



Monitoring Yellow-billed Loons in Alaska

ARCN Inventory and Monitoring Network, Data Quality Standards

Natural Resource Report NPS/ARC/NRR—2018/1737



ON THE COVER

A Yellow-billed Loon hunkers on a nest in northern Alaska.
(USGS/TREVOR HAYNES)

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Executive Summary

The purpose of this report is to document the standards used by the National Park Service (NPS) Arctic Network (ARCN) Inventory and Monitoring Program for activities related to the collection, processing, analysis, and publication of Yellow-billed Loon monitoring data as described in the Yellow-billed Loon Monitoring Protocol for the Arctic Network, Alaska (Flamme *et al.* 2018; <https://irma.nps.gov/App/Reference/Profile/2216938>). This 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. The format and content of this document borrows heavily from Wilson and Shepherd (2017), as well as Rattenbury *et al.* (2017) and Rattenbury and Schmidt (2017).

Acknowledgments

Funding for this project was provided through the National Park Service, Arctic Network Inventory and Monitoring Program. The creation of the protocol narrative and associated documents involved the contributions of numerous individuals.

Introduction

The purpose of this report is to document the standards used by the Arctic Network (ARCN) Inventory and Monitoring Program for activities related to the collection, processing, storage, analysis, and publication of monitoring data as described in Yellow-billed Loon Monitoring Protocol for the Arctic Network (Flamme *et al.* 2018). The policies and procedures documented in this quality-assurance plan for activities follow the quality-assurance plan for other monitoring activities conducted by the ARCN and supplement the National Inventory & Monitoring Division Quality Management Plan. The Standard Operating Procedures provide detailed protocol/program activities associated with Yellow-billed Loon monitoring. This plan serves as a guide for all 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

This protocol outlines how monitoring data will be collected, managed and reported for the Yellow-billed Loon “Vital Sign”, as part of the NPS Vital Signs Inventory and Monitoring program and as described in the ARCN Monitoring Plan (Lawler *et al.* 2009). The study design, data collection methods, and analytical protocols have been previously documented in a peer-reviewed journal publication in the Condor (Schmidt *et al.* 2014).

Rationale for Yellow-billed Loon Monitoring

The Alaska National Interest Lands Conservation Act (ANILCA, U. S. Congress 1980) contains enabling legislation and mandates relevant to Yellow-billed Loon conservation in NPS units in Alaska. Management purposes include protection of “habitat for internationally significant populations of migratory birds” in Bering Land Bridge Natural Preserve (BELA) (ANILCA § 201(2)); and protection of “habitat for, and populations of, birds” in Cape Krusenstern National Monument (CAKR) (ANILCA § 201(3)). In 2007, the Yellow-billed Loon population in western Alaska was selected for long-term monitoring in BELA and CAKR under the NPS Arctic Network Vital Signs Monitoring Plan (Lawler *et al.* 2009). The Yellow-billed Loon is a rare, international species of concern with an estimated global population of 16,650-21,000 (Fair 2002; Earnst 2004; Earnst *et al.* 2005; Earnst *et al.* 2006). Worldwide, the loon’s circumpolar breeding range includes Beringia and Arctic and near Arctic habitats between 60°-66° N latitude across portions of northern Canada, Russia, and Alaska (Fair 2002; Federal Register 2014). The entire U. S. population of Yellow-billed Loons is seasonally located in Alaska where the total summer breeding population is estimated at 3,700-4,900 birds (North and Ryan 1989; Earnst 2004; Earnst *et al.* 2005; Earnst *et al.* 2006; USFWS 2006; Federal Register 2014). The species’ range in Alaska is restricted to tundra landscapes with large, deep, clear, freshwater, fish-bearing lakes with low-profile and convoluted shorelines and stable water levels (North and Ryan 1989; Earnst 2004; Earnst *et al.* 2006; Haynes *et al.* 2014; Schmidt *et al.* 2014). Most Yellow-billed Loons in Alaska are found in the National Petroleum Reserve-Alaska (NPR-A), however, smaller populations of 2,000-2,500 birds are located in northwestern Alaska on the Seward Peninsula, Cape Krusenstern and Kotzebue lowlands (Fair 2002; Mallek *et al.* 2006; Bollinger *et al.* 2007; Schmidt *et al.* 2014; Mizel and Flamme, pers. comm. 2017). This area includes two parklands, BELA and CAKR (Figure 1).

