



Data Quality Standards for ARCN Lagoon Communities Monitoring

Natural Resource Report NPS/ARCN/NRR—2018/1825



ON THE COVER

Photograph of NPS biologists documenting saltmarsh
NPS

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Abstract

This narrative documents the data quality standards objectives used by the National Park Service (NPS) Arctic Inventory and Monitoring Network (ARCN) for activities related to the collection, processing, storage, analysis, and publication of monitoring data as described in the Coastal Lagoons Vital Signs Monitoring Protocol for the Arctic Network (Jones et al. 2017). There is a description of the general timing of the protocol for data analysis and reporting relative to the rest of the implementation of the monitoring efforts, as well as the data considerations associated with the implementation of the protocol. The ultimate purpose is to describe the variables to be collected, their frequency, units, data type, precision, and accuracies. It also describes the general timing of the protocol for data analysis and reporting relative to the rest of the implementation of the monitoring efforts.

Introduction

The purpose of this report is to document the standards, used by the National Park Service (NPS) Arctic Inventory and Monitoring Network (ARCN) for activities related to the collection, processing, storage, analysis, and publication of monitoring data as described in the Coastal Lagoons Vital Signs Monitoring Protocol for the Arctic Network (Jones et al. 2017). The policies and procedures documented in this quality-assurance plan for activities complement the quality-assurance plans for other monitoring activities conducted by the Arctic Inventory and Monitoring Network and supplement National Inventory & Monitoring Division Quality Management Plan. The plan also serves as a guide for all ARCN personnel who are involved in protocol/program activities and as a resource for identifying memoranda, publications, and other literature that describe associated techniques and requirements in more detail.

Protocol Overview

Coastal lagoons are a prominent feature of Alaska's Arctic coastline and serve as critical habitat to globally important concentrations of marine mammals, birds, and fish populations. Furthermore, these habitats are of vital importance for the food and economic security of indigenous residents. Lagoon systems are highly dynamic coastal features at the interface marine, terrestrial, and freshwater environments. They exhibit seasonal biophysical changes due to connectivity to larger water masses and changes in ice cover. Environmental changes including, erosion, melting permafrost, ocean acidification, invasive species and increased human activity in the western Arctic region have the potential to significantly impact lagoon systems. Understanding current physical and biological variability in these systems will allow managers to better understand, anticipate, and manage future impacts of environmental change and human activity in the region.

Protocol Activities and Modules

Data are collected or derived as a part of the Arctic Lagoon Monitoring Protocol (Jones et al. 2017) during several different field operations (Table 1).

The Coastal Lagoon Monitoring Protocol will be implemented in two ARCN parks: Cape Krusenstern National Monument (CAKR) and Bering Land Bridge National Preserve (BELA). Both parks are located along the southeastern Chukchi Sea coast. This protocol provides the methodology for addressing two monitoring questions:

- 1) What are the ranges and variances of water quality parameters within lagoons and how are they changing?
- 2) What are the conditions, compositions, and trends of fish communities within lagoons and how are they changing?

The first question objective is to determine the status and trend of water quality parameter (temperature, pH, conductivity, and dissolved oxygen) ranges and spatial variances within, and among, coastal lagoons on an annual basis. The second question objective is determining the status

and trends of species composition and condition of fish communities within and among lagoons, with a secondary objective of assessing temporal trends of whitefish, a key subsistence species.

Five lagoons will be monitored for this protocol, 2 in BELA, and 3 in CAKR. Within each lagoon, three random sites and four fixed sites will be sampled for water quality and 4 fixed sites will be sampled for fish. This design provides for the ability to provide both status and trend information. In addition, the use of extended deployment temperature and depth sensors will allow for additional environmental trend analyses. Data will be maintained in the Arctic Inventory and Monitoring program (ARCN) database, with annual reporting.

Table 1 indicates the annual schedule for the protocol including field preparations, field operations, post field data handling, and data management. The data collected are identified in Table 2 and Table 3, which indicate the type of data being collected, the frequency and how it is being collected. Table 4 documents the data deliverables associated with data collection for the Arctic Lagoon monitoring Protocol.

Table 1. Approximate annual schedule for the Arctic Lagoon Monitoring Protocol (Jones et al. 2017).

