

Regional Information Report No. 4K11-09

Karluk Lake Sockeye Salmon Smolt Study Operational Plan, 2011

by

Michelle L. Moore

and

M. Birch Foster

July 2011

Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries



REGIONAL INFORMATION REPORT 4K11-09

**KARLUK LAKE SOCKEYE SALMON SMOLT SAMPLING
OPERATIONAL PLAN, 2011**

by

Michelle L. Moore

Alaska Department of Fish and Game, Division of Commercial Fisheries, Kodiak

and

M. Birch Foster

Alaska Department of Fish and Game, Division of Commercial Fisheries, Kodiak

Alaska Department of Fish and Game
Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, Alaska, 99518-1565

July 2011

The Regional Information Report Series was established in 1987 and was redefined in 2006 to meet the Division of Commercial Fisheries regional need for publishing and archiving information such as project operational plans, area management plans, budgetary information, staff comments and opinions to Board of Fisheries proposals, interim or preliminary data and grant agency reports, special meeting or minor workshop results and other regional information not generally reported elsewhere. Reports in this series may contain raw data and preliminary results. Reports in this series receive varying degrees of regional, biometric, and editorial review; information in this series may be subsequently finalized and published in a different department reporting series or in the formal literature. Please contact the author or the Division of Commercial Fisheries if in doubt of the level of review or preliminary nature of the data reported. Regional Information Reports are available through the Alaska State Library and on the Internet at: <http://www.adfg.alaska.gov/sf/publications/>.

*Michelle L. Moore and M. Birch Foster
Alaska Department of Fish and Game, Division of Commercial Fisheries
211 Mission Road, Kodiak, AK 99615, USA*

This document should be cited as:

Moore, M. L. and M. B. Foster. 2011. Karluk Lake sockeye salmon smolt study operational plan, 2011. Alaska Department of Fish and Game, Regional Information Report 4K11-09, Kodiak.

The Alaska Department of Fish and Game (ADF&G) administers all programs and activities free from discrimination based on race, color, national origin, age, sex, religion, marital status, pregnancy, parenthood, or disability. The department administers all programs and activities in compliance with Title VI of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, Title II of the Americans with Disabilities Act (ADA) of 1990, the Age Discrimination Act of 1975, and Title IX of the Education Amendments of 1972.

If you believe you have been discriminated against in any program, activity, or facility please write:

ADF&G ADA Coordinator, P.O. Box 115526, Juneau, AK 99811-5526

U.S. Fish and Wildlife Service, 4401 N. Fairfax Drive, MS 2042, Arlington, VA 22203

Office of Equal Opportunity, U.S. Department of the Interior, 1849 C Street NW MS 5230, Washington DC 20240

The department's ADA Coordinator can be reached via phone at the following numbers:

(VOICE) 907-465-6077, (Statewide Telecommunication Device for the Deaf) 1-800-478-3648, (Juneau TDD) 907-465-3646, or (FAX) 907-465-6078

For information on alternative formats and questions on this publication, please contact:

ADF&G Division of Sport Fish, Research and Technical Services, 333 Raspberry Road, Anchorage AK 99518 (907) 267-2375.

TABLE OF CONTENTS

	Page
LIST OF FIGURES	ii
LIST OF APPENDICES	ii
ABSTRACT	1
INTRODUCTION	1
Goal	2
Objectives	2
Tasks	2
Project Personnel	3
PROCEDURES	3
Smolt Trap Installation, Monitoring, and Maintenance	3
Smolt Trap Catch and Species Enumeration	4
Smolt Age, Weight, and Length Sampling (AWL)	5
Collection of Smolt Samples for Stable Isotope Analysis	6
OTHER REQUIREMENTS	6
Safety	6
Resupply	6
REFERENCES CITED	8
FIGURES	9
APPENDIX A. SMOLT AGE-WEIGHT-LENGTH SAMPLING	13

LIST OF FIGURES

Figure		Page
1.	Location of the Karluk Lake outlet, Karluk River weir, the village of Karluk, and the neighboring village of Larsen Bay.	10
2.	Main east bank location of fyke net (Canadian fan trap in 2011).....	11
3.	Alternate west side location of fyke net.	11
4.	Catch, river, and weather reporting form.	12

LIST OF APPENDICES

Appendix		Page
A1.	Procedure for sampling adult salmon for age, weight, and length.....	14
A2.	Meazura MEZ1000 Rugged Digital Assistant (RDA).....	23
A3.	Sampling weeks and associated calendar dates, 2011.	24
A4.	Photo of a smolt with the preferred area highlighted.	25
A5.	An example of two correctly labeled smolt slides representing fish 1 through 10 from a sample collected on 5/27/11.	26

ABSTRACT

Karluk Lake sockeye salmon *Oncorhynchus nerka* returns from 2008 to 2010 were the lowest since the early 1980s. In recent years, annual restrictions on the subsistence, sport, and commercial fishery were necessary in order to conserve escapement. In 2010, Alaska Department of Fish and Game (ADF&G) in conjunction with Kodiak Regional Aquaculture Association (KRAA) reinstated sockeye smolt sampling at Karluk Lake to detect possible causes between adult returns and smolt age, size, and body condition. The resulting one-year pilot project at the Karluk Lake outlet was successfully conducted from late May to mid-June 2010, and prompted a proposal seeking funding for a dedicated smolt monitoring project. The Alaska Sustainable Salmon Fund provided funding to ADF&G and KRAA to complete three seasons (2011–2013) of the Karluk Lake sockeye salmon smolt study. Age, size, condition, and isotopic signature of sockeye salmon smolt outmigrating from Karluk Lake will be sampled. This operational plan provides the instruction and procedures to properly conduct the study.

Key words: Kodiak, sockeye salmon, *Oncorhynchus nerka*, smolt, Karluk, fyke, Canadian fan trap, isotope.

INTRODUCTION

Karluk Lake is located on the southwest side of Kodiak Island (Figure 1), and supports the largest sockeye salmon *Oncorhynchus nerka* run in the Kodiak Management Area (Foster 2011). It is estimated that the lake has produced sockeye returns greater than five million fish (Koenings and Burkett 1987a). Some of the earliest recorded commercial harvests of sockeye salmon are from Karluk Lake, dating from the late 1800s (Bean 1891). In the early 1900s, sockeye salmon harvests and escapements at Karluk Lake were lightly regulated and overfishing is suspected to have occurred. A weir was established on the river in 1912 to enumerate escapement, and the White Act was implemented in 1924 to reserve 50% of the run for escapement. Despite these efforts, Karluk Lake sockeye salmon suffered a long-term decline in adult returns, and did not significantly increase until the late 1970s (Barnaby 1944; Schmidt et al. 1997; Schmidt et al. 1998).