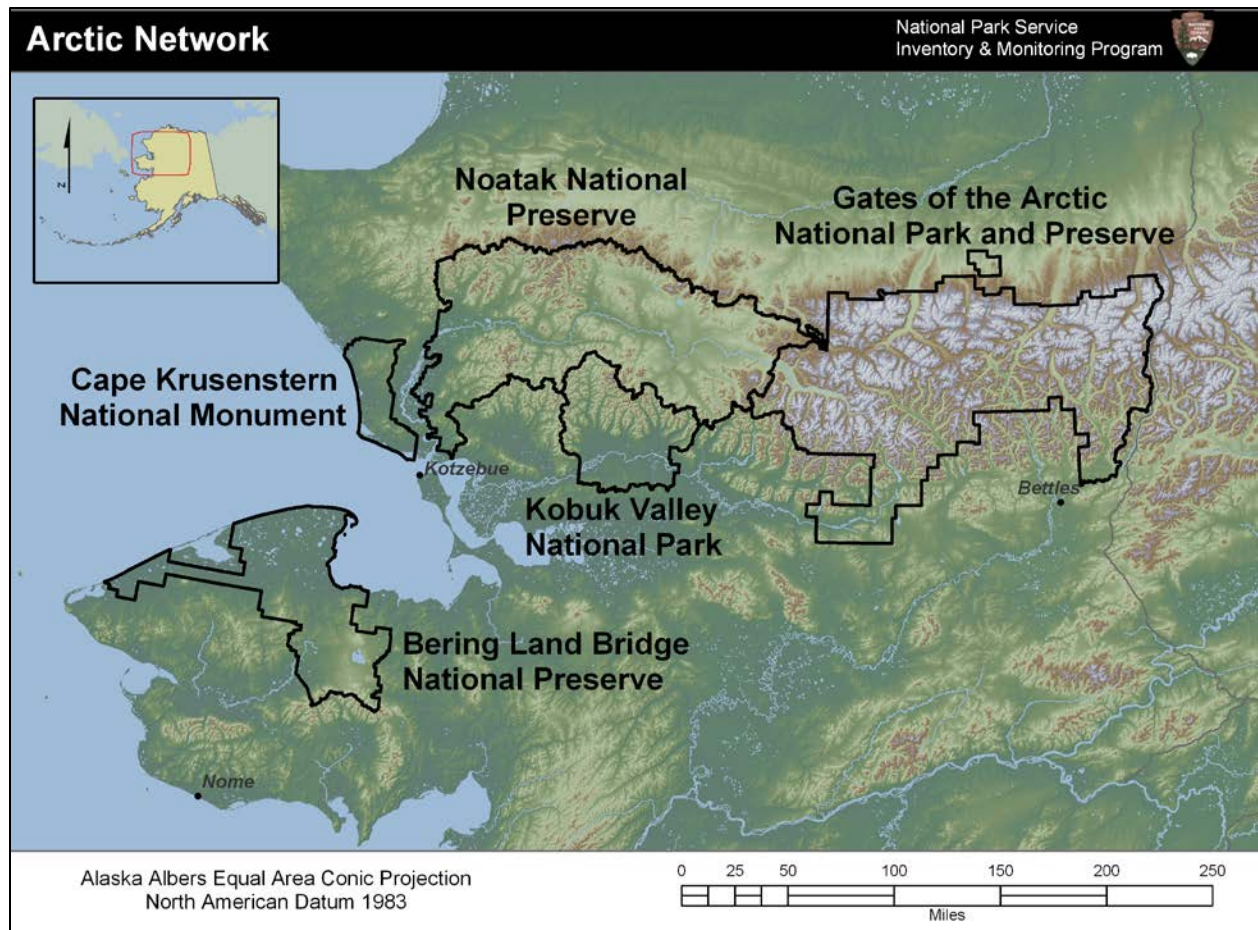


Figure 1. Location of the Arctic Network (ARCN) parklands in northern Alaska, USA: Bering Land Bridge National Preserve, Cape Krusenstern National Monument, Kobuk Valley National Park, Noatak National Preserve and Gates of the Arctic National Park and Preserve. Yellow-billed Loons are monitored in Bering Land Bridge National Preserve and Cape Krusenstern National Monument.

A Species of Concern

In 2004, the U.S. Fish and Wildlife Service (USFWS) was petitioned to consider listing the Yellow-billed Loon as threatened or endangered under the Endangered Species Act, either throughout its range or as a Distinct Population Segment in the U. S. The agency was also petitioned to designate areas of critical Yellow-billed Loon habitat due to the species' small population size, restricted Alaskan distribution and low reproductive success (Evers 2004; Federal Register 2007, 2009). In 2009, the USFWS announced that it had determined "that listing the Yellow-billed Loon as a threatened or endangered species is warranted under the Endangered Species Act, but an immediate proposal to list this species is precluded by other higher priority listing actions" (Federal Register 2009). The species listing as "warranted but precluded" meant that the USFWS was required to review their finding annually until either the species was listed as a threatened or endangered species or the species is deemed "not warranted" for listing. Though the USFWS found that the listing of the birds as either endangered (in danger of extinction) or threatened (likely to become endangered

within the foreseeable future) was not warranted at this time (Federal Register 2014), the loons continue to be considered an international species of concern by many organizations.

This species is of particular interest to the ARCN since the enabling legislation for all 5 ARCN parklands, including BELA and CAKR, specifies protection for birds, their habitats and populations under ANILCA (U. S. Congress 1980). Additionally, several international treaties, federal laws, agreements and initiatives provide protections and conservation guidance for migratory birds and require action by NPS. Conservation concerns that may impact Yellow-billed Loons in western Alaska include gravel extraction, road construction, proposed natural gas extraction with accompanying power infrastructure