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Natural Resource Stewardship and Science

Elk Monitoring Protocol for Lewis and Clark National Historical Park

Version 1.0

Natural Resource Report NPS/NCCN/NRR—2011/455

ON THE COVER
Bull elk photographed in the Fort Clatsop unit of Lewis and Clark National Historical Park.
Photograph courtesy of Lewis and Clark National Historical Park.

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Prepared by USGS in cooperation with NPS North Coast and Cascades Network

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Executive Summary

Maintaining elk (*Cervus elaphus roosevelti*) herds that frequent Lewis and Clark National Historical Park (NHP) is central to the park's purpose of preserving the historic, cultural, scenic, and natural resources. Elk were critical to sustaining the members of the Lewis and Clark expedition by providing food and clothing over the winter of 1805-1806. Today, elk viewing opportunities in the park and surrounding region generate broad appeal with the visiting public, which number over 250,000 per year at the Fort Clatsop visitor center.

This protocol describes procedures for monitoring trends in the use of the Fort Clatsop area by Roosevelt elk. Specific objectives of elk monitoring in Lewis and Clark NHP are to measure the relative use and proportion of area used by elk during winter in the Fort Clatsop Unit of the park, and the rate at which elk are sighted from roads in and around the park. Relative use and the proportion of area used by elk are determined from elk fecal pellet surveys conducted every other year in the Fort Clatsop park unit. Pairs of observers visit a systematic array of permanent plots in the fall to clear them of elk fecal pellets, and return to the plots in late winter to count elk fecal pellets that have accumulated during winter. Half of the subplots are counted by two independent observers, which allows for the estimation of relative use and proportion of area occupied by elk with analyses of detection biases that account for unseen elk pellet groups. Standardized road surveys are conducted in and near the Fort Clatsop park unit three or four times monthly during alternate months. Data from road surveys are used to quantify the rate that park visitors would be expected to see elk, when driving the selected set of routes. The monitoring protocol is based on three field seasons of development and testing.

The protocol narrative describes the background, rationale, sampling design, field methods, analytical methods, data management, reporting, personnel requirements, and operational requirements for elk monitoring in Lewis and Clark NHP. The sampling design reflects tradeoffs between statistical and ecological considerations, safety, and current budget considerations. The protocol provides adequate power to detect a doubling or halving of elk use in the Fort Clatsop unit and surrounding areas within 15 years. Step-by-step guidance for planning and completing the monitoring tasks are in the attached standard operating procedures (SOPs).

Information on the status and trends of elk use in Lewis and Clark NHP will allow park managers to assess the effects on elk of restoration programs within the park, build community partnerships, and identify potential linkages between regional land use changes and elk use of the Park. Lewis and Clark NHP has an active ecological restoration program that aims to recreate, where possible, ecological conditions that Lewis and Clark encountered. The restoration program includes an extensive exotic plant removal program, wetland restoration, and silvicultural treatments that will hasten development of late-seral conditions in recently acquired forest lands of the Fort Clatsop park unit. In the future, monitoring results can be used to test for spatial associations between ecological restoration treatments and relative use by elk. The park also plans to feature results from elk monitoring prominently in its educational outreach activities to help interpret the historical and current ecological context of the Lewis and Clark story, and engender public support for the park mission and management activities. Although NPS does not manage non-park lands, information about trends in the distribution of elk use will be valuable in public outreach and discussions with other partnering agencies and regional private landowners.

Acknowledgments

This protocol was developed using funding from the USGS Status and Trends Program and the National Park Service Inventory and Monitoring Program. We are grateful to Patti Happe (NPS), the elk monitoring program lead for the NCCN, as well as Paul Geissler (USGS) and Mark Huff (NPS) for supporting our project administratively and through productive review and discussion. We are indebted to the staff at Lewis and Clark National Historical Park (NHP) for providing critical ideas and numerous logistical supports. We thank Chip Jenkins, Scott Stonum, and David Szymanski for providing critical early leadership, and Zach Bolitho, Nancy Eid, Deborah Montgomery and Deborah Wood for their participation in protocol development. We thank Lindsay Chiquoine, Amanda Holmgren, Lynne Johnson, Jason Smith and Rachel Stokeld for their help conducting field surveys, Katherine Beirne and Patti Haggerty for providing support with Geographic Information Systems and data management, and Janice Cimmer for administrative support. For acquisition of satellite imagery, we thank the USGS Commercial Remote Sensing Space Policy. We thank an independent panel of experts who convened at our request in 2007 to review ideas for this monitoring protocol and provided recommendations; these included Oz Garton, Jeffrey Laake, Bruce Lubow, Scott McCorquodale, Glenn Sargeant, and Kate Schoenecker. Lastly, we appreciate the review comments provided by Mike Adams, Scott Bates, and Paul Geissler on an earlier draft of this narrative, and the constructive critical review provided by Penelope Latham, and three independent reviewers.

Introduction

This protocol narrative outlines the rationale, sampling design, and methods for monitoring trends in elk (*Cervus elaphus*) use of the Fort Clatsop Unit of Lewis and Clark National Historical Park (NHP) and surrounding areas. The protocol reflects the decision made by the North Coast and Cascades Network (NCCN) to monitor elk use as an important indicator of the long-term integrity of Lewis and Clark NHP (Weber et al. 2009). The methods outlined here result from recommendations made by an expert review panel (Jenkins 2007), as well as consultation between the U.S. Geological Survey Forest and Rangeland Ecosystem Science Center and staff from Lewis and Clark NHP. The protocol narrative describes the monitoring methods generally, and its structure adheres to the recommendations developed by Oakley and others (2003) and adopted by the NPS. The accompanying standard operating procedures (SOPs) give finer details of the monitoring methods, including field forms and maps. Additional supporting materials that are not clearly part of the narrative or SOPs are included as Appendices.

1.0 Background and Objectives

A. Ecological, Historical, Aesthetical Importance of Elk in Lewis and Clark NHP

Monitoring trends in the use of Lewis and Clark National Historical Park by elk is a high priority of the North Coast and Cascades Network (NCCN). The preservation of elk herds that frequent Lewis and Clark NHP is central to the park's purpose "to preserve for the benefit of the people of the United States the historic, cultural, scenic, and natural resources associated with the arrival of the Lewis and Clark Expedition in the lower Columbia River area, and for the purpose of commemorating the culmination and the winter encampment of the Lewis and Clark Expedition in the winter of 1805-1806 following its successful crossing of the North American Continent…" (U.S. Congress 2004). Elk were an important source of food and materials for the Chinookan and other indigenous Native American tribes that inhabited the region for millennia prior to the arrival of the Lewis and Clark expedition. Elk were also centrally important to the Corps of Discovery during their entire expedition, as elk meat was an important staple throughout the voyage. Specifically, the abundance of elk around the Netul River (now called the Lewis and Clark River) contributed to Lewis' choice for the winter encampment site that would become Fort Clatsop (DeVoto 1997). Members of the Corps of Discovery shot hundreds of elk (Burroughs 1961), including more than 130 elk over the course of the 1804-1805 winter in the Lewis and Clark NHP region, and used elk skins to make over 350 pairs of moccasins in preparation for the return journey.

Today, elk viewing opportunities in the park and surrounding Clatsop Plains region (Figure 1) generate broad appeal with the visiting public. Elk sightings are a valued aspect of the park visitor's experience, to the extent that suggested locations to see elk near Lewis and Clark NHP are listed in NPS park visitor guidebooks. Some interpretive programs at Lewis and Clark NHP feature elk as a central topic, and include lessons in identifying elk sign (pellets, hoofprints) found on walks in the park. Over 250,000 visitors come to Fort Clatsop each year. More than seven thousand school children participated in interpretive education at the Fort Clatsop unit in 2008 (Harding 2005); that number is expected to double by 2011. The Fort-to-Sea trail passes mainly through this park unit and, with a right-of way that extends to the Sunset Beach State Recreation Area (Oregon State Parks), the trail affords wildlife viewing opportunities in forest, pasture, and beach dune habitats.

Monitoring elk will complement other NCCN and park-based monitoring projects at Lewis and Clark NHP, and will alert park management to changes in the patterns of elk use and spatial distribution in and near the Fort Clatsop unit. The NCCN program that monitors landscape changes (Kennedy et al. 2007) in and around Lewis and Clark NHP will provide context for interpreting changes in elk use of the park. The NCCN program that monitors trends in forest vegetation (Acker et al. 2010) will document changes in composition and structure of forested habitats used by elk in the park. In addition to these NCCN monitoring programs, in areas affected by ecological restoration activities such as forest thinning and wetland creation, Lewis and Clark NHP monitors vegetation and uses motion-triggered cameras to record wildlife species presence (NPS 2010). Current efforts to monitor changes in both elk use and vegetation patterns may indicate how elk respond to future changes in land use in the surrounding areas, as well as to forest management and natural disturbances that regularly affect park vegetation.

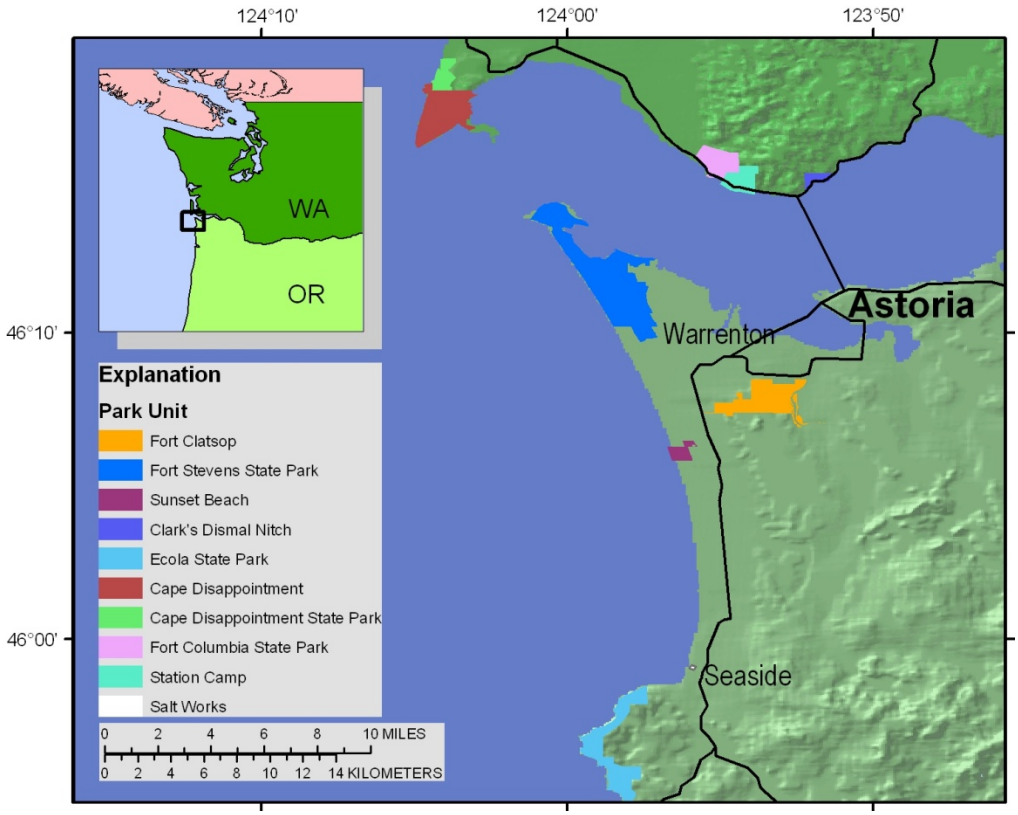

Figure 1. Lewis and Clark National Historical Park units and state parks. The box on the inset map shows the location of Lewis and Clark National Historical Park in the regional context of Oregon (OR, light green in inset), Washington (WA, dark green in inset), and Canada (light red in inset). The larger map shows Lewis and Clark National Historical Park units and State Park units. The 495 hectare (1221 acre) Fort Clatsop unit is shown in orange. The area referred to as the "Clatsop Plain" roughly corresponds to lands from Seaside through Fort Stevens along the coast, and inland approximately as far east as Astoria.

B. Rationale for Selecting this Resource to Monitor

Several priorities for managing resources within Lewis and Clark NHP include (NPS 2004):

(1) Proactively monitoring the park's cultural and natural resources in order to mitigate potential impacts;
(2) Where possible, restore ecosystems and processes to a less impaired state;
(3) Work closely with a wide variety of land managers, tribal representatives, scientists, educators, and organizations to provide a more integrated approach to landscape management, and;
(4) Foster an awareness and appreciation among park visitors and neighbors for the significance of the park and its resources.

Elk were selected for monitoring over several other potential wildlife species or groups of species (Weber et al. 2009) because of their inherent importance to interpreting the Lewis and Clark story, their popularity with the visiting public, their potentially large influence on ecosystems where they occur (Hobbs 1996), and the many agents of change that are expected to influence future populations of elk. Examples of change that could influence elk populations

include both the potential for habitat restoration actions in the park to benefit elk and the potential for human developments outside the park to adversely affect elk.

