

SEAN sea otter monitoring SOP 16: Annual summary brief (deliverable SO_F)

Revision History Log:

Previous SOP version	Effective Date	Revised By	Changes Made	New SOP version
-	September 2018	Jamie Womble	Initial version	1.0

Summary

The annual summary brief disseminates up-to-date information from the SEAN sea otter monitoring program to NPS staff and resource managers, external scientists, and the general public. For each survey, the report summarizes field efforts, presenting statistical analyses of survey data related to status, abundance, and spatial distribution of sea otters in Glacier Bay. After survey completion and acceptance of data and data analyses, the Project Leader generates this report.

Abundance estimates are generated using the processes specified in SOPs 9 and 10. Inputs for analysis are count of sea otters from imagery (SO_D), count data used to estimate availability (DO_I), and a bathymetry LPK layer (SO_J) which provides boundary and covariate data.

The annual summary brief is published by the NPS NRSS publication section as part of the Natural Resource Data Series (NRDS). The final report must meet the requirements and standards currently defined for NRDS publication.

Format and Content

The annual summary brief is formatted as an NPS Natural Resource Report (see National Park Service 2010, available at <https://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.
- II. **Methods:** Brief summary detailing the survey design, field methods, timing of field work, transect sampled, and analytical methods.
- III. **Results:** Summary statistics and parameter estimates for the current year's data, including information pertaining to sampling effort, field conditions, spatial distribution of sea otters and estimates of abundance.
- IV. **Discussion:** Summary and interpretation of results relevant to management issues, technical aspects of the monitoring protocol, and public interest. Results will be placed in context of prior monitoring data and relevant scientific literature.

- V. **Recommendations (optional):** As needed, recommend refinements to the monitoring protocol or issues requiring further consideration.

Statistical Analyses

The primary objective of the statistical analysis is to use the analytical approach in SOP 9, SOP10, Williams et al. 2017a, and Williams et al. 2017b to estimate spatio-temporal occupancy and abundance of sea otters in Glacier Bay. Analyses are conducted in R version 3.3.3 (R Core Team 2013) and all code for conducting the analysis can be found in SOP 9 and SOP 10. Although the analysis is automated as much as practical, exploratory analyses and judgment are required to ensure appropriate application of statistical methods.

A spatio-temporal point process model, in combination with an N-mixture model framework, is used to simultaneously estimate detection probability, occupancy probability, and total abundance based on an intensity surface that is a realization of a continuous spatio-temporal inhomogenous Poisson process. An MCMC algorithm is used to fit the spatio-temporal occupancy abundance model (Williams et al. 2017a and 2017b). Several diagnostic plots will be provided in the annual report including plots of adaptive tuning values for parameters sampled using Metropolis-Hastings algorithm, trace plots of model parameters, density plot of MCMC values sampled from each parameters full-conditional posterior distribution, marginal posterior distribution of detection probability (Figures 16.1-16.4), and a table that includes posterior mean and 95% credible intervals for estimated parameters in sea otter occupancy-abundance model (Table 16.1).

After data are collected from each year, we can examine the gain in information obtained from each sampling type, and further optimize sampling for future years. Further, we can assess the amount of sampling effort that will be required in future years (potentially reducing the amount of survey days and effort) by comparing the precision of model parameters from a model fit to the full data set that was collected to a model fit to a restricted data set, where some transects are omitted, representing less sampling effort. Increased precision in model parameters helps to identify the effect size and significance level of each parameter in our model. Thus, by comparing the precision of model parameters from a model fit to the full data set that was collected to a model fit to a restricted data set, we are effectively conducting a power analysis among the differing survey types. Optimal dynamic surveys are aimed at identifying the survey design that most increases parameter precision. Thus, optimal dynamic survey designs are analogous to power analyses that are commonly used in phenomenological statistical models, but for the mechanistic statistical models, as will be used for sea otter monitoring in Glacier Bay.

Detailed Steps

1. Project leader tasks
 1. Prepare estimates using methods specified in SOP 9.
 2. Download the latest MS Word template for NRDS reports posted on <https://nature.nps.gov/publications/nrpm/templates.cfm>.
 3. NRDS content.

