National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science

Moose Monitoring Protocol for the Arctic Inventory and Monitoring Network

Standard Operating Procedure (SOP) # 1 Survey Preparation and Timing



ON THE COVER
Moose cow calf pair along the North Fork of the Koyukuk during March.
NPS photograph by Kyle Joly.

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Overview

This SOP describes logistical considerations to prepare for a moose survey, and some guidance on survey timing.

General Summary

Prior to either the spring abundance or fall composition survey the PI should line up aircraft and pilots for the survey as much as four months in advance. This may seem early, but the more experienced pilots are scheduled for moose surveys far in advance, and the more experienced the pilots the better and safer the survey. One observer should be lined up for each aircraft, and at least one alternate pilot and observer should be made aware that they may be asked to participate in the survey should the need arise. Additionally, if an aerial stratification is planned, 3 observers and a 4-passenger aircraft (C-206 or C-185) should be arranged. The biologists and all observers should review the entire protocol, including all of the SOPs, and review Gasaway et al. (1986) and Kellie and DeLong (2006).

The PI needs to make two full map sets of the sample units for each aircraft (one for the pilot and one for the observer) and two extra copies, one of which can be used as a master map at the base camp for the survey. Moving maps that can be used on GPS units, such as Garmin's or iPad's, should be created for both pilot and observer. Numerous copies of the Moose Abundance Form (see Appendix A) should be made. A supply of 250 copies is sufficient for most populations and allows for extra copies.

Review and Survey Schedule

Procedures

1. Review Gasaway et al. (1986), Ver Hoef (2000, 2001, 2002), and Kellie and DeLong (2006), and Delong (2006). These documents go into great detail on how to conduct a moose survey and process data. This protocol and SOPs attempts to summarize these documents in the required format. If any questions arise they can likely be answered by referencing these documents.

2. All reports from previous surveys, or other studies of moose covering the survey area should be reviewed by the PIs. Most reports and datasets can be found within the NPS IRMA data store (https://irma.nps.gov/App/Reference/Profile/2222140).
   As early as possible, establish the budget and a preliminary idea of where and how large the area to be surveyed is (survey areas range from 4,000 mi^2 (10,360 km^2) to 6,500 mi^2 (17,834 km^2) within the five ARCN parks, defined in SOP #2, "Selecting the Survey Area"). This will allow calculation of the number of aircraft to schedule and how much fuel to have available. Primary moose monitoring areas for each park should be carefully chosen to remain unchanged from year to year if at all possible.

3. Determine the number of aircraft needed. Generally four or five planes are typically used for most surveys. The more planes there are, the faster the survey can be finished, which is an advantage with the frequently short windows of good flying weather.

4. Calculate and order enough fuel for the survey, not forgetting the fuel requirements for stratification. Most survey aircraft burn eight or nine gallons per hour so using 10 gallons per hour as an average is safe. Plan on each survey aircraft flying eight hours per day even though it will probably be less. Stratification aircraft are typically a Cessna 185 or 206 and they typically burn about 14 gallons per hour, but a conservative estimate would be 15 gallons per hour. Three 8 hour days of stratification typically will cover a 4,000 mi^2 (10,360 km^2) sized area. Using these criteria will create a small surplus of fuel, which is better than running out, and the extra fuel is always useable for unforeseen contingencies or other work. Once the fuel is gone, the survey is over if more cannot be delivered. When the survey is based at Dahl Creek or any other remote fueling site (Bettles in GAAR; See Table 1), this detail is particularly important as fuel becomes extremely expensive (two to three times as much per gallon) to be flown in on an airstrip where ski-equipped aircraft are required. As an example, using the above criteria and assuming four survey aircraft for five days and one stratification plane for three days, total fuel needs add up to 1960 gallons of fuel.

Table 1 – Remote refueling locations used for moose surveys in ARCN.

Tank Location	Owner	Tank Size (gal)	Survey Areas
Bettles	GAAR[1]/Kanuti NWR[2]	4000	GAAR
Coldfoot	AST[3]	500	GAAR
Dahl Creek	GAAR	1500	Upper Kobuk
Kotzebue	WEAR[4]	4000	Lower Kobuk, Lower Noatak, Upper Noatak, 23SW, 22E
Selawik	Selawik NWR[5]	300	Selawik and Tag

[1]GAAR – Gates of the Arctic National Park and Preserve
[2]Kanuti NWR – Kanuti National Wildlife Refuge
[3]AST – Alaska State Troopers
[4]WEAR – Western Artic National Parklands
[5]Selawik NWR – Selawik National Wildlife Refuge

