

FRI-UW-8309  
June 1983

Fisheries Research Institute  
School of Fisheries  
University of Washington  
Seattle, Washington 98195

A DATA FILE FOR BRISTOL BAY SOCKEYE SALMON LAKES

by

D. E. Rogers, P. H. Poe, F. J. Hardy,  
T. C. Kline, and C. C. Swanson

ANNUAL REPORT

November 1, 1982 to June 30, 1983  
Final Report due July 1, 1983  
Bristol Bay Data File  
Imarpik Regional Aquaculture Corporation

Approved

Submitted June 14, 1983

  
Director

## TABLE OF CONTENTS

	Page
LIST OF TABLES . . . . .	iv
LIST OF FIGURES . . . . .	v
INTRODUCTION . . . . .	1
FRI STUDIES IN BRISTOL BAY . . . . .	4
DESCRIPTION OF DATA FILE . . . . .	6
Structure . . . . .	6
Operational Procedures . . . . .	6
Tape Format . . . . .	6
The DATALIB Data Management System . . . . .	7
Adding Data to the System . . . . .	8
DESCRIPTION OF LAKES . . . . .	10
Physical, Chemical, and Productivity Measurements . . . . .	10
Sampling Areas . . . . .	10
DESCRIPTION AND METHODOLOGY RELATED TO DATA INPUTS . . . . .	10
Environmental Factors . . . . .	10
Precipitation and Air Temperature . . . . .	11
Light . . . . .	11
Water Temperature . . . . .	12
Water Transparency . . . . .	13
Lake Level . . . . .	13
River Discharge . . . . .	13
Ice Breakup . . . . .	14
Primary Production . . . . .	14
<sup>14</sup> C Assimilation Rates . . . . .	14
Limnetic Chlorophyll <u>a</u> . . . . .	15
Littoral Chlorophyll <u>a</u> in Periphyton . . . . .	17
Limnetic Net Phytoplankton . . . . .	18
Secondary Production . . . . .	20
Wood River Zooplankton . . . . .	20
Kvichak Zooplankton . . . . .	21
Emergent Insects . . . . .	23

	Page
Juvenile Salmon . . . . .	24
Wood River Beach Seine . . . . .	24
Kvichak Beach Seine . . . . .	25
Townet . . . . .	26
Length-weight . . . . .	28
Adult Salmon . . . . .	29
Wood River Adult Escapement and Return . . . . .	29
Kvichak Spawning Ground Surveys . . . . .	29
BIBLIOGRAPHY . . . . .	33
EPILOGUE . . . . .	34
REFERENCES . . . . .	35
APPENDICES . . . . .	64

LIST OF TABLES

Number		Page
1	Name and contents of Wood River/Kvichak data files . . . . .	43
2	Physical measurements of lakes in the Igushik and Snake systems . . . . .	45
3	Physical measurements of lakes in the Tikchik system . . . . .	46
4	Physical measurements of lakes in the Wood River system . . . . .	47
5	Physical measurements of lakes in the Kvichak system . . . . .	48
6	Primary productivity, water transparency, and chemical characteristics of sockeye salmon lakes of the Nushagak and Kvichak systems, 1961-1962 . . . . .	49
Appendix A	Tables - Name and contents, terminology, and formats of Wood River/Kvichak data files . . . . .	64
Appendix B	Tables - Explanatory code lists related to Wood River/Kvichak data files . . . . .	107
Appendix C	- DATALIB . . . . .	116
Appendix D	- Ancillary Programs . . . . .	170
Appendix E	- Bibliography of FRI Bristol Bay studies . . . . .	179

## LIST OF FIGURES

Number		Page
1	Bristol Bay sockeye salmon river systems and fishing districts . . . . .	51
2	Map of the Wood River lake system, show- ing sampling areas (A, B, C) . . . . .	52
3	Beach seine stations and lake sampling areas in Lake Aleknagik . . . . .	53
4	Sampling stations on Little Togiak Lake . . . . .	54
5	Location of spawning areas surveyed in the Wood River lakes . . . . .	55
6	Location of limnology stations used in the 1960's - Tikchik lake system . . . . .	56
7	Location of limnology stations used in the 1960's - Igushik and Nunavaugaluk lake systems . . . . .	57
8	Numerical designations of lake sections and areas, Lake Clark and Iliamna Lake . . . . .	58
9	Location of standardized limnology sta- tions, Lake Clark and Iliamna Lake . . . . .	59
10	Location of standardized townetting transects, Iliamna Lake and Lake Clark . . . . .	60
11	Location of standardized periphyton stations and beach seine stations, Iliamna Lake . . . . .	61
12	Stream spawning areas of Iliamna Lake . . . . .	62
13	Known beach spawning areas of Iliamna Lake and spawning areas of Lake Clark . . . . .	63

## ABSTRACT

This report documents the structure, contents, and operational procedures of a computerized data file of biological and environmental data pertaining primarily to the freshwater phase of the life cycle of sockeye salmon in Bristol Bay. The emphasis is on pertinent biological and environmental information compiled by Fisheries Research Institute (FRI) in the Nushagak and Kvichak districts. The rationale and methodology related to the data inputs and areas of study are discussed. A bibliography pertaining to FRI's Wood River and Kvichak projects is discussed.

Key words: Bristol Bay, sockeye salmon, FRI freshwater studies, computerized data file, structure and formats, data inputs, rationale and methodology, references and bibliography.

## ACKNOWLEDGMENTS

The biological data contained in this report span up to 60 years and have been generated from a variety of sources. A great number of biologists and support staff employed by the Fisheries Research Institute (FRI), the State of Alaska, and federal agencies participated in collecting field data or performing data analysis in addition to the local population's contribution of observations and information. Data entry and keypunching of a very large number of cards was efficiently done by the staff of the Fisheries Analysis Center. Special appreciation is extended to colleague Mr. P. B. Roger who performed much of the work in defining the structure, organizing, and compiling the Kvichak data files.

This report was assembled under a contract with the Imarpik Regional Aquaculture Association. Over the years the Bristol Bay salmon industry has made substantial contributions of additional funds for FRI salmon programs which it had been supporting, and provided funds for equipment, camp, and lab facilities for the Wood River and Kvichak projects. This continuous support base has made possible a larger and more detailed program of research which has produced a very valuable long-term data base.

The industry funding of FRI research was supplemented significantly since the late 1950s by funds from Bureau of Commercial Fisheries (more recently, National Marine Fisheries Service). Cooperation and funding have also been provided by Alaska Department of Fish and Game.

## A DATA FILE FOR BRISTOL BAY SOCKEYE SALMON LAKES

### INTRODUCTION

Salmon runs to Bristol Bay are among the largest on the North American continent and produce the vast majority of sockeye salmon in western Alaska. The individual stocks of sockeye salmon that make up the Bristol Bay run belong to ten major river systems that comprise five commercial fishing districts: three single river systems - the Togiak, Ugashik, and Egegik; the four-river Nushagak district; and the three-river Naknek-Kvichak district (Figure 1). The salmon run to the Kvichak River system, the largest, differs from other Bristol Bay river systems in having highly cyclic changes in abundance and predominates in the catches in peak cycle years. In some peak cycle years, more than 60 million adult sockeye salmon have been recorded returning to Bristol Bay, while in other non-peak cycle years, runs have amounted to less than 5 million fish.

Commercial harvest of Bristol Bay sockeye salmon began in 1883. During the historical period, after the initial buildup of the fishery, catches peaked in all districts in the 1920s and 1930s and then declined during the 1940s and 1950s to a low point in the early 1970s. Since 1978, catches in non-peak cycle years have been the largest in the history of the fishery.

Management of the Bristol Bay gill net fishery has existed since 1889. Early management by the Bureau of Commercial Fisheries (BCF) consisted of the preseasonal establishment of fishing districts, fishing

time, and gear, with only very minimal knowledge of run size. A different approach came in 1924 with the enactment of the White Act, whereby escapement targets were set at 50 percent of total run size. This established preservation of an escapement as the essential element of conservation and management. Concomitant with Alaska statehood in 1959, regulation of Bristol Bay salmon runs was transferred from BCF in Washington, D. C., to the Alaska Department of Fish and Game (ADF&G). The principal goal of management became that of securing an adequate escapement.

During the historical period up through 1945, information on catch and effort in the fishing districts was well-documented by the fishing companies and management agents and wardens of the BCF, while information on the true size of escapements to the different river systems was limited to a few years of weir counts and generally incomplete indexing of spawner abundances on the spawning grounds. During this time period, scales and measurements of length were taken regularly from the catches in some districts and at times from fish in the escapement to assess the biological characteristics of the run.

During the postwar years, extensive data pertaining to the life history of Bristol Bay sockeye salmon were collected mainly through the efforts of the Fisheries Research Institute of the University of Washington (FRI), BCF, and ADF&G. This information was used to establish the life history and biological requirements of sockeye salmon in Bristol Bay, and has been translated into guidelines for management in regard to regulating catch and escapement by area and time.

With voluminous data of this type generated every year, some sort of filing system was needed for timely retrieval and updating of information. A Bristol Bay Data File was assembled in 1972 by FRI (1), updated in 1977 (2), and transferred from the University of Washington to the University of Alaska under the supervision of ADF&G. This data file, which dealt primarily with offshore and inshore test fishing indices, catch and effort data from the inshore fishery, and trunk stream escapement information, has greatly aided management in the daily decision process of whether or not to harvest, and, if so, in which districts.

Over the course of Bristol Bay salmon investigations, considerable data pertaining to the capacity of both the spawning grounds and nursery areas of sockeye salmon in the different Bristol Bay rivers and lake systems have also been accumulated. This report describes a computerized data file of biological and environmental data compiled by FRI pertaining primarily to the freshwater phase of the life cycle of sockeye salmon in the Nushagak and Kvichak districts. Included is a short history of FRI's involvement in Bristol Bay, a description of the structure and operational procedures of the data files, information on the lakes, a discussion of the purpose and methodology related to data inputs and areas of study, and a bibliography of FRI publications, theses, circulars, annual and final reports, and unpublished reports pertaining to Bristol Bay studies. The primary purpose of this data file is to make available relevant data in an accurate and systematic manner that can be easily accessed, interpreted, and updated. A primary application of

this data file will be to provide data that can be used in the formulation of escapement goals in the Nushagak and Kvichak systems.

In the future, additional data from studies in the Wood River and Kvichak River systems together with data from other Bristol Bay sockeye salmon rivers and lake systems can be incorporated into the freshwater data file. Also, one can envision a third file that would contain all biological and environmental information pertaining to the saltwater phase of the sockeye salmon's life.

#### FRI STUDIES IN BRISTOL BAY

FRI was founded in 1947 to study the salmon fisheries in Alaska. Sockeye salmon research programs in the Kvichak and Nushagak systems were initiated in 1946, and until 1955, studies were supported almost entirely by the Bristol Bay salmon industry through the Association of Pacific Fisheries. During the years 1946-1954, we concentrated in collecting quantitative and qualitative data on the adult sockeye salmon returns. In the mid-1950s, with additional funding from BCF, studies were expanded to include enumeration of the escapements and smolt indexing programs to assess the relative abundance, age, and size of smolts. In 1961, the sampling of both the smolts and returning adults was assumed by ADF&G, and we initiated studies directed toward determining the factors limiting freshwater production. Programs were initiated to study juvenile sockeye salmon in nursery lakes and to determine the extent of available and utilized spawning areas.

Since 1961, we have maintained a program of studies to monitor the ecological conditions and changes that have taken place in the spawning and nursery areas of the Wood River and Kvichak systems. The primary purposes of our research have been to determine the mechanisms that regulate the abundance of the numerous populations of sockeye salmon which constitute the Nushagak and Kvichak stocks. Although conditions during the oceanic life of the salmon seem to explain some of the long-term variation in their abundance, they do not explain the considerable annual variation in the abundances of individual populations nor the differences in populations and stocks within each district. We believe that the source of this variation is in the freshwater phase of the salmon's life. For example, favorable environmental conditions during the period between emergence of juvenile salmon from the gravel and movement into the littoral zone of lakes and the subsequent commencement of feeding may be critical to early survival.

Recent FRI Bristol Bay projects include post-monitoring of the lake fertilization study of Little Togiak Lake in the Wood River system, and studies of the sockeye salmon run of the Newhalen River-Lake Clark system, an important component of the Kvichak River system. These studies are presently supplementing those maintained by ADF&G, and have been supported by the Bristol Bay salmon industry through the Pacific Seafood Processors Association, the Alaska Department of Fish and Game, the National Marine Fisheries Service, Dames and Moore through the Alaska Power Authority, and the Alaska Independent Fishermen's Marketing Association.

## DESCRIPTION OF DATA FILE

### Structure

The Wood River/Kvichak Freshwater Data File is stored on computer magnetic tape. Management of the numerous files on tape is accomplished with the CYBER computer (CDC) utility called DATALIB. The user manual is included in this report as Appendix C. The names and contents of the files are listed in Table 1, and the formats for the Wood River files and Kvichak River files are described in Appendix A. Explanatory code lists are contained in Appendix B. A number of ancillary computer programs that are unique to producing some of the Kvichak files are contained in Appendix D. The input data are mixed in the sense that they are in part derived from original field data and in part from summary or processed blocks of data.

### Operational Procedures

#### Tape Format

The Wood River/Kvichak Data Files are stored on magnetic tapes. All of the files were copied on to a single tape, and multiple copies of the tape were made for backup. The tapes were written using a CDC Cyber 173/750 computer under the NOS operating system, and have the following characteristics:

9-track

1600 bpi

ANSI-standard labels

NOS internal format.

The tapes are currently stored at the University of Washington Academic Computer Center tape library.

Each of the files named in Table 1 comprises one separate file on the tape, with no internal file marks. The files were written in standard BCD or card image form, where "card images" are not limited to 80 columns. The formats of the files are described in Appendix A.

#### The DATALIB Data Management System

The DATALIB data management system was chosen for maintaining and accessing the Wood River/Kvichak data for three main reasons: (1) it was designed to keep track of the size, location and format of data files, and the tapes or disk packs on which these files are stored; (2) it has an "access" feature which can selectively retrieve subsets of data from files, or sort files, or copy entire tape files to and from the system disk; and (3) unlike other database management systems currently available on the University of Washington's CDC computer system, DATALIB does not transform the data into any special internal format.

The DATALIB user manual is contained in Appendix C of this report. This manual explains the DATALIB functions, how to build a directory, how to run DATALIB, error messages, sample sessions (including retrievals), and general comments and information.

The DATALIB directory is the key to accessing the data files. The directory for the Kvichak/Wood River Data Files is stored as file 1 of each copy of the data tape. It is also stored on disk when appropriate.

Given the name of a file one wishes to access (see Table 1), one need only invoke DATALIB with the directory present to copy the entire file from tape to disk (a "GETFILE") or selectively retrieve card images from the file according to certain criteria (an "ACCESS"). Note that you do not need to know the file position on tape of the file you want (DATALIB gets this information from the directory).

The directory contains a format name and description for each of the data files. Within each format, there are field names for each of the fields that would be used for making selective retrievals (e.g. "STATION" for col. 1 and "YEAR" for col. 3-4 of KWEATHR). Therefore, a current listing of the directory will be very helpful to those using the "ACCESS" (selective retrieval) feature of DATALIB. The directory is a card-image and can simply be listed at a printer.

#### Adding Data to the System

Data to be added to the system can be of two types: (1) additional data to be added to an existing file, or (2) a new data type, to be assigned a new file name.

In order to add data to an existing file, it becomes necessary to know the file's position on the tape. This information is contained in the directory (always maintained as file 1 on the tape, if not already on disk). The person maintaining the system must get the existing file from tape, copy the new data on to it and remove any internal file marks, and then copy it back to the same position on the tape (this implies re-copying all the files which come after it). These will be

standard "copy-binary-file" operations. Don't forget to update all copies of the tape. The directory need not be changed unless you wish to update some of the "optional" information such as file size in sectors, date last modified, etc. If the directory is changed, see comments below about replacing it on tape.

When adding a whole new file to the system, the system manager can simply copy it on to the end of each tape. In addition, the directory must be updated using the "DEDIT" function of DATALIB. Information about the file itself (its name, position on the tape, project, size, etc.), the format of the file, and field descriptions of fields that will be used for selective retrievals will all be entered. Then the directory should be copied back into file position 1 of the tape(s), which implies re-copying all subsequent files.

## DESCRIPTION OF LAKES

### Physical, Chemical, and Productivity Measurements

The position, length, width, and area of lakes in the Nushagak and Kvichak system were determined from U.S. Geological Survey maps or from the U.S. Army Corps of Engineers (3). Data on the physical measurements are summarized in Tables 2-5 (4-8). Data on chemical and productivity measurements are summarized in Table 6 (6). Additional information on the physical, chemical, and productivity characteristics of lakes in the Nushagak and Kvichak systems can be found in several references (4-11).

### Sampling Areas

Each lake was divided into sampling areas which are shown on maps, along with the location of limnological stations, spawning areas and beach seine stations (Figures 2-13). Entries in the data file conform to these standardized sampling areas.

## DESCRIPTION AND METHODOLOGY RELATED TO DATA INPUTS

### Environmental Factors

Changes in the freshwater production of sockeye salmon lakes are linked to changes in environmental conditions. Monitoring of the character of the environment is needed to help explain the variations we see in the abundances of individual salmon populations in the Wood River and Kvichak systems.

### Precipitation and Air Temperature

Climatological data summarized from monthly reports of the United States Department of Commerce, National Oceanic and Atmospheric Administration, Environmental Data and Information Service (EDIS), are reported for Dillingham, Alaska. Monthly mean air temperature values ( $^{\circ}\text{C}$ ) for January to December from 1919 until 1982 and monthly total precipitation (inches) for January to December from 1919 until 1982 are included in the data file.

Daily measurements were made of maximum and minimum air temperature ( $^{\circ}\text{F}$ ) and daily precipitation (inches) at Porcupine Island, Iliamna Lake, when researchers were present. Daily weather data from EDIS for King Salmon, Iliamna, Lake Clark, and Intricate Bay from 1959-1973 are included and data for recent years will be added later.

### Light

Records of incident solar radiation are an indicator of general environmental conditions, and can provide information on conditions during the critical spring period when salmon fry emerge from the gravel and move into the littoral areas of nursery lakes. Incident solar radiation influences the timing of the breakup of lake ice and the subsequent spring bloom of phytoplankton. Annual variations in thermal conditions in lakes reflect the effect of each summer seasons' solar radiation, and hence, changes in solar radiation are related to changes in lake productivity and temperature.

Incident solar radiation was measured daily at Mosquito Point, Aleknagik, from 1962 to 1982, and at Porcupine Island or Iliamna, Iliamna Lake, with an 8-day Belfort Pyrheliometer. Daily incident solar radiation expressed as  $\text{g cal}\cdot\text{cm}^{-1}$  was calculated from the charts by measuring the area under the lines with a planimeter or by counting the number of squares on the gridded recording paper.

### Water Temperature

Lake water temperature strongly affects the hatching and subsequent growth and survival of juvenile sockeye salmon, as well as the standing crop and production rates of primary and secondary producers.

Bathythermograph casts have been made to determine the thermal conditions in Iliamna Lake and Lake Clark in the Kvichak system. Vertical casts have been made from the surface to 135 m or to the bottom at stations less than 135 m. Water temperatures by depth were determined with a precision of  $\pm 0.1^{\circ}\text{C}$ . The data file includes water temperature data from 0-100 m by lake station or area for 1961-1966 and 1970-1982 for Iliamna Lake with annual measurements for areas of Lake Clark in some years. In the Wood River lakes, temperature profiles were taken with a bathythermograph until 1976, and with a T4 marine thermometer from 1977 to 1982. Water temperatures from 0-60 m by area from 1962-1982 are reported for Lake Aleknagik, with additional seasonal information for Little Togiak Lake, and annual measurements for Nerka, Beverly, and Kulik lakes.

### Water Transparency

Secchi disk depth readings have been made at limnology stations in Iliamna Lake and Lake Clark in the Kvichak system and in the different lake systems of the Nushagak system to determine the relative depth of light penetration. Data for the Kvichak system for 1961-1982 are in the data file and data for the Wood River system will be added later.

### Lake Level

Measurements of lake level reflect amounts of precipitation or watershed runoff which can affect all ages of sockeye salmon in the freshwater environment, e.g., feeding juveniles in the spring and adult spawners in the fall.

The relative lake level was measured daily in Lake Nerka from June through September (0 = mean annual low water which occurs in April), and reported by 5-day periods from 1952 until 1982. In Iliamna Lake, the relative lake level referenced to a value of annual low water was measured daily whenever personnel were present at the Porcupine Island research station from 1961 until 1982.

### River Discharge

River discharge rates provide year-long information on levels of and fluctuations in watershed runoff which affects the physical, chemical, and biological environment of juvenile and adult sockeye salmon populations. Daily discharge data from the U.S. Geological Survey's water stage elevation gauging stations on the Newhalen and Kvichak

Rivers are included in the data file. The period of record for the Newhalen River is 1952-1967 and 1982. The gauging station on the Kvichak River was installed in 1967 and the period of record is from 1967 until 1982. Nuyakuk River (1953-69) and Wood River (1958-69) data will be added later. The Wood River discharges are correlated with the Lake Nerka lake levels (12).

### Ice Breakup

Information on the timing of the spring breakup of lake ice in Bristol Bay lakes provides an environmental yardstick for evaluating seasonal trends in primary and secondary production, and growth of juvenile sockeye salmon. Data on the relative timing and progression of the breakup of Iliamna Lake ice from 1961 until 1982 are included in the data file. Annual dates of breakup for Lake Aleknagik (1949-1982) will be added later (12).

### Primary Production

#### <sup>14</sup>C Assimilation Rates

The rate of carbon fixation ( $\text{mgC}\cdot\text{m}^{-3}\cdot\text{4h}^{-1}$  and  $\text{mgC}\cdot\text{m}^{-2}\cdot\text{4h}^{-1}$ ) was determined in Iliamna Lake and Lake Aleknagik by the in situ light - and dark-bottle <sup>14</sup>C technique (Method I of Steeman-Nielsen (13)) between June 20 and mid-September over the years 1962-1970. This provided a measure of the natural level of annual and seasonal productivity (14-16). Carbon fixation determinations were also made in other lakes of the Nushagak system and Lake Clark, mostly in 1961 and 1962. Some of

these data are summarized in Table 6 (6). Only data for Iliamna Lake from 1961-1969 are presently in the data file, but the Lake Aleknagik data will be added.

#### Limnetic Chlorophyll a

The food chain leading from inorganic nutrients to production of juvenile salmon is complicated by many factors. Studies at the primary trophic level are necessary to understand how changes in escapement level affect the food base and hence the survival rate and growth of juvenile salmon. One hypothesis has been that the biogenic elements released by decomposed adult carcasses enrich the productivity of the nursery lakes and thereby enhance the survival rate of juvenile salmon proportional to the size of the escapement. In both the Kvichak River and Wood River systems chlorophyll a concentrations have shown an increasing trend with recent increased escapements of sockeye salmon (11, and 17-19).

Water samples for filtration to determine chlorophyll concentrations were routinely taken at each station, from individual depths. During 1961 and 1962 composite samples (made up of a percentage of water from each depth according to the percentage of the water column represented by the depth) were filtered. A sample size of 1 liter was used in all lakes in 1961, and increased to 2 liters in 1962. Water samples were collected in plastic Van Dorn water sampling bottles and the appropriate subsamples stored in darkened polyethylene bottles until filtration. Two to three drops of magnesium carbonate suspension were added

to each sample prior to filtration through a HA Millipore filter (1.2 or .8 m, 47 mm diameter). Filtration was performed at 15 inches Hg vacuum immediately upon return to the field laboratory, usually within four hours after collection. The filters were placed in a dessicator for drying before being refrigerated for later analysis. Earlier samples were shipped to Seattle for analysis, whereas in later years (Wood River 1974-1982, Iliamna 1971-1982), extraction was usually performed in the field laboratories.

Pigments were extracted by placing the filters in 15-ml stoppered centrifuge tubes to which 5 ml of 90 percent acetone was added. The tubes were refrigerated in the darkness for 18-24 hours before centrifuging, then absorbances were measured on a Bausch and Lomb spectronic 20 spectrophotometer with a 1 cm path length. Calculations of chlorophyll a followed the procedure of Parsons and Strickland (20).

Chlorophyll a was measured in the early 1960s in Lakes Aleknagik, Nerka, Beverley, and Kulik. In the Wood River lakes, investigators used composite samples from several depths in the early 1960s. Data before 1967 are not included in this file for the Wood River lakes because the water samples were combined. Most values included represent natural levels of chlorophyll; however, fertilization experiments were conducted in Lake Aleknagik (Stations 3 and 4, 1970 and 1971), Lake Nerka (Stations 1 and 2, 1971 and 1972), and Little Togiak Lake (Stations 1 or 5, 1974 through 1978). The Wood River data file includes measurement of chlorophyll a ( $\text{mg}\cdot\text{m}^{-3}$ ) from 1967 to 1982 for depths 0-45 m.

The concentration of chlorophyll a in Iliamna Lake (Stations 19, 107, 143, and to a much lesser extent, 149) have been measured since 1961. The Iliamna stations were initially chosen to represent distinct physical regions in the lake. Measurements included represent natural levels of chlorophyll and were made throughout the summer in most years to determine seasonal variations of biomass. The Iliamna data file includes measurements of chlorophyll a concentrations ( $\text{mg}\cdot\text{m}^{-3}$ ) at 1, 2, 3, 4, 5, 7, 10, 15 and 25 m depths at Station 19 and two additional depths, 35 and 45 m, at Stations 107, 143, and 149, 1961-1982. Additional chlorophyll a data are included for limited sampling in Lake Clark over the same time period. Data from Iliamna Lake chlorophyll a variability studies in 1970 are also included in the data file (17).

The effects of the 1976 volcanic ash fall on primary productivity in Iliamna Lake were studied from 1976-1978 (11 and 21). Chlorophyll a data from these studies are also in the file and include some measurements of winter chlorophyll concentrations.

#### Littoral Chlorophyll a in Periphyton

In addition to primary production in the water column, algal growth (periphyton) occurs on the bottom in shallow water where light penetration is sufficient. While in the littoral, juvenile salmon feed primarily on insect larvae which may depend on periphyton and detritus for their food.

Periphyton on the island beaches of Iliamna Lake consists of a green and brown algal growth on the rocks from the edge of the water to

a depth of about two feet. Diatoms comprise most of the periphyton, but filamentous algae becomes abundant during late summer. Periphyton growth was studied by placing trays of clean glass slides (50 x 75 mm) under 30 cm of water at selected littoral stations on island beaches (22). The trays were moved up and down to maintain a 30 cm depth because of the changes in lake level. Slides were periodically removed during the field season from each station and the colonized growth of periphyton was scraped off with a razor blade into a small bowl containing approximately 50 ml of water. This concentrate was filtered through an HA Millipore filter (1.2 m, 47 mm diameter) and analyzed for chlorophyll a content. The chlorophyll pigment was extracted by dissolving the filter in 90% acetone and the chlorophyll a content was determined by the procedure of Parsons and Strickland (20).

A correlation has been found between periphyton production and the abundance of spawner carcasses on Iliamna Lake Island beaches (7, 11, and 22). Data on the amounts of chlorophyll a ( $\text{mg}\cdot\text{m}^{-2}$ ) in periphyton colonized on glass slides at five stations in the vicinity of Porcupine Island since 1972 are included in the data file.

#### Limnetic Net Phytoplankton

Since 1965, the relative abundance, cell volume, and composition of selected larger phytoplankton species were determined in Iliamna Lake from vertical hauls with a No. 20 mesh size (73  $\mu$ m aperture), 1/2 m closing net at Stations 19, 107, 143 and 149 in June, July, August and September at irregular time intervals. Some additional samples were

taken under the ice in March 1976 and in February, May, and October 1977. Vertical hauls were made at 10 m intervals from 100 m to the surface at Stations 107, 143, and 149 from 20 m to the surface at Station 19 from 1965-1975, except for 1969 when hauls were made at 10 m intervals from 50 m to the surface at Stations 107 and 143 and at 10 m intervals from 130 m to the surface at Station 149. Beginning in 1976, changes in depth strata were made. Vertical hauls were made from 10-0, 30-0, 60-30, 100-60, and 130-100 m. Some limited sampling has also been conducted in Lake Clark, mostly in recent years beginning in 1979. All samples were preserved in 4% formalin prior to analysis.

Counting procedures differed over the course of the study period (11, 17, 23 and 24). All net phytoplankton data from sampling in Iliamna Lake and Lake Clark from 1965 until 1982 are in the data file. All data have been standardized to adjust for differences in counting procedures (11).

The species composition, abundance, and vertical distribution of phytoplankton in the summer of 1968 and results of Iliamna Lake net phytoplankton studies 1965-1978 have been reported (23 and 11).

Phytoplankton composition and relative abundance were determined in Little Togiak Lake and in Lake Aleknagik in 1976 and 1977 to investigate the effects of inorganic fertilization (18). These data are not included in this report.

### Secondary Production

The general purpose of zooplankton sampling in Bristol Bay sockeye salmon producing lakes is to obtain an estimate of planktonic crustacean relative abundance and distribution which may be related to the abundance, distribution, and growth of juvenile sockeye salmon and sticklebacks. Also to be determined are seasonal differences of forms and abundance, spatial differences in or between lakes, and diel vertical movement.

#### Wood River Zooplankton

Zooplankton samples were taken monthly during the summer in Lake Aleknagik from 1967 to 1982, and weekly in Little Togiak lake from 1973 to 1982. The other lakes were sampled once a summer from 1967 to 1982. Vertical hauls were taken from 60 m to the surface at Stations 1 to 5, and from 20 m to the surface at Station 6, Lake Aleknagik. Twenty meter hauls were made at the two stations in the shallow end of Little Togiak Lake, from 45 m at Station 3, and from 60 m at the remaining 3 stations.

A 1/2 m No. 6 mesh (223 micron) plankton net was used which allowed the small nauplii and most of the rotifers to escape, but retained most of the larger organisms. Each plankton sample was poured into a graduated cylinder and settled volumes were measured after 1/2 hour. Counts were made by species or lowest practical category on 1 ml subsamples taken with a Hensen-Stempel pipette after samples were diluted to a known volume and thoroughly mixed. Two or three subsamples were counted from each sample and the number of organisms per sample was calculated

by averaging the subsample counts and then multiplying by the diluted volume. From these data, the numbers of zooplankton per square meter of lake surface were calculated. Data are reported from 1967 to 1982 in  $100's \cdot m^{-2}$ . The response of zooplankton to inorganic fertilization of Little Togiak Lake has been reported (25).

#### Kvichak Zooplankton

Secondary production studies in Iliamna Lake and Lake Clark have sought to determine the point at which the zooplankton production becomes a limiting factor in the production of juvenile sockeye salmon. Studies of the limnetic zooplankton community of Iliamna Lake and Lake Clark were initiated in 1961, and since 1963, zooplankton samples have been taken at 22-30 stations throughout Iliamna Lake and in some years at 1 to 4 stations in Lake Clark. From 1961 until 1969, Iliamna Lake sampling consisted of three zooplankton sampling rounds during the field season; the first round went from late June to early July; the second round was conducted from late July to early August; and the third round ran from late August to early September. From 1970 through 1972, only two rounds were made; one each in the first and third periods. From 1973 until 1982, usually only one complete sampling round was made, but additional zooplankton sampling was usually done several other times during the season at the primary production or chlorophyll stations.

All of the samples were collected with a nylon No. 6 mesh (aperture 223 microns), conical plankton net with mouth opening of 1/2 m diameter. The hauls were made vertically at a velocity of about .625 m/sec. A

flowmeter was attached to the net ring and positioned in the center of the opening. At the surface the net was thoroughly rinsed and the sample concentrated in the collecting bucket. Two hauls were usually made at each station.

After collection the samples were immediately preserved in a 4% formaldehyde solution. Usually the samples were counted for species composition and abundance within 6 months of collection and were then stored. Each sample was diluted from 25 to 250 ml, according to the density of zooplankton, mixed well, and 1 ml subsample removed. The subsample was placed in a gridded plexiglass tray under a 20 X dissecting microscope and counted. Two and three subsamples were counted from each sample. From these data a computer program FRR 347 (26) computed the densities of zooplankters per cubic meter and numbers per square meter of lake surface area for each haul and these data are presented in the data file.

Subsequently some of the zooplankton samples were dried and weighed to provide a measure of zooplankton relative biomass to compare with estimates of numerical abundance (27). Zooplankton dry weight data for the period 1961-1973 are in the present data file and dry weight and settled volume data for 1974-1982 are to be added. Additional life history and population studies have been made on the zooplankton community of Iliamna Lake (28, 29, 30, and 31), but these special data sets are not included in the present data file.

### Emergent Insects

Emergent insects were collected in the Wood River system by simple submerged funnel traps similar to those described by Sublette and Dendy (32). Each trap was made with a cone of polyethylene film, the wide base of which was weighted down and held open by a 78 cm diameter steel hoop. The upper end of the cone held a 1 pint Mason jar which was half-filled with water, and insects entering the jar through a screened funnel were trapped on the air-water interface. The 1 m high traps were tied to anchored floats, held about 1 m off the bottom in water 3-4 m deep.

The traps were checked daily during periods of peak emergence and every other day at other times. Traps were cleaned frequently to avoid a shading effect by periphyton and insect growth. Water surface temperatures were also taken at each station every time the traps were checked.

The insects, which were primarily chironomids, were counted by family and life stage (i.e., larva, pupa, adult). The data are recorded in this file as average daily catch of chironomid adults plus pupae for 5 day periods for 5 stations in Little Togiak Lake, 1973-1982, and 3 stations in Lake Aleknagik, 1969-1982. Insects were not collected in the Kvichak system.

Juvenile SalmonWood River Beach Seine

The primary objective in beach seine sampling of the Wood River lakes has been to obtain annual estimates of fish length and relative abundance in early summer. The annual relative abundance and growth of fish species associated with juvenile sockeye salmon were estimated to determine what effect, if any, they have on survival and growth of juvenile sockeye salmon. The relationship between relative abundance of sockeye salmon fry and the abundance of returning adult sockeye salmon is also being investigated.

Beach seine hauls were made in Lake Aleknagik at 24 stations in 1962. In 1963, nine stations were sampled, and from 1964 to 1982, ten stations were sampled at five weekly intervals from late June to early August. Little Togiak Lake was also sampled from 1973-1982 at 7 stations.

The seine used was 35 m in length and had a midsection of 6 mm mesh, 7.6 m long and 3.7 m deep. A 1.8 m bridle and a 17 m hauling rope were attached to each end of the net. The seine was set in a semicircle about 15 m from shore and hauled by hand. Catches consisting of less than 500 fish were preserved in 10% formalin. Larger catches were successively divided in half until approximately between 200 and 500 fish remained. Between 1 and 7 days after collection, the fish were enumerated and measured to the nearest millimeter from tip of snout to end of middle ray of the tail. Only 50 sockeye salmon fry were measured

in samples containing more than 75 sockeye salmon fry, and only 200 threespine sticklebacks were measured in samples containing more than 250 of this species.

#### Kvichak Beach Seine

Since 1964, beach seining has been conducted in Iliamna Lake to 1) determine the early size and growth of juvenile sockeye salmon and sticklebacks, 2) ascertain the relationships of the relative population densities of juvenile salmon and sticklebacks, and 3) monitor the timing of the movement of juvenile salmon from the littoral to the pelagic zone of Iliamna Lake. Some 10 to 20 stations were sampled in a lake-wide sampling program during the mid- to late-1960s, which included stations near major spawning areas where sockeye salmon fry were likely to be found and exposed to interspecific competition. However, since that time, sampling has become limited to several monitoring stations located in the eastern portion of Iliamna Lake.

Sampling has been done with a small-mesh beach seine 2.44 m deep by 43.28 m long with a 12.19 m bag of 6 mm mesh, number 16 knotless nylon. Measurements of length and weight have been mostly made of live, or anaesthetized fish; however, in some years, samples were preserved in 10 percent formalin for later measurement. Correlation of preserved length and weight were made (33). Details of length-weight measurements are described in FRI Circular No. 143 (34). Both raw and processed Iliamna Lake beach seine catch and length data are included in the data file.

### Townet

Since 1962, the Fisheries Research Institute has conducted townetting programs to determine the relative abundance, distribution, and growth of juvenile sockeye salmon in the Wood River and Kvichak systems. These studies provide an early indication of the success of spawning of each brood year and contribute to the understanding of interactions between biotic and abiotic factors affecting juvenile salmon production. The movement of age 0 sockeye salmon from the littoral to pelagic areas of the lakes is usually not complete until after August 1; thus tows were conducted in August and September.

The tow net used to sample the relative abundances of juvenile sockeye salmon and associated fish in the pelagic area of the Wood River lakes and in Iliamna and Lake Clark was developed by Dr. R. L. Burgner in 1961. The opening of the net was 2.7 square m and the entire net was 8.2 m long. The forward section of the net was made of 38.1 mm mesh, was 2.7 m in length and tapered to a hoop of stainless steel, and the rear section was made of 6.4 mm mesh, was 3.1 m in length and contained a 3.2 mm mesh liner in the cod end. Spreader bars of 6.4 mm pipe held the mouth open vertically while two boats towed the net to hold the mouth open horizontally.

In the Wood River lakes, the net was towed during darkness between two boats 5 m in length powered by 40 hp outboards, and towed for 5 minutes at 3 knots. Each 5 minute (or adjusted to 5 minutes) tow strained about 3,439 cubic m of water (35), and usually 12 tows were made each night. The catches were processed in the same manner as fish

caught in the beach seine. Data from townet catches in the Wood River lakes are on file from 1958 to 1982.