Introduction: Overview of the purpose, objectives, prior results, and any substantive changes to the monitoring program (e.g., new personnel, equipment, or methods).

Methods: Brief summary detailing the survey design, field methods, timing of field work, panels sampled, equipment and personnel employed, and analytic methods.

Results: Summary statistics and parameter estimates for the current year's data, including information pertaining to sampling effort, field conditions, distribution of otter populations, and estimates of density and abundance, and spatial distribution of populations.

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.

Recommendations (optional): As needed, recommended refinements to the monitoring protocol or issues requiring further consideration.

4. Arrange for copy editing.
5. Submit to peer review manager.
2. Peer review manager tasks (typically Program Manager for NRDS reports)
 1. Determine level of review required.
 2. Recruit reviewers.
 3. Distribute draft for review.
 4. Send review comments to Project Leader.
3. Project leader tasks
 1. Update report to satisfy review comments.
 2. Respond to reviews in writing for peer review manager's file.
 3. Arrange for final copy editing and formatting.
 4. Resubmit to peer review manager.
 5. Initiate manuscript submission online form and provide link to peer review manager and program manager (form can be found here:
<https://nrss.sharepoint.nps.gov/prg/nrpm/Pages/Form.aspx>).
4. Peer review manager tasks
 1. Accept final revisions and recommend report for publication.
 2. Complete applicable section of manuscript submission online form
 3. Submit package to IMD publication staff.
5. Program Manager tasks
 1. Approve report for publication by completing applicable section of manuscript submission form
6. IMD publication staff
 1. Finalize format.
 2. Obtain TIC number and citation.
 3. Draft Data Store reference.
 4. Return finalized document with formatting comments to project leader.
7. Project leader tasks

1. Effect any corrections required by IMD publications staff.
2. Forward to data manager for dissemination.
8. Data Manager
 1. Complete Data Store reference.
 2. Generate a PDF from the DOCX document.
 3. Upload PDF to Data Store repository.
 4. Activate reference.
 5. Install PDF and web links in development web site and test.
 6. Propagate to the integration and production environments, and retest.
 7. Update and distribute deliverable tracking sheet.
 8. Update deliverable submission database.

Literature Cited

- R Core Team (2013). R. A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. <http://www.R-project.org/>
- Williams, P. J., M. B. Hooten, J. N. Womble, G. G. Esslinger, M. L. Bower, and T. J. Hefley. 2017a. An integrated data model to estimate occupancy, abundance, and colonization dynamics. *Ecology* 98:328-336.
- Williams, P. J., M. B. Hooten, J. N. Womble, and M. R. Bower. 2017b. Estimating occupancy and abundance using aerial images with imperfect detection. *Methods in Ecology and Evolution* 8(12): DOI: 10.1111/2041-210X.12815.
- Williams, P. J., M. B. Hooten, J. N. Womble, G. G. Esslinger, and M. R. Bower. (In Press) Monitoring dynamic spatio-temporal processes optimally. *Ecology*.

