

**Westward Region Lake Sampling and Kodiak Island
Limnology Laboratory Processing Schedule, 2015**

by

Alyssa M. Hopkins

April 2015

Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries



REGIONAL OPERATIONAL PLAN CF.4K.2015.06

**WESTWARD REGION LAKE SAMPLING AND KODIAK
ISLAND LIMNOLOGY LABORATORY PROCESSING
SCHEDULE, 2015**

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Alyssa M. Hopkins

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

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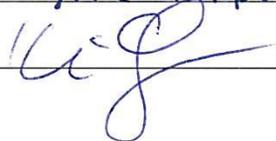
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PURPOSE

The Lake Assessment Project for Kodiak and Afognak islands was started in 1987 as part of a comprehensive study to examine the chemical, biological, and physical characteristics of lake ecosystems and to help managers assess the production potential for juvenile sockeye salmon (*Oncorhynchus nerka*). The Alaska Department of Fish and Game (ADF&G), Near Island Laboratory (NIL) was established in 2000 to continue these investigations, and since then has expanded sample collection and analysis throughout the Westward Region. In 2013, ADF&G NIL moved into a new ADF&G building and was renamed the ADF&G Kodiak Island Laboratory (KIL). This report provides the specific lake assessment sample collection schedule and sample processing protocol for KIL in 2015.

Key words: Limnology, lake assessment, water sample collection, zooplankton, laboratory analyses, Kodiak Island, Afognak Island, Alaska Peninsula.

BACKGROUND

The ADF&G Division of Fisheries Rehabilitation, Education, and Development began sampling Kodiak and Afognak Island lakes for limnological data in 1963. Limnological sampling was invigorated and expanded in 1989 because of concern for the effects of the Exxon Valdez oil spill upon local sockeye salmon (*Oncorhynchus nerka*) stocks. As part of the Kodiak Regional Comprehensive Salmon Plan established in 1992, limnological and fishery investigations were also initiated to determine a strategy for rehabilitation of depressed sockeye salmon stocks and also to evaluate the potential for stocking barriered lakes without anadromous fish. The limnology program was expanded to the Alaska Peninsula in 2000 working in conjunction with fishery and smolt monitoring projects to assess salmon rearing habitat and production.

The 2015 Lake Assessment Project consists of a joint limnological sampling program with Kodiak Regional Aquaculture Association (KRAA) on Kodiak and Afognak islands. Alaska Peninsula limnology investigations will continue to be conducted solely by ADF&G in 2015. The Lake Assessment Project supports the long-term goals of the Kodiak Regional Comprehensive Salmon Plan (KRPT 1992; Honnold et al. 1996; Schrof et al. 2000) and has become an integral part of salmon enhancement, rehabilitation, and biological monitoring projects within the Kodiak Management Area.

The 2015 Lake Assessment Project consists of field sampling and laboratory processing of samples from 23 Kodiak and Afognak Island lakes (Tables 1&2; Figure 1). Limnological sampling will be conducted at Afognak, Akalura, Big Waterfall, Crescent, Dry Spruce, Frazer, Hidden, Karluk, Laura, Little Kitoi, Little Waterfall, Lower Jennifer, Lower Olga, O'Malley, Red (Ayakulik), Ruth, Saltery, Spiridon, Thumb, Uganik, Upper Jennifer, Upper Malina, and Upper Olga lakes. Additionally in 2015, the Kodiak Island Laboratory (KIL) will process and analyze zooplankton and nutrient samples from Bear, Black, Chignik, McLees, and Orzinski lakes (Table 1; Figure 2) located on the Alaska Peninsula.

To assist programs in other regions, KIL processed samples from other parts of the state for various agencies. ADF&G, Region I, Division of Commercial Fisheries (CF, Southeast) has utilized KIL to process zooplankton samples for the past ten years (2005 to 2014) and nutrient samples for the past six years (2009 to 2014). In 2015, zooplankton samples from Chilkat, Chilkoot, Coghill, and McDonald lakes located in Southeast Alaska will be processed and the data summarized at KIL (Table 1). McDonald Lake will have nutrients processed and analyzed in 2015. KIL also processed nutrient samples sent from Norton Sound Economic Development Corporation (NSEDC) for the past seven years (2008 to 2014) and zooplankton samples since 2010 from Salmon Lake in Nome. Nutrient and zooplankton samples from Salmon Lake will be processed at

KIL in 2015 (Table 2). Additionally, ADF&G has assisted Dr. Bruce Finney of Idaho State University with the collection of zooplankton and chlorophyll samples for stable isotope analysis. This collaboration will continue in 2015 with the collection of samples from Karluk, Red, Spiridon, Thumb, and O'Malley lakes.