Kvichak townetting programs have differed over the course of the study period in respect to: 1) the location of transects, 2) the distribution of coverage, and 3) the number of tows. Iliamna Lake transects have generally been orthogonal to the long-axis of the lake, except in the eastern bays where transects have generally followed the long-axis of the lake. From 1962-1972, except in 1965, Iliamna Lake towing consisted of lake-wide coverage with a total of 90 to 100 tows made in lake sections 1-11. In 1965, no tows were made in lake section 2. From 1973-1977, coverage was complete for lake sections 4-11, with minimal, or sometimes no sampling in lake sections 1-3. From 1978 until 1982, Iliamna Lake townetting consisted of 20 tows or less in lake sections 7-9. In Lake Clark from 1962-1967, transects generally conformed to the long axis of the lake. In 1968, standardized townetting transects were established in Lake Clark and from 1968-1976 and 1979-1982, transects in Lake Clark were generally conducted orthogonal to the long axis of the lake. In every year Lake Clark was sampled, tows were made in all lake sections. From 1962-1967, an average of 17 tows, range 12-27, were made in Lake Clark, while from 1968-1976 and 1979-1982, an average of 23 tows, range 21 to 25, were made. In addition to the townetting in Iliamna Lake and Lake Clark, 1-3 tows were made in Six-Mile Lake in 1973 and 1979-1982.

In the Kvichak system, the net was towed during darkness between either two outboard-powered skiffs or between a power boat and an out-

board-powered skiff at a velocity of approximately 4.3 ft/sec. Standard deep (4.6-7.6 m) and shallow (0-3 m) 20 minute tows were made. A computer program FRK 317R was used to determine arithmetic and geometric mean catches of juvenile salmon and resident fish in Iliamna Lake and Lake Clark (36). Distribution, daily growth rates (in length), and weighted mean weight of juvenile sockeye salmon and age I threespine sticklebacks were also determined. Results of Kvichak townet sampling have been reported (37-47). Data from townet sampling in the Kvichak system are on file from 1962 to 1982. Both raw and processed townet data are included.

#### Length-weight

The length-weight relationships of juvenile sockeye salmon and sticklebacks were studied in conjunction with the beach seining and townetting programs conducted in the Wood River lakes and the Kvichak River system (33 and 34). These data were collected to compare the "well-being" of fish and suitability of their environment for growth. Fish were measured in a live-anaesthetized state and the fork length was recorded to the nearest millimeter. Fish were weighed individually to an accuracy of at least 50 mg (0.05 g) after blotting off surface moisture with an ordinary paper towel. The length-weight data collected in the Kvichak system from 1962 until 1982 are included in the data file.

## Adult Salmon

### Wood River Adult Escapement and Return

Escapements to the Wood River system spawning grounds and lakes were estimated from the enumerated escapement to the lake system with aerial and ground surveys of individual spawning grounds. The total escapement to the system was apportioned to the individual lakes according to the aerial survey estimates. Aerial estimates were used to estimate the number of spawners in the individual large rivers and lake beaches, ground counts were used to estimate the escapements in the individual small creeks. Age compositions of the escapements were determined from scales or otoliths collected from carcasses on the spawning grounds. Data are reported from 1946 to 1982. The runs (catch plus escapement in each year) and the returns (catch plus escapement by age according to brood year) to individual lakes and spawning grounds were calculated from the escapements and the ratios of run to escapement (by age) for the entire lake system.

### Kvichak Spawning Ground Surveys

Observations on the spawning grounds of the Kvichak system have provided information on the timing, distribution and relative abundance of returns to the major spawning units. The stream surveys conducted to monitor the relative magnitude of returns, together with systematic programs that provide age composition data for the major spawning units, provide a scientific basis for formulating escapement goals for component lake and river systems within the Kvichak River system. Continued observations are needed to follow the effects of the Bristol Bay commercial fishery on Kvichak sockeye salmon stocks.

Since 1955, FRI has conducted systematic aerial, and to a much lesser extent, ground, boat and scuba surveys of the more than 100 spawning areas utilized by sockeye salmon in the Kvichak system. The common procedure has been to conduct aerial surveys on calm, clear days between 1000 h and 1500 h whenever practicable. Optimal airspeed and altitude have ranged between 70 to 100 mph and 300 to 500 ft., respectively. Observers wearing polaroid glasses have made counts of live and dead salmon, usually in units of 100 and 1000.

Attempts were made to cover all major spawning areas at least once and sometimes two or three times during a season to assure observations during the peak of spawning, here defined as the time of the maximum abundance of spawners. In the cases where individual spawning areas were surveyed more than once during a season, the peak index values were selected by considering 1) the experience and consistency of the observer; it is statistically better to use only one observer over a number of years, 2) the quality of the survey; light, wind, and other visibility factors, 3) the extent and coverage of the survey, and 4) the timing of the survey. During those years when spawning areas were generally only surveyed once during the season, even though surveys of some areas were not timed to the peak abundance of spawners, the index values obtained were entered into the data file as peak index counts.

Entries in the data file represent yearly peak index values for individual Kvichak spawning areas and have not been standardized to adjust for differences between observers or timing according to spawner abundance curves (49, 50, and 51). In practice, this maximum observed

abundance has been used as an index to the numbers of spawners and is used for year-to-year comparisons. This index represents at best a measure of peak abundance or some unknown portion of the true population returning to a spawning area. Entries in the file cover the period 1920 until 1982, but for some years not all the data have been entered. There is a need to complete the peak index file and to expand the file to include all index counts, not just peak counts.

Peak index data from individual spawning areas have also been grouped by spawning area type and location to represent returns of spawners to geographical regions of the Kvichak system (52). However, data in this summarized form are presently not in the data file.

Except in the case of the Tazimina River (53), peak index counts of spawners to individual spawning areas, or geographical regions of the Kvichak system, have not been expanded to represent true estimates of escapement or return as conducted in the Nushagak system, some other areas of Alaska, British Columbia, and other areas of the Pacific Northwest (51, 54, and 55).

Relative escapement-return relationships and trends in relative production for different spawning area types and major geographical areas were procured through the sampling of a selected few Kvichak spawning areas for age and size composition. Age composition was determined from scales and length data prior to 1962, and from otolith readings from 1962 until 1982. Size composition was determined by measuring fish of each sex from mid-eye to hypural plate on the spawning

grounds and from mid-eye to tail-fork when sampled from catches of resident subsistence fisheries.

Ages were determined prior to any comparison with corresponding length data. Repeated otolith readings were made whenever age-length relationships were questionable. For examination, the otoliths from each fish were placed in a depression on a black plastic card and covered with a drop of water. Freshwater and marine ages were determined through a binocular dissecting scope under reflected light. Annuli were determined in accordance with the technique described by Kim and Roberson (56).

Both raw and processed age and size composition data from the Kvichak spawning ground sampling are included in the data file for the period 1962 until 1982. The age and length data collected from 1947-1961 need to be added.

## BIBLIOGRAPHY

A bibliography of references dealing with FRI's Bristol Bay studies is included in this report as Appendix E. Publications, theses, circulars, annual and final reports, and unpublished reports are arranged by year and by project (Wood River/Kvichak). This bibliography is not exhaustive in that it does not include 1) references to considerable material contained in the abstracts of the annual "Research in Fisheries," annual report of the School of Fisheries, University of Washington, 1958-1982, 2) references to information contained in quarterly or progress reports to the U.S. Department of Commerce, NOAA, National Marine Fisheries Service, 1955-1982, and 3) some references to FRI studies in Bristol Bay rivers and lake systems outside of the Nushagak and Kvichak.

In the future, a cross-referencing annotated bibliography organized by specific categories should be prepared to make available all information from FRI's studies in Bristol Bay.

## EPILOGUE

The management of Bristol Bay salmon resources for conservation and full utilization has been operative for nearly one hundred years. Assessments of the success of management programs to affectively manage the Bristol Bay sockeye salmon resource to accommodate biological, and socio-economic needs can only be rationally made through evaluating a long-term information base that includes knowledge of mechanisms operating to control abundance of sockeye salmon populations in the freshwater environment in the river and lake systems of Bristol Bay.

The creation and documentation of a computerized freshwater data file for the Nushagak and Kvichak river systems can be viewed as Phase I in the incorporation of knowledge concerning the freshwater phase of sockeye salmon in Bristol Bay lakes into the Bristol Bay Data File. The many people and agencies who have contributed in establishing the Bristol Bay Data File should be commended for contributing to sustaining the salmon resources of Bristol Bay and other areas of Alaska, which will continue to be of tremendous economic importance and social value to the different human user groups.

One can now hope that a commitment will be made to: 1) complete the data files for the Nushagak and Kvichak systems; 2) complete Phase I by incorporating freshwater data from other Bristol Bay lake systems; and 3) complete the synthesis of freshwater knowledge in a Phase II program whereby compiled information would be applied toward optimizing the Bristol Bay sockeye salmon resource to accommodate ever-changing biological, economic, and social needs.

## REFERENCES

1. Knudson, B., P. H. Poe, and O. A. Mathisen. 1972. A data file for the Bristol Bay sockeye salmon fishery. Univ. Washington, Fish. Res. Inst. Circ. 72-9. 42 pp.
2. Mundy, P. R. 1977. Bristol Bay data base, revision and update of 1972 data base. Special Rep. FRI-UW-7726-A & B.
3. U.S. Army Corps of Engineers. 1957. Harbors and rivers in southwestern Alaska. Report of the Chief of Engineers, Department of the Army, House Document 390, 84th Congress, 2nd session. 89 pp.
4. Anderson, J. W. 1969. Bathymetric measurements of Iliamna Lake and Lake Clark, Alaska. Univ. Washington, Fish. Res. Inst. Circ. 69-17. 40 pp.
5. Burgner, R. L., and W. L. Hartman. 1963. INPFC sockeye salmon data summary report. (SSR-F). Unpublished manuscript.
6. Burgner, R. L., C. J. DiCostanzo, R. J. Ellis, G. Y. Harry, Jr., W. L. Hartman, O. E. Kerns, Jr., O. A. Mathisen, and W. F. Royce. 1969. Biological studies and estimates of optimum escapements of sockeye salmon in the major river systems in southwestern Alaska. U.S. Fish Wildl. Serv., Fish. Bull. 68(2):405-469.
7. Donaldson, J.R. 1967. The phosphorous budget of Iliamna Lake, Alaska, as related to the cyclic abundance of sockeye salmon. Ph.D. Dissertation, Univ. Washington, Seattle. 141 pp.

8. Hartman, W. L., and R. L. Burgner. 1972. Limnology and fish ecology of sockeye salmon nursery lakes of the world. *J. Fish. Res. Bd. Can.* 29:699-715.
9. Donaldson, J. R. 1966. Hydromechanics of Iliamna Lake, Alaska, 1964 and 1965. *Univ. Washington, Fish. Res. Inst. Circ.* 66-10. 18 pp.
10. Mathisen, O. A. 1966. Some adaptations of sockeye salmon races to limnological features of Iliamna Lake, Alaska. *Verh. Intl. Ver. Limnol.* 16:1025-1035.
11. Poe, P. H. 1980. Effects of the 1976 volcanic ash fall on primary productivity in Iliamna Lake, Alaska, 1976-1978. M.S. Thesis, Univ. Washington, Seattle. 210 pp.
12. Rogers, D. E., D. H. Siler, and T. Croker. 1970. A summary of climatological observations and water temperatures in the Wood River lake system. *Univ. Washington, Fish. Res. Inst. Circ.* 70-10. 38 pp.
13. Steeman-Nielsen, E. 1952. The use of radioactive carbon ( $^{14}\text{C}$ ) for measuring organic production in the sea. *J. Cons.* 18:117-140.
14. Burgner, R. L. 1966. Food production in two lake chains in southwestern Alaska. *Verh. Intl. Ver. Limnol.* 16:1036-1043.
15. Baxter, R. A. 1968. Primary production in Iliamna Lake, Alaska, 1962-1967. M.S. Thesis, Univ. Washington, Seattle. 81 pp.

16. Burgner, R. L., and D. E. Rogers. 1972. Limnetic production in Lake Aleknagik, Alaska. Prelim. Rep. in IBP/UNESCO Sympos., Reading, England, September 12-18, 1972.
17. Low, L. L. 1972. Chlorophyll a, phytoplankton and primary production in Iliamna Lake, Alaska. M.S. Thesis, Univ. Washington, Seattle. 101 pp.
18. Hardy, F. J. 1979. Effects of inorganic fertilization of phytoplankton in Lake Togiak Lake, Alaska. M.S. Thesis, Univ. Washington, Seattle. 108 pp.
19. Rogers, D. E., B. J. Rogers, and F. J. Hardy. 1982. Effects of fertilization of Little Togiak Lake on the food supply and growth of sockeye salmon. Proc. North Pacific Aquaculture Symposium. Univ. of Alaska. Alaska Sea Grant Report 82-2.:125-142.
20. Parsons, T. R., and J. D. H. Strickland. 1963. Discussion of spectrophotometric determination of marine-plant pigments, with revised equations for ascertaining chlorophyll and carotenoids. J. Mar. Res. 21:155-163.
21. Stables, T. B., P. H. Poe, and O. A. Mathisen. 1980. The effect of volcanic ash on phytoplankton production. Univ. Washington, Fish. Res. Inst. Unpublished report.
22. Low, L. L., and G. W. Miller. 1971. Periphyton studies in Iliamna Lake, Alaska, 1968-1970. Univ. Washington, Fish. Res. Inst. Unpublished manuscript. 18 pp.

23. Miller, G. W. 1969. Species composition, abundance, and vertical distribution of phytoplankton in Iliamna Lake in the summer of 1968. Univ. Washington, Fish. Res. Inst. Circ. 69-9. 26 pp.
24. Bayona, J. D. R. 1978. Variability in phytoplankton abundance as observed in the eastern sector of Iliamna Lake, 1965-1977. Univ. Washington, Fish. Res. Inst. Unpublished manuscript. 22 pp.
25. Rogers, B. J. 1979. Response of juvenile sockeye salmon and their food supply to inorganic fertilization of Little Togiak Lake, Alaska. M.S. Thesis, Univ. Washington, Seattle. 112 pp.
26. Roger, P. B. 1975. Plankton data analysis. Univ. Washington, Fish. Res. Inst. Computer Program No. FRR 347, Fish. Analy. Ctr. 3 pp.
27. Carlson, T. J. 1973. Dry weight determination of Iliamna Lake zooplankton. Univ. Washington, Fish. Res. Inst., unpublished manuscript. 120 pp.
28. Lenarz, W. H. 1966. Population dynamics of Cyclops scutifer and an evaluation of a sampling program for estimating the standing crop of zooplankton in Iliamna Lake. M.S. Thesis, Univ. Washington, Seattle. 120 pp.
29. Hoag, S. H. 1968. The food of juvenile sockeye salmon, Oncorhynchus nerka, related to the zooplankton of Iliamna Lake, Bristol Bay, Alaska. M.S. Thesis, Univ. Washington, Seattle. 72 pp.

30. Gunnerød, T. B. 1971. The life history and population dynamics of Cyclops scutifer sars in Pedro Bay, Iliamna Lake, Alaska. Ph.D. Dissertation, Univ. Washington, Seattle. 136 pp.
31. Carlson, T. J. 1974. The life history and population dynamics of Bosmina coregoni in Pedro Bay, Iliamna Lake, Alaska. M.S. Thesis, Univ. Washington, Seattle. 142 pp.
32. Sublette, J. E., and J. S. Dendy. 1959. Plastic materials for simplified tent and funnel traps. S. West. Nat. 3:220-223.
33. Rogers, D. E. 1964. Variability in measurement of length and weight of juvenile sockeye salmon and threespine stickleback. Univ. Washington, Fish. Res. Inst. Circ. 224. 34 pp.
34. Fisheries Research Institute. 1961. Field Manual. Univ. Washington, Fish. Res. Inst. Circ. 143. 116 pp.
35. Rogers, D. E. 1967. Estimation of pelagic fish populations in the Wood River lakes, Alaska, from townet catches and echogram marks. Ph.D. Dissertation, Univ. Washington, Seattle. 91 pp.
36. Roger, P. B. 1972. Analysis of Kvichak townet data-revised. Univ. Washington, Fish. Res. Inst. Computer Program No. FRK-317R, Fish. Analy. Ctr. 9 pp.
37. Kerns, O. E., Jr. 1965. Abundance and size of juvenile red salmon and major competitor species in Iliamna Lake and Lake Clark, 1962 and 1963. Univ. Washington, Fish. Res. Inst. Circ. 231. 35 pp.

38. Kerns, O. E., Jr. 1966. Abundance and size of juvenile sockeye salmon and major competitor species in Iliamna Lake and Lake Clark, 1964 and 1965. Univ. Washington, Fish. Res. Inst. Circ. 66-13. 35 pp.
39. Kerns, O. E., Jr. 1968. Abundance, distribution, and size of juvenile sockeye salmon and major competitor species in Iliamna Lake and Lake Clark, 1966 and 1967. Univ. Washington, Fish. Res. Inst. Circ. 68-11. 35 pp.
40. Mathisen, O. A. 1970. Studies of juvenile sockeye salmon in Iliamna Lake and Lake Clark. Final Report for Project No. AFC 20-1 (Anadromous Fish Act), Contract No. 14-17-0005-237. 26 pp.
41. Mathisen, O. A., P. H. Poe, and P. B. Roger. 1971. Carrying capacity of the sockeye salmon nursery areas in the Kvichak District, Bristol Bay, Alaska. Univ. Washington, Fish. Res. Inst. 23 pp.
42. Roger, P. B. 1973. Studies of juvenile sockeye salmon and major competitor species in the Kvichak River system, Bristol Bay, Alaska, 1971-1972. Univ. Washington, Fish. Res. Inst. Unpublished manuscript. 37 pp.
43. Poe, P. H. 1975. 1973 data report. Kvichak sockeye salmon studies. Univ. Washington, Fish. Res. Inst. Unpublished manuscript. 103 pp.
44. Poe, P. H., G. D. Cortner, N. A. Lemberg, P. B. Roger, and O. A. Mathisen. 1975. Monitoring of the Kvichak spawning and nursery

- areas, 1974. Univ. Washington Fish. Res. Inst. Final Report - Contract NO. 1243, Alaska Department of Fish and Game. FRI-UW-7502. 111 pp.
45. Poe, P. H., G. C. Cortner, and O. A. Mathisen. 1976. Monitoring of the Kvichak spawning and nursery areas in 1976. Univ. Washington, Fish. Res. Inst. Final Report-Contract No. 2131 Alaska Department of Fish and Game. FRI-UW-7603. 82 pp.
46. Poe, P. H., T. B. Stables, C. A. Kreger, and O. A. Mathisen. 1977. The production of sockeye salmon in the Kvichak River system during peak cycle years. Univ. Washington, Fish. Res. Inst. Final Report - Alaska Department of Fish and Game and Association of Pacific Fisheries. FRI-UW-7716. 93 pp.
47. Poe, P. H. 1979. Townetting programs in Iliamna Lake, 1977 and 1978. Univ. Washington, Fish. Res. Inst. Unpublished manuscript. 6 pp.
48. Poe, P. H., and O. A. Mathisen. 1982. Tazimina River sockeye salmon studies. Evaluation of spawning ground survey data. Univ. Washington, Fish. Res. Inst. Final Report - Contract No. 12023-006-20 Dames and Moore. FRI-UW-8201. 30 pp.
49. Bevan, D. E. 1961. Variability in aerial counts of spawning salmon. J. Fish. Res. Bd. Can. 18(3):337-348.
50. Neilson, J. D., and G. H. Geen. 1981. Enumeration of spawning salmon from spawner residence time and aerial counts. Trans. Am. Fish. Soc. 110:554-556.

51. Cousens, N. B. F., G. A. Thomas, C. G. Swann, and M. C. Healey. 1982. A review of salmon escapement estimation techniques. Can. Tech. Rpt. Fish. Aq. Sci. No. 1198. 122 pp.
52. Roger, P. B., and P. H. Poe. 1973. Compilation of summary data to provide input into a proposal to create a National Fish Refuge in the Kvichak River system. Univ. Washington, Fish. Res. Inst. Report for U.S. Bur. Sport Fish and Wildl., Alaskan Region. Unpublished manuscript.
53. Crutchfield, J. A., S. Langdon, O. A. Mathisen, and P. H. Poe. 1982. The biological, economic, and social values of a sockeye salmon stream in Bristol Bay, Alaska: A case study of Tazimina River. Univ. Washington, Fish. Res. Inst. Circ. 82-2. 39 pp.
54. Gilbert, J. R. 1968. Surveys of sockeye salmon spawning population in the Nushagak District, Bristol Bay, Alaska, 1946-1958. Univ. Washington, Publ. in Fish., New Ser. 3:151-168.
55. Nelson, M. L. 1965. Red salmon spawning ground surveys in the Nushagak and Togiak Districts, Bristol Bay, 1965. Alaska Dept. Fish Game Inf. Leaflet No. 84. 40 pp.
56. Kim, W. S., and K. Roberson. 1968. On the use of otoliths of sockeye salmon for age determination. Univ. Washington Publ. in Fish., New Ser. 3:151-168.

## Tables

Table 1. Name and contents of Wood River/Kvichak data files.

Project: Wood River

File name	Contents	Period
WRWATER	Water temperature for Wood River lakes	1962-1982
WRAIR	Monthly mean air temperature at Dillingham	1919-1982
WRPRCP	Monthly total precipitation at Dillingham	1919-1982
WRLEVEL	Lake Nerka lake level by 5-day periods	1952-1982
WRSOLAR	Daily solar radiation at Mosquito Point, Lake Aleknagik	1962-1982
WRCHLOR	Chlorophyll a concentrations by depth, Wood River lakes	1967-1982
WRZOOPS	Zooplankton counts, Wood River lakes	1967-1982
WRINSEC	Emergent insect counts, Lake Aleknagik and Little Togiak Lake	1969-1982
WRTNET	Townet catches and mean lengths, Wood River lakes	1958-1982
WRBSEIN	Beach seine catches and mean lengths, Wood River lakes	1958-1982
WRESCAP	Escapement and returns for the major Wood River lakes	1946-1982

Project: Kvichak

KWEATHR	U.S. Weather Bureau data from King Salmon FRI and U.S. Weather Bureau data from Iliamna	1959-1973 1959-1973
	U.S. Weather Bureau data from Lake Clark	1959-1973
	U.S. Weather Bureau data from Intricate Bay FRI weather and lake level data, Porcupine Island	1961-1973 1961-1982
KDISCH	Daily discharge Newhalen River	1952-1967, 1982
	Daily discharge Kvichak River	1967-1982
KBTFD	Water temperatures Iliamna Lake and Lake Clark	1961-1966, 1970-1982
KSECDISK	Secchi disk depth readings, Iliamna Lake and Lake Clark	1961-1982
KICEBUP	Dates of breakup of Iliamna Lake ice	1961-1982
KCHLRAW	Spectronic 20 readings of filtered water samples, Iliamna Lake and Clark Lake	1961-1982
KCHLOR	Chlorophyll a concentrations ( $\text{mg}\cdot\text{m}^{-3}$ ) by depth, Iliamna Lake and Lake Clark	1961-1982
KCHLVAR	Spectronic 20 readings of filtered water samples, Iliamna Lake variability studies	1970
KCHLVPR	Chlorophyll a concentrations ( $\text{mg}\cdot\text{m}^{-3}$ ) by depth Iliamna Lake variability studies	1970

Table 1 (continued).

Project: Kvichak

File name	Contents	Period
KPERI	Chlorophyll <u>a</u> ( $\text{mg}\cdot\text{m}^{-2}$ ) littoral periphyton Iliamna Lake	1972-1982
KNPHYTO	Net phytoplankton counts, Iliamna Lake and lake Clark	1965-1982
KC14ASM	Carbon 14 assimilation rates by depth and station, Iliamna Lake	1962-1969
KC14SUP	Secchi depth and solar radiation data associated with Iliamna Lake carbon 14 measurements	1962-1969
KZOOPS	Zooplankton numbers, Iliamna Lake and Lake Clark	1961-1982
KZDWTSV	Zooplankton dry weight	1961-1973
KBSRAW	Beach seine log and length frequency data, Iliamna Lake	1964-1982
KBSEINE	Beach seine catches and mean lengths, Iliamna Lake	1964-1982
KTOWRAW	Townet log and length frequency data, Iliamna Lake and Lake Clark	1962-1982
KTNET	Standardized townet catches and length data (processed) Iliamna Lake and Lake Clark	1962-1982
KTGROW	Live length and weight data from townet and beach seine sampling, Iliamna Lake	1962-1982
KSPRAW	Spawning ground age and length data	1962-1982
KSPAWN	Spawning ground age and length statistics	1962-1982
KSGINDX	Spawning ground peak index counts for individual Kvichak spawning areas	1920-1982

Table 2. Physical measurements of lakes in the Igushik and Snake systems.

Measurement <sup>1</sup>		Lake Ualik	Lake Amanka	Lake Nunavaugaluk
Latitude		59°6'N	59°6'N	59°15'N
Longitude		159°26'W	159°14'W	158°54'W
Altitude	(meters)	15	9	14
Maximum length	$l$ (km)	12	13	23
Maximum depth	$Z_m$ (meters)	72	65	162
Mean depth	$\bar{Z}$ (meters)	28	23	57
Depth of cryptodepression				
$Z_c$ (meters)		>35	>26	>41
Maximum width	$b_x$ (km)	4.4	2.9	6.5
Mean width	$\bar{b}$ (km)	3.3	1.8	3.5
Surface area	$A$ (km <sup>2</sup> )	39	35	89
Shore line	$L$ (km)	31	53	50
Shore line development	$D_L$	1.78	3.94	1.94
Volume	$V$ (km <sup>3</sup> )	1.10	0.80	5.10

<sup>1</sup>Terminology and notations are those of Hutchinson (1957).

Sources: Burgner and Hartman (5) and Burgner et al. (6).

Table 3. Physical measurements of lakes in the Tikchik system.

Measurement <sup>1</sup>		Tikchik Lake	Nuyakuk Lake	Lake Chauekuktuli
Latitude		59°57'N	59°56'N	60°3'N
Longitude		158°20'W	158°49'W	158°54'W
Altitude	(meters)	95	95	98
Maximum length	l (km)	15	40	37
Maximum depth	Z <sub>m</sub> (meters)	45	283	268
Mean depth	$\bar{Z}$ (meters)	15	113	111
Depth of cryptodepression				
Z <sub>c</sub> (meters)			>188	>115
Maximum width	b <sub>x</sub> (km)	5.5	6.2	3.0
Mean width	$\bar{b}$ (km)	3.6	3.6	2.1
Surface area	A (km <sup>2</sup> )	53	144	82
Shore line	L (km)	63	123	91
Shore line development	D <sub>L</sub>	2.44	2.92	2.83
Volume	V (km <sup>3</sup> )	.80	16.27	8.94

<sup>1</sup>Terminology and notations are those of Hutchinson (1957).

Sources: Burgner and Hartman (5) and Burgner et al. (6).

Table 4. Physical measurements of lakes in the Wood River system.

Measurement <sup>1</sup>	Lake Aleknagik	Lake Nerka	Lake Beverley	Lake Kulik	Little Togiak Lake
Latitude	59°20'N	59°35'N	59°40'N	59°50'N	59°40'N
Longitude	158°40'W	158°40'W	158°35'W	159°40'W	159°10'W
Altitude (meters)	10	21	30	43	23
Maximum length $l$ (km)	32	46	35	27	10
Maximum depth $Z_m$ (meters)	110	164	188	160	77
Mean depth $\bar{Z}$ (meters)	43	39	55	77	30
Depth of cryptodepression $Z_c$ (meters)	100	143	158	117	54
Maximum width $b_x$ (km)	4.8	7.0	6.1	2.3	1.2
Mean width $\bar{b}$ (km)	2.6	2.4	2.2	1.8	0.6
Surface area $A$ (km <sup>2</sup> )	83	201	90	45	6
Shore line $L$ (km)	136	286	116	67	30
Shore line development $D_L$	4.22	5.70	3.46	2.80	3.50
Volume $V$ (km <sup>3</sup> )	3.57	7.84	4.95	3.47	0.18
Volume development $D_V$	0.39	0.24	0.29	0.48	0.39
Morphoedaphic index	0.71	--	--	--	--

<sup>1</sup>Terminology and notations are those of Hutchinson (1957).

Sources: Burgner and Hartman (5), Burgner et al. (6), and Hartman and Burgner (9).

Table 5. Physical measurements of lakes in the Kvichak system.

Measurement <sup>1</sup>		Iliamna Lake	Source Code	Lake Clark	Source Code
Latitude		59°35'N	(5)	60°15'N	(5)
Longitude		155°0'W	(5)	154°20'W	(5)
Altitude	(meters)	15	(6)	67	(6)
Maximum length	$l$ (km)	125	(8)	65	(8)
Maximum depth	$Z_m$ (meters)	301	(6)	262	(6)
Mean depth	$\bar{Z}$ (meters)	44.1	(4)	102.5	(4)
Depth of cryptodepression $Z_c$	(meters)	286	(8)	195	(8)
Maximum width	$b_x$ (km)	35	(8)	6	(8)
Mean width	$\bar{b}$ (km)	23.3	(5)	4.6	(5)
Surface area	$A$ (km <sup>2</sup> )	2621.6	(4)	266.8	(4)
Shore line	$L$ (km)	499.6	(8)	245.5	(8)
Shore line development	$D_L$	2.75	(6)	3.60	(6)
Volume	$V$ (km <sup>3</sup> )	115.3	(4)	27.3	(4)
Volume development	$D_V$	0.13	(5)	--	
Morphoedaphic index		.60	(9)	--	

<sup>1</sup>Terminology and notations are those of Hutchinson (1957).

Sources: (4), (5), (6), (7), and (9) see references.

Table 6. Primary productivity, water transparency, and chemical characteristics ( $\text{mg}\cdot\text{l}^{-1}$ ) of sockeye salmon lakes of the Nushagak and Kvichak systems, 1961-62.

	Mean Carbon fixation rates		Mean	Total	Total						
	$\text{mgC}\cdot\text{m}^{-2}\cdot 4\text{h}^{-1}$	$\text{mgC}\cdot\text{m}^{-3}\cdot 4\text{h}^{-1}$	Secchi disk (m)	dissolved solids	alkalinity	Na	K	Mg	$\text{C}_a$	$\text{NO}_3\text{-NO}_2$	Si
<u>Igushik System</u>											
Amanka Lake	-	-	8.5	21.5	10.84	.55	<.22	.75	5.10	.075	4.3
Ualik Lake	73	2.5	9.7	17.5	10.50	.80	.35	.70	3.95	.020	2.1
<u>Snake System</u>											
Lake Nunavaugaluk	66	1.4	13.0	18.0	10.42	.55	<.30	.65	4.90	.120	2.1
<u>Wood System</u>											
Lake Aleknagik	65	2.0	8.7	30.5	12.51	.63	.35	.95	4.95	.111	2.6
Lake Nerka	58	1.7	12.6	20.7	11.99	.45	.37	.87	4.68	.167	2.2
Lake Beverley	71	1.7	12.0	24.0	11.90	.80	<.33	.80	4.23	.160	2.8
Lake Kulik	66	1.6	11.5	25.3	12.46	.68	.33	.68	4.65	.173	3.0
Little Togiak Lake	73	1.9	10.4	35.0	18.69	.75	.50	1.33	7.23	.160	3.3
<u>Nuyakuk-Tikchik System</u>											
Tikchik Lake	52	1.6	10.7	42.0	22.45	.55	<.70	2.12	7.70	.090	5.4
Nuyakuk Lake	-	-	10.0	36.5	22.99	.40	Trace	1.55	8.40	.110	6.4
Lake Chauekuktuli	54	1.0	15.3	50.0	29.46	.40	Trace	2.60	11.00	.135	6.4
<u>Kvichak System</u>											
Iliamna Lake	54	1.5	9.8	26.3	13.96	.83	.60	.83	5.11	.058	4.5
Lake Clark	13	1.6	3.8	32.0	19.59	.80	1.28	1.03	6.75	.113	8.6

Source: Burgner et al. (6).

## Figures

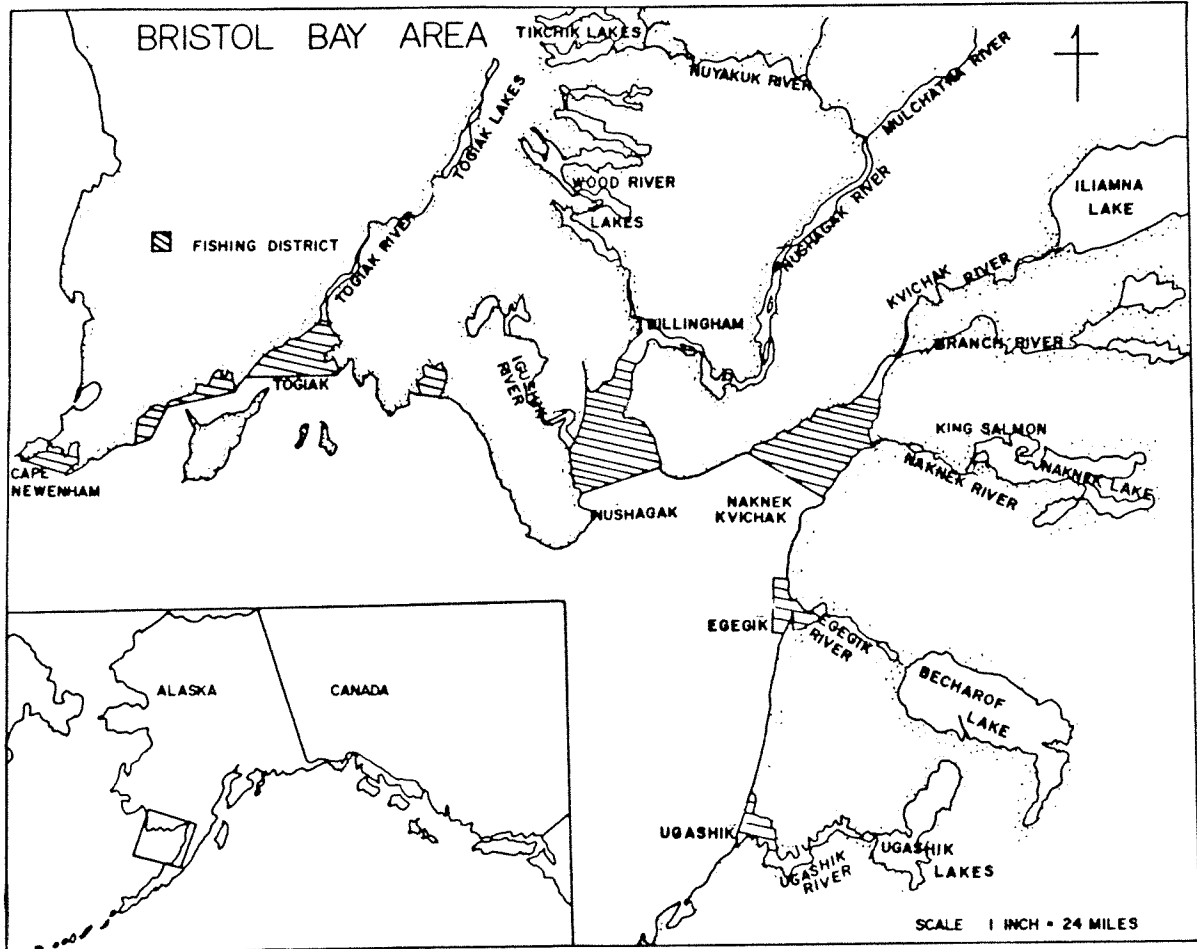


Fig. 1. Bristol Bay sockeye salmon river systems and fishing districts.

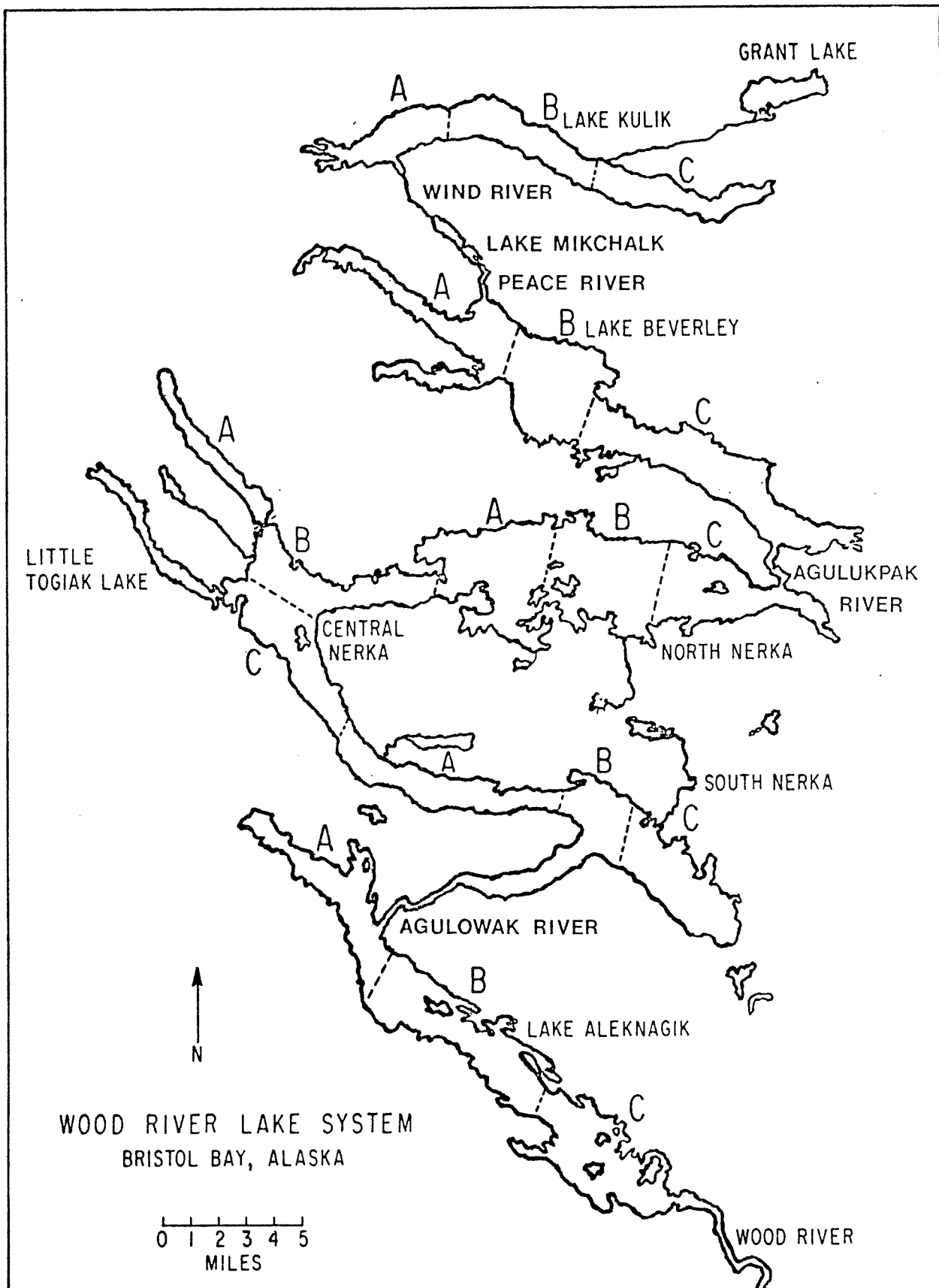


Fig. 2. Map of the Wood River lake system, showing sampling areas (A, B, C).

