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) # 5 Data Analysis and Reporting



ON THE COVER
Solitary moose in Selawik National Wildlife Refgue in March.
NPS photograph by Kyle Joly.

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Overview

This Standard Operating Procedure explains the procedures for estimating moose population size and procedures for reporting moose monitoring data. The steps for changing the protocol are outlined in SOP #6, "Revising the Protocol."

Estimating Moose Population Parameters from Moose Survey Data

Procedures:

1. **Data sorting and validation**. Moose data collected from an aerial moose survey (as described in the Moose Monitoring Protocol and other SOPs) are comprised of individual moose or groups within surveyed sample units. Moose population parameters are estimated via a spatial analysis involving finite population block kriging (for a complete description of the statistical analysis, reference Ver Hoef 2001and 2002). This statistical analysis method has been packaged in a software tool called the GSPE by Jay Ver Hoef and Rob Delong (ADFG, Fairbanks Alaska) and can be found at ADFG's web site, WinfoNet :http://winfonet.alaska.gov (Delong 2006). This software package requires the input data to be in a specific Microsoft Excel format. An example file, (ARCN_Moose_ExampleDataFileGeoSpatialAnalysis_12092004), can be found in the 'Supplemental Materials' folder at the ARCN drive.

   Before beginning to analyze moose population data, the database of moose locations should be reviewed to ensure that proper formatting has been adhered to and that no errors have occurred (see SOP#5 Data Management for more on error checking data). One effective method to error check is to display all moose locations on a map overlaid by the survey grid and determine if each moose group was within the survey unit.

2. **Using GSPE software to analyze the data.** Access to the GSPE software is through the Alaska Department of Fish and Game (ADFG) web site mentioned above. In order to access the site, biologists need to create an account with a username and password. This free service is administered through ADFG (Contact Rob Delong, Fairbanks). Once access has been granted users can upload their own files onto the website. Uploaded files will show up in a drop-down menu of other moose survey files for selection. The appropriate file is chosen from the list, appropriate parameters for the survey are selected and the information is submitted by a mouse click. An output screen appears with all of the data parameters and a simple map of the survey area (Figure 1); for complete instructions, refer to the "GeoSpatial population estimator software user's guide" (Delong 2006). These data can be copied and pasted to an MSWord file in order to save it, and can then be analyzed.

Moose Population Estimate--Geo Technique

Survey: GAARALL
Year: 2015
Season: Spring

REQUEST PARAMETERS	
Analysis Column:	[TotalMoose]
Analysis Area:	GAAR
Strata Column:	StratName
Counted Column:	Counted
Unit Area Column:	AreaMi

Right click to download data used to calculate estimate.

Right click to download RCode used to calculate estimate.

RESULTS

Estimate	
Population Estimate:	833.3722
Standard Error:	75.02617

Confidence Intervals		
Confidence	Interval (moose)	Interval (proportion of the mean)
80%	737.2223 929.5221	0.1153745
90%	709.9651 956.7793	0.1480816
95%	686.3236 980.4208	0.1764501

SAMPLE DETAILS

Total Samples	Stratum N 1 High 472 2 Low 723 3 TOTAL 1195	Total Area	Stratum Area 1 High 2418.729 2 Low 3699.040 3 TOTAL 6117.769
Sample Sizes	Stratum n 1 High 129 2 Low 104 3 TOTAL 233	Area Sampled	Stratum Area 1 High 660.921 2 Low 532.093 3 TOTAL 1193.014
Moose Counted	Stratum Counted 1 High 164 2 Low 43 3 TOTAL 207		

Figure 1. Example of output data from GSPE software (from the total population estimate from GAAR March 2015 survey).

ESTIMATE DETAILS		
Stratum	High	Low
Empirical Semi-Variogram	distance gamma np 1 4.383414 0.07550268 106 2 9.714103 0.09576217 270 3 15.970572 0.09385277 480 4 22.071699 0.11061871 618 5 28.063978 0.10009759 696 6 34.390415 0.11747181 770 7 40.723120 0.10675425 810 8 47.038582 0.13728482 890	distance gamma np 1 4.411328 0.02946901 54 2 9.740294 0.02371413 210 3 16.078745 0.03597693 328 4 22.026163 0.04497886 370 5 28.294085 0.03164047 452 6 34.542627 0.03965659 472 7 40.694566 0.04085558 512 8 46.981190 0.03843356 590
Parameter Estimates	nugget parsil range 1 0.07148059 0.06423153 16.12425	nugget parsil range 1 0.02315328 0.01366569 8.734891

MAPS

Figure 1 [continued]**.** Example of output data from GSPE software (from the total population estimate from GAAR March 2015 survey).