Elk population trends are not currently monitored within Lewis and Clark NHP. Oregon's Department of Fish and Wildlife (ODFW) conducts roadside and aerial composition surveys in the much larger area of the Saddle Mountain Game Management Unit, which includes most of Clatsop county, and parts of Tillamook and Columbia counties. Because ODFW counts take place over a much larger spatial scale and do not include regular surveys of the park the ODFW counts do not meet park needs. The park staff favors the development of new monitoring protocols that will better inform park management decisions to benefit elk within the park as well as to facilitate building new partnerships and educational programs that will benefit the park's mission.

Concerns over the future protection and welfare of elk in and around Lewis and Clark NHP stem from the fact that the park is composed of several individual park units, which range in size from the 0.1 hectare (0.25 acre) Salt Works unit to the 505 hectare (1246 acres) Cape Disapoinment unit (Figure 1). Each unit is too small to support a year-round resident herd. Elk range widely outside of park boundaries, where habitat conditions are affected by urbanization, forest management and agricultural practices, and where populations and behaviors of elk are influenced by hunting patterns, other human disturbance factors and habitat change. The most important agents of change with the potential to influence regional elk population trends are increased human population growth and development pressures both regionally and adjacent to park lands. The Clatsop Plain is scenic, coastal, and close to the growing cities of Warrenton and Astoria. As such it is an attractive location for continued residential and commercial development. Expanded development is expected to influence elk behavior, movement, and susceptibility to vehicular collision.

Information on the status and trends of elk use in Lewis and Clark NHP will allow park managers to assess the effects on elk of restoration programs within the park, and adapt programs accordingly. Lewis and Clark NHP has an active ecological restoration program that aims to recreate, where possible, ecological conditions that Lewis and Clark encountered. Throughout the park, personnel are aggressively replacing exotic plants with native plants. In Fort Clatsop unit lands along the Lewis and Clark River, park managers are removing dikes to restore large areas of tidally-influenced wetland. And across a wide swath of recently acquired second- and third-growth forest lands of the Fort Clatsop unit, the development of late-successional characteristics is a central goal in the park's vegetation management plan (NPS 2007). Vegetation management in the Fort Clatsop unit incorporates natural disturbance events such as the Great Coastal Gale of 2007, as well as silvicultural activities such as tree thinning, gap creation, and biomass removal.

Staff at Lewis and Clark NHP specifically selected elk monitoring as a useful tool for building community partnerships, highlighting regional habitat and land use planning effects on park resources, and providing leverage in regional discussions of policies that may influence the park's elk population. NPS does not manage actions on non-park lands, but information about trends on the distribution of elk could be valuable for discussions with other partnering agencies and private landowners, in several venues. First, NPS jointly manages several parks in Lewis and Clark NHP with Oregon State Parks. Second, park personnel actively represent the interests of

natural resources, in meetings with cooperative groups (e.g., Columbia River Estuary Study Task Force, Camp Rilea Armed Forces Training Center, Lower Columbia River Estuary Partnership) and in public outreach. Third, data indicating any substantial decline in the reported distribution of elk sightings over long time periods could allow park staff to raise concerns about elk populations and their movement through public and private lands in the region. Lastly, the park plans to feature results from elk monitoring prominently in its educational outreach activities to help interpret the Lewis and Clark story, and engender public support for the park's mission and resource management activities.

C. Program Goals and Measurable Objectives

The goal for elk monitoring is to detect changes in the magnitude and spatial patterns of elk use of landscapes at several spatial and temporal scales within and adjacent to selected areas of Lewis and Clark NHP. We have chosen three measures for monitoring trends in elk use: an index of relative use, the proportion of area occupied (PAO) by elk, and the rate at which elk are sighted during roadside surveys. These measures will meet the park's primary monitoring objectives of determining the extent to which elk remain part of the park's cultural and natural fabric, while also using monitoring to build partnerships for resource management and public communication.

Changes in relative use and PAO by elk will be based on pellet group surveys conducted in the Fort Clatsop unit of Lewis and Clark NHP (Figure 1). Relative use refers to the abundance of elk fecal pellet groups at survey points that are distributed systematically throughout the Fort Clatsop Unit, whereas PAO refers to the proportion of points at which the detection of elk pellets indicates a site has been occupied or 'used' by elk (MacKenzie et al. 2002).

Pellet group surveys, hence monitoring of relative elk use and PAO, will be limited to the Fort Clatsop Unit of Lewis and Clark NHP for several practical reasons. Although it would be optimum to also monitor trends in elk use in other units of the park, funding and logistic constraints on the park's staff do not permit park-wide coverage at this time. To ensure that monitoring objectives do not exceed available funding, we are limiting the relative use and PAO measures to the Fort Clatsop unit – a unit where elk are frequently seen and that was central to the Corps of Discovery's encampment. Furthermore, the Fort Clatsop Unit is the site of the most active vegetation restoration programs that may affect elk use and distribution. Although the protocol will be limited to the Fort Clatsop unit at present, pellet group surveys could be expanded to additional park units if specific management questions and funding sources develop. To prepare for that possibility, Geographic Information System (GIS) files with sampling coordinates for other park units have been stored in the project workspace.

We will infer trends in elk viewing opportunities in selected areas adjacent to the Fort Clatsop unit by monitoring the rate at which elk are sighted in roadside surveys on specified routes. The road survey sighting rate is a direct index to the rate that park visitors driving the selected set of roads would be expected to see elk. Although road surveys will be standardized, the road survey sighting rate is not a direct measure of abundance because changes in elk distribution, behavior, or visibility could all influence the rate of elk sightings from roads.

This monitoring program is designed to detect gradual changes in elk use of landscapes within and adjacent to Lewis and Clark NHP over a 15 year time period. We have designed our

monitoring methods to detect a 5% per year change over a 15 year period, with 80% probability of detecting the trend (i.e., statistical power), and a 10% probability of falsely concluding that a change has occurred (i.e., the type 1 error rate). A 5% change per year equals approximately halving or doubling over 15 years. If a 50% decline in one or more of the measures below is detected, it may signify an excessive decrease in the elk population, which could warrant a call for more intensive study examining the causes of such a decline.

We chose this level of change for the analyses of trend detection because we believe that a halving of elk use in the park would adversely affect the park's ability to preserve and interpret the elk resource, and doubling may adversely affect other resource values. Because the park contains only a small fraction of the habitat used by elk in the area, it's not likely that the changes would prompt specific actions capable of affecting regional population trends. However, the scientific information obtained from elk monitoring has multiple applications for management decision-making, research, education and efforts to promote public understanding of resource management issues surrounding elk in the park and local communities. Park-specific management actions that may be triggered through the detection of a significant reduction in elk use might include enhanced forest or wetland management activities, or visitor management in key areas used by elk. Such changes in elk use would also trigger additional research to determine causal factors and perhaps stimulate multi-agency collaboration to determine feasible management solutions to problems of a broader scale.

Below, we review the three measures and present our approach to meeting the objectives.

Objective 1: Monitor trends in relative use by elk in the Fort Clatsop unit.
We will monitor trends in the relative use by elk in winter through the estimation of pellet group density, as measured during late winter surveys each year.

Fecal pellet groups have been used extensively as indices of ungulate distribution and use (Neff 1968, Rowland et al. 1984, White 1992, Forsyth et al. 2007), fecal pellet groups are used in other NPS monitoring protocols (Bates 2006, Peitz et al. 2007), and the assumptions behind their application are well-known (Harestad and Bunnell 1987, Campbell et al. 2004). Ungulate pellet group density can be a reliable index of relative use so long as decay rates and probabilities of detecting pellet groups are comparable across the sampled space, or can be estimated (Weckerly and Ricca 2000, Jenkins and Manly 2008).

In estimating relative use of the Fort Clatsop Unit by elk we will employ double-observer counting methods (Williams et al. 2002) to explicitly estimate the probability of detecting pellet groups and account for variability in detection probabilities in the estimation of pellet group density (Grant et al. 2005). Pilot data suggest that the probability of detecting pellet groups in the Fort Clatsop unit is relatively high, especially for larger pellet groups in relatively open vegetation, but previous studies (Jenkins and Manly 2008) have shown there is large variation in the ability of observers to detect pellet groups in different levels of vegetation cover. Double-observer methods will minimize variability in pellet group counts associated with different vegetation conditions across space and time.

We will estimate indices of pellet group density based on data collected every other year, during late winter. We will estimate pellet density averaged across the Fort Clatsop unit, and for each sample point. Additionally, we will map spatial distribution of relative use throughout the Fort Clatsop unit, based on interpolation of pellet group densities at the systematically sampled points. The spatially distributed values of relative use can be used to test for quantitative relationships between elk and factors important to management, such as silvicultural treatments, or between elk and measures that are recorded during the course of survey, such as understory vegetation. Also, because trends in relative use can be estimated at each sampled point, monitoring can document the changing spatial patterns of use that may underlie any overall change in mean relative use.

Fecal pellet group density estimates have strongest inference to relative use when they are counted in survey units that are cleared of pellets at the start of a known accumulation time interval (Lehmkuhl et al. 1994, Campbell et al. 2004). If survey units are not cleared and pellet groups vary in their rate of decay, then the time intervals represented by the pellet groups present vary from point to point. Because pellet groups can decay at different rates depending, for example, on slope and topographic aspect (Harestad and Bunnell 1987), not clearing survey units at a known time could potentially introduce unwanted variation in raw pellet group counts. Our sampling design for pellet surveys includes pellet clearing, during a late fall visit to each sampled point.

Objective 2: Monitor PAO for elk in the Fort Clatsop unit.
We will monitor the proportion of area occupied (PAO), based on fecal pellet groups detected during late winter surveys each year.

PAO is the fraction of sampled points that a species is estimated to occupy, and is synonymous with 'occupancy' (MacKenzie et al. 2006). For wide-ranging species such as elk, PAO indicates the prevalence of species use within the sampled area, for a specified time. This proportion can change over time, due to changes in animal behavior and / or abundance (MacKenzie et al. 2006). PAO is used widely in monitoring programs (e.g., Atkinson et al. 2003, Weir et al. 2005, O'Connell et al. 2006, Penman et al. 2009). As with other estimates of occupancy that account for imperfect detection probabilities (MacKenzie et al. 2002), PAO estimates rely on data from multiple visits to each sampled point. In this protocol, elk pellet groups are the evidence of elk occupancy at sampled pellet points. Two observers search for pellet groups independently at each survey point. Their records provide data for direct estimation of the probability of detecting any elk pellet groups, given that there was at least one group present. Estimates from pilot surveys indicate that this probability is relatively high, at ~70% per observer or ~90% for two observers; as a result, sampling variation in the estimate of PAO should be relatively low (MacKenzie and Royle 2005). Clearing subplots in late fall allows the PAO estimate from late winter pellet group counts to be specific to the time period between the late fall and late winter sampling sessions.

Objective 3: Monitor elk viewing opportunities.
On specified driving routes, we will monitor the rate at which elk groups are sighted during roadside surveys, and we will monitor the average total number, and sex and age composition, of elk seen per survey morning. We will record this measure for each of six one-month periods.

By recording the seasonal patterns of elk herd sightings we will document trends in elk viewing opportunities for visitors during different seasons. Road surveys in and near the Fort Clatsop unit will result in an improved understanding of elk viewing opportunities there. As with other indices, it is important to standardize observation methods. Standardization in this protocol specifies that surveys be conducted only at certain times of day, under certain weather conditions, and following only certain routes. The surveys focus on the Fort Clatsop unit for three reasons. First, the unit is a central and popular driving destination for park visitors. Second, Fort Clatsop was a centrally important place for Corps of Discovery elk hunters. Finally, elk sightings in and near the unit are still relatively frequent. Additional survey routes in and near other Lewis and Clark NHP units could be added in the future.

2.0 Sampling Design

A. Pellet Group Counts

A recent review of proposed NCCN elk monitoring examined potential methods for monitoring trends in elk distribution, population size, and viewing opportunities in Lewis and Clark NHP, and provided recommendations for future monitoring (Jenkins 2007). Expert panelists agreed that monitoring trend in population size is not feasible in Lewis and Clark NHP due to limited budgets, complex detection issues, and the fact that the elk move across park boundaries. There was general consensus that a rigorous elk fecal pellet group survey could be developed in Lewis and Clark NHP that would meet the primary information needs within Fort Clatsop unit – quantifying trends in PAO, the mean relative use, and spatial distribution of relative use.

It is valid to use fecal pellet group counts as an index to ungulate habitat use if several key assumptions are met: (1) the ability of observers to detect pellet groups does not vary across time or space, or individual differences in detectability can be estimated (Williams et al. 2002); (2) pellet groups counted are deposited over a known and constant interval; and (3) there are no differences in defecation rate of elk over time (Rowland et al. 1984, Harestad and Bunnell 1987, Plumptre and Harris 1995). Our sampling methods (**SOP 6: Conducting Pellet Counts**) will use double-observer counting methods to estimate detection probabilities for estimation of PAO and relative use derived from pellet group counts. We will record measures of covariates that could influence the probability of elk pellet detection, such as the number of pellets in a pellet group, their decay class, lighting conditions, and the surrounding vegetation category and density. Further, we will clear all of the surveyed subplots to limit the time interval of deposition. To minimize effects of season, diet, or microclimate on defecation rate, we will limit trend analysis to the time interval between fall and late winter sampling.