on the Kobuk River Delta, increased marine vessel traffic and potential for industrial spills in the Bering and Chuckchi Seas, subsistence harvest, fish species distribution shifts, anthropogenic disturbance and climate-induced water level changes (Smith 1995; USFWS 2006). Habitats in NPS units may become more important to maintaining nesting habitat for Yellow-billed Loon populations in Alaska as other areas become more developed.

Objective

The primary monitoring objective of the ARCN Yellow-billed Loon monitoring protocol is to:

Biennially estimate status and trends in distribution, occupancy, and habitat use of Yellow-billed Loons in freshwater arctic lakes during the breeding season in BELA and CAKR.

Methods

Sampling Design

The USFWS Migratory Bird Division developed techniques for conducting aerial surveys specifically for breeding Yellow-billed Loons in northern Alaska (Stehn *et al.* 2005). Prior to 2005 (1986-2004), population indices for Yellow-billed Loons in Alaska were largely a by-product of the USFWS Arctic Coastal Plain Breeding Pair (ACP) straight-line transect surveys conducted to monitor the majority of waterfowl species (Mallek *et al.* 2003 and 2004; Stehn *et al.* 2005). These transect surveys were also conducted in 1992-1993 in portions of BELA and CAKR (USFWS unpublished data). However, these straight-line transect methods neither specifically addressed nor adequately accounted for Yellow-billed Loon populations because they could only establish presence, but not absence, of these loons and largely missed location of nesting sites (Stehn *et al.* 2005; Smith 1995). Given the species' status as potentially threatened or endangered in the early 2000s, the USFWS developed a new lake-circling methodology to optimize the detection of both the presence and absence of Yellow-billed Loons based on comprehensive surveys of lakes located within large randomly chosen plots (Ernst *et al.* 2005; Stehn *et al.* 2005; Mallek *et al.* 2006; Bollinger *et al.* 2007). The new methods were optimized for lake-habitat parameters indicated likely to be significant for Yellow-billed Loons based on logistic regression analyses, including larger lakes, deeper lakes, hydrologic connectivity, presence of shoreline emergent vegetation and flooded tundra land cover classes, more complex lake shoreline shape, and absence of Pacific Loons (Ernst *et al.* 2005).

