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) # 3 Survey Methods and Flight Patterns



ON THE COVER
Looking down the wing during a moose survey in Yukon Charley Rivers National Preserve in November.

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Overview

This Standard Operating Procedure explains how to conduct the sampling of the moose survey units. It explains the following: (1) how to divide the survey area into sub areas; (2) various flight patterns used to survey the units; (3) placing observed moose into age categories; and (4) how to manage the data from each day's flight. Most of these instructions are taken directly from Gasaway et al. (1986), Ver Hoef (2000), and Kellie and Delong (2006).

How to divide the survey area into flight areas

The survey area should be divided into reasonable geographic regions and each aircraft assigned to one or more regions. From a safety standpoint, this ensures separation of aircraft to avoid midair collisions. An aircraft radio frequency should be agreed on and aircraft should talk to each other frequently as a flight following safety measure as well. From a survey management perspective, separate regions help to efficiently manage the aircraft and allocate survey units to each survey team. Each aircraft should go out each day with maps of the entire survey area and knowledge of which units have been surveyed on previous days in their region and nearby regions. In this way, if unforeseen weather conditions prevent flying in the area where units are assigned, each aircraft can make decisions on their own as to which alternate units they should fly, independent of the survey PI. If the aircraft must move into a different region they must first make contact with the aircraft assigned to that region to learn which units have already been surveyed that day and to allocate the remaining units for the day. This method also allows aircraft to survey additional units (as time and fuel allow) at the end of the day when returning to base. This helps to optimize the efficiency of each survey aircraft.

Survey search effort and flight patterns

Search effort is reported in minutes of search time per square mile. Ver Hoef (2000) recommends an average search effort of about 8 minutes/mi^2, which equates to 30-50 minutes to complete an average sample unit in ARCN parks (~5mi^2). These times should be used only as a general guide. Units with heavy spruce cover will require more search effort and units in open country can be completed in less time. The time spent circling each moose group and classifying the moose in it is included in the search time. The GSPE method assumes 100% sightability, and therefore, the goal is to see every moose in the unit (Ver Hoef's 2000). The observer is responsible for maintaining survey methodology while in the air and suggesting corrections when necessary. When a unit is completed, it is not uncommon to go back to some areas of thicker vegetation to ensure no moose were missed. Studies have shown that even at 12 to 14 minutes/mi^2 some moose are still missed (Gasaway et al. 1986, Boertje and Kellie 2007), so Ver Hoef's (2000) assumption of 100% sightability is violated at times. Survey-specific sightability correction factors (SCF) estimation using both radio collars (Boertje and Kellie 2007, Boertje et al. 2009, Keech 2012) and intensive search areas (Kellie and DeLong 2006: Appendix A) have been described and implemented in a few surveys.

Flight patterns are dictated by the terrain and vegetative cover. In flat terrain with fairly open vegetation, parallel transects about 0.2 mile can be flown at 60-70 mph and 200 to 300 feet above ground level (see Figure 1 and diagrams in Kellie and Delong (2006) pages 34 - 35). Height should be greatest when flying over tall timber. In steeper terrain, the flight pattern will have to switch to flying elevational contours, circles, and flights along ridges and creeks. If particularly thick stands of spruce are encountered, it can help to fly linked circles across the stand. This allows looking more straight down into the spruce stand. Circling is also effective at the heads of valleys or over the ends of ridges. When flying the survey unit, it is not necessary to be overly concerned with the exact boundary of the survey unit except when a moose is found close to the boundary. At that time, the GPS should be used to determine whether the moose is in or out of the unit. It is important to fly one or more circles around each moose group seen to classify it and make sure no other moose are nearby. Additional moose are often found nearby when circling what was thought to be a single moose.

The pilot's main responsibilities are to fly safely, to monitor where the plane is relative to the sample unit boundary, and then to spot moose. It is the observer's responsibility to look for moose, record the data, and keep track of which units have been completed and which need to be surveyed. The pilots are frequently skilled observers and often spot the majority of the moose first.

