Regional Operational Plan SF.1J.2017.01

Juneau Area Rainbow Trout Pre-stocking Assessment, 2017-2018

by

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and

Adam Reimer

This operational plan has been amended. See ROP.SF.1J.2018.11 for the final version.

March 2017

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat or long
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$log_{2,}$ etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

REGIONAL OPERATIONAL PLAN SF.1J.2017.01

JUNEAU AREA RAINBOW TROUT PRE-STOCKING ASSESSMENT, 2017-2018

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Alaska Department of Fish and Game
Division of Sport Fish

March 2017

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SIGNATURE PAGE

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Approval

Title	Name	Signature	Date
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ABSTRACT

Beginning in 2018, the Alaska Department of Fish and Game, Division of Sport Fish (ADF&G-SF) is scheduled to begin stocking 4 lakes (Crystal, Glacier, Moraine, and Twin lakes) along the Juneau roadside freshwater fishery with all-female triploid rainbow trout (*Oncorhynchus mykiss*). Prior to these releases, lake assessments will be conducted to evaluate existing biological, chemical, and physical conditions at each lake scheduled to be stocked. Pre-release surveys are designed to identify species occupancy in each lake. Fish will be captured using a combination of traps (hoop and minnow), a tangle net, and hook-and-line (i.e., sport fishing) gear. Water quality profiles will be performed in each lake to measure water clarity, temperature, dissolved oxygen, pH, specific conductivity, salinity, and total dissolved solids. Bathymetry data will be collected for each lake scheduled to be stocked and the hydrography associated with Crystal, Glacier, and Moraine lakes will be mapped. After bathymetric data has been collected and spatially enabled, bathymetric maps will be created and other lake characteristics (i.e., surface area, maximum length and width, mean depth, maximum depth, shoreline length, shoreline development, and volume) will be calculated using a Geographic Information System. Results from these surveys, as well as results from future post-release surveys, will help managers determine the success of these stocking efforts and whether the stocking strategy needs to be modified.

Key words: triploid rainbow trout, *Oncorhynchus mykiss*, stocking, Juneau roadside fishery, pre-release surveys, lake assessment, water quality, bathymetry, hydrography, Crystal Lake, Glacier Lake, Moraine Lake, Twin Lakes.

PURPOSE

The purpose of this project is to evaluate 4 lakes along the Juneau roadside freshwater fishery where all-female triploid rainbow trout are scheduled to be stocked, beginning in 2018. Lake assessments will include pre- and post-release surveys. Pre-release surveys, described in this operational plan, will include evaluation of existing biological, chemical, and physical conditions at each lake scheduled to be stocked. Post-release surveys, which will be described in a subsequent operational plan, will include evaluation of lake conditions, as well as monitoring survival, growth, movement, fishing effort, and harvest of stocked fish. Over time, results from these surveys will help managers determine the success of these stocking efforts and whether the stocking strategy needs to be modified.

BACKGROUND

One of the core functions of the Alaska Department of Fish and Game, Division of Sport Fish (ADF&G-SF) is to create and diversify sport fishing opportunities for anglers through fisheries enhancement (ADF&G 2015). The stocking of Alaska's lakes with hatchery-reared fish was initiated in the 1950's and continues to be an integral component of the ADF&G-SF management program (ADF&G 2013; Havens et al. 1995; Swanton and Taube 2009). Benefits of lake stocking programs include helping to divert pressure from natural stocks and providing diverse, year-round fishing opportunities for sport anglers (ADF&G 2017b; Havens et al. 1995).

Currently, ADF&G-SF owns and operates 2 hatcheries where fish are produced for stocking prioritized waters across the state: the William Jack Hernandez Sport Fish Hatchery (WJHSFH) in Anchorage and the Ruth Burnett Sport Fish Hatchery in Fairbanks. In addition to the state owned hatcheries, there are several private non-profit hatcheries around the state that are also involved in the sport fish stocking program. The primary hatchery product used for lake stocking in Alaska is rainbow trout (*Oncorhynchus mykiss)*, currently produced from captive broodstock maintained at the WJHSFH (ADF&G 2017b).

In general, stocking sites tend to be located near population centers to maximize the benefits to sport anglers (ADF&G 2017b). There are 4 lakes in the Juneau roadside freshwater fishery where fish have been stocked in recent years: Twin Lakes, located near downtown Juneau (Figures 1 and 2); and Crystal, Glacier, and Moraine lakes, located in the Mendenhall Glacier Recreation Area (MGRA; Figures 1 and 3). Fish stocking in Twin Lakes occurs annually, in support of a popular annual event known as Family Fishing Day. Stocking in the 3 MGRA lakes has happened a few times since 2010, but has not occurred on an annual or consistent basis because of an insufficient number of fish available for all 4 lakes due to poor hatchery survival in certain years (ADF&G 2017a).

Past practices have been to stock these Juneau roadside lakes using the Chinook salmon (*O. tshawytscha*) stock that is already being raised at the local Macaulay Salmon Hatchery (MSH), operated by Douglas Island Pink and Chum, Inc. (DIPAC), for on-going local marine waters stocking programs. An alternative stocking product has been proposed and approved for stocking the 4 Juneau area lakes; the new stocking product will be certified, all-female, triploid rainbow trout that will come from the WJHSFH broodstock. The rainbow trout will be transported from the hatchery in Anchorage to be raised at MSH in Juneau for 2-3 years before being released in Crystal, Glacier, Moraine, and Twin lakes. The change in stocking product is scheduled to begin in 2018; after the stocking begins, it will continue to occur on an annual basis at each of the 4 lakes (ADF&G 2017b). Catchable-sized rainbow trout were chosen as the stocking product because they are considered non-anadromous and more suitable for the freshwater lakes stocking program. Rainbow trout are expected to have higher over-winter survival than the catchable-sized Chinook salmon used currently, which should improve stocking success and diversify opportunity for sport anglers (ADF&G 2017b).

The project described in this operational plan is a pre-stocking evaluation of the 4 Juneau roadside lakes, mentioned above, that are scheduled to be stocked with rainbow trout (Figure 1). In addition to sampling the 4 lakes that will be stocked, there is one additional lake (Moose Lake) in the MGRA that will be sampled due to the fact that the lake is located downstream from the other 3 MGRA lakes that will be stocked (Figure 3). The additional sampling at Moose Lake will be conducted to determine whether stocked fish are moving out of the lake where they were originally released. Pre-release surveys will include evaluation of existing biological, chemical, and physical conditions at each lake scheduled to be stocked. Post-release surveys will also occur as part of the overall project; however, the post-release surveys will be described in a separate operational plan. Over time, results from these surveys will help managers determine the success of these stocking efforts and whether the stocking strategy needs to be modified. Funding for the work outlined in this operational plan is by Federal Aid in Sport Fish Restoration, Dingell-Johnson (DJ) Fund (75%) with a 25% match provided by the Fish and Game Fund.