OBJECTIVES

1. Estimate monthly and seasonal average pH, alkalinity, and nutrient and chlorophyll-*a* concentrations.
2. Estimate the seasonal mean density, biomass, and size of each genus or species of macrozooplankton in each sampled lake.
3. Estimate the seasonal mean density, biovolume, and size of each of the genus and species of phytoplankton from Afognak, Chignik, Frazer, Hidden, Karluk, Little Waterfall, and Spiridon lakes.
4. Estimate the light penetration, euphotic volume, and euphotic zone depth of each sampled lake.
5. Determine the temperature and dissolved oxygen depth profiles of each sampled lake.
6. Collect stable isotope zooplankton and chlorophyll-*a* samples from Frazer, Karluk, Red, Spiridon, Thumb, and O'Malley.

METHODS

Instrument measurements and water, zooplankton, and phytoplankton samples will be collected from each lake as summarized below and in Table 1. Sample collection, processing, and nutrient analyses will follow the methods outlined in Ruhl (2013). The dates of nutrient analysis and the samples included in each analysis will tentatively follow Table 2. The Black Lake Habitat Project goals, objectives, and methods are covered in the specific statement of work (Finkle 2012). The Afognak Lake project goals, objectives, and methods are comprehensively covered in the specific project operational plan (Thomsen et al. 2013). The samples will be processed and data compiled and entered into the ADF&G limnology database.

SCHEDULE AND DELIVERABLES

Date	Activity
April 1–May 8	Prepare for field season
May 11–October 12	Take monthly limnology samples, process water and zooplankton samples, enter data
May 27–December 11	Analyze all collected water samples for nutrient levels, send off phytoplankton samples
July 30–November 15	Ship stable isotope and phytoplankton samples for processing.
December 14–January 15	Review limnology database entries, analyze data, and compile season reports

LOCATION, FREQUENCY, AND COLLECTION TYPE

All lakes will be tentatively sampled at four week intervals.

Afognak Island Lakes

Afognak Lake: (stations 1 and 2)

1. Instrument readings (DO/Temperature, Light, and Secchi)
2. Zooplankton tow
3. 1 meter water sample (station 1 only)

Big Waterfall Lake: (station 1)

1. Instrument readings (DO/Temperature, Light, and Secchi)
2. Zooplankton tow

Hidden Lake: (station 1)

1. Instrument readings (DO/Temperature, Light, and Secchi)
2. Zooplankton tow
3. 1 and 30 meter water samples

Laura Lake: (station 1)

1. Instrument readings (DO/Temperature, Light, and Secchi)
2. Zooplankton tow

Little Waterfall Lake: (station 1)

1. Instrument readings (DO/Temperature, Light, and Secchi)

2. Zooplankton tow
3. 1 and 15 meter water samples

Upper Malina Lake: (station 2)

1. Instrument readings (DO/Temperature, Light, and Secchi)
2. Zooplankton tow

Alaska Peninsula Lakes

Bear Lake: (stations 2 and 4)

1. Instrument readings (DO/Temperature, Light, and Secchi)
2. Zooplankton tow
3. 1 & 29 meter water samples

Black Lake: (station 1)

1. Instrument readings (DO/Temperature, Light, and Secchi)
2. Zooplankton tow
3. 1 meter water sample

Chignik Lake: (station 1 thru 4)

1. Instrument readings (DO/Temperature, Light, and Secchi)
2. Zooplankton tow
3. 1 & 29 meter water samples (station 2 & 4 only)

McLees Lake: (station 1)

1. Instrument readings (DO/Temperature, Light, and Secchi)
2. Zooplankton tow

Orzinski Lake: (station 1)