Sampling Frame

A legitimate sampling frame is required for valid inferences about trends in relative use or PAO estimated from fecal pellet surveys. We would like to make inference about trends for the entire area of the Fort Clatsop unit of Lewis and Clark NHP. Within that sampling frame we will sample pellet groups at a systematic grid of survey points, with 250 m from each point to the six nearest points (Figure 2).

The systematic sample provides valid inference to the entire Fort Clatsop unit. We chose this arrangement of points over stratified random point placement because:

1) There was no prior information about elk habitat use that could have been used for stratification;
2) Statistical analysis from systematically sampled points do not require variance components for each stratum (Lohr 1999); and
3) Future changes in forest stand structure will cause points to change strata over time.

For this protocol, systematically placed points are also preferable to random point placement because:

1) Systematic points simplify navigation;
2) Systematic points completely cover the survey frame, and;

3) Having each point 250 m distant from up to six of its closest neighbors allows for straightforward mapping and calculation of statistics that have a spatial component (McDonald and Geissler 2004).

Coordinates for potential points were determined using Hawth's Tools in ArcMap, in an area defined by bounding vertices at the northwest (UTM datum NAD 83, E442850, N5110400) and southeast (E433400, N5176500). There are 82 points in the sample frame, numbered zero to 81. Access is unsafe for eight points because they have slopes over 35 degrees, and/or have extreme amounts of tree blowdown or blackberry brambles. Six more points are submerged under water, and three numbered points are actually outside the park boundaries. As a result, 65 points comprise the current sample, although others may be added if water, vegetation conditions, or park boundaries change. Each permanently-marked sampling point defines the center of a 9-m radius plot that is used to describe general habitat conditions. Within each plot are four 3-m radius subplots in which pellet groups are counted.

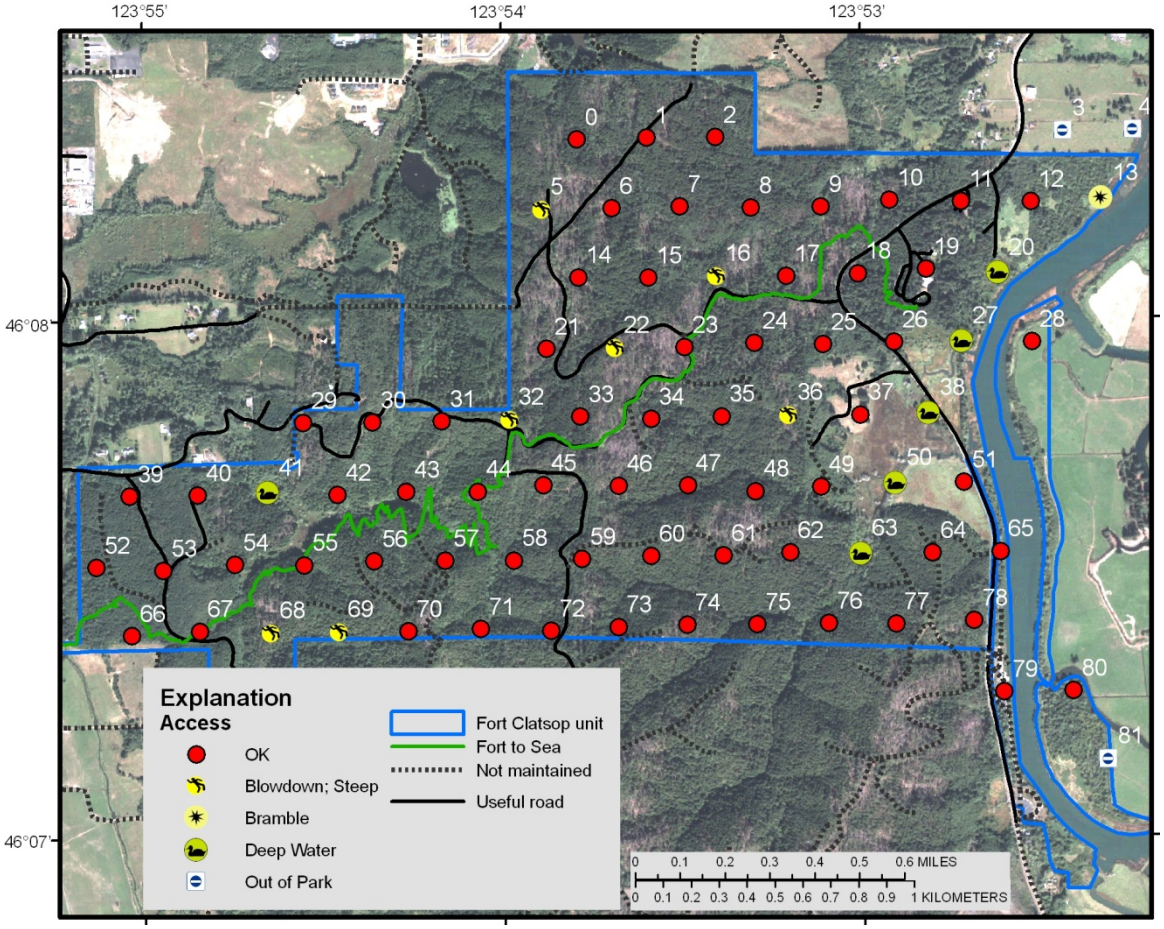

Figure 2. Points for the elk pellet survey within the Fort Clatsop unit. Points labeled with a red dot are accessible and should be visited once per survey session. Points with yellow symbols are inaccessible, unsafe, or under water. The satellite imagery is from September 2008 (Digital Globe Inc.); mottled brownish areas within the forested part of the Fort Clatsop unit indicate areas of windthrown trees (blowdown) caused by a windstorm in 2007.

Sampling Frequency and Sample Size

Pellet group surveys take place every other year. In fiscal years during which pellet group surveys are conducted, there are two sampling sessions: a fall session in the last week of October or first week of November, for the purpose of plot-clearing, and a late winter session in the last week of February or first week of March, for quantifying pellet group abundance. Sessions are scheduled so that they are separated by approximately 110 days. We will not make conclusions about relative use or PAO based on data from the fall sampling session. Inference from fall counts is limited because the number of pellet groups counted could be influenced by variation in the effective accumulation times at different points, depending on topography and vegetative cover. Pellets present in fall sessions result from accumulation and decay over some time interval from the preceding spring, summer and early fall, but that time interval may not be consistent from point to point. During the >200-day interval between late winter and the subsequent fall sampling, pellets may decay more rapidly at some points (i.e., warm, wet places) than others (i.e., dry places).

We will estimate PAO and relative use for late winter surveys. The late winter sampling session allows for unambiguous inferences to the winter time period that has elapsed since the fall sampling session. Fall sampling sessions are essential for subplot clearing, so that the pellet accumulation interval is known.

PAO and the mean value of relative use are estimated from data collected at sampled points, which currently number 65. Sample size influences the estimated precision for PAO and mean relative use; higher sample size tends to increase precision, which is reflected in smaller standard error values for PAO and mean relative use. Having two observers per point means that there are two 'visits' to search for evidence of occupancy; this is the optimal number of repeat visits for survey design, given our preliminary estimates of PAO and detection probability (MacKenzie and Royle 2005).

Statistical Power

We made prospective estimates of the power of our monitoring design to detect a 5% change per year in 15 years (approximately equal to an overall halving or doubling). Preliminary estimates of relative use and PAO used in power simulations were taken from preliminary analyses of the late winter 2009 and late winter 2010 sampling sessions. Based on those data, the coefficient of variation, defined as the standard error of the estimate divided by the estimate, was 0.23 for relative use, and 0.18 for PAO.

For relative use, we estimated power with program TRENDS (Gerrodette 1987, Gerrodette 1991) and $\alpha = 0.10$ (Table 1). Power for estimating trends in mean relative use, $\hat{G}_{mean}$, was estimated for sampling scheduled to take place every other year, with an exponential model of growth, and two-tailed statistical tests.

For PAO, which is bounded by zero and one, we estimated power by running Monte Carlo simulations (*after* Gibbs and Melvin 1997). PAO in each of 500 simulated iterations changed at the annual rate specified, but sampling was simulated to take place every other year. Each simulated estimate of PAO for sampled years was taken from a normal distribution around the simulated PAO value, with variance based on the preliminary analyses of the pilot data. Estimated power for PAO (Table 1) was the fraction of simulations in which a linear regression

of the sampled points had a statistically significant declining or increasing slope (with $\alpha = 0.10$ to define significance).

For simplicity's sake, in Table 1 we present the estimated power for either population increase or decrease, whichever was the lower estimate. The sampling design appears to provide the desired power to detect halving or doubling of relative use and PAO at the 15-year time scale, except that power to detect an increasing $\hat{G}_{mean}$ trend in 15 years was only 0.79. For a decreasing value of $\hat{G}_{mean}$, however, expected power to detect a change after 15 years of monitoring was 0.82. Actual power to detect change may be greater than projected, because we already have three successive years of sampling at the beginning of the study (2008-2010). Power would also be improved if additional sampling were conducted annually at any time in the future.

Table 1. Expected power to detect changes in PAO and mean relative use ($\hat{G}_{mean}$). Simulations were based on initial values and variance estimates from late winter 2009 and late winter 2010 in the Fort Clatsop unit, with a 5% per year level of change, and assuming that pellet group sampling occurs every other year. For example, during the 15 year time period, there are eight years of pellet survey.

Time	Power, PAO	Power, $\hat{G}_{mean}$
5 years	0.06	0.12
10 years	0.31	0.28
15 years	0.81	0.79
20 years	0.88	0.97

B. Road Surveys

We will measure the rate of elk sightings during road surveys as the number of elk groups seen per occasion of driving each route. This rate will be calculated for each route separately, with means and variance estimated in each of the sampled months. We will also calculate the total number of elk seen per survey morning and observed age and sex composition per survey morning. Elk movements often follow regular patterns, according to season (Irwin 2002), so trend estimation should be separate for each calendar month, e.g., for February 2009, February 2010, February 2011.

Sampling Frame

The roads included in numbered, regularly surveyed routes (**SOP 7: Conducting Road Surveys**) were chosen for proximity to the Fort Clatsop unit, vistas of open landscapes, public access, and safety (Figure 3). Inferences from these road surveys are limited to areas that are directly visible from the roads sampled because the selection of those roads and their placement in the landscape is neither random nor systematic.

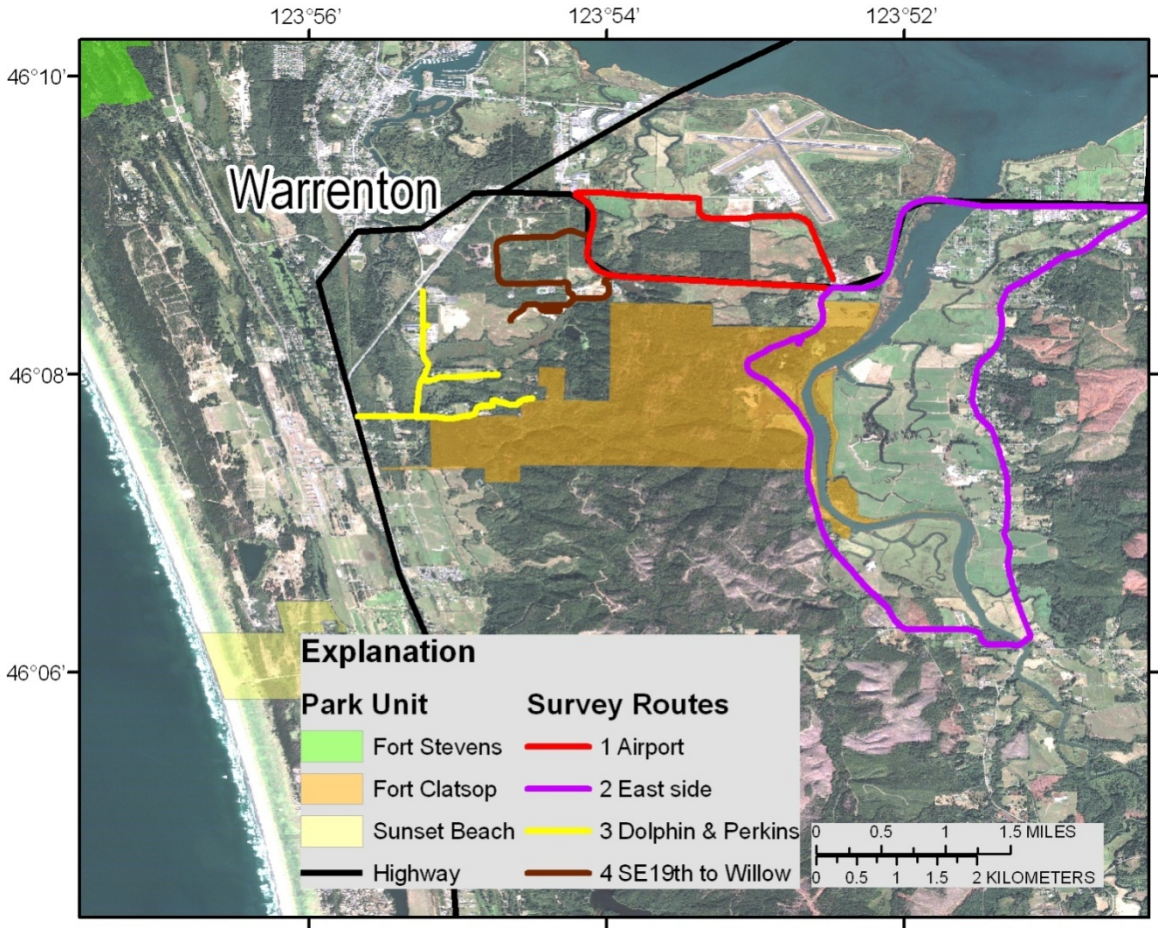

Figure 3. Four survey routes for elk road surveys. All four routes are in the vicinity of the Fort Clatsop unit, which is shaded in orange. The Clatsop Plain includes areas to the north, west, and southwest of the unit. Satellite imagery is from September 2008 (Digital Globe Inc.). Major highways are shown as black lines.

