

SEAN sea otter monitoring SOP 17: Periodic abundance report (deliverable SO_G)

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 periodic abundance report disseminates information from the SEAN sea otter monitoring program to NPS management, other resource managers, and the scientific community. The periodic report will be created at approximately seven year intervals (or as needed) and provide a more in-depth analysis of survey data than the annual brief (SOP 16). Primary objectives of the periodic report are to (1) estimate abundance of sea otter of multiple years, (2) ensure that key assumptions of monitoring methods are valid, (3) review the most current data and summarize implications for monitoring protocol, and (4) recommend any changes to the monitoring protocol. Periodic reviews may require advanced statistical expertise and may require the need to engage additional personnel with advanced statistical expertise, who will develop review objectives and methods in coordination with the Project Leader.

The periodic abundance report is published by the NPS NRSS publication section under the Natural Resource Report (NRR) series. The final report must meet the requirements and standards currently defined for NRR publications.

Format and Content

The periodic abundance report 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 periodic report will use the same analytical framework that has been developed for the abundance and distribution report (SO_F) (SOP 16) which includes using a spatio-temporal point process model, in combination with an N-mixture model framework, 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 periodic 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 17.1-17.4), and a table that includes posterior mean and 95% credible intervals for estimated parameters in sea otter occupancy-abundance model (Table 17.1).

The periodic abundance report will encompass multiple years and will include the following:

- I. **Summary and Descriptions:** Overview of survey data and data collection (e.g., sample sizes, sampling dates, notable events for each survey year, etc.) and relevant summary statistics.
- II. **Estimates of Abundance over Time:** For each survey year, a table of posterior mean and 95% credible intervals for estimated parameters in sea otter occupancy-abundance model (Table 17.1).
- IV. **Spatial Distribution over time:** Results presented should be appropriate to analyses conducted, but at a minimum should include visual and/or statistical summaries of spatial distribution of sea otters over time period of interest.

In addition to estimating abundance and spatial distribution over a longer time period for the periodic abundance and trend report, the dynamic survey design allows investigators to explicitly incorporate models of spatio-temporal processes that characterize the colonization dynamics of a spreading population (Williams et al. *In Press*). Dynamic sampling is concerned with selecting monitoring locations that optimally improve inference about a process of interest (e.g., abundance and distribution). Dynamic sampling designs incorporate data collected during previous surveys to inform optimal sampling locations for future surveys. Optimal dynamic sampling increases sampling efficiency by surveying the areas that will aid in inference the most. Optimal dynamic sampling designs are considerably more efficient than static sampling designs, allowing managers to obtain a greater understanding of the system with fewer resources (Wikle and Royle 1999, Hooten et al. 2012). Thus after data collection over a given time period, we will 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. Program manager tasks
 1. Determine when it is appropriate to create a trend report.
 2. Engage a subject matter expert to author the synthesis
2. Project leader tasks
 1. Download the latest MS Word template for NRR reports posted on <https://nature.nps.gov/publications/nrpm/templates.cfm>.
 2. Provide the subject matter expert with the complete set of formally accepted SO_D count data and any supporting information requested.
 3. Provide authors with explanations regarding the field surveys, quality control actions, and other details of the monitoring program.
 4. Assist in drafting the NRR.
 5. Arrange for copy editing.
 6. Submit to Program Manager for peer review management.
3. Peer review manager
 1. Determine level of review required.
 2. Recruit reviewers.
 3. Distribute draft for review.
 4. Send review comments to Project Leader.
4. Project leader tasks
 1. Work with authors to revise drafts in light of 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 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>)
5. Peer review manager tasks

1. Accept final revisions and recommend report for publication by completing applicable section of manuscript submission online form
6. Program Manager tasks
 1. Approve report for publication by completing applicable section of manuscript submission online form
7. 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.
8. Project leader tasks
 1. Effect any corrections required by IMD publications staff.
 2. Forward to data manager for dissemination.
9. Data Manager
 1. Complete Data Store reference.
 2. Generate a PDF from the DOCX document.
 3. Verify the final PDF meets all quality control criteria for the deliverable.
 4. Upload PDF to Data Store repository.
 5. Activate reference.
 6. Install PDF and web links in development web site and test.
 7. Propagate to the integration and production environments, and retest.
 8. Update and distribute deliverable tracking sheet.
 9. Update submission database.
10. Project leader tasks
 1. Notify interested parties of the availability of the final report.