1. Instrument readings (DO/Temperature, Light, and Secchi)
2. Zooplankton tow
3. 1 meter water sample

Kodiak Island lakes

Akalura Lake: (station 1)

1. Instrument readings (DO/Temperature, Light, and Secchi)
2. Zooplankton tow
3. 1 meter water sample

Crescent Lake: (station 1)

1. Instrument readings (DO/Temperature, Light, and Secchi)
2. Zooplankton tow

Dry Spruce Lake: (station 1)

1. Instrument readings (DO/Temperature, Light, and Secchi)
2. Zooplankton tow

Frazer Lake: (stations 1 and 3)

1. Instrument readings (DO/Temperature, Light, and Secchi)
2. Zooplankton tow
3. 1 & 30 meter water samples (station 1)
4. 1 & 50 meter water samples (station 3)
5. Isotope zooplankton tow (station 3)

Karluk Lake: (stations 3, 4, and 7)

1. Instrument readings (DO/Temperature, Light, and Secchi)
2. Zooplankton tow
3. 1 and 30 meter water samples
4. Isotope zooplankton tow at station 3 and 4 only

Lower Olga Lake: (station 1)

1. Instrument readings (DO/Temperature, Light, and Secchi)
2. Zooplankton tow
3. 1 meter water sample

O'Malley Lake: (station 1)

1. Instrument readings (DO/Temperature, Light, and Secchi)
2. Zooplankton tow
3. 1 meter water sample
4. Isotope zooplankton tow

Red (Aykulik) Lake: (station 1)

1. Instrument readings (DO/Temperature, Light, and Secchi)
2. Zooplankton tow
3. 1 & 30 meter water samples
4. Isotope zooplankton tow

Saltery Lake: (station 1)

1. Instrument readings (DO/Temperature, Light, and Secchi)

2. Zooplankton tow

Spiridon Lake: (stations 1 and 2)

1. Instrument readings (DO/Temperature, Light, and Secchi)
2. Zooplankton tow
3. 1 & 50 meter water samples
4. Isotope tow (station 1)

Thumb Lake: (station 1)

1. Instrument readings (DO/Temperature, Light, and Secchi)
2. Zooplankton tow
3. 1 meter water sample
4. Isotope tow

Uganik Lake: (station 1)

1. Instrument readings (DO/Temperature, Light, and Secchi)
2. Zooplankton tow
3. 1 & 50 meter water samples

Upper Olga Lake: (station 1)

1. Instrument readings (DO/Temperature, Light, and Secchi)
2. Zooplankton tow
3. 1 & 50 meter water samples

Kitoi Bay Lakes

Kitoi Bay Hatchery personnel (KRAA) will collect data from Little Kitoi, Lower Jennifer, Ruth, and Upper Jennifer lake stations.

Little Kitoi Lake: (station 1)

1. Instrument readings (DO/Temperature, Light, and Secchi)
2. Zooplankton tow

Lower Jennifer Lake: (station 1)

1. Instrument readings (DO/Temperature, Light, and Secchi)
2. Zooplankton tow

Ruth Lake: (station 1)

1. Instrument readings (DO/Temperature, Light, and Secchi)
2. Zooplankton tow

Upper Jennifer Lake: (station 1)

1. Instrument readings (DO/Temperature, Light, and Secchi)
2. Zooplankton tow

RESPONSIBILITIES

SAMPLE PROCESSING

1. Process and analyze water samples from prescribed Kodiak and Afognak Island lakes at KIL for the following nutrients, water chemistry parameters, and algal pigment concentrations:
 - alkalinity
 - chlorophyll *a*
 - filterable reactive phosphorous (FRP)
 - nitrate + nitrite (N+N)
 - pH
 - phaeophytin *a*
 - reactive silicon (SI)
 - total ammonia (TA)
 - total filterable phosphorous (TFP)
 - total Kjeldahl nitrogen (TKN)
 - total phosphorus (TP)
2. Process and analyze water samples from Bear, Black, Chignik, and Orzinski lakes on the Alaska Peninsula at KIL for the following nutrients, water chemistry parameters, and algal pigment concentrations:
 - chlorophyll *a*
 - FRP
 - N + N
 - phaeophytin *a*
 - TA
 - TFP
 - TKN
 - TP
 - SI