The ARCN Yellow-billed Loon aerial surveys are conducted biennially in late June, just after ice-off on the lakes and nest initiation, but before hatch (Table 1). The surveys are conducted each time in the same 24 randomly selected 12km × 12km plots scattered across BELA (n=18) and CAKR (n=6) (Figure 2; see Bollinger *et al.* 2007). The study area has 1291 lakes >7ha in size and the selected plots contain approximately 35% of these lakes (n=447). Surveys are conducted at an altitude of 300-500 feet above ground level and at speeds between 60-80 knots. Although this protocol is focused on Yellow-billed Loons, data are collected on and all five species of loons encountered (Yellow-billed, Common, Red-throated, Pacific and Arctic) and their nests as well as other large waterfowl (grebes, ducks, swans, geese) both within plots and outside of them ("OUT" anecdotal data). The cost of recording the additional species is negligible and improves estimation for Yellow-billed Loons (see Data Analysis section, SOP 10 and Schmidt *et al.* 2014).

Table 1. Proposed biennial survey schedule to monitor Yellow-billed Loon distribution, occupancy and habitat use in BELA and CAKR. Some exceptions to this schedule (consecutive years: 2016, 2017, 2018) to enable joint surveys with a three-year concurrent Red-throated Loon study (see table for details). Surveys are scheduled to be conducted biennially into the future.

Park Unit / Survey Area	2009¹	2011²	2013²	2015	2016²	2017²	2018²	2020	2022...
BELA	X	X	X	–	X*+	X*+	X*+	X	X
CAKR	X	X*	*	–	X*+	X*+	X*+	X	X

¹ The survey conducted in 2009 was a pilot survey, conducted with a single tandem aircraft on floats.

² In 2011, 2013, 2016, 2017 and 2018 we used two tandem aircraft on floats to conduct repeat surveys of plots and estimate detection probability. We will continue to do this for future surveys.

*In 2011, 2013, 2016, 2017 and 2018 some YBLO plots were not repeat sampled or not sampled at all (e.g., 2013 CAKR) due to weather.

In 2015, surveys were not conducted. This year was skipped so work could be conducted in 2016 instead.

+In 2016-2018, as a special exception to the monitoring schedule, surveys were done jointly with a three-year Red-throated Loon study (2016-2018). This enabled three consecutive surveys to be conducted to assess annual, rather than biennial, habitat use, occupancy, distribution and nest-site fidelity. Surveys are scheduled to be conducted biennially for future surveys beyond 2018.