Literature Cited

- Hooten, M. B., B. E. Ross, and C. K. Wikle. 2012. Optimal spatio-temporal monitoring designs for characterizing population trends. Gitzen, R.A., J.J. Millspaugh, A.B. Cooper, and D.S. Licht (eds). In: Design and Analysis of Long-Term Ecological Monitoring Studies. Cambridge University Press.
- R Core Team (2013). R. A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. <http://www.R-project.org/>
- Wikle, C. K. and J. A. Royle. 1999. Space: time dynamic design of environmental monitoring networks. *Journal of Agricultural, Biological, and Environmental Statistics* 4:489-507.
- 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*.

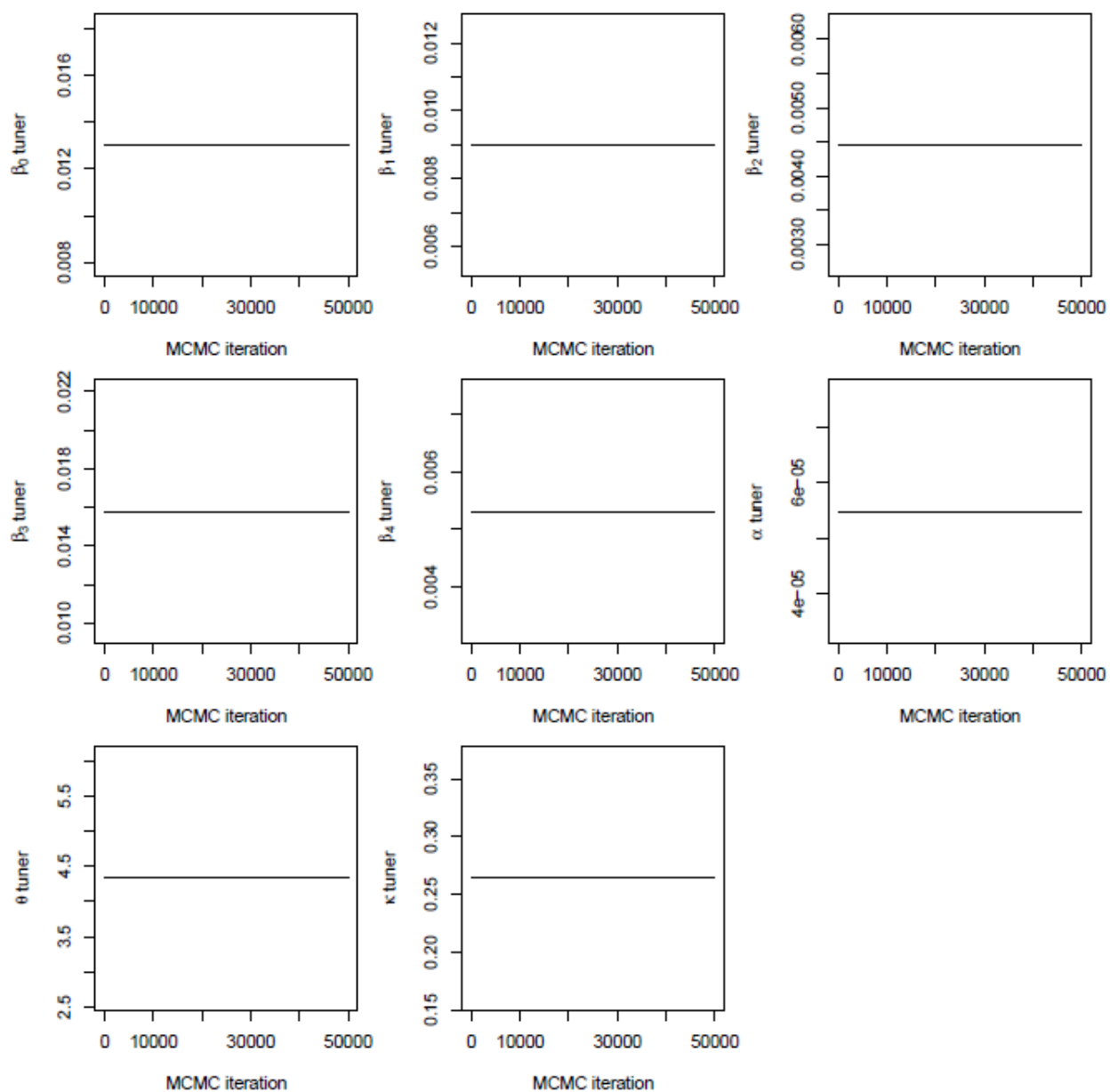


Figure SOP 17.1. Example of adaptive tuning values for parameters sampled using Metropolis-Hastings algorithm.