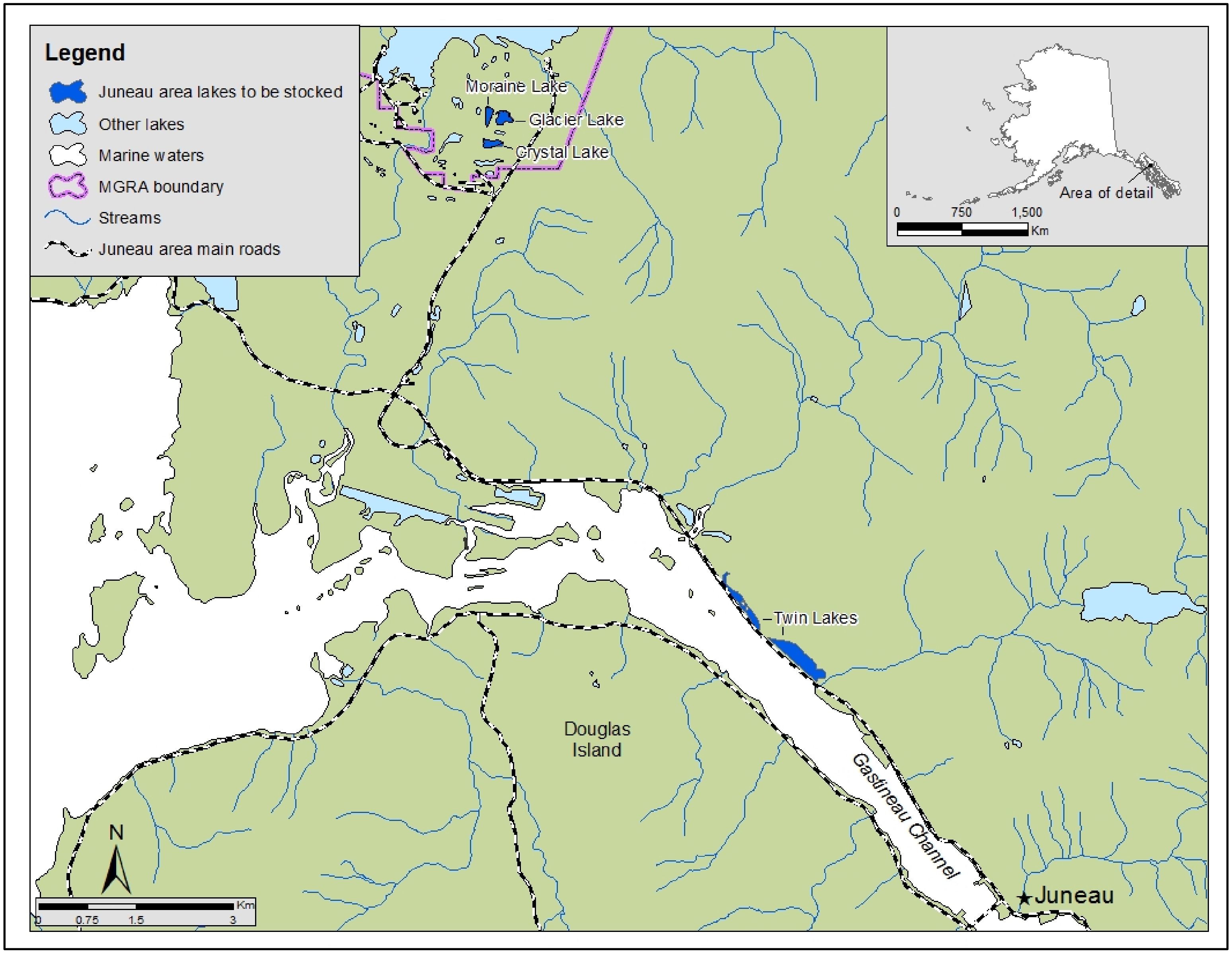

Figure 1.–Locations of the 4 lakes scheduled to be stocked with rainbow trout in the Juneau roadside fishery, Southeast Alaska.

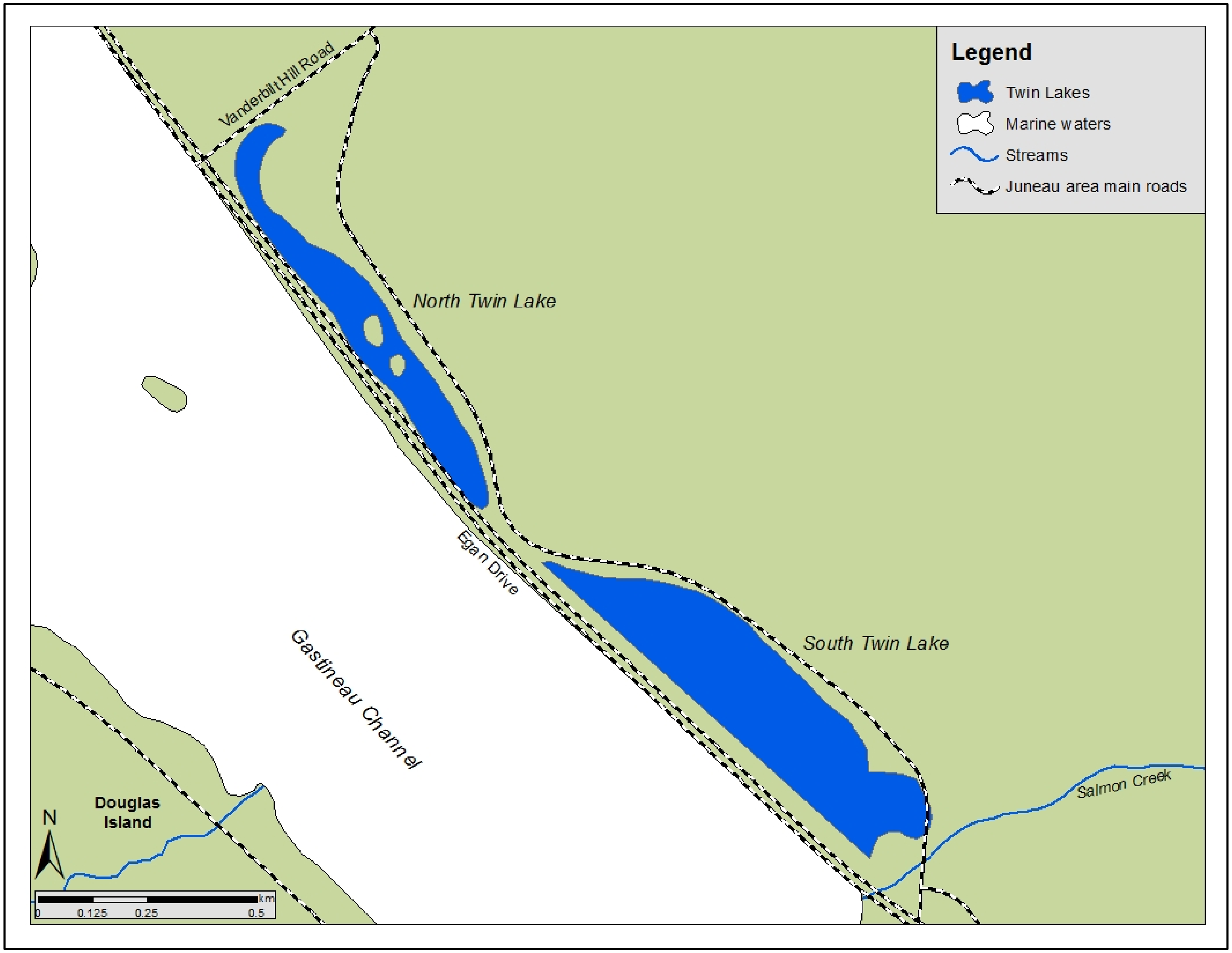

Figure 2.–Map of the Twin Lakes area, Juneau, Alaska.