Sampling Frequency and Sample Size

We will conduct road surveys during February, April, June, August, October, and December. Each of three or more surveys per month will be separated by at least four days, to reduce temporal autocorrelation between successive surveys.

The road survey sighting rate and the total number of elk seen per survey morning will be based on observations along all four numbered routes. There will be three or four mornings of survey per month, depending on staff availability and weather. All four routes will be surveyed on each survey morning.

Statistical Power

We will estimate the level of change in the road survey sighting rate for each month separately. We used program TRENDS (Gerrodette 1987, Gerrodette 1991) to assess power prospectively, using three surveys per route per month. Based on preliminary data collected in 2008 and 2009, the mean was 1.33 groups per route, and the worst case scenario for monthly variance in the pilot data was also 1.33; we used these values to assess power. Based on these simulations, the road surveys will have the desired power to detect 5% per year changes over 15 years (Table 2).

Power to detect the 5% change per year was comparable, whether the population was simulated to decline or increase; in Table 2 we present whichever was the lower estimated power.

Table 2. Expected power to detect changes in road sighting rates for single months. Simulations were based four routes each sampled three times per month, and with a 5% per year level of change.

Time	Power, Road surveys
5 years	0.13
10 years	0.46
15 years	0.88
20 years	1.0

C. Rationale for Selecting these Sampling Designs over Others

Elk move widely, and the effort and cost required to monitor trends in elk distribution and abundance at the scale necessary to include a biological population would be prohibitive. For measures of use within the Fort Clatsop unit, we chose pellet group counts because they can be used across the entire unit, and can provide valid inference to elk use within specific seasons (Litvaitis et al. 1996). We chose to count the number of elk sightings per road surveys because that is a quantifiable index that relates to the probability of park visitors seeing elk while driving. We chose to record sex and age composition of elk sightings near the park because the sex and age composition of elk may inform park visitors about which seasons and where they are most likely to see bull or calf elk. This information may also be useful to the park staff for interpreting trends in observed numbers of elk. We also considered and rejected several alternative monitoring methods, discussed as follows:

Camera-trapping

Remote cameras have been used extensively to study presence and occupancy patterns of many species of large mammals (Karanth et al. 2004). Remote cameras, however, are expensive to purchase and operate, and they sample over a limited time period. Fecal pellets, in contrast, accumulate and reflect elk presence over a longer time horizon. Park staff currently operates several remote digital cameras at various sites throughout the park to record the presence of species, such as large carnivores. Unlike those relatively rare and cryptic species, elk are well known to use the Fort Clatsop unit. Fecal pellets indicate elk use at a point much less expensively than remote cameras. Replication of 60 sample points using cameras would be cost prohibitive.

Aerial Survey

Aerial surveys are not suitable for estimating elk use patterns within Fort Clatsop because use of the park by elk is highly variable in time. Elk may move in and out of the park on daily or even more frequent intervals, so presence or absence on a single day is not a reliable index of use. Moreover, aerial surveys are expensive, pose safety risks, and are unreliable where canopy cover limits visibility, such as in the low-elevation forest of western Oregon.

Radio Telemetry

Radio-telemetry is a valuable technique for estimating distribution and habitat use patterns of radio-collared animals. If it were possible to place radio collars on a selection of elk from each herd that enters the Fort Clatsop unit, then it would be possible to track their movements both

within and outside of park lands, and determine landscape elements selected by the sampled elk. As a method for long-term monitoring, however, radio-telemetry is a poor choice. Capturing and immobilizing elk for radio collar fitting is expensive and time-consuming. This tool is more suitable to answer specific research questions than for long-term monitoring.

Shape and Size of Surveyed Subplots

Designing a pellet group survey requires choosing a suitable shape, configuration, and size for survey units. Many pellet group studies have selected belt transects, line transect sampling, or circular plots, each with its own advantages and disadvantages. Our pilot work indicated that establishing and maintaining linear transects through dense brush and thickets of blown down timber at Lewis and Clark NHP would be extremely laborious for setup, recounting, and permanent marking. We experimented using 1-m, 2-m, 3-m, and 4-m plots and found 3-m plots were optimal for searching efficiency and ability to easily trace the plot perimeter. The 3-m circular subplots in this protocol are easier to set up and revisit than smaller circular plots distributed along a transect that have also been used in Pacific Northwestern forests (Fairbanks 1979). Circular subplots have another advantage in that decisions about whether a pellet group is in the subplot or outside the subplot are relatively unambiguous (McKelvey et al. 2002, Murray et al. 2002), because the center of the circle is plainly marked by pvc pipe or rebar, and the perimeter of the subplot is readily identified (**SOP 5: Establishing and Marking Permanent Monitoring Points**).

Distance Sampling

Mark-Recapture Distance Sampling (MRDS) (Laake and Borchers 2004, Borchers et al. 2006) was identified as one potentially useful method for estimating pellet group density (Jenkins 2007). MRDS in this context would entail conducting repeated counts of pellet groups along linear transects, and measuring the distance from each pellet group to the transect centerline. MRDS yields estimates of pellet group density, and an estimate of how detection probability varies as a function of distance from the center line. The decision to avoid linear transects largely precluded use of distance sampling for pellet surveys.

Distance sampling is also commonly used to estimate animal density from visual surveys conducted along linear survey routes, such as roads (Buckland et al. 2004). We considered using distance sampling to estimate density of elk observed from the roadside surveys we proposed. We concluded, however, that estimates of elk density as derived from roadside surveys would be unreliable. First, the sampling frame is not suitable for unbiased inference to elk abundance, as the road network is distributed neither randomly nor systematically through the population of elk sampled. Secondly, we speculate that increased development along roadsides in the future may reduce elk detectability from roadways. Detection probability varies as a function of many factors, including obscuring vegetation and buildings, and cannot be estimated reliably without a population of marked animals. Hence, we chose to monitor trends in the raw numbers of elk groups and individuals seen from roadways as measures of viewing opportunities for park visitors, rather than attempting to estimate elk density.

3.0 Field Methods

Note: Refer to **Appendix A: Yearly Project Task List** for a schedule of tasks for years with NCCN I&M elk pellet surveys.

A. Permitting and Compliance

Park management staff has reviewed this protocol to ensure that resource protections are adequate. There are no further permitting or compliance requirements with the National Environmental Policy Act, according to the following Categorical Exclusion concerning resource management actions: "Nondestructive data collection, inventory (including field, aerial, and satellite surveying and mapping), study, research, and monitoring activities."

B. Pellet Counts

Field Preparations

Project planning and field supply preparations (**SOP 2: Before Each Pellet Group Sampling Session**), should occur before field work begins. Arrangements must be made to schedule staff and volunteer time. The Project Lead should ensure that all personnel involved are willing and able to conduct the surveys, which entails travel off trails and potentially in blown down forest.

Field supplies include the personal and project equipment that each person will need for each day of field work. A detailed list of materials and other field supplies to be assembled before the field season is presented in **SOP 2: Before Each Pellet Group Sampling Session**). The Project Lead should ensure that park equipment is ready for the survey personnel, including the testing of GPS units and park radios, at most one week before each pellet survey session. Copies of safety measures (**SOP 2: Before Each Pellet Group Sampling Session**) and field protocols (**SOP 6: Conducting Pellet Counts**) should be printed and distributed to participants at least 1 week before field work begins.

Participants should prepare the equipment for which they are personally responsible, such as field clothing and essentials for hiking. First-time and refresher training for staff and volunteers (**SOP 3: Training Observers**) should include a review of safety considerations, navigation with GPS, point and subplot setup, pellet identification and classification, and data recording.

Sampling Methods

In both the fall and late winter sessions, two-person teams conduct pellet surveys at points throughout the Fort Clatsop unit. Before leaving the office, teams identify the set of sampling points for the day, choose parking spots from which to begin walking, and note trails or roads that can be used to minimize travel time. Team members record their departure time from a vehicle or building on the Walking Time Data Sheet. This sheet is also where observers record whether or not they see any elk pellets while walking to or between points, and any notes about navigation to each point, or other unusual animal-related observations. Records of elk pellets seen by walking observers between plots will not be analyzed quantitatively. However, such records are easily recorded and may provide useful ancillary interpretations of the measured data.

The team uses a handheld GPS unit to navigate to the first point (**SOP 4: GPS Use**). The team members record their arrival time at the point, on the Walking Time Data Sheet and on the Elk

Pellet Survey Form. In almost all instances, the point will already be established, with a marker there that indicates the center of the 9-m radius plot (**SOP 5: Establishing and Marking Permanent Monitoring Points**). Four 3-m radius subplots are centered 6 m from the point, at the cardinal directions (Figure 4). If the point has not already been established, the team members use the GPS unit to navigate to within 1 m of the target coordinate, mark the point center there, and record GPS data necessary to estimate the exact coordinates of the point. Post-processing the recorded data will provide accurate coordinates for the actual point. When establishing a point, team members also locate and mark subplot centers.

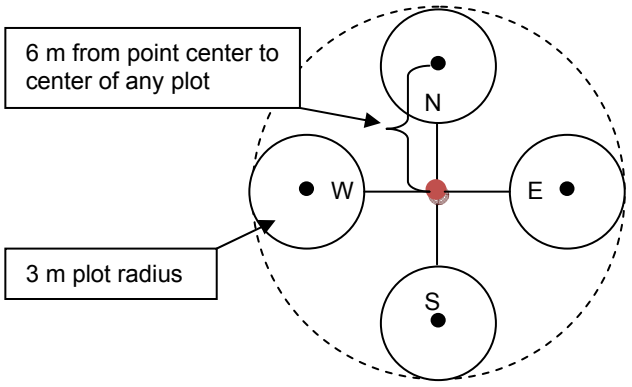

Figure 4. Schematic diagram of a survey point. A 9-m radius plot encompasses four 3-m radius subplots. Subplot centers are 6 m north, south, east and west from the point's center.

During fall pellet surveys, data collection at the sampled point is limited. Each observer searches for elk pellet groups in two of the four subplots, noting the number of elk pellet groups they find, and removing all elk pellets from the subplot. To increase the probability that each subplot is completely cleared of elk pellets, each observer then searches the other two subplots for any elk pellet groups that may have been missed by the first observer and also records the numbers of pellet groups removed. Recording the numbers of pellet groups removed by each observer serves as documentation that the plot was inspected by both observers.

During late winter pellet surveys, data collection at the sampled point is more detailed. Team members first will record general attributes that might influence elk use and elk pellet group detection probability within the 9-m radius plot such as vegetation characteristics, lighting conditions, and the amount of blowdown. The purpose of recording these general data at the plot level is two-fold; the attributes may be factors used in the analysis of pellet group detection probabilities (e.g., lighting conditions) or occupancy patterns (e.g., blowdown), and they may signal changes in vegetation or blowdown that affect future observations at survey points. The objective of this monitoring program is neither to summarize changes in vegetation conditions over time, nor to determine elk distributional responses to vegetation changes. Nonetheless, the ocular estimation of a few vegetation attributes takes very little time to record and could be useful for future interpretations. Therefore, in addition to vegetation class, crew members record their ocular estimation of percent cover for the five most dominant shrub species within the plot. Observers record the proportion of individuals from the five primary shrub species that appear to have been browsed by ungulates; for ferns, clusters of stems coming from a single root mass

constitute an individual, while for clonal species, single identifiable stems coming from the ground are considered an individual. For the same species, observers categorize the most common level of browsing severity evident on the individuals of that species (none, light, heavy), as defined in **SOP 6: Conducting Pellet Counts**. After characterizing general conditions within the 9-m-radius plot, observers will then record subplot attributes that are potentially related to pellet group detection within the four 3-m radius subplots, specifically the vegetation type in the subplot and the percentage of vegetation cover below 1 m height that would obscure views of pellets.