From 1985 through 2007, Karluk sockeye salmon runs were consistently strong, averaging roughly 1.3 million sockeye salmon annually. Established early run upper escapement goals were exceeded 16 years in the 22 year period, and late run upper escapement goals were exceeded 8 years of the 22 year period. Sockeye salmon stocks in Karluk Lake experienced diminished adult returns from 2008 through 2010 which necessitated annual restrictions on the subsistence, sport, and commercial salmon fishery in order to conserve escapement. In a series of memorandums published in 2009 and 2010, the Alaska Department of Fish and Game (ADF&G) suggested that overescapement contributed to the downturn in adult sockeye salmon production. Using available data, ADF&G reported that continually high escapements from 1985 to 2005 in both the Karluk Lake early and late runs promoted high densities of rearing juvenile sockeye salmon, which likely grazed down zooplankton abundance, and resulted in poor rearing conditions and extended freshwater residence of juvenile sockeye salmon. This theory explains the reduced size of sockeye salmon outmigrants beginning in 2005 and 2006 and the low adult salmon returns observed starting in 2008. Seasonal water temperatures were also unfavorable during this time, further taxing the forage base.

Extended freshwater residence for sockeye salmon often signifies decreased overall lake productivity and subsequent adult salmon returns (Foerster 1968). Sockeye salmon smolt studies, an immediate indicator of freshwater residence, have been conducted sporadically on Karluk Lake: 1925 through 1936, 1961 through 1968, 1979 through 1992, 1994 through 1995, 1997, 1999 through 2006, and in 2010. Historically, age-2. smolt have been the dominant emigrating age class followed by age-3. (Kyle et al. 1988; Rounsefell 1958). While it has been found that

lake residence time of Karluk sockeye salmon juveniles is longer than most systems, in 2009 the freshwater-age-3 component of the escapement was an unprecedented 90% (Koenings and Burkett 1987b; Foster 2010).

Stable isotope sampling is a way to assess the level of marine-derived nutrients in juvenile sockeye salmon (Finney et al. 2000). It allows for determination of any trophic level differences between age classes. In addition, $\delta^{13}\text{C}$ analysis and C/N ratios provide an index of lipid content and thus fitness of fish and can be compared to calculated condition factor. The $\delta^{13}\text{C}$ ratios, once corrected for lipid contribution, provide another possible index of lake productivity.

The Karluk lake sockeye salmon smolt study will be a comparable source of data to previous collections of smolt sampled at Karluk Lake. The average size of outmigrating age-2 and age-3 sockeye salmon smolt has a strong positive correlation with magnitude of total returns from an outmigration. A better understanding of the smolt age, size, condition, and isotopic signature may prove valuable in understanding overall Karluk Lake salmon production. This document provides a description of the current goals and objectives of the Karluk Lake sockeye salmon smolt study and the specific methods the smolt field crew will use in 2011 to collect data.

GOAL

The project goal is to assess the age, size, and condition of sockeye salmon smolt outmigrating from Karluk Lake to attain a better understanding of lake productivity, which will ultimately be reflected in the further development of forecasting production levels and escapement goal evaluations. Stable isotope analysis will help to assess the level of marine-derived nutrients, trophic level differences between age classes, and fitness level of Karluk Lake sockeye salmon smolt.

OBJECTIVES

To achieve the project goal, project personnel will collect data to:

1. Estimate average age, weight, length, (AWL) and condition factor of sockeye salmon smolt emigrants from Karluk Lake. Sampling is such that the estimated mean weight of the major age class per strata will be within 5% and the mean length within 2% of the true value with 95% confidence (Thompson 1992).
2. Determine the stable isotopic composition ($\delta^{15}\text{N}$ and $\delta^{13}\text{C}$) of a subsample of juvenile sockeye salmon corresponding to the sampling in objective 1.

TASKS

1. Install and operate a Canadian fan trap (inclined plane trap) and fyke net to capture emigrating sockeye salmon smolt.
2. Enumerate catch by species.
3. Collect physical data daily: air temperature, water temperature, water level, cloud coverage, wind direction and velocity, and precipitation.
4. Conduct weekly random sampling of 280 sockeye salmon smolt for age (scale samples), weight, and length.
5. Collect a maximum of 120 whole fish samples during the season and conduct stable isotope analysis.

PROJECT PERSONNEL

Project Biologists: *M. Birch Foster* – Principal Investigator – Westward Region Finfish Research Biologist (Fishery Biologist III)

Tina Fairbanks – Co-Investigator – KRAA – Remote Operations Manager

Dr. Bruce Finney – Professor of Science, Idaho State University – Lead for stable isotope analysis

Michelle Moore – Field Project Leader – Westward Region Finfish Research Biologist (Fishery Biologist I)

Field Staff: *Colleen Buckley* – KRAA Intern

James (Jamie) Lyons – KRAA Intern

The principal investigator oversees the project, provides logistical and technical assistance, and writes annual and final reports with the assistance of other project biologists. The co-investigator will assist in report writing and supervise the KRAA interns. The field project leader will coordinate day to day samples and assist with various aspects of the project as needed. KRAA interns will implement the ADF&G safety guidelines, and ensure daily operations are conducted. KRAA interns will work together, and with project biologists, in conducting field operations and other assigned tasks. Bruce Finney will conduct all stable isotope analyses.

PROCEDURES

SMOLT TRAP INSTALLATION, MONITORING, AND MAINTENANCE

A Canadian fan trap should be located approximately 125 meters downstream from the outlet of Karluk Lake on the east bank of the river, at the site established in the 2010 pilot project (Figure 2). Perforated aluminum plate should be installed as wings on either side of the trap to improve flow and increase capture efficiency. After the initial setup, multiple digital pictures should be taken from different viewpoints and dimensions (trap and wings) should be recorded. It is important that the distance from the trap to the east and west river banks is measured and documented. A reference stake should be driven on the bank at the leading edge of the trap; in addition a river level indicator should be placed near a permanent structure in the river (preferably a boulder). A smolt holding box should be located near, but downstream, of the trap. An unframed, winged fyke net with detachable cod end should be placed on the west bank of the river opposite of the main trap (Figure 3). This net will be fished twice a week (in tandem with the Canadian fan trap) to identify possible biases in samples collected from the main site.

The trap and fyke net will:

- Be kept free of debris to maintain consistent trap efficiency and minimize smolt mortality.
- Require frequent monitoring and maintenance to ensure that they are working properly. The trap and fyke net, when fishing, should be checked every hour from sunset to sunrise.
- Be fished following the sampling rules lined out in this operational plan from ~25 May until ~12 June. Attention to changes in migration patterns should be monitored and recorded.

- Be modified or pulled from the water if conditions become dangerous or loss of equipment may occur. If this action is necessary, the project biologist should be notified as soon as possible.