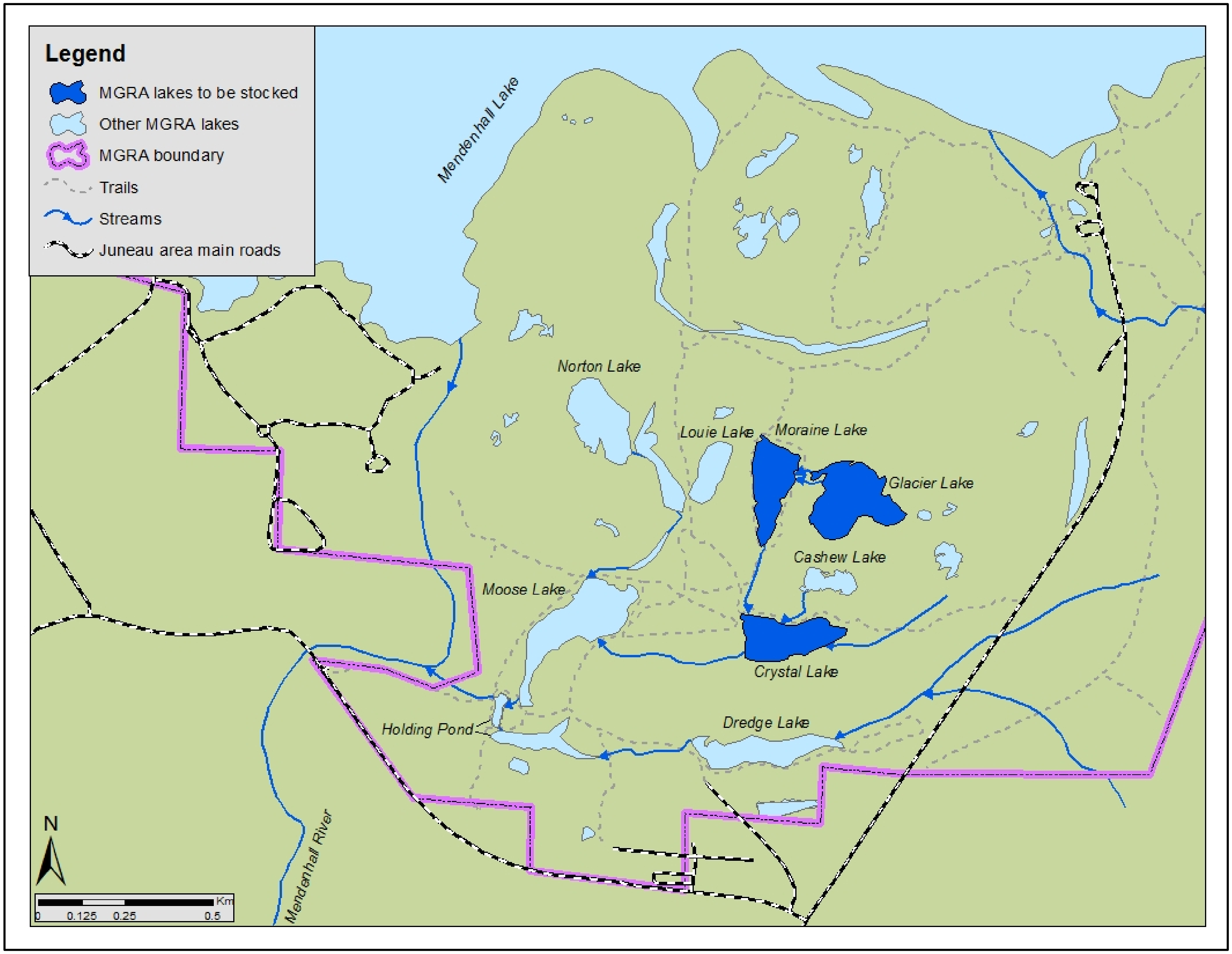

Figure 3.–Map of the Dredge Lakes area, located within the Mendenhall Glacier Recreation Area (MGRA), Juneau, Alaska.

DESCRIPTION OF PROJECT AREA

Twin Lakes

Twin Lakes are a pair of manmade lakes that were developed along the Juneau road system during the construction of Egan Drive, in the 1970's. The 2 lake basins (North Twin and South Twin lakes; Figure 2) were developed from tidal mud flats and marsh and are nearly separated by a small point of land that extends out from the mainland toward Egan Drive (Bethers et al. 1995). The lakes stretch between approximately mile 4 and mile 5.5 of Egan Drive (ADOT&PF 2011).

North Twin Lake is bounded on the northwest end by Vanderbilt Hill Road and is the smaller of the two basins, covering approximately 22 acres when full. South Twin Lake covers approximately 47 acres and is bounded on the southeast end by an earthen dike which separates the lake from Salmon Creek (Bethers et al. 1995). Both lakes have gate valves on culverts under Egan Drive through which the lakes can be partially drained and flooded with salt water. Each lake also has screened outlet control structures, which are used to regulate lake levels. Both lakes receive fresh water inputs from small streams that drain into the lake (Bethers et al. 1995).

The City and Borough of Juneau has developed the southern part of South Twin Lake as an outdoor recreation area that includes a playground, picnic area, restrooms, a shallow swimming area, a fishing dock, and a small boat launch ramp. There is also a paved walking path that extends along the east side of both lakes, with a parking lot located at each end of the path. Over the past 40 years, Twin Lakes has been stocked with a variety of salmonid species (Appendix A1) and has provided a popular, easy access, year-round sport fishery on the Juneau road system (Bethers et al. 1995). Since 1989, the fish stockings in Twin Lakes have supported a popular annual event known as Family Fishing Day (ADF&G 2013; Bethers et al. 1995), as well providing fishing opportunity during the rest of the year.

Mendenhall Glacier Recreation Area

The USDA Forest Service (USFS) manages the federally protected land in the MGRA, which encompasses 5,815 acres at the head of the Mendenhall Valley. By the early 1950's, this area was set aside as a Special Interest Area that was divided into five management units, each having different management objectives (USFS 1996). Included in the MGRA Special Interest Area is the Dredge Lakes unit, which contains 9 main lakes ranging in size from approximately 2 to 10 acres (Bethers et al. 1995; Figure 3); this unit is also commonly referred to as "Dredge Lakes" or "Mendenhall Ponds". Five of the lakes in the Dredge Lakes area are natural kettle ponds (Cashew, Glacier, Louie, Moraine, and Norton lakes) and the other 4 were excavated (Crystal, Dredge, Holding Pond, and Moose lakes).

There is a long history of fish stocking in the Dredge Lakes area (Appendix A2), which extends as far back as 1931 (Bethers et al. 1995). One of the management objectives established for the Dredge Lakes unit is to improve sport fishing opportunities for members of the public (USFS 1996), which has been realized through dedicated stocking efforts, as well as providing and maintaining an extensive trail system that allows the public easy access to the lakes in the area. Motorized vehicles are not allowed in the Dredge Lakes unit; however, the public is able to gain access to the trail system though established entrance points. Beaver activity is high in the area, which frequently results in high water and flooded trails during periods of heavy rain and snow melt.