Each team member searches for and counts elk pellet groups in two of the four subplots, such that all four subplots get searched in this first round of survey. Within each subplot, observers count the number of pellet groups. Observers record the number of pellets and pellet clumps per group, and note the decay class for each pellet group; those attributes may influence pellet group detection probabilities, and they will be used to estimate detection biases associated with the surveys (**SOP 11: Data Summary, Analysis and Reporting**). Observers carry a collapsible 3-m long stick to determine whether a pellet group is within or outside of the 3-m radius subplot. The observer notes the approximate location of the pellet group within the subplot on a circular sketch for reference.

The estimation of detection biases associated with counting pellet groups is based on independent recounts of subplots. After the first round of surveys, each observer recounts a randomly-selected subplot that was previously counted by the team partner providing the basis for the double-observer estimation of detection biases (**SOP 11: Data Summary, Analysis and Reporting**). In this way, two of the four subplots are counted twice (once by each team member). After two subplots are recounted, the observers compare notes about which pellet groups were seen by one or both team member. Reference to the sketches can help determine which pellet group was seen by whom. The data for each pellet group in recounted subplots is coded with a letter that signifies whether that pellet group was seen by only the first observer, only by the second observer, or by both. Observers then 'clear' any pellets that were found from all of the subplots, meaning that they remove all elk pellets from those subplots.

Upon completing the sampling session at a point, the team notes the end time, and moves to the next point, noting the start of walking time on the Walking Time Data Sheet. Back at the office, the team returns data forms to the Project Lead, and notes what points they completed on the checklist of points.

After the Field Season

At the end of the field season, field equipment for the pellet surveys (pin flags, 3-m PVC sticks, stopwatches) is returned to storage in the Resource Building garage at LEWI. Laminated maps and SOPs should be returned to the Project Lead for filing and storage until the next sampling session. The Project Lead ensures that data from the entire survey are entered into the pellet survey database, and that hard copies of the survey forms go to the park archives.

C. Road Surveys

Field Preparations and Sampling Methods

Detailed descriptions of methods for road surveys are presented in **SOP 7: Conducting Road Surveys**. Before conducting surveys, the driver and/or observer should assemble equipment, including reflective safety vests, clipboard and field forms, maps and route directions, binoculars, a sighting compass, and a laser rangefinder. The volunteers or staff acting as driver and observer on the survey should be trained in the methods for data recording. Drivers must possess a valid license, and must be authorized to drive a government vehicle, if one is used.

Surveys require two people. In the interests of safety, responsibilities of the survey team must be understood. It is the responsibility of the driver to drive safely at all times, focusing attention entirely on driving and related road conditions. It is the observer's responsibility to look for elk during the survey and to help navigate.

The survey team should assemble before sunrise, so that they are at the beginning of their first route of the day no later than 15 minutes after sunrise. Vehicle windows should be very clean. Personnel should wear high-visibility safety vests so that they will be seen if they step out of the vehicle. The routes to follow should be determined before driving begins. The order of routes surveyed should vary between survey events. Road surveys can be conducted on any morning with adequate weather conditions, defined by the lack of high winds, heavy rain, sleet, snow, dense fog, or hail (see **SOP 7: Conducting Road Surveys**).

Before initiating the survey, the observers will prepare the field forms and enter data to indicate the times and the weather conditions at the time of the survey. Although it's not an objective of this protocol to examine relationships between weather variables and elk sightings, the information is quickly and easily recorded and provides a simple verification that the surveys were conducted under proper prescriptions. The data on weather also may useful for interpreting potential anomalies in the data set and could be useful in exploratory analyses in the future.

Specified routes are driven slowly – between 15 and 25 mph. When an elk group (one or more elk) is seen, the driver should safely pull off the road. Each unique elk group observation gets its own number. The number of elk in the herd and their location are of high interest. Because the vehicle is stopped, both driver and observer can count the group size and the numbers of elk in different age and sex categories. The observer should note the UTM coordinates of the vehicle, or the miles and tenths of miles along the route closest to their parked location. The observer uses a laser range finder to record the distance to the center of the elk group. The observer also steps away from the vehicle and uses a sighting compass to record the compass bearing from observer to elk group (the azimuth). Although distances and azimuths are often used in distance sampling methods to estimate densities of animals seen, that is not the monitoring objective, due to problems with methodological assumptions (see above, **2.C. Rationale for Selecting these Sampling Designs over Others**). Distances and azimuths will be recorded to assist in plotting locations of animals seen and providing a graphical summary of observations.

After completing one route, the observer and driver can proceed to another route. After the road survey is done, the observer should return data forms to the Project Lead, who ensures that data

are entered into the road survey database, and that hard copies of the survey forms go to the park collections.

4.0 Information Management

This chapter describes the procedures for data handling, analysis, and report development. Additional details and context for this chapter are provided in the NCCN Data Management Plan (Boetsch et al. 2009), which describes the overall information management strategy for the network. The NCCN website (http://science.nature.nps.gov/im/units/nccn/datamgmt_guide.cfm) also contains guidance documents on various information management topics (e.g., report development, GIS development, GPS use).

A. Project Information Management Overview

Project information management may be best understood as an ongoing or cyclic process, as shown in Figure 5. Specific yearly information management tasks for this project and their timing are described in **Appendix A: Yearly Project Task List**. Readers may also refer to each respective chapter section for additional guidance and instructions.

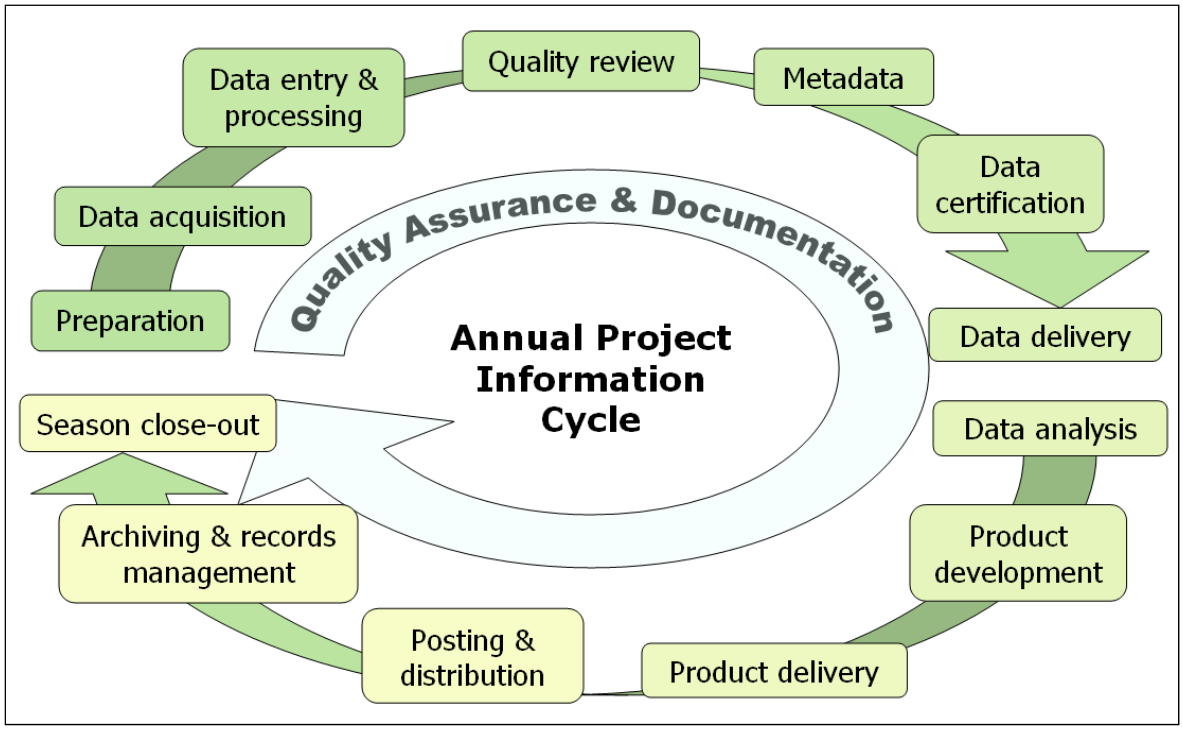

Figure 5. Idealized diagram of the cyclical stages of project information management. Stages flow sequentially from pre-season preparation to season close-out. Note that quality assurance and documentation are thematic and not limited to any particular stage.

The stages of this cycle are described in greater depth in later sections of this chapter, but can be briefly summarized as follows:

- *Preparation* – Training, logistics planning, print forms and maps
- *Data acquisition* – Field trips to acquire data
- *Data entry & processing* – Data entry and database uploads, GPS data processing, etc.

- *Quality review* – Data are reviewed for structural integrity, completeness and logical consistency
- *Metadata* – Documentation of the year's data collection and results of the quality review
- *Data certification* – Data are certified as complete for the period of record
- *Data delivery* – Certified data and metadata are delivered for archiving
- *Data analysis* – Data are summarized and analyzed
- *Product development* – Reports, maps, and other products are developed
- *Product delivery* – Deliver reports and other products for posting and archiving
- *Posting & distribution* – Distribute products as planned and/or post to NPS clearinghouses
- *Archiving & records management* – Review analog and digital files for retention (or destruction) according to NPS Director's Order 19. Retained files are renamed and stored as needed
- *Season close-out* – Review and document needed improvements to project procedures or infrastructure, complete administrative reports, and develop work plans for the coming season

B. Pre-season Preparations for Information Management

Project Workspace Setup

A section of the networked file server at each host park is reserved for this project, and access privileges are established so that project staff members have access to needed files within this workspace. Prior to each season, the Project Lead should make sure that network accounts are established for each new staff member, and that the Data Manager is notified to ensure access to the project workspace and databases. Workspace structure, naming conventions, and additional details are provided in **SOP 1: Project Workspace and Records Management**.

GPS Loading and Preparation

The GIS Specialist and Project Lead should work together to ensure that target coordinates and data dictionaries are loaded into the GPS units prior to the onset of field work, and that GPS download software is available and ready for use. Additional details on GPS use and GPS data handling are provided in **SOP 4: GPS Use** and in NCCN GPS Guidelines (North Coast and Cascades Network– National Park Service 2007a).

Project Database Application

Prior to the field season, the Data Manager will update the project database application as needed to ensure proper access on the part of the project staff. Refer to **Section 4C, Overview of Database Design** for additional information about the database design and implementation strategy.

C. Overview of Database Design

We maintain a customized relational database application to store and manipulate the data associated with this project. The design of this database is consistent with NPS I&M and NCCN standards. The Data Manager is responsible for development and maintenance of the database, including customization of data summarization and export routines.

The database is divided into two components – one for storing data in a series of related tables composed of fields and records (i.e., the "back-end database"), and another that acts as a portal or user interface through which data may be entered, viewed, edited, error-checked, summarized and exported (i.e., the "front-end application"). By splitting the database into front-and back-end components, multiple users may interact with the data simultaneously, and user interface updates can be implemented without service disruptions.

The back-end database schema (tables, fields and relationships) is documented in **Appendix B: Lewis and Clark NHP Elk Monitoring Protocol Database Documentation**. The back-end database is implemented in Microsoft SQL Server to take advantage of the automated backup and transaction logging capabilities of this enterprise database software.

The front-end is implemented in Microsoft Access. It contains the forms, queries, and formatted report objects for interacting with the data in the back-end. Its features and functionality are customized using Visual Basic for Applications (VBA) programming code. The application has separate forms for data entry that mirror the layout of hard-copy field forms used during data collection. There are also forms for browsing and editing data, for completing the annual quality review, and for summarizing and exporting data to other software (e.g., for analysis and graphics production).

D. Data Entry and Processing

During the field season, the project crew will be provided with a copy of the project database front-end, through which they enter, process, and quality-check data for the current season.

Technicians should enter data as soon as possible after each field trip in order to keep current with data entry tasks, and to identify any errors or problems as close to the time of data collection as possible. The front-end database application is found in the project workspace. For enhanced performance, it is recommended that users copy the front-end onto their workstation hard drives and open it there. This front-end copy may be considered "disposable" because it does not contain any data, but rather acts as a pointer to the data that reside in the back-end database. Whenever updates to the front-end application are made available by the Data Manager, an updated front-end should be copied from the project workspace to the workstation hard drive.

The functional components of the front-end application are described in **SOP 8: Data Entry and Verification**. Each data entry form is patterned after the layout of the corresponding field form, and has built-in quality assurance components such as pick lists and validation rules to test for missing data or illogical combinations. Although the database permits users to view the raw data tables and other database objects, users are strongly encouraged to use only these pre-built forms as a way of ensuring maximum data quality.

Regular Data Backups

Automatic database backups are scheduled in the SQL Server database management system to help prevent data loss in case of user error, drive failure, or database file corruption. Full backups are scheduled on a weekly basis, with daily transactional backups to enable restore operations to a point in time within a moving eight-week window. Weekly backups and transaction files are retained for eight weeks to conserve drive space. Full monthly backups are stored for at least one

year after data have been certified. Snapshot backup copies of certified data, made at the time of certification, are retained indefinitely.