3. Process and analyze water samples from Salmon Lake in Nome at KIL for the following nutrients, water chemistry parameters, and algal pigment concentrations:
 - chlorophyll *a*
 - color
 - FRP
 - N + N
 - phaeophytin *a*
 - TA
 - TFP
 - TKN
 - TP
4. Process and analyze water samples from McDonald Lake in Southeast Alaska at KIL for the following nutrients and water chemistry parameters:
 - N + N
 - TKN
 - TP
5. Process zooplankton samples from Kodiak and Afognak Islands, Alaska Peninsula, Southeast, and Nome lakes for seasonal mean density, biomass, and size of each genus or species of macrozooplankton at KIL.
6. Preserve and process phytoplankton samples from unfiltered water samples from Kodiak and Afognak Islands, and Alaska Peninsula lakes. Phytoplankton sample analysis will be subcontracted to BSA Environmental Services Inc. and processed by John Beaver (Appendix A1). Contract phytoplankton samples will consist of the following:

Afognak Island

- Afognak (5 samples; station 1, 1 m)
- Hidden (5 samples; station 1, 1 m)
- Little Waterfall (5 samples; station 1, 1 m)

Alaska Peninsula

- Chignik (8 samples; station 2, 1 and 29 m)

Kodiak Island

- Frazer (12 samples; stations 1 and 3, 1 m)
- Karluk (12 samples; stations 3 and 4, 1 m)
- Lower Olga (5 samples; station 1, 1 m)
- Spiridon (12 samples; stations 1 and 2, 1 m)
- Upper Olga (5 samples; station 1, 1 m)

7. Process 1m water samples for stable isotope chlorophyll-*a* analysis for:

Kodiak Island

- Karluk (5 samples; station 3)
- Red (5 samples; station 1)
- Spiridon (6 samples; station 1)
- Thumb (5 samples; station 1)
- O'Malley (5 samples; station 1)

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TABLES AND FIGURES

Table 1.--Limnology sampling schedule and number of samples, by lake, in Kodiak and Afognak islands, and Alaska Peninsula, 2015.

	Number of		Project	Sample Types	Sample Months	Sample Events	Number of Samples				
	Stations	Lakes					Water	Zooplankton	Phytoplankton	Isotopes	
Afognak Lakes											
	Afognak	2	1	Stock status	W, Z, P	May-Sept	5	5	10	5	0
	Big Waterfall	1	1	Stocking	Z	May-Sept	5	0	5	0	0
	Hidden	1	1	Stocking/EA compliance	W, Z, P	May-Sept	5	10	5	5	0
	Laura	1	1	General monitoring	Z	May-Sept	5	0	5	0	0
	Little Kitoi	1	1	Stocking	Z	May-Sept	5	0	4	0	0
	Little Waterfall	1	1	Stocking	W, Z, P	May-Sept	5	10	5	5	0
	Lower Jennifer	1	1	Stocking	Z	May-Sept	5	0	4	0	0
	Ruth	1	1	Stocking	Z	May-Sept	5	0	4	0	0
	Upper Jennifer	1	1	Stocking	Z	May-Sept	5	0	4	0	0
	Upper Malina	1	1	General monitoring	Z	May-Sept	5	0	5	0	0
	Totals:	11	10					25	51	15	0
Kodiak Lakes											
	Akalura	1	1	General monitoring	Z	May-Sept	5	5	5	0	0
	Crescent	1	1	Stocking	Z	May-Sept	5	0	5	0	0
	Dry Spruce	1	1	General monitoring	Z	May-Sept	5	0	5	0	0
	Frazer	2	1	General monitoring	W, Z, P, I	May-Oct	6	24	12	12	6
	Karluk	3	1	General monitoring/EA	W, Z, P, I	April-Oct	7	42	21	14	12
	Lower Olga	1	1	General monitoring	W, Z, P	April-Sept	6	6	6	6	0
	O'Malley	1	1	General monitoring	W, Z, I	April-Oct	7	7	7	0	5
	Red	1	1	General monitoring	W, Z, I	May-Sept	5	10	5	0	5
	Saltery	1	1	Broodstock monitoring	Z	May-Sept	5	0	5	0	0
	Spiridon	2	1	Stocking/EA compliance	W, Z, P, I	May-Oct	6	24	12	12	6
	Thumb	1	1	General monitoring	W, Z, I	April-Sept	6	6	6	0	5
	Uganik	1	1	General monitoring	W, Z	May-Sept	5	10	5	0	0
	Upper Olga	1	1	General monitoring	W, Z, P	April-Sept	6	12	6	6	0
	Totals:	17	13					146	100	50	39
Peninsula Lakes											
	Bear	2	1	General monitoring	W, Z	May-Aug	4	16	8	0	0
	Black	1	1	General monitoring	W, Z	May-Aug	4	4	4	0	0
	Chignik	4	1	General monitoring	W, Z, P	May-Aug	4	16	16	16	0
	McLees	1	1	General monitoring	Z	June-Aug	3	0	3	0	0
	Orzinski	1	1	General monitoring	W, Z	June-Aug	3	3	3	0	0
	Totals:	6	5					39	34	16	0
Outside Region Contracts											
	Region I (SE)		4					24	54	0	0
	Region III (Nome)		1					12	12	0	0
Totals all	Totals all		33					246	251	73	39