OBJECTIVES

MORPHOMETRY, HYDROGRAPHY, AND OTHER LAKE CHARACTERISTICS

Management Objective 1: Create bathymetric and hydrographic maps and document physical and anthropomorphic features for select lakes.

Research Objective 1: Survey the lake bottom to obtain depth measurements, along with longitude and latitude data for producing bathymetric maps.

Research Objective 2: Describe the hydrography in the watershed for select lakes, including inlets, outlets, and delineation of streams and lake – lake connections.

Research Objective 3: Photograph select lakes and surrounding area.

WATER QUALITY

Management Objective 2: Describe physical and chemical properties in the selected lakes during fish sampling (approximately April – September).

Research Objective 4: Measure water clarity, temperature, dissolved oxygen, pH, specific conductivity, salinity, and total dissolved solids in selected lakes.

BASIC POPULATION INFORMATION

Management Objective 3: Provide fishery managers and anglers with current information about fish species present and size range of captured fish.

Research Objective 5: Survey selected lakes to determine fish species and life stages present, to characterize the size range of the fish captured and the overall condition of the fish observed.

METHODS

MORPHOMETRY, HYDROGRAPHY, AND OTHER LAKE CHARACTERISTICS

Study Design

Prior to conducting fish sampling surveys, crew members will collect bathymetry data for the 4 lakes scheduled to be stocked. Bathymetric maps will be produced and will be used to calculate several lake characteristics, including: surface area, maximum length and width, mean depth, maximum depth, shoreline length, shoreline development, and volume. Bathymetry data collection points will be generated in ArcGIS®[1] by creating a sampling grid and positioning it over the lake polygon. Cell size for the sampling grid is estimated to be 10 m for the 3 lakes in the MGRA and 50 m for Twin Lakes. Latitudes and longitudes will be derived from the grid cell centers and the resulting locations will be uploaded as waypoints into a handheld GPS. Figure 4 shows an example of bathymetry sampling waypoints generated for Crystal Lake. During bathymetry surveys, the crew will collect position and depth data at each uploaded waypoint. Position data will be obtained by navigating to uploaded waypoints using one GPS unit, then collecting a new waypoint at each location using a second handheld GPS (i.e., a GPS that does not have the sampling waypoints that were generated in ArcGIS uploaded to it). Depths will be measured at each location using a Hawk Eye digital handheld sonar (for depths > 1 m) or by using a weighted line with measurements marked on it (for depths < 1 m). The crew will also collect GPS waypoints to document locations of inlet and outlet streams, as well as other features (e.g., anthropomorphic, beaver dams, etc.) encountered during the surveys.

Due to beaver activity in the Dredge Lakes area, it is possible the existing hydrography data available for use in ArcGIS is no longer accurate. Hydrography data will be collected in the Dredge Lakes area to provide investigators with current information on stream connections between the lakes and the Mendenhall River. Methods used for hydrography surveys will be modified from established stream survey protocols described in Nichols et al. (2013). Surveys will begin at the main confluence with the Mendenhall River and will continue upstream through each of the connected lakes until either the stream terminus is reached or until the stream reaches the road that runs along the east side of the Dredge Lakes area (Figure 3).

[1] This and subsequent product names are included for a complete description of the process and do not constitute product endorsement.

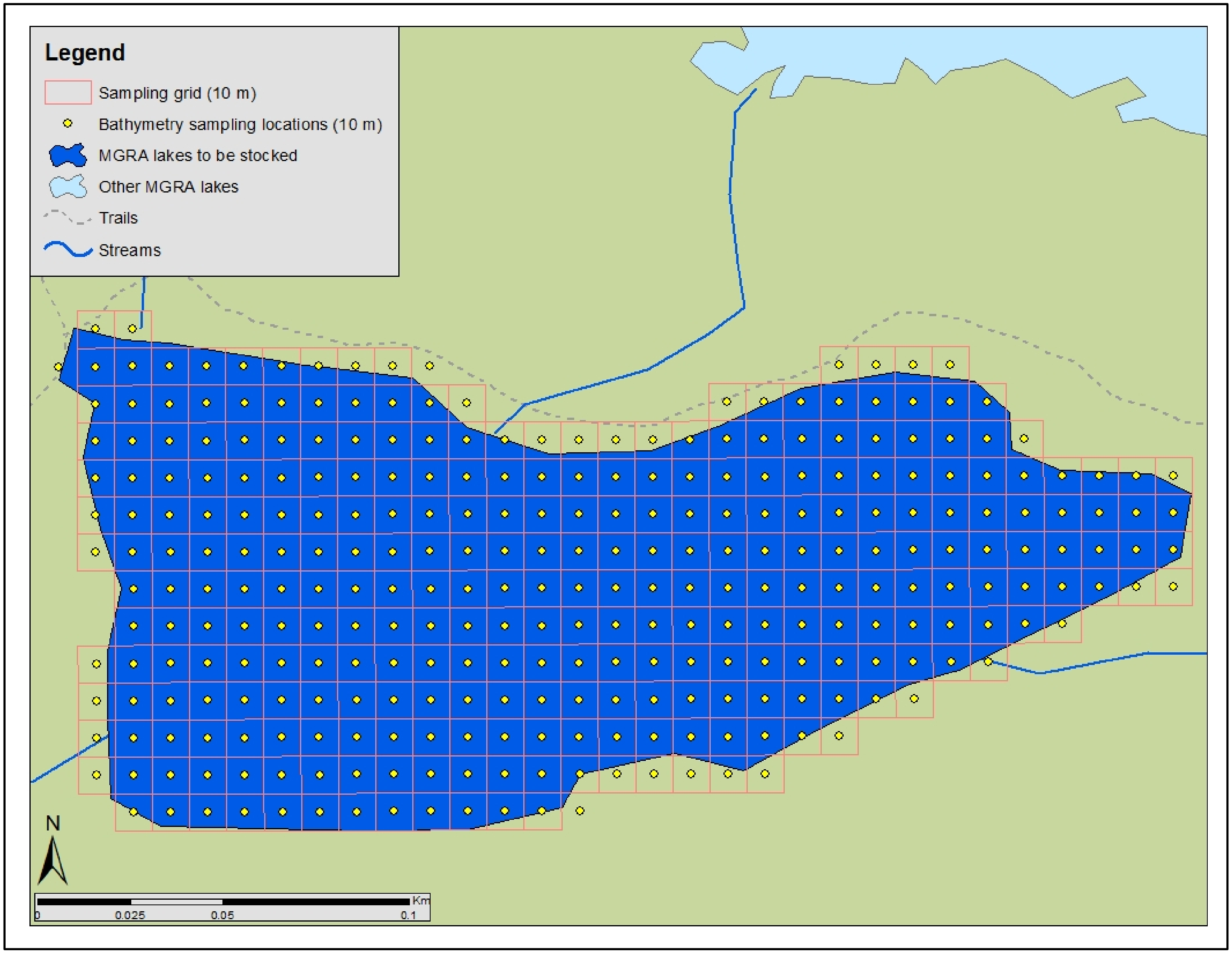

Figure 4.–Map showing the 10 m sampling grid and bathymetry sampling locations generated for Crystal Lake, Juneau, Alaska.

Data Collection

Prior to field activities, hardcopy color maps that include the bathymetry sampling locations will be printed on weatherproof paper for each lake. The "ADF&G Bathymetry" data forms (Appendix B1) will also be printed on weatherproof paper, prior to field activities.