Month	Preparation & Maintenance	Responsible Party
Oct-Jan	Finalize budget for fiscal year	PI and Fish Biologist
Oct-Jan	Plan summer monitoring and permitting/compliance for ARCN	PI, Fish Biologist, and ARCN Natural Resource Scientists
Jan	Equipment purchases	PI and Fish Biologist
Mar	Complete BELA and CAKR winter monitoring data entry and initial data management	PI and Biological/Water Quality Technicians
Feb-Apr	Plan summer monitoring	PI, Fish Biologist, and ARCN Natural Resources Scientist
Apr	Re-evaluate budget status for fiscal year	PI and Fish Biologist
Apr-May	Equipment evaluation	PI and Biological/Water Quality Technicians
May (or as needed)	Training/safety needs evaluation	Fish Biologist, Biological/Water Quality Technician(s), Park staff
Feb	Initial annual data analysis	PI and Biological/Water Quality Technician(s)
Jun – Aug	Field monitoring in BELA and CAKR	Fish Biologist, and Biological/Water Quality Technicians
Aug-Sep	Data upload and entry	Fish Biologist, and Biological/Water Quality Technicians
Aug-Sep	Close out year-end budget and finalize equipment purchases for fiscal year.	PI and Fish Biologist
Sep	Complete annual reporting (protocol summary and annual analysis may be completed earlier, this is the annual deadline for the previous calendar year.)	PI and Fish Biologist
Sep	End of the year equipment evaluation	PI, Fish Biologist

Table 2. Water Quality activity-level sample design matrix for the Arctic Lagoon Monitoring Protocol (Jones et al. 2017).

Variable	Units	Frequency	Instrument	Data Type
Temperature	°C	Each sample event, each site	EXO2 Sonde	Point sample; Continuous logging every 15 minutes
Conductivity	mS/cm	Each sample event, each site	EXO2 Sonde	Point sample; Continuous logging every 15 minutes
Salinity	ppt	Each sample event, each site	EXO2 Sonde	Point sample; Continuous logging every 15 minutes
Dissolved Oxygen	mg/L	Each sample event, each site	EXO2 Sonde	Point sample; Continuous logging every 15 minutes
pH	units	Each sample event, each site	EXO2 Sonde	Point sample; Continuous logging every 15 minutes
Turbidity	FNU	Each sample event, each site	EXO2 Sonde	Point sample; Continuous logging every 15 minutes
Chlorophyll	µg/L	Each sample event, each site	EXO2 Sonde	Point sample; Continuous logging every 15 minutes
Depth	m	Each sample event, each site	EXO2 Sonde	Point sample; Continuous logging every 15 minutes
Level	m	Each lagoon	Hobo Level Logger	Continuous logging
Temperature	°C	Each lagoon	Hobo Level Logger	Continuous logging
Bathymetry	data file	Periodic	hydrosurveyor	Hydrosurveyor data file
Velocity	data file	Periodic	hydrosurveyor	Hydrosurveyor data file
Total Nitrogen	mg/L	3 - 9 samples per lagoon	Water bottle	Lab processing
Nitrate	mg/L	3 - 9 samples per lagoon	Water bottle	Lab processing
Phosphate	mg/L	3 - 9 samples per lagoon	Water bottle	Lab processing
Total Alaklinity	uEquiv/kg	3 - 9 samples per lagoon	Water bottle	Lab processing
Ω-aragonite	units	3 - 9 samples per lagoon	Water bottle	Calculated
Dissolved Inorganic Carbon	µmol/kg	3 - 9 samples per lagoon	Water bottle	Lab processing

Table 3. Fish sample activity-level sample design matrix for the Arctic Lagoon Monitoring Protocol (Jones et al. 2017).

Variable	Units	Frequency	Instrument	Data Type
Humpback Whitefish abundance	CPUE	8 samples per lagoon	Gill net, fyke net	point sample
Starry Flounder abundance	CPUE	8 samples per lagoon	Gill net, fyke net	point sample
Ninespine Stickleback abundance	CPUE	8 samples per lagoon	Beach seine, fyke net	point sample
Humpback Whitefish length distribution	Fork Length (mm)	8 samples per lagoon	Gill net, fyke net	point sample
Starry Flounder length distribution	Fork Length (mm)	8 samples per lagoon	Gill net, fyke net	point sample
Ninespine Stickleback length distribution	Fork Length (mm)	8 samples per lagoon	Beach seine, fyke net	point sample
Species Diversity	Simpson's (Ds), and Shannon's (H')	12 samples per lagoon	Gill net, fyke net, beach seine	point sample
Species Evenness	Evenness index (V)	12 samples per lagoon	Gill net, fyke net, beach seine	point sample
Species Richness	Species count (n)	12 samples per lagoon	Gill net, fyke net, beach seine	point sample

Table 4. Data deliverables matrix for the Arctic Lagoon Monitoring Protocol (Jones et al. 2017).