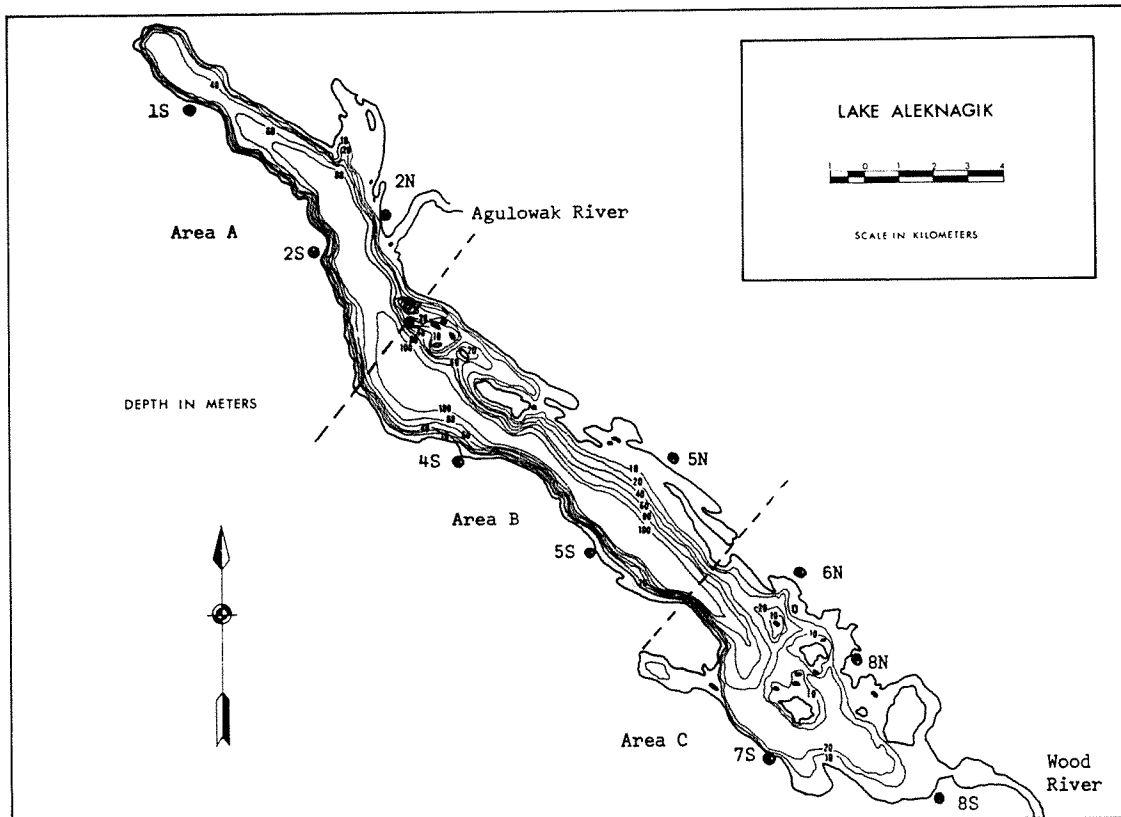


Fig. 3. Beach seine stations and lake sampling areas in Lake Aleknagik.

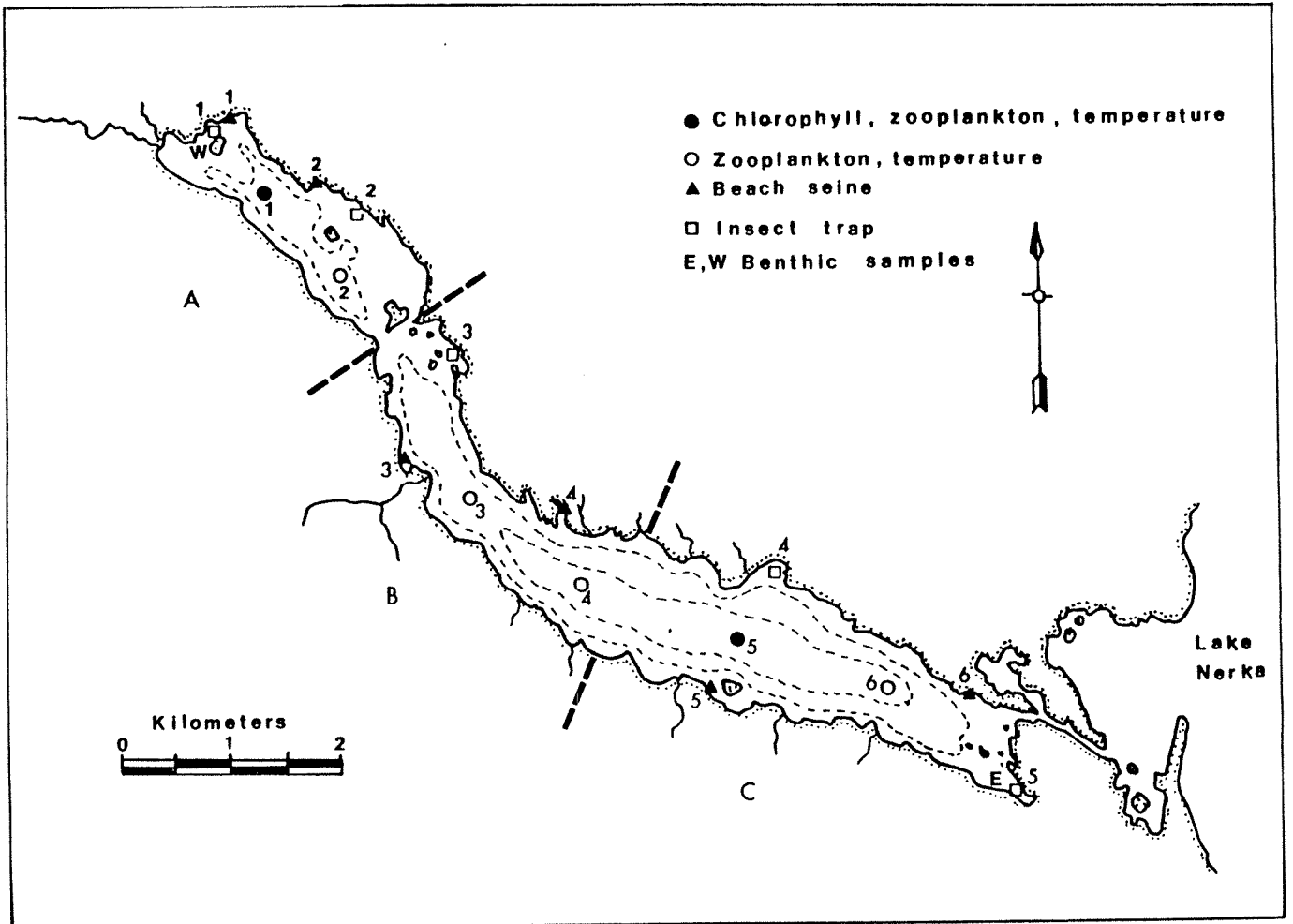


Fig. 4. Sampling stations on Little Togiak Lake. Depth contours at 20 m and 60 m indicated by dashed lines.

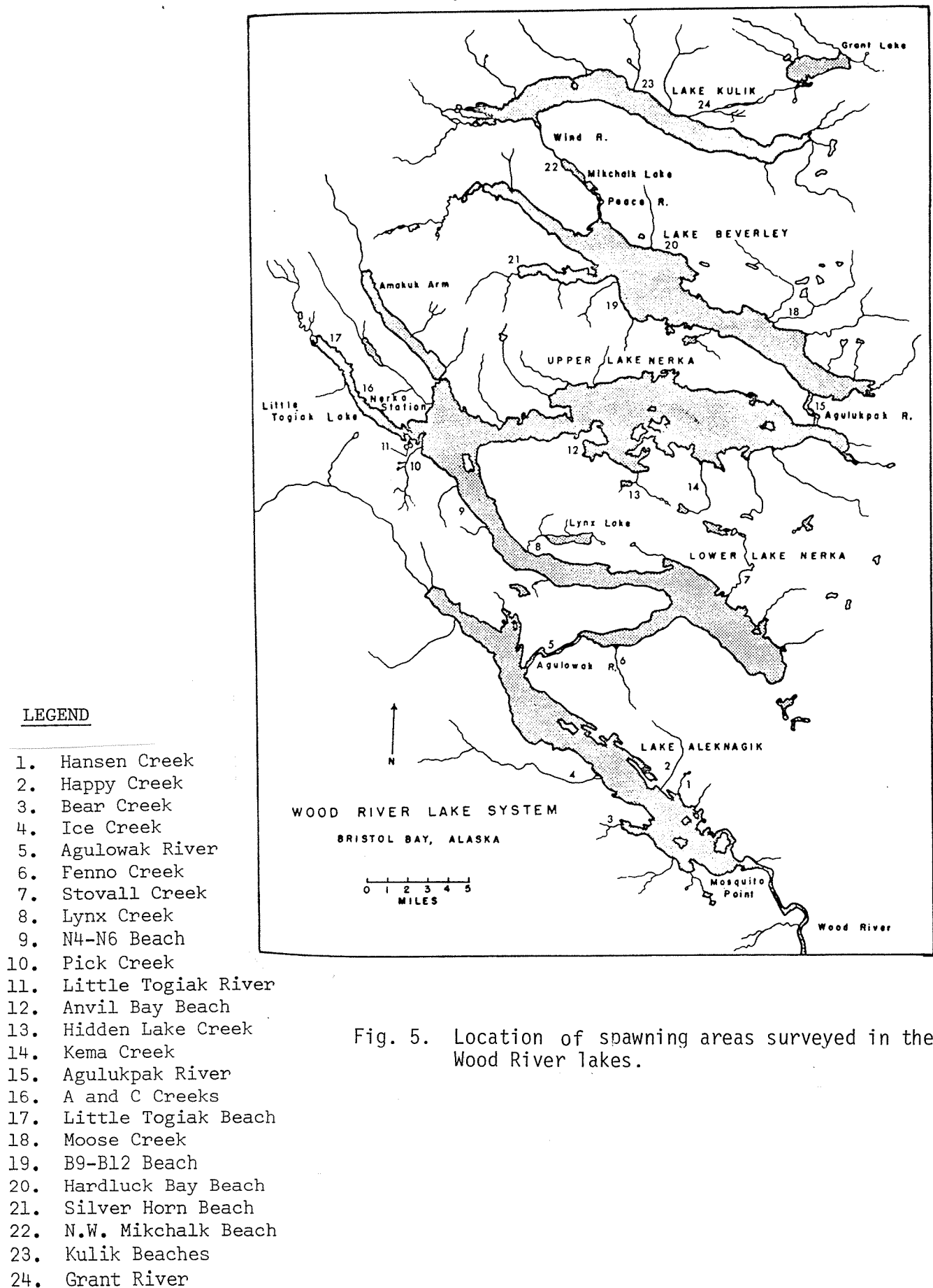


Fig. 5. Location of spawning areas surveyed in the Wood River lakes.

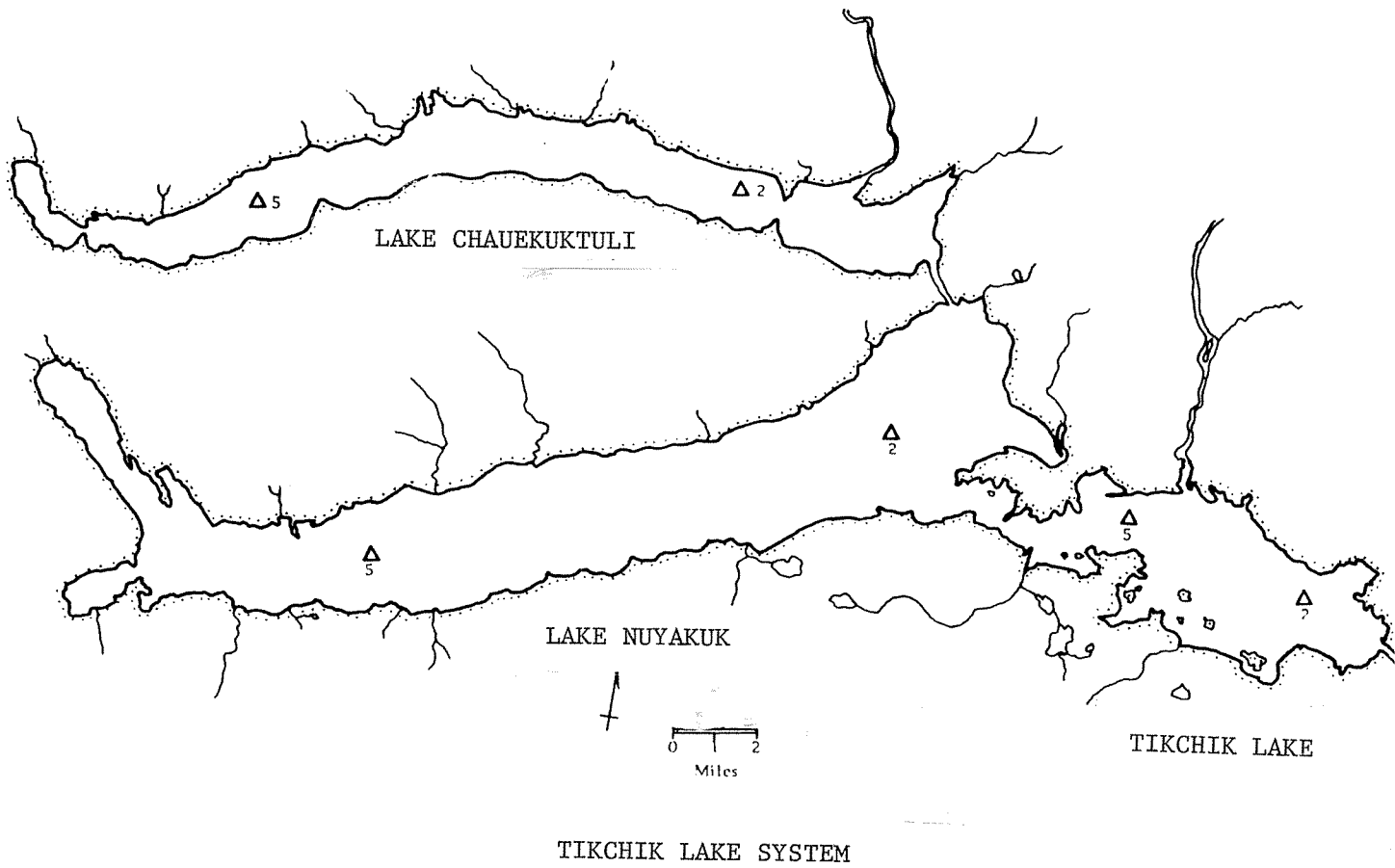


Fig. 6. Location of limnology stations used in the 1960's -  
Tikchik lake system

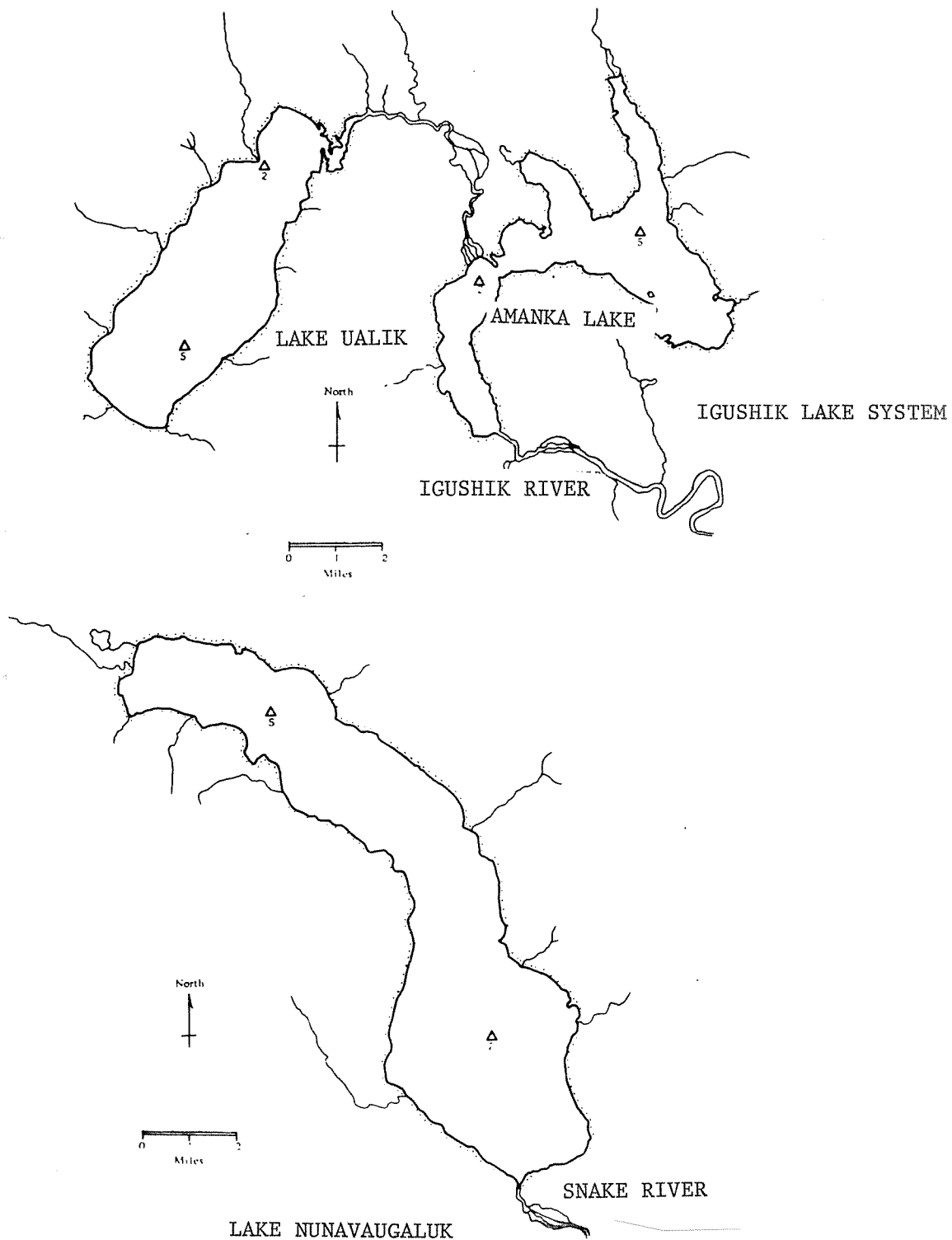


Fig. 7. Location of limnology stations used in the 1960's - Igushik and Nunavaugaluk lake systems

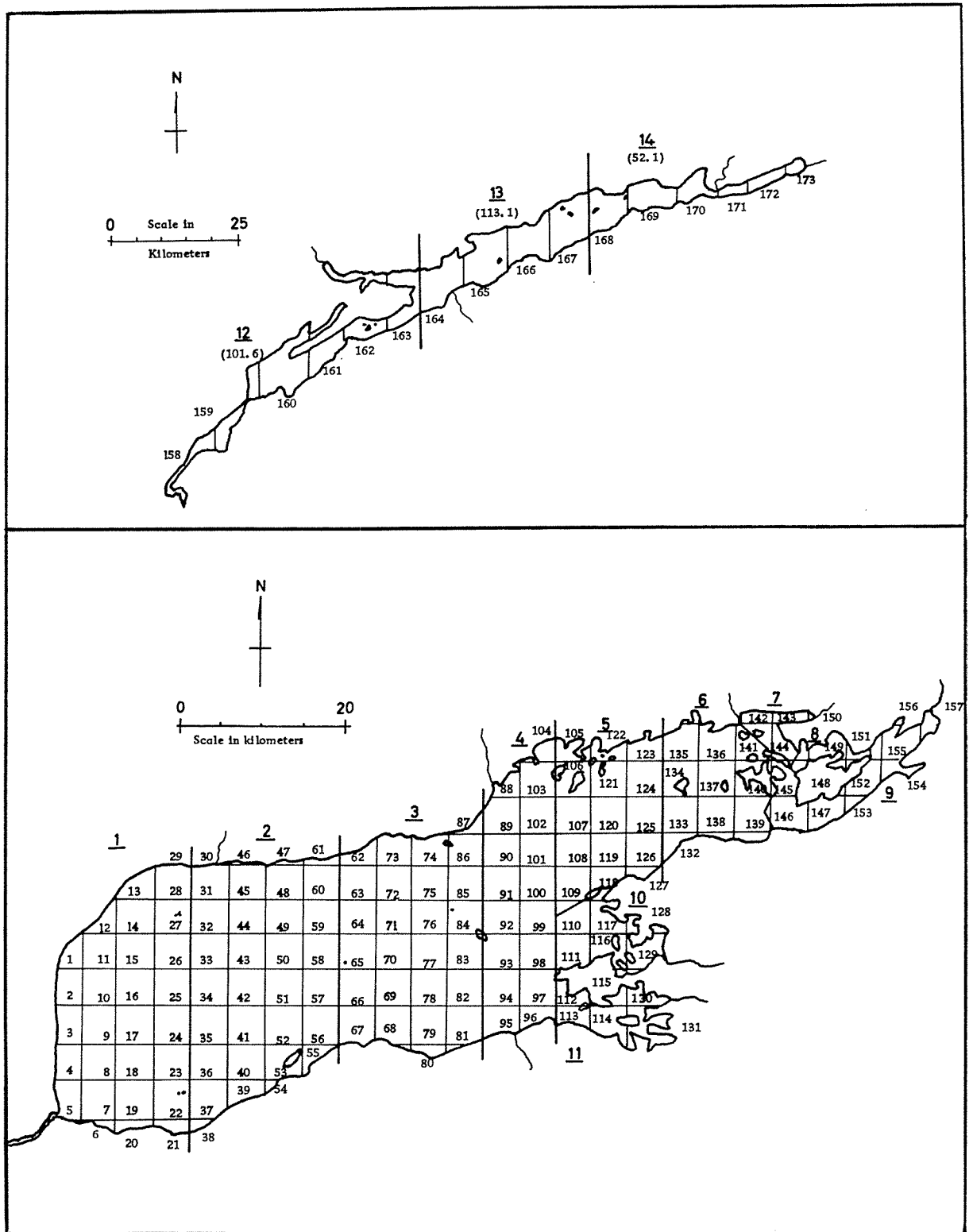


Fig. 8. Numerical designations of lake sections and areas, Lake Clark (upper), Iliamna Lake (lower).

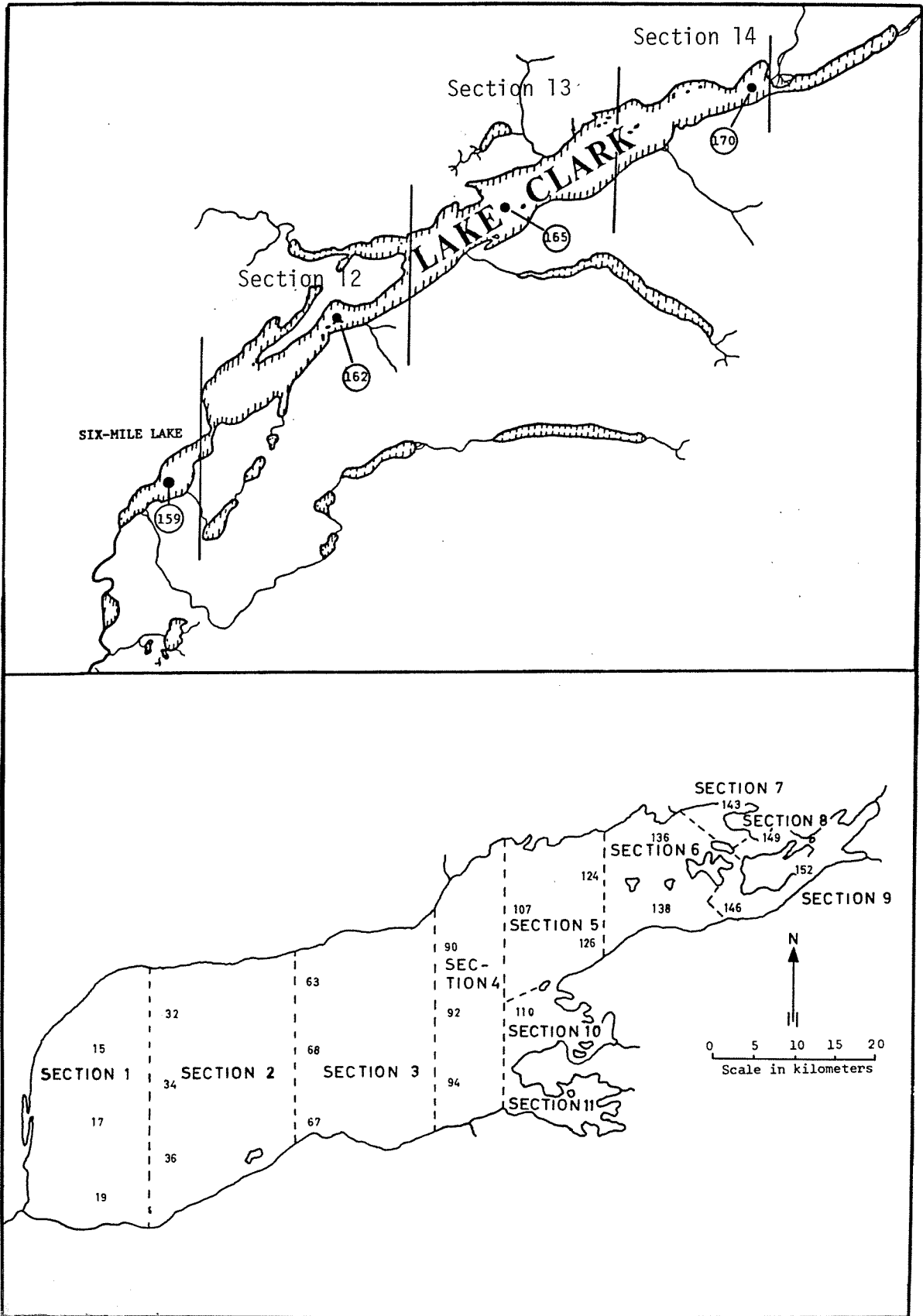


Fig. 9. Location of standardized limnology stations, Lake Clark (upper) and Iliamna Lake (lower).

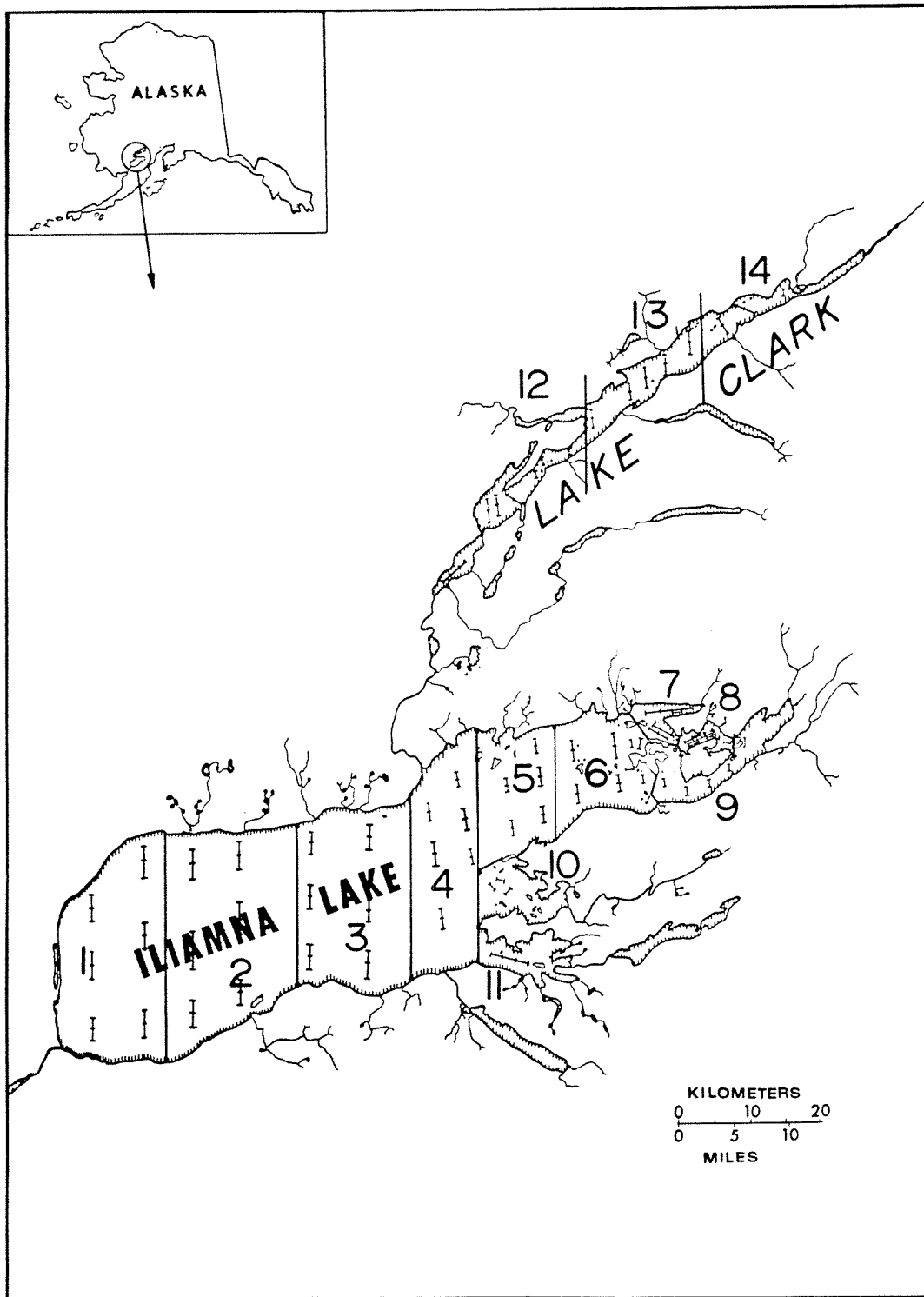


Fig. 10. Location of standardized townetting transects, Iliamna Lake and Lake Clark.

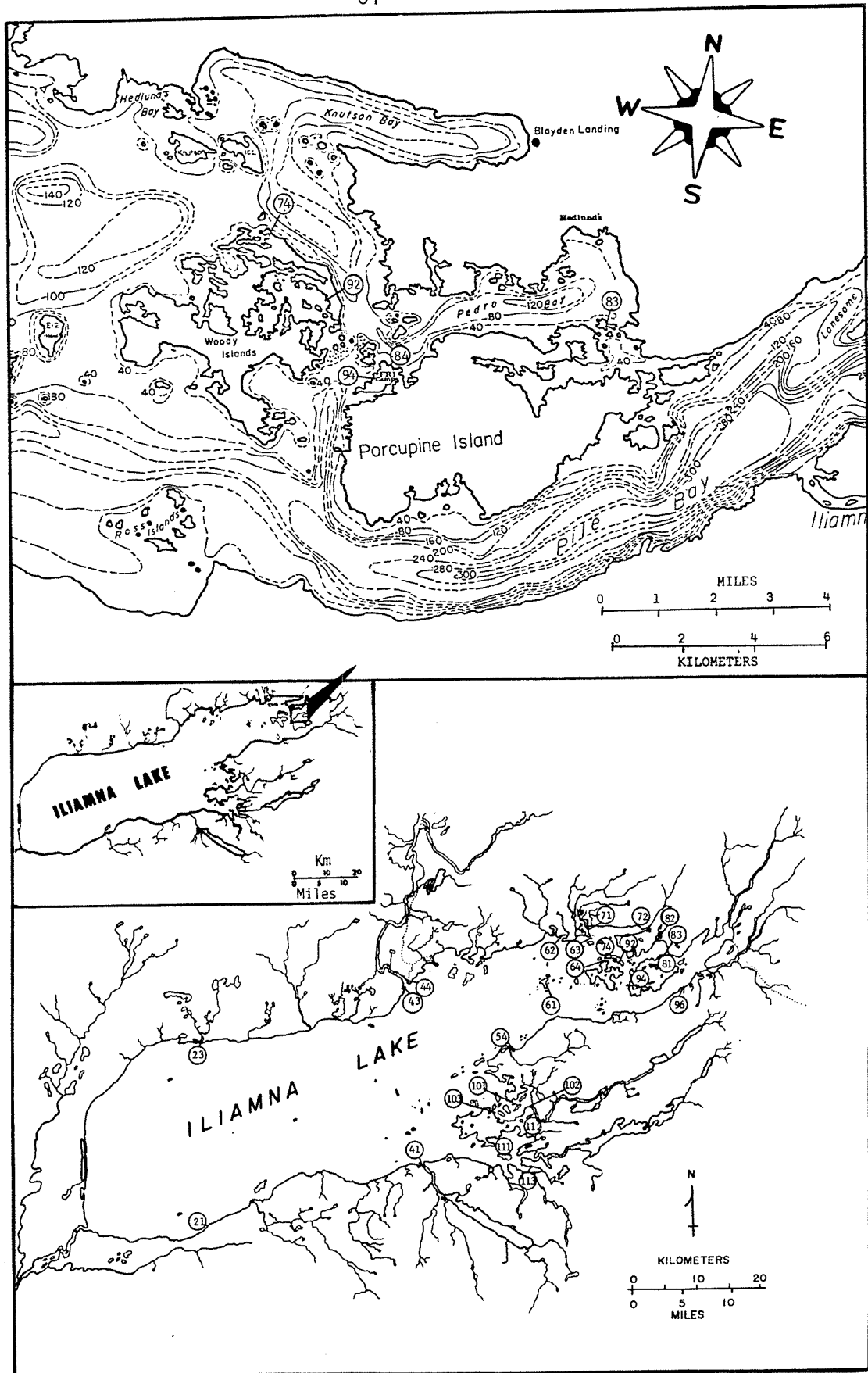


Fig. 11. Location of standardized periphyton stations (upper) and beach seine stations (lower), Iliamna Lake.

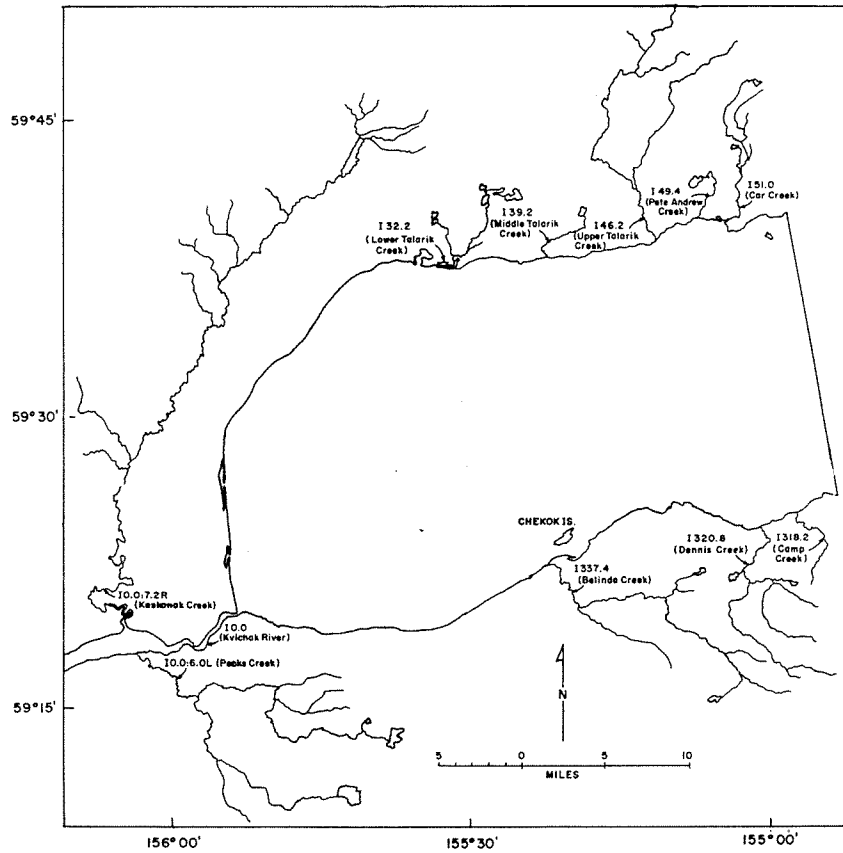
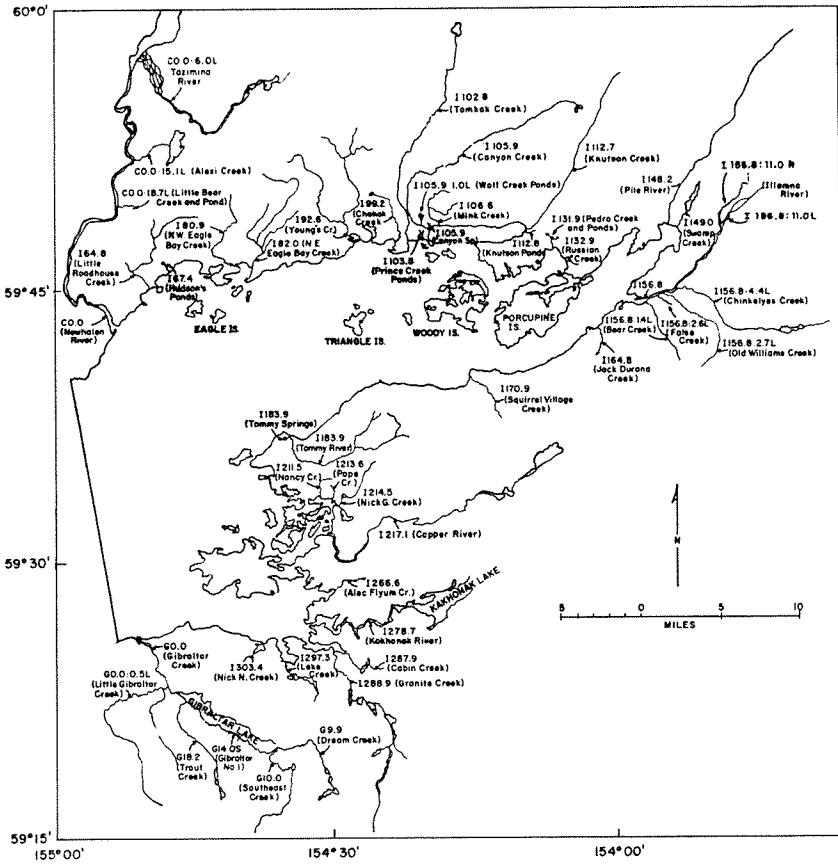


Fig. 12. Stream spawning areas of Iliamna Lake (upper shows eastern half, lower shows western half).