Data collection for bathymetry mapping will require a crew of 2 people and will be conducted out of small inflatable rafts. GPS waypoints for each point on the bathymetry sampling grid will be uploaded to a Garmin GPSmap 60CSx. Before starting the survey, the crew will fill out the following information on the data sheet: sampling date(s), lake being sampled, sampling crew, and GPS unit ID (for the GPS unit that new waypoints will be recorded on during the survey). Observers will then navigate to established sampling points using the "GOTO" function on the GPS that has the uploaded waypoints that were generated in ArcGIS. After reaching a sampling point, one crew member will record a new waypoint on the GPS unit that does not have the uploaded sampling grid waypoints on it, while the other crew member measures the depth at that location. Depths will be measured using a Hawk Eye digital handheld sonar (for depths > 1 m) or by using a weighted line with measurements marked on it (for depths < 1 m). Care will be taken to make sure the sonar is pointed straight down in order to obtain an accurate measurement. The new GPS waypoint, the associated GPS error, and the depth at that location will get recorded in the row that corresponds with the original uploaded waypoint number that was navigated to. For example, if the crew navigates to uploaded waypoint number "21", the new waypoint number and depth data will be recorded in the row for "Uploaded Waypoint" number "21" (these numbers will be pre-filled on the data sheet; Appendix B1). This process will get repeated until a new waypoint and depth are obtained and recorded for every single uploaded waypoint from the bathymetry sampling grid. The crew will record a depth of 0 m for locations that fall on the lake shoreline.

If possible, an aerial photograph that shows the entire shoreline will be taken at each lake. If it is not possible to capture an aerial photo, a minimum of 2 digital photographs will be taken at the lake; in an effort to capture as much of the lake as possible, a photo will be taken from each end of the lake (along the longest axis of the lake).

During bathymetry surveys, crew members will also capture waypoints to document inlet and outlet streams, as well as other features encountered (e.g., anthropomorphic features, beaver dams, etc.). Data associated with these features will be recorded in a field notebook containing weatherproof paper. Prior to field activities, the crew will prepare the notebook to record the following information: sampling date(s), lake being sampled, sampling crew, GPS unit ID, GPS waypoint and associated error, feature code(s) observed at the location (Table 1), photo number(s) associated with the feature (digital photographs will be captured at these locations), photo direction (taken facing upstream or downstream, if applicable), and any comments the crew has related to the feature.

Table 1.–List of lake and stream mapping feature codes and descriptions.

Feature code	Feature description
BAR	Location of any potential fish passage barrier; take a photo and measure the height of the barrier above the water surface (i.e., measure the height that a fish would have to jump to get upstream)
BVD	Location of a beaver dam or potential fish passage barrier (take a photo and measure the height of dam)
CON	Location where 2 or more streams merge; observers should identify which side of the main stream channel (always looking downstream) the un-surveyed stream connects with the surveyed stream through the use of RB (river right bank) or LB (river left bank)
FOP	Fish observation point; this is normally reserved for fish surveys, but if a fish is encountered during lake or stream mapping that is worth noting (i.e., the fish is large, a different species, etc.), then make note of it
INL	Location where a stream enters a lake or pond
MAP	General stream mapping point (captured every 15 m, or more often depending on sinuosity)
OUT	Location where a stream exits a lake or pond
SXG	Trail or road (specify which type of road) crosses the stream; take a photo
WCS	Water control structure; many of the inlet/outlet streams in the Dredge Lakes area have man made water control structures, which at one point in time were used to raise or lower water levels. Take photos of all water control structures and provide a good description of their current condition, including to what extent beaver activity is affecting their utility

Data collection for hydrography surveys will be modified from established stream survey protocols described in Nichols et al. (2013). Data associated with these surveys will be recorded in a field notebook and will use the same headings as mentioned in the previous paragraph for recording data associated with features encountered during bathymetry surveys. Hydrography mapping will only occur in the Dredge Lakes area and will include stream connections between the lakes and the Mendenhall River. These surveys should begin at a known location (i.e., the Mendenhall River, a lake inlet stream, or a lake outlet stream) and if possible will continue in an upstream direction. Stream channels will be mapped using a GPS unit to record waypoints approximately every 15 m while walking along the stream bank. Feature codes identified in Table 1 will be used during these surveys and at least one digital photo will be taken to document all features, except “MAP” points. It is possible for a waypoint to represent more than one feature code, for example if there is a beaver dam at the point where an inlet stream enters a lake, the crew will record “BVD” and “INL” feature codes for that waypoint. Hydrography mapping in this area will continue upstream until a terminus is reached or until the stream reaches the road that runs along the east side of the Dredge Lakes area (Figure 3).

Data Reduction

At the end of each day of sampling, the field crew will ensure that data forms and field notebooks are kept up to date and will check all data for errors. After completion of each sampling event, datasheets will be taken to the office and the data will then be transferred from data sheets or notebooks to Microsoft Excel files. After data has been entered into spreadsheets, it will be checked for accuracy against the original field data.

All data collected on electronic devices will be downloaded and saved in their respective folders for each lake. This includes waypoint files from GPS receivers (S:\RMIG\DJ_ReportingPlanning\Juneau_RBT_Enhancement\WaypointDownloads) and digital photograph files from cameras (S:\RMIG\DJ_ReportingPlanning\Juneau_RBT_Enhancement\Photos). Waypoints associated with sampling will be imported into ArcGIS for subsequent mapping and saved as shapefiles in NAD83, State Plane, AK1, FIPS5001 projection.

Bathymetric maps will be created in ArcGIS using the water depths and corresponding location coordinates recorded during field surveys. Waypoints collected on lake shorelines will have an associated depth of 0 m and may be used to refine the shoreline delineation of the lakes. However, this process will require consideration and understanding that shorelines are dynamic and the waypoints collected during surveys are dependent on the water level at that point in time. Lake shorelines represent a depth of 0 m and will be used to determine the interpolated lake bathymetry extent. ArcGIS 3D and Spatial Analyst extensions will be used to produce the maps, including bathymetric contours.

Accumulated data for this project will be stored in Juneau at the following folder location: S:\RMIG\DJ_ReportingPlanning\Juneau_RBT_Enhancement\Data\DataEntry. A final, edited electronic copy of the data and relevant ArcGIS shapefiles will be sent to Research and Technical Services (RTS) in Anchorage for archiving.

Data Analysis

Bathymetric maps will be used to calculate the following lake characteristics using ArcGIS: surface area, maximum length and width, mean depth, maximum depth, shoreline length, shoreline development, and volume.

WATER QUALITY

Study Design

Prior to fish sampling activities, physicochemical conditions will be assessed at each lake using similar methods to those described in Skaugstad and Behr (2016) and USEPA (2011). A vertical water quality profile will be obtained at the maximum depth of each major basin present in the lake being sampled. Locations of water quality sampling stations will be determined after bathymetry data is collected for each lake. Lake bathymetry will be used to identify the number of major lake basins in each lake and the deepest point of each basin. Each sampling station will be given a unique station ID that will be used to identify the lake and specific station (e.g., Glacier Lake has a total of 3 basins; the deepest basin will be assigned a station ID of “G1” and the shallowest basin will be assigned a station ID of “G3”). At each sampling station, profile measurements will be collected in 0.5 m increments, between the surface and the lake bottom. A YSI Inc. Environmental Monitoring System ProDDS Sonde will be used to measure temperature, dissolved oxygen, percent dissolved oxygen, pH, specific conductivity, salinity, and total dissolved solids. Methods for operating and maintaining this instrument will follow procedures described in the instruction manual (YSI Inc. 2014). Water transparency will also be measured at each water quality sampling station by averaging the depths at which a Secchi disk disappears when being lowered in the water and when it reappears as it gets raised.