SMOLT TRAP CATCH AND SPECIES ENUMERATION

Smolt migrate primarily at night, so a single sampling day will be the 24-hour period from noon of the first day to noon the following day and is identified by the calendar date corresponding to the first noon. The Canadian fan trap should be fished five nights per week. A total of 200 fish will be caught per night. Half of the sample should be captured before midnight, and half of the sample captured after midnight. If 100 fish were not caught in the trap before midnight, sampling should continue until a total 200 fish have been caught. After 200 sockeye smolt have been collected for the night, the trap door at the rear of the live box should be opened to allow smolt to swim out. Smolt behavior should be monitored as they approach and enter the mouth of the trap to qualitatively assess possible avoidance. This is easily done using LED headlamps. To minimize smolt mortality, the trap should be checked at least every hour between sunset and sunrise when collecting smolt. When fishing the alternate fyke net, the same guidelines apply. The east bank net should be fished twice a week in tandem with the main Canadian fan trap. It should be fished from 1900 hours until 0500 hours or until a total of 40 sockeye smolt are captured; at which point the cod end of the net should be detached. It is important to check the fyke net at least every hour when it is fishing.

Handling of smolt should be done very carefully as smolt are sensitive to stress, and mortality can easily occur. To collect the smolt caught in the Canadian fan trap, use a dip net to transfer the contents of the live box into a 5-gallon bucket. The fish in the 5-gallon buckets should be identified and counted by species. A tally counter should be used to enumerate the trap's catches to ensure accurate counts. Sockeye salmon should be moved from the bucket to the covered live box for sampling the next morning. The live box should be divided so that fish caught before and after midnight are separated. Other species caught in the net should be released downstream of the trap. The same general procedure should be followed when fishing the fyke net. To collect the contents, unzip the codend and empty the fish caught in the net into a 5-gallon bucket. Use a tally counter to enumerate catches, move sockeye salmon smolt into a separate live holding box, and release other species downstream of the fyke net. All data should be entered on the *CATCH, RIVER, AND WEATHER REPORTING FORM* (Figure 4) daily. There are separate forms for the east and west bank sites. Pollard et al. (1997) provides color pictures and explanations in the *Field Identification of Coastal Juvenile Salmonids* key for species identification. Contact the project biologist if any questions regarding identification occur.

Smolt sampling will be conducted for a period of three weeks (strata): Strata 1 (May 25–30), Strata 2 (May 31–June 6), and Strata 3 (June 7–June 12). Sampling will be done five days per week for age, weight, and length from the Canadian fan trap. A total of 200 fish will be collected from the trap each night it is fished. Forty of the 200 fish will be sampled the next morning. Randomly selecting from a pool of 200 fish will help assure the samples are less clustered temporally, and add a measure of protection against holding box malfunctions or anomalous predation from small land mammals. Half of the sample should be from fish caught before midnight, and the other half of the sample should be from fish caught after midnight. If less than 40 smolt are caught in a sampling day, the sample size for that day will be the number of fish caught. An additional forty sockeye salmon smolt will be sampled twice per week from a fyke

net located on the west bank of the river. The fyke net should be fished in tandem with the fan trap. Fish from the two different sites may not be mixed in the live box, so it will be necessary to have two holding boxes when fishing both sites. A total of only 40 fish per night will be collected and sampled from the fyke net on the two nights it is fished. The length and weight information for individuals from both sites will be recorded using a rugged digital assistant data logger (hereafter referred to as an RDA).

SMOLT AGE, WEIGHT, AND LENGTH SAMPLING (AWL)

The standard procedures for collecting and recording salmon AWL data are defined in Appendix A. During the 2011 season, the data recording will be accomplished using an RDA. The field crew will be provided new equipment and sampling protocols as the new hardware and software becomes available. Until that time, Appendix A will serve as the standard.

All scales should be collected from the preferred area of each fish (Appendix A4) following the methods described by International North Pacific Fish Commission (1963). Scales should be mounted on microscope slides (Appendix A5). Age determination will be made by project biologists in the office by examining scales for annual growth increments using a microfiche reader fitted with a 48X lens following designation criteria established by Mosher (1968).

The most common method of age determination in Pacific salmon is the analysis of the concentric rings (circuli) on the scale and is the method to be used by this study. Fast summer growth results in wide spacing between circuli, whereas slow winter growth results in closer spaced circuli; age is determined by enumerating the number of winters observed on the scale (Gilbert 1913). This method of age determination is ideal because the scale can be collected, processed, and aged quite rapidly.

A total of seven 40-fish samples will be collected weekly (sample or “statistical” week) to provide a good representation emigrating smolt. During 2011, the sampling week will start on Tuesday and end on Monday. Sampling weeks and corresponding calendar dates are listed in Appendix A3.

Smolt should be sampled on the morning after capture. Smolt should be measured to the nearest mm from the tip of the snout to the tail fork (Appendix A4). Excess water should be removed from the smolt before weighing by using a paper towel as a blotter, and individual smolt weights should be measured to the nearest 0.1 g. A scalpel should be used to remove 5–10 scales from the preferred area of the fish (Appendix A4). The scales should be mounted on a glass microscope slide as shown in Appendix A5. Scales from five fish should be mounted on each slide. The left portion of each slide should be labeled with slide number, sample location, species, date, and inclusive fish numbers that correspond to information entered in to the RDA (Appendix A5). After sampling, the fish should be moved to an aerated recovery bucket and held until all smolt are swimming normally. Both the recovery and pre-sampling holding buckets should be covered to minimize stress on the fish. Smolt should be released downstream of the trap and fyke net after all fish are swimming normally in the recovery bucket.

Common mistakes to avoid include:

1. Poorly mounted scales – Too many scales in a smear or slime and debris present when mounting. The rows of scales should not be too close together to avoid confusing scales from two different smolt.

2. Improper numbering in the RDA – Take care to ensure numbers on the slides match the data and numbers put into the RDA. Look at the review screen on the RDA if it is believed a mistake has been made.
3. Scales removed from one fish contaminating the scale smear of the previous fish – Wipe the scalpel blade and dissecting probe off between each fish sampled.

COLLECTION OF SMOLT SAMPLES FOR STABLE ISOTOPE ANALYSIS

Whole fish samples of sockeye salmon smolt should be collected from the outlet of Karluk Lake for stable isotope analysis. Samples should be taken from early and late in the smolt migration. Fish should be collected based on both timing and estimated age-class. For the purpose of this study, early migrating fish will be fish caught in the trap prior to June 1. Fish caught June 1st or after will be considered later in the migration. Twenty age-2, twenty age-3, and if present twenty age-1 smolt should be collected from both the early and late migrations. Whole smolt samples should be kept as cold as possible and stored in zip-lock bags. If age-1 fish are present throughout, there would be a total of 120 fish collected for stable isotope analysis. It is best to collect samples when it is known that a chartered plane will be arriving in the near future, as the whole fish samples need to be frozen as soon as possible.