5. Contact prospective pilots as soon as possible and try to give them some estimate of survey dates, even though the schedule will likely change due to weather and snow conditions or scheduling of other agency surveys. At the same time, be sure to line-up observers for each aircraft and have one or two alternates in case someone cannot make it or you pick up additional aircraft at the last minute. Many moose surveys are conducted every year across the state, and often many biologists are trying to do them at the same time. If aircraft are not lined up ahead of time it is likely that none will be available when the survey should be completed, or the most experienced pilots will be unavailable. Using experienced pilots cannot be overemphasized, not just for safety reasons but for data quality and overall success of the survey. Less-experienced pilots can be used, particularly to train new pilots so more are available in the future, but the majority of pilots on a survey should have considerable past experience. The most experienced biologist/observers should be matched up with the least experienced pilots and vice versa. Moose surveys can be dangerous because of long hours of low, slow flying, and indeed aerial wildlife survey work in general is considered one of the more dangerous occupations, particularly in Alaska (Sasse 2003). As a result, safety should be thoroughly addressed, and cannot be overemphasized. One of the best and most effective safety measures a biologist can make is to use the most experienced pilots available, regardless of cost or agency affiliation. When it comes to aircraft safety in wildlife survey work, there is no replacement for experience with that type of flying. Experience with routine, point to point flying doesn't replace experience with aerial survey work.

6. Surveys should be scheduled for the time of year when most moose surveys were conducted in that area in the past. If unusually late (late April, early May) snowfall occurs in the survey area, it is tempting to fly the survey then, but this may confound making comparisons to past surveys, because of moose migration patterns. It is better to wait and conduct the survey when most past surveys were completed.

   Schedule the survey for a time when the area will most likely have good snow cover. If adequate snow cover is lacking (see discussion of adequate snow cover below), the survey will need to be postponed until enough snow falls or a decision will need to be made weather to wait until the following spring.

7. All required safety equipment (helmets, cold weather gear, park radios and satellite phones) should be assembled well in advance. A Project Aviation Safety Plan (PASP) needs to be written and approved by the park superintendent. Daily "Go/No Go" determinations are made for each flight immediately before flight commences, and flight plan and flight following procedures will need to be met for each aircraft. These requirements are often fulfilled by using ARCC center for flight following

8. Pilots and observers using federal government aircrafts or contracts must receive appropriate aviation training. At minimum, observers must be qualified and current "Aircrew members" within the interagency aviation training (IAT) program (www.iat.gov). Coursework for "Aircrew member" includes: A-100, A-116, and A-200.

Organizing Supplies and Equipment

Procedures

1. Paper and electronic maps of the survey area should be prepared using a GIS such as ArcGIS. The grid of sample units (explained in SOP#3) is overlaid on 1:250,000 scale topographic maps. A good template to follow is to have the grid and unit numbers on the front/map side of the map and the grid, unit number and coordinates of the southeast corner on the back (without a map as a background) this makes the map less cluttered and more readable. Laminating the maps makes them far more durable while in use in the aircraft. An alternative is to produce maps of the entire survey area with a plotter, placing the unit numbers and coordinates in the southeast corner of each unit. Such maps can then be folded and marked as needed by individual observers and pilots. If the area has been stratified, the sample units can be color coded as to which stratum they are in and then further colored or shaded to reflect those units that have been randomly selected to be surveyed.

2. Survey forms (see Appendix A) should be printed out double-sided and photocopied. Numerous copies of the survey data form should be made, with 250 copies probably being adequate for most surveys. Other potential data forms that can prove useful at times are found in Gasaway et al. (1986).

3. A simple spreadsheet should be developed to track daily costs of aircraft rental. This becomes particularly useful near the end of the survey. Do not forget fuel costs, ferry time and per diem for the pilots. Buying group food can save a lot in pilot per diem costs.

4. A list of all sample units in numeric order should be made and enough copies made so each aircraft will have a copy as well as a few extras.

5. Input data files for the GSPE should be set up and tested with example files or previous survey files for testing the input data file.

Snow Conditions

Snow conditions have a major influence on moose sightability (Oehlers et al. 2012). The PIs of the survey should ensure that satisfactory snow conditions exist throughout the survey area. Gasaway et al. (1986, pages 19-23) has a thorough description of snow conditions that will only be summarized here. Gasaway et al. (1986) breaks the evaluation of snow conditions into two parts, snow age and snow cover. The best snow conditions are a complete snow cover of 6 – 12 inches with at least 3 inches that is less than a week old with little or no wind scouring. However, surveys can be completed with less than perfect snow conditions, the minimum being defined as complete snow cover that is two or more weeks old, or snow of moderate age (between one and two weeks old) with some low vegetation showing, or fresh snow (at least 3 inches less than a week old) with some low vegetation showing. These are just subjective guidelines and the decision to conduct the survey will fall to the PIs and their evaluation of the snow conditions in the survey area. This may require a reconnaissance flight if no other way to determine snow cover exists. Air taxi operators and local residents are possible sources for information regarding snow conditions. Also, data from ARCN's climate stations or MODIS images will be available to help assess snow conditions in the survey area.

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