In addition to the profile data collected with the YSI sonde, an ONSET HOBO Pro V2 temperature data logger will also be deployed at each lake. Data loggers will be deployed in spring 2017, after lakes become ice free, and will remain deployed for the duration of the project; the only exception will be if the crew is unable to successfully download data in the field and have to take the data logger to the office to download. If a data logger has to be taken to the office to download, it will be redeployed within a day. Data will be downloaded in the field each spring (using the shuttle download cable), after lakes become ice free, and in the fall, prior to the lakes freezing over. Data loggers will be set up to record temperature data once every 15 minutes. To ensure data loggers stay in place and can easily be retrieved, they will be attached to a small buoy line on one end and will be attached to a weight on the other end. Data loggers will be placed in areas of relatively low foot traffic and will be submerged to a depth of approximately 1 m. Methods for setting up, operating, and maintaining the data loggers will follow procedures described in the instruction manual (ONSET 2010).

Data Collection

Prior to field activities, hardcopy color maps showing sampling stations will be printed on weatherproof paper for each lake. GPS waypoints for each sampling station will be uploaded to a Garmin GPSmap 60CSx. Observers will navigate to established sampling stations using the "GOTO" function on the GPS.

The "ADF&G Water Quality" form will be used to record data associated with water quality sampling (Appendix B2). This form will be printed on weatherproof paper, prior to field activities. Information to be recorded includes: sampling date, lake being sampled, sampling crew, station ID (unique station ID for each lake and lake basin sampled), general weather observations, and Secchi depths (i.e., the depth it disappears when getting lowered, the depth it reappears when getting raised back to the surface, and the average of the 2 measurements). The depths at which water quality data will be obtained is identified on the data sheet (i.e., rows include pre-filled depth values in 0.5 m increments, to record data collected from the lake surface to the lake bottom). Vertical water quality profiles will include measuring the following parameters: temperature, dissolved oxygen, percent dissolved oxygen, pH, specific conductivity, salinity, and total dissolved solids.

A HOBO temperature data logger will be deployed in each of the 4 lakes scheduled to be stocked. A GPS waypoint will be recorded for the location of each data logger. Data will be downloaded in the field each spring (using the shuttle download cable), after lakes become ice free, and in the fall, prior to the lakes freezing over. If there are issues with downloading data in the field, the data loggers will be taken to the office to download and will be redeployed as soon as possible afterward.

Data Reduction

Data reduction related to water quality will follow the same data reduction procedures described in the Morphometry, Hydrography, and Other Lake Characteristics section.

In addition to the previously described data reduction procedures, the shuttles containing downloaded HOBO temperature data will be taken to the office and will be downloaded using HOBOware Pro (Version 3.7.8) software.

Data Analysis

Graphic profiles of temperature, dissolved oxygen, and salinity will be generated using Microsoft Excel and will be saved in the same file as the data was entered in.

The Secchi disk transparency will be calculated as the average of the 2 depth readings measured (i.e., the depth when the disk disappeared and when it reappeared).

Graphs will be produced using Microsoft Excel to summarize weekly average water temperatures recorded on the data loggers.

BASIC POPULATION INFORMATION

Study Design

A minimum of a 2-person crew will be dedicated to capturing and sampling fish in 5 Juneau roadside lakes. Fish sampling will occur in the 4 lakes scheduled to be stocked with triploid rainbow trout (i.e., Crystal, Glacier, Moraine, and Twin lakes; Figure 1), as well as Moose Lake which is located downstream from the 3 MGRA lakes scheduled to be stocked (Figure 3).

Each lake will be sampled once in the spring of 2017 and 2018, after lakes become ice free, and in the fall of 2017, prior to lakes freezing over. In an effort to reduce stress to captured fish, sampling will be conducted when surface water temperatures are <18°C. Literature reviews also indicate the salmonids move offshore when water temperatures exceed 18°C and that large fish have a lower temperature preference than small fish and will likely be the first to seek thermal refuge offshore as temperatures in the littoral areas increase (Skaugstad and Behr, 2016). Fish will be captured using a combination of collapsible hoop traps, minnow traps, a tangle net, and hook-and-line (i.e., sport fishing) gear. Traps will be set in each lake before the crew sets the tangle net or attempts to catch fish with sport fishing gear. Fish sampling will be conducted primarily out of an open skiff.

Methods that will be used for operation of traps will be similar those described in Magnus et al. (2006). Hoop traps are approximately 1.25 m long, have a diameter of 50 cm, are covered with untreated 6 mm delta knotless mesh, and have an inward pointing funnel at one end of the trap and a cod end at the other to release fish. Minnow traps are approximately 42 cm long, have a diameter of 22 cm, are covered with 6 mm wire mesh, and have an inward pointing funnel at each end of the trap. An effort will be made to achieve uniform coverage across the lake; however, trap locations and spacing will ultimately be left to the discretion of the crew during the first sampling event. Once trap locations are established during the first sampling event, traps will be set in the same locations during subsequent sampling events. Hoop traps and minnow traps will be baited with treated salmon eggs (following egg preparation instructions provided in Magnus et al. (2006)) and will soak overnight. Set and pull times will be recorded for each trap, which will provide sampling effort information. Minnow traps will be used to trap areas too shallow to completely submerge the entrance hole on hoop traps (i.e., at depths < 35 cm). Depths will be measured at each trap location using a Hawk Eye digital handheld sonar (for depths > 1 m) or by using a weighted line with measurements marked on it (for depths < 1 m). Most traps will be set on the lake bottom; however, traps will be suspended at locations where there is concern about critically low dissolved oxygen levels (i.e., < 7 mg/L; ADF&G 1983) at depth. A buoy line will be attached to each hoop trap and suspended traps will also be attached to a weight that will rest on the lake bottom to hold the trap in place. Minnow traps will either be tied off to a secure object or will have a buoy line tied to it. A total of 15 hoop traps and 5 minnow traps will be set in each lake in the Dredge Lakes area, as well as in each basin of Twin Lakes.

As time allows, the crew will set one tangle net and will use sport fishing gear to sample after traps have been set. Sampling methods for the tangle net will follow those described in Skaugstad and Behr (2016). Sport fishing will consist of crew members using a variety of spin casting lures to sample deeper water areas of each lake (approximately > 0.5 m depth), where aquatic vegetation will be less likely to hinder sport fishing efforts. The tangle net will be checked every 30 minutes; sport fishing will occur while the tangle net is fishing.

All fish captured will be placed in an aerated tote. Salmonids will be identified to species and will be counted. Other species captured will be noted, but will not be counted or identified to species level. For each stocked lake, every Chinook salmon, Dolly Varden, and cutthroat trout captured, and every 5th fish of other salmonid species will be measured from the snout to the fork of the tail (FL), to the nearest 1 mm. The same sampling frequency will be used for Moose Lake, except that every 5th Dolly Varden will be measured instead of each one being measured. Fish will be released after processing.