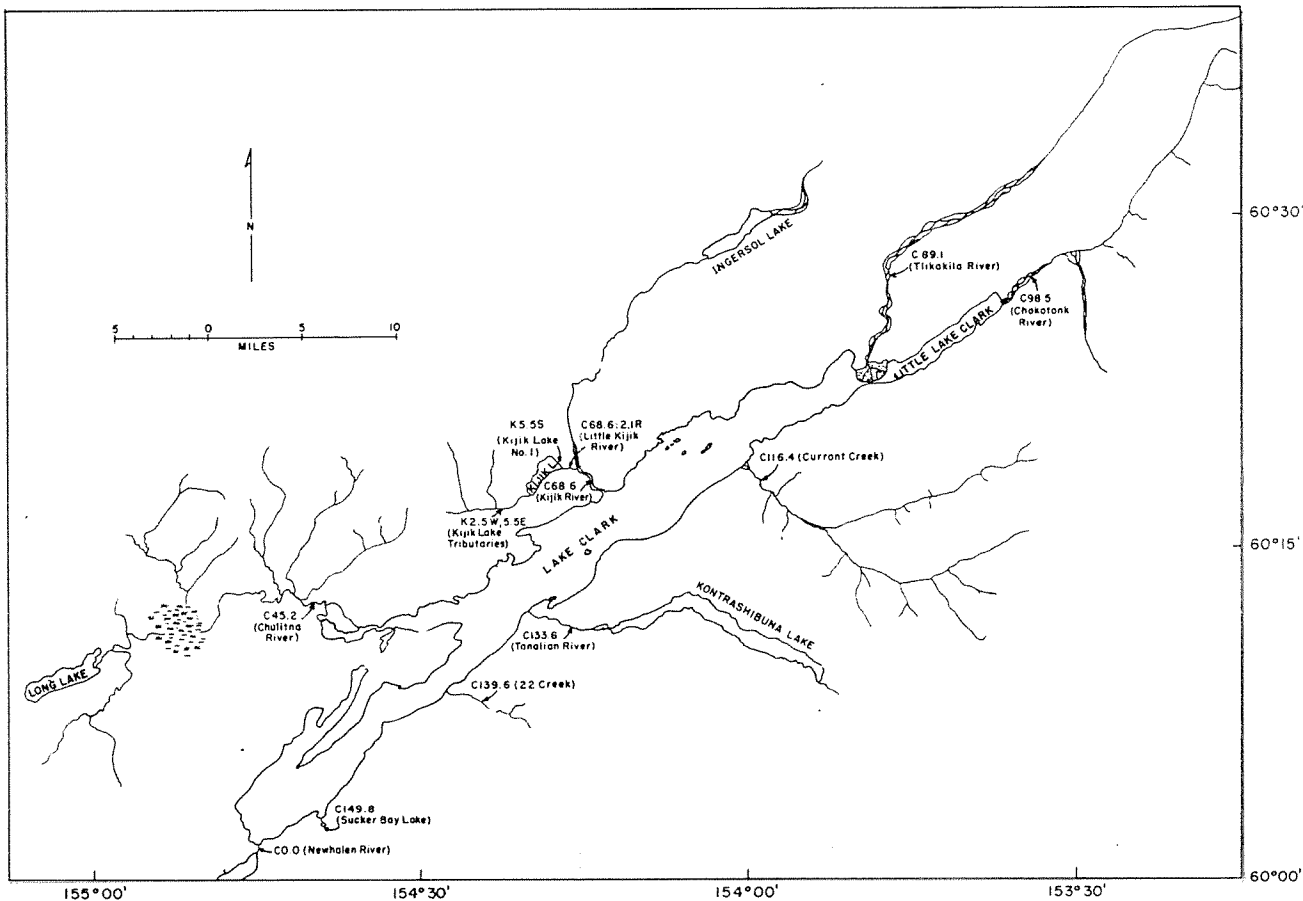
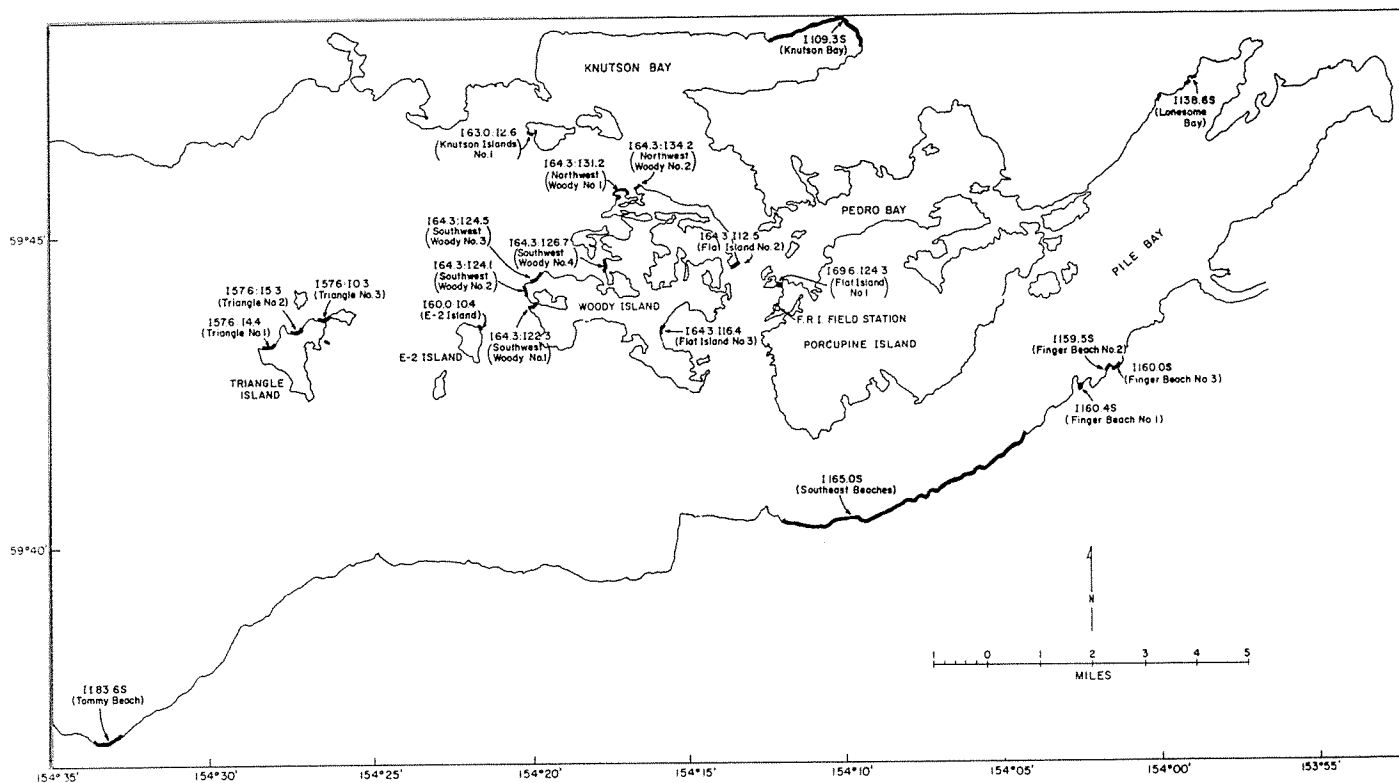


Fig. 13. Known beach spawning areas of Iliamna Lake (upper) and spawning areas of Lake Clark (lower).

Appendix A. Name and contents, terminology, and formats of Wood River/Kvichak data files.

Appendix Table A.1. Name and contents of Wood River/Kvichak data files.

Project: Wood River

File name	Contents	Period
WRWATER	Water temperature for Wood River lakes	1962-1982
WRAIR	Monthly mean air temperature at Dillingham	1919-1982
WRPRCP	Monthly total precipitation at Dillingham	1919-1982
WRLEVEL	Lake Nerka lake level by 5-day periods	1952-1982
WRSOLAR	Daily solar radiation at Mosquito Point, Lake Aleknagik	1962-1982
WRCHLOR	Chlorophyll <i>a</i> concentrations by depth, Wood River lakes	1967-1982
WRZOOPS	Zooplankton counts, Wood River lakes	1967-1982
WRINSEC	Emergent insect counts, Lake Aleknagik and Little Togiak Lake	1969-1982
WRTNET	Townet catches and mean lengths, Wood River lakes	1958-1982
WRBSEIN	Beach seine catches and mean lengths, Wood River lakes	1958-1982
WRESCAP	Escapement and returns for the major Wood River lakes	1946-1982

Project: Kvichak

KWEATHR	U.S. Weather Bureau data from King Salmon	1959-1973
	FRI and U.S. Weather Bureau data from Iliamna	1959-1973
	U.S. Weather Bureau data from Lake Clark	1959-1973
	U.S. Weather Bureau data from Intricate Bay	1961-1973
	FRI weather and lake level data, Porcupine Island	1961-1982
KDISCH	Daily discharge Newhalen River	1952-1967, 1982
	Daily discharge Kvichak River	1967-1982
KBTDF	Water temperatures Iliamna Lake and Lake Clark	1961-1966, 1970-1982
KSECDSK	Secchi disk depth readings, Iliamna Lake and Lake Clark	1961-1982
KICEBUP	Dates of breakup of Iliamna Lake ice	1961-1982
KCHLRAW	Spectronic 20 readings of filtered water samples, Iliamna Lake and Clark Lake	1961-1982
KCHLOR	Chlorophyll <i>a</i> concentrations ( $\text{mg}\cdot\text{m}^{-3}$ ) by depth, Iliamna Lake and Lake Clark	1961-1982
KCHLVAR	Spectronic 20 readings of filtered water samples, Iliamna Lake variability studies	1970
KCHLVPR	Chlorophyll <i>a</i> concentrations ( $\text{mg}\cdot\text{m}^{-3}$ ) by depth Iliamna Lake variability studies	1970

Appendix Table A.1 - continued.

Project: Kvichak

File name	Contents	Period
KPERI	Chlorophyll <u>a</u> ( $\text{mg}\cdot\text{m}^{-2}$ ) littoral periphyton Iliamna Lake	1972-1982
KNPHYTO	Net phytoplankton counts, Iliamna Lake and lake Clark	1965-1982
KC14ASM	Carbon 14 assimilation rates by depth and station, Iliamna Lake	1962-1969
KC14SUP	Secchi depth and solar radiation data associated with Iliamna Lake carbon 14 measurements	1962-1969
KZOOPS	Zooplankton numbers, Iliamna Lake and Lake Clark	1961-1982
KZDWTSV	Zooplankton dry weight	1961-1973
KBSRAW	Beach seine log and length frequency data, Iliamna Lake	1964-1982
KBSEINE	Beach seine catches and mean lengths, Iliamna Lake	1964-1982
KTOWRAW	Townet log and length frequency data, Iliamna Lake and Lake Clark	1962-1982
KTNET	Standardized townet catches and length data (processed) Iliamna Lake and Lake Clark	1962-1982
KTGROW	Live length and weight data from townet and beach seine sampling, Iliamna Lake	1962-1982
KSPRAW	Spawning ground age and length data	1962-1982
KSPAWN	Spawning ground age and length statistics	1962-1982
KSGINDX	Spawning ground peak index counts for individual Kvichak spawning areas	1920-1982

## Appendix A.2 Explanation of Format Specifications

---

The format specifications used in the tables on the following pages will be of this form:

<u>Description type</u>	<u>Descriptor</u>	<u>Meaning</u>
Character	AW	Character with specified length
Numeric	IW	Decimal integer
Numeric	Fw.d	Single-precision floating point without exponent
Numeric	Ew.d	Single precision floating point with exponent

For each descriptor, uppercase letters indicated the type of conversion. Lowercase letters indicate information that has the following meaning:

- W field width in number of character positions (includes any leading blanks, + or - signs, decimal point, and exponent)
- d number of digits to the right of the decimal point within the field.

The following conventions were adopted regarding the use of the "Fw.d" format specification in these tables:

1. for a whole number which is to be read as type REAL:  
Fw.0
  2. for a REAL number with an implied decimal point (the decimal point is not encoded in the field):  
Fw.d
  3. for a REAL number with the decimal point specifically encoded in the field:  
Fw.d. and an additional notation after the contents description, e.g. "(xx.x)" for an F4.1 format.
-



Appendix A.3 Table 2. WRAIR. Monthly mean air temperature (°C)  
at Dillingham, Alaska.

---

Wood River/Kvichak Freshwater File:

Project: Wood River  
File name: WRAIR

Period: 1919-1982

\*FORMAT\* (Input Data)

<u>Col.</u>	<u>Format</u>	<u>Contents</u>
1- 2	I2	Location code
3- 6	I4	Year

Monthly mean air temperature °C

7-11	F5.1	Jan (xxx.x)
12-16	F5.1	Feb (xxx.x)
17-21	F5.1	Mar (xxx.x)
22-26	F5.1	Apr (xxx.x)
27-31	F5.1	May (xxx.x)
32-36	F5.1	Jun (xxx.x)
37-41	F5.1	Jul (xxx.x)
42-46	F5.1	Aug (xxx.x)
47-51	F5.1	Sep (xxx.x)
52-56	F5.1	Oct (xxx.x)
57-61	F5.1	Nov (xxx.x)
62-66	F5.1	Dec (xxx.x)

Note: Includes some negative values.

---



Appendix A.3 Table 4. WRLEVEL. Lake Nerka lake level (cm) by 5-day period.

Wood River/Kvichak Freshwater File:

Project: Wood River

File name: WRLEVEL

Period: 1952-1982

\*FORMAT\* (Input Data) 2 cards

<u>Col.</u>	<u>Format</u>	<u>Contents</u>
Card 1		
1- 7	I3,1X,I3	Beginning and ending Julian dates (5-day period)
8	I1	Card number 1
		<u>Lake level (cm)</u>
		<u>Year</u>
9-11	F3.0	1952
12-14	F3.0	1953
15-17	F3.0	1954
18-20	F3.0	1955
21-23	F3.0	1956
24-26	F3.0	1957
27-29	F3.0	1958
30-32	F3.0	1959
33-35	F3.0	1960
36-38	F3.0	1961
39-41	F3.0	1962
42-44	F3.0	1963
45-47	F3.0	1964
48-50	F3.0	1965
51-53	F3.0	1966
54-56	F3.0	1967
57-59	F3.0	1968
60-62	F3.0	1969
63-65	F3.0	1970
66-68	F3.0	1971
69-71	F3.0	1972

Appendix A.3 Table 4. - Continued.

---

<u>Col.</u>	<u>Format</u>	<u>Contents</u>
Card 2		
1- 7	I3,1X,I3	Beginning and ending Julian dates (5-day period)
8	I1	Card number 2
		<u>Lake level (cm)</u>
9-11	F3.0	1973
12-14	F3.0	1974
15-17	F3.0	1975
18-20	F3.0	1976
21-23	F3.0	1977
24-26	F3.0	1978
27-29	F3.0	1979
30-32	F3.0	1980
33-35	F3.0	1981
36-38	F3.0	1982

---

Note: Values of lake level in cm, including a few negative values.





Appendix A.3 Table 7. WRZOOPS. Zooplankton counts, Wood River lakes.

---

Wood River/Kvichak Freshwater File:

Project: Wood River  
File name: WRZOOPS

Period: 1967-1982

\*FORMAT\* (Input data)

<u>Col.</u>	<u>Format</u>	<u>Contents</u>
1- 3	I3	Lake code
4- 6	I3	Station code
7- 9	I3	Julian code
10-13	I4	Year
14-16	F3.0	Depth of haul (m)
<u>NUMBERS (100's·m<sup>-2</sup>)</u>		
<u>Zooplankton species</u>		
17-22	F6.0	<u>Diaptomus</u>
23-28	F6.0	<u>Eurytemora</u>
29-35	F7.0	<u>Total calanoids</u>
36-41	F6.0	<u>Cyclops</u>
42-44	F3.0	<u>Nauplii</u>
45-50	F6.0	<u>Daphnia</u>
51-56	F6.0	<u>Bosmina</u>
57-60	F4.0	<u>Holopedium</u>
61-63	F3.0	<u>Asplanchna</u>
64-66	F3.0	<u>Kellicotia</u>
67-71	F5.0	<u>Total Rotifers</u>

---

Note: Values 100/m<sup>2</sup>.





Appendix A.3 Table 9 - continued.

<u>Col.</u>	<u>Format</u>	<u>Contents</u>
		<u>Mean Length (mm)</u>
61	I1	BT reading
62	I1	Plankton sample
63	I1	Remarks
64-66	F3.0	Sockeye fry
67-70	F4.0	Sockeye yearling
71-73	F3.0	Age I threespine sticklebacks







Appendix A.3 Table 13. KDISCH. Daily discharge rates of Kvichak and Newhalen rivers.

Wood River/Kvichak Freshwater File:

Project: Kvichak  
File Name: KDISCH

Period: Newhalen River  
1952-1967, 1982  
Kvichak River 1967-  
1982

\*FORMAT\* (Input Data)

Col.	Format	Contents
Card 1		
1- 3	I3	Julian date
4	I1	Card number 1
5-16	A12	Stream code (ADF&G)

DISCHARGE RATE (cfs)  
Year

17-21	F5.0	1967
22-26	F5.0	1968
27-31	F5.0	1969
32-36	F5.0	1970
37-41	F5.0	1971
42-46	F5.0	1972
47-51	F5.0	1973
52-56	F5.0	1974
57-61	F5.0	1975
62-66	F5.0	1976
67-71	F5.0	1977
72-76	F5.0	1978

Card 2

1- 3	I3	Julian date
4	I1	Card number 2
5-16	A12	Stream code (ADF&G)

DISCHARGE RATE (cfs)  
Year

17-21	F5.0	1979
22-26	F5.0	1980
27-31	F5.0	1981
32-36	F5.0	1982









Appendix A.3 Table 18. KCHLOR. Chlorophyll a concentrations ( $\text{mg}\cdot\text{m}^{-3}$ ) by depth, Iliamna Lake and Lake Clark.

Wood River/Kvichak Freshwater File:

Project: Kvichak  
File name: KCHLOR

Period: 1961-1982

\*FORMAT\* (Input Data)

<u>Col.</u>	<u>Format</u>	<u>Contents</u>
1- 3	I3	Lake code
4- 6	I3	Station code (numeric system)
7- 9	F3.0	Julian date
10-13	I4	Year

CONCENTRATION CHLOROPHYLL a ( $\text{mg}\cdot\text{m}^{-3}$ )  
Depth

14-18	F5.2	0 m (xx.xx)
19-23	F5.2	1 m (xx.xx)
24-28	F5.2	2 m (xx.xx)
29-33	F5.2	3 m (xx.xx)
34-38	F5.2	4 m (xx.xx)
39-43	F5.2	5 m (xx.xx)
44-48	F5.2	7 m (xx.xx)
49-53	F5.2	10 m (xx.xx)
54-58	F5.2	15 m (xx.xx)
59-63	F5.2	20 m (xx.xx)
62-67	F4.2	25 m (x.xx)
68-71	F4.2	30 m (x.xx)
72-75	F4.2	35 m (x.xx)
76-79	F4.2	45 m (x.xx)
80-82	I2	Bottom depth sampled

Note: For station 158 (Six-mile Lake), chlorophyll a value at bottom depth sampled is coded into 10 m field (col. 49-53).

Appendix A.3 Table 19. KCHLVAR. Spectronic 20 readings for chlorophyll a of filtered water samples, Iliamna Lake variability studies (raw data).

Wood River/Kvichak Freshwater File:

Project: Kvichak  
File name: KCHLVAR

Period: 1970

\*FORMAT\* (Input Data)

<u>Col.</u>	<u>Format</u>	<u>Contents</u>
1- 7	F7.0	Sample number
8-10	I3	Station code (numeric system)
11-13	I3	Julian date
14-15	I2	Year
16-19	F4.1	Depth
20-23	F4.2	Volume (liters), water filtered
24-27	F4.2	Volume (ml), acetone
28-29	F2.1	Cell length (cm)

SPECTRONIC 20 ABSORBANCE READINGS

30-32	F3.3	Wavelength 750 nm
33-35	F3.3	" 665 nm
36-38	F3.3	" 645 nm
39-41	F3.3	" 630 nm
42-44	F3.3	" 510 nm
45-47	F3.3	" 480 nm
48-49	I2	Control

Appendix A.3 Table 20. KCHLVPR. Chlorophyll a concentration ( $\text{mg}\cdot\text{m}^{-3}$ ) by depth Iliamna Lake variability studies (processed data).

---

Wood River/Kvichak Freshwater File:

Project: Kvichak  
 File name: KCHLVPR  
 Period: 1970

\*FORMAT\* (Input Data)

<u>Col.</u>	<u>Format</u>	<u>Contents</u>
1- 3	I3	Station code (numeric system)
6- 8	I3	Julian date
9-10	I2	Year
<u>CONCENTRATION CHLOROPHYLL <u>a</u> (<math>\text{mg}\cdot\text{m}^{-3}</math>)</u>		
<u>Depth</u>		
11-15	F5.2	1 m
16-20	F5.2	2 m
21-25	F5.2	3 m
26-30	F5.2	4 m
31-35	F5.2	5 m
36-40	F5.2	7 m
41-45	F5.2	10 m
46-50	F5.2	15 m
51-55	F5.2	25 m
56-60	F5.2	35 m
61-65	F5.2	45 m

---

Appendix A.3 Table 21. KPERI. Chlorophyll a ( $\text{mg}\cdot\text{m}^{-2}$ ) littoral periphyton, Iliamna Lake.

Wood River/Kvichak Freshwater File:

Project: Kvichak  
File name: KPERI

Period: 1972-1982

\*FORMAT\* (Input Data)

<u>Col.</u>	<u>Format</u>	<u>Contents</u>
1- 2	I2	Year
3- 5	I3	Station code (numeric system)
6- 8	I3	Set date: Julian date start of slide incubation
9-11	I3	Sample date: Julian date removal of slide(s) for analysis
12-14	F3.1	Water temp. °C
15-18	F4.1	Depth of slide rack (cm) at sampling depth
19-25	F7.0	Chlorophyll <u>a</u> ( $\text{mg}\cdot\text{m}^{-2}$ )*

\*Calculation of mg chlorophyll a/ $\text{m}^2$

$$\text{Chlorophyll } \underline{a} = 11.6 (D_{665} - D_{750}) - .14 (D_{630} - D_{750}) - 1.31 (D_{645} - D_{750})$$

$$\text{Chlorophyll } \underline{a}/\text{m}^2 = [\text{chlorophyll } \underline{a}] \left[ \frac{\text{ml acetone extract}}{\text{surface area of substrate } \text{m}^2} \right]$$

$$\text{Surface area } 50 \times 75 \text{ mm slide} = 0.007500 \text{ m}^2$$



Appendix A.3 Table 23. KC14ASM. Carbon 14 assimilation rates ( $\text{mg C}\cdot\text{m}^{-3}\cdot\text{4h}^{-1}$ ) by depth and station depth weighted mean.

---

Wood River/Kvichak Freshwater File:

Project: Kvichak  
 File Name: KC14ASM  
 Period: Iliamna Lake  
 1962-1969

\*FORMAT\* (Input Data)

<u>Col.</u>	<u>Format</u>	<u>Contents</u>
1- 3	I3	Station code (numeric system)
6- 8	I3	Julian date
9-10	I2	Year
<u><math>^{14}\text{C}</math> ASSIMILATION RATES (<math>\text{mg C}\cdot\text{m}^{-3}\cdot\text{4h}^{-1}</math>)</u>		
<u>Depth</u>		
11-15	F 5.2	1 m
16-20	F 5.2	2 m
21-25	F 5.2	3 m
26-30	F 5.2	4 m
31-35	F 5.2	5 m
36-40	F 5.2	7 m
41-45	F 5.2	10 m
46-50	F 5.2	15 m
51-55	F 5.2	25 m
56-60	F 5.2	35 m
61-65	F 5.2	45 m
66-70	F 5.2	Depth weighted mean

---

Appendix A.3 Table 24. KC14SUP. Secchi depth and solar radiation data associated with Iliamna Lake carbon 14 assimilation measurements.

---

Wood River/Kvichak Freshwater File:

Project: Kvichak  
 File name: KC14SUP  
 Period: 1962-1969

\*FORMAT\* (Input Data)

<u>Col.</u>	<u>Format</u>	<u>Contents</u>
1- 3	I3	Station code (numeric system)
6- 8	I3	Julian date
9-10	I2	Year
11-15	F5.1	Secchi disk depth reading (m)
16-20	F4.1	Pyrheliometer readings as solar energy input at lake surface ( $\text{g}\cdot\text{cal}\cdot\text{cm}^{-2}$ ) during time of incubation - 4 hours

---



Appendix A.3 Table 26. KZWDTSV. Zooplankton dry weight and settled volume, Iliamna Lake and Lake Clark.

---

Wood River/Kvichak Freshwater File

Project: Kvichak  
File name: KZWDTSV

Period: 1961-1973

\*FORMAT\* (Input Data)

<u>Col.</u>	<u>Format</u>	<u>Contents</u>
1- 2	I2	Lake code
3- 5	I3	Julian date
6- 7	I2	Year
8-11	I4	Time
12-14	I3	Sample (haul) number
17-19	I3	Station code (numeric system)
20-21	I2	Gear
22	I1	Haul type (1 = vertical)
23-25	I3	Depth at start of haul
26-28	I3	Depth at end of haul
29-31	I3	Depth of station
32-34	I3	Duration of tow (seconds)
35-38	I4	Flowmeter number
39-42	I4	Flowmeter reading
43-48	F6.4	Filter dry weight (x.xxxx)
49-54	F6.4	Filter + sample dry weight (x.xxxx)
55-60	F6.4	Dry weight, sample (x.xxxx)
61-64	F4.1	Settled volume (ml)*

---

Note: 1974-1982 data to be added.

\*Settled volume only for years 1975-1982.

Appendix A.3 Table 27. KBSRAW. Beach seine log and length frequency data, Iliamna Lake (raw data).

Wood River/Kvichak Freshwater File

Project: Kvichak  
File name: KBSRAW

Period: 1964-1982

Note: This file consists of beach seine catch and length measurement data. For each year the file contains sets of beach seine catch and length frequency cards. The beach seine catch cards are keypunched from Kvichak Towntet and Beach Seine Log Form S27.1A or S27.1B. The length frequency cards are keypunched from Small Fish Measurement Form S16.2 or S16.2A. The formats of the beach seine catch and fish measurement data follow.

\*FORMAT\* (Input Data)

Beach seine card(s) Form S27.1A or S27.1B

<u>Col.</u>	<u>Format</u>	<u>Contents</u>
1- 3	I3	Beach seine haul or sample number
4- 5	I2	Lake section
6- 8	I3	Station number (numeric system)
13-18	3 I2	Month, day, year
24	I1	Gear type, 3 = beach seine
34-36	F3.1	Surface water temperature (°C)

Catch Data

37-41	F5.0	Sockeye Age 0+
42-46	F5.0	Sockeye Age I+
47-51	F5.0	Threespine sticklebacks
52-56	F5.0	Ninespine sticklebacks
57-61	F5.0	Least ciscos
62-66	F5.0	Sculpin
72-75	F4.2	Total weight, or dippers full
76-79	F4.2	Subsample weight or dippers full
80	I1	Remarks code 9 denotes lengths on length frequency cards are live lengths

Length Frequency Card(s) Form S16.2 or S16.2A

<u>Col.</u>	<u>Format</u>	<u>Contents</u>
1-72	12(2F3.0)	Frequency, length (mm)
73	I1	Species code*
74-76	I3	Haul, or sample number
77-79	I3	Station

Appendix A.3 Table 27 - continued.

\*Species Code

- 1 Sockeye fry Age 0+
- 2 Sockeye yearling, age I+
- 3 Threespine sticklebacks
- 4 Ninespine sticklebacks
- 5 Least ciscos
- 9 Sculpin

Note: Catches of miscellaneous other species, e.g., pond smelt, char fry, recorded on field forms but not included in this data file.





## Appendix A.3 Table 29 - continued.

Catch - continued

<u>Col.</u>	<u>Format</u>	<u>Contents</u>
72-75	F4.2	Total weight or dippers full of catch
76-79	F4.2	Subsample weight of dippers full
80	I1	Remarks code, 9 denotes lengths on length frequency cards are live lengths.

Length Frequency Card(s) Form S16.2 or S16.

<u>Col.</u>	<u>Format</u>	<u>Contents</u>
1-72	12(2F3.0)	Frequency, length (mm)
73	I1	Species code**
74-76	I3	Tow number
77-79	I3	Lake area

---

\*See Appendix B.1

\*\*Species Code:

- 1 Sockeye fry Age 0+
- 2 Sockeye yearlings, Age I+ or Age II+
- 3 Threespine sticklebacks
- 4 Ninespine sticklebacks
- 5 Least ciscos

Note: Catches of miscellaneous other species, e.g., pygmy whitefish, arctic lamprey, etc. recorded but not consistently coded in this data file.



## Appendix A.3 Table 30 - continued.

<u>Col.</u>	<u>Format</u>	<u>Contents</u>
		<u>Mean Live Lengths &amp; Sample Size*</u> - continued
87-91	F5.1	Mean length ninespine sticklebacks
92-95	F4.0	Number measured ninespine sticklebacks
96-100	F5.1	Mean length least ciscos
101-104	F4.0	Number measured least ciscos

---

\*In accordance with standard output of program FRK317R (Analysis of Kvichak Townet Data - Revised) the catch data is adjusted to a 20-minute tow, and the lengths are adjusted to represent live lengths if the specimens were preserved.







Appendix A.3 Table 34. KSGINDX. Spawning ground peak index counts for individual Kvichak spawning areas.

---

Wood River/Kvichak Freshwater File:	Project: Kvichak
	File name: KSGINDX
	Period: 1920-1982

\*FORMAT\* (Input Data)

<u>Col.</u>	<u>Format</u>	<u>Contents</u>
1- 2	I2	Data code (11 = spawning ground)
3-17	A15	Area identification*
19-20	I2	Year
21-22	I2	Month
23-24	I2	Day
26	I1	Survey type code*
27	I1	Spawning area type code*
29-39	A11	Extent of survey (miles when numeric)
41-47	F7.0	Estimated index live fish (all live fish)
48-55	F8.0	Estimated index dead fish
56-61	F6.0	Estimated index schooled fish
62-69	F8.0	Estimated total index (total live and dead)
70	A1	Remarks notation
71	I1	Observation conditions code* (quality of survey)
73-75	F3.0	Estimated date of peak spawning (Julian date)
77-79	A3	Observer code*

---

\*See Appendix B.3.

Appendix B. Explanatory code lists related to Wood River/  
Kvichak data files.

Appendix B.1. Wood River/Kvichak Freshwater File general codes.

---

Lake Codes:

01 = Aleknagik  
 02 = South Nerka  
 03 = North Nerka  
 04 = Little Togiak  
 05 = Beverley and Mikchalk  
  
 06 = Kulik  
 07 = Nunavaugaluk (Snake)  
 08 = Amanka  
 09 = Ualik  
 10 = Tikchik  
  
 11 = Nuyakuk  
 12 = Chauekuktuli  
 13 = Iliamna  
 14 = Clark  
 15 = Kijik  
  
 16 = Gibraltar  
 17 = Chignik  
 18 = Black  
 19 = Central Nerka

Gear Codes:

Plankton

06 = #6 mesh (223  $\mu$ )  
 10 = #10 mesh (130  $\mu$ )  
 20 = #20 mesh (73  $\mu$ )

Tow Net/Beach Seine

3 = Beach seine  
 4 = Tow Net 9 x 9 ft

Haul Type Codes:

Plankton

1 = vertical  
 2 = oblique

Tow Net/Beach Seine

1 = Horizontal

Appendix B.1. Wood River/Kvichak Freshwater File general codes - cont'd.