OTHER REQUIREMENTS

SAFETY

Prior to field deployment each crewmember should be certified in CPR and First Aid, and have read the following sections of the ADF&G SOP guidelines.

- Safety Policy Standards
- Field Camp Safety
- Aircraft Passenger Safety
- Small Tool Handling
- Firearm and Bear Safety

The ADF&G safety policies should be reviewed and followed by each field crewmember at the beginning of the season and referenced throughout the field season.

In the event of a life or limb emergency contact should be made directly to USCG emergency rescue at **1-800-478-5555** or VHF Channel 16. The Karluk Lake outlet is located at

57.44093° N lat and 154.10942° W long.

The Karluk Lake sockeye salmon smolt study is in bear country, and trash produced from this camp will be handled in a responsible manner. All organic matter will be disposed of in the lake. All inorganic materials will be doubled-bagged with trash bags and shipped to town via the next available chartered plane.

RESUPPLY

Resupply items (e.g., groceries, fuel, mail, etc.) will be sent via chartered float plane. All air charter flights will be set up by office staff. Appropriate information in regard to flight logistics and times will be relayed via satellite phone communications. When planning for the resupply

flights it will be import to prepare back haul items and maximize the use of the chartered aircraft. Items to send back to town will include empty fuel containers, trash, biological data, and whole fish samples.

REFERENCES CITED

- Barnaby, J. T. 1944. Fluctuations in abundance of red salmon, *Oncorhynchus nerka* (Walbaum), of the Karluk River, Alaska. *Fishery Bulletin* 50: 237-295.
- Bean, T. H. 1891. Report on the salmon and salmon rivers of Alaska, with notes on the conditions, methods and needs. *Bulletin US Fisheries Commission*. 9: 165-208.
- Finney, B. P., I. Gregory-Eaves, J. Sweetman, M. S. V. Douglas, and J. Smol. 2000. Impacts of Climatic Change and Fishing on Pacific Salmon Abundance Over the Past 300 Years. *Science* 290: 795-799.
- Foerster, R. E. 1968. The Sockeye Salmon, *Oncorhynchus nerka*. Bulletin 162, Fisheries Research Board of Canada, Ottawa.
- Foster, M. B. 2010. Kodiak management area salmon escapement and catch sampling results, 2009. Alaska Department of Fish and Game, Fishery Management Report No. 10-28, Anchorage.
<http://www.sf.adfg.state.ak.us/FedAidPDFs/fmr10-28.pdf>
- Foster, M. B. 2011. Kodiak management area salmon escapement and catch sampling results, 2010. Alaska Department of Fish and Game, Fishery Management Report No. 11-30, Anchorage.
- Gilbert, C. 1913. Age at maturity of the Pacific coast salmon of the genus *Oncorhynchus*. *United States Bureau of Fisheries Bulletin* 32:1-22.
- International North Pacific Fisheries Commission. 1963. Annual Report 1961, Vancouver, British Columbia.
- Koenings, J. P. and R. D. Burkett. 1987a. An aquatic Rubie's cube: restoration of the Karluk Lake sockeye salmon (*Oncorhynchus nerka*). [In] H. D. Smith, L. Margolis, and C. C. Wood (ed.) Sockeye salmon (*Oncorhynchus nerka*) population biology and future management. *Can. Spec. Pub. Fish. Aquat. Sci.* 96: 419-434.
- Koenings, J. P. and R. D. Burkett. 1987b. The production patterns of sockeye salmon (*Oncorhynchus nerka*) smolt relative to temperature regimes, euphotic volume, fry density, and forage base within Alaskan Lakes. [In] H. D. Smith, L. Margolis, and C. C. Woods, editors. Sockeye salmon (*Oncorhynchus nerka*): effects of smolt length and geographic latitude when entering the sea. *Canadian Special Publication of Fisheries and Aquatic Sciences* 96.
- Kyle, G., J. Koenings, and B. Barrett. 1988. Density-dependent, trophic level responses to an introduced run of sockeye salmon (*Oncorhynchus nerka*) at Frazer Lake, Kodiak Island, Alaska. *Canadian Journal of Fisheries and Aquatic Science* 45:856-867.
- Mosher, K. 1968. Photographic atlas of sockeye salmon scales. Bureau of the U.S. Fish and Wildlife Service. *Fishery Bulletin* 67(2):243-280.
- Pollard, W. R., C. F. Hartman, C. Groot, and P. Edgell. 1997. Field identification of coastal juvenile salmonids. Harbour Publishing. Maderia Park, B.C. Canada.
- Rounsefell, G. A. 1958. Factors causing decline in sockeye salmon of Karluk River, Alaska. *Fishery Bulletin* 58:83-169.
- Schmidt, D. C., G. B. Kyle, S. R. Carlson, H. J. Geiger, and B. Finney. 1997. Alaska's sockeye salmon fishery management: can we learn from success? [In] D. A. Hancock, D. C. Sminth, A. Grant, and J. P. Beumerm (ed.) *Developing and Sustaining World Fisheries Resources: The State of Science and Management*. 2nd World Fisheries Congress Proceedings, CSIRO, Collingwood, VIC, Australia.
- Schmidt, D., S. Carlson, G. Kyle, and B. Finney. 1998. Influence of carcass-derived nutrients on sockeye salmon productivity of Karluk Lake, Alaska: Importance in the assessment of an escapement goal. *North American Journal of Fisheries Management* 18: 743-763.
- Thompson, S. K. 1992. *Sampling*. John Wiley & Sons Inc., New York.