Data Collection

Prior to field activities, hardcopy color maps will be printed on weatherproof paper for each lake. Maps will include lake bathymetry contours, locations of inlet and outlet streams, and established trap locations (after the first sampling event at each lake), for the crew to reference while setting traps. All data forms associated with fish sampling (Appendix B3 and B4) will also be printed on weatherproof paper, prior to field activities.

The “ADF&G Gear” form (Appendix B3) will be used to record information about sampling location and effort. Information to be recorded includes: sampling dates, lake being sampled, sampling crew, GPS unit ID, general weather comments, GPS waypoint and associated error (for documenting trap locations, tangle net locations, and places where fish are captured using sport fishing gear), gear type used at each waypoint, lake depth at the waypoint, and the date and time when fishing started and stopped at each sampling waypoint.

The “ADF&G Fish Sampling” form (Appendix B4) will be used to record fish capture data. Information will be recorded at each sampling waypoint, regardless of whether fish are captured or not. The following information will be recorded: sampling date, lake being sampled, sampling crew, GPS unit ID, GPS waypoint (corresponds with the waypoints recorded on the “ADF&G Gear” form described above), gear type used at the waypoint, species captured, lengths for fish measured (FL measurements; in stocked lakes, every Chinook salmon, Dolly Varden, and cutthroat trout captured and every 5th fish of other salmonid species will be measured, except Moose Lake where only every 5th Dolly Varden will be measured), condition of the fish inspected, total counts for each salmonid species captured at a trap location, and any relevant comments the samplers might have.

As stated previously, GPS waypoints will be collected at each lake, for each trap location, in spring 2017. For subsequent sampling events, trap location waypoints will be uploaded to a Garmin GPSmap 60CSx. The Garmin GPSmap 60CSx is WAAS-enabled for accuracy to within 3 m, 95 percent of the time (Garmin Ltd. 2017). Observers will navigate to established trap sampling locations using the "GOTO" function on the GPS.

Data Reduction

Data reduction for this section will follow the same data reduction procedures described in the Morphometry, Hydrography, and Other Lake Characteristics section.

Data Analysis

Sampling data will be summarized for each lake to show species present and their associated size distribution. Lengths will be summarized as medians and ranges when less than 10 lengths are recorded per species and as a histogram when 10 or more lengths are recorded per species.

SCHEDULE AND DELIVERABLES

The timeline for field and office activities associated with this project are included in Table 2. Note that the timeline does not include specific dates; this is because actual sampling dates will depend on weather conditions (i.e., timing of lakes becoming ice-free in the spring and when they ice up in the fall) and the availability of people conducting the surveys. At this time, actual dates have not been identified for the 2018 stocking releases. Pre-release surveys will be conducted at all lakes in spring 2018; however, it is unknown whether sampling in fall 2018 will include pre- or post-release surveys.

Table 2.–Schedule for all office and field related activities for this project, 2017-2018.

Date	Years	Activity
April	2017	Preparations for spring field sampling
April-June	2017	Spring field sampling at all lakes
June-August	2017	Data entry, ArcGIS mapping, and preparing for fall field sampling
August-September	2017	Fall field sampling at all lakes
September-March	2017, 2018	Data entry/analysis and remaining ArcGIS mapping
April	2018	Preparations for spring field sampling
April-June	2018	Spring field sampling at all lakes
June-August	2018	Data entry, ArcGIS mapping, and preparing for fall field sampling

Each year, a federal aid performance report will be prepared in September that will detail all activities performed and any results produced during the reporting period. A Fisheries Data Series report will be prepared by December 31, 2019 that will summarize results from the pre-release surveys described in this operational plan.

RESPONSIBILITIES

Kercia Schroeder, Fishery Biologist II (Douglas).

Project leader. Oversees all aspects of the project, including study design, planning, budgeting, equipment acquisition, training, logistical matters, data collection, data entry, QA/QC, etc. Writes all required documents related to the project.

Jeff Nichols, Regional Research Coordinator (Douglas).

Oversees and reviews the following aspects of the project including study design; planning, budgeting, equipment acquisition, training, and supervision of project personnel. Will review all operational plans and reporting documents. Assists with field work and data collection.

Kathy Smikrud, Research Analyst II (Douglas).

Will provide GIS assistance for the project.

Vacant, Fish and Wildlife Technician III (Douglas).

Assists with all aspects of field work and data collection, including preparation and cleanup from sampling events.

Adam Reimer, Biometrician II (Soldotna).

Responsible for biometric input including study design, writing of operational plan, analysis and coauthoring of all reporting documents.

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APPENDIX A. FISH STOCKING HISTORY FOR TWIN, CRYSTAL, GLACIER, AND MORAINE LAKES

Appendix A1.–Fish stocking history for Twin Lakes.

Date	Species	Number released
09/15/76	Rainbow trout	13,020
04/26/77	Rainbow trout	3,642
05/27/82	Coho salmon	7,999
08/06/83	Coho salmon	3,972
09/21/83	Coho salmon	5,285
06/22/84	Dolly Varden	1,894
09/05/84	Coho salmon	3,997
05/28/85	Coho salmon	3,062
02/07/86	Coho salmon	5,010
06/17/87	Coho salmon	10,000
10/21/87	Coho salmon	2,307
10/21/87	Coho salmon	4,100
05/19/88	Coho salmon	5,232
05/27/89	Coho salmon	2,885
05/27/89	Coho salmon	6,500
1989	Chinook salmon	10,000
05/05/90	Chinook salmon	9,200
1991	Chinook salmon	11,540
05/28/92	Chinook salmon	10,900
1992	Steelhead	1,445
1992	Steelhead	150
06/14/05	Coho salmon	1,700
10/22/92	Coho salmon	1,719
05/27/93	Chinook salmon	10,736
06/11/93	Coho salmon	4,796
1993	Steelhead	1,800
06/01/94	Chinook salmon	10,000
1994	Chinook salmon	3,400
05/14/95	Chinook salmon	6,216
08/19/95	Chinook salmon	4,730
08/19/95	Coho salmon	4,730

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Date	Species	Number released
04/15/96	Chinook salmon	3,249
05/30/96	Chinook salmon	734
10/08/96	Coho salmon	4,506
06/03/97	Coho salmon	8,265
10/09/97	Chinook salmon	1,521
05/14/98	Chinook salmon	10,574
06/10/98	Chinook salmon	4,029
03/17/99	Chinook salmon	10,153
07/18/99	Steelhead	12,278
10/29/99	Chinook salmon	2,520
04/05/00	Chinook salmon	10,680
01/24/01	Chinook salmon	2,947
04/05/01	Chinook salmon	5,972
05/22/01	Chinook salmon	5,765
10/22/01	Chinook salmon	3,941
04/16/02	Chinook salmon	4,928
05/29/02	Chinook salmon	5,408
10/23/02	Chinook salmon	3,890
03/27/03	Chinook salmon	5,561
05/07/03	Chinook salmon	4,628
10/23/03	Coho salmon	5,816
02/19/04	Coho salmon	4,034
05/19/04	Coho salmon	5,152
06/08/04	Coho salmon	50,039
09/23/04	Chinook salmon	3,019
06/02/05	Chinook salmon	7,811
10/05/05	Chinook salmon	4,002
06/01/06	Chinook salmon	8,799
10/20/06	Chinook salmon	3,498