---

WEATHER:Sky Cover

0 = no observation  
1 = clouds covering not more than 1/10 of sky  
2 = clouds covering not more than 1/2 of sky  
3 = clouds covering more than 1/2 of sky  
4 = fog or thick haze  
5 = intermittent rain  
6 = continuous rain  
7 = snow or rain and snow mixed  
8 = hail  
9 = thunderstorm with or without precipitation

Light

0 = no observation  
1 = daylight  
2 = twilight  
3 = dark  
4 = moderate moonlight  
5 = bright moonlight

Wind Direction

0 = no wind  
1 = NE  
2 = East  
3 = SE  
4 = South  
5 = SW  
6 = West  
7 = NW  
8 = North  
9 = no observation

---

## Appendix B.2. Codes Kvichak File KSPRAW.

---

<u>Column Number(s)</u>	<u>Type of entry</u>	<u>Title</u>	<u>Explanation</u>
1,2	#	Lake	13 Iliamna
4,5	#	Area	14 Clark
			15 Kijik
			16 Gibraltar
			1 Canyon Creek
			2 Chinkelyes Creek (Iliamna River)
			3 Copper River
			4 Finger Beach
			5 Finger Beach #1
			6 Finger Beach #2
			7 Finger Beach #3
			8 Flat Island
			9 Flat Island #1
			10 Flat Island #2
			11 Flat Island #3
			12 Gibraltar Creek
			13 Gibraltar Lake beach
			14 Hudson's Ponds
			15 Iliamna River
			16 Iliamna River left fork
			17 Iliamna River right fork
			18 Kijik Lake
			19 Knutson Bay
			20 Newhalen River
			21 Nondalton Fishery
			22 Pedro Bay Ponds
			23 Southeast Beaches
			24 Tanalian River
			25 Tommy Beach
			26 Tommy River
			27 Tommy Springs
			28 Wolf Creek Ponds
			29 Woody Island
			30 Woody Island #1
			31 Woody Island #2
			32 Woody Island #3
			33 NW Woody Island #1
			34 NW Woody Island #2
			35 Lower Talarik Creek

## Appendix B.2. Codes of Kvichak File KSPRAW - cont'd.

---

<u>Column Number(s)</u>	<u>Type of entry</u>	<u>Title</u>	<u>Explanation</u>
			36 Triangle Island
			37 Porcupine Island
			38 Lonesome Bay
			39 Tazimina River
7	#	Type of spawning area	1 Rivers
			2 Creeks
			3 Mainland beaches
			4 Island beaches
			5 Ponds
			6 Gill net Fishery
18	#	Type of measure- ment	1 ME-FT
			2 TS-FT
			3 ME-HP
19	#	Sex	1 Male
			2 Female

---

## Appendix B.3 Codes Kvichak File KSGINDEX.

AREA IDENTIFICATION CODES

11LO.TALRK.CK.ALL = LOWER TALARIK CREEK-ALL (BOTH FORKS+MAIN STEM)  
 11MID.TALARIK CK. = MIDDLE TALARIK CREEK  
 11UP.TALARIK CK. = UPPER TALARIK CREEK  
 11PETE ANDREW CK. = PETE ANDREW CREEK  
 11CAR CREEK  
 11ROADHOUSE CK. = ROADHOUSE CREEK  
 11HUDSONS CK+PDS = HUDSONS CREEK PLUS HUDSONS PONDS  
 11NW.EAGLE BAY CK. = NORTHWEST EAGLE BAY CREEK  
 11NE.E-BAY CK+PDS = NORTHEAST EAGLE BAY CREEK PLUS NORTHEAST EAGLE BAY  
 CREEK PONDS  
 11NE.EAGLE BAY CK. = NORTHEAST EAGLE BAY CREEK  
 11NE.E-BAY CK.PDS. = NORTHEAST EAGLE BAY CREEK PONDS  
 11YOUNGS CREEK  
 11CHEKOK CR.+PONDS = CHEKOK CREEK PLUS CHEKOK PONDS  
 11TOMKOK CREEK  
 11PRINCE CK.PONDS = PRINCE CREEK AND PRINCE CREEK PONDS  
 11CANYON CREEK  
 11CANYON SPRINGS = CANYON CREEK SPRING AREA  
 11WOLF CREEK PONDS  
 11MINK CREEK  
 11KNUTSON CREEK  
 11KNUTSON PONDS  
 11PEDRO CK+PONDS = PEDRO CREEK PLUS BOTH EAST AND WEST PEDRO PONDS  
 11RUSSIAN CREEK  
 11DUMBELL LAKES = DUMBELL LAKES (SOURCE OF RUSSIAN CREEK)  
 11PILE RIVER  
 11SWAMP CREEK  
 11ILIAMNA R.(ALL) = ILIAMNA RIVER-ALL (MAIN STEM, RIGHT FORK AND LEFT FORK)  
 11ILIAMNA R. L-FK. = ILIAMNA RIVER LEFT FORK ONLY  
 11ILIAMNA R. R-FK. = ILIAMNA RIVER RIGHT FORK ONLY  
 11BEAR CR.+ PONDS = BEAR CREEK AND PONDS (ILIAMNA RIVER)  
 11FALSE CREEK = FALSE CREEK (ILIAMNA RIVER)  
 11CHINKELYES CREEK = CHINKELYES CREEK (ILIAMNA RIVER)  
 11JACK DURAND CK. = JACK DURAND CREEK  
 11SURPRISE CREEK = SURPRISE CREEK (PORCUPIE ISLAND)  
 11SQUIRREL VIL.CK. = SQUIRREL VILLAGE CREEK  
 11TOMMY RIVER  
 11TOMMY SPRINGS = TOMMY RIVER SPRING AREA  
 11TOMMY R+BCH+SPGS = TOMMY RIVER, BEACHES, AND SPRINGS COMBINED  
 11NANCY CREEK  
 11POPE CREEK  
 11NICK G. CREEK  
 11COPPER RIVER  
 11ALEC FLYUM CREEK  
 11BEAR CK(KAK.BAY) = BEAR CREEK IN KAKHONAK BAY  
 11KAKHONAK RIVER  
 11CABIN CREEK  
 11GRANITE CREEK  
 11LAKE CREEK  
 11NICK N. CREEK  
 11CAMP CREEK  
 11DENNIS CREEK  
 11BELINDA CREEK

## Appendix B.3 Codes Kvichak File KSGINDX-- continued.

AREA IDENTIFICATION CODES

11GIBRALTAR CREEK = GIBRALTAR CREEK (KAKHONAK CREEK)  
 11LIL.GIBRALTAR CK = LITTLE GIBRALTAR CREEK (GIBRALTAR CREEK)  
 11LEON CREEK = LEON CREEK (GIBRALTAR CREEK)  
 11DREAM CREEK  
 11SOUTHEAST CREEK  
 11TROUT CREEK  
 11GIB.NO.1 PONDS = GIBRALTAR NO.1 PONDS  
 11GIB. LK. BEACHES = GIBRALTAR LAKE BEACHES--ALL  
 11NEWHALEN RIVER  
 11LOVERS CREEK = LOVERS CREEK (NEWHALEN RIVER)  
 11LIL. BEAR CK+PD = LITTLE BEAR CREEK AND POND(S) (NEWHALEN RIVER)  
 11ALEXI CREEK = ALEXI CREEK (NEWHALEN RIVER)  
 11ALEXI LAKES = ALEXI LAKES (ALEXI CREEK-NEWHALEN RIVER)  
 11STEAM BATH CREEK = STEAM BATH CREEK-NEWHALEN RIVER  
 11TAZIMINA RIVER = TAZIMINA RIVER (NEWHALEN RIVER)  
 11PICKEREL CREEK = PICKEREL CREEK (NEWHALEN RIVER)  
 11PICKEREL LAKES = PICKEREL LAKES (NEWHALEN RIVER)  
 11SIX MILE LK.BCHS = SIX MILE LAKE BEACHES (NEWHALEN RIVER)  
 11KIJIK RIVER  
 11LITTLE KIJIK R. = LITTLE KIJIK RIVER  
 11KIJIK LK.TRIBS. = KIJIK LAKE TRIBUTARIES  
 11PRIEST RK.CK+PDS  
 11TLIKAKILA RIVER  
 11CHOKOTONK RIVER  
 11CURRANT CREEK  
 11TANALIAN RIVER  
 1122 CREEK  
 11NO.SHORE BEACHES = NORTH SHORE BEACHES (INCLUDES EAGLE BAY, KNUTSON BAY,  
 PEDRO BAY, PEDRO PENINSULA, LINCOLN ROCK, AND LONESOME  
 BAY MAINLAND BEACHES)  
 11EAGLE BAY = EAGLE BAY MAINLAND BEACHES  
 11KNUTSON BAY = KNUTSON BAY MAINLAND BEACHES  
 11PEDRO PENINSULA = MAINLAND BEACHES ALONG THE SOUTH SIDE OF PEDRO MOUNTAIN  
 WEST OF PEDRO ISLAND GROUP  
 11PEDRO BAY BEACHES = MAINLAND BEACHES OF PEDRO BAY EXTENDING TO PEDRO  
 ISLAND GROUP  
 11LINCOLN ROCK = LINCOLN ROCK MAINLAND BEACHES (PILE BAY)  
 LONESOME BAY = LONESOME BAY MAINLAND BEACHES  
 11SO.SHORE BEACHES = SOUTH SHORE BEACHES (INCLUDES PILE BAY, FINGER, SOUTH-  
 EAST, SOUTHSHORE, TOMMY, INTRICATE BAY, AND KAKHONAK,  
 BAY MAINLAND BEACHES)  
 11PILE BAY = PILE BAY MAINLAND BEACHES EXTENDING FROM PILE BAY VILLAGE WEST  
 TO FINGER BEACHES  
 11FINGER BEACHES = FINGER BEACHES--ALL (INCLUDES NOS. 1,2, AND 3)  
 11FING.BEACH NO.1 = FINGER BEACH NO.1  
 11FING.BEACH NO.2 = FINGER BEACH NO.2  
 11FING.BEACH NO.3 = FINGER BEACH NO.3  
 11SOUTHEAST BCHS. = SOUTHEAST BEACHES (MAINLAND BEACHES THAT EXTEND BETWEEN  
 FINGER BEACHES AND SQUIRREL VILLAGE CREEK)  
 11SOUTHSHORE BCHS. = SOUTHSHORE BEACHES (MAINLAND BEACHES BETWEEN SQUIRREL  
 POINT AND TOMMY BEACHES)  
 11TOMMY BEACHES = TOMMY BEACHES (MAINLAND BEACHES ADJACENT TO TOMMY RIVER)  
 11INTR.BAY BEACHES = INTRICATE BAY MAINLAND BEACHES  
 11KAKHONAK BEACHES = KAKHONAK BAY MAINLAND BEACHES  
 11SUCKER BAY LAKE = SUCKER BAY LAKE BEACHES

## Appendix B.3 Codes Kvichak File KSGINDX - continued.

AREA IDENTIFICATION CODES

11KIJIJK LK. BEACHES = KIJIK LAKE BEACHES  
 11LAKE CLK.BEACHES = LAKE CLARK BEACHES (MAINLAND)  
 11ISLAND BEACHES = ALL ISLAND BEACHES OF ILIAMNA LAKE  
 11RABBIT IS. GROUP = RABBIT ISLAND GROUP  
 11EAGLE IS. GROUP = EAGLE ISLAND GROUP  
 11TRIANGLE IS.GROUP = TRIANGLE ISLAND GROUP  
 11TRIANGLE NO.1 = TRIANGLE ISLAND BEACH NO. 1  
 11TRIANGLE NO.2 = TRIANGLE ISLAND BEACH NO. 2  
 11TRIANGLE NO.3 = TRIANGLE ISLAND BEACH NO. 3  
 11TRIANGLE NO.4 = TRIANGLE ISLAND BEACH NO. 4  
 11HALWY.ISD.+REEFS = HALFWAY ISLAND AND ADJACENT REEFS  
 11SEAL ROOKERY IS. = SEAL ROOKERY ISLAND  
 11E-2 IS. GROUP = E-2 ISLAND GROUP  
 11KNUTSON ISLANDS = KNUTSON ISLANDS (LARGE OUTSIDE ISLANDS)  
 11KNUTSON ISLETS = KNUTSON ISLETS (JUST WEST PEDRO PENINSULA)  
 11HED.ISDS+KN.ISLS = HEDLUNDS ISLANDS AND KNUTSON ISLETS COMBINED  
 11HEDLUNDS ISLANDS = HEDLUNDS ISLANDS (FAR WEST END KNUTSON BAY)  
 11WOODY ISLAND = WOODY ISLAND PROPER  
 11FLAT ISLAND NO.1 = FLAT ISLAND NO.1 (KNOWN AS FUEL DUMP ISLAND+NARROWS)  
 11FLAT ISLAND NO.2  
 11FLAT ISLAND NO.3  
 11N.W. WOODY NO.1 = NORTHWEST WOODY NO.1  
 11N.W. WOODY NO.2 = NORTHWEST WOODY NO.2  
 11S.W. WOODY NO.1 = SOUTHWEST WOODY NO.1  
 11S.W. WOODY NO.2 = SOUTHWEST WOODY NO.2  
 11S.W. WOODY NO.3 = SOUTHWEST WOODY NO.3  
 11S.W. WOODY NO.4 = SOUTHWEST WOODY NO.4  
 11PEDRO BAY ISDS. = PEDRO BAY ISLANDS (GROUP OF ISLANDS SW. END PEDRO BAY)  
 11PORCUPINE IS. GRP = PORCUPINE ISLAND GROUP  
 11ROSS IS. GROUP = ROSS ISLAND GROUP  
 11MIDDLE ISLANDS = MIDDLE ISLANDS (ISLANDS AND ROCKS SW.OF TRIANGLE ISLAND)  
 11INTR.BAY ISLANDS = INTRICATE BAY ISLANDS  
 11KAK.B.ISLANDS = KAKHONAK BAY ISLANDS

TYPE OF SPAWNING AREA

- 1 = STREAM
- 2 = POND OR SPRINGS
- 3 = ISLAND BEACH
- 4 = MAINLAND BEACH

OBSERVATION CONDITIONS

- |                            |                  |                        |
|----------------------------|------------------|------------------------|
| 0 = UNKKNOWN               | 4 = FAIR TO POOR | 8 = VERY GOOD          |
| 1 = TOO POOR FOR SURVEY    | 5 = FAIR         | 9 = EXCELLENT OR IDEAL |
| 2 = VERY POOR-WATER TURBID | 6 = FAIR TO GOOD |                        |
| 3 = POOR                   | 7 = GOOD         |                        |

OBSERVER CODE

- |                                   |                               |
|-----------------------------------|-------------------------------|
| JWA = JOHN W. ANDERSON (FRI)      | OAM = OLE A. MATHISEN (FRI)   |
| CDB = CLARENCE D. BECKER (FRI)    | JCO = JAMES C. OLSEN (FRI)    |
| JRD = JOHN R. DONALDSON (FRI)     | RFO = RUSS F. OPPELL (FRI)    |
| RLD = ROBERT L. DEMORY (FRI)      | LAP = LOYD A. PHINNEY (FRI)   |
| BCF = BUREAU COMMERCIAL FISHERIES | PHP = PAT H. POF (FRI)        |
| JRG = JOHN R. GILBERT (FRI)       | REP = RAY E. PARKS (FRI)      |
| DRH = DON R. HEINLE (FRI)         | RBR = RICH B. RUSSELL (ADF+G) |
| OEK = ORRA E. KERNS (FRI)         | HDS = HOWARD D. SMITH (FRI)   |
| DWL = D. WAYNE LINN (FRI)         | EPW = E. PHIL WRIGHT (FRI)    |

SURVEY TYPE

- 1 = AERIAL
- 2 = GROUND
- 3 = SCUBA
- 4 = BOAT

Appendix C. DATALIB

```

0  0  000  0000  00000  00000  0000  0  0
00  0  0  0  0  0  0  0  0  0  0
0  0  0  0  0  0000  0000  0  000  00000
0  00  0  0  0  0  0  0  0  0  0
0  0  000  0  0  0  00000  0000  0  0

```

NI53

Technical Report 80

USER'S GUIDE  
DATALIB DATA MANAGEMENT SYSTEM

Version 2.2

Alan Lindsay, David Somerton and James Buss

This is a revision of an informal report of preliminary research results of NORFISH -- a project supported by University of Washington Sea Grant. It is intended for University of Washington use only and no distribution or reproduction should be made without permission from the NORFISH program director.

NOTICE: This NOS/BE document applies, with few changes, to the NOS system. For changes to the examples, see our Conversion Guide, which can be obtained by following the instructions in the latest Academic Computer Center NewsLetter. The NewsLetter also contains an up-to-the-minute NOS calling sequence.

## Table of Contents

1.	INTRODUCTION .....	1
2.	THE DIRECTORY .....	3
3.	DATALIB FUNCTIONS .....	6
	DEDIT .....	8
	CODES .....	11
	DIRECT .....	11
	GETFILE .....	12
	PUTFILE .....	12
	ACCESS .....	13
	RANDOM .....	18
	SORT .....	20
4.	QUERY .....	21
5.	HOW TO BUILD A DIRECTORY .....	24
6.	HOW TO RUN DATALIB .....	26
7.	APPENDIX 1--ERROR MESSAGES .....	27
8.	APPENDIX 2--DIRECTORY .....	29
9.	APPENDIX 3--SAMPLE SESSION .....	38

## INTRODUCTION

DATALIB is a utility designed for creating, maintaining, and manipulating libraries of data and program files on the University of Washington's CDC computer system. It provides two basic capabilities routinely needed by those who deal with a large number of program and data files stored on tapes or user disk packs, and by those who deal with large data files. First, it keeps track of the size, location, and format of data and program files, and the tapes or disk packs on which these files are stored. Second, it selectively retrieves subsets of data from files, sorts files, and copies tape or disk pack files to and from the system disk.

The hub of DATALIB is a directory containing information about your data and program files such as their name, location, and format. DATALIB includes an interactive editor for building and maintaining this directory. The directory is used by the various DATALIB functions for data retrieval and sorting and can be summarized for reference or interactively queried at any time during a DATALIB session.

By keeping track of the location of data and program files, the directory eliminates the need to have these files physically contiguous on one storage medium. A library of data and program files can thus be comprised of files residing on any number of tapes or user disk packs or on the system disk. Your files are organized by name, and when you retrieve them you don't need to worry which tape they're on, or where on the tape--the directory provides that information. You supply just the file name, and DATALIB generates the appropriate tape job and submits it to the CDC batch system.

Unlike other data and file management programs currently available (e.g., SIR, System 2000, UPDATE, BACKUP, FILESET), DATALIB does not transform your files into any special format; they are kept in standard BCD or card image form.[1] Since data and program files remain untouched, the initial setup cost of a library is only that of creating a directory, your tapes are preserved in a form readable by anyone, and retrieval takes the form of only a simple copy. Retrieval of your programs and data in the distant future or on another machine does not depend upon the continued, compatible availability of (e.g.) BACKUP or UPDATE, or even NOS/BE. Card image form usually also minimizes your storage costs.

[1] "Cards" or "card images" are not limited to 80 columns; in fact DATALIB will handle card images up to 999 columns long. Beware, however, that other programs may not; for instance, MNF and SIMPLOT cannot read card images longer than 150 columns.

The various tasks of data management are accomplished by executing specific DATALIB functions. Many of these functions perform their tasks in a manner which will be recognized as familiar. For example, you may make a selective data retrieval from a tape in the following way: 1) a Fortran program is written which reads the file and writes to an output file those cards with some specified values in certain columns or fields; 2) control cards are then added to the program which mount and position a tape to the proper data file; 3) the completed job is submitted to the computer. The DATALIB function named ACCESS does all of this automatically, using the information stored in the directory.

Using ACCESS to retrieve selected subsets of information from a data file merely requires you to enter the name of the data file, which columns or fields to test, and the desired values of these fields. To make this whole process even simpler, columns, fields, and even specific values may be given names. Thus a statement equivalent to "columns 21-23 equal to 205" can be specified in DATALIB as "SPECIE .EQ. COD". The resulting DATALIB program will cost about one fourth as much as the standard Fortran program performing the same selective retrieval, and it will take you only a few moments to "write" the program--that is, to have DATALIB generate it for you.

For certain special situations, DATALIB permits yet more inexpensive random access retrievals, and allows you to keep multiple format card images together in the same file.

DATALIB is quite easy to use. Familiarity with permanent files is a prerequisite, however. We recommend the Academic Computer Center's Beginner's Guide to Permanent Files (Announcement 67). You should also be familiar with the rudiments of batch job creation and submission via Intercom; a good primer is Introduction to Intercom, Computer Center document W40.



having a unique copy number. There is one DATASET package in a directory for each dataset copy in the library; each copy is referenced by its dataset name and copy number. In backup and updating operations it is common to copy the complete contents of one tape to another. By defining the contents of a tape as a separate entity, the DATASET, we can avoid having to change the tape number of umpteen FILE packages when we execute these global copies.

Each DATASET package is associated with one other package describing the attributes of the storage medium on which the dataset resides. Two types of these packages, TAPE and DISK, contain such information as VSN number, set name, and permanent file name. An additional package type, ALTERNATE STORAGE, is used to document the location of ultimate backup copies of a dataset which are stored on cards, papertape, or listings and which are not directly accessible by the computer.

Following the format branch of the diagram, the first package type encountered is the FORMAT package. This package contains information about the format type of a data file, that is, whether the data can be read with a single format (card structured data) or if several formats must be used (case structured). More will be said about the format types of data files in a later section. Associated with a FORMAT package are a number of FIELD packages, each of which assigns a name to a specified column or field on a data card. These field names are conceptually the same as variable names used with read statements in a Fortran program or on an SPSS VARIABLE LIST command. A FIELD package may be in turn associated with a number of MNEMONIC packages, each assigning a name to a specific value which the field may assume. Mnemonics simplify the job of referencing coded values in a data file. For example, a species of fish like bass may be coded into the data as a "205". A MNEMONIC package could associate the value "205" with the mnemonic "BASS" which may be easier to recall than the value itself.

The independence of files, datasets, projects, formats, and codesets, is a design feature of DATALIB. You may mix files from different projects and files with different formats on the same dataset if you like. For instance, suppose we had three files of Alaska crab and Oregon shrimp catch data that shared the same format, and a Fortran program to summarize the data, in two separate versions for crab and shrimp. Our library might look like this:

<u>file</u>	<u>dataset</u>	<u>format</u>	<u>project</u>
CRAB76	A2	CRAB	ALASKA
SUMMC	A2	none	ALASKA
CRAB77	A6	CRAB	ALASKA
SHR77	XM	CRAB	OREGON
SUMMS	A2	none	OREGON

This allows you to store data and programs from several projects in

chronological or other haphazard order--as they come in or as they are finished--and still preserve project relationships and avoid duplication of format information. Additionally, mnemonics are collected in "codesets," each of which may be referenced from any number of formats and fields. You can store the set of mnemonics JAN, FEB, etc. only once, for instance, and reuse the same codeset whenever you specify a month field.

Each package has a unique name. For seven of the ten package types this name is specified as the first attribute of the package. The three exceptions, DATASET, FIELD, and MNEMONIC, require both the first and second attributes for a unique specification of the package name. The unique name of a package, as referred to in the sections on DEDIT and QUERY, is either the first and second attributes separated by a period for these three package types, or just the first attribute for the other seven.

Unfortunately a lot of nomenclature must be used to deal with the directory. To avoid later confusion there are several points to remember:

1. A package is a block of information of a specific package type, with a unique name
2. A directory may contain many packages of each type; individual packages are referenced by their unique names
3. Package types are referred to by codes which are listed in Appendix 2
4. Packages have attributes that contain information entered by yourself or whoever maintains the directory
5. Attributes have names by which they are referenced; these attribute names are listed for each package type in Appendix 2
6. The format of a file is a collection of information contained in a FORMAT package and its associated FIELD and MNEMONIC packages
7. A format name is synonymous with the name of a FORMAT package

By using DEDIT, QUERY, and CODES, you can deal with your directory entirely as though it were free-field. When you SAVE your directory from DEDIT, so you can catalog it as a permanent file, it is written out in fixed field card image form. You should keep a current listing of this file, so it could be keypunched in an emergency. You may copy your directory to tape, use DATALIB to PUTFILE it, or otherwise treat it as a standard card image file; it will still be usable to DATALIB when restored to the disk.

## DATALIB FUNCTIONS

DATALIB has the following eight functions:

- DEDIT - creates and modifies a directory
- CODES - summarizes the format of a data file
- DIRECT - selects a different directory file
- GETFILE - makes a permanent file copy of a data or program file stored on tape or other media
- PUTFILE - places a copy of a permanent file onto the end of a specified copy of a dataset
- ACCESS - selectively retrieves a subset of data from a file
- RANDOM - creates an index for a random access data file
- SORT - sorts a data file

The first three of these functions are completely interactive and are primarily concerned with managing a directory file. The last five functions interactively build batch jobs that perform their specific tasks. GETFILE and PUTFILE are tape-disk file management functions, the last three are data management functions.

Each function can be executed by entering the function name after the DATALIB prompt "DATALIB>". All functions except DEDIT automatically terminate and transfer control back to DATALIB after they have completed their specific tasks. DEDIT must be explicitly terminated by entering "END". If you find it necessary to exit from a function before normal termination, the universal abort command, "%A", may be entered; however, this transfers control back to Intercom and requires DATALIB to be restarted from the beginning. After terminating in this manner, any directory modified by DEDIT and not explicitly saved will be lost.

In executing a DATALIB function, you enter a dialog, supplying the information requested by prompts from the function. Most requests are self-explanatory; any which are not are discussed later, in the section for each specific function. The functions RANDOM, ACCESS, and SORT provide options that may be selected. If any option is desired you must first respond "YES" to the prompt "DO YOU WANT TO SELECT ANY OPTIONS", then enter the appropriate response to the prompt for each specific option. These options are discussed in the sections for each function. Functions that build batch jobs request the input of

several necessary control card parameters. The parameters that may be requested are shown below along with a sample response.

<u>JOB CARD PARAMETERS</u>	<u>SAMPLE ENIRY</u>
JOBNAME	TEST
CP TIME	50
I/O TIME	100
PRIORITY	3
ACCOUNT NO.	9XX54U08
PASSWORD	FAKE
OUTPUT FILE NAME	TEMPFIL
OUTPUT FILE ID	HOLD
RETENTION PERIOD	0

None of these parameters have preset default values; consequently some value must be entered for each. DATALIB also asks you if all is okay before it sends the job to the batch input queue. It will say "ROUTE TO INPUT?" to which you may respond with YES, NO, LIST, or SAVE. LIST will list the job at your terminal; SAVE will make a local file copy of the job so you can later examine it, modify it, resubmit it, or whatever you choose. After entering SAVE or LIST, the question is recycled so you must still answer YES or NO.

The DATALIB file and data management functions, such as GETFILE and ACCESS, require (with an exception or two) the presence of a directory. When you enter DATALIB, the local file you specify is indexed and copied to a random access scratch file. The DEDIT function alters this scratch file, but unless it is explicitly saved as a new local file (with the DEDIT command SAVE), it is lost when you leave DATALIB or when you replace it by executing a new DIRECT command. When you are using DATALIB, you may have a permanent file copy, one or more local file copies, and the scratch file copy of your directory, and they may all be different. When you execute DATALIB functions requiring a directory, you must keep in mind that it is the current scratch file copy that is used, whether it has been SAVED or not.

## DEDIT

Before DATALIB can be used to manipulate data files, certain information about these files must be incorporated into a directory. It is the user's responsibility to build this directory, and DEDIT is the tool which is used for this purpose. Directories are created or modified by entering DEDIT directives. These directives were styled after UEDIT, a file editing utility available on the University of Washington CDC Computer. However, unlike UEDIT, which treats a file as a single unit, DEDIT creates and modifies subunits of a directory file, the directory packages. Thus a directory is edited package by package.

DEDIT indicates that it is ready to process a directive by issuing the prompt "DEDIT>". This prompt is reissued after each directive has been successfully processed. After all editing has been completed, the user exits from DEDIT by entering "END".

The available DEDIT directives are listed below. Each of these directives consists of a directive name, which may be abbreviated with the underlined characters, followed by one or more arguments. In all of the following, "ptype" refers to a package type code (such as FILE or one of its acceptable abbreviations) and "name" refers to any valid package name (such as a valid FILENAME). See Appendix 2 for package type codes and package name specifications.

ADD,ptype=name  
adds a package to the directory.

ADDR,ptype=nam1  
repeatedly adds the same package type to the directory. For reasons discussed later, this directive can be used to enter only DATASET, FIELD and MNEMONIC packages. "nam1" is the first component of the two part unique "name" for these packages; that is, for field FMTNAME.FIELDNAME, "nam1" is FMTNAME.

CHANGE,ptype=name,attr=value,attr=value,...  
changes the contents ("value") of specified attributes within an existing package. "attr" refers to an attribute name appropriate to the specified package (see Appendix 2 for attribute names), and "value" is the new contents for the attribute. If "attr=value" is omitted, CHANGE behaves in a manner similar to ADD and ADDR; that is, input for each attribute is sequentially prompted. Any number of attributes may be specified.

DELETE,ptype=name  
deletes a package from the directory.

**LIST,ptype=name**

lists the names and contents of all attributes of a package.

**SAVE,fname[,O]**

saves the edited directory on a local file named "fname". The optional parameter "O" is an overwrite flag similar to that used in UEDIT. This parameter returns any local file by the name of "fname" before saving the directory.

**END**

terminates editing.

The directives ADD, ADDR, and CHANGE sequentially prompt the user for each attribute of the specified package type. These prompts consist of the attribute name followed by its current value. For ADD and ADDR, all attribute values are preset to blank. A user may respond to a prompt in any of three ways:

1. A value can be entered, which may be one or more blanks
2. An "=" can be entered, indicating the displayed attribute is to remain unchanged
3. An "==" can be entered, indicating the displayed attribute and all succeeding attributes in the package are to remain unchanged

Each of these responses is of course followed by a carriage return; if you enter a carriage return without a preceding value or at least a blank, nothing happens. When "attr=value" is included in a CHANGE directive, no values are prompted--only the specified attributes are changed. When textual information is entered into the TEXT attribute of any package, it must be preceded and terminated with quotes or some other delimiter in a manner similar to the ADD and INSERT directives in UEDIT. Valid delimiters are #, %, !, \*, ", &, \. To skip the TEXT attribute (ie, leave it null) on ADD and ADDR, you must enter two delimiters in a row, then carriage return. Up to 540 characters are allowed in a TEXT attribute.

ADDR is designed especially for entering a series of FIELD or MNEMONIC packages. For example, it is often the case that several mnemonics will be associated with one field. Since the MNEMONIC packages defining these mnemonics all have the same value for the first attribute (CODESET value) and are usually added to the directory sequentially, it is easier to enter all of the packages at one time using ADDR rather than singly using ADD. After the first package has been completely entered using ADDR, the first attribute of the next package is automatically filled and the second attribute is then displayed and ready for input. To terminate ADDR, you enter "%END" in response to the first prompt of a new package. If "%END" is entered at any other time in DEDIT, the current package is discarded and a new

package is begun.

If an edited directory has not been saved when "END" is entered, DEDIT issues a warning message. The user may then save the directory and reenter "END". In many situations the edited directory need not be saved. The edited directory is maintained on a scratch file which DATALIB functions reference in preference to the input directory. Thus, temporary changes to a directory may be made for the purpose of some special type of ACCESS retrieval. DEDIT may be entered at any time before either exiting from DATALIB or referencing a new directory with DIRECT, and the edited directory may be saved at that time.

In the following, several examples of DEDIT use are shown. Underscored lower case characters are entered by yourself.

1. Adding a package:

```

DEDIT> add,file=fish

PROJECT = norfish
DATASET = a1
FILEORD = 1
...
FORMAT = fmt1
-ENTER TEXT-
" fish data file "

DEDIT>

```

2. Changing the FILENAME and DATASET attributes in the above package:

```

DEDIT> change,file=fish

FILENAME = FISH = fish2
PROJECT = NORFISH = =
DATASET = A1 = a2
FILEORD = 1 = =

DEDIT>

```

3. Changing the same attributes the short way:

```

DEDIT> c,file=fish,filename=fish2,dataset=a2

DEDIT>

```

## CODES

CODES--short for CODESHEET--produces a summary of the format of a data file. This summary is arranged in a manner which is especially useful when you are writing ACCESS retrieval specifications. All FIELD names are listed alphabetically along with their column positions and any textual description. If any MNEMONICS are associated with a field, they are listed alphabetically with their values after the appropriate FIELD name. To have a summary made a user must supply the name of a local file to receive the CODES listing and the name of the format to be summarized.

## DIRECT

DIRECT is used to change directories during a DATALIB session. To get a new directory, you must enter the name of a local file containing the new directory. A note of caution: DIRECT overwrites the scratch copy of the previous directory, so it is destroyed if it was modified by DEDIT and not subsequently saved.

## GETFILE

GETFILE makes a permanent file disk copy of an entire data file from tape or user disk pack. You must provide a FILENAME whose location is fully documented in your directory, a permanent file name and ID for the new disk file, and various control card parameters for a batch job, in response to the appropriate prompts. The parameters are listed on page 7.

## PUTFILE

PUTFILE copies a permanent file onto the end of a specified copy number of a dataset. After the copy has been made, an ITEMIZE of the dataset is made. You must provide the name and ID of the permanent file, the DATASET code and copy number, and various control card parameters for a batch job (see page 7).

Once a successful copy has been made, it is your responsibility to DEDIT the directory to include the new file. At a minimum this would involve a new FILE package, and updating the NFILES attribute of the DATASET package. For clean recordkeeping, of course, you would also want to update the LENGTH, CHECKSUM, BLOCKS or SECTORS, and LASTMOD attributes.

## ACCESS

Those of you who deal with data files often find it necessary to extract a subset of data, with specific values in given fields, from a much larger file. ACCESS is designed for this purpose. It is capable of performing a variety of different types of data retrieval, depending upon the structure of the data file and how a retrieval is made. For a simple sequential file in which every card image has the same format, you specify the fields and values of the data subset by just entering a set of retrieval parameters. The syntax for this will be given shortly. To fully appreciate the more esoteric capabilities, we must first explain the differences in the types of file structure acceptable to ACCESS.

Two distinct types of data files are recognized by ACCESS, card structured and case structured. In a card structured file, all card images or lines have an identical format; that is, a particular variable will be found in the same column or field of every card. Furthermore, cards are not logically related; the retrieval of one card does not depend upon the retrieval of some other card. In a case structured file, cards are logically blocked together into cases, with all cards in each case having a field containing some unique case identifier (CASEID). Within a case, cards may have any number of formats. However, the particular format of each card must be identified on the card (CARDID). The CASEID and CARDID fields must occupy the same columns on each format. If any card within a case qualifies for retrieval, the entire case is retrieved.

Card structured files are just the simple ordinary single format card image files that you are undoubtedly familiar with. By comparison, case structured files can be quite complex and are sufficiently unfamiliar to warrant further description with the following example. Suppose a file is comprised of a number of cases, each consisting of a block of information about a single person. The first card in a case could have the person's name, age, and sex. A second card could have his occupation, education, and income. A third card could have his scores on a variety of tests. Each of these cards would have a different format. Identical CASEID fields on all three cards identify them as belonging to the same person, and a unique CARDID field on each card indicates which format the card is to be interpreted with. The first format type might have a ten column alphanumeric field (name) in columns 11-20; the second card of each case might have a pair of two column coded integer fields (occupation and education) and a six column real number field (income) in the same columns. In this example a case consists of three cards, each having a separate format; however, a case may have any number of formats and any number of cards with each type of format.

ACCESS recognizes a third type of data file which is essentially identical in form to a card structured file but which differs in how information may be retrieved. This type of file is known as a random

access file or more appropriately an indexed sequential file. For a normal card structured file, a data retrieval consists of reading every card in the file and testing fields on each card for some specified values. By comparison, an indexed file has associated with it a set of pointers that relate the values of certain fields on each card to the location of the card in the file. Using these pointers allows the retrieval program to skip over sections of the file which do not have the specified field values. For large data files this can result in a great savings in the cost of retrieval since fewer cards must be read; however, to achieve real efficiency the index fields must be judiciously chosen and the data file must be sorted with respect to these index fields. More will be said about indexed files in a later section on the DATALIB function named RANDOM.

ACCESS provides several options which add additional flexibility to retrievals. You select an option by entering "YES" in response to the appropriate prompt. The prompts for these options are:

1. ALTERNATE INPUT DATA FILE?

This option allows you to specify a disk file that is not defined in the directory. If this option is selected, you will be prompted for the permanent file name and ID of the alternate data file. If you're making several retrievals from the same tape file or several retrieval or sort passes on a file, you'll probably use this option to avoid repeated tape mounts.

2. SPLIT RETRIEVAL?

If you select this option, data cards failing the retrieval tests are written to a secondary output file, thus splitting the data file into accepted and rejected parts. You will be prompted for the permanent file name and ID to be assigned to this secondary output file when ACCESS requests other job card parameters. This option is handy for data checking; you can ask for card images with values beyond specified ranges to be retrieved to one file and the remainder to another. After editing the smaller file to correct errors, you can remerge the two subsets.

3. THIS IS A CASE STRUCTURED FILE  
DO YOU WANT TO IGNORE STRUCTURE?  
OR  
THIS IS AN INDEXED FILE  
DO YOU WANT TO IGNORE INDEXING?

Files are flagged as case structured or indexed in the directory, with the FORMAT attribute FMITYPE (set to "M" for multiple format or case structure) and the FILE attribute FILETYPE ("R" for random or indexed). ACCESS recognizes whether a file is case structured or indexed and issues the appropriate prompt. When this option is selected, a file will be treated as if it were card structured or

nonindexed.

Options 1 and 3 can be especially useful in making two pass retrievals. With case structured files, a first pass could be used to retrieve a subset of cases and a second pass could retrieve from this subset a smaller subset consisting of certain cards from each case. This second pass must: (1) declare the output file from the first pass as an alternative input file, (2) "turn off" the case structure of the input file, and (3) retrieve cards with a specified value in their CARDID field. With an indexed file, a first pass using indexed retrieval could efficiently extract a "coarse" data subset, and subsequent retrievals from this subset could be made ignoring indexing to extract "fine" subsets. When indexing is suppressed, index fields are treated identically to nonindex fields; thus all fields, whether they are index or not, are available for use in specifying retrieval attributes.

You specify the attributes of a data subset by entering a set of retrieval parameters. For indexed retrieval, two parameter sets must be entered, one for index fields and another for nonindex fields. ACCESS indicates it is ready to process retrieval parameters by issuing either of two prompts:

```
FOR INDEXED RETRIEVAL  
ENTER RETRIEVAL PARAMETERS
```

or

```
FOR SEQUENTIAL RETRIEVAL  
ENTER RETRIEVAL PARAMETERS
```

followed by the prompt "ACCESS>".

The first prompt is given when the data file is indexed and the index suppression option has not been selected. In this situation you enter a set of retrieval parameters for index fields, wait for the second prompt, then enter a set of retrieval parameters for nonindex fields. If you can't recall which fields are indexed, QUERY may be used. For case structured files or nonindexed card structured files, only the second prompt is given. In either case, you may enter all or part of a parameter set followed by a carriage return. ACCESS will process each line of input and reissue the prompt "ACCESS>" until all parameters are entered or a fatal error is detected. If a fatal error occurs, a message explaining the nature of the error is issued (see Appendix 1 for error messages), followed by the message "\*\*\*\*\*RESTART\*\*\*\*\*" and the prompt "ACCESS>". You must then reenter the entire retrieval parameter set from the beginning. If for any reason you desire to abort the retrieval parameter set and start from the beginning, "RESTART" may be entered.

name, relational comparisons are alphanumeric (display code collating sequence).

Retrieval parameters are evaluated in a manner similar to Boolean expressions in Fortran, except that the logical operator .NOT. is not allowed. When parentheses are not used, the retrieval parameters are scanned from left to right, with AND having precedence over OR. For example, A.OR.B.AND.C is treated as A.OR.(B.AND.C). For a given card image or case, retrieval parameters are evaluated only as far as necessary to determine whether to select a card or not. In the Boolean expression shown above, if A is true, then the card image is selected and (B.AND.C) is not evaluated. The cost of retrieving a subset of data thus partially depends on the order of the ORed retrieval parameters. The best strategy is to enter first those variables and values most likely to be found.

Some examples of retrieval parameter sets are:

1. SPECIE.EQ.COD.AND.(YEAR.LT.78.AND.YEAR.GT.56).END
2. 11-14 LT 1974 OR  
(STATION LT "A17" AND STATION GT "B27") END
3. SPECIE.NE.HAKE.AND.  
SPECIE.NE.COD.AND.  
SPECIE.NE.SALMON.AND.  
((YEAR.GT.73.AND.  
(MONTH.LT.10.AND.MONTH.GT.5))  
.END
4. TEMP.LT.12.5.END

After successfully entering all retrieval parameters, you will be prompted next for control card parameters of a batch job. The parameter "CP time" should be overestimated slightly to guard against a time limit abort of the retrieval job. CP time increases with the number of cards and the complexity of the retrieval parameter set; however, allotting 1 CP second per 1000 cards is usually sufficient.

The general form of the retrieval parameter set is:

<VAR> <REL> <VALUE/MNEMONIC> <AND/OR/END>

where

<VAR> is a FIELD name or a column specification  
<REL> is a relational operator (EQ,NE,LT,LE,GT,GE)  
<VALUE/MNEMONIC> is either a value or mnemonic  
<AND/OR/END> is either a logical operator (AND,OR)  
or "END" to indicate the end of the retrieval  
parameter set.

Each of the above four elements must be delimited from the next by either a period or blank. Successive delimiters are ignored. The sequence may be repeated indefinitely until an "END" is used. Optional parentheses may be used freely and may be nested up to 25 levels deep.

To avoid ambiguity in the interpretation of the elements, certain conventions must be followed. These are:

1. If <VAR> begins with a letter, it is assumed to be a FIELD name in the directory.
2. If <VAR> begins with a number, it is assumed to be a column specification. Column specifications may have either of two forms; C1-C2 or C1/LN. In both forms C1 refers to the number of the first column on the card image of the field to be scanned. C2 in the first form refers to the ending column of the field; LN in the second form refers to the number of columns in the field. Hence, 27/9 means "a 9 column field starting in column 27," and 27-35 means "a field starting in column 27 and ending in column 35." A 1 column field may be specified as C1/1, or just C1. Column specification can not be used with random access files or case structured files unless the indexing or structure is suppressed.
3. If <VALUE/MNEMONIC> begins with a letter, and contains only numbers and letters, it is assumed to be a mnemonic defined in the directory. Otherwise, <VALUE/MNEMONIC> is assumed to be a value. Any value that would qualify as a mnemonic must be enclosed in either single quotes (') or double quotes (") to be recognized as a value.
4. Any value, whether given explicitly to ACCESS or referenced by a mnemonic, must be compatible with the FIELDTYPE of the corresponding FIELD, as defined in the directory. Relational comparisons are made with the collating sequence specified by FIELDTYPE. If column specifications are given instead of a FIELD

## RANDOM

RANDOM is used to create a random access index for a card structured data file. This index consists of a table relating the values of index fields you have specified with the location of the corresponding card images in the data file. Since an index is external to its associated data file, the process of indexing does not alter the file. An index is itself a separate file, and like any other file in a data library, it must be referenced in a directory with a set of packages.