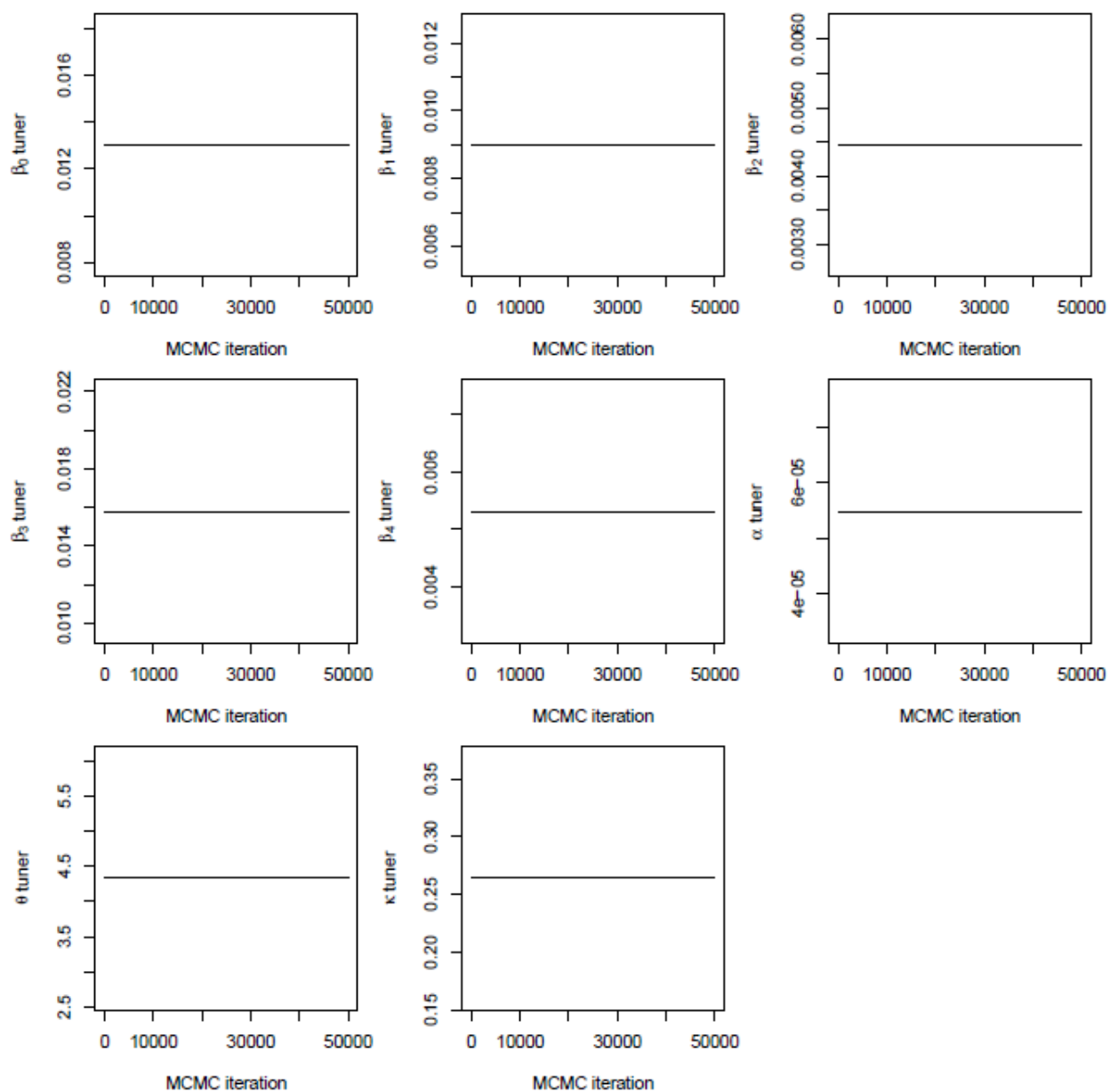


Figure SOP 16.1. Example of adaptive tuning values for parameters sampled using Metropolis-Hastings algorithm.