Data Verification

As data are being entered, the person doing the data entry should visually review them to make sure that the data on screen match the field forms. This should be done for each record prior to moving to the next form for data entry. At regular intervals and at the end of the field season the Field Lead should inspect the data being entered to check for completeness and perhaps identify avoidable errors. The Field Lead may also periodically run the Quality Assurance Tools that are built into the front-end database application to check for logical inconsistencies and data outliers (this step is described in greater detail in **Section 4E, Data Quality Review** and also in **SOP 9: Data Quality Review and Certification**).

Field Form Handling Procedures

As field data forms are part of the permanent record for project data, they should be handled in a way that preserves their future interpretability and information content. If changes to data on the forms need to be made subsequent to data collection, the original values should not be erased or otherwise rendered illegible. Instead, changes should be made as follows:

1. Draw a horizontal line through the original value, and write the new value adjacent to the original value with the date and initials of the person making the change.
2. All corrections should be accompanied by a written explanation in the appropriate notes section on the field form. These notes should also be dated and initialed.
3. If possible, edits and revisions should be made in a different color ink to make it easier for subsequent viewers to be able to retrace the edit history.
4. Edits should be made on the original field forms and on any photocopied forms.

These procedures should be followed throughout data entry and data revision. On a four-year basis, data sheets are to be scanned as PDF documents and archived (see the product delivery specifications in **SOP 13: Product Delivery, Posting and Distribution**). The PDF files may then serve as a convenient digital reference of the original if needed.

Image Handling Procedures

This section covers photographic images collected by project staff or volunteers during the course of conducting project-related activities. Images that are acquired by other means – e.g., downloaded from a website or those taken by a cooperating researcher – are not project records and should be filed and named in such a way that they will not be confused with project records.

Care should be taken to distinguish data photographs from incidental or opportunistic photographs taken by project staff. Data photographs are those taken for at least one of the following reasons:

- To document a particular feature or perspective for the purpose of site relocation
- To capture site characteristics and possibly to document gross structural changes over time
- To document a species detection that is also recorded in the data

Data photographs are often linked to specific records within the database, and are stored in a manner that permits the preservation of those database links. Other photographs – e.g., of field crew members at work, or photographs showing the morphology or behavior of certain elk individuals – may also be retained but are not necessarily linked with database records.

At present we do not anticipate collecting data photographs for this project. If this changes, an SOP will be developed to specify image file naming conventions and handling procedures. Otherwise, project staff should follow common-sense practices for digital file maintenance as articulated in **SOP 1: Project Workspace and Records Management**.

GPS Data Procedures

The following general procedures should be followed for GPS data (see **SOP 4: GPS Use** and **Appendix A: Yearly Project Task List**):

1. GPS data should be downloaded by the field crew from the units at the end of each field trip and stored in the project workspace (see **SOP 1: Project Workspace and Records Management**)
2. Raw files should be sent in a timely manner to the GIS Specialist for processing and correction
3. The GIS Specialist will process the raw GPS data and store the processed data in the project workspace
4. The GIS Specialist will upload corrected coordinate information into the database and create or update any project GIS data sets as needed

The Field Lead should periodically review the processed GPS data to make sure that any errors or inconsistencies are identified early.

E. Data Quality Review

After the data have been entered and processed, they need to be reviewed by the Project Lead for structural integrity, completeness and logical consistency. The front-end database application facilitates this process by showing the results of pre-built queries that check for data integrity, data outliers and missing values, and illogical values. The user may then fix these problems and document the fixes. Not all errors and inconsistencies can be fixed, in which case a description of the resulting errors and why edits were not made is documented and included in the metadata and certification report (see **Sections 4F, Metadata Procedures** and **4G, Data Certification and Delivery**, and **SOP 9: Data Quality Review and Certification**).

Data Edits After Certification

Due to the high number of data changes and/or corrections during data entry, it is not efficient to log all changes until after data are reviewed and certified. Prior to certification, daily backups of the database provide a crude means of restoring data to the previous day's state. After certification, all edits to certified records are tracked in an edit log (refer to **Appendix B: Lewis and Clark NHP Elk Monitoring Protocol Database Documentation**) so that future data users will be aware of changes made after certification. In case future users need to restore data to the certified version, we also retain a separate, read-only copy of the original, certified data for each year in the NCCN Digital Library (refer to **SOP 13: Product Delivery, Posting and Distribution**).

Geospatial Data

The Project Lead and GIS Specialist may work together to review the surveyed coordinates and other geospatial data for accuracy. The purpose of this joint review is to make sure that geospatial data are complete and reasonably accurate, and also to determine which coordinates will be used for subsequent mapping and field work.

F. Metadata Procedures

Data documentation is a critical step toward ensuring that data sets are usable for their intended purposes well into the future. This involves the development of metadata, which can be defined as structured information about the content, quality, condition and other characteristics of a given data set. Additionally, metadata provide the means to catalog and search among data sets, thus making them available to a broad range of potential data users. Metadata for all NCCN monitoring data will conform to Federal Geographic Data Committee (FGDC) guidelines and will contain all components of supporting information such that the data may be confidently manipulated, analyzed and synthesized.

At the conclusion of the field season (according to the schedule in **Appendix A: Yearly Project Task List**), the Project Lead will be responsible for providing a completed, up-to-date metadata interview form to the Data Manager. The Data Manager and GIS Specialist will facilitate metadata development by consulting on the use of the metadata interview form, by creating and parsing metadata records from the information in the interview form, and by posting such records to national clearinghouses.

An up-to-date metadata record is a required deliverable that should accompany each season's certified data. For long-term projects such as this one, metadata creation is most time consuming the first time it is developed – after which most information remains static from one year to the next. Metadata records in subsequent years then only need to be updated to reflect changes in contact information and taxonomic conventions, to include recent publications, to update data disposition and quality descriptions, and to describe any changes in collection methods, analysis approaches or quality assurance for the project.

Specific procedures for creating, parsing and posting the metadata record are provided in NCCN Metadata Development Guidelines (North Coast and Cascades Network—National Park Service, 2007b). General procedures are as follows:

1. After the annual data quality review has been performed and the data are ready for certification, the Project Lead (or a designee) updates the metadata interview form.
    a. The metadata interview form greatly facilitates metadata creation by structuring the required information into a logical arrangement of 15 primary questions, many with additional sub-questions.
    b. The first year, a new copy of the NCCN Metadata Interview form (available at: http://science.nature.nps.gov/im/units/nccn/datamgmt_guide.cfm) should be downloaded. Otherwise the form from the previous year can be used as a starting point, in which case the Track Changes tool in Microsoft Word should be activated in order to make edits obvious to the person who will be updating the XML record.

c. Complete the metadata interview form and maintain it in the project workspace. Much of the interview form can be filled out by cutting and pasting material from other documents (e.g., reports, protocol narrative sections, and SOPs).
d. The Data Manager can help answer questions about the metadata interview form.

2. Deliver the completed interview form to the Data Manager according to the product delivery instructions in **SOP 13: Product Delivery, Posting and Distribution**.
3. The Data Manager (or GIS Specialist for spatial data) will then extract the information from the interview form and use it to create and update an FGDC- and NPS-compliant metadata record in XML format. Specific guidance for creating the XML record is contained in NCCN Metadata Development Guidelines (North Coast and Cascades Network—National Park Service, 2007b).
4. The Data Manager will post the record and certified data to the NPS Natural Resource Information Portal (NRInfo), and maintain a local copy of the XML file for subsequent updates. NRInfo has help files to guide the upload process.
5. The Project Lead should update the metadata interview content as changes to the protocol are made, and each year as additional data are accumulated.

G. Data Certification and Delivery

Data certification is a benchmark in the project information management process that indicates that: 1) the data are complete for the period of record; 2) they have undergone and passed the quality assurance checks (**Section 4E, Data Quality Review**); and 3) they are appropriately documented and in a condition for archiving, posting and distribution as appropriate. Certification is not intended to imply that the data are completely free of errors or inconsistencies that may or may not have been detected during quality assurance reviews.

To ensure that only quality data are included in reports and other project deliverables, the data certification step is an annual requirement for all tabular and spatial data. The Project Lead is the primary person responsible for completing an NCCN Project Data Certification Form, available at: http://science.nature.nps.gov/im/units/nccn/datamgmt_guide.cfm. This brief form should be submitted with the certified data according to the timeline in **Appendix A: Yearly Project Task List**. Refer to **SOP 9: Data Quality Review and Certification** and the delivery specifications in **SOP 13: Product Delivery, Posting and Distribution** for specific instructions.

H. Analysis, Reporting and Product Development

After data for the most recent season have been certified, data analysis and report development may proceed. Specific analysis methods and report content are described in **Chapter 5: Analysis and Reporting**.

Standard Report Format

Biennial reports and four-year analysis reports will use the NPS Natural Resource Publications template, a pre-formatted Microsoft Word template document based on current NPS formatting standards. Biennial reports will use the Natural Resource Report template, and four-year analysis and other peer-reviewed technical reports will use the Natural Resource Technical Report template. These templates and documentation of the NPS publication standards are available at: http://www.nature.nps.gov/publications/NRPM/index.cfm.

Review Products for Sensitive Information

Before preparing data in any format for sharing outside NPS – including presentations, reports, and publications – the Project Lead should refer to the guidance in the next section and in **SOP 12: Sensitive Information Procedures**. Certain information that may convey specific locations of sensitive resources may need to be screened or redacted from public versions of products prior to release.

I. Identifying and Handling Sensitive Information

Certain project information related to the specific locations of rare or threatened taxa may meet criteria for protection and as such should not be shared outside NPS except where a written confidentiality agreement is in place prior to sharing. Before preparing data in any format for sharing outside NPS – including presentations, reports, and publications – the Project Lead should consider whether or not the resulting information might put protected resources at risk. Information that may convey specific locations of sensitive resources may need to be screened or redacted from public versions of products prior to release.

Although it is the general NPS policy to share information widely, the NPS also realizes that providing information about the location of park resources may sometimes place those resources at risk of harm, theft, or destruction. This can occur, for example, with regard to caves, archeological sites, tribal information, and rare plant and animal species. Therefore, information will be withheld when the NPS foresees that disclosure would be harmful to an interest protected by an exemption under the Freedom of Information Act (FOIA). The National Parks Omnibus Management Act, Section 207, 16 U.S.C. 5937, is interpreted to prohibit the release of information regarding the "nature or specific location" of certain cultural and natural resources in the national park system. Additional details and information about the legal basis for this policy are in the NPS Management Policies (National Park Service 2006), and in Director's Order 66 (available at: http://data2.itc.nps.gov/npspolicy/DOrders.cfm).

These guidelines apply to all NCCN staff, cooperators, contractors, and other partners who are likely to acquire or otherwise have access to information about protected NPS resources. The Project Lead has primary responsibility for ensuring adequate protection of sensitive information related to this project.

The following are highlights of our strategy for protecting this information:

- *Protected resources*, in the context of the NCCN Inventory and Monitoring Program, include species that have State- or Federally-listed status, and other species deemed rare or sensitive by local park taxa experts.
- *Sensitive information* is defined as information about protected resources that may reveal the "nature or specific location" of protected resources. Such information must not be shared outside the National Park Service, unless a signed confidentiality agreement is in place.
- In general, if information is withheld from one requesting party, it must be withheld from anyone else who requests it, and if information is provided to one requesting party. without a confidentiality agreement, it must be provided to anyone else who requests it

- To share information as broadly as legally possible, and to provide a consistent, tractable approach for handling sensitive information, the following shall apply if a project is likely to collect and store sensitive information:
    - Random coordinate offsets of up to 2 km for data collection locations, and
    - Removal of data fields likely to contain sensitive information from released data set copies.

It is also imperative to not associate elk observations outside the park with any specific dates. Elk group observations will be grouped into a time scale no finer than 4-month periods to allow seasonal movement patterns to be discerned without revealing details about fine-scale elk movement, which can be quite regular from year to year.

Additional details for identifying, handling and protecting sensitive information are described in **SOP 12: Sensitive Information Procedures**.

J. Product Delivery, Posting and Distribution

Refer to **SOP 13: Product Delivery, Posting and Distribution** for the complete schedule for project deliverables and instructions for packaging and delivering them. Upon delivery products will be posted to NPS websites and clearinghouses (e.g., Reference, NPSpecies, NRInfo) as appropriate.

Holding Period for Project Data

To permit sufficient time for priority in publication, certified project data will be held upon delivery for a period not to exceed two years after it was originally collected. After the 2 year period has elapsed, all certified, non-sensitive data will be posted to NRInfo. Note: This hold only applies to raw data, and not to metadata, reports or other products which are posted to NPS clearinghouses immediately after being received and processed.

Special Procedures for Sensitive Information

Products that have been identified upon delivery by the Project Lead as containing sensitive information will normally be revised into a form that does not disclose the locations of protected resources – most often by removing specific coordinates and only providing coordinates that include a random offset to indicate the general locality of the occurrence. If this kind of measure is not a sufficient safeguard given the nature of the product or the protected resource in question, the product(s) will be withheld from posting and distribution.