Identifier	Deliverable	Format	Schedule	Responsibility
L01	GPS waypoint files	GPS export format. Text file format.	End of field operations (Aug-Sep).	PI, FB
L02	Hydrosurveyor files	Hydrosurveyor export format. Text file format.	End of field operations (Aug-Sep).	PI and WQT
L03	EXO2 Sonde Probe data	EXO2 Sonde Probe data and calibration data files. Text file formats.	End of field operations (Aug-Sep)	PI and WQT
L04	HOB0 Level Logger	HOB0 Level Logger export format. Text file format.	End of field operations (Aug-Sep)	PI and WQT
L05	Digital Photographs	TIFF	Post field season (Sep-Dec)	PI, WQT, FB
L06	Data from contracted lab(s)	Formats as received. Text file format.	End of field operations (Aug-Sep)	PI
L07	Chain of custody form	PDF	End of field operations (Aug-Sep)	PI, Lab
L08	Scanned field data forms	PDF	End of field operations (Aug-Sep)	FB, BT
L09	Original paper data forms	Paper data forms	End of field operations (Aug-Sep)	PI

Data Quality Objectives

Measurement quality objectives for the water quality parameters measured by the ARCN coastal lagoon protocol (both field and laboratory) are expressed in terms of bias, precision, and completeness goals (Table SOP 13.1). Bias is defined as the difference between a measured value and the true value (representation of net bias); precision is defined as variation among individual identical measurements (representation of random error); and completeness is the number of samples taken relative to the number of samples expected. These objectives were established by estimating the most likely realistic achievable data quality based on instrument manufacturer's specifications, scientific experience, or historical data.

Representativeness

The sampling design for the Coastal Lagoon monitoring protocol incorporates both fixed and random sampling sites. The inclusion of randomly chosen stations should represent a spatially unbiased characterization of the water quality parameters monitored within lagoons. The inclusion of fixed sites will allow for monitoring of trends by park resource managers.

Site Location

Sampling locations for each lagoon will be provided to field personnel as coordinates of latitude/longitude and decimal degrees. The crew will use global positioning system (GPS) equipment to locate each sampling site. The acceptable tolerance goal for locating sampling stations is within ± 100 ft of the given coordinates (closest site on land).

Unless there are substantiated reasons that prevent field crew from sampling within a define area, field crews will strictly adhere to the above guidelines for establishing a sampling station. Randomly selected sites may fall in locations not suitable for sampling. If this situation occurs, field personnel will note the current environmental conditions and proceed to the next random point.

Qualitative Data Quality Values

Data quality values included are to clarify specific data quality parameters (Table 5). Further specifications for sensors, quality objectives, and laboratory requirements are seen in Tables 6 – 8.

Taxonomic Standards

The taxon name is the data exchange standard to be used when recording species observation data. The reference used for making the identification should be included in the metadata for this measure, and should be the same throughout the field season, and generally should not change unless newer simpler identification references are developed (this is parallel to including the “units of measurement” that is done with other measures).

Protected Data Standards

Data are intended to be open and public by default. There is no anticipated sensitive data to be collected.

Table 5. Data Quality Values (DQVs) for the Arctic Lagoon Monitoring Protocol (Jones et al. 2017).

Type	Data Quality Value	Definition	Protocol Considerations
Intrinsic Data Quality	Accuracy	Measurements reflect the true value of the parameter being observed. This applies to measures (length, width, position) or classes (species, types, or categories). Includes components of precision and bias.	Protocol data collections methods and procedure requirements are designed to ensure the most accurate results possible, taking into account environmental variability, equipment accuracies, estimated precision, and bias.
	Representativeness	Measurements represent conditions at the time of sampling. Combined with accuracy, leads to repeatable data collection.	Parameters and methods are chosen such that they measure representative conditions. Measurements will be direct measures and indicators of conditions, while indexes will be calculated from direct measures. The sampling design provides for both status and trend measures in individual lagoons. There is no direct intent to use this data to extrapolate beyond sampled lagoons.
Contextual Data Quality	Comparability	The degree to which data can be compared among sample locations, data sources, or periods of time.	It is assumed the data will be comparable over time in order to conduct trend analyses. Data is collected with the intent that data analysis may include other data sets (collected from other projects and/or agencies). When comparing with other data sets it is important to consider the comparability of the methodological approaches of each study.
	Timeliness / Currency	How recent the data need to be to be considered valid for their intended use. Data represents conditions and/or is available and in a format for use at the appropriate time in the decision-making process.	Data processing will occur in a timely fashion following the field season and based on certification requirements. Where data are required for resource management decisions prior to certification of the data, data dissemination requires a provisional data caveat.
	Completeness	All data/ measures required to evaluate accuracy representativeness are present; incomplete data sets (either at a location, across sampling locations, or over time) lose utility or relevance.	Methods, sampling plans, and analyses are designed and implemented such that they result in a complete dataset across space and the planned period of record. It is anticipated that there may be missing data sets (equipment failure and corrupted data). Annual sampling reduces the impact of lost data within a season for the purposes of evaluating long term trends.