Sampling and Stratification

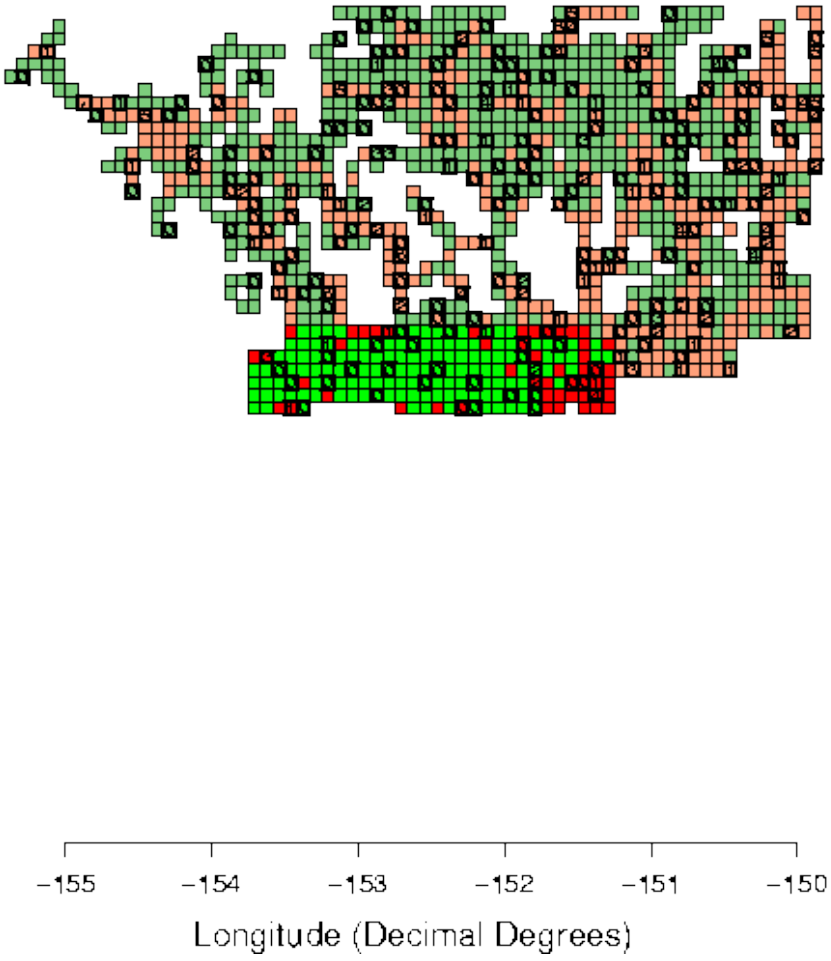


Figure 1 [continued]**.** Example of output data from GSPE software (from the total population estimate from GAAR March 2015 survey). Boxes colored in shades of green or red represent low and high stratum, respectively. Surveyed units are outlined in bold black.

3. **Additional analyses not covered by GSPE software.** There are some analyses that should be performed and reported for each moose survey that are not covered by GSPE software. Moose density is not specifically calculated by GSPE software but can be obtained by simply dividing the population estimate by the survey area. Density is a measurement commonly reported from moose surveys. Search effort or search intensity is another commonly reported measurement that allows evaluation of the data quality. Search effort can be calculated by adding up the total minutes of search time from all of the units surveyed and dividing that by the total area of those units. Vegetative cover can vary tremendously among survey areas and survey units, and search time for individual units is highly dependent on vegetative cover. This must be factored in when evaluating search effort between different survey areas.

4. **Analysis of moose population changes over time.** A comparison of the 90% confidence intervals around the point estimate will be used to determine whether a statistically significant difference exists between any two survey estimates.

Reporting of Moose Monitoring Data

Procedures:

1. **General features of monitoring reports.** Reports generated by the moose monitoring effort, and the vital signs monitoring program in general, will be designed to be promptly produced, appropriate to their target audience, widely available, and visually accessible. Concise summaries will be a part of each report produced. Reports will conform to guidelines set by the ARCN and the Alaska Region Inventory and Monitoring Plan. Graphical methods, maps, and other visual aids will be used to make results readily understood.

2. **Annual administrative report and workplan.** This report is designed to be incorporated into the annual report to Congress on the nationwide Vital Signs Monitoring Program. It will be produced in the fall of each year. The report will account for the expenditure of funds and FTEs, and describe the objectives, tasks, accomplishments, and products of the monitoring effort during the previous fiscal year. The report is designed to improve communication within each park, the ARCN, the Alaska Region, and the National Monitoring Program. Its intended audience includes park superintendents, network staff, regional coordinators, and Service-wide program managers. The report will be written by the park biologists implementing the Moose Monitoring Protocol, and reviewed and approved by ARCN, and the Alaska Regional Office.

3. **Survey report.** A report will be prepared for publication each June following a spring abundance survey, reporting the moose population estimate results of that particular survey. Surveys will likely occur once every four or eight years for a given area. The annual report will provide a summary of all moose monitoring activities and data for the year, and describe the current condition of the moose population in the areas monitored. Any changes in monitoring protocols will be documented. The intended audience for the annual report includes park resource managers, network staff, and external scientists. The report will be

written by the park biologists implementing the Moose Monitoring Protocol, and peer-reviewed within the ARCN.

4. **Other reporting.** In addition to the two scheduled annual (in years of surveys) reports, results of the moose monitoring effort will be presented at symposia, conferences, and workshops. Moose monitoring data will be provided to park interpretive staff for written and oral presentation to visitors. Significant findings will be reported in scientific journals and popular publications.

References

DeLong, R. A. 2006. GeoSpatial population estimator software user's guide. Alaska Department of Fish and Game, Fairbanks, Alaska, USA. 72pp.

Ver Hoef, J. M. 2001. Predicting finite populations from spatially correlated data. 2000 Proceedings of the section on Statistics and the Environment of the American Statistical Association, pp. 93-98.

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