If requests for distribution of products containing sensitive information are initiated by the NPS, by another federal agency, or by another partner organization (e.g., a research scientist at a university), the unedited product (i.e., the full data set that includes sensitive information) may be shared only after a confidentiality agreement has been established between NPS and the agency, organization, or person(s) with whom the sensitive information is to be shared. Refer to **Section 4I, Identifying and Handling Sensitive Information** for more information.

K. Archiving and Records Management

All project files should be reviewed and organized by the Project Lead on a regular basis (e.g., annually in January). Unneeded draft documents and other intermediate files should be deleted to conserve space and maintain a clear and unambiguous record for future project staff. See **SOP 1:**

Project Workspace and Records Management for more details. Decisions on what to retain and what to destroy should be made following guidelines stipulated in NPS Director's Order 19 (available at: http://data2.itc.nps.gov/npspolicy/DOrders.cfm), which provides a schedule indicating the amount of time that the various kinds of records should be retained.

Because this is a long-term monitoring project, good records management practices are critical for ensuring the continuity of project information. Files will be more useful to others if they are well organized, well named, and stored in a common format. Details for handling project files are described in **SOP 1: Project Workspace and Records Management**. In addition, files containing sensitive information must be stored in a manner that will enable quick identification. Refer to **Section 4I, Identifying and Handling Sensitive Information**.

L. Season Close-out

After the conclusion of the field season, the Project Lead, Data Manager, and GIS Specialist should meet to discuss the recent field season, and to document any needed changes to the field sampling protocols, to the database structure or front-end application, or to any of the SOPs associated with the protocol.

5.0 Analysis and Reporting

A. Data Analysis

Data will be analyzed at time intervals that are appropriate for the monitoring objectives. Biennial reports will not rely on data analysis, other than tabular and graphical summaries of the observations from the preceding two years; this will include one year of NCCN I&M elk pellet survey data and two years of road surveys (Table 3). Four-year synthesis reports will be produced after the fourth year of elk pellet data collection, and will include detailed trend analyses (Table 3). Additional trend analyses could be conducted more frequently if biennial results provide compelling reason to do so, and if funding is available.

Biennial Summaries

Biennial summaries of pellet survey data should include the number of points sampled, and the number of subplots sampled at each point. Usually four subplots are searched per point, but sometimes one or more subplots is inaccessible. The average number of pellet groups observed per subplot, $\bar{R}_t$, is the mean of the number of pellet groups per subplot at each of the *i* points in year t, $R_{i,t}$. The only two maps that we suggest including in biennial summaries will depict the sampled points at which any elk pellets were observed; separate maps should be prepared for each sampling session (e.g., Figure 6).

Biennial summaries of road survey data include, for each year and month, the number of surveys conducted, the average and standard deviation of the number of elk groups seen per survey, the average and standard deviation of the total number of elk, calves, and bulls seen per survey. We will also compute observed calf:cow and bull:cow ratios for each year of survey, and report the monthly median and ranges of those ratios.

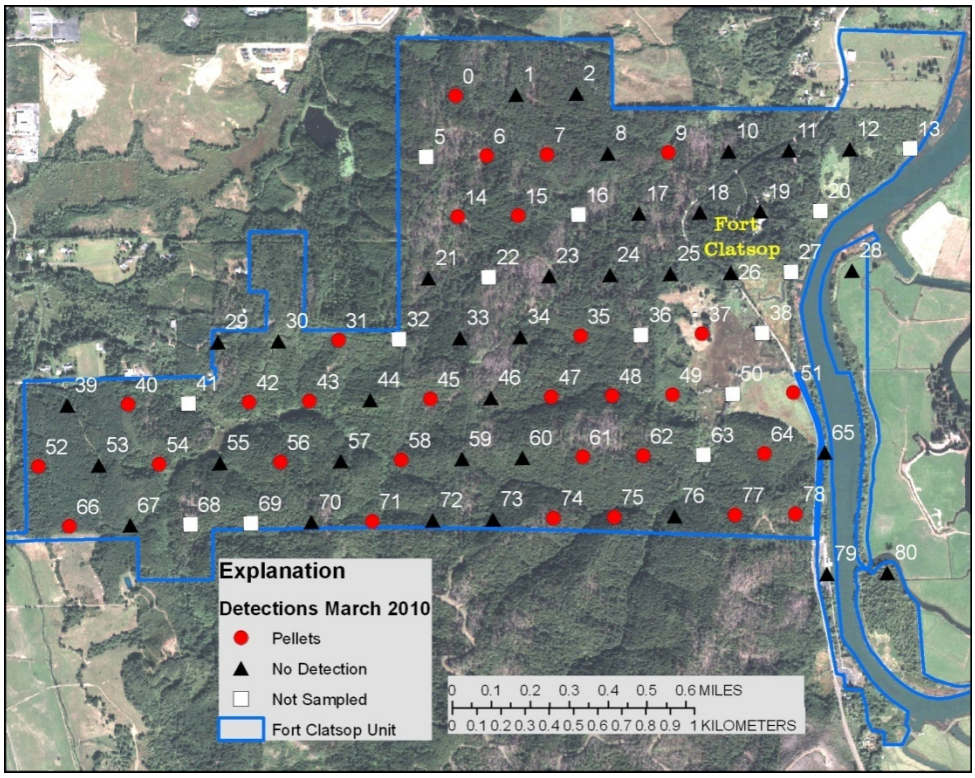

Figure 6. Example figure of results showing elk pellet detections at sampled points. These data are from March 2010. Elk pellets were detected at points with red circles, but were not detected at points with black triangles. No sampling took place at points with white squares. Yellow text indicates the vicinity of Fort Clatsop and the visitor center.

B. Four-year Analysis

The analysis summarized in this section will be conducted for four-year reports. **SOP 11: Data Summary, Analysis, and Reporting** contains more detailed presentation of analytical methods.

Estimates of PAO, mean relative use, and monthly road survey sighting rates are amenable to trend analysis. These measures have associated point estimates and standard errors, so a linear regression of those estimates can be used to test for statistically significant decline or increase. Trends in PAO and mean relative use allow for inference to biological processes, because these measures include modeling that accounts for incomplete detection (Link and Sauer 1998). Trend estimates for these parameters should be updated every four years.

Estimating PAO

Having two independent 'visits' per point allows for the estimation of PAO and the associated function for $\hat{p}_{\text{detection}}$, the probability of detecting elk pellets, given that any are present at a point. We will use occupancy models (MacKenzie et al. 2002) in Program MARK (White and Burnham 1999) to assess which of several competing occupancy models best fits the observed data. Different models will allow $\hat{p}_{\text{detection}}$ to vary at different surveyed points, as a function of covariates that could potentially influence detection probability, including plot-level covariates such as light level, blowdown severity, or the number of subplots searched. The values for each year's estimates of PAO (along with associated variance estimates) will be taken from the best

fitting of those competing occupancy models (**SOP 11: Data Summary, Analysis, and Reporting**).

Estimating Relative Use and Detection Probability of Single Pellet Groups

A "raw" estimate of the average number of pellet groups per subplot at point *i* in year *t*, which we term $R_{i,t}$, is an incomplete measure of elk relative use, because it does not account for the probability of detecting a given pellet group, which we call $\hat{p}_{\text{group}}$. The recounted subplots allow for estimation of $\hat{p}_{\text{group}}$, because individual pellet groups can be either seen or not seen by each observer. The combined records of pellet group observation by only first, only second, or both observers, serve as data that are similar to the kind collected in mark-recapture studies of wild animal abundance (Williams et al. 2002). Those data can be analyzed to estimate $\hat{p}_{\text{group}}$, which could vary as a function of factors that might influence detection (Huggins 1989, 1991), such as the size of a pellet group, light conditions during search, or the density of vegetative cover in a subplot (Jenkins and Manly 2008). We use program MARK (White and Burnham 1999) to compare the relative fit of different closed-population mark-recapture models, which may or may not include effects of those covariates. We take the estimate of $\hat{p}_{\text{group}}$ from the best fitting of these models, where relative fit is assessed with Akaike weights (Burnham and Anderson 2002). For each pellet group that is found in late winter surveys, we define a pellet-group-specific weight,$\widehat{w}$, which is a function of the pellet-group-specific value of $\hat{p}_{\text{group}}$. The weight is the number of pellet groups represented by a pellet group that is found – the higher the probability of seeing a pellet group, the closer the weight is to one.

$\hat{G}_{i,t}$ is the estimate of relative use for each sampled point in year t; its units are the estimated number of pellet groups per subplot. The value of $\hat{G}_{i,t}$ for point *i* is the sum of all the weights for the particular pellet groups that were found in all the surveyed subplots at point *i*, divided by the number of surveyed subplots there. The mean estimate of relative use for the Fort Clatsop unit is what we call $\hat{G}_{mean,t}$; it is the average of all the sampled $\hat{G}_{i,t}$ values. We will test for trends in the mean value of relative use over time.

Mapping Spatial Distributions of Relative Use

To approximate a surface of elk use we interpolate the estimated point values for $\hat{G}_{i,t}$ across the unsampled spaces, using inverse square distance weighting. The result is a map of estimated relative use for the entire Fort Clatsop unit.

Because mean relative use can change over time, we also calculate a unit-less, standardized measure of relative use, which we call $\widehat{U}_{i,t}$. The standardized relative use value for each sampled point is its relative use value, minus the mean relative use for that sampling session, and divided by the standard deviation of that mean value. $\widehat{U}_{i,t}$ is not affected by the magnitude of mean relative use, so it is particularly useful for monitoring temporal changes in the spatial pattern of elk use. The four-year analysis will include calculation of linear trend for $\widehat{U}_{i,t}$ at each point, with the slopes of those regressions used as point values for interpolation across the Fort Clatsop unit. The resulting map will show which parts of the unit have experienced broad increases or decreases in elk use over time.

Road Survey Trends

For each month in which surveys took place, four-year analysis will test for a trend in temporal changes in the number of elk groups sighted per survey, the total number of elk seen per survey, and in median observed calf:cow and bull:cow ratios.

The four-year report will include a map showing the locations of all elk group observations made during road surveys. These locations will be grouped according to three 4-month periods: January to April; May to August, and; September to December. Specific dates will not be associated with any elk observations in products that will be shared with the public (**SOP 12: Sensitive Information Procedures**).

C. Reporting

Details about biennial report guidelines are provided in **SOP 11: Data Summary, Analysis, and Reporting**. Biennial and four-year reports will include information as outlined in Table 3.

Table 3. Results to include in biennial and four-year reports.

Biennial reports
Pellet Survey
Names and roles of project personnel
Number of points sampled
Table of observed number of pellet groups per subplot, $R_{i,t}$, for each point,i, in year t
Fraction, for each sampling session, of sampled points with any elk pellets found
Map for each sampling session of pellet detection at sampled points
Road Surveys
Names and roles of project personnel
Number of road surveys conducted per route per month
Sighting rate: Mean and SD of number of elk group observations per survey, per month, separate for each route
Monthly mean and SD of total number of elk
Monthly median, and range, of calf:cow ratio and bull:cow ratios
Four-year reports
Pellet Survey
Estimates of PAO for each year
Estimates of relative use, in terms of $\widehat{G}_{mean}$, for each year, and the equation for the associated detection probability function describing $\widehat{p}_{\text{group}}$
Separate maps for each year's estimates of $\widehat{G}_i$ at sampled points, interpolated across the Fort Clatsop unit
Trends in estimated mean relative use, $\widehat{G}_{mean}$
Trends in standardized relative use at each point $\widehat{U}_i$, mapped and interpolated
Map that shows line segments, where elk pellets were either seen or not seen by survey teams walking *en route* to survey points
Road Surveys
Monthly trends in the number of elk groups seen per survey
Monthly trends in average total number of elk seen per survey
Monthly trends in the median bull:cow and calf:cow ratios
Map of all elk locations recorded during road surveys, grouped into three 4-month periods

6.0 Personnel Requirements and Training

A. Roles and Responsibilities

Specific responsibilities of personnel involved with this project are detailed in Table 4. The Project Lead assures the overall completion of the protocol, including project administration, personnel supervision, data certification, and reporting. Currently, the Project Lead is also the Field Lead who plans, oversees, and executes pellet surveys and road surveys. Other observers on the pellet survey will be NPS technicians and, when possible, volunteers. Pellet survey field operations are to be conducted in teams of two. At least one person per team should be NPS staff and/or experienced in conducting the surveys. The most efficient and cost-effective staffing for conducting pellet sampling sessions is to have one Project Lead, two NPS technicians, and three volunteers; if volunteers are not available, other park staff should be encouraged to assist.

Road surveys are conducted by a driver and an observer. Either, or both, of these could be NPS volunteers, but any driver must have the necessary permissions to operate a park vehicle, if one is used. Road survey personnel are supervised by, and may include, the Project Lead.

B. Qualifications

Technicians involved with pellet survey must be physically fit, with good or correctable vision and excellent balance. Technicians involved with road surveys should have good or correctable vision. Drivers involved with road surveys should also have a valid driver's license and legal permission to drive any federal vehicles that are used.