Indexing is used to make data retrieval more cost efficient by minimizing the number of cards which must be read to extract a specified subset of data from a file. How much more efficient an indexed retrieval is over a normal sequential retrieval depends largely on which fields are used as index variables and how retrieval parameters are specified. There is an additional overhead associated with indexed retrieval, which will be discussed later; indexing can be recommended only for large files (i.e. greater than 500,000 cards) which are stored on a private user disk pack.

RANDOM produces an index in the following way. For a card structured file, which is fully documented in a directory, a user supplies one or more fields to be used as index variables. RANDOM creates a batch job that reads the data file, and whenever any of the index variables changes value these values and the current position of the file (PRU ordinal number) are written to an index file. In essence, this process logically partitions a data file into blocks with all cards in each block having the same value for each index variable. There is no physical blocking of the data file; the index created by RANDOM merely contains information which points to the beginning of each logical block in the file.

ACCESS makes use of the index for data retrieval in the following way: For an indexed retrieval, you specify the attributes of the desired subset of data with two sets of retrieval parameters, one for the index fields and one for the nonindex fields. The index is read, and the specified index fields are checked against the indexed retrieval parameter specifications. When a match is found, the location (PRU ordinal number) associated with that set of index field values is used to position the data file at the beginning of the appropriate logical block. From this point, cards are read from the data file and checked against the sequential retrieval parameter set until the end of the logical block is found. Going back to the index, the next relevant block is then sought. Thus the retrieval program toggles between two procedures: using index parameters for file positioning and using sequential parameters for card retrieval.

The efficiency of indexing becomes pronounced when only a small part of a file needs to be read in order to retrieve a subset of data, and when a minimum amount of file positioning is required to find the proper sections of the file to read. This requires that the data file be properly sorted with respect to the index variables. Since sorting is hierarchical, the sort order of the variables is very important. For example, suppose that two index variables are MONTH and YEAR, and a data file is sorted first by YEAR and second by MONTH. If the file contains data for all months in ten years, then a retrieval for all months of one year requires one file positioning, but a retrieval for one month over all years requires ten file positionings. If data are to be routinely retrieved by month the above sort order is obviously not the most efficient. Thus to gain efficiency you must anticipate your future retrieval requirements, judiciously choose the index fields, and properly sort the data file.

Creating an indexed data file involves four separate steps. These are:

1. A directory is built for the data file as if it were in card structured form with no random access index variables.
2. Index fields are chosen and the data file is sorted with respect to these variables. The DATALIB function SORT has been provided to minimize the trouble of sorting a file.
3. RANDOM is used to create an index. This function asks you to supply the name of the file to be indexed, the names of the fields to be used as index variables, and the name and ID of a permanent file on which to place the completed index.
4. DEDIT is used to modify the directory to indicate that the data file is now indexed and to include packages which reference the index. These modifications are discussed later, in the section on building a directory.

The index file is maintained in the DATALIB directory as a separate file. When ACCESS is called to perform indexed retrievals, the index file must be on disk and described as a disk file (with FILE, DATASET and DISK packages) in the directory. ACCESS will ask you for the FILENAME of this file when you request a retrieval from an indexed file, unless you opt to ignore the indexing.

You may optionally specify the permanent file name and ID of a data file to index in place of a file declared in a directory. To do this, you must respond "YES" to the prompt "DO YOU WANT ANY OPTIONS", then supply the requested information.

## SORT

SORT is used to sort a data file with respect to a set of sort variables. The function builds a batch job that calls CDC's SORT/MERGE package and routes it to the input queue. To use SORT, you must respond to prompts requesting the name of a data file, a set of field names to be used as sort variables, and various control card parameters needed for a batch job. The sorted file is cataloged as a permanent file, with a name and ID specified by yourself, in response to appropriate prompts (see page 7). You have the OPTION of requesting an alternate input file, but you must have at least a dummy directory FILE entry in any case. SORTMRG typically requires 1 to 3 CP seconds per 1000 card images; a job card estimate of 5 per 1000 is usually adequate.

Data files are sorted as if they were card structured; however, case structured files may be sorted if the sort variables are restricted to fields common to all cards in a file. Data files must be fully documented in a directory before sorting.

SORT issues the prompt "SORT>" when it is ready to receive a sort variable. You enter one sort variable per line and indicate the end of the sort variable set by entering "%END". Sorting is hierarchical, and the order of variable entry determines the sort order of the file. For example, an entire data file is sorted with respect to the first variable, subsets of the data file having the same value of the first variable are sorted with respect to the second variable, and so forth.

Sort variables may be either FIELD names or column specifications (see ACCESS for column specification format). One or two modifiers may be entered along with each sort variable. These are:

,AL	For alphabetic sort	or
,NM	for numeric sort	
	and	
,A	for ascending sort	or
,D	for descending sort	

The specification for a descending numeric sort of the variable YEAR is thus "YEAR,D,NM". If no modifiers are used, the sort is ascending display code. The alphabetic and numeric sort options differ from the default in the treatment of blanks. For an alphabetic sort, blanks are equated with colons, and the ascending sort order is blank, letters, numbers, punctuation. Thus, "GREEN" would precede "GREENBURG". A default sort puts blanks with the punctuation characters; see Computer Center Announcement 66, Beginner's Guide to SORT/MERGE, for details of default (display code) order. For a numeric sort, blanks are equated with zeroes, so the ascending order is letters, blanks and zeros, other numbers, punctuation.

## QUERY

QUERY is an interactive routine for displaying selective portions of a directory. Unlike CODES, QUERY is extremely flexible and gives you a wide range of possible ways to summarize directory information. QUERY is discussed here, separate from the DATALIB functions, because unlike these functions it can be executed at any time, either while in DATALIB or while executing one of the DATALIB functions. Upon leaving QUERY, you return to the same place in the DATALIB session where you were before you entered QUERY. This capability of examining a directory at any time is especially useful when DEDIT is used to modify a directory, or when retrieval specifications are formulated in ACCESS.

A user begins QUERY by entering "?", either by itself or immediately followed on the same line by the first QUERY directive. QUERY indicates it is ready to accept further directives by issuing the prompt "QUERY>". To exit from QUERY a user must enter "END".

QUERY directives have the following form.

```
{ptype[=name]}  
  or      [,LIST=attr[,attr]...] [,A0=fname] [,attr=value]  
{*}
```

where one of the two elements in {} is required and all elements in [] are optional.

The various elements are:

**ptype** This is a package type code. These codes are listed in Appendix 2.

**name** This is a package name. If "name" is omitted, or if a FIELD, MNEMONIC, or DATASET package name is included but specified incompletely (see the Directory section for a discussion of how to specify package names), then only the package names associated with the specific package type are displayed. If a complete specification of a package name is given, then the contents of that package are displayed. This difference will be clarified with examples at the end of this section.

**\*** This indicates that a summary is to be made over all package types. When entered by itself, "\*" produces an alphabetically arranged list of package names for each package type. When used in conjunction with LIST=ALL, the contents of all packages are listed.

FILE,DATASET=A1,LIST=FILENAME,TEXT  
lists the FILENAME and TEXT attributes for all FILE  
packages with a DATASET code of A1

\*,AO=NAME,DATASET=A1  
lists in summary form the names of all packages (FILE,  
DATASET, TAPE, DISK) with a value of A1 in their  
DATASET attribute. The list is placed on the local  
file called "NAME"

\*,LIST=ALL  
list the entire directory contents in summary form

LIST=attr,attr,...

This restricts the listing to only those package attributes specified. Attribute names ("attr") must be spelled as they are shown in Appendix 2. There is no limit to the number of attributes that may be specified; LIST=ALL lists all attributes. This option may be used to force a listing of specified package attributes in situations which would otherwise only produce a listing of package names.

AD=fname This results in the listing being copied to a local file called "fname" rather than being displayed. (AD stands for "alternate output" file.)

attr=value

This restricts the list to only those packages with the specified "value" of the given attribute ("attr").

Some examples of QUERY directives:

FILE lists the names of all FILE packages

FILE=FL lists the contents of the FILE package named FL

FILE,LIST=FILENAME,DATASET,TEXT,AD=NAME  
lists the FILENAME, DATASET, and TEXT attributes of all FILE packages in the directory and puts the list on a local file called "NAME"

FIELD lists the names of all FIELD packages

FIELD=FMT lists the names of all FIELD packages associated with the FORMAT package named FMT

FIELD=FMT.F1  
lists the contents of the FIELD package named F1 associated with the FORMAT package named FMT

FIELD=FMT,LIST=ALL  
lists the contents of all FIELD packages associated with the FORMAT package named FMT

## HOW TO BUILD A DIRECTORY

In order for the DATALIB functions to perform their tasks, they must reference a properly constructed directory. The job of building a directory may at first seem complicated. However, this first impression is deceiving because many of the package types and many of the attributes for these packages are not required for a functioning directory. In this section, we will show how to construct a basic directory for the three different types of data files. Frequent reference should be made to Appendix 2 where the structure of a directory is outlined in detail. When referring to this section, remember that those package types or attributes which are flagged with "\*\*\*" are always required, those flagged with "\*" are required only in certain situations, and those not flagged at all are never required but are provided to allow you to better document your data and program library.

Card structured files (nonindexed)

This type of file is the easiest to add to a data library. As an absolute minimum, only three package types must be included in a directory.

These packages, plus the respective attributes which are required, are:

1. FILE DESCRIPTION PACKAGE.  
Required attributes--FILENAME, DATASET, FILEORD, FILETYPE, NFILES, plus FORMAT if a format package is included. FILETYPE should be set to "S".
2. DATASET DESCRIPTION PACKAGE.  
Required attributes--DATASET, COPYNO, SOURCETYPE, SOURCENAME, NFILES.
3. DISK or TAPE DESCRIPTION PACKAGE, depending upon the storage medium of the data file. Required attributes for tapes--VSN, DENSITY and, if appropriate, LABEL and PASSWORD. Required attributes for disk--PFNAME and optionally PFID. With a user disk pack, VSN and SETNAME are also necessary.

A directory containing these three packages is suitable for file copying with GETFILE and PLTFILE which only require information about the location of a file. However, the DATALIB functions SORT, RANDOM and ACCESS need information describing the format of a file in addition to the location information. To specify the format of a file package, type 4 below is necessary; types 5 and 6 are needed only if you want to assign names to fields and mnemonics to field values.

4. **FORMAT DESCRIPTION PACKAGE.**  
Required attributes--FMTNAME, FMTTYPE, MAXCOL. FMTTYPE is set to "S".
5. **FIELD DESCRIPTION PACKAGE.**  
Required attributes--FMTNAME, FIELDNAME, FIELDTYPE, START, LENGTH and optionally CODESET if mnemonics are used. For each field which you wish to name or document, one field description package is required. Field packages may describe overlapping columns.
6. **MNEMONIC DESCRIPTION PACKAGE.**  
Required attributes--CODESET, MNEMONIC, VALUE. One mnemonic description package is required to define each mnemonic assigned to a particular field value.

#### Indexed sequential files

A directory for an indexed sequential file is essentially the same as above except for the following:

1. The FILETYPE attribute of the appropriate FILE package is set to "R".
2. The INDEX attribute in the FIELD package for each index variable is set to any nonblank character.
3. FILE, DATASET and DISK description packages for the index file must be included. The index file must be on disk when it is used by the ACCESS function.

#### Case structured files

A directory for a case structured file is essentially the same as for a card structured file except for the following:

1. The format description package must also include CASECOL, CASELEN, CARDCOL, CARDLEN, and MAXCASE attributes, which specify the column positions of the CASEID and CARDID attributes on each data card and the maximum number of cards per case.
2. The FMTTYPE attribute in the format description package is set to "M".
3. Specific CARDID values must be entered into the CARDID attribute of each field description package.

## HOW TO RUN DATALIB

DATALIB is operated via an interactive terminal. After logging in on Intercom, you execute DATALIB by entering:

```
PUBLIC,DATALIB.  
DATALIB,D=dirfile[,F=func].
```

where:

**dirfile** is the name of a local file or local copy of a permanent file which contains a directory. If a new directory is to be created with DEDIT, use a dummy file name. If omitted, DATALIB will ask for a directory file name.

**func** (optional) specifies the DATALIB function you want to perform; for example, F=DEDIT. If this option is used, DATALIB terminates upon completion of the function. Otherwise, DATALIB will respond with "DATALIB>" and you continue to enter DATALIB function names, directives, and other information until you terminate by entering "END" in response to the "DATALIB>" prompt.

## APPENDIX 1 ERROR MESSAGES

In general, DATALIB checks for errors and issues error messages only when it is absolutely necessary. The main advantage of this is that DATALIB can be very flexible about what it stores in the directory file. The main disadvantage is that errors may not be reported until long after they are generated.

The list that follows covers DATALIB's most common (and/or least obvious) error messages. Messages not mentioned here are assumed to be self explanatory.

### ...WHAT?

is DATALIB's catch-all error message. It means "The last command you typed makes no sense at all". "WHAT" errors are usually caused by misspelling or improperly punctuating a command, or when you try to call ACCESS without first leaving DEDIT, for instance.

### ERR- CAN'T FIND pkg=name

occurs when DATALIB attempts to look up a package that does not exist; "pkg=name" identifies the package in question.

### IN pkg=name, attr CONTAINS value

this type of message appears as part of some other error message. DATALIB issues "attr CONTAINS value" messages in an attempt to identify the source of the error. "attr" is an attribute name.

### INVALID DIRECTORY FORMAT...

appears when DATALIB attempts to process a directory file that has been garbaged or otherwise tampered with. This message is always followed by another message giving more detail about what is actually wrong with the directory.

### DIRECTORY CONTENT ERROR

and the "attr CONTAINS value" messages that will follow indicate that DATALIB found something in the directory that was not expected. The most common cause of this error is an implicitly numeric directory attribute (such as FILEORD or NFILES) with some nonnumeric value in it.

DIRECTORY INDEX FULL

this message occurs when DEDIT tries to make one too many additions or deletions to the directory file. The directory remains intact (up to the last command) and you can still SAVE it and use it. DEDIT maintains the scratch copy of your directory using pointers in program memory, so there is an upper limit on the size of one directory. At default Intercom memory limits (60K), you have room for over 600 packages. If you are doing extensive deleting and reentering with DEDIT, the deleted packages will still consume memory; if this is the case, SAVEing your directory and leaving and reentering DATALIB will clear the wasted space, and you can then resume DEDITing.

INTERNAL ERROR...

indicates that something has happened within DATALIB that shouldn't have. Please report any internal errors to Norfish (543-2016) immediately.

Appendix 2  
DIRECTORY

The contents of a directory are arranged into blocks or directory packages. There are ten different types of these packages with each type being identified by one of several package type codes. The codes:

<u>Package Type</u>	<u>Valid Codes</u>
FILE	FILE,FIL,F
DATASET	DATASET,SET,S
TAPE	TAPE,T,VSN,V
DISK	DISK,DSK
FORMAT	FORMAT,FOR,FMT
FIELD	FIELD,FIE,FLD
MNEMONIC	MNEMONIC,MNEM,MNE
ALTERNATE STORAGE	ALTERN,ALT,OTHER
PROJECT	PROJECT,PRO,PRJ,P
DESCRIPTIVE TEXT	DESCRIP,DES,D

A directory may contain one or more packages of each type, and each individual package is referenced by its unique name. For seven of the ten packages this name is specified as the first attribute of the package. The three exceptions, DATASET, FIELD, and MNEMONIC, require both the first and second attributes for a unique specification of the package name. A complete name referred to in the sections on DEDIT and QUERY is either the first and second attributes separated by a period for these last three package types or just the first attribute for the other seven.

In the following each package type is described in detail. Included in the descriptions is a list of attribute names, each followed by an "=" and a variable number of dashes. The number of dashes indicates the maximum number of characters that can be entered for each attribute. The text attribute on each package may contain up to 540 characters of text. As an aid in building a directory, those package types and attributes which are always required in order to have a functional directory are flagged with "\*\*\*" and those which are required in certain situations are flagged with "\*". Unflagged package types and attributes are only for documentation.

FILE DESCRIPTION PACKAGE \*\*

```

FILENAME ** = ----- PROJECT      = ----- DATASET ** = --
FILEORD **  = --- FILETYPE ** = - LENGTH      = -----
CHECKSUM    = ---- SECTORS       = ----- LASTMOD     = -----
NFILES **  = ----- NCARDS      = ----- FORMAT *   = ----
TEXT       =

```

The FILE package contains information about a particular data file. This file is uniquely defined by its FILENAME. The information in this package describes the size of the file and contains pointers to information concerning its location and format.

<u>Attribute</u>	<u>Content</u>
FILENAME **	any legitimate NDS/BE file name (1-7 characters)
PROJECT	name of project to which the data file belongs (1-7 characters)
DATASET **	name of the dataset package which describes where the file is stored (2 characters)
FILEORD **	a decimal ordinal giving the position or file number of the file within the dataset (1-3 digits)
FILETYPE **	1-character code: S = sequential card structure or case structure R = random access or indexed file
LENGTH	length of the file in words, as shown on an ITEMIZE listing (1-7 digits)
CHECKSUM	checksum for the file as shown on an ITEMIZE listing (4 digits)
SECTORS	length of the file in disk sectors (1-5 digits)
LASTMOD	date of last change to the file, in the form YYMMDD
NFILES **	number of end-of-file marks within the file, including the trailing EOF (1-7 digits)
NCARDS	number of cards or card images in the file (1-7 digits), if a data file
FORMAT *	name of FORMAT package describing the internal format of the file (4 characters), if a data file

DATASET DESCRIPTION PACKAGE \*\*

```

DATASET **      = --          COPYNO **      = -          SOURCETYPE** = -
SOURCENAME** = -----      NFILES **      = ---          LENGTH       = -----
CHECKSUM       = ----        BLOCKS       = -----      SECTORS      = -----
LASTMOD        = -----      TEXT          =

```

A dataset is the contents of a tape or other medium--a sequential set of files that may be otherwise unrelated. The dataset intercedes between the file and the tape in order to make it easier to update the directory when you copy the contents of one tape to another. DATASET.COPYNO uniquely identifies a given dataset.

<u>Attribute</u>	<u>Content</u>
DATASET **	unique dataset code (2 characters)
COPYNO **	1-digit copy number identifying a specific copy of the dataset: 1 = primary copy which is used for retrievals 2 = backup copy other values = other copies
SOURCETYPE **	storage medium of this copy (1-character code): T or V = tape D or W = disk X = any alternate medium
SOURCENAME **	name of medium (1-7 characters): permanent file name for disk file volume serial number for tape any name for an alternate medium
NFILES **	total number of end-of-file marks on tape or permanent file (1-3 digits)
LENGTH	total length in characters of the dataset as shown on an ITEMIZE listing (1-7 digits)
CHECKSUM	total CHECKSUM from an ITEMIZE listing (4 digits)
BLOCKS	total number of blocks used, if on tape (1-7 digits)
SECTORS	length of dataset in disk sectors (1-7 digits)
LASTMOD	date of last modification: YYMMDD

TAPE DESCRIPTION PACKAGE \*

VSN **	= -----	DENSITY **	= --	STATUS	= -
LABEL **	= -	PASSWORD *	= -----	DATASET	= --
NEXTREEL *	= -----	CHARGES	= -----	OWNER	= -----
NFEET	= ----	TEXT	=		

This package describes a magnetic tape, and is required only for datasets that reside on tape. The VSN attribute represents the unique "name" of a tape package.

<u>Attribute</u>	<u>Content</u>
VSN **	volume serial number (VSN) of the tape (1-6 characters)
DENSITY **	indicates recording format and density of tape (2 characters): LO = 7 track, 200 BPI HI = 7 track, 556 BPI      HY = 7 track, 800 BPI HD = 9 track, 800 BPI      PE = 9 track, 1600 BPI
STATUS	1-character code which describes the quality of the tape; code values are defined by yourself
LABEL **	label type (1-character code): blank = no label S or E = standard NOS/BE label P = password label
PASSWORD *	if label type is P, this attribute contains the password (1-8 characters)
DATASET	dataset code associated with the tape (2 characters)
NEXTREEL *	if the dataset spans more than one tape, then this attribute contains the VSN of the next continuation tape (1-6 characters)
CHARGES	first 6 characters of account number to which storage charges are billed
OWNER	first 7 characters of last name of the owner of the tape
NFEET	number of feet of tape on reel (1-4 digits)

**DISK STORAGE DESCRIPTION PACKAGE \***

PFNAME **	= -----	PFID *	= -----	SETNAME *	= -----
VSN *	= -----	CHARGES	= -----	OWNER	= -----
SECTORS	= -----	DATASET	= --	TEXT	=

A disk storage package describes various features of a disk file on which a dataset resides. This package is required only when a data file resides on disk. PFNAME uniquely identifies a disk storage description package.

<u>Attribute</u>	<u>Content</u>
PFNAME **	permanent file name of a dataset residing on disk (1-7 characters)
PFID *	permanent file ID of the dataset; if omitted, standard University of Washington NOS/BE procedures are used for ID definition (1-7 characters)
SETNAME *	if the permanent file resides on a user disk pack (other than DEFAULT), this attribute contains the setname associated with the disk file (1-7 characters)
VSN *	if the permanent file resides on a user disk pack, this attribute contains the VSN associated with the disk pack (1-6 characters)
CHARGES	first 6 characters of account to which any storage charges are billed
OWNER	first 7 characters of last name of the owner of the disk pack
SECTORS	total number of sectors available on this disk pack (1-7 digits)
DATASET	dataset code associated with this disk (2 characters)

FORMAT DESCRIPTION PACKAGE \*

FMTNAME **	= ----	FMTTYPE **	= -	MAXCOL **	= ---
CASECOL *	= ---	CASELEN *	= ---	CARDCOL *	= ---
CARDLEN *	= ---	MAXCASE *	= ----	TEXT	=

This package describes the format type of the data. The unique "name" of a format package is FMTNAME. CASECOL, CASELEN, CARDCOL, CARDLEN, MAXCASE are required only for case structured data.

AttributeContent

FMTNAME **	name of FORMAT package (4 characters)
FMTTYPE **	1-character code: S = single format or card structured data M = multiple formats or case structured data
MAXCOL **	maximum number of columns per card image (1-3 digits)
CASECOL *	starting column of unique case identifier which is on all cards in each case (1-3 digits)
CASELEN *	length of case identifier (1-3 digits)
CARDCOL *	starting column of card identifier which indicates card number or card format type within a case (1-3 digits)
CARDLEN *	length of card identifier (1-3 digits)
MAXCASE *	maximum number of cards per case. Should be larger than the maximum expected, but not too large because storage is allocated for this maximum by ACCESS (1-4 digits)

**FIELD DESCRIPTION PACKAGE \***

```

FMTNAME ** = ----      FIELDNAME** = -----      FIELDTYPE** = -
START **   = ---       LENGTH **   = ---          POINT *     = --
CODESET *  = ---       UNITS       = -----      MINVAL      = ----
MAXVAL     = ----      CARDID     = -----      INDEX       = -
TEXT       =

```

Describes the structure and content of a field on a data card. To uniquely identify a field package, FMTNAME.FIELDNAME is required.

<u>Attribute</u>	<u>Content</u>
FMTNAME **	name of format package (4 characters)
FIELDNAME **	name of field (1-7 characters); since both FMTNAME and FIELDNAME are required to uniquely identify a field, a given FIELDNAME may be repeated in any number of different formats
FIELDTYPE **	1-character code:            I = integer A = alphanumeric            F = real
START **	starting column of field on data card (1-3 digits)
LENGTH **	number of columns occupied by a field on a data card (1-3 digits)
POINT *	number of characters to the right of the decimal point for F-type fields (1-2 digits)
CODESET *	name of a group of mnemonics associated with values of this field (3 characters); any given codeset may be "called" from any number of fields within any format
UNITS	units of measure of field, for example, grams (1-7 characters)
MINVAL	minimum value of field (1-5 digits)
MAXVAL	maximum value of field (1-5 digits)
CARDID *	for case structured files, CARDID contains the unique identifier of the particular card type containing the field (1-10 characters)
INDEX *	flag for random access; the field is a random index if INDEX is nonblank (1 column)



### ALTERNATE STORAGE PACKAGE

ALTNAME \*\* = ----- MEDIUM = ----- LOCATION = -----  
DATASET = -- TEXT =

Used to describe the medium and location of files stored on cards, paper tape, or other media. ALTNAME is the unique identifier.

### PROJECT DESCRIPTION PACKAGE

PROJNAME \*\* = ----- TEXT =

A project description is simply a brief textual description of a particular project. Normally, there should be a project description for every project referenced in a FILE package. PROJNAME uniquely identifies a project description package.

### DESCRIPTIVE TEXT PACKAGE

NAME \*\* = ----- LASTMOD = ----- TEXT =

This package is designed to increase the capacity of the directory to hold descriptive text extending the information in any other package. For example, if the text needed to describe a FILE package exceeds 540 characters, then a message may be placed in the text section of the FILE package to refer to the DESCRIPTIVE TEXT package called NAME. Because CODES, QUERY, and DEDIT routinely list the contents of the text fields in other package types, it is convenient to keep these fields concise and make any extensive textual messages by referencing a descriptive text package. The unique "name" of a descriptive text package is NAME.

Appendix 3  
SAMPLE SESSION

A sample session with DATALIB follows. The session builds a directory describing a data file that is to be copied to two blank tapes, sorted, and selectively retrieved from.

We start with the two blank tapes, vsn's 9907 and 9908, and the data file on disk, containing about 18,000 cards (9 boxes). The permanent file name is CRABDAT, ID=CRAB. Each data card on CRABDAT contains the following fields:

<u>FIELD</u>	<u>CCLS</u>	<u>DATA TYPE</u>
Vessel Code	1- 2	Integer
Station Code	4- 6	Alpha
Sex Code	29	Integer
Size	30-32	Integer
Species Code	40	Integer
Tow Number	78-80	Integer

We first set up directory entries for the data file, the two vsn's, and a dataset to link them. We then put a copy of the data file on each of the two tapes. We also sort the file by species, and extract all cards with species codes 2 and 3 and size less than 100, putting these card images on a separate file.

DATALIB and INTERCOM prompts and responses are in upper case, and your commands are in lower case. The entries in square brackets, [], are comments.

login,.....

COMMAND- public,datalib

COMMAND- datalib,d=dummy [enter datalib with no directory]  
-EMPTY DIRECTORY-  
DATALIB 2.2

DATALIB> dedit  
0 PACKAGES IN DIRECTORY  
BEGIN DIRECTORY EDITING

[ The first thing to do is to build up enough of a  
directory to permit us to move CRABDAT to tape. ]

DEDIT> add,file=crabdat [create a file package for CRABDAT]

PROJECT = [a blank followed by a carriage return  
DATASET = aa is entered when we do not wish to enter  
FILEORD = 1 anything into a given attribute]  
FILETYPE = s  
LENGTH =  
CHECKSUM =  
SECTORS =  
LASTMOD = 110878  
NFILES = 1  
NCARDS = 18000  
FORMAT =  
-ENTER TEXT-  
"our very first crab data file"

DEDIT> add,dataset=aa.1 [now a package for the dataset referenced  
by CRABDAT; "aa.1" means dataset AA,  
copy no. 1]

SOURCETYPE = t  
SOURCENAME = 9907  
NFILES = 0  
LENGTH =  
CHECKSUM =  
BLOCKS =  
SECTORS =  
LASTMOD = 110878  
-ENTER TEXT-  
""

DEDIT> add,dataset=aa.2 [now the second copy]

SOURCETYPE = t  
SOURCENAME = 9908  
NFILES = 0  
LENGTH = == [skip the rest of the prompts since  
all else is blank]

DEDIT> add,tape=9907 [now some tape packages, as referenced]

```
DENSITY      = hy
STATUS       =
LABEL        = p
PASSWORD     = crab
DATASET      = aa
NEXTREEL    =
CHARGES     = 7xx250
OWNER        = smith
NFEET       = 2400
```

```
-ENTER TEXT-
""
```

```
DEDIT> add,tape=9908
```

```
DENSITY      = hy
STATUS       =
LABEL        = p
PASSWORD     = crab
DATASET      = aa
NEXTREEL    = ""
```

[ Now we slip into QUERY to look at what we just did. ]

```
DEDIT> ?
```

```
QUERY> *,list=all
```

```
----- FILE PACKAGE(S) -----
```

```
FILENAME     = CRABDAT      PROJECT      =          DATASET      = AA
FILEORD      = 1           FILETYPE     = S          LENGTH       =
CHECKSUM     =             SECTORS          =          LASTMOD     = 110878
NFILES       = 1           NCARDS       = 18000     FORMAT       =
TEXT         = OUR VERY FIRST CRAB DATA FILE
```

```
----- DATASET PACKAGE(S) -----
```

```
DATASET      = AA          COPYNO       = 1          SOURCETYPE   = T
SOURCENAME   = 9907       NFILES       = 0          LENGTH       =
CHECKSUM     =           BLOCKS          =          SECTORS     =
LASTMOD      = 110878
TEXT         =
```

```
DATASET      = AA          COPYNO       = 2          SOURCETYPE   = T
SOURCENAME   = 9908       NFILES       = 0          LENGTH       =
CHECKSUM     =           BLOCKS          =          SECTORS     =
LASTMOD      =
TEXT         =
```

```
----- TAPE STORAGE PACKAGE(S) -----
```

VSN	= 9907	DENSITY	= HY	STATUS	=
LABEL	= P	PASSWORD	= CRAB	DATASET	= AA
NEXTREEL	=	CHARGES	= 7xx250	OWNER	= SMITH
NFEET	= 2400				
TEXT	=				

VSN	= 9908	DENSITY	= HY	STATUS	=
LABEL	= P	PASSWORD	= CRAB	DATASET	= AA
NEXTREEL	=	CHARGES	=	OWNER	=
NFEET	=				
TEXT	=				

QUERY> end [exit QUERY mode, back to DEDIT]

DEDIT> save,qdir [save the directory in local file QDIR]  
FILE SAVED - 5 PACKAGES IN DIRECTORY

DEDIT> end [now leave DEDIT]  
[ Now we're ready to put files on tape. ]

DATALIB> putfile

ENTER P.F. NAME - crabdat  
ENTER P.F. ID - crab  
ENTER DATASET - aa  
ENTER COPY NO. - 1  
ENTER CONTROL CARD PARAMETERS-  
JOBNAME ----- xmp1  
PRIORITY ----- 2  
ACCOUNT NO. -- 7xx25011  
PASSWORD ----- xxxxx  
ROUTE TO INPUT? - yes

[ Since we set NFILES to zero for this dataset,  
the file will be put onto file 1 of the tape,  
and the tape will be relabeled. ]

XMPLOEI ROUTED TO INPUT

DATALIB> putfile [now we do the same for copy no. 2]

ENTER P.F. NAME - crabdat  
ENTER P.F. ID - crab  
ENTER DATASET - aa  
ENTER COPY NO. - 2  
ENTER CONTROL CARD PARAMETERS-  
JOBNAME ----- xmp1  
PRIORITY ----- 2  
ACCOUNT NO. -- 7xx25011  
PASSWORD ----- xxxxx  
ROUTE TO INPUT? - yes

XMPLOED ROUTED TO INPUT

[ While those two jobs are running, let's go back into DEDIT and set up some packages to describe the data format. ]

DATALIB> dedit

5 PACKAGES IN DIRECTORY  
BEGIN DIRECTORY EDITING

DEDIT> change,file=crabdat,format=crab

DEDIT> add,format=crab [gives general info about the format]

FMTTYPE = s  
MAXCOL = 80  
CASECOL =  
CASELEN =  
CARDCOL =  
CARDLEN =  
MAXCASE =

-ENTER TEXT-

"basic crab data format"

[ Now we will set up the FIELD packages for FORMAT=CRAB using the "ADD REPEATED" command. ]

DEDIT> addr,field=crab

FIELDNAME = vessel  
FIELDTYPE = i  
START = 1  
LENGTH = 2  
POINT =  
CODESET =  
UNITS =  
MINVAL =  
MAXVAL =  
CARDID =  
INDEX =

-ENTER TEXT-

""

FMTNAME = CRAB  
FIELDNAME = station  
FIELDTYPE = a  
START = 4  
LENGTH = 3  
POINT = ==

[since everything else will be blank,  
we can skip to the next package]

FMTNAME = CRAB  
FIELDNAME = sex  
FIELDTYPE = i  
START = 29  
LENGTH = 1  
POINT = ==

FMTNAME = CRAB  
FIELDNAME = size  
FIELDTYPE = i  
START = 30  
LENGTH = 3  
POINT = ==

FMTNAME = CRAB  
FIELDNAME = species  
FIELDTYPE = i  
START = 40  
LENGTH = 1  
POINT = ==

FMTNAME = CRAB  
FIELDNAME = tow  
FIELDTYPE = i  
START = 78  
LENGTH = 3  
POINT = ==

FMTNAME = CRAB  
FIELDNAME = %end [exit from the ADDR command]

DEDIT> ? [let's look at some of the new stuff]

QUERY> field=crab,list=all

[ Field names are e.g. CRAB.SEX; by giving only the  
format name FIELD=CRAB, we request all fields in  
format CRAB. ]

FMTNAME	= CRAB	FIELDNAME	= SEX	FIELDTYPE	= I
START	= 29	LENGTH	= 1	POINT	=
CODESET	=	UNITS	=	MINVAL	=
MAXVAL	=	CARDID	=	INDEX	=
TEXT	=				

FMTNAME	= CRAB	FIELDNAME	= SIZE	FIELDTYPE	= I
START	= 30	LENGTH	= 3	POINT	=
CODESET	=	UNITS	=	MINVAL	=
MAXVAL	=	CARDID	=	INDEX	=
TEXT	=				

FMTNAME	= CRAB	FIELDNAME	= SPECIES	FIELDTYPE	= I
START	= 40	LENGTH	= 1	POINT	=
CODESET	=	UNITS	=	MINVAL	=
MAXVAL	=	CARDID	=	INDEX	=
TEXT	=				

FMTNAME	= CRAB	FIELDNAME	= STATION	FIELDTYPE	= A
START	= 4	LENGTH	= 3	POINT	=
CODESET	=	UNITS	=	MINVAL	=
MAXVAL	=	CARDID	=	INDEX	=

```
TEXT      =

FMTNAME   = CRAB      FIELDNAME  = TOW      FIELDTYPE  = I
START     = 78        LENGTH     = 3        POINT     =
CODESET   =          UNITS      =          MINVAL    =
MAXVAL    =          CARDID    =          INDEX    =
TEXT      =

FMTNAME   = CRAB      FIELDNAME  = VESSEL   FIELDTYPE  = I
START     = 1         LENGTH     = 2        POINT     =
CODESET   =          UNITS      =          MINVAL    =
MAXVAL    =          CARDID    =          INDEX    =
TEXT      =
```

QUERY> end

DEDIT> save,qdir,o [save new directory, overwriting the old]  
FILE SAVED - 12 PACKAGES IN DIRECTORY

DEDIT> end

DATALIB> end [leave DEDIT, then DATALIB]  
[ Catalog the new directory. ]

COMMAND- catalog,qdir,id=dlib,rp=999

INITIAL CATALOG

CT ID= DLIB PFN=QDIR

CT CY= 001 2 SECTORS

[ ...After an interlude for tape turnaround... ]

COMMAND- files

-FILES IN USE-

\*DATALIB \*QDIR

--REMOTE OUTPUT FILES--

XMPLOEO XMPLOEI

[ We now check on our PUTFILE jobs, using DAYFILE (see  
ACC document W40, Introduction to Intercom. )

COMMAND- dayfile,xmploei

XMPL BATCHED TO LOCAL

JOB RAN ON BATCH MACHINE

19.37.37.XMPLOEI FROM /QG

19.37.37.XMPL(T30,ID200,P2,MT1)

19.37.37.ACCOUNT(7XX25011,\*\*\*\*\*,B)

19.37.37.ACCOUNT BALANCE = \$ 22.56

19.37.37.ATTACH(RRRRRIN,CRABDAT,ID=CRAB)

19.37.37.PF CYCLE NO. = 001

19.37.37.VSN(RRRRRDU=9907)

19.37.37.REQUEST(RRRRRDU,MT,HY,N,PW=,RING)

19.38.39.( MT 054 ASSIGNED)

19.38.39.LABEL(RRRRRDU,W,L=DATALIB,PW=)

19.38.39.MT54 VOLUME SERIAL NUMBER IS 009907

19.38.40. LABEL WRITTEN WAS DATALIB

19.38.40. EDITION NUMBER 00

```

19.38.40. RETENTION CYCLE 000
19.38.40. CREATION DATE 79023
19.38.40. REEL NUMBER 0001
19.38.40. COPYF(RRRRRIN,RRRRROU,99999)
19.39.05. EOI ENCOUNTERED - 1 FILE
19.39.06. MT54 BLOCKS WRITTEN -000339
19.39.06. REWIND(RRRRRROU)
19.39.06. ITEMIZE(RRRRRROU)
19.39.33. MT54 BLOCKS READ- 000339
19.39.33. 1 FILE ITEMIZED
19.39.33. MT54 BLOCKS READ 000339
19.39.33. DP 000003B SECTORS, FILE OUTPUT , DC 40
19.39.33. .ACCOUNT 7XX25011 01/23/79
19.39.33. .728 CP SECONDS
19.39.33. 47.247 PP SECONDS
19.39.33. 17.447 I/O SECONDS
19.39.34. 691.782 CM SECONDS
19.39.34. 17.804 TAPE SECONDS
19.39.34. 1 TAPE MOUNTS
19.39.34. 1 READ SECTORS
19.39.34. 3 PRNT SECTORS
19.39.34. 56 RMS SECTORS
19.39.34. PRIORITY 2 CLASS I ID QC
19.39.34. RESOURCE UNITS = 11.586
19.39.34. MOUNTS = $ .25
19.39.34. PROCESSING = $ .39
19.39.34. JOB COST = $ .74
19.39.34. 01/23/79 XMPLOEI 7XX25011 40

```

```

>>rewind [now let's check the itemize output]
>>I 25

```

```

PAGE 1 01/23/79 LABEL: HDR1DATALIB 00990700010001
RECORD LEVEL LENGTH CHECKSUM PREFIX TABLE

```

```

FILE 1 ITEMIZE(RRRRRROU)
  1 00B 17730 61438 ***** 14 Z05052207854406509044
  2 00B 17532 5253B ***** 14 E1206017856206059 270
  3 00B 17847 5322B ***** 14 G1205287857006056 340
  4 00B 15417 2271B ***** 14 G06052378565596436037
  5 00B 101880 2076B ***** 14 H09052578573162470261
  6 17B 0 0000B
-----
TOTAL 170406 5331B
-----

```

```
*EOR
```

```
>>bye [looks okay: let's print it for bookkeeping]
```

COMMAND- batch,xmp10ei,print  
XMPLO6V BATCHED TO PRINT

COMMAND- files  
-FILES IN USE-  
\*QDIR \*DATALIB  
--REMOTE OUTPUT FILES--  
XMPLOED

[ Now back to DATALIB to update the dataset info. ]

COMMAND- datalib,d=qdir  
DATALIB 2.2

DATALIB> dedit  
12 PACKAGES IN DIRECTORY  
BEGIN DIRECTORY EDITING

DEDIT> change,dataset=aa.1

FIELD	OLD VALUE	NEW VALUE
SOURCETYPE	= T	= =
SOURCENAME	= 9907	= =
NFILES	= 0	= 1
LENGTH	=	= 170406
CHECKSUM	=	= 5331
BLOCKS	=	= 339
SECTORS	=	= =
LASTMOD	= 110878	= 012379

-NO OLD TEXT-  
-ENTER TEXT-  
\*

[ The dataset package now reflects what is really on tape; this is an important step that must not be ignored if your directory is to be up to date and you don't want to be overwriting your data accidentally. We don't do it here, but you would go through the same process (checking dayfile and itemize listing and modifying the DATALIB directory accordingly) for the second tape. ]

DEDIT> save,newdir  
FILE SAVED - 12 packages in directory

DEDIT> end

[ While we're in DATALIB, let's initiate the sort. ]

DATALIB> sort

ENTER NAME OF FILE TO BE PROCESSED- crabdat  
DO YOU WANT TO SELECT ANY OPTIONS? - yes  
ALTERNATE INPUT DATA FILE? - yes  
ENTER P.F. NAME- crabdat  
ENTER P.F. ID- crab  
ENTER VARIABLE NAMES IN SORT ORDER,  
ONE VARIABLE PER LINE. END WITH %END  
SORT> species,nm

SDRT> %end

ENTER CONTROL CARD PARAMETERS-

JOBNAME ----- xmpl

CP TIME ----- 100

I/O TIME ----- 200

PRIORITY ----- 2

ACCOUNT NO. -- 7xx25011

PASSWORD ----- xxxxx

OUTPUT FILE NAME - crbsort

OUTPUT FILE ID - crab

RETENTION PERIOD - 0

ROUTE TO INPUT? - yes

XMPLOF9 ROUTED TO INPUT

[ Now for the retrieval run with ACCESS. ]

DATALIB> access

ENTER NAME OF FILE TO BE PROCESSED- crabdat

DO YOU WANT TO SELECT ANY OPTIONS? - no

-FOR SEQUENTIAL RETRIEVAL-

ENTER RETRIEVAL PARAMETERS-

ACCESS> (species.eq.2.or.species.eq.3).and.