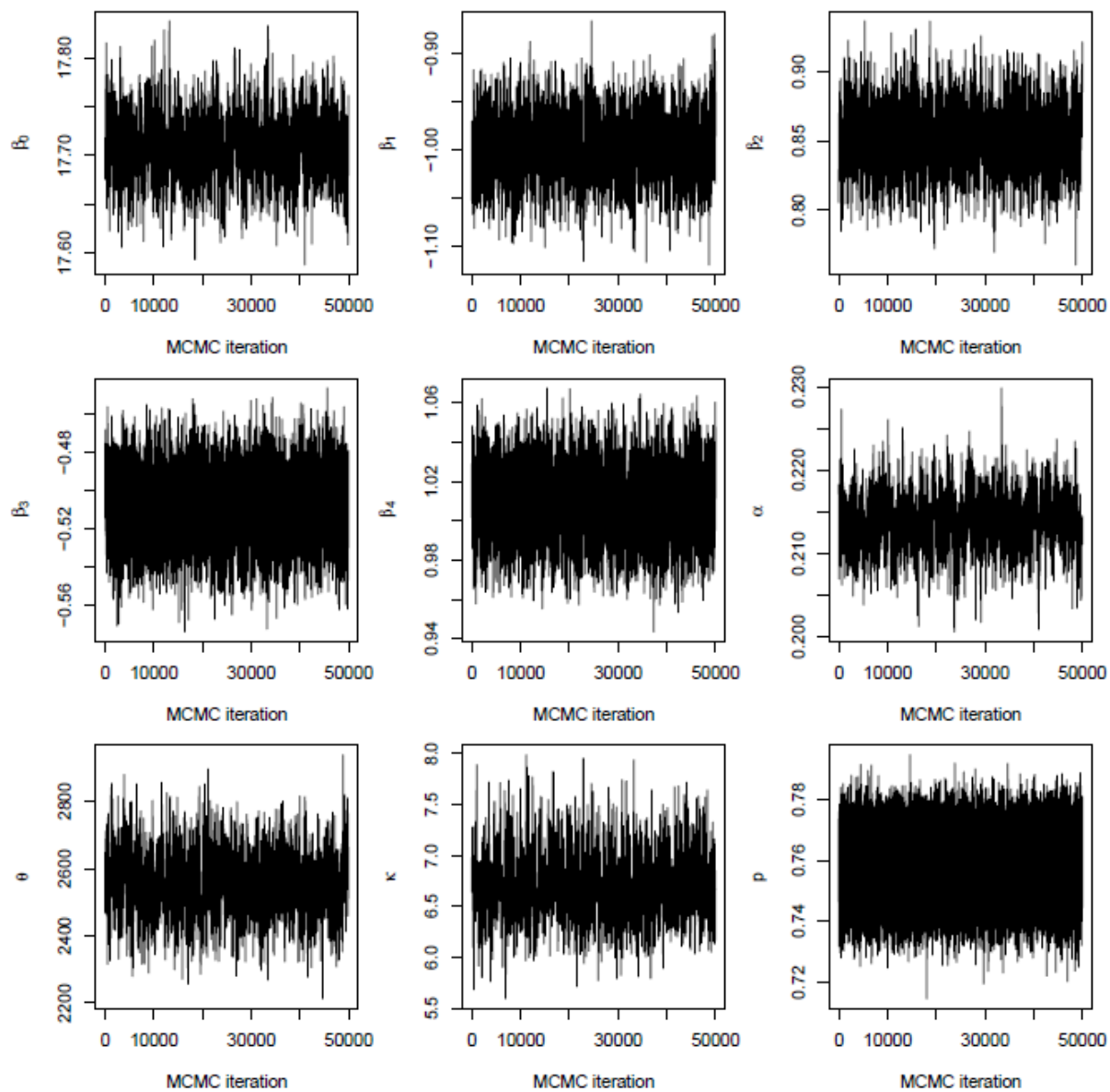


Figure 17.2. Examples of trace plots of model parameters.