Notes: Exact sampling dates are not provided to account for inclement weather and to allow for project cost-sharing, however the target sampling interval is every 4 weeks. April and May sample dates are dependent on when the lakes become ice free. W = water sampling, Z = zooplankton sampling and supporting physical data, P = phytoplankton sampling, and I=isotopes.

Table 2.–Limnology nutrient experiment schedule and number of water samples to be tested, by date, from Kodiak and Afognak islands, and Alaska Peninsula 2015.

Test Date	Experiment	# Samples	Samples Included
May 27-28th	Chl a	30	May
June 23-25th	TA/N+N	60	May/June
July 1-2rd	TP	60	May/June
July 7-8th	TFP/FRP	60	May/June
July 27-28th	Chl a	30	June
July 30-31st	Chl a	30	July
August 24-26th	TA/N+N	60	July/August
August 31- September 1	TP	60	July/August
September 8-10th	TFP/FRP	60	July/August
September 21-22nd	Chl a	30	August
September 24-25th	Chl a	30	September
September 29-30th	TA/N+N	70	September/Ak Peninsula/Contract
October 6-8th	TP	70	September/Ak Peninsula/Contract
October 20-22nd	TFP/FRP	70	September/Ak Peninsula/Contract
October 26-27th	Chl a	28	Ocober/Contract
October 29-30th	Chl a	38	Ak Peninusla (Nyssa)
November 3-5th	Si	225	All Samples
November 10-11th	TA/N+N	16+	October/Redos
November 13th	Color	12	Contract (Nome)
November 17-19th	TP/TFP/FRP	90	August/September/October/Redos