ACCESS> size.lt.100.end

ENTER CONTROL CARD PARAMETERS-

JOBNAME ----- xmpl

CP TIME ----- 100

I/O TIME ----- 200

PRIORITY ----- 2

ACCOUNT NO. -- 7xx25011

PASSWORD ----- xxxxx

OUTPUT FILE NAME - crab23

OUTPUT FILE ID - crab

RETENTION PERIOD - 0

ROUTE TO INPUT? - yes

XMPLOGH ROUTED TO INPUT

DATALIB> end

[ We must catalog the new version of the directory before  
we forget. ]

COMMAND- catalog,newdir,qdir,id=dlib,rp=999

NEWCYCLE CATALOG

CT ID= DLIB PFN=QDIR

CT CY= 002 2 SECTORS

COMMAND- purge,qdir

PR ID= DLIB PFN=QDIR

PR CY= 001 2 SECTORS

```

COMMAND- files
-FILES IN USE-
  *NEWDIR  *DATLIB  QDIR
--REMOTE OUTPUT FILES--
XMPLOF9  XMPLOGH
      [ Now to examine the results of the sort. ]

```

```

COMMAND- dayfile,xmp10f9

```

```

XMPLOF9 BATCHED TO LOCAL
JOB RAN ON BATCH MACHINE
20.00.06.XMPLOF9 FROM /QG
20.00.06.XMPL(T100,IO200,P2)
20.00.06.ACCOUNT(7XX25011,*****,B)
20.00.06.ACCOUNT BALANCE = $ 21.08
20.00.06.ATTACH(RRRRRIN,CRABDAT,ID=CRAB)
20.00.06.PF CYCLE NO. = 001
20.00.06.FILE(RRRRRIN,BT=C,RT=Z,FL=80)
20.00.07.FILE(RRRRRDU,BT=C,RT=Z,FL=80)
20.00.07.SORTMRG.
20.00.09.***KEY COMPARISON USED
20.01.51. ** INSERTIONS DURING INPUT *****0
20.01.51. ** DELETIONS DURING INPUT *****0
20.01.51. ** TOTAL RECORDS SORTED *****18934
20.01.51. ** INSERTIONS DURING OUTPUT *****0
20.01.51. ** DELETIONS DURING OUTPUT *****0
20.01.51. ** TOTAL RECORDS OUTPUT *****18934
20.01.51. ** MERGE ORDER USED *****12
20.01.51. **END SORT RUN
20.01.51.CATALOG(RRRRRDU,CRBSORT,ID=CRAB,RP=0)
20.01.52.INITIAL CATALOG
20.01.56.CT ID= CRAB PFN=CRBSORT
20.01.56.CT CY= 001 2663 SECTORS
20.01.56.OP 000001B SECTORS, FILE OUTPUT , DC 40
20.01.56.,ACCOUNT 7XX25011 01/23/79
20.01.56. 23.519 CP SECONDS
20.01.56. 37.556 PP SECONDS
20.01.56. 54.796 I/O SECONDS
20.01.56. 20888.548 CM SECONDS
20.01.56. 5759.659 DISK SECONDS
20.01.56. 2 READ SECTORS
20.01.56. 1 PRNT SECTORS
20.01.56. 5824 RMS SECTORS
20.01.56.PRIORITY 2 CLASS I ID QG
20.01.56.RESOURCE UNITS = 132.497
20.01.56.PROCESSING = $ 4.42
20.01.56.JOB COST = $ 5.53
20.01.56. 01/23/79 XMPLOF9 7XX25011 40

```

```
>>bye
```

COMMAND- return,xmpl0f9  
[ That looked okay. ]

COMMAND- dayfile,xmpl0gh  
XMPLOGH BATCHED TO LOCAL

JOB RAN ON BATCH MACHINE  
20.03.01.XMPLOGH FROM /QG  
20.03.01.XMPL(T100,I0200,P2,MT1)  
20.03.01.ACCOUNT(7XX25011,\*\*\*\*\*,B)  
20.03.01.ACCOUNT BALANCE = \$ 15.55  
20.03.01.FTN(OPT=2,A)  
20.03.01. .178 CP SECONDS COMPILATION TIME  
20.03.03.PUBLIC(DTLLIB)  
20.03.03.LIBRARY(DTLLIB)  
20.03.04.LIBLOAD(DTLLIB ,PULL)  
20.03.04.LOAD(LGD)  
20.03.04.NOGD(PULL)  
20.03.07.VSN(RRRRRIN=9907)  
20.03.07.REQUEST(RRRRRIN,HY,MT,E,NORING)  
20.03.39.( MT 054 ASSIGNED)  
20.03.39.PULL.  
20.03.40.MT54 VOLUME SERIAL NUMBER IS 009907  
20.03.58. RETRIEVAL COMPLETED.  
20.03.58. 18934 CARDS READ.  
20.03.58. 2348 CARDS WRITTEN.  
20.03.58. 0 ERRORS.  
20.03.58.IF(FILE,RRRRROU,1)  
20.04.00.CATALOG(RRRRRROU,CRAB23,ID=CRAB,RP=0)  
20.04.01.INITIAL CATALOG  
20.04.02.CT ID= CRAB PFN=CRAB23  
20.04.02.CT CY= 001 332 SECTORS  
20.04.02.IF(FILE,RRRRRER,2)  
20.04.03.OP 000015B SECTORS, FILE OUTPUT , DC 40  
20.04.03..ACCOUNT 7XX25011 01/23/79  
20.04.03. 7.728 CP SECONDS  
20.04.03. 28.113 PP SECONDS  
20.04.03. 10.302 I/O SECONDS  
20.04.03. 2616.521 CM SECONDS  
20.04.03. 135.045 DISK SECONDS  
20.04.03. 16.116 TAPE SECONDS  
20.04.03. 1 TAPE MOUNTS  
20.04.03. 2 READ SECTORS  
20.04.03. 13 PRNT SECTORS  
20.04.03. 560 RMS SECTORS  
20.04.03.PRIORITY 2 CLASS I ID QG  
20.04.03.RESOURCE UNITS = 26.194  
20.04.03.OUTPUT (EST) = \$ .04  
20.04.03.MOUNTS = \$ .25  
20.04.03.PROCESSING = \$ .87  
20.04.03.JOB COST = \$ 1.34  
20.04.03. 01/23/79 XMPLOGH 7XX25011 40

>>bye

COMMAND- batch,xmp10gh,print

COMMAND- logout

Appendix D. Ancillary programs.

## Appendix D.I ANALYSIS OF KVICHAK TOW NET DATA - Revised

IDENTIFICATION

FRK 317R - Analysis of Kvichak Tow Net Data - Revised  
Rewritten by Phillip B. Roger, March, 1972  
Fisheries Research Institute, University of Washington

PURPOSE

Each year the abundance of juvenile sockeye salmon in the Kvichak nursery areas is determined from catches made with a tow net. The tows are made at different depths and in various sections of the lakes. A yearly index of abundance is based on a weighted average of all catches. The weighting factors are lake areas at the present time, but any suitable factors may be used. Average length measurements of each category of fish are obtained for each section and are combined for all sections by weighting by the weighted mean catch in each section.

This program replaces an earlier tow net analysis program (FRK 317), and corrects certain calculating and logical errors in the former program. Output has been changed and expanded, principally by adding statements to calculate mean live length of each category of fish and adjust it to September 1, by allowing tows with zero catch to be included in the calculations, and by providing the option of calculating arithmetic or geometric mean indices.

PROCEDURE

A standard tow is of 20 minutes duration. If different towing times were used, the catches must be adjusted to correspond to the standard 20 minute haul. When very large catches were made some fraction of the total catch was analyzed and the remainder returned to the water. This program automatically adjusts both types of subsampled tows to standard conditions.

The Iliamna Lake and Lake Clark nursery areas are presently divided into 14 sections. Each section may be subdivided into as many as 9 depth strata. A section may be defined arbitrarily by use of the End of Section Card (Set 8).

Output for each section consists of means and standard deviations of catch and length for each fish group, for each depth stratum, and for all strata combined. A weighted mean catch and a mean length as of September 1 are computed for each fish group for all strata combined.

The weighted mean catch is computed as follows. An arithmetic mean catch is obtained for each fish type for all tows made in each section. This mean catch is multiplied by the specified weighting factor (currently percentage surface area of each section) to obtain the weighted mean catch for each section. Values for each section are summed to obtain weighted mean catches for each problem.

Because towing is normally conducted over a period of a month or more it would be improper to compare the length of fish captured near the beginning and end of towing, because of growth during that period. Therefore, all fish lengths are adjusted to length as of September 1. This adjustment is done by the program in two steps. First, since fish are measured after preservation in formalin, preserved length is adjusted to live length from a regression line which has been established independently (Rogers, 1964). Second, live length is adjusted to September 1 by adding or subtracting growth which occurred between September 1 and the day of capture. This adjustment is determined by multiplying the number of days from September 1 by the daily growth rate, in millimeters per day.

### INPUT

#### Set 1 - Problem card

- 1 - 60 Identification of the data
- 61 - 62 KT = Number of fish categories (species and age groups).  
KT ≤ 10 (I format)
- 64 NDEP = Number of depth strata (I format)
- 65 - 66 0 or blank - calculate arithmetic mean catches (I format)  
1 - calculate geometric mean catches

#### Set 2 - Depth strata card

- 1 - 6 UNIT = Units in which depth limits are given  
(e.g. METERS) (A format)
- 7 - 10 Upper depth of stratum 1 (I format)
- 11 - 14 Lower depth of stratum 1 (I format)
- 15 - 18 Upper depth of stratum 2 (I format)
- 19 - 22 Lower depth of stratum 2 (I format)
- .
- .
- .
- 75 - 78 Lower depth of stratum 9 (I format)

NOTE: Depth limits specified on this card must be mutually exclusive, e.g. 1-4, 5-8, ....not 1-4, 4-8, 8-12 ..... but need not be adjacent.

#### Set 3 - Label cards

- 1 - 6 Name of first species or age group of fish  
(e.g. S. FRY)
- 8 Corresponding species number which appears on the length-frequency cards
- 9 - 12 Corresponding growth rate (in mm/day), if known.

Otherwise leave blank. (F4.2)

- 13 - 15 Minimum length for this age group, when recorded.  
Otherwise, leave blank. (F3.0)
- 16 - 18 Maximum length for this age group, when recorded.  
Otherwise, leave blank. (F3.0)
- 19 - 72 Repeat columns 1-18 for each of KT species or age groups of fish. Four species per card. Maximum 10 species or age groups. Order of species must agree with order of catches on tow net card; species codes must agree with codes used on L-F cards

Set 4 - Format card

- 1 - 72 Format of tow net cards. Fields must be of the type specified for each variable on the tow net card.

Set 5 - Section card

- 1 - 12 Section name
- 16 - 20 Weighting factor (F5.4)

Set 6 - Tow net card § 27.18

Format determined by the Format card, Set 4. Variable format allowed, but the variables must be in the following order:

<u>Variable</u>	<u>Field Type</u>	<u>Explanation</u>
TOW	I	Tow number
SEC	I	Section number
MO	I	Month
DAY	F	Day
TIM	F	Duration of tow, in minutes
DEP	I	Depth of tow
CATCH(I)	F	Catch of fish type I. Repeat for as many fish types as necessary.
TOTWT	F	Weight of total catch if subsampled. Otherwise, leave blank.
SAMWT	F	Weight of subsample if taken, Otherwise, leave blank.

MEAS

I

Column 80 = 9:

If lengths on length-frequency cards are live lengths. Otherwise, any number or blank.

Set 7 - Length-frequency cards for data set 6 \$16.2A

1 - 3      Frequency 1  
 4 - 6      Length 1  
 7 - 9      Frequency 2  
 10 - 12    Length 2  
 . . . . .  
 . . . . .  
 67 - 69    Frequency 12  
 70 - 72    Length 12  
 73          Species or age group of fish as given on label cards  
 74 - 76    Tow number  
 77 - 79    Area number

Repeat as many times as necessary for each separate tow.

This set is designed for length-frequency data summarized on FRI Small Fish Measurement Forms S16.2 or S16.2A. Zero frequencies need not be punched and lengths need not be in ascending order. However, each card punched from this form must have 12 or fewer pairs of frequency and length and must have the required identifying information in columns 73 - 79.

Set 8 - Separator card

4 - 6      10 if the previous tow net card was followed by no length-frequency cards, otherwise blank.  
 7 - 9      Blank if previous tow was not the last tow in a section.  
 998        If previous tow was the last tow in a section and data for another section follows.  
 999        If previous tow was the last tow in a section and data for another section does not follow.

Repeat sets 6 - 8 for each tow in the section.

Repeat sets 5 - 8 for each section in the problem.



from the Kvichak data file sorted on magnetic tape and accessed through UPDATE. Therefore, the following example shows how to set up this type of problem on the SCOPE 3.4 system.

Job card

Account card

REQUEST(X,VSN = P667,INPUT)

REWIND(X,ØLDPL)

control cards to position tape X to correct file

CØPYBF(X,ØLDPL)

REWIND(ØLDPL)

RANDØM(ØLDPL)

UPDATE(C=TAPE3)

FØRTRAN.

LGØ(TAPE3)

7-8-9 Record separator card

\*COMPILE dname<sub>a</sub>, dname<sub>b</sub> (see UPDATE manual for explanation)

7-8-9 Record separator card

FRK317R version B deck

6-7-8-9 End of file card

SAMPLE INPUT

	(columns 1-60)	(columns 62-68)
SET 1.	Iliamna Lake 1971 - Indexes and mean lengths 8/10-8/29	4 2 111
SET 2.	FEET 4 10 15 25	
SET 3.	(1-6 8 9-12 19-24 26 27-30 37-42 44 45-48 55-60 62 63-66 columns) FRY 1 .25 YEAR 2 .53 3-SP. 3 .09 9-SP. 4 .09	
SET 4.	(I3,I2,7X,I2,F2.0,2X,F3.1,I2,13X,3F5.0,15X,F5.0,2F4.0)	
SET 5.	SECTION 8 .0084	
SET 6.	Tow net card (keypunched from Kvichak Towntet and Beach Seine Log Form S27.1A or S27.1B. The format can be modified to fit desired data form.)	

SET 7. Length-frequency cards (keypunched from Small Fish Measurement Form S16.2 or S16.2A.)

SET 8. Blank card (separator card)

SET 6. Tow net card

SET 7. Length-frequency cards

SET 8. Blank card (separator card)

.

.

.

(Repeat Sets 6 - 8 until all tows in a section are entered.)

SET 8. 998 (columns 7 - 9)

.

.

.

(Repeat Sets 5 - 8 until all sections in a problem are entered.)

SET 8. 999 (columns 7 - 9)

SET 9. NEW

.

.

.

(Repeat Sets 1 - 9 until all problems are entered.)

SET 9. END

MACHINE PROCESSING REQUIREMENTS

The core required to compile on the CDC 6400 SCOPE 3.4 was 44500 octal. Time and lines requirements for a job containing 3 problem sets with a total of 19 sections were as follows:

Input	~ 1300 cards (including source deck)
Output	945 lines
Central Processor Time	14.7 seconds
Peripheral Processor Time	4.4 seconds
Unit Records Cost	\$1.12
Total Cost	\$2.24

LITERATURE CITED

Rogers, D. E. 1964. Variability in measurement of length and weight of juvenile sockeye salmon and threespine stickleback. Univ. Washington, Fish. Res. Inst. Circ. 224. 34 p.

Appendix E. Bibliography of FRI Bristol Bay  
Studies.

## APPENDIX E.1. Bibliography, Wood River Project.

## PUBLICATIONS

Anonymous. 1950. The fruits of research. (About the Ekuk beach mesh experiments). Pac. Fish., April 1950. Pp. 17-19.

Royce, W. F., and O. A. Mathisen. 1959. Optimum escapement of red salmon in the Nushagak area of Bristol Bay. Pac. Fish., Oct. 1959. 3 pp.

Thompson, W. F., and D. W. Clancy. 1959. Length measurement of migrating salmon by paired underwater cameras. Photogrammetric Engineering, June, 1959. Pp. 449-455.

Burgner, R. L. 1962a. Sampling red salmon fry by lake trap in the Wood River lakes, Alaska. Univ. Washington, Publ. in Fish., New Ser. 3:317-348.

Burgner, R. L. 1962b. Studies of red salmon smolts from the Wood River lakes, Alaska. Univ. Washington, Publ. in Fish., New Ser. 3:249-295.

Mathisen, O. A. 1962a. Comparative characteristics of age and growth of red salmon in Lake Kuril, Kamchatka, and in Bristol Bay, Alaska. Voprosy. Ikh., Moscow 2(1):42-54. (In Russian).

Mathisen, O. A. 1962b. Photographic enumeration of red salmon escapement. Univ. Washington, Publ. in Fish., New Ser. 3:351-372.

- Mathisen, O. A. 1962c. The effect of altered sex ratios on the spawning of red salmon. Univ. Washington, Publ. in Fish., New Ser. 3:139-222.
- Koo, W. S. 1962. Age and growth of red salmon scales by graphical means. Univ. Washington, Publ. in Fish., New Ser. 3:51-100.
- Mathisen, O. A., R. L. Burgner, and S. Y. Koo. 1963. Statistical records and computations on red salmon runs in the Nushagak District, Bristol Bay, Alaska, 1946-59. U.S. Fish. Wildl. Serv. Spec. Sci. Rep. -- Fish. No. 468. 32 pp.
- Burgner, R. L. 1964. Factors influencing production of sockeye salmon in lakes of western Alaska. Verh. Internat. Verein. Limnol. 15:504-513.
- Burgner, R. L., et al. 1964. Summary report of studies on the optimum escapement of sockeye salmon in southwestern Alaska, 1961 and 1962. U.S. Bur. Com. Fish., Manuscript Rep. 64-2. 119 pp., Auke Bay, Alaska.
- Marriott, R. A., N. Aspinwall, S. Y. Koo. 1964. Stream catalog of the Wood River Lake system, Bristol Bay, Alaska. U.S. Fish. Wildl. Serv., Spec. Sci. Rep. Fish. No. 494. 210 pp.
- Burgner, R. L. 1966. Food production in two lake chains of southwestern Alaska. Verh. Internat. Verein. Limnol. 16:1036-1043.

- Gilbert, J. R. 1968. Surveys of sockeye salmon spawning populations in the Nushagak District, Bristol Bay, Alaska, 1946-1958. Univ. Washington, Publ. in Fish., New Ser. 3:151-168.
- Kim, W. S., and K. Roberson. 1968. On the use of otoliths of sockeye salmon for age determination. Univ. Washington, Publ. in Fish., New Ser. 3:151-168.
- Pella, J. J. 1968. Distribution and growth of sockeye salmon fry in Lake Aleknagik, Alaska during the summer of 1962. Univ. Washington, Publ. in Fish., New Ser. 3:47-111.
- Rogers, D. E. 1968. A comparison of the food of red salmon fry and threespine sticklebacks in the Wood River lakes. Univ. Washington, Publ. in Fish., New Ser. 3:1-43.
- Mathisen, O. A. 1971. Escapement levels and productivity of the Nushagak sockeye salmon runs from 1908-1966. N.O.A.A. Fish. Bull. 69(4):747-763.
- Hartman, W. L., and R. L. Burgner. 1972. Limnology and fish ecology of sockeye salmon nursery lakes of the world. J. Fish. Res. Bd. Can. 29:699-715.
- Hartman, W. L., and R. L. Burgner. 1972. Limnology and fish ecology of sockeye salmon nursery lakes of the world. J. Fish. Res. Bd. Can. 29:699-715.

- Rogers, D. E. 1973. Abundance and size of juvenile sockeye salmon and associated species in Lake Aleknagik, Alaska in relation to their physical environment. N.O.A.A. Fish. Bull. 71(4):1061-1075.
- Rogers, D. E., B. J. Rogers, and F. J. Hardy. 1982. Effects of fertilization of Little Togiak Lake on the food supply and growth of sockeye salmon. Proc. North Pacific Aquaculture Symposium. Univ. of Alaska. Alaska Sea Grant Report 82-2. Pp. 125-142.

## THESES

- Mathisen, O. A. 1955. Studies on the spawning biology of the red salmon, Oncorhynchus nerka (Walbaum) in Bristol Bay, Alaska with special reference to the effect of altered sex ratios. Ph.D. Dissert., 285 pp.
- Duncan, R. E. 1956. Two measures of the length of red salmon, Oncorhynchus nerka (Walbaum), their relation and application in the study of the catch and escapement in Bristol Bay, Alaska. M.S. Thesis, 92 pp.
- Burgner, R. L. 1958. Fluctuations in abundance, growth and survival in the early life stages of red salmon of the Wood River lakes, Alaska. Ph.D. Dissert., 200 pp.
- Rogers, D. E. 1961. A comparison of the food of red salmon fry and threespine sticklebacks in the Wood River lakes. M.S. Thesis, 60 pp.
- Kim, W. S. 1963. On the use of otoliths of red salmon for age and racial studies. M.S. Thesis, 63 pp.
- Pella, J. J. 1964. Sockeye salmon fry distribution and growth in Lake Aleknagik, Alaska, during the summer of 1962. M.S. Thesis, 132 pp.
- Aspinwall, N. 1965. Spawning characteristics and early life history of the Alaskan blackfish, Dallia pectoralis Bean. M.S. Thesis, 78 pp.
- Gadau, E. L. 1966. Mineral study of the four lake systems in the Nushagak district of Alaska. M.S. Thesis, 299 pp.

- Nelson, M. O. 1966. Food and distribution of Arctic char in Lake Aleknagik, Alaska, during the summer of 1962. M.S. Thesis, 164 pp.
- Rogers, D. E. 1967. Estimation of pelagic fish populations in the Wood River lakes, Alaska, from tow net catches and echogram marks. Ph.D. Dissert., 91 pp.
- Waters, B. 1968. Variation in the abundance of young sockeye salmon and four associated species in the littoral zone of Lake Aleknagik, Alaska, as determined from beach seine catches. M.S. Thesis, 85 pp.
- Reeves, J. 1969. A comparative analysis of Arctic char populations in sockeye salmon lakes of the Nushagak district, Alaska. Ph.D. Dissert., 218 pp.
- Geist, R. W. 1975. A tagging plan to determine the proportion of Bristol Bay sockeye salmon (Oncorhynchus nerka) taken in the Japanese high-seas fishery. M.S. Thesis, 113 pp.
- Newcome, N. W. 1976. Relative distribution, abundance, size, and food habits of juvenile sockeye salmon and associated species in the Igushik Lakes, Alaska. M.S. Thesis, 71 pp.
- Burke, J. A. 1977. Occurrence and effects of the parasite Triaenophorus crassus in sockeye salmon, Oncorhynchus nerka, of the Wood River lake system, Bristol Bay, Alaska. M.S. Thesis, 73 pp.

- Moriarity, D. S. 1977. Arctic char in the Wood River lakes. M.S. Thesis, 68 pp.
- Hardy, F. J. 1979. Effects of inorganic fertilization on phytoplankton in Little Togiak Lake, Alaska. M.S. Thesis, 108 pp.
- Rogers, B. J. 1979. Response of juvenile sockeye salmon and their food supply to inorganic fertilization of Little Togiak Lake, Alaska. M.S. Thesis, 112 p.
- Gilbertson, L. G. 1980. Variation and natural selection in an Alaskan population of the threespine stickleback (Gasterosteus aculeatus L.). Ph.D. Dissert., 201 pp.
- Burke, J. A. 1981. Infectious hematopoietic necrosis virus: an examination of diagnostics, quantitative techniques and pathogenesis. Ph.D. Dissert., 60 pp.
- Ruggerone, G. T. 1981. Arctic char predation on sockeye salmon smolts at Little Togiak River, Alaska. M.S. Thesis, 57 pp.

## FISHERIES RESEARCH INSTITUTE CIRCULARS

(By year, 1952-1982)

- FRI Staff. 1952. Memorandum on the effects of net marks. Univ. Washington, Fish. Res. Inst. Circ. 35, Memo 3.
- Thompson, W. F. 1955. Red salmon of the Nushagak. Univ. Washington, Fish. Res. Inst. Circ. 50, Memo 9.
- Burgner, R. L., and S. Y. Koo. 1954. Results of the red salmon seaward migrant enumeration, Wood River lakes, 1951-1953. Univ. Washington, Fish. Res. Inst. Circ. 63, Memo 5.
- FRI Staff. 1954. Observations of physical conditions and salmon survival in Bristol Bay. Univ. Washington, Fish. Res. Inst. Circ. 63, Memo 6.
- FRI Staff. 1954. Nushagak red salmon forecast for 1955. Univ. Washington, Fish. Res. Inst. Circ. 66, Memo 7.
- FRI Staff. 1955. Summary tables of morphometric material collected by FRI on Bristol Bay red salmon. Univ. Washington, Fish. Res. Inst. Circ. 77.
- FRI Staff. 1956. Nushagak red salmon forecast for 1958. Univ. Washington, Fish. Res. Inst. Circ. 84, Memo 11.
- Thompson, W. F. 1957. Letter to FRI Advisory Board re. Nushagak catch, 1900-1957. Univ. Washington, Fish. Res. Inst. Circ. 95.

- FRI Staff. 1959. The expected run of red salmon in 1959 and the optimum escapement. Univ. Washington, Fish. Res. Inst. Circ. 99.
- Koo, S. Y. 1959. Red salmon smolt enumeration in the Wood River system. Univ. Washington, Fish. Res. Inst. Circ. 103.
- Burgner, R. L., and W. A. Church. 1960. Observations on mortality of red salmon eggs in the Wood River lakes, Fall 1959. Univ. Washington, Fish. Res. Inst. Circ. 113.
- Marriott, R. A. 1960. Size, age, and sex composition of red salmon commercial catch in Nushagak, 1959. Univ. Washington, Fish. Res. Inst. Circ. 116.
- Koo, S. Y. 1960. Abundance, size, and age of red salmon smolts from the Wood River system, 1959. Univ. Washington, Fish. Res. Inst. Circ. 118.
- Nelson, M. O. 1960. Red salmon spawning ground surveys in the Nushagak District, Bristol Bay, Alaska, 1959. Univ. Washington, Fish. Res. Inst. Circ. 119.
- Marriott, R. A. 1960. Size and age composition of red salmon escapement to the Wood River lakes in 1961. Univ. Washington, Fish. Res. Inst. Circ. 154.
- Kim, W. S. 1962. Estimation of red salmon spawning population in Little Togiak Lake, Alaska, by means of tagging. Univ. Washington, Fish. Res. Inst. Circ. 156.

- Finn, E. 1961. Little Togiak River red salmon escapement enumeration, 1961. Univ. Washington, Fish. Res. Inst. Circ. 157.
- Colby, D. R., and S. Y. Koo. 1962. Lake Kulik red salmon escapement enumeration, 1961. Univ. Washington, Fish. Res. Inst. Circ. 158.
- Marriott, R. A. 1963. Lake Kulik smolt enumeration, 1961. Univ. Washington, Fish. Res. Inst. Circ. 175.
- Aspinwall, N. 1963. Little Togiak River smolt enumeration, 1961. Univ. Washington, Fish. Res. Inst. Circ. 181.
- Burgner, R. L., and J. H. Green. 1963. Study of interlake migration of red salmon fry, Agulowak River. Univ. Washington, Fish. Res. Inst. Circ. 182.
- Koo, S. Y. 1964. Factors affecting marine age at return in sockeye salmon. Univ. Washington, Fish. Res. Inst. Circ. 208.
- Rogers, D. E. 1964. A summary of climatological observations and water temperatures in the Wood River lake system. Univ. Washington, Fish. Res. Inst. Circ. 209.
- Burgner, R. L. 1964. Age composition of Nushagak red salmon runs, 1946-1963. Univ. Washington, Fish. Res. Inst. Circ. 219.
- Rogers, D. E. 1964. Variability in measurement of length and weight of juvenile sockeye salmon and threespine stickleback. Univ. Washington, Fish. Res. Inst. Circ. 224.

- Burgner, R. L., J. Reeves, and D. E. Rogers. Observations on resident fishes in the Tikchik and Wood River lake systems. Univ. Washington, Fish. Res. Inst. Circ. 229.
- Burgner, R. L. 1965. Age composition of Nushagak sockeye runs by river system, 1950-1964. Univ. Washington, Fish. Res. Inst. Circ. 234.
- Royce, W. F. 1965. Almanac of Bristol Bay sockeye salmon. Univ. Washington, Fish. Res. Inst. Circ. 235.
- Aspinwall, N., and K. Roberson. 1965. Report on age and size of sockeye sampled from spawning grounds in the Wood River and Tikchik lakes, 1964. Univ. Washington, Fish. Res. Inst. Circ. 237.
- Aspinwall, N., and K. Roberson. 1966. Report on age and size of sockeye sampled from Wood River and Tikchik spawning grounds, 1963. Univ. Washington, Fish. Res. Inst. Circ. 66-4.
- Aspinwall, N., and K. Roberson. 1966. Report on age and size of sockeye salmon sampled from spawning grounds in the Wood River and Tikchik lakes, 1964. Univ. Washington, Fish. Res. Inst. Circ. 66-5.
- Roberson, K. 1966. Report on age and size of sockeye salmon sampled from spawning grounds in the Wood River lakes, 1965. Univ. Washington, Fish. Res. Inst. Circ. 66-8.

- Waters, B. 1967. Abundance, distribution, and species composition of zooplankton in the lakes of the Nushagak District, Alaska, 1961-1965. Univ. Washington, Fish. Res. Inst. Circ. 67-2.
- Roberson, K. 1967. Report on age composition and abundance of sockeye salmon sampled from spawning grounds in the Wood River lakes, 1966. Univ. Washington, Fish. Res. Inst. Circ. 67-5.
- Batts, B. S., and K. J. Fischler. 1967. Historical data on the sockeye salmon runs to the Nushagak District, Bristol Bay, Alaska, 1890-1945. Univ. Washington, Fish. Res. Inst. Circ. 67-10.
- Reeves, J. 1968. A quantitative comparison of bottom faunas of freshwater lakes in southwestern Alaska. Univ. Washington, Fish. Res. Inst. Circ. 68-1.
- Roberson, K. 1968. Report on the age composition of sockeye salmon sampled from spawning grounds in the Wood River lakes, 1947-1967. Univ. Washington, Fish. Res. Inst. Circ. 68-3.
- Roberson, K. 1968. Report on the abundance of sockeye salmon as determined by marking studies on the spawning grounds in the Wood River lakes, 1967. Univ. Washington, Fish. Res. Inst. Circ. 68-4.
- Mathisen, O. A. 1969. Tagging experiments in Bristol Bay, Alaska, in 1946 and 1947. Univ. Washington, Fish. Res. Inst. Circ. 69-1.
- Siler, D. 1970. Report on the abundance and age composition of sockeye salmon in sampled spawning grounds in the Wood River lakes, 1968 and 1969. Univ. Washington, Fish. Res. Inst. Circ. 70-4.

- Rogers, D. E., D. Siler, and T. Croker. 1970. A summary of climatological observations and water temperatures in the Wood River lake system. Univ. Washington, Fish. Res. Inst. Circ. 70-10.
- Rogers, D. E. 1972. Estimates of abundance and growth in the early summer from beach seine catches in Lake Aleknagik, 1962 through 1971. Univ. Washington, Fish. Res. Inst. Circ. 72-4.
- Rogers, D. E., L. Gilbertson, and D. Eggers. 1972. Predator-prey relationship between Arctic char and sockeye salmon smolts at the Agulowak Rivers, Lake Aleknagik, in 1971. Univ. Washington, Fish. Res. Inst. Circ. 72-7.
- Rogers, D. E., and A. Hamalainen. 1972. Abundance and age composition of sockeye salmon from spawning grounds in the Wood River Lakes in 1970-1971 and from 1946-1971. Univ. Washington, Fish. Res. Inst. Circ. 72-6.
- Rogers, D. E. 1973. Forecast of the sockeye salmon run to Bristol Bay in 1973. Univ. Washington, Fish. Res. Inst. Circ. 73-1, 33 pp.
- Rogers, D. E. 1974. Forecast of the sockeye salmon run to Bristol Bay in 1974. Univ. Washington, Fish. Res. Inst. Circ. 74-1, 30 pp.
- Rogers, D. E. 1975. Forecast of the sockeye salmon run to Bristol Bay in 1975. Univ. Washington, Fish. Res. Inst. Circ. 75-3, 45 pp.
- Rogers, D. E. 1976. Forecast of the sockeye salmon run to Bristol Bay in 1976. Univ. Washington, Fish. Res. Inst. Circ. 76-1, 49 pp.

Rogers, D. E. 1977. Forecast of the sockeye salmon run to Bristol Bay in 1977. Univ. Washington, Fish. Res. Inst. Circ. 77-2, 36 pp.

Harris, C. K., and D. E. Rogers. 1978. Forecast of the sockeye salmon run to Bristol Bay in 1978. Univ. Washington, Fish. Res. Inst. Circ. 78-1.

Harris, C. K., and D. E. Rogers. 1979. Forecast of the sockeye salmon run to Bristol Bay in 1979. Univ. Washington, Fish. Res. Inst. Circ. 79-2.

## FISHERIES RESEARCH INSTITUTE ANNUAL AND FINAL REPORTS

Numbered

Series

FRI-UW-7310 August 15, 1973

Annual progress report. Contract No. N-208-0086-73 National Marine Fisheries Service

Systems modeling of sockeye salmon in the Wood River lakes. 1973. By D. M. Eggers, and D. E. Rogers. 9 pp.

FRI-UW-7402 Feb. 13, 1974.

Informational report.

Acoustic stock estimation in Lake Nunavaugaluk in the Nushagak District of Bristol Bay, Alaska. 1974. By N. A. Lemberg, E. P. Nunnallee, and O. A. Mathisen. 16 pp.

FRI-UW-7506 June 28, 1974.

Annual report - Grant No. 04-4-208-31 National Marine Fisheries Service

Systems modeling of sockeye salmon in the Wood River lakes. 1974. By D. E. Rogers. 110 pp.

FRI-UW-7508 July 15, 1975.

Final report - Alaska Department of Fish and Game  
Distribution, abundance, and size of juvenile sockeye salmon and associated species in the Igushik lakes. 1975. By D. E. Rogers, and N. Newcome. 46 pp.

