ug/L P)	Total filterable-P ((ug/L P)	Filterable reactive-P (ug/L P)	Total Kjeldahl nitrogen (ug/L N)	Ammonia (ug/L N)	Nitrate+ nitrite (ug/L N)	Reactive silicon (ug/L Si)	Organic Carbon (ug/L)	Chlorophyll a (ug/L)	Phaeophytin a (ug/L)
6/16/00	1	5.6	1.5	0.3	1.8	1.1	0.7	30.8	14.3	22.4	811	50	0.09	0.07
6/16/00	50	5.6	1.9	0.3	1.8	1.1	0.8	30.8	12.4	30.9	885	33	0.06	0.12
7/20/00	1	5.7	3.2	0.9	2.1	1.1	0.7	32.1	9.0	17.6	760	77	0.15	0.06
7/20/00	50	5.6	3.2	0.5	1.7	4.5	3.6	32.1	14.3	26.8	890	64	0.10	0.14
8/18/00	1	5.5	1.2	0.3	1.7	4.3	2.7	33.4	11.3	3.2	757	55	0.19	0.08
8/18/00	50	5.4	1.5	0.2	1.5	0.9	0.6	33.4	9.7	34.8	868	27	0.09	0.13
9/30/00	1	5.3	1.0	0.5	1.7	1.0	0.7	41.2	10.6	11.3	848	51	0.64	0.28
9/30/00	50	5.5	1.3	1.3	2.0	0.9	0.6	30.8	12.1	32.3	910	7	1.18	1.13

Figure 6. Plan View Solf Fishway.