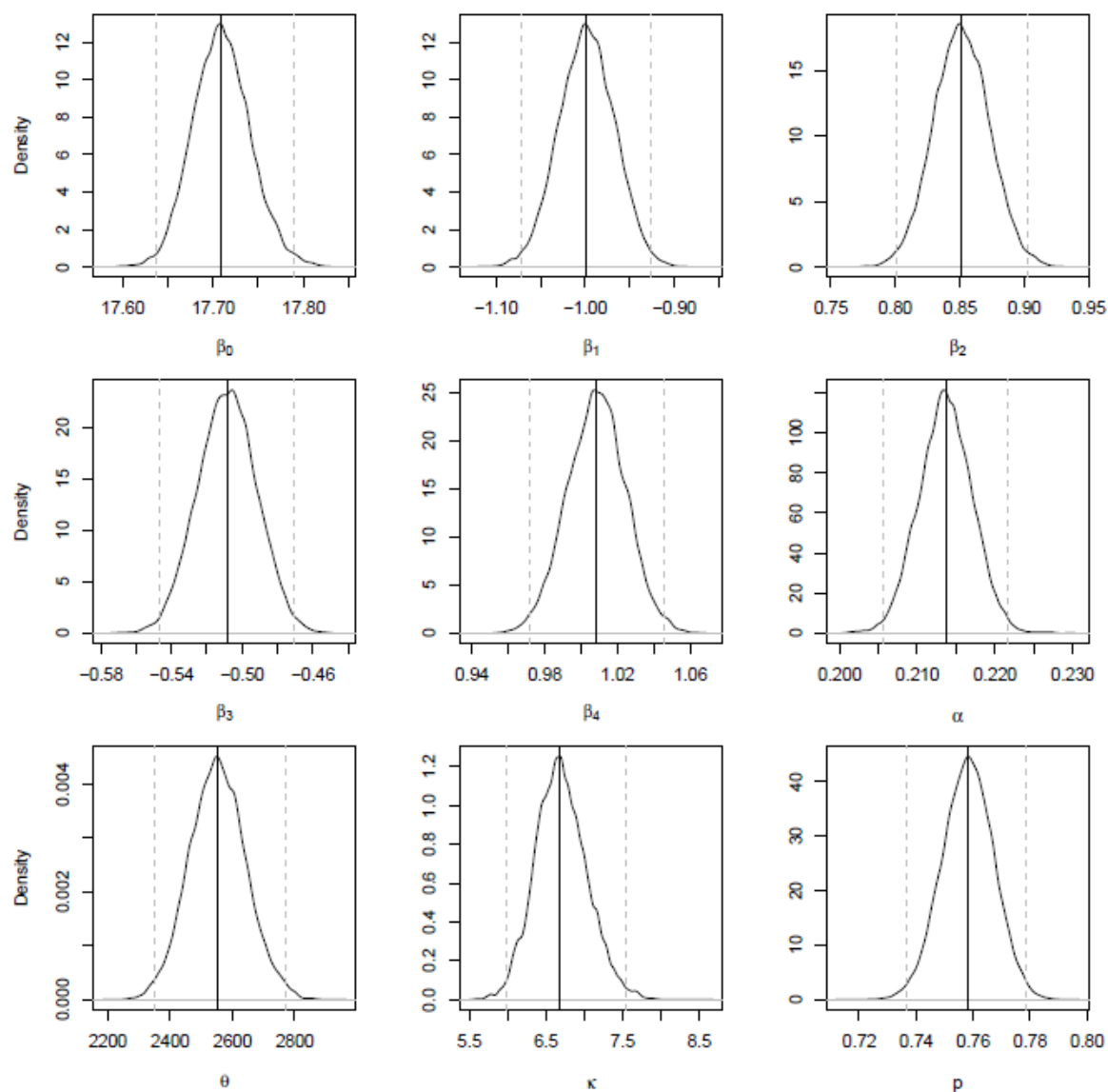


Figure 17.3. Example density plot of MCMC values sampled from each parameters full conditional posterior distribution. Solid gray line indicates posterior mean, dashed-gray line indicate the 99% credible intervals.

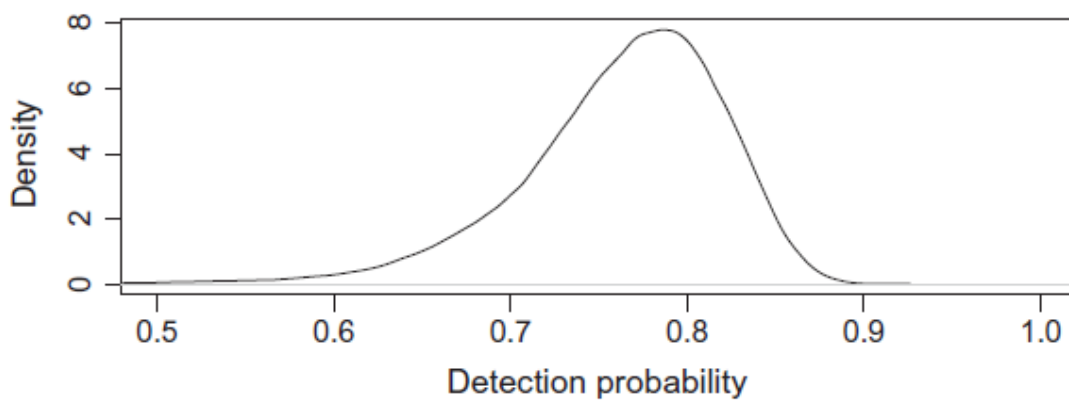


Figure 17.4. Example plot of marginal posterior distribution of detection probability.

Table 17.1 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-17.A: Periodic trend report – detailed deliverable definitions

Purpose of Deliverable

Inform park management, resource management professionals, and the scientific community of estimated trends of the abundance and distribution of the sea otter population in Glacier Bay proper.

Frequency Produced

SO_G is produced when enough survey data have been collected over a period of time to support statistical trend analyses. There is no fixed schedule.

Prerequisites

Accepted SO_D count data over a number of surveys must be available. A number of SO_F abundance and distribution reports should also be available.