FRI-UW-7511 August 25, 1975

Annual report - Grant No. 04-5-208-65 National Marine Fisheries  
Service

Systems modeling of sockeye salmon in the Wood River lakes. 1975. By  
D. E. Rogers. 51 pp.

FRI-UW-7601 June 2, 1976

Grant No. 04-5-208-65 National Marine Fisheries Service  
Sockeye systems model. 1976. By D. E. Rogers

FRI-UW-7602 Feb. 18, 1976

Alaska Dept. of Fish and Game  
Fertilization, Little Togiak. 1976. By D. E. Rogers.

FRI-UW-7617A Dec. 6, 1976

Alaska Dept. of Fish and Game  
Artificial fertilization - Nushagak District. 1976. By J. Hardy.

FRI-UW-7617B Dec. 29, 1976

Alaska Dept. of Fish and Game  
Artificial fertilization - Nushagak District. 1976. By D. E. Rogers.

FRI-UW-7618 Dec. 21, 1976

Alaska Dept. of Fish and Game  
Arctic char in Wood River. 1976. By D. S. Moriarity.

FRI-UW-7705

Final Report - Alaska Dept. of Fish and Game  
Arctic char in the Wood River lakes. 1977. By D. S. Moriarity. 68 pp.

FRI-UW-7706

Alaska Dept. of Fish and Game

Collection and analysis of biological data from the Wood River lake system, Nushagak District, Bristol Bay, Alaska. Biology of the three-spine stickleback in the Wood River lakes, part D. (1977). By D. E. Rogers. 38 pp.

FRI-UW-7707

Final Report - Alaska Dept. of Fish and Game

Collection and analysis of biological data from the Wood River lake system, Nushagak District, Bristol Bay, Alaska. Prediction of sockeye salmon runs to the Wood River lakes. Part E. By D. E. Rogers. 21 pp.

FRI-UW-7708

Final Report - Alaska Dept. of Fish and Game

Collection and analysis of biological data from the Wood River lake system, Nushagak District, Bristol Bay, Alaska. How to increase catches of sockeye salmon in the Nushagak District. Part F. By D. E. Rogers. 5 pp.

FRI-UW-7802 Jan. 30, 1978.

Alaska Dept. of Fish and Game

Collection and analysis of biological data from the Wood River lake system, Nushagak District, Bristol Bay, Alaska (Fertilization of Little Togiak Lake). By D. E. Rogers.

FRI-UW-7806 May 22, 1978.

Contract No. 03-6-208-03257 National Marine Fisheries Service  
Modeling the migration of sockeye salmon smolts through Bristol Bay,  
Alaska. By D. M. Eggers and D. E. Rogers.

FRI-UW-7924 1979

Final Report - Alaska Dept. of Fish and Game  
Little Togiak Lake fertilization. By D. E. Rogers. 34 pp.

FRI-UW-8019

Annual report - Contract No. 03-78-M-02-250 National Marine Fish-  
eries Service  
Alaska Salmon Studies: The study of red salmon in the Nushagak  
District. By D. E. Rogers and G. T. Ruggerone.

FRI-UW-8123 10/1/80 - 9/30/81

Annual Report - Contract No. 81-ABC-0039 National Marine Fisheries  
Service  
Alaska Salmon Studies: The study of red salmon in the Nushagak  
District. By D. E. Rogers.

FRI-UW-8208 7/1/81 - 6/30/82

Annual Report to ADF&G, Contract No. 82-0282 Alaska Dept. of Fish and  
Game  
Evaluation of Nushagak sockeye escapements. By D. E. Rogers.

## UNPUBLISHED REPORTS (Wood River Studies)

Adult Identification

Burgner, R. L. 1954. Regarding the use of the Nushagak red salmon as a tracer population to identify Bristol Bay reds at sea. 7 pp.

Nushagak Bay Tagging and Mesh Studies

Baade, R. T. 1946. Tagging program, Nushagak, 1946.

Burgner, R. L. 1947. Mesh experiment-Ekuk Beach, 1946. 47 pp.

MacRae, J. W. 1947. Mesh experiments - Clarks Point, Alaska. 26 pp.

Parasite Study

Burgner, R. L. 1952. Preliminary notes on cestode infestation.

Spawning Ground Studies

Burgner, R. L. 1947. Spawning ground survey study. 1. Lake Aleknagik  
2. Tikchik region.

MacRae, J. W. 1947. Spawning ground survey study. Wood River lakes region.

FRI staff. 1955. Small streams study - quarterly report, July - September, 1955.

Winter Studies

Charlton, R. 1950. Report on winter survey - Bristol Bay, February - March, 1950.

- Church, W. A. 1955. Preliminary studies on the effect of winter environment on red salmon, Lake Nerka.
- Church, W. A. 1956. Report on the 1955-56 studies of the effect of winter conditions on survival of red salmon eggs and larvae in the Wood River lakes. 69 pp.
- Church, W. A. 1959a. Report on the 1956-57 studies on the effect of winter environment on red salmon eggs and larvae in the Wood River lakes. 24 pp.
- Church, W. A. 1959b. Report on the 1957 studies of recently emerged red salmon fry in the Wood River lakes. 11 pp.
- Church, W. A. 1959c. Studies on the effect of winter climate on survival of red salmon embryos in the Wood River lakes, Alaska, 1952-1959.

#### Weather Reports

- Bruckelmeyer, F. 1947. Weather report. Lake Aleknagik, Sourdough camp, 1947.
- FRI staff. 1947. Bathythermograph observations and graphs, Lake Aleknagik, Wood River, 1947.
- Church, W. A. 1947. Weather report, Lake Chauekuktuli, Allen River, November 1956 - March 1947.
- Church, W. A. 1952-1959. Weather compilations, Nerka station, 1952-1959.

Young Fish Studies

- Burgner, R. L. 1951. Preliminary report on the young red salmon index sampling problem in Bristol Bay, with particular reference to the 1951 studies into the use of floating lake traps in the Wood River lakes.
- Coulton, T. 1951. Marking experiments of fingerling silver salmon by the injection of biological stains.
- Burgner, R. L. 1953a. Age composition of young red salmon in the Wood River lakes as shown by length frequency and subsequent scale study of samples taken during single sampling period.
- Burgner, R. L. 1953b. A preliminary comparison of Kvichak and Nushagak red salmon fingerling samples.
- Koo, S. Y. 1953a. Report on red salmon smolt enumeration at Mosquito Point, Lake Aleknagik, 1953.
- Koo, S. Y. 1953b. An adjusted appraisal of the relative abundance of red salmon smolt migration at Mosquito Point in the years 1951, 1952, and 1953.
- Burgner, R. L. 1954. An evaluation of the sampling procedure used at Mosquito Point, Lake Aleknagik, to determine the age and size composition of red salmon smolts at time of seaward migration.
- Burgner, R. L. 1954-1955a. Age composition of the 1953 (and 1954) smolt migration, Wood River lakes.

Burgner, R. L. 1954-1955b. Seasonal changes in size of smolts passing Mosquito Point, 1953 and 1954.

Koo, S. Y. 1954. Is the 2100-2300 hour fishing period for smolt migrants adequate for enumeration purpose?

Koo, S. Y. 1954-1958. Report on red salmon smolt enumeration at Mosquito Point, Lake Aleknagik, (1954-1955).

Burgner, R. L. 1955. Second report on sampling procedures used at Mosquito Point, Lake Aleknagik, to determine size and age composition of the red salmon smolts.

Burgner, R. L. 1956. Study of migration and movements of red salmon fingerlings by tattooing release, and recovery procedures.

Burgner, R. L. 1957. Factors affecting timing of the Mosquito Point seaward migration.

Burgner, R. L. 1958. Methods of measuring condition of red salmon fingerlings.

#### Modeling

Eggers, D. M., and D. E. Rogers. 1971. Trophic relation model in aquatic communities sockeye salmon model, Wood River lakes, Alaska. Yearly progress report.

#### Limnology and Fish Population Studies

Burgner, R. L., and W. L. Hartman. 1963. INPFC sockeye salmon data summary report (SSR-F). Unpublished manuscript.

## APPENDIX E.2 Bibliography, Kvichak Project

## PUBLICATIONS

- Becker, Clarence D. 1959. The unexpected appearance of pink salmon in the Kvichak River, p. 13. In Alaska Fishery Briefs. U.S. Fish Wildl. Serv., Circ. 59.
- Tyler, Richard W. 1960. Use of dynamite to recover tagged salmon. U.S. Fish. Wildl. Serv., Spec. Sci. Rep., Fish. 353. 9 p.
- Koo, Ted S. Y., and Howard D. Smith. 1960. Mainstem and tributary sampling of red salmon scales for population studies. U.S. Fish. Wildl. Serv., Spec. Sci. Rep., Fish. 362. 10 p.
- Kerns, Orra E., Jr. 1961. Abundance and age of Kvichak River red salmon smolts. U. S. Fish. Wildl. Serv., Fish. Bull. 61(189):301-320.
- Becker, Clarence Dale. 1962. Estimating red salmon escapements by sample counts from observation towers. U.S. Fish Wildl. Serv., Fish. Bull. 61(192):355-369.
- Demory, Robert L., Russell F. Orrell, and Donald R. Heinle. 1964. Spawning ground catalog of the Kvichak River system, Bristol Bay, Alaska. U.S. Fish. Wildl. Serv., Spec. Sci. Rep., Fish. 488. 292 pp.
- Mathisen, Ole A., and O. E. Kerns, Jr. 1964. Abundance, distribution, and size of juvenile red salmon of the 1960 year class in Iliamna

- Lake, Alaska, p. 191-202. In George Dahlgren [ed.], 14th Alaskan Sci. Conf., Proc. August 27-30, 1963.
- Smith, Howard D. 1964. The segregation of red salmon in the escape-ments to the Kvichak River system, Alaska. U.S. Fish. Wildl. Serv., Spec. Sci. Rep., Fish. 470. 20 pp.
- Mathisen, Ole A. 1965. Length-weight relationship of mature Bristol Bay sockeye salmon in 1963. Alaska Fish Game Dept. Informa. Leaf. #56.
- Mathisen, Ole A. 1966. Some adaptations of sockeye salmon races to limnological features of Iliamna Lake, Alaska. Verh. Internat. Verein. Limnol. 16:1025-1035.
- Kerns, Orra E., Jr., and John R. Donaldson. 1968. Behavior and distri-bution of spawning sockeye salmon on island beaches in Iliamna Lake, Alaska, 1965. J. Fish. Res. Bd. Can. 25(3):485-494.
- Royce, William F., Lynwood S. Smith, and Allan C. Hartt. 1968. Models of oceanic migrations of Pacific salmon and comments on guidance mechanisms. U.S. Fish. Wildl. Serv., Fish. Bull. 66(3):441-462.
- Olsen, James C. 1968. Physical environment and egg development in a mainland beach area and an island beach area of Iliamna Lake. Univ. Washington Publ. in Fish., New Ser. 3:169-197.
- Burgner, Robert L., Charles J. DiCostanzo, Robert J. Ellis, George Y. Harry, Jr., Wilbur L. Hartman, Orra E. Kerns, Jr., Ole A. Mathisen,

- and William F. Royce. 1969. Biological studies and estimates of optimum escapements of sockeye salmon in the major river systems in southwestern Alaska. U.S. Fish. Wildl. Serv., Fish. Bull. 67(2):405-459.
- Mathisen, Ole A. 1969. Allocation of weight and length measurements for estimation of the average weight of juvenile sockeye salmon. J. Fish. Res. Bd. Can. 26(10):2741-4726.
- Mathisen, Ole A. 1969. Growth of sockeye salmon in relation to abundance in the Kvichak District, Bristol Bay, Alaska. Fisk. Dir. Skr. Ser. HavUnders. 15:172-185.
- Mathisen, Ole A., and Tor B. Gunnerød. 1969. Variance components in the estimation of potential egg deposition of sockeye salmon escapements. J. Fish. Res. Bd. Can. 26(2):405-412.
- Mathisen, Ole A. 1970. "The sockeye salmon Oncorhynchus nerka," by R.E. Forester, Fish. Res. Bd. Can. Bull. 162, 1968, 422 pp. J. Fish. Biol. 2(1):81-82. (Book Review).
- Hoag, Stephen H. 1972. The relationship between the summer food of juvenile sockeye salmon, Oncorhynchus nerka, and the standing stock of zooplankton in Iliamna Lake, Alaska. NOAA Fish. Bull. 70(2):355-362.
- Mathisen, Ole A. 1972. Biogenic enrichment of sockeye salmon lakes and stock productivity. Verh. Internat. Verein. Limnol. 18:1089-1095.

- Mathisen, Ole A., T. R. Crocker, and E. P. Nunnallee. 1973. Acoustic estimation of juvenile sockeye salmon. In Press. ICES/FAO/ICNAF Symposium on Acoustic Methods in Fisheries Research. Bergen. June 19-22.
- Pennell, David A., C. Dale Becker, and Nora R. Scofield. 1973. Helminths of sockeye salmon (Oncorhynchus nerka) from the Kvichak River system, Bristol Bay, Alaska. U.S. NOAA Fish. Bull. 71(1):267-277.
- Mathisen, Ole A., and Edmund P. Nunnallee. 1974. Acoustic stock estimation as a tool in management of sockeye salmon (Oncorhynchus nerka, Walbaum) runs. Univ. Washington Coll. Fish. Contrib. 147.
- Mundy, P. R., and O. A. Mathisen. 1977. In-season estimation of the sockeye salmon runs to Bristol Bay, Alaska. Contributed paper to 197th Annual Meeting of the American Fisheries Society, Vancouver, British Columbia, Canada, September 17, 1977. 7 pp (Processed).
- Mathisen, O. A., and P. H. Poe. 1978. Effect of volcanic ash deposits on sockeye salmon lakes. Verh. Internat. Verein. Limnol. 20:165-172.
- Mathisen, O. A. 1978. Salmon management in Bristol Bay. Univ. Washington, Coll. Fish. Contrib. 487. 33 pp.
- Mathisen, O. A. 1978. Toward computerized fisheries management in Bristol Bay, pp. 74-77. In Robert A. Henning et al. (eds.), Bristol Bay Basin, Alaska Geographic Society. 5(3).

- Mathisen, O. A., and P. H. Poe. 1981. Sockeye salmon cycles in the Kvichak River, Bristol Bay, Alaska. Verh. Internat. Verein. Limnol. 21:1207-1213.
- Mathisen, O. A., and P. H. Poe. 1983. Management, escapement levels and carrying capacity in some sockeye salmon producing systems in Bristol Bay, Alaska. XV. Pacific Science Conference Station I5, New Zealand, Feb. 10, 1983. (In press).
- Mundy, P. R., and O. A. Mathisen. 1981. Abundance estimation in a feedback control system applied to the management of a commercial salmon fishery. Applied Operations Research in Fishing, 1981.
- Mathisen, O. A., and P. H. Poe. 1981. Sockeye salmon cycles in the Kvichak River, Bristol Bay, Alaska. Verh. Internat. Verein. Limnol. 21:1207-1213.
- Mathisen, O. A., and P. H. Poe. 1983. Management, escapement levels and carrying capacity in some sockeye salmon producing systems in Bristol Bay, Alaska. XV Pacific Science Conference Section I 5, New Zealand, Feb. 10, 1983 (in press).

## THESES

- Smith, Howard Donald. 1960. The segregation of red salmon in the escapements to Kvichak River system, Alaska. M.S. thesis. 65 pp.
- Fowler, Charles Winsor. 1966. The design and testing of a photo-electric zooplankton counting device. M.S. thesis, 61 pp.
- Lenarz, William H. 1966. Population dynamics of Cyclops scutifer and an evaluation of a sampling program for estimating the standing crop of zooplankton in Iliamna Lake. M.S. thesis, 120 pp.
- Donaldson, John Russell. 1967. The phosphorus budget of Iliamna Lake, Alaska as related to the cyclic abundance of sockeye salmon. Ph.D. dissert., 141 pp.
- Mathews, Stephen B. 1967. The economic consequences of forecasting sockeye salmon (Oncorhynchus nerka, Walbaum) runs to Bristol Bay, Alaska: A computer simulation study of the potential benefits to a salmon canning industry from accurate forecasts of the runs. Ph.D. dissert., 238 pp.
- Baxter, Richard Andrew. 1968. Primary production in Iliamna Lake, Alaska, 1962-1967. M.S. thesis, 81 pp.
- Hoag, Stephen Holly. 1968. The food of juvenile sockeye salmon, Oncorhynchus nerka, related to the zooplankton in Iliamna Lake, Bristol Bay, Alaka. M.S. thesis, 72 pp.

- Gunnerød, Tor Bertel. 1971. The life history and population dynamics of Cyclops scutifer Sars in Pedro Bay, Iliamna Lake, Alaska. Ph.D. dissert., 136 p.
- Roger, Phillip Bruce. 1971. The ecology of two species of cottids in Iliamna Lake, Alaska, and their relation to sockeye salmon. M.S. thesis, 80 pp.
- Low, Loh Lee. 1972. Chlorophyll a, phytoplankton, and primary production in Iliamna Lake, Alaska. M.S. thesis, 101 pp.
- Nunnallee, Edmund Pierce, Jr. 1973. A hydroacoustic data acquisition and digital data analysis system for the assessment of fish stock abundance. M.S. thesis. 70 pp.
- Carlson, Thomas J. 1974. The life history and population dynamics of Bosmina coregoni in Pedro Bay, Iliamna Lake, Alaska. M.S. thesis, 142 pp.
- Mundy, Phillip R. 1979. A quantitative measure of migratory timing illustrated by application to the management of commercial salmon fisheries. Ph.D. dissert., 85 pp.
- Gaudet, David M. 1980. Hydroacoustic sampling of salmon escapements in trunk streams of Bristol Bay, Alaska. M.S. thesis, 104 pp.
- Poe, Patrick H. 1980. Effects of the 1976 volcanic ash fall on primary productivity in Iliamna Lake, Alaska, 1976-1978. M.S. thesis. 210 pp.

- Nunnallee, E. P. 1980. Application of an empirically scaled digital echo integrator for assessment of juvenile sockeye salmon (Oncorhynchus nerka Walbaum) populations. Ph.D. dissert., 117 pp.
- Brannian, Linda K. 1982. The estimation of daily escapement and total abundance from catch per unit effort of the sockeye salmon fishery in Togiak Bay, Alaska. M.S. thesis, 173 pp.

## FISHERIES RESEARCH INSTITUTE CIRCULARS

(by year, 1954-1982)

- Thompson, William F., Robert L. Burgner, Ole A. Mathisen, John R. Gilbert, and Ted. S. Y. Koo. 1954. Discussion of the proposed regulatory closure of a section of the Bristol Bay fishery. Univ. Washington, Fish. Res. Inst. Circ. 73. 13 pp.
- Anonymous. 1959. Kvichak red salmon studies, p. 20. In Ted. S. Y. Koo (ed.). Report of Operations, 1958. Univ. Washington, Coll. Fish. Contrib. 51.
- Martin, J. W., and O. E. Kerns, Jr. 1960. Photo-electrical counting of red salmon (Oncorhynchus nerka Walbaum) smolts in the Kvichak River, Alaska. Univ. Washington, Fish. Res. Inst. Circ. 114. 9 pp.
- Kerns, Orra E., Jr., Ted S. Y. Koo, and Charles O. Junge, Jr. 1961. Summary report on photo-electric counting of red salmon smolts, 1960. Univ. Washington, Fish. Res. Inst. Circ. 141. 3 pp.
- Fisheries Research Institute. 1961. Field Manual. Univ. Washington, Fish. Res. Inst. Circ. 143. 116 pp.
- Dunn, Jean R. 1962. Abundance, distribution, age and growth of juvenile red salmon and threespine stickleback in Iliamna Lake, 1961. Univ. Washington, Fish. Res. Inst. Circ. 166. 11 pp.
- Horton, Howard F., and James. C. Olsen. 1962. Spawning density study of red salmon in Copper River, Iliamna Lake, Alaska. Univ. Washington, Fish. Res. Inst. Circ. 169. 10 pp.

- Kerns, Orra E., Jr. 1962. Segregation of red salmon spawning units, p. 10-12. In Fisheries Research Institute Presentation at the 24th Annual Canned Salmon Cutting Demonstration held at Olympic Hotel, Seattle, March 13, 1962. Univ. Washington, Fish. Res. Inst. Circ. 163.
- Mathisen, O. A., R. L. Demory, and R. F. Orrell. 1962. Notes on the time of hatching of red salmon fry in Iliamna District, Bristol Bay, Alaska. Univ. Washington, Fish. Res. Inst. Circ. 1972. 12 pp.
- Olson, James C. 1962. Weather observations, Iliamna Lake, Alaska, 1961. Univ. Washington, Fish. Res. Inst. Circ. 165. 3 pp.
- Orrell, Russell F., and Robert L. Demory. 1962. Kvichak salmon studies, 1961 spawning ground studies. Univ. Washington, Fish. Res. Inst. Circ. 164. 8 pp.
- Bond, Carl E., and C. Dale Becker. 1963. Key to the fishes of the Kvichak River system. Univ. Washington, Fish. Res. Inst. Circ. 189. 9 pp.
- Gregory, Richard W., and Ole A. Mathisen. 1963. The use of echosounders to determine density and distribution of young red salmon in Iliamna Lake in 1962. Univ. Washington, Fish. Res. Inst. Circ. 191. 13 pp.
- Kim, Wan Soo, and Robert L. Demory. 1963. Kvichak salmon studies, 1962 spawning ground studies. Univ. Washington, Fish. Res. Inst. Circ. 196. 26 pp.

- Mathisen, Ole A. 1963. The 1960 cycle in Kvichak, p. 16-21. In Fisheries Research Institute Presentation at the 25th Annual Canned Salmon Cutting Demonstration held at Olympic Hotel, Seattle, March 12, 1963. Univ. Washington, Fish. Res. Inst. Circ. 1964.
- Munn, John. 1963. Summer thermal conditions in Iliamna Lake, Bristol Bay, Alaska in 1961 and 1962. Univ. Washington, Fish. Res. Inst. Circ. 1966. 24 pp.
- Orrell, R. F. 1963. Abundance and age of Lake Clark red salmon smolts, 1962. Univ. Washington, Fish. Res. Inst. Circ. 186. 13 p.
- Fowler, Charles W. 1964. Weather observations, Iliamna Lake, Alaska, 1962-1963. Univ. Washington, Fish. Res. Inst. Circ. 207. 29 pp.
- Kerns, Orra E., Jr. 1964. The changing Kvichak cycle, p. 1-7. In Fisheries Research Institute Presentation at the 26th Annual Canned Salmon Cutting Demonstration held at Olympic Hotel, Seattle, March 17, 1964. Univ. Washington, Fish. Res. Inst. Circ. 210.
- Kerns, Orra E., Jr., and Duane E. Phinney. 1964. Red salmon spawning ground studies in the Kvichak River system, Alaska, 1963. Univ. Washington, Fish. Res. Inst. Circ. 211, 15 pp.
- Donaldson, J. R. 1967. Hydromechanics of Iliamna Lake, Alaska, 1964 and 1965. Univ. Washington, Fish. Res. Inst. Circ. 66-10. 18 pp.
- Baxter, Richard A. 1967. Thermal studies of Iliamna Lake, 1966. Univ. Washington, Fish. Res. Inst. Circ. 67-6. 15 pp.

- Gunnerød, Tor B. 1967. Climatological observations, water level and water temperatures, Iliamna Lake, Alaska, 1966. Univ. Washington, Fish. Res. Inst. Circ. 67-11. 31 pp.
- Mathisen, Ole A. 1967. Past and escapement levels in the Nushagak system. Pages 8-14 in Fisheries Research Institute Presentation at the 29th Annual Canned Salmon Cutting Demonstration and Technical Conference, held at the Olympic Hotel, Seattle, March 7, 1967. Univ. Washington, Fish. Res. Inst. Circ. 67-12.
- Anderson, John W. 1968. Addendum to spawning ground catalog of the Kvichak River system, Bristol Bay, Alaska. Univ. Washington, Fish. Res. Inst. Circ. 68-2.
- Anderson, John W. 1968. Sockeye salmon spawning ground studies in the Kvichak River system, Alaska, 1965, 1966, and 1967. Univ. Washington, Fish. Res. Inst. Circ. 68-12. 34 pp.
- Anderson, John W. 1968. Distribution of fish on the spawning grounds of the Kvichak River system, p. 1-11. In Fisheries Research Institute Presentation at the 30th Annual Canned Salmon Cutting Demonstration and Technical Conference held at the Olympic Hotel, Seattle, March 12, 1968. Univ. Washington, Fish. Res. Inst. Circ. 68-10.
- Gunnerød, Tor B. Climatological observations, water level, and water temperatures, Iliamna Lake, Alaska, 1967. Univ. Washington, Fish. Res. Inst. Circ. 68-5. 37 pp.

- Kerns, Orra E., Jr. 1968. Abundance, distribution, and size of juvenile sockeye salmon and major competitor species in Iliamna Lake and Lake Clark, 1966 and 1967. Univ. Washington, Fish. Res. Inst. Circ. 68-11. 35 pp.
- Mathisen, Ole A. 1968. Some production problems in the Kvichak nursery area, p. 12-21. In Fisheries Research Institute Presentation at the 30th Annual Canned Salmon Cutting Demonstration and Technical Conference held at the Olympic Hotel, Seattle, March 12, 1968. Univ. Washington, Fish. Res. Inst. Circ. 68-10.
- Anderson, John W. 1969. Bathymetric measurements of Iliamna Lake and Lake Clark, Alaska. Univ. Washington, Fish. Res. Inst. Circ. 69-17. 40 p.
- Anderson, John W., and Patrick H. Poe. 1969. Sockeye salmon spawning ground studies in the Kvichak River system, Alaska, 1968. Univ. Washington, Fish. Res. Inst. Circ. 69-4. 45 p.
- Gunnerød, Tor B. 1969. Climatological observations, water level, and water temperatures, Iliamna Lake, Alaska, 1968. Univ. Washington, Fish. Res. Inst. Circ. 69-8. 35 p.
- Mathisen, Ole A. 1969. Tagging experiments in Bristol Bay, Alaska, in 1946 and 1947. Univ. Washington, Fish. Res. Inst. Circ. 69-1. 15 pp.
- Mathisen, Ole A., and Helen I. Bailey. 1969. Statistical data and vital parameters of the Kvichak/Naknek sockeye salmon catches, 1947-1954. Univ. Washington, Fish. Res. Inst. Circ. 69-12. 34 p.

- Mathisen, Ole A., and Patrick H. Poe. 1969. Studies of Lake Clark and its sockeye salmon runs, 1961-1968. Univ. Washington, Fish. Res. Inst. Circ. 69-5. 21 p.
- Miller, Gary W. 1969. Species composition, abundance, and vertical distribution of phytoplankton in Iliamna Lake in the summer of 1968. Univ. Washington, Fish. Res. Inst. Circ. 69-9. 26 p.
- Gunnerød, Tor B. 1970. Climatological observations, water level, and water temperatures, Iliamna Lake, Alaska, 1969. Univ. Washington, Fish. Res. Inst. Circ. 70-9. 34 pp.
- Poe, Patrick P. 1970. Sockeye salmon spawning ground studies in the Kvichak River system, Alaska, 1969. Univ. Washington, Fish. Res. Inst. Circ. 70-8. 20 pp.
- Low, Loh L. 1971. Climatological observations, water levels, and water temperatures, Iliamna Lake, Alaska, 1970. Univ. Washington, Fish. Res. Inst. Circ. 71-5. 32 pp.
- McKenzie, Daniel H., and Ole A. Mathisen. 1971. A systems analysis of the Bristol Bay sockeye salmon fishery. Univ. Washington, Fish. Res. Inst. Circ. 71-11. 31 pp.
- Low, Loh Lee. 1972. Climatological observations, water levels, and water temperatures, Iliamna Lake, Alaska, 1971. Univ. Washington, Fish. Res. Inst. Circ. 72-5. 33 pp.

- Knudsen, Becky, Pat H. Poe, and Ole A. Mathisen. 1972. A data file for the Bristol Bay sockeye salmon fishery. Univ. Washington, Fish. Res. Inst. Circ. 72-9. 42 pp.
- Poe, P. H., and O. A. Mathisen. 1981. Distances from sea and elevation of important sockeye salmon spawning grounds. 81-1. 23 pp.
- Brannian, Linda K., Mathisen, O. A., Nunnallee, E. P., Whitt, F. R. 1981. Acoustic estimation of juvenile salmon in the nursery lakes of the Kvichak district, Bristol Bay, Alaska. 81-4. 51 pp.
- Crutchfield, J. A., Langdon, S., Mathisen, O. A., Poe, P. H. 1982. The biological, economic, and social values of a sockeye salmon stream in Bristol Bay, Alaska. A case study of the Tazimina River. 82-2. 39 pp.

## FISHERIES RESEARCH INSTITUTE ANNUAL AND FINAL REPORTS

Kerns, O. E., Jr., and R. A. Marriott. 1962. Enumeration of red salmon smolt migration. Final Report for Kaskanak Studies, Alaska Dept. Fish and Game. 22 pp.

University of Washington, Fisheries Research Institute. 1955-1973. Alaska Salmon Studies, Part B. Kvichak Salmon Studies. Periodic Reports, U.S. Dept. Com., NOAA, Nat. Mar. Fish. Ser. (By the Kvichak Staff).

Mathisen, Ole A. 1970. Studies of juvenile sockeye salmon in Iliamna Lake and Lake Clark. Final Report for Project No. AFC 20-1 (Anadromous Fish Act), Contract No. 14-17-0005-237. 26 pp.

Mathisen, Ole A., Patrick H. Poe, and Phillip B. Roger. 1971. Carrying capacity of the sockeye salmon nursery areas in the Kvichak District, Bristol Bay, Alaska. Final Report for Project No. AFC 20-35 (Anadromous Fish Act), Contract No. 14-17-0005-278. 23 pp.

Roger, P. B., and P. H. Poe. 1973. Compilation of summary data to be provided as input into a proposal to create a National Fish Refuge in the Kvichak River system. Report for P. O. No. 1675. U.S. Bur. Sport Fish. Wild., Alaskan Region.

Mathisen, O. A., and P. H. Poe. 1981. The fertilizing effect of volcanic ash fall on lake systems. Final Tech. Rpt. NSF Grant DEB-77-15316. 3 pp.

Numbered Series

FRI-UW-7501

Final Report-Contract No. 1735. Alaska Department of Fish and Game. Hydroacoustic fish stock assessment survey in Becharof and Ugashik Lakes. By N. A. Lemberg and O. A. Mathisen. April 21, 1975. 37 pp.

FRI-UW-7502

Final Report-Contract No. 1243. Alaska Department of Fish and Game. Monitoring of the Kvichak spawning and nursery areas, 1974. By P. H. Poe, G. D. Cortner, N. A. Lemberg, P. B. Roger, and O. A. Mathisen. April 21, 1975. 111 pp.

FRI-UW-7603

Final Report-Contract No. 2131. Alaska Department of Fish and Game. Monitoring of the Kvichak spawning and nursery areas in 1975. By P. H. Poe, G. D. Cortner, and O. A. Mathisen. February 25, 1976. 82 pp.

FRI-UW-7716

Final Report-Alaska Department of Fish and Game. 2nd Association of Pacific Fisheries. The production of sockeye salmon in the Kvichak River system during peak cycle years. By P. H. Poe, T. B. Stables, C. A. Kreger, and O. A. Mathisen. October 17, 1977. 93 pp.

FRI-UW-7720

Final Report-Contract No. 3253. Alaska Department of Fish and Game. Handbook of Bristol Bay sockeye salmon management. By P. R. Mundy and O. A. Mathisen. June 16, 1977. 100 pp.

FRI-UW-7726 A & B.

Special Report-Contract No. 3253. Alaska Department of Fish and Game. Bristol Bay data base - Revision and update of the 1972 data base. By P. R. Mundy. September 1, 1977.

FRI-UW-7817

Final Report-Contract No. 4265. Alaska Department of Fish and Game. Handbook of Bristol Bay salmon management. By P. R. Mundy and O. A. Mathisen. October 25, 1975. 76 pp.

FRI-UW-7926

Final Report-Contract No. 3253. Alaska Department of Fish and Game. Nushagak Bay salmon fishery model. By M. L. Hornberger, P. R. Mundy, and O. A. Mathisen. December 14, 1979. 74 pp.

FRI-UW-8008

Final Report-Contract No. 80-267. Alaska Department of Fish and Game. Nushagak Bay salmon fishery model. By M. L. Hornberger and O. A. Mathisen. May 27, 1980. 38 pp.

FRI-UW-8105

Final Report-Alaska Department of Fish and Game. Nushagak Bay salmon fishery model. By M. L. Hornberger and O. A. Mathisen. April 17, 1981. 97 pp.

FRI-UW-8114

Final Report-Alaska Department of Fish and Game. Nushagak Bay King salmon escapement model. M. Alexandersdottir and O. A. Mathisen. July 21, 1981. 43 pp.

FRI-UW-8201

Final Report-Contract No. 12023-006-20. Dames and Moore. Tazimina River sockeye salmon studies. By P. H. Poe and O. A. Mathisen. January 31, 1982. 30 pp.

FRI-UW-8210

Final Report-Contract No. 82-0769. Alaska Department of Fish and Game. Variance estimates of sockeye salmon predictions with reference to the Egegik River system of Bristol Bay, Alaska. By L. K. Brannian, O. A. Mathisen, and D. A. McCaughran. June 23, 1982. 105 pp.

FRI-UW-8211

Final Report-Contract No. 81-827. Alaska Department of Fish and Game. 1981 Newhalen River sockeye escapement studies. By P. H. Poe and O. A. Mathisen. July 8, 1982. 42 pp.

## UNPUBLISHED REPORTS

General

Poe, P. H. 1975. 1973 data report Kvichak sockeye salmon studies.  
103 pp.

Mathisen, O. A. 1981. A decade of Alaskan fisheries community analysis and modeling.

Limnology

Neal, Richard. 1963. 1962 plankton report, Iliamna Lake, with supplementary tables and figures. 38 pp.

Cortner, G. D. 1977. Field manual for limnological sampling in Iliamna Lake. 28 pp.

Low, L. L., and G. W. Miller. 1971. Periphyton studies in Iliamna Lake, Alaska, 1968-1970. 18 pp.

Bayona, John D. R. 1978. Variability in phytoplankton abundance as observed in the eastern sector of Iliamna Lake, 1965-1977. 22 pp.

Stables, T. B., and P. H. Poe. 1978. Lake Becharof ash fall studies: results through 1978. 8 pp.

Stables, T. B., and P. H. Poe. 1979. The effect of recent volcanic ash falls on the productivity of two Bristol Bay sockeye salmon lakes. Presented at Bristol Bay Interagency meeting, 1979. 5 pp.

Stables, T. B., P. H. Poe, and O. A. Mathisen. 1980. The effect of volcanic ash on phytoplankton production. 23 pp.

Goering, John G., Mathisen, O. A. 1982. Water sampling in Naknek River in 1980 and 1981. Report to the Salmon Processing Industry in Bristol Bay, Alaska. 15 pp.

#### Young Fish Studies

Roger, P. B. 1973. Studies of juvenile sockeye salmon and major competitor species in the Kvichak River system, Bristol Bay, Alaska, 1971-1972. 37 pp.

Poe, P. H. 1979. Towing programs in Iliamna Lake, 1977 and 1978. 6 pp.

#### Adult Studies

Poe, P. H. 1977. Kvichak data base subfile 11-spawning ground survey peak indices, 1920-1975. 205 pp.

Poe, P. H. 1978. Kvichak spawning ground surveys. 12 pp.

Monsen, Melvin J., Jr. 1979. A preliminary study of stock separation of Kvichak River sockeye salmon, Oncorhynchus nerka, based on lacustrine scale characteristics. Fish. 499.

Mathisen, O. A. 1979. Kvichak system data analysis with special reference to Kvichak escapement goals in 1979. Presented at Bristol Bay Interagency Meeting, 1979. 8 pp.

- Mathisen, O. A. 1979. Salmon management for tomorrow. Presented at the annual meeting of AIFMA, 1979.
- Mathisen, O. A., Schonberg, Sandra. 1979. Size, age, and timing of sockeye salmon in the historical Kvichak River catches. Interdepartmental report, 8 pp.
- Mundy, P. R. 1979. An integrated fishing system for Bristol Bay. Presented at Bristol Bay Interagency Meeting, 1979. 11 pp.
- Mathisen, O. A. 1980. 1980 management of salmon resources, especially in Bristol Bay, Alaska. Presented to the annual convention of AIFMA, 1980.
- Poe, P. H. and O. A. Mathisen. 1980. The 1979 and 1980 enumeration of sockeye salmon runs to the Newhalen River-Lake Clark system. 27 pp.
- Poe, Patrick H. 1981. Kvichak spawning ground surveys. Preliminary report. 14 pp.
- Poe, P. H., and O. A. Mathisen. 1981. Enumeration of sockeye salmon escapements to the Newhalen River-Lake Clark system in 1979 and 1980. 29 pp.
- Mathisen, O. A., and P. H. Poe, and W. R. Lew. 1982. 1982 Newhalen River sockeye escapement studies. 25 pp.

Hydroacoustics

- Carlson, T. J. 1976. Egegik Bay hydroacoustic survey, July 1976. 12 pp.
- Hamalainen, Asko H. 1976. Hydroacoustic assessment of vertical diel migration of juvenile sockeye salmon in Lake Clark during August, 1975.
- Johnson, R. L. 1977. Naknek River hydroacoustic survey, June-July, 1977. 16 pp.
- Lindem, T. 1977. Target-strength measurement on sockeye salmon and determination of counting threshold on the echosounder. 4 pp.
- Mausolf, R. G. 1978. Determination of the entry pattern of the adult sockeye salmon migration in the Kvichak River using hydroacoustic techniques. 60 pp.
- Gaudet, David M., Mathisen, O. A. 1979. A feasibility study of using a sonar counter for indexing the salmon escapement to a trunk stream. Presentation for the Bristol Bay Interagency Meeting, 1979.