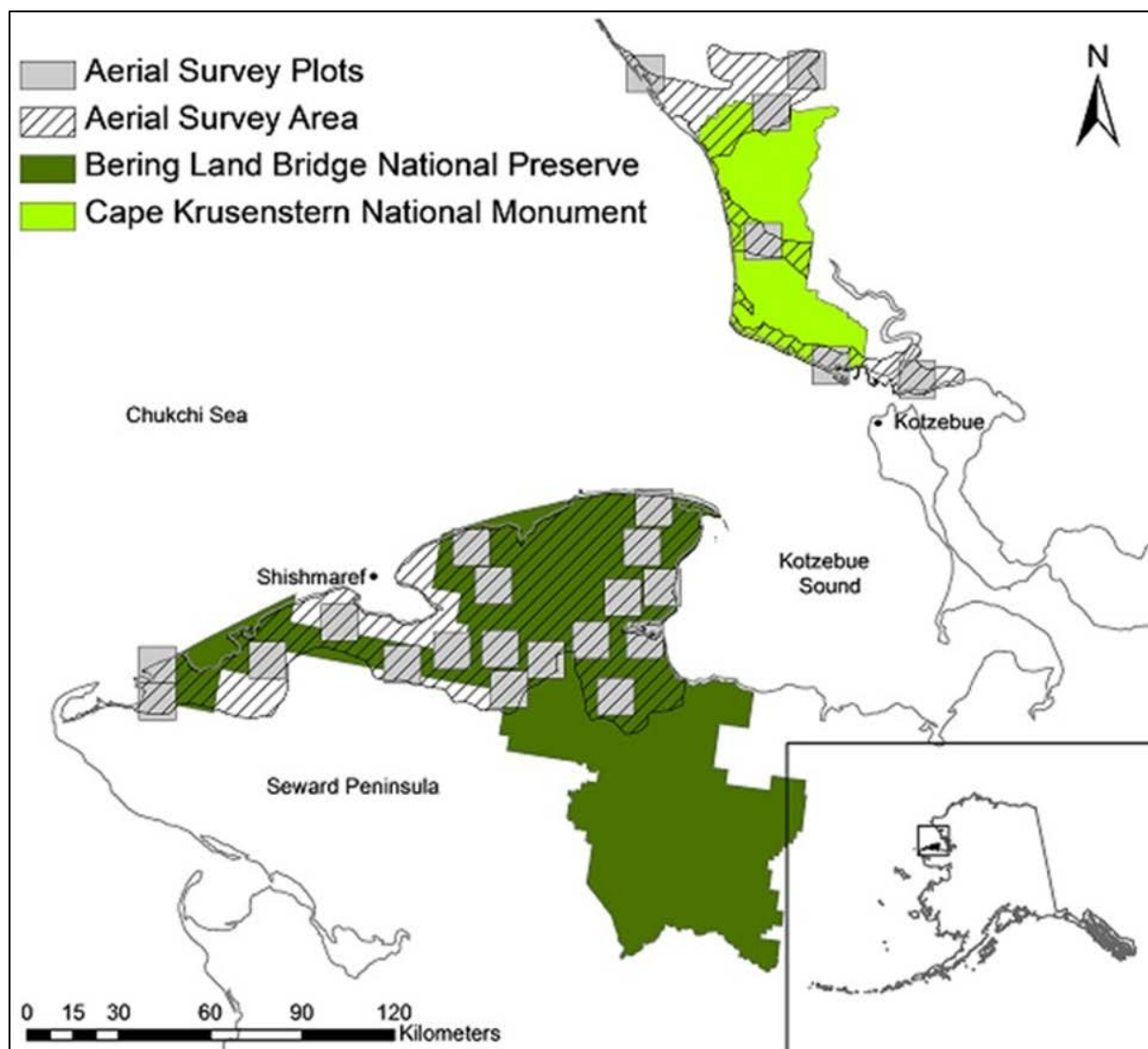


Figure 2. Location of survey area on the northwestern coast of the Seward Peninsula, Alaska, USA. Squares indicate sampled plots, hatched lines indicate the study area boundary, and colored areas indicate U.S. National Park Service units for Bering Land Bridge National Preserve (dark green) and Cape Krusenstern National Monument (light green).

Aerial surveys are conducted via tandem aircraft (on floats) using lake-circling methods to improve detection of both the presence and absence of Yellow-billed Loons and their nests based on comprehensive surveys of lakes located within the plots (see SOPs 1-8 for detailed field procedures). Lake-circling techniques allow loons to be confidently associated with specific lakes and improve the detection of nests along shorelines as compared to straight-line transect surveys (Stehn *et al.* 2005). The lake-circling methods target lakes with habitat parameters likely to be attractive to Yellow-billed Loons for foraging and nesting (Earnst *et al.* 2006). The initial surveys by USFWS in 2005 and 2007 were conducted using amphibious Cessna 206 aircraft (Stehn *et al.* 2005; Mallek *et al.* 2006; Bollinger *et al.* 2007). Techniques were subsequently modified again by switching to two or more tandem aircraft (on floats) to increase the probability of detecting loons and loon nests. These planes

fly lower and more slowly and seat the observer behind the pilot so both can view simultaneously out of the same side of the aircraft without obstruction from the pilot. Five surveys (2011, 2013, 2016, 2017, 2018) using independent counts (repeats) of plots have been conducted to enable us to estimate detection probability (see Schmidt *et al.* 2014 for further details). These adjustments to the USFWS method were needed to address the lack of detection probability estimates and to improve detection of loons and nest sites by using the more maneuverable, slower and lower-flying aircraft.

The USFWS lake-circling survey methodology (Stehn *et al.* 2005), ARCN Dall's Sheep Monitoring SOPs for conducting aerial surveys (Rattenbury *et al.* 2017), data collection and processing, and the multistate occupancy modeling approach (Schmidt *et al.* 2014) have all been adopted and modified for implementation in Yellow-billed Loon Monitoring. Modifications include:

1. ARCN Yellow-billed Loon monitoring will implement the USFWS published lake-circling methods (Stehn *et al.* 2005) except ARCN will use two or more, smaller tandem aircraft on floats (rather than one larger aircraft) that are capable of lower and slower flight to improve detection probability.
2. ARCN Yellow-billed Loon monitoring will implement repeat (duplicate) sampling of all 24 plots in BELA and CAKR to provide an estimate of detection probability (Schmidt *et al.* 2014).
3. ARCN Yellow-billed Loon monitoring surveys will occur biennially, not annually. Biennial surveys are a compromise between cost and adequate survey frequency.
4. ARCN Yellow-billed Loon monitoring surveys will not generate new random selections of possible plots to be sampled for each survey. Rather, the same 24 plots that were surveyed by USFWS in 2007 (Bollinger *et al.* 2007) will be sampled in perpetuity for the long-term monitoring. Yellow-billed Loons have strong nest-site fidelity and return to the same breeding sites each year. Using the same plots and lakes for the long-term will enable us to examine long-term lake occupancy and habitat use by various species of loons over time.
5. A multistate occupancy modeling analyses (Schmidt *et al.* 2014) will be used, rather than the analytical methods developed by USFWS (Stehn *et al.* 2005; Mallek *et al.* 2006; Bollinger *et al.* 2007).
6. The ARCN Yellow-billed Loon monitoring program utilizes many of the same methods developed for the ARCN Dall's Sheep protocols (Rattenbury *et al.* 2017; <https://irma.nps.gov/DataStore/Reference/Profile/2238929>), including GPS set up, the Park Observer application for data collection on the iPad and data downloading and processes methods. We will reference these sheep standard operating procedures (SOPS) when they have been adopted for use in loon monitoring.

Survey Area

The survey area includes 13,572 km² of potential Yellow-billed Loon habitat in portions of BELA and CAKR in western Alaska (Figure 2). All lakes >7 ha in size are included as selected lakes in the survey (Earnst *et al.* 2006). The minimum lake size of >7 ha was based on data from the Colville River Delta, where the smallest lake found with a brood of Yellow-billed Loons was 13.4 ha (North

and Ryan 1989). Additionally, spring Yellow-billed Loon Surveys on the Arctic Coastal Plain (Mallek *et al.* 2003 and 2004) indicated that out of 479 Yellow-billed Loon observations, 98% were on lakes larger than 10 hectares; just 2% were on lakes 7-10 ha.