Table 5 (continued). Data Quality Values (DQVs) for the Arctic Lagoon Monitoring Protocol (Jones et al. 2017).

Type	Data Quality Value	Definition	Protocol Considerations
Representational Data Quality	Consistent Representation	Use of standard definitions when describing data quality or resource quality based on data	This is particularly relevant when reporting data in comparison to other projects.
Data Accessibility	Secure	Access to data, products, and systems limited to appropriate audiences.	It is not anticipated that there is any sensitive data associated with this protocol. If subsistence user data is collected, it is assumed this data will be non-sensitive in nature and no PII will be collected or attributed to the collection of this data. Should sensitive data be acquired, the PI must work with the data manager to secure this data.

Table 6. Measurement Quality Objectives for Arctic Lagoon Monitoring Protocol (Jones et al. 2017).

Type	Measure/Quality Indicator	Quality Objective
Site Recon	Location Accuracy	Sample location within +/- 10m of established waypoint.
Site Establishment	Location Accuracy	+/- 3m (horizontal)
	Location Description Detail	Description provided with enough detail to relocate without use of GPS equipment
Photopoints	Image resolution	10 megapixel
	Image format	TIFF w/ embedded EXIF metadata
Nutrient Samples	MDL, Precision, Bias	See lab method performance requirements for specifications

Table 7. Laboratory method performance requirements and analysis methods to be used for nutrient chemistry analysis in the Arctic Lagoon Monitoring Protocol (Jones et al. 2017).

Analyte	Units	MDL Objective	Transition Value	Precision Objective	Accuracy Objective	Potential Methods conforming to NELAC guidance
Ammonia (NH ₃)	mg N/L	0.01 (0.7 µeq/L)	0.10	± 0.01 or ±10%	± 0.01 or ±10%	EPA Method 350.2 (1979)
Nitrate-Nitrite (NO ₃ -NO ₂)	mg N/L	0.01	0.10	± 0.01 or ±10%	± 0.01 or ±10%	-EPA Method 353.2 (1979) -Enzyme Catalyzed Reduction
Total Nitrogen (TN)	mg/L	0.01	0.10	± 0.01 or ±10%	± 0.01 or ±10%	Standard Methods #4500-N C, 4500-NO ₃ F and EPA Method 353.2 (1979)
Total Phosphorous (TP)	µg P/L	2.0	20.0	± 2 or ±10%	± 2 or ±10%	Standard Methods #4500-P.B.5, #4500 P.E, and EPA Method 365.1 (1979)

Table 8. Sensor performance requirements for use in the Arctic Lagoon Monitoring Protocol (Jones et al. 2017).

Sensor	Range	Accuracy	Response	Resolution
Temperature	-5 to 35°C	±0.01°C	<1 sec	0.001 °C
Conductivity	0 to 200 mS/cm	0 to 100: ±0.5% 100 to 200: ±1%	<2 sec	0.01 mS/cm
Salinity	0 to 70 ppt	0.2 ppt	Calculated from conductivity	0.01 ppt
Dissolved Oxygen	0 to 50 mg/L	0 to 20 mg/L: ±0.1 mg/L 20 to 50 mg/L: ±5%	<5 sec	0.01 mg/L
pH	0 – 14 units	±0.1 pH unit	<3 sec	0.01 units
Turbidity	0 – 4000 FNU	0 – 1000 FNU: 2% 1000 – 4000 FNU 5%	<2 sec	0.1 FNU
Chlorophyll	0 to 400 µg/L Chl	Linearity: R ² >0.999	<2 sec	0.01 µg/L Chl
Depth	0 – 10 m	0.004 m	<2 sec	m
Level	1.0	20%	30%	95%

Literature Cited

- Jones, T., S. Apsens, S. Miller, T. Haynes, and M. Robards 2018. Coastal lagoons vital signs monitoring protocol for the Arctic Network: volume 1, protocol narrative, version 1.0. Natural Resource Report NPS/ARCN/XXXX – 2018/XXX. National Park Service, For Collins, Colorado.
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The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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