FIGURES

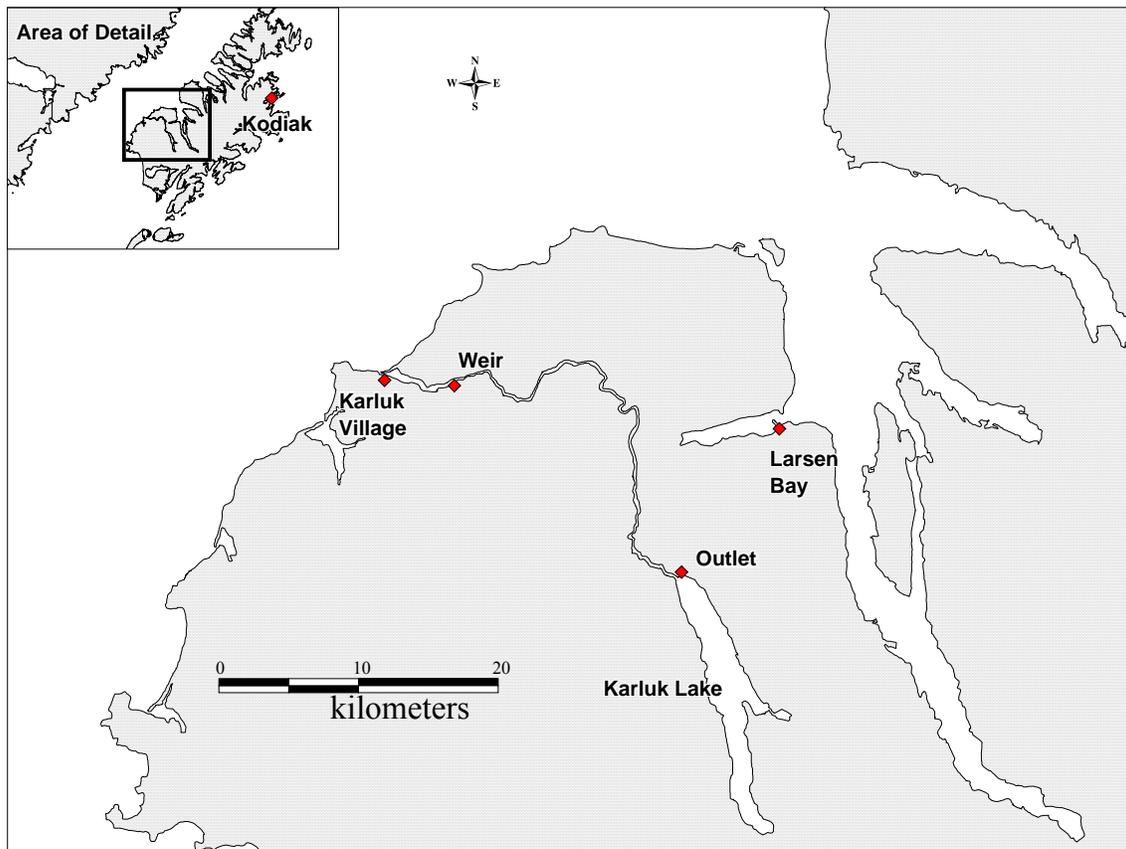


Figure 1.—Location of the Karluk Lake outlet, Karluk River weir, the village of Karluk, and the neighboring village of Larsen Bay.



Figure 2.—Main east bank location of fyke net (Canadian fan trap in 2011).



Figure 3.—Alternate west side location of fyke net.

**APPENDIX A. SMOLT AGE-WEIGHT-LENGTH
SAMPLING**

Annually sockeye salmon smolt are sampled for age (scales), weight, and length by field crews throughout the State. The database that results from these samples is crucial for sound management of the State's salmon resources.

Data obtained while sampling is recorded completely and accurately using the Meazura MEZ1000 Rugged Digital Assistant (RDA). The RDA is a waterproof Palm Powered™ device used to digitally record sampling data. Sample information is transferred from the device to a small computer, also known as a netbook, after each sample. A USB flash drive is used to save and transfer data from the netbooks located in field camps, to the office periodically throughout the season. An RDA is shown in Appendix A2.

Scale samples corresponding to the fish entered into the RDA are collected and mounted properly onto glass slides to ensure accurate age determination (Appendices A4 and A5).

The following procedures are to be strictly adhered to when sampling sockeye salmon smolt for age, weight, and length.

PROCEDURES

ENTERING DATA INTO THE RDA:

To begin using the RDA, turn it on by pressing the power button . Using the stylus, tap the home icon in the bottom portion of the screen . This will bring up the main menu. It may be necessary to press the home icon several times to bring up the entire main menu. Next, tap the Forms 5.1 icon . The Pendragon Forms screen will appear. If a form was left open, it may be necessary to hit the **Quit** or **Done** button to get to the main list of forms. Highlight the appropriate sampling form (**Smolt_0.22**) and select **New** which is found in the lower left corner of the screen. The four main buttons of the form will now be visible: **Enter Background Info**, **Sample Next Fish**, **Review**, and **Quit**, and are explained below.

Enter Background Info

The information entered in this section of the form was formerly the header information on OPSCAN forms. Background information must be entered at the start of each sampling event. A new day always constitutes a new sampling event, so it will be necessary to enter new background information typically once per sampling day. For most projects, changing the background information each day will consist of updating the date only. It is important to edit background information when any change in sampling information occurs. A change in sampling crew, gear, or location would all require an update to the background information. Background information changes correspond with the use of a new glass slide. If information in one of the below categories changes, it is necessary to change the background information. To change the background information, simply click the **Enter Background Info** button.

-continued-

Species

Select the appropriate species from the drop down list on the RDA, such as **Socketeye**.

Management Area

Choose the relevant management area from the dropdown list. Samples collected from Kodiak Island must have **Kodiak** selected as the proper management area.

Area Sampled

Select the area that best represents where the fish were sampled, such as **Karluk River**, from the dropdown list.

Location ID (only entered for some Areas)

Enter the site which the fish being sampled are from. For the Karluk Lake sockeye salmon smolt study, **Site 1** is the main east bank site and **Site 2** is the alternate west bank location.

Location Type

Indicate the type of area in which the fish were sampled. For this study, River is generally the best option. Additional options for location types include lake, weir, lagoon, and THA.

Gear Type

Select the type of gear in which the fish were caught, such as **Incline Plane (Fan) Trap** or **Fyke Net**.

Date of Sample

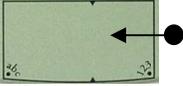
Use appropriate digits for the date the fish are caught, such as 5/27/11.

Sampler Initials

Enter the initials of the sampling crew (up to 3 persons). This can be done by writing in the box on the bottom of the screen, or by using the pop up keyboard.

Notes:

1. When entering text, tap on the dot by the abc icon to bring up a keyboard .
2. To delete a character, place the stylus in the text box and draw a small straight line from

right to left. 

Sample Next Fish

After entering background information, the RDA is ready to collect individual fish data. The **Sample Next Fish** button is used to enter the details of each fish sampled. It is not necessary to click on the **Sample Next Fish** button when entering the first fish of a new sample. After entering the background information, the form automatically knows to go to the sample next fish section of the form. As you continue to sample, simply tap **Sample Next Fish** or **Next** to enter fish data. This option is used when continuing to the next fish of a sample where no background information has changed. Fish data that is entered here is associated with the current background information logged. The following constitute fish data and should be entered for each fish.

-continued-

Scale Slide (Card) Number

Slides are numbered sequentially by date throughout the season starting with 1. A separate numbering sequence will be used for each species or major location change. Start the east bank site with slide number 001 and the west bank site with slide 201. Consult your crew leader for the current slide number. It is crucial to make sure the number written on the slide matches the slide (card) number entered into the RDA. The slide number will automatically advance to next number after five fish have been sampled.

