

SOP 7: Annual Report (KM_G: Annual report creation)

Version 1.0

Revision History Log:

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
	October 2013	S. Hoekman, W. Johnson, B. Moynahan, C. Sergeant	Initial version		1.0

Summary

The annual report disseminates up-to-date information from the SEAN murrelet monitoring program to NPS staff and resource managers, external scientists, and the general public. For each survey year, the report summarizes field efforts, present statistical analyses of survey data related to status, trend, and distribution for KIMU and MAMU populations in Glacier Bay. After July surveys and certification of data and data analyses, the Project Leader generates the annual report.

Report generation requires substantial prior statistical analyses, as described in SOPs 11 and 12. Inputs for analyses are the current survey year's transects (in KM_A: Target transects), observations and trackpoints (in KM_E: Cumulative observation database), and waypoints recording exceptional events (in KM-I: Waypoints). Analyses produce descriptive statistics summarizing survey effort and characteristics of the sample, estimates of component parameters used for population estimates (detection probability, group size, encounter rates), species-specific estimates of on-water density and abundance, and maps summarizing spatial distributions of populations. Outputs from the report generation process include data deliverables KM_J: Detection function and KM_K: Abundance estimates.

Format and Content

The annual report is formatted as a NPS Natural Resource Technical Report (see National Park Service 2010, available at <http://www.nature.nps.gov/publications/NRPM/>) and contains the following sections:

- I. **Introduction:** Overview of the purpose, objectives, prior results, and any substantive changes to the monitoring program (e.g., new personnel, equipment, or methods).
- II. **Methods:** Brief summary detailing the survey design, field methods, timing of field work, panels sampled, equipment and personnel employed, and analytic methods.
- III. **Results:** Summary statistics and parameter estimates for the current year's data, including information pertaining to sampling effort, field conditions, distribution of murrelet populations, and estimates of density and abundance, and spatial distribution of populations.

- IV. **Discussion:** Summary and interpretation of results relevant to management issues, technical aspects of the monitoring protocol, and public interest. Results should be placed in context of prior monitoring data and relevant scientific literature.
- V. **Recommendations (optional):** As needed, recommended refinements to the monitoring protocol or issues requiring further consideration (e.g., in six-year review).

As an example of an Annual Report, see Hoekman et al. (2013).

Statistical Analyses

The primary objective of statistical analyses is to use Distance Sampling (Buckland et al. 2001, 2004) to estimate on-water density and abundance of each murrelet species within the survey area. Initial steps involve estimating several component parameters (Table SOP 7.1) that combine to produce density and abundance estimates. Analyses are automated as much as is practical, but exploratory analyses and judgment are required to ensure meeting critical assumptions and appropriate application of statistical methods. Our sampling methods require separate estimation of group sizes, density, and abundance for analyses of population status (density and abundance) versus population trend. Because periodic reviews (see SOP 8) include sophisticated analyses of population trend, we recommend annual reports focus on population status.

Detection Function and Group Size

Distance sampling allows estimation of a detection function and detection probability for murrelet groups across the transect width. Exploratory analyses ensure critical statistical assumptions are met and apply appropriate truncation and binning strategies. Model selection procedures are then used to select an appropriate model for estimation of the detection function. Step-by-step procedures and pre-defined templates for conducting analyses in Program DISTANCE (Thomas et al. 2010) are detailed in SOP 11. Distance sampling assumes detection probability near the transect center line is 1, but an estimate from prior research (Hoekman et al. 2011) provides an adjustment for this parameter actually being slightly <1. Group size for each species class (Kittlitz's, marbled, and unidentified) is also estimated in Program DISTANCE. Based on statistical criteria, estimates of group size may be averages or be derived from regression analyses accounting for increased detection probability for larger groups.

Density and Abundance

Estimated detection probability and group size are then used in concert with estimated encounter rates (groups detected/km) to estimate on-water density and abundance for populations of each species. SOP 12 presents analytic methods developed to estimate species-specific encounter rates adjusted to account for unidentified murrelets and species-specific density and abundance. Computer code for the R Statistical Package (R Development Core Team 2011) expedites analyses (see Appendix D).