C. Training

Training for pellet surveys will take place the first day of a pellet survey session. Technicians that have not conducted pellet surveys before should be trained. Training will be accomplished with training exercises and measurement of one or more sample points. Training will include reference to an extensive library of photographs illustrating elk pellet groups of many sizes, arrangements, and decay classes (**SOP 3: Training Observers**).

The following topics will be covered, as detailed in **SOP 3: Training Observers**:

- Safety – including safety off trail
- Navigation with GPS
- Sample point layout, sampling procedures, and data recording
- Pellet identification and decay classification

Training for road surveys will take place as needed so that technicians can take part as drivers or observers. The trainee will sit in the rear seat, and the observer will explain navigation and data recording to the trainee during the course of surveying all the designated routes.

Table 4. Roles and responsibilities for elk monitoring in Lewis and Clark NHP.

Role	Responsibilities	Name / Position
Project Lead	• Project administration, operations, and implementation • Track project objectives, budget, requirements, and progress toward meeting objectives • Coordinate and ratify changes to protocol • Ensure project compliance with park requirements • Lead training of field crews • Maintain and archive project records • Certify each season's data for quality and completeness • Complete reports, metadata, and other products according to schedule	Carla Cole, Natural Resource Project Manager, LEWI*
Data Analyst	• Perform data summaries and analysis, assist interpretation and report preparation	
Field Lead	• Assist in training and ensuring safety of field crew • Plan and execute field visits • Acquire and maintain field equipment • Oversee data collection and entry, verify accurate data transcription into database • Complete a field season report	
Technicians	• Collect, record, enter and verify data	Permanent and seasonal technicians, volunteers and interns, LEWI
Data Manager	• Consult on data management activities • Facilitate check-in, review and posting of data, metadata, reports, and other products to national databases and clearinghouses according to schedule • Maintain and update database application • Provide database training as needed	John Boetsch, Data Manager, OLYM*
GIS Specialist	• Consult on spatial data collection, GPS use, and spatial analysis techniques • Facilitate spatial data development and map output generation • Work with Project Lead and Data Analyst to analyze spatial data and develop metadata for spatial data products • Primary steward of GIS data and products	Katherine Beirne, GIS Specialist, OLYM*
Network Coordinator	• Review biennial reports for completeness and compliance with I&M standards and expectations	Mark Huff, NCCN Network Program Manager
Park Curator	• Receive and archive copies of biennial reports, analysis reports, and other publications • Facilitate archiving of other project records (e.g., original field forms, etc.)	Tessa Langford, Curator, FOVA
USGS Liaisons	• Consultant on technical issues related to project sampling design, statistical analysis, or other issues related to changes in protocol and SOPs	Kurt Jenkins and Paul Griffin, USGS-FRESC

* These individuals act as coordinators and primary points of contact for this project. Their responsibility is to facilitate communication among network and park staff and to coordinate the work which may be shared among various staff to balance work load and to enhance the efficiency of operations.

7.0 Operational Requirements

A. Workload and Field Schedule

For those years with pellet surveys, **Appendix A: Yearly Project Task List** presents a table of annual project tasks with a listing of who is responsible and the timing of those tasks. In addition to the specific data collection tasks below, pellet group data, and road survey data will require attention from the Project Lead, Field Lead, Data Manager, and GIS Specialist who are all involved with biennial reporting.

Pellet group sampling sessions require the most planning of all project tasks, and also are the most labor-intensive. Pellet group sampling takes place every other year. In fiscal years with pellet group sampling, one sampling session takes place in late October / early November, and the other takes place in late February / early March. Approximately 20 person-days are needed to complete the fall sampling session and approximately 22 person-days are needed to complete the late winter sampling session. Training new observers requires approximately an additional four hours per observer, plus four hours per trainer. Two complete sampling sessions per year require approximately 42 person-days of field time.

The sampling frequency of road surveys is six months per year. In months that have road surveys, there should be three surveys completed per month. Each complete survey of all four numbered routes (~20 miles of survey plus ~ 10 miles of transit) takes two people approximately 2 ½ hours to complete. Therefore, each month of road surveys requires approximately three person-days.

B. Facility and Equipment Needs

Field supplies for the pellet survey, listed in **SOP 2: Before Each Pellet Group Sampling Session**, notably include park radios for each team of observers, one sighting compass and one GPS unit for each pellet survey team of two people, and stopwatches for each observer who lacks a digital watch. Field forms for pellet survey and for road surveys should be printed on waterproof paper.

Field supplies for road surveys, listed in **SOP 7: Conducting Road Surveys**, notably include a vehicle, high-visibility safety vests, at least one pair of binoculars of 8X or greater magnification, a sighting compass, a thermometer, and one laser range finder capable of measuring distances to ~1000 m.

For pellet surveys and road surveys, Lewis and Clark NHP will continue to provide the necessary vehicle. During the brief periods of fecal pellet surveys in the fall and late winter, all parts of the Fort Clatsop unit could be reached by foot from the park administrative center. It is, however, more efficient to drive and park closer to sample points on the western side of the Fort Clatsop unit. One vehicle must be available for early morning road surveys when they occur.

C. Costs and Budget Considerations

Based on three years of field testing, the costs to implement the protocol are modest; mostly for staff time for field operations and data management (Table 5). Costs to implement the protocol are shared between NCCN I&M and NCCN parks, but are primarily in-kind funding of staff of Lewis and Clark NHP. Opportunities to use qualified volunteer labor may be explored in the

future to keep implementation costs low (i.e., citizen science). Paired with experienced personnel, volunteers are a good fit for road surveys, pellet group surveys, or both, so long as the volunteers complete the required prior training.

Table 5 shows the implementation budget for years with elk pellet group surveys. Biennial reports will be produced for years with NCCN I&M funded pellet surveys, and will focus on summarized data from field counts of pellets and elk road surveys. We currently plan to conduct the comprehensive analysis of trends in pellet group counts, occupancy (PAO), and road survey counts once per four years of NCCN I&M funded pellet survey. However, if apparent trends that generate concerns among park managers are observed, the full analysis could be conducted at any time interval, provided that funding is available. The costs to produce these trend reports are shown in the lower section of Table 5.

Table 5. Implementation budget for elk monitoring at Lewis and Clark NHP. This is the implementation budget for the alternating years when NCCN funding is available to support pellet group surveys and biennial report production. During the alternating non-funded years, road surveys will be supported by LEWI, as staffing costs are minimal. The additional costs of synthesis analyses and reporting once per four years of NCCN I&M pellet survey are listed below the total cost for years with pellet surveys. Costs are in 2009 dollars. The Project Lead is currently also the Field Lead and the Data Analyst, but those roles are separated here, in case the tasks are split in the future.

Project Stage / Budget Category	Personnel	Grade	Pay Periods	NCCN I&M Basic Protocol Costs[1]	In-Kind Support from LEWI	Other NCCN I&M Support Costs[2]
Preparation	Project Lead	GS-9	0.05	$ 115		
	Field Lead	GS-9	0.05	$ 115		
	Technicians	GS-5	0.1		$ 170	
	Data Manager	GS-11	0.4			$1,232
Data Collection, Entry & Processing	Field Lead	GS-9	1.2	$ 2,760		
	Techs, pellet	GS-5	1.2		$ 2,040	
	Techs, road	GS-5	1.3		$ 3,400	
	Data Manager	GS-11	0.1			$ 308
Quality Review	Project Lead	GS-9	0.1		$ 230	
	Data Manager	GS-11	0.3			$ 924
	GIS Specialist	GS-9	0.2			$ 584
Data Certification & Documentation	Project Lead	GS-9	0.2		$ 460	
	Data Manager	GS-11	0.4			$1,232
Data Analysis	Data Analyst	GS-9	0.1		$ 230	
	GIS Specialist	GS-9	0.1			$ 292
	Data Manager	GS-11	0.1			$ 308
Reporting & Product Development	Data Analyst	GS-9	0.3		$ 690	
	Field Lead	GS-9	0.05		$ 115	
	Data Manager	GS-11	0.3			$ 924
	GIS Specialist	GS-9	0.1			$ 292
Archiving, Product Posting & Records Mgmt.	Data Manager	GS-11	0.3			$ 924
	Project Lead	GS-9	0.1		$ 230	
	NCCN Coordinator	GS-12	0.05			$ 190
Season Close-out	Field Lead	GS-9	0.05		$ 115	
	Project Lead	GS-9	0.05		$ 115	
	Data Manager	GS-11	0.2			$ 616
Travel (mileage)					$ 240	
Supplies				$ 30	$ 20	
Total Cost				**$ 3,020**	**$ 8,055**	**$ 7,826**
Additional costs of four-year analyses and reporting	Data Analyst	GS-9	1.5	$ 3,450		
	Wildlife Biologist[3]	--	--	$ 5,000		
	GIS Specialist	GS-9	0.4	$ 1,168		
	Data Manager	GS-11	0.5	$ 1,540		
	Project Lead	GS-9	1.0	$ 2,300		
Estimated Four-Year Report Total				**$13,458**		

[1] NCCN Basic Protocol Costs are NCCN funding, with the budget administered by the Project Lead.
[2] Other NCCN I&M Support Costs are contributions to salaries of NCCN staff that support the project.
[3] NCCN or contract / cooperative agreement.

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SOP 1: Project Workspace and Records Management

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Overview

This SOP describes how and where project files and records are managed by project staff. Workspace structure, naming conventions, and procedures for handling project files are included.

NCCN File Workspace

NCCN has a centralized file system and project workspaces available for use by field crews and project staff at: \\inpolymfs\parkwide\NCCN. This will help avoid the problem of NCCN projects having several versions of files on different servers around the network. These folders are set up so that park and network staff members at the network parks all have read privileges throughout the directory structure. Project leads and a few other individuals associated with each project have full privileges for their project folder so they can manage their own permissions. These workspaces are intended to be a more familiar and convenient way of storing information, as an adjunct to the NCCN SharePoint site. Project leads will decide what is to be stored locally in these project workspaces as opposed to on the team SharePoint site. Examples of files kept in these project workspaces include: working files for project field crews, GPS downloads, GIS map files, database files, and other project records.

The NCCN workspace is organized as follows under four main folders: Libraries, Projects, Temp, and Workspace. Project staff members will primarily be working in one or more of the project folders under Projects, and may wish to make desktop shortcuts to one or more of the project subfolders by right-clicking on the desired folder and selecting Send To > Desktop (create shortcut).

Project staff members should create a network shortcut to the project workspace by going to the Desktop in Windows Explorer and adding a new network place under My Network Places. Project staff located at OLYM will typically already have this path available to them via a mapped drive (e.g., the I:\ drive); however, they should still create this network shortcut where multiple parks are concerned for the sake of communications and consistency among parks. Performance is the main rationale for using network shortcuts instead of mapped drives at other parks.

Instructions for creating a network shortcut to the NCCN workspace:

1. Open an instance of Windows Explorer. One way is from the Start menu, go to: All Programs > Accessories > Windows Explorer. Another is to open My Documents, My Computer, or any other folder browser shortcut.
2. Navigate to the Desktop, and then to My Network Places.
3. Double-click the Add Network Place option to open the setup wizard.
4. Choose the option to specify the network location, then under network address, type in: \\inpolymfs\parkwide\NCCN
5. When prompted for a name for the network place, enter "NCCN" (or something similarly brief and meaningful).
6. This network place shortcut should now be available each time you log in to that particular computer, and can be accessed when navigating within most Windows software.

Project Workspace

A section of the NCCN workspace is reserved for this project. The recommended file structure within this workspace is shown in Figure SOP 1.1.

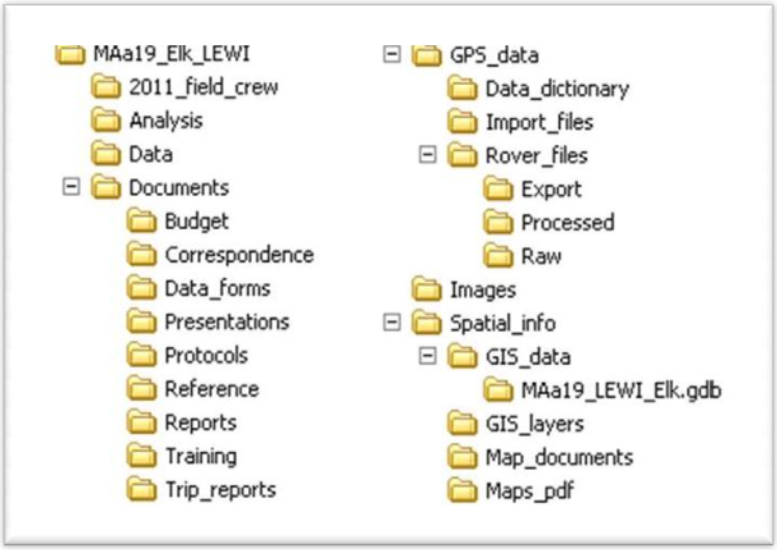

Figure SOP 1.1. Recommended file structure for project workspace. Note: The workspace folder name includes 'MAa19', the NