

Standard Operating Procedure: Field Measurements

Arctic Inventory and Monitoring Network

Lake Communities and Ecosystems Monitoring Protocol

Jonathan A. O'Donnell

National Park Service
240 W. 5th Avenue
Anchorage, Alaska 99501

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U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

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The main Narrative for the Protocol for monitoring Lake Communities and Ecosystems for the National Park Service's (NPS) Arctic Inventory and Monitoring Network (ARCN) is available from the NPS ARCN website (<http://science.nature.nps.gov/im/units/arcn>).

SOP: Field Measurements

Version 1.0 (September 2018)

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Introduction

This Standard Operating Procedure (SOP) describes the methods for conducting field measurements of water quality of lakes. This SOP is a component of the Lake Communities and Ecosystems Monitoring Protocol (O'Donnell and Miller 2018). Tasks associated with this SOP include (1) measuring water quality in lake profiles, and (2) secchi depth measurements.

Field Measurements of Water Quality Parameters

1. Field measurements of the four main water quality parameters (temperature, pH, specific conductivity, and DO) are generally conducted using a multi-parameter sonde (e.g., YSI Professional Plus).
2. For lakes, measurements should be co-located with the location of water sample collection (see *SOP: Chemical Characterization of Surface Water*). Use existing bathymetric maps or recent bathymetric surveys to identify the deepest part of the lake, and conduct measurements from that location. Lake depths can be confirmed *in situ* using a hand-held depth sounder.
3. Measurements are conducted either from the float of a float plane, or from a small boat (e.g., Alpacka packraft).
4. Take the first measurement at 0.5 m below the lake surface. Use the multi-parameter sonde to log and record the measurement.
5. For temperature, read the temperatures to the nearest 0.2°C.
6. For pH, read the values to the nearest 0.01 pH unit.
7. Measures can be logged using the meter associated with the multi-parameter sonde. See instrument-specific instruction manual for details on how to log observations. Measurements should also be logged on a field sheet (see Appendix: Field Sheet).
8. Take the next three measurements at depths of 1.0, 1.5, and 2.0 meters below the lake surface.
9. From 2 to 20 meters, collect, log, and record measurements every one meter.
10. From 20-40 meters, collect, log, and record measurements every two meters.
11. Below 40 meters, collect, log and record measurements every 5 meters.

Lake Stratification

1. Most large, deep lakes in ARCN parklands display some degree of thermal stratification during summer months (LaPerriere et al. 2003). During this period of stratification, the lake is divided into three distinct zones (Wetzel 2001):
 - The **epilimnion** is the relatively warm layer near the lake surface characterized by low-density, well-mixed, and turbulent water.
 - The **hypolimnion** is the deep, cool layer near the lake bottom characterized by higher-density and less-turbulent water.
 - The **metalimnion** is the transition layer between the epilimnion and hypolimnion, characterized by a rapid decline in temperature with increasing depth. The **thermocline** is the plane of maximum rate of decrease within the metalimnion.
2. Following temperature profile measurements (see above), examine temperature patterns to identify the thermocline, and record approximately depths of the base of the epilimnion and top of the hypolimnion.
3. By determining the approximate depths of the thermocline, we can then identify epilimnion and hypolimnion sampling depths (see *SOP: Chemical Characterization of Surface Water*).

Notes: Seasonal patterns of lake temperature dynamics, stratification, and mixing can be used to categorize lakes into different types (Kalff 2002). Most deep lakes in ARCN parklands are dimictic (LaPerriere et al. 2003), characterized by a period of ice cover, a period of summer stratification, and two periods when the lake is mixed. Some ARCN lakes (e.g., Itkillik Lake) have been categorized as cold polymictic lakes (LaPerriere et al. 2003), which are often wind-exposed or are mountain lakes at high elevation.

Secchi Depth Measurements

Secchi depth measurements have been adopted from standard methods developed by the USGS (Berkman and Canova 2007) and also Wetzel and Likens (2000).

1. Secchi disks measure water transparency, and are widely used in lakes and reservoirs. A simple rule of thumb is that the photic zone is approximately 2.5 times the Secchi Depth (Green et al. 2015).
2. The Secchi disk is a 20-cm diameter disk with alternating white and black quadrants:



3. The sun should be behind you whenever you take a Secchi depth measurement, unless the sun is directly overhead.
4. Remove sunglasses prior to conducting measurement.
5. Lower the Secchi disk straight down into the water until the disk disappears from sight.
6. Mark the rope at the depth at which the disk disappears. Record the depth (see Appendix: Field Sheet).
7. Next, raise the disk up through the water column until it becomes visible. Record the depth at which the disk reappears.
8. The Secchi depth is the midpoint between the disappearance and reappearance measurements.
9. Record the Secchi depth on the field form.

Site Photos

1. Take aerial photographs during the approach to the lake while in the aircraft.
2. On the ground, document any other interest features, including new depositional zones, active bank erosion, odd coloration of surface water, groundwater seeps, and etc.

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Appendix: Field Sheet

Lake Communities and Ecosystems Arctic Inventory and Monitoring Network

Site Name: _____ Coordinates: _____
Date/Time: _____ Personnel: _____
Park Unit _____

Lake depth at sampling location _____

Secchi Depth Measurement

Depth where disc disappears _____

Depth where disc reappears _____

Secchi depth _____

Field Measurements

Depth	Temp	pH	Specific Cond	DO (mg/L)

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Natural Resource Stewardship and Science

1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525

www.nature.nps.gov