Monitoring Schedule

ARCN Yellow-billed Loon monitoring surveys are conducted during the last 10 days of June in northwestern Alaska, after subarctic lakes have largely thawed and loon nesting has commenced, but eggs have not yet hatched. The surveys occur biennially in BELA and CAKR. Biennial surveys are a compromise between cost and adequate survey frequency. Yellow-billed Loons have strong nest-site fidelity and tend to return to the same breeding sites each year on nesting lakes, making biennial sampling feasible and appropriate for generating occupancy estimates, even with a gap in survey years. Typically, Yellow-billed Loon surveys are conducted biennially. In 2016 and 2018, we also conducted surveys to collect consecutive years of data (2016, 2017, 2018) in conjunction with a concurrent Red-throated Loon (RTLO) study. By combining efforts with the three-year RTLO study (2016-2018), which includes an additional 31 plots scattered over BELA, we can assess annual, rather than biennial habitat use, distribution and nest-site fidelity of Yellow-billed Loon (YBLO) and RTLO. Further, we cover a larger area of loon habitat across BELA, which will be useful for understanding habitat use for the YBLO monitoring program.

Data Analysis

Data analysis will meet the monitoring objectives estimating lake occupancy state, rates of transition between occupancy states (used, used for nesting and unused) and trend after each survey. The multistate occupancy modeling analyses (see Schmidt *et al.* 2014) allows us to examine occupancy and habitat use of the lakes in the survey area for several loon species simultaneously across years. Because Yellow-billed Loons are rare and the number of detections is relatively smaller than detections of other loons, we will leverage the detections of other loon species (that have similar habitat and behavior: e.g., Pacific Loons) to enhance the analysis of habitat use of lakes by loons across the survey area.

Data Quality Objectives

This section is intended to demonstrate how this project generates data of known and documented quality, resulting in complete, accurate and transferable information.

Representativeness and Data Comparability. The initial randomized survey design of the project assures that inference applies to the population of Yellow-billed Loons included in the sampling frame. Therefore, there is no sample selection bias and the sample is representative of the entire population for surveys conducted under the protocol. Under the dynamic model, all the information in the data are used through time to estimate trends in occupancy rates. Any changes in detection probability will have no impact on data comparability because detection probability can be estimated from each annual set of replicate survey data. The approximate 2-year sampling interval will be sufficient to detect large scale trends in overall occupancy patterns. Due to direct dependence on loon densities, which may vary through time, power to detect trends cannot be conclusively determined. However, preliminary results suggest estimator precision will be sufficient to meet study objectives (see Schmidt *et al.* 2014). Precision will also increase as more data are collected.

Completeness. If surveys are unable to be completed in a scheduled year due to funding or logistical issues, they will be attempted in the next year if possible to provide information. Although completing replicate surveys on all plots is desirable, it is not required. Due to the flexibility of the analytical framework, valid estimates can still be produced if some plots are not surveyed or if some replicates are unable to be completed. That said, at some point, incomplete coverage becomes a problem. Consultation with a biometrician is considered necessary if >25% of plots remain uncompleted at the end of the survey period. The biometrician must use expert judgement to determine proper inference when surveys are incomplete.

Measurement Quality Objectives and Performance Standards

The measure and quality indicators used to assess quality objectives for field observations and data analysis are shown in Table 2.

Table 2. Quality objectives for Yellow-billed Loon monitoring protocol field observations and data analysis.

Measure / Quality Indicator	Quality Objective
Loon/nest location accuracy	+/- 50m (horizontal), no standards for vertical accuracy
Group size	Pilot and observer must mutually agree on total count
Species ID	Pilot and observer must mutually agree on the species
Nest occupancy	Dynamic multistate occupancy analysis (SOP 10, Schmidt <i>et al.</i> 2014)
Loon occupancy	Dynamic multistate occupancy analysis (SOP 10, Schmidt <i>et al.</i> 2014)

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