Fish Number

The fish number is a sequential numbering system that begins with the number 1 each sampling event. This allows samplers to keep track of the number of fish sampled each day (or since the background was changed). By default, the fish number in the RDA will automatically advance after each fish is sampled.

Length in mm

Enter the length of the smolt from tip of snout to tail fork in millimeters (i.e., 108). If for some reason you do not collect a length measurement, enter 999.

Weight

Enter the weight of the smolt to the nearest 0.1g, such as 10.2.

Fin Clip and Tag

Select the button if appropriate

Optional: Fin Clip

Indicate the type of fin clip (e.g., axillary process) using the drop down menu, then press .

Optional: Tag ID

Enter the appropriate tag ID.

Select to continue sampling.

The review button can be a very useful tool during sampling. It can be used to ensure data being entered is accurate, or it can be used for editing fish data during a sample. The review portion of the form displays card number, fish number, weight, and length. The most recently sampled fish appear first. To enter the review screen, tap on the button on the main screen of the form. After the data has been reviewed and edited tap the button on the bottom right of the screen to return to the main screen of the form. If is selected after leaving the review screen, the auto-increment will continue as if the review screen was never entered.

Reviewing Data

To review the last data entered, tap the button on the main screen of the form. Use the scroll bar on the right side of the screen to look at the fish that have been entered.

-continued-

Editing Data

If fish data needs to be edited, tap on the individual fish using the stylus. Tap on the **Sample** **Next Fish** button to go through the fish data that was previously entered for that fish. Changes can be made as needed. Buttons chosen prior to the review are highlighted with asterisks. After a fish has been edited, the main review screen appears. If a fish is accidentally selected from the main review screen, click the button that has the **Card#-Fish#** to return to the main review screen without going through the fish data. As mentioned above, tap **Done** to exit the review portion of the form and return to the main screen.

Quit

When sampling is complete, tap **Quit** to exit the form.

BACKING UP AND DOWNLOADING DATA – TO BE DONE DAILY ON SAMPLING DAYS

After sampling is done for the day, the data must be backed up on the RDA itself and then transferred (synched) to the netbook.

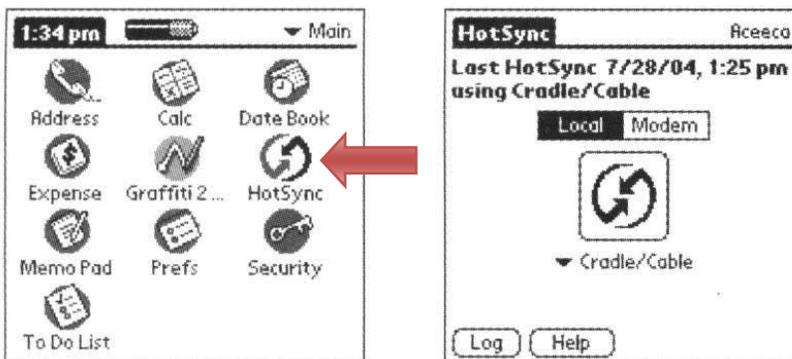
Backing up data:

There are two compact flash drives located inside the RDA. Each night the RDA should be backed up so that data is stored on both of the compact flash drives. Turn the RDA on, and tap the home icon in the bottom portion of the screen to bring up the main menu. Tap the CardBkup icon, and then the **Backup Now** button at the top left of the screen. The data will now be on both flash drives.

Downloading Data to Netbook:

The RDA must be COMPLETELY DRY before downloading (syncing) data from the RDA to the netbook. Connect the communications cable into the RDA and into one of the USB ports on the netbook. Press the power button to turn on the RDA and begin a HotSync by tapping the home icon, and then the HotSync icon found on the main menu. Tapping the large icon in the center of the screen will start the HotSync operation (Figure 1). The HotSync transfers the data to the netbook.

Figure 1: HotSync Screens Found on the RDA



-continued-

EDITING, NAMING, AND SAVING DATA

If a mistake is realized during the sample it can be changed using the review portion of the form in the RDA. Data can also be changed after it is downloaded onto the netbook, but this is not recommended unless the Kodiak office is consulted first. A HotSync operation after changes have been made on the netbook will update the RDA.

To view data, HotSync the RDA to the computer and open Pendragon Forms Manager (a shortcut should be located to the right of the start menu). Select the form (Smolt_0.22), and click Edit/View under Data Functions on the right side of the window. All data will now be visible. Simply make the necessary minor changes here and exit out of the window to save. A HotSync will update the RDA with the changes you have made on the netbook. The netbook will hold the “master” copy.

After data has been edited and verified, a copy of the database will need to be exported from the Pendragon software and saved on the netbook. In Pendragon Forms Manager under Data Functions on the right side of the window click To ASCII. Navigate to the D drive (D:), PendragonForms folder, and then the Data folder found within PendragonForms. Type in the file name and then save. The file name should follow this format: Area_Sampled_Smolt_YYYYMMDD.csv (e.g., Karluk_River_Smolt_20110527.csv). After saving, a window will pop up stating the file has been created. Each .csv file will contain all of the data that has been collected up to that point in the season.

TRANSFERRING DATA FROM NETBOOK ONTO USB FLASH DRIVE

Up to date data should be sent into the main office as often as possible (e.g., with the grocery plane). Insert a USB flash drive into an appropriate port on the netbook. Double click on MyComputer, which is found on the desktop of the netbook. Double click on Local Disk (D:) and then PendragonForms. Double click on the Data folder. The .csv files you have exported from Pendragon Forms Manager should be visible. The title should be formatted to include the area sampled and date (e.g., Karluk_River_Smolt_20110527.csv). Highlight the most recent file (determined by the date) by single clicking. With the file highlighted, click on edit at the top of the window and then copy. It is important to click on copy, not cut.

Open up MyComputer and double click on the USB flash drive (often called “Removable Disk”) found under the heading “Devices with Removable Storage”. Click on edit at the top of the window, and then paste. The .csv file that was copied earlier will appear in the window indicating it was copied to the flash drive. Exit out of all windows and single click on the safely remove hardware button  on the bottom right corner of the desktop in the quick start menu. Click on “Safely remove USB Mass Storage Device.” A pop-up will verify that it is now safe to remove the flash drive from the system.

POWERING THE NETBOOK AND RDA

1. The RDA can be charged with either the AC or DC powering options. It is the crew leaders responsibility to keep it charged
2. The netbook can only be charged with the AC power adaptor, therefore plan accordingly for generator use. The charging light on the netbook is red when charging, and green when fully charged.
3. If there are powering problems, please contact the office immediately.