Data Flow

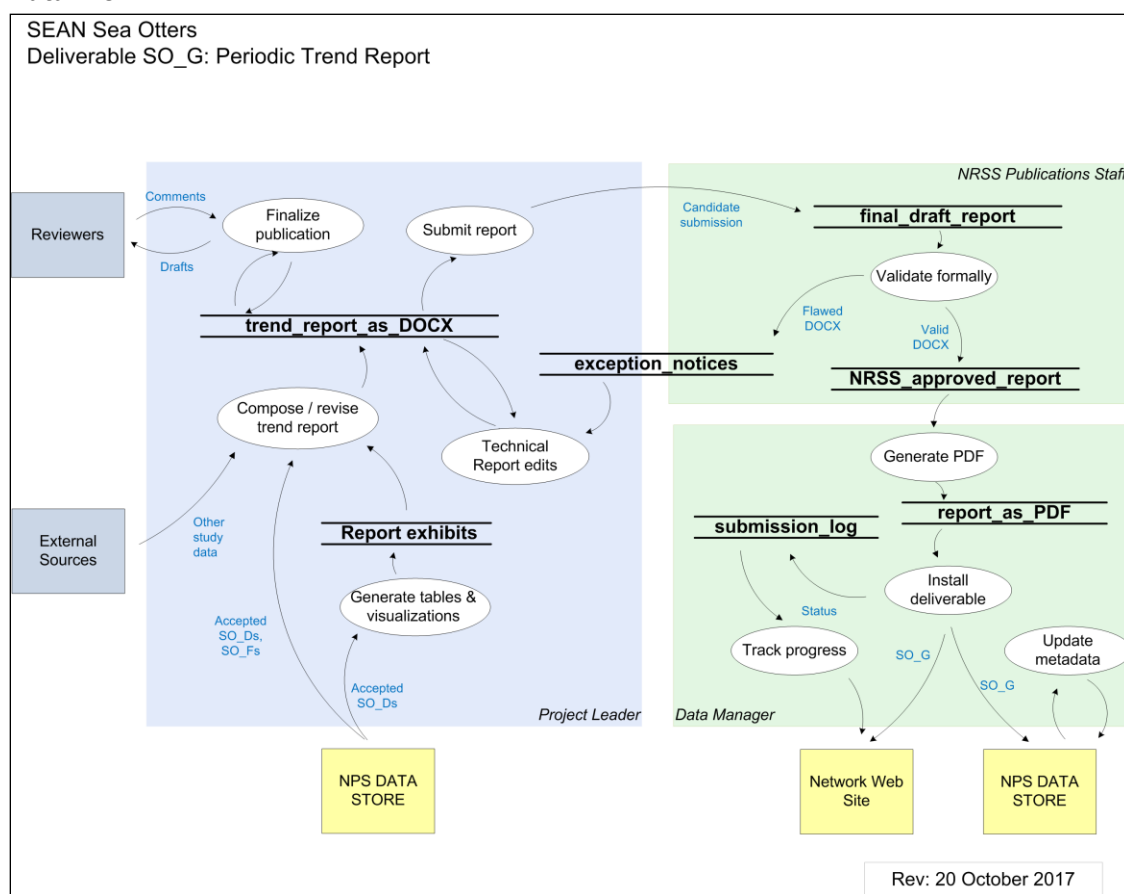


Figure SOP-17.A.1 Data flow required to generate deliverable SO_G Periodic abundance report.

Deliverable Definition Forms

Form A: Non-tabular Information Deliverable

<i>Vital Sign:</i> SO Sea Otters	<i>Deliverable ID:</i> SO_G	<i>Deliverable Title:</i> Periodic abundance report
<i>File Format:</i> PDF	<i>Associated Software and Version:</i> Adobe reader DC version 12 or greater	<i>Revision Date:</i> 10-20-2017
<i>Expected Frequency:</i> No set schedule	<i>Submission Unit:</i> n/a	<i>ID of first protocol it applies to:</i> SO-2017.1
<i>What purpose does this deliverable serve?</i> Inform park management, professional resource managers, and the scientific community of estimated trends in the status and distribution of the sea otter population in Glacier Bay proper for purposes such as making resource management decisions.		
<i>Summary of content:</i> Analysis of sea otter population and distribution resulting in trend estimates. This follows the form of an NPS Natural Resource Report (NRR). The final product is stored in the NPS Data Store repository using the reference type Published Report.		
<i>Mandatory validation criteria:</i> 1. This must successfully pass the requirements set forth in the process for NRR 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> 1. Should meet all Section 508 compliance requirements. .		
<i>Deliverable ID of any other SEAN data products required to create this product</i> SO_D count data are required. SO_F Abundance and distribution reports may be useful.		
<i>Description and source of any outside data required to create this product:</i> Formal publication citation and TIC number from NRSS publication section.		