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Date	Species	Number released
06/01/07	Chinook salmon	10,316
10/15/07	Chinook salmon	4,038
06/06/08	Chinook salmon	10,172
10/30/08	Chinook salmon	5,133
06/11/09	Chinook salmon	10,260
10/16/09	Chinook salmon	5,200
05/14/10	Chinook salmon	4,200
06/01/10	Chinook salmon	5,800
06/01/11	Chinook salmon	2,231
06/01/11	Chinook salmon	7,920
11/03/11	Chinook salmon	2,500
05/18/12	Chinook salmon	7,500
05/18/12	Chinook salmon	2,100
11/05/12	Chinook salmon	3,300
05/31/13	Chinook salmon	2,000
05/31/13	Chinook salmon	5,500
05/19/14	Chinook salmon	9,516
12/18/14	Chinook salmon	2,500
06/05/15	Chinook salmon	6,300
10/23/15	Chinook salmon	1,800
05/16/16	Chinook salmon	8,200
11/14/16	Chinook salmon	1,500

Appendix A2.–Fish stocking history for the 4 lakes in the Mendenhall Glacier Recreation Area that will be sampled for the project described in this operational plan (i.e., Crystal, Glacier, Moose, and Moraine lakes).

Date	Location	Species	Number released
1954	Glacier & Moraine lakes	Rainbow trout	8,000
08/08/1955	Glacier & Moraine lakes	Rainbow trout	2,500
1956	Glacier & Moraine lakes	Rainbow trout	10,600
1958	Glacier & Moraine lakes	Rainbow trout	9,000
1959	Glacier & Moraine lakes	Rainbow trout	8,000
1960	Glacier & Moraine lakes	Rainbow trout	8,000
1960	Glacier & Moraine lakes	Rainbow trout	5,000
1961	Glacier & Moraine lakes	Rainbow trout	10,000
1963	Glacier & Moraine lakes	Rainbow trout	10,000
1965	Glacier & Moraine lakes	Grayling	20,000
1965	Glacier & Moraine lakes	Rainbow trout	15,000
06/11/1968	Mendenhall ponds	Grayling	30,000
06/11/1968	Glacier & Moraine lakes	Grayling	50,000
09/25/1973	Mendenhall ponds	Coho salmon	156,165
09/25/1973	Moose Lake	Chinook salmon	155,078
10/13/1973	Mendenhall ponds	Chinook salmon	129,740
1974	Glacier & Moraine lakes	Rainbow trout	4,030
05/21/1974	Mendenhall ponds	Chinook salmon	82,184
05/28/1974	Glacier Lake	Not recorded	2,273
05/28/1974	Glacier Lake	Rainbow trout	2,273
05/28/1974	Moraine Lake	Rainbow trout	1,725
09/16/1974	Mendenhall ponds	Coho salmon	110,000
09/16/1974	Mendenhall ponds	Coho salmon	100,000
09/16/1974	Moose Lake	Coho salmon	209,485
05/19/1975	Mendenhall ponds	Coho salmon	45,045
05/23/1975	Mendenhall ponds	Coho salmon	60,475
06/23/1975	Mendenhall ponds	Coho salmon	150,000
06/24/1975	Moose Lake	Coho salmon	149,500
1976	Glacier & Moraine lakes	Cutthroat trout	349

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Date	Location	Species	Number released
06/07/1976	Moose Lake	Coho salmon	545,000
05/04/1977	Mendenhall ponds	Coho salmon	30,030
05/04/77	Mendenhall ponds	Coho salmon	20,020
05/1977	Moose Lake	Coho salmon	15,272
05/01/1978	Mendenhall ponds	Not recorded	10,565
1982	Glacier & Moraine lakes	Cutthroat trout	354
06/01/1984	Mendenhall ponds	Not recorded	199,893
11/01/1989	Moose Lake	Coho salmon	70,000
12/18/1989	Mendenhall ponds	Coho salmon	100,763
10/27/2010	Crystal Lake	Chinook salmon	500
10/27/2010	Glacier Lake	Chinook salmon	500
10/27/2010	Moraine Lake	Chinook salmon	500
05/18/2012	Crystal Lake	Chinook salmon	500
05/18/2012	Glacier Lake	Chinook salmon	500
05/18/2012	Moraine Lake	Chinook salmon	500
06/04/2013	Crystal Lake	Chinook salmon	850
06/04/2013	Moraine Lake	Chinook salmon	650
05/30/2014	Glacier Lake	Chinook salmon	700
05/30/2014	Moraine Lake	Chinook salmon	700

Note. The 9 lakes in the Dredge Lakes area are also collectively referred to as the “Mendenhall ponds”. Historical stocking records containing a location of “Mendenhall ponds” are for records that do not specify which lake the release occurred in.

APPENDIX B. FIELD DATA FORMS

Appendix B1.–Data sheet used to record GPS locations and associated depths used to create bathymetric maps.

ADF&G Bathymetry Pg 1 of _____

Date(s) ________________

Location ____

Personnel ____

GPS ID (new waypoints) ___________

Uploaded Waypoint	**New Waypoint**	**Error** (m)	**Depth** (m)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			

Appendix B2.–Data form used to record water quality measurements.

ADF&G Water Quality

Pg __ of __

Date(s) ________________

Location ____________________________________

Personnel ____

Station ID ___________

Weather (cloud cover, precip, wind, etc.) ____

Air Temp (°C) ___________

Surface Water Temp (°C) ___________

Secchi depths:

Disappear (m) _____

Reappear (m) _____

Average (m) ______

Depth (m)	**Temp** (°C)	**DO** (mg/L)	**DO%**	**pH**	**SpC** (mS/cm)	**Salinity** (PSS)	**TDS** (mg/L)
0							
0.5							
1							
1.5							
2							
2.5							
3							
3.5							
4							
4.5							
5							
5.5							
6							
6.5							
7.0							

Appendix B3.–Data form used to record GPS location information and to identify the gear type used, total lake depth at the location, and the sampling start and stop times.

ADF&G Gear Pg ______ of ______

Date(s) ________________

Location ____ Personnel _________________________________

GPS ID ________________

Weather (cloud cover, precip, wind, etc.) ____

Waypoint	**Error** (m)	**Gear Type**	**Depth** (m)	**Date/Time SET**	**Date/Time PULL**

Gear Codes

hoop trap = HT tangle net = TN
minnow trap = MT fishing rod = rod

Appendix B4.–Data form used to record fish capture data, including species counts and FL measurements.

ADF&G Fish Sampling Pg _____ of _____

Date(s) _______________

Location ____ Personnel _____________________________________

GPS ID _______________

Waypoint (on gear sheet)	**Gear Type**	**Species**	**Length** (mm FL)	**Condition**	**Count**	**Comments**

Gear Codes
hoop trap = HT
minnow trap = MT
tangle net = TN
fishing rod = rod

Fish Codes
rainbow trout = RT
cutthroat trout = CT
Dolly Varden = DV
Chinook salmon = KS
coho salmon = CS
pink salmon = PS
sculpin = SCL
stickleback = STB

Condition (can use more than one; include details in the Comments section)
thin = T
fat = F
injured = I
parasite = P*
disease = D*
* - P/D if uncertain