SLIDES:

Slides for sampling sockeye salmon smolt are shown in Appendix A3. Be sure to fill out the side of the slides in pencil, and number the fish above with a fine point sharpie as shown in Appendix A5.

Slide Number

Write the number of the slide. It is crucial to make sure the number written on the slide matches the slide (card) number entered into the RDA.

Species

Write out completely (e.g., sockeye).

Area Sampled

Write area where the fish were sampled, such as Karluk.

Sampling date

Write the date the fish were caught and sampled (this should be the same date).

Fish Numbers

Fish should be sequentially numbered, beginning with 1 each sampling event. Sampling events usually correspond with new days. This makes it simple to know how many fish you have sampled each day. Five fish are placed on each slide. For example, the slide might have Fish #1-5 written on the bottom left side.

SAMPLING CHECKLIST

Operational Plan	No. 2 Pencils
Glass Microscope Slides	Scalpel
MS-222	Baking Soda
Dish pan for anesthetizing	Scale
Measuring Board	5-gallon buckets
Dip Nets	Dissecting Probe
Fine Point Sharpie	Aerators
Gloves	Paper Towels
RDA (case and accessories)	Netbook (and accessories)
USB Flash Drive (in RDA case)	Log Book (Rite-in-the-Rain)
Thermometer	Headlamps

-continued-

SAMPLING PROCEDURE

1. Sample smolt as soon as possible after they are captured.
2. Label the left portion of each slide with slide number, species, area sampled, date, and inclusive fish numbers. A diagram of a properly labeled slide is located in Appendix A5.
3. Enter background info, scale slide (card) number, and fish number into the RDA.
4. Wearing latex gloves to prevent direct exposure to the anesthetic, dissolve a small amount (approximately of 1 g) of Tricane Methanesulfate (MS-222) and baking soda in about 2 L of cold water in a dish pan. (The amount of anesthetic needed will vary depending on the water temperature, freshness of the chemical, and size of the smolt.)
5. Transport smolt, using clean 5-gallon buckets, to the sampling area. Buckets containing smolt should be filled with fresh water, aerated, and covered to avoid stress on the fish. Fish can be placed into the bucket using a dip net, or by dipping the bucket into the live box.
6. Set up an additional bucket of water to be used as a recovery bucket. This bucket should also be filled with fresh water, aerated, and covered to avoid stress on the fish.
7. Place a few smolt in the anesthetic solution until they become subdued to a point where they can no longer flex their axial musculature but can still ventilate their gills. The concentration of the solution should be such that it immobilizes the fish in 2-3 minutes.
8. After the fish are anesthetized, carefully remove a fish from the dish pan and gently pat dry with a paper towel.
9. Place the fish on its right side to sample the left side
10. Quickly take length and weight measurements and record them directly into the RDA using the stylus. Using a scalpel, remove 5-10 scales from the preferred area of the smolt. On salmon species, the preferred scale is located where a straight line between the posterior insertion of the dorsal fin and the anterior insertion of the anal fin crosses the second scale row dorsal to the lateral line. In smolt, the area directly around this scale is considered the preferred area (Appendix A4). If scales are not present in this area then scales should be taken from the secondary location, which is the same area on the right side of the fish.
11. Transfer smolt from the sampling station to the recovery bucket. It is important to sample as quickly as possible and immediately place smolt into the recovery bucket to prevent mortality.
12. Using the dissecting probe, line up and spread out the scales on the slide under the correct fish number (Appendix A5).
13. Wipe off the scalpel and dissecting probe to remove scales and slime.
14. Once the fish have recovered and are swimming normally in the recovery bucket, they should be released downstream of the trapping location.

-continued-

15. Repeat steps 5 through 14 until the sample is complete. Note that you will not need to enter background information into the RDA for each fish sampled, simply press **Next** or **Sample Next Fish**. It will be necessary to repeat step 3 several times. Depending on how long it takes to complete the sample, the water in all buckets (holding, recovery, and anesthetizing) may need to be refreshed.
16. When sampling you may use “Rite in the Rain”® books to record notes. **Notebooks should be returned to your supervisor at the end of the season.**

SOME NOTES AND REMINDERS

1. Connect the AC adaptor to the bottom of the communications cable to charge the RDA batteries. If using the DC charger, connect the charger into the communications port.
2. If a mistake is noticed before moving onto the next fish, the **Previous** button can be used to make changes in the RDA without having to go to the review screen or alter the data on the netbook.
3. **Each length, weight, and scale must correspond to a single fish! It is the responsibility of the crew leader to be sure the data has been entered correctly.**
4. **Never** put data from different dates onto one glass slide, and always enter new background information. Even if only one scale is collected that day, enter new background information and use a new slide.
5. Be careful when collecting and mounting scales in wet conditions (rain, high humidity, etc.). Scales adhere poorly to wet slides.
6. Responsibility for accuracy lies with the primary data collector(s).
7. Ensure that all equipment is well kept. Electronics should be stored in a clean safe place. Dry off the RDA with a paper towel after sampling events. The RDA must be **completely** dry before transferring data to the netbook. RDA batteries must be charged to make certain sampling is not hampered. **Make sure that all data is carefully examined and edited before returning it to the office.**
- 8.