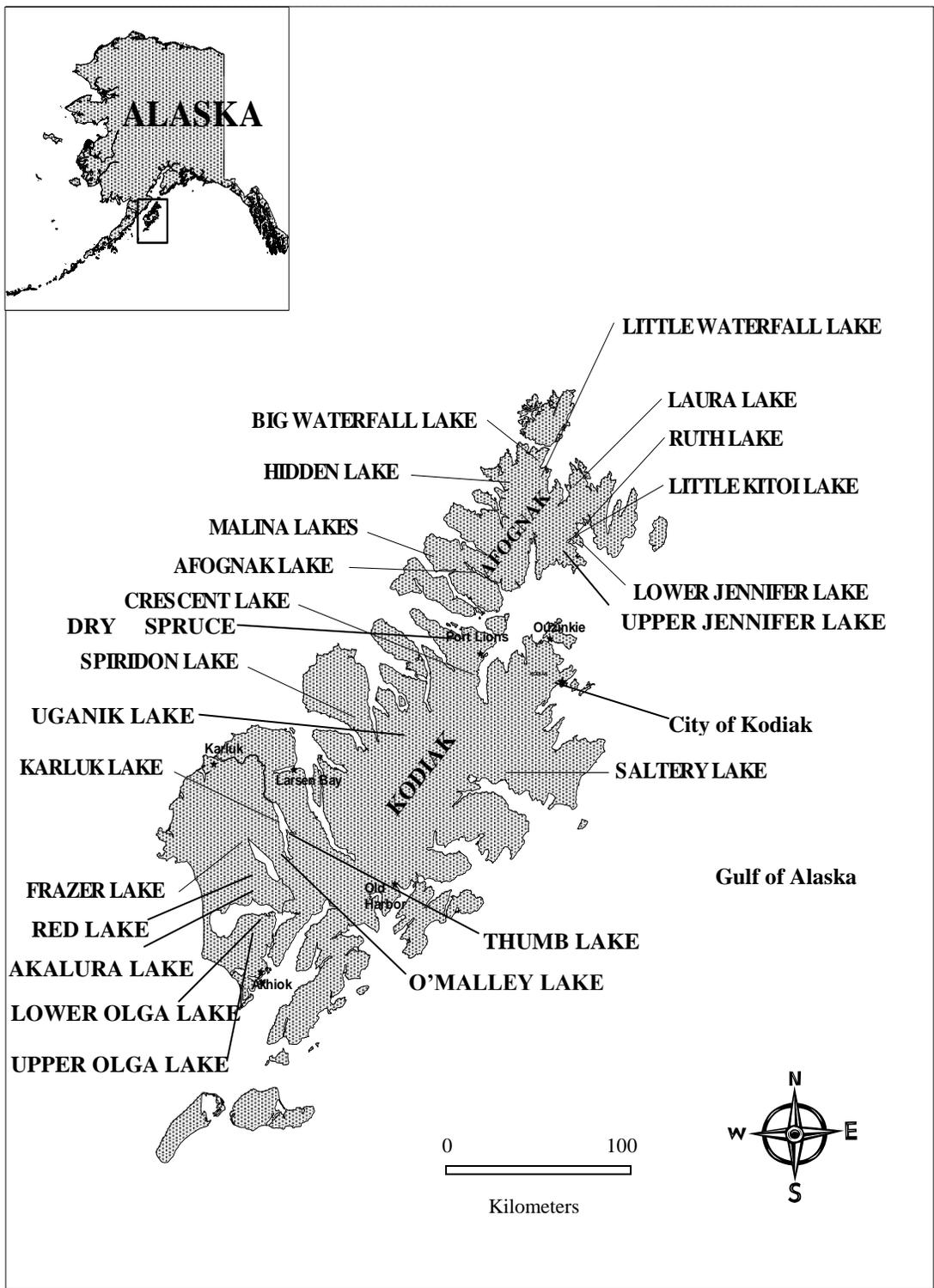


Figure 1.—Locations of lakes on Kodiak and Afognak islands scheduled for limnology sampling in 2015.

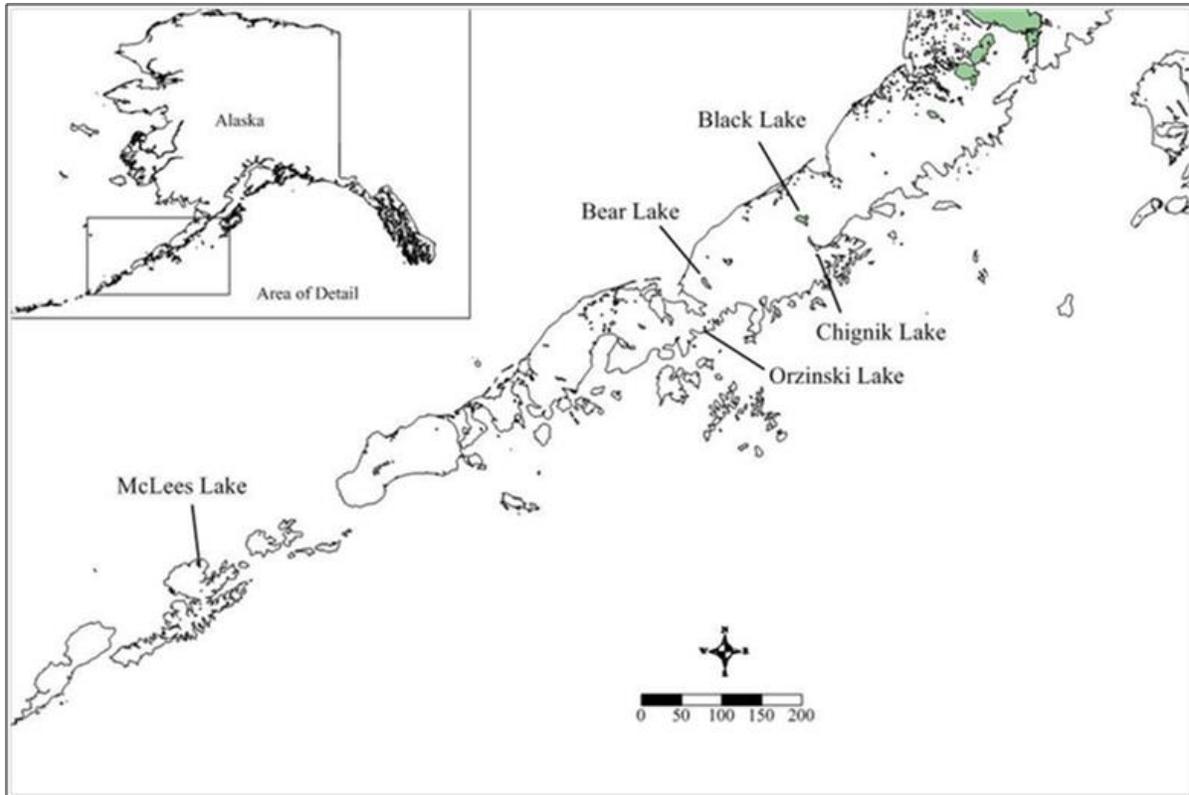


Figure 2.—Locations of lakes on the Alaska Peninsula scheduled for limnology sampling in 2015.

**APPENDIX A. KODIAK ISLAND LIMNOLOGY
LABORATORY SAMPLE PROCESSING AND
CONTRACTUAL CONTACT LIST FOR 2015**

Appendix A1.–Kodiak Island Laboratory sample processing and contractual contact list for 2015.

Contact	Processing/Analysis	Institution	Address	Phone Number
Uttam Saha	Total Kjeldahl Nitrogen (TKN)	University of Georgia, Feed and Environmental Water Laboratory	2300 College Station Rd. Athens, GA 30602	(706) 542-7690
David Parks	Total Kjeldahl Nitrogen (TKN)	University of Georgia, Feed and Environmental Water Laboratory	2300 College Station Rd. Athens, GA 30602	(706) 542-7690
Regina Wixon	Total Kjeldahl Nitrogen (TKN)	South Dakota Agricultural Laboratories	1006 32nd Ave, Suite 105 Brookings, SD 57006	(605) 692-7325
John Beaver	Phytoplankton	BSA Environmental Services Inc.	23400 Mercantile Rd., Ste 8 Beachwood, OH 44122	(216) 765-0582
Kerry Parish	Quality Control Testing	Department of Fisheries & Oceans	4222 Columbia Valley Highway Cultus Lake, B.C. V2R 5B6	(604) 824-4704
Kevin Keith	Nome Water/Zooplankton Contract	Norton Sound Economic Development Corporation	P.O. Box 358 Nome, AK 99762	(907) 443-2477
Andrew Piston	SE Water/Zooplankton Contract	Alaska Dept. Of Fish and Game	2030 Sea Level Dr. #205 Ketchikan, AK 99901	(907) 225-9677
Malika Brunette	SE Water/Zooplankton Contract	Alaska Dept. Of Fish and Game	2030 Sea Level Dr. #205 Ketchikan, AK 99901	(907) 225-9677
Steve Heint	SE Zooplankton Contract	Alaska Dept. Of Fish and Game	2030 Sea Level Dr. #205 Ketchikan, AK 99901	(907) 225-9677
Randall Bachman	SE Zooplankton Contract	Alaska Dept. Of Fish and Game	P.O. Box 330 Haines, AK 99827	(907) 766-2830
Amanda Wiese	SE Zooplankton Contract	Alaska Dept. Of Fish and Game	401 Railroad Ave. Cordova, AK 99574	(907) 424-3212