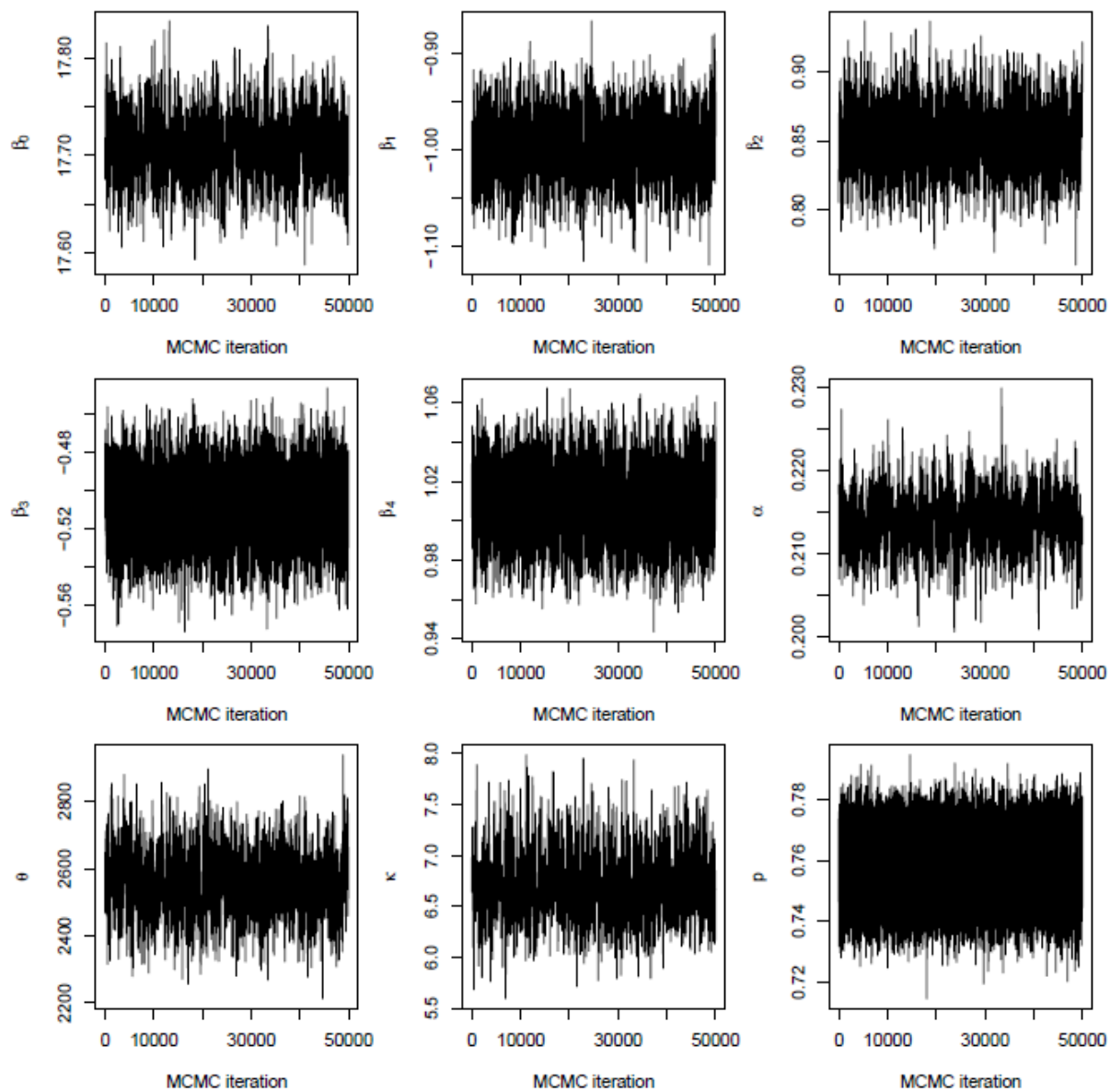


Figure 16.2. Examples of trace plots of model parameters.

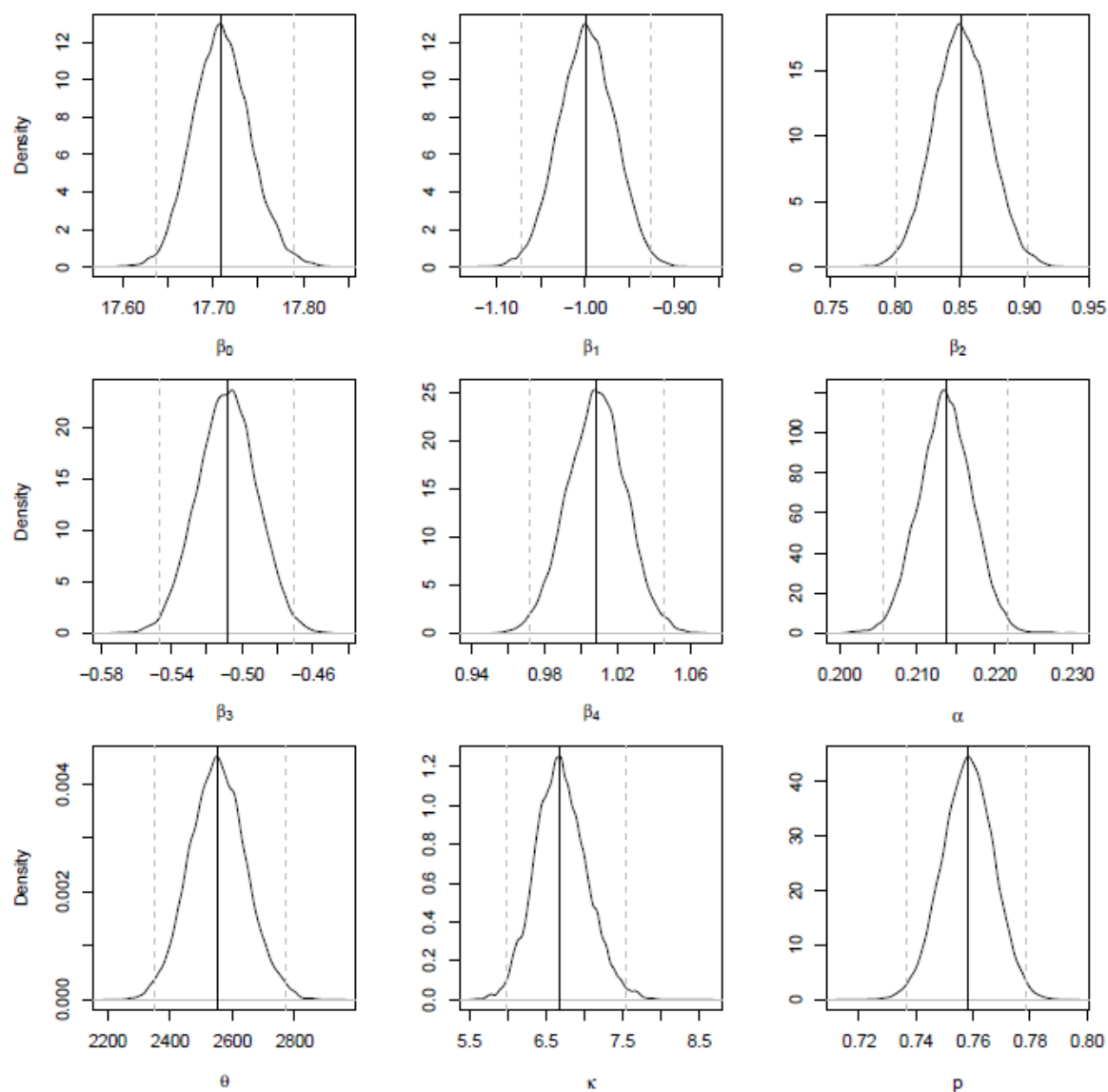


Figure 16.3. Example density plot of MCMC values sampled from each parameters full conditional posterior distribution. Solid gray line indicates posterior mean, dashed-grey line indicate the 99% credible intervals.

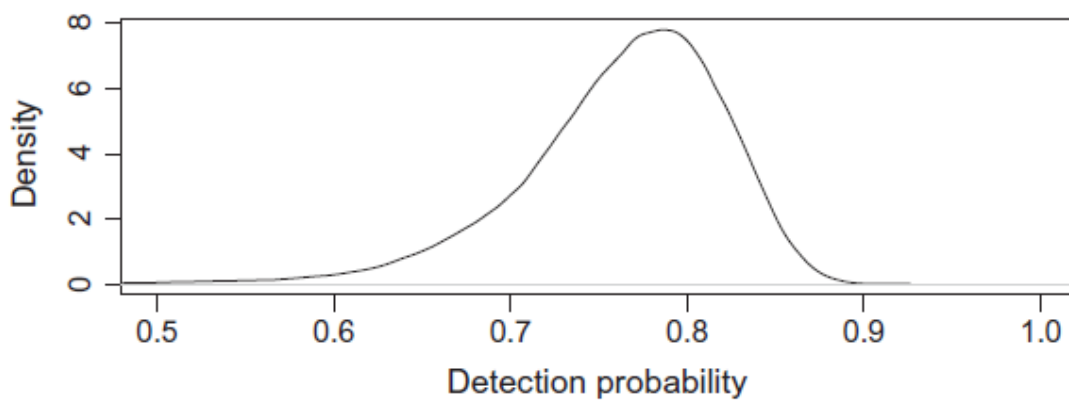


Figure 16.4. Example plot of marginal posterior distribution of detection probability.

Table 16.1 Example results table that includes posterior mean and 95% credible intervals for estimated parameters in sea otter occupancy-abundance model.

Table 1: Results table			
	Lower Bound	Mean	Upper Bound
$\sum_{i=1}^{q_s} n_{i,1993}$	641.00	715.69	793.00
$\sum_{i=1}^{q_s} n_{i,1994}$	672.00	739.35	809.00
$\sum_{i=1}^{q_s} n_{i,1995}$	661.00	724.00	790.00
$\sum_{i=1}^{q_s} n_{i,1996}$	697.00	761.33	828.00
$\sum_{i=1}^{q_s} n_{i,1997}$	766.00	832.41	900.00
$\sum_{i=1}^{q_s} n_{i,1998}$	861.00	930.16	1001.00
$\sum_{i=1}^{q_s} n_{i,1999}$	978.00	1051.20	1126.00
$\sum_{i=1}^{q_s} n_{i,2000}$	1117.00	1194.30	1274.00
$\sum_{i=1}^{q_s} n_{i,2001}$	1277.00	1360.31	1445.00
$\sum_{i=1}^{q_s} n_{i,2002}$	1462.00	1551.03	1641.00
$\sum_{i=1}^{q_s} n_{i,2003}$	1674.00	1768.80	1865.00
$\sum_{i=1}^{q_s} n_{i,2004}$	1914.00	2016.68	2120.00
$\sum_{i=1}^{q_s} n_{i,2005}$	2188.00	2298.66	2412.00
$\sum_{i=1}^{q_s} n_{i,2006}$	2497.00	2618.87	2744.00
$\sum_{i=1}^{q_s} n_{i,2007}$	2847.00	2983.52	3123.00
$\sum_{i=1}^{q_s} n_{i,2008}$	3243.00	3397.53	3554.00
$\sum_{i=1}^{q_s} n_{i,2009}$	3691.00	3868.98	4050.00
$\sum_{i=1}^{q_s} n_{i,2010}$	4198.00	4404.84	4615.00
$\sum_{i=1}^{q_s} n_{i,2011}$	4774.00	5014.88	5260.00
$\sum_{i=1}^{q_s} n_{i,2012}$	5420.00	5710.16	6006.00
β_0	17.65	17.71	17.78
β_1	-1.06	-1.00	-0.94
β_2	0.81	0.85	0.89
β_3	-0.54	-0.51	-0.48
β_4	0.98	1.01	1.04
α	0.21	0.21	0.22
θ	2374.51	2549.91	2733.73
κ	6.07	6.70	7.39
p	0.74	0.76	0.78

Appendix SOP-16.A: Abundance and distribution report – detailed deliverable definitions

Purpose of Deliverable

Inform park management of the estimated abundance, distribution, and possibly trends of the sea otter population in Glacier Bay proper to assist them in making resource management decisions.

Frequency Produced

SO_F is produced once for each full survey performed. Typically this is once per year.

Prerequisites

All the products necessary to generate population estimates required by the processes defined in SOP 9.

Data Flow

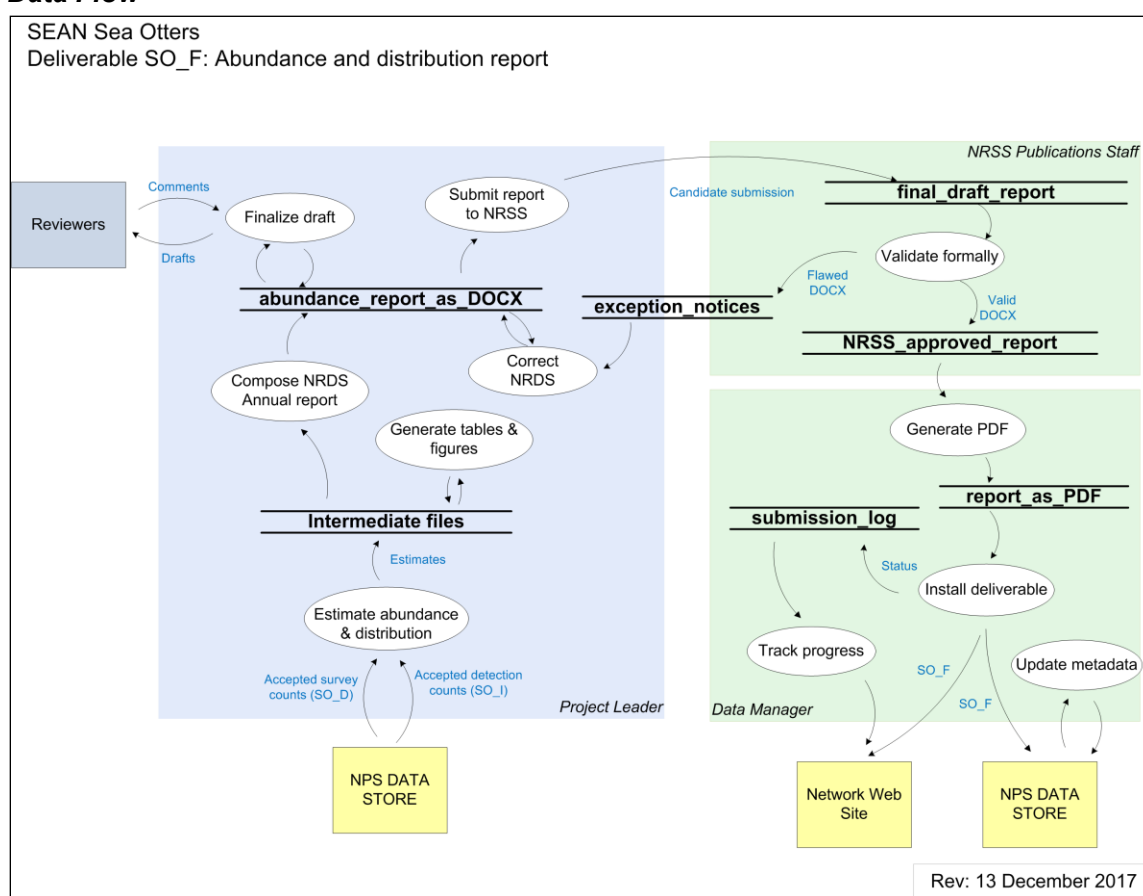


Figure SOP-16.A.1 Data flow required to generate deliverable SO_F Abundance and distribution report.

Deliverable Definition Forms

Form A: Non-tabular Information Deliverable

<i>Vital Sign:</i> SO Sea Otters	<i>Deliverable ID:</i> SO_F	<i>Deliverable Title:</i> Abundance and distribution report
<i>File Format:</i> PDF	<i>Associated Software and Version:</i> Adobe reader DC version 12 or greater	<i>Revision Date:</i> 10-06-2017
<i>Expected Frequency:</i> Once per survey mission	<i>Submission Unit:</i> Survey year	<i>ID of first protocol it applies to:</i> SO-2017.1
<i>What purpose does this deliverable serve?</i> Inform park management of the status of the sea otter population in Glacier Bay proper to assist them in making resource management decisions.		
<i>Summary of content:</i> Estimates of sea otter population and spatial density in sections of Glacier Bay, Alaska based on the current survey. Report of current survey operations summarizing both routine and exceptional circumstances. This follows the form of an NPS Natural Resource Data Series (NRDS) report and, as such, does not directly express management recommendations. This is stored using Data Store reference type Published Report.		
<i>Mandatory validation criteria:</i> 1. This must successfully pass the requirements set forth in the process for NRDS publications as defined at the time the document is submitted to the NRSS publications staff. 2. The final PDF file must be fully readable using Adobe Reader DC.		
<i>Optional validation criteria:</i> None		
<i>Deliverable ID of any other SEAN data products required to create this product</i> SO_D		
<i>Description and source of any outside data required to create this product:</i> Formal publication citation and TIC number from NRSS/IMD publication section.		