TROUBLESHOOTING

Resetting the RDA

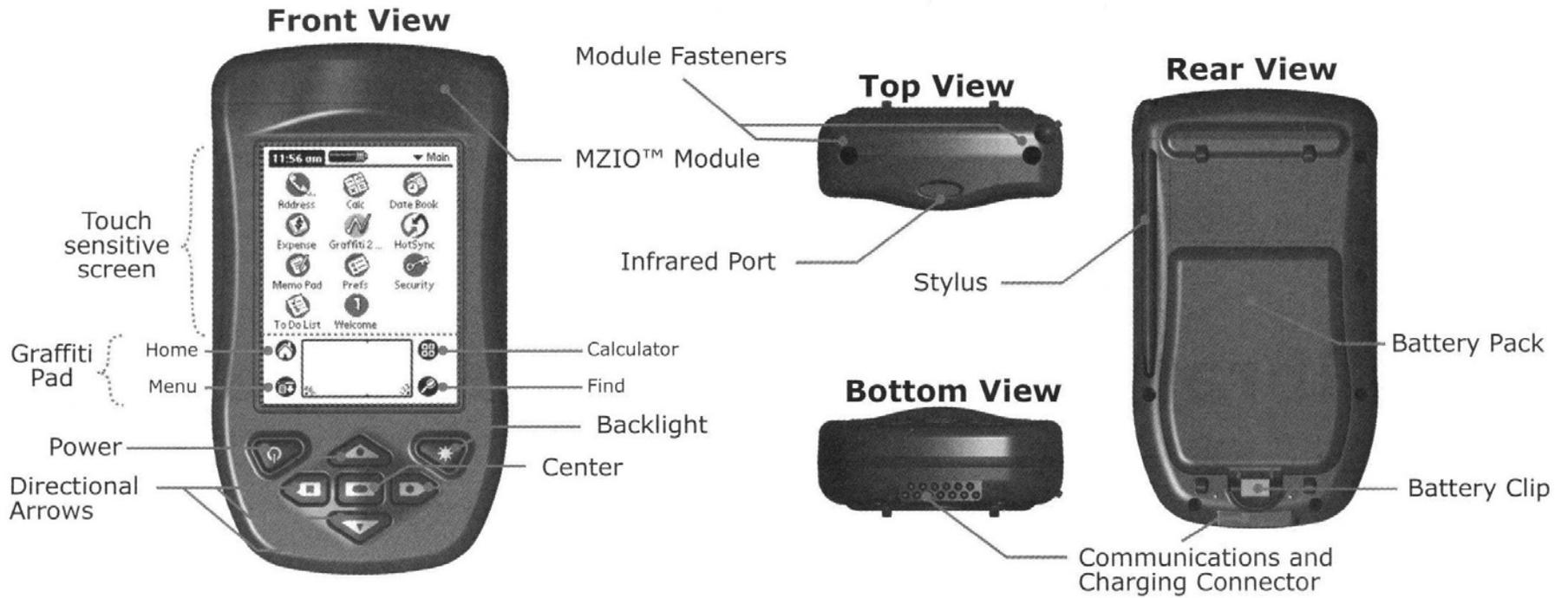
If problems are encountered with the RDA, A soft reset can be done without losing data. To perform a soft reset hold the power and backlight button down together, and release at the same time. If a soft reset does not work, the office should be contacted about other options for resetting.



Press and release Power and Backlight button together

HotSync message includes "*Exceeded user storage space limit of 500KB in form 'Smolt_###'*"

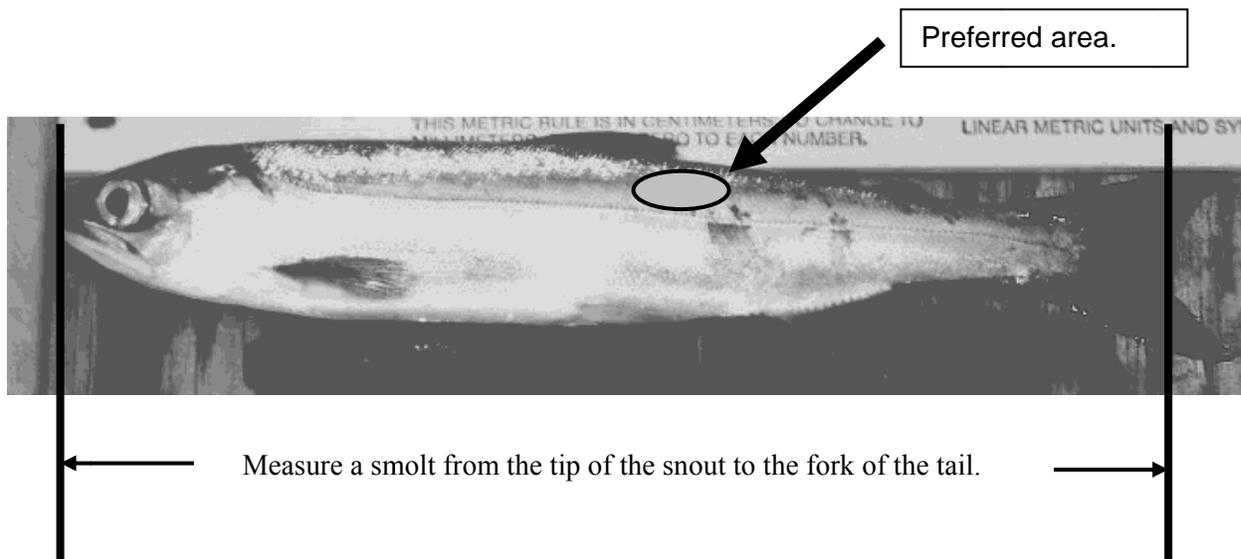
1. Open Pendragon Forms Manager
2. Under Form Function click on "Properties"
3. Click on "Advanced Properties"
4. Click on the "Synchronization Tab"
5. Change the Storage Limit (KB) to 5000 instead of 500.
6. Click "OK"
7. Under Form Functions Click on "Distribute"
8. Hotsync the RDA and the Netbook



Appendix A3.–Sampling weeks and associated calendar dates, 2011.

Week	Calendar Dates	Week	Calendar Dates
10	1-Mar - 7-Mar	28	5-Jul - 11-Jul
11	8-Mar - 14-Mar	29	12-Jul - 18-Jul
12	15-Mar - 21-Mar	30	19-Jul - 25-Jul
13	22-Mar - 28-Mar	31	26-Jul - 1-Aug
14	29-Mar - 4-Apr	32	2-Aug - 8-Aug
15	5-Apr - 11-Apr	33	9-Aug - 15-Aug
16	12-Apr - 18-Apr	34	16-Aug - 22-Aug
17	19-Apr - 25-Apr	35	23-Aug - 29-Aug
18	26-Apr - 2-May	36	30-Aug - 5-Sep
19	3-May - 9-May	37	6-Sep - 12-Sep
20	10-May - 16-May	38	13-Sep - 19-Sep
21	17-May - 23-May	39	20-Sep - 26-Sep
22	24-May - 30-May	40	27-Sep - 3-Oct
23	31-May - 6-Jun	41	4-Oct - 10-Oct
24	7-Jun - 13-Jun	42	11-Oct - 17-Oct
25	14-Jun - 20-Jun	43	18-Oct - 24-Oct
26	21-Jun - 27-Jun	44	25-Oct - 31-Oct
27	28-Jun - 4-Jul	45	1-Nov - 7-Nov

Appendix A4.–Photo of a smolt with the preferred area highlighted.



Appendix A5.—An example of two correctly labeled smolt slides representing fish 1 through 10 from a sample collected on 5/27/11.

Slide 001	1				5
Sockeye	•	•	•	•	•
Karluk	•	•	•	•	•
5/27/2011	•	•	•	•	•
Fish 1-5	•	•	•	•	•

Slide 002	6				10
Sockeye	•	•	•	•	•
Karluk	•	•	•	•	•
5/27/2011	•	•	•	•	•
Fish 6-10	•	•	•	•	•

When the slides are completed, return them to the box in order by Slide # and label the slide box on top with the following information:

Location: Karluk Lake

Slide Numbers: #001- #_ _ _

Beginning and end dates: 5/27/11- _/_/11

Sockeye Salmon Smolt