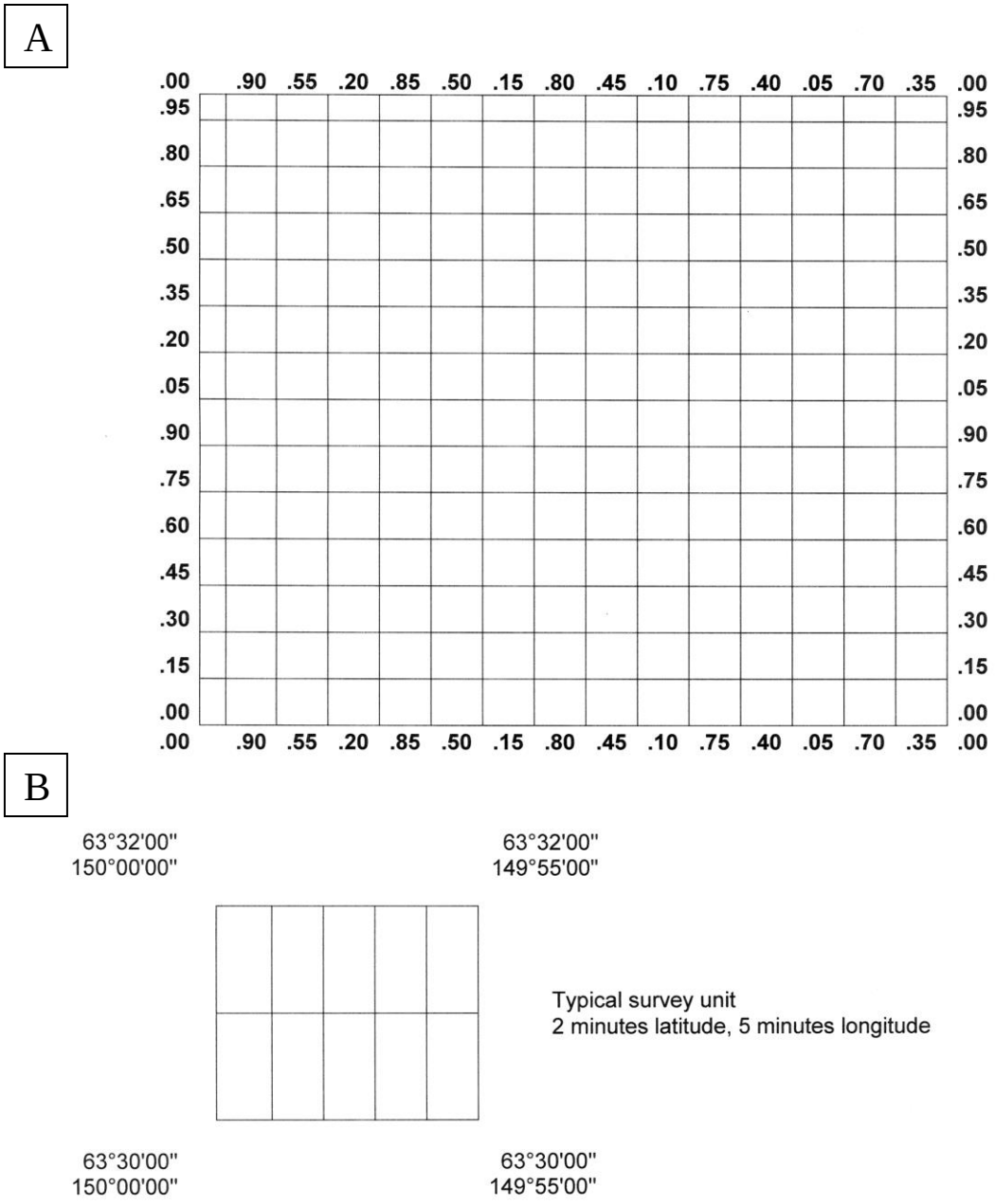


Figure 1. A. Sample grid pattern for searching rectangular moose survey units (pattern of flight for flat terrain only; direction of flight is either north-south or east-west, not both). The grid pattern adds or subtracts .35 minutes of longitude or .15 minutes of latitude to determine the spacing between transects. B. The resulting transects are about 0.2 miles apart. See also Kellie and Delong (2006).

Data on Moose Groups: Classification and Location

Classifying moose into age classes is fairly straightforward. Calves are identified by their smaller size and shorter heads and faces. Lone calves are rare but may be seen. During spring abundance surveys moose are classified as either adult or calves.

The GPS coordinates of each moose group is recorded from the aircraft's GPS, which should be set to display in the WGS84 Alaska datum. All coordinates should be in the degrees + decimal minutes format. A backup plan is to save waypoints in the observer's GPS and record waypoint numbers. A program such as DNRGPS (http://www.dnr.state.mn.us/mis/gis/DNRGPS/DNRGPS.html) can be used to upload the latitude and longitude data from the GPS units to a project computer to reduce potential for transcribing errors. Some Garmin GPS units will *display* in NAD27, but *download* in WGS84.

How to manage the data from each day's flying

After each day's flying, the data sheets should be gathered from each aircraft and data entered into an Excel spreadsheet (Appendix A; an example of this Excel file, ExampleDataFileGeoSpatialAnalysis.xls, can be found in the 'Supplemental Materials' folder on the ARCN server: O:\Monitoring\Vital Signs\Moose\ARCN Moose Surveys\Data). This data should then be moved to an Excel file in the format described in Appendix A and run through GSPE software to get a preliminary daily population estimate and confidence interval. Follow the directions described in detail in Delong (2006). Backup the files each night.

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Appendix A. Supplemental Material

Example data file for GSPE

UnitID	Unit	Strat	Selected	Counted	Calf	Adult	Total	Subunit
6700-15025	1113	H	1	1	0	1	1	1
6700-15030	1112	H	0	0	0	0	0	1
6700-15035	1111	H	0	0	0	0	0	0
6700-15040	1110	H	0	0	0	0	0	1
6700-15045	1109	H	1	1	0	1	1	1
6700-15055	1107	H	0	0	0	0	0	1
6700-15100	1106	H	0	0	0	0	0	0
6700-15105	1105	L	1	1	0	3	3	1
6700-15110	1104	H	0	0	0	0	0	1
6702-15030	1072	H	0	0	0	0	0	1
6702-15035	1071	L	0	0	0	0	0	1
6702-15040	1070	H	0	0	0	0	0	0
6702-15045	1069	H	1	1	0	0	0	1
6702-15050	1068	L	0	0	0	0	0	1
6702-15055	1067	H	0	0	0	0	0	1
6702-15100	1066	L	0	0	0	0	0	1
6702-15110	1064	L	1	1	0	1	1	1
6704-15025	1033	H	0	0	0	0	0	1
6704-15030	1032	H	0	0	0	0	0	1
6704-15035	1031	H	0	0	0	0	0	1
6704-15040	1030	H	1	1	0	1	1	1

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