Content of Results Section

The Results section provides information for assessment of status, trend, and spatial distribution of murrelet populations in the Glacier Bay survey area and also provides technical information about

the operating characteristics of this monitoring protocol. Contents should be flexible to include exceptional information, but should include the following core components:

Summary and Descriptive Statistics

Recommended summary results provide a synopsis of the surveys, including the timing of surveys, personnel involved, general weather and visibility conditions during surveys, and any other exceptional events or patterns relevant to collection or analyses of data or interpretation of results. Recommended descriptive statistics characterizing the sampling effort include: the number and total length of transects sampled, any scheduled transects that were not sampled, partially sampled, altered, or significantly disturbed. Recommended descriptive statistics characterizing survey observations include: the number of groups encountered for each species class and corresponding percent composition by class, overall identification rates (percent of murrelets identified versus unidentified), and the average size of groups by species class. Other summary statistics related to distance estimation calibration assessment (see SOP 9) may also be included to document performance of Observers.

Detection Function and Group Size

Relevant details of exploratory analyses are reported, including the selected right-truncation distance, distance bins (if any), and the model (key function and series expansion and associated parameter estimates) selected to estimate the detection function. The estimated detection function is presented in a figure along with associated scaled frequencies for the raw observation data (Figure SOP 7.1). For each species class, estimates of group size and associated output (SE, *df*, *P*-values) derived from both average group size and regression-based methods should be presented in text or a table, along with specification of which estimates were selected for population analyses.

Density and Abundance

The component parameters and associated sampling error used to estimate on-water density and abundance are presented in a unified table (Table SOP 7.1), which should include estimated detection probability near the transect center line and across the transect width and also estimates of group size and encounter rate. Estimates of detection probability near the center line likely will be taken from prior research (e.g., Hoekman et al. 2011). For each species class, only estimates of group size selected for population analyses should be presented in the Table. Estimated encounter rates for each species class should be presented along with encounter rates for each species adjusted to account for unidentified murrelets. Estimates of species-specific density (birds/km²) and abundance (extrapolated across survey area) along with associated sampling error are presented in a table with estimates for each survey year (Table SOP 7.2). A figure of abundance ($\pm$ SE) for each survey year may also be useful to display variability in estimates.

Spatial Distribution of Populations

Maps showing the spatial distribution of observations of each species along survey transects are presented using symbols showing group sizes (Figure SOP 7.2). If densities of observations are too high, showing total individuals in an area rather than individual observations may be necessary. It may be useful to also display distributions from prior surveys or distributions depicting average prior densities, etc.

Content of the Discussion

The Discussion places the Results section in context of prior results for this and other regions, of relevant scientific literature, and of NPS policy. Abundance and spatial distributions of populations for each species are interpreted relative to prior local and global results. Although discussing effects of exceptional circumstances or hypotheses about causal factors for patterns in the Results are appropriate, the periodic review (SOP 8) will be the preferred outlet for analyses and conclusions concerning trends in populations and their spatial distributions. Addressing other salient topics, such as performance of survey methods or implications of Results for future surveys may also be useful.

Content of the Recommendations

Include as needed to provide recommendations relevant to future monitoring, such as: potential changes to monitoring methods, identification of key research needs, identification of management or policy issues requiring action or investigation, etc.

Validation and Submission

The final version of KM_G is generated as a PDF file and submitted to the Project Leader for standard validation and certification. Upon certification, the Data Manager will install the report in the repository and publish it on the NPS web site.

Literature Cited

- Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers, and L. Thomas. 2001. Introduction to Distance Sampling: Estimating Abundance of Biological Populations. Oxford, New York, New York, USA.
- Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers, and L. Thomas. 2004. Advanced Distance Sampling: Estimating Abundance of Biological Populations. Oxford, New York, New York, USA.
- Hoekman, S. T., B. J. Moynahan, M. S. Lindberg, L. C. Sharman, and W. F. Johnson. 2011. Line transect sampling for murrelets: Accounting for incomplete detection and identification. *Marine Ornithology* 39:35–44.
- Hoekman, S. T., B. J. Moynahan, and M. S. Lindberg. 2013. Monitoring Kittlitz's and marbled murrelets in Glacier Bay National Park: 2012 annual report. Natural Resource Technical Report NPS/SEAN/NRTR—2013/810. National Park Service, Fort Collins, Colorado, USA.
- National Park Service (NPS). 2010. Instructions to authors — Natural Resource Report, Natural Resource Technical Report, and Natural Resource Data Series: version 3.0. Natural Resource Report. NPS/NPRC/IMD/NRR—2010/256. National Park Service, Fort Collins, Colorado, USA.
- Thomas, L., S. T. Buckland, E. A. Rexstad, J. L. Laake, S. Strindberg, S. L. Hedley, J. R. B. Bishop, T. A. Marques, and K. P. Burnham. 2010. Distance software: Design and analysis of distance sampling surveys for estimating population size. *Journal of Applied Ecology* 47:5–14.

R Development Core Team. 2011. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. Retrieved September 20, 2012, from <http://www.R-project.org>.

SOP 7 Figures and Tables

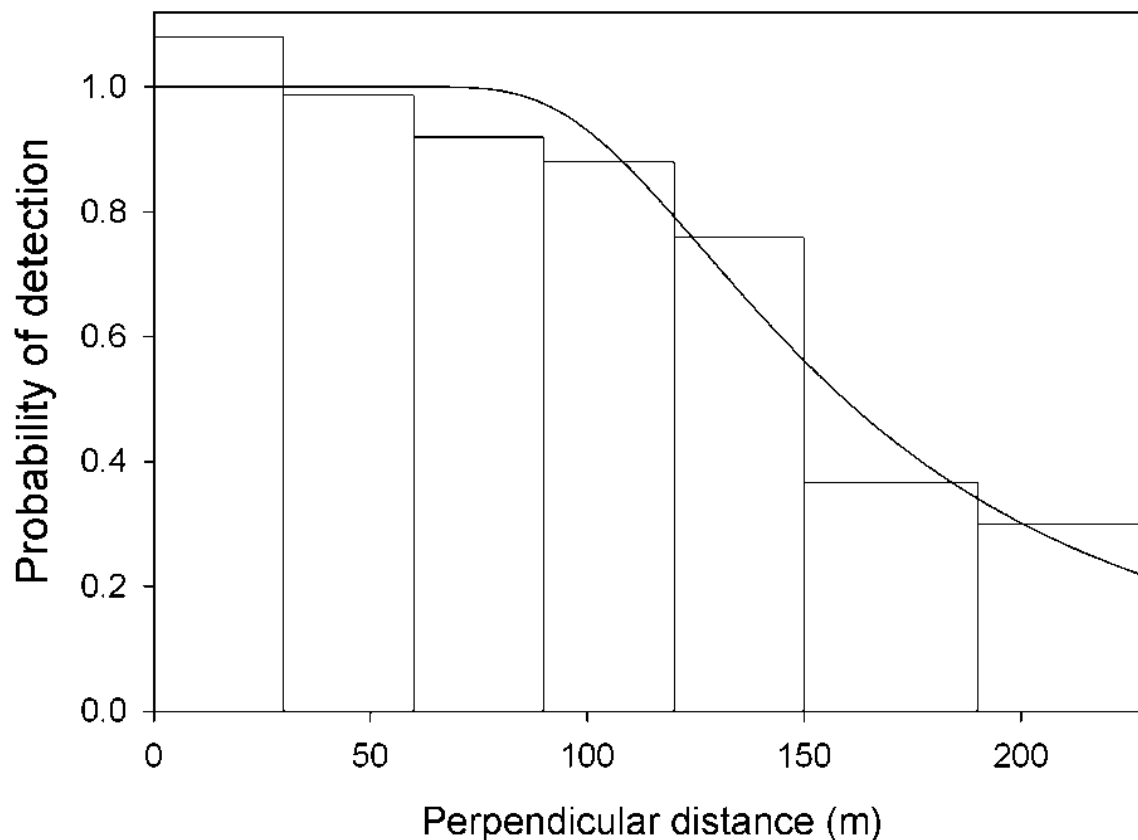


Figure SOP 7.1. Example of an estimated detection function (solid line) showing probability of detection of murrelet groups relative to perpendicular distance from the transect center line. Bars show the scaled frequencies of detections in each distance category for the raw data.

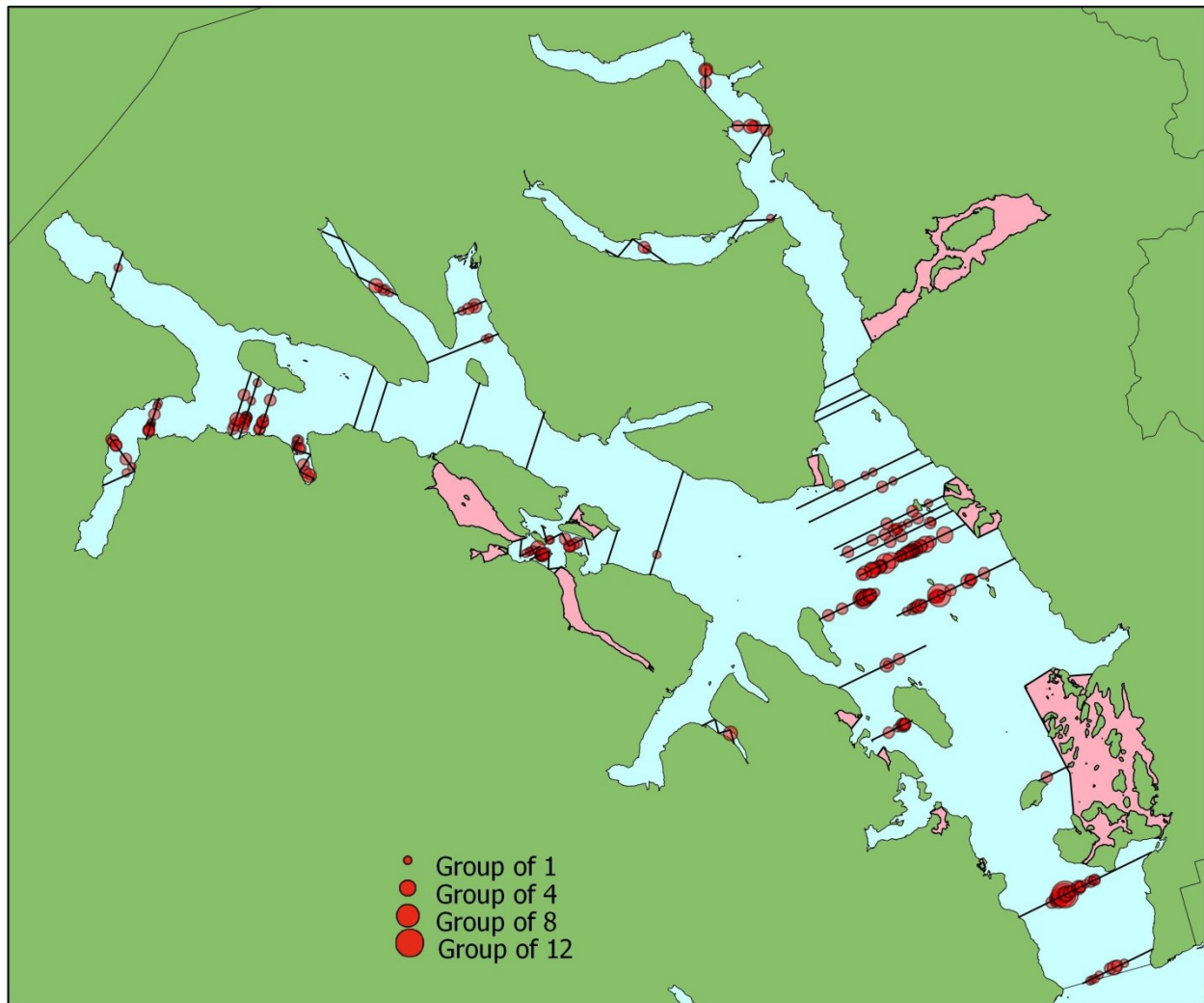


Figure SOP 7.2. Example of a map showing spatial distribution of murrelets along survey transects. Red circles show locations of groups, with the volume proportional to group size. Pale red areas were excluded from the survey area.

Table SOP 7.1. Example of table showing estimates for component parameters used to estimate on-water density and abundance for populations of Kittlitz's and marbled murrelets.

Parameter	Estimate	SE	Degrees of freedom
Detection across transect width	0.72	0.02	1,239
Detection near transect center line	0.94	0.03	66
Group size			
Kittlitz's murrelet	2.05	0.08	223
Marbled murrelet	2.50	0.07	723
Unidentified murrelet	3.45	0.26	292
Encounter rate ^a			
Kittlitz's murrelet	1.17	0.10	39
Marbled murrelet	4.71	0.41	39
Unidentified murrelet	1.66	0.14	39

^aGroups encountered per km.

Table SOP 7.2. Example table showing estimated on-water density and abundance of Kittlitz's and marbled murrelets in the Glacier Bay during July during each survey year. Abundance is projected across the survey area.

Year	Kittlitz's murrelet				Marbled murrelet			
	Density ^a	SE	Abundance ^b	SE	Density ^a	SE	Abundance ^b	SE
2011	6.4	1.0	7,477	1,119	63.1	6.0	73,766	7,055
2010	11.4	1.2	13,308	1,357	52.7	4.6	61,717	5,372

^aIndividuals/km².

^bAbundance extrapolated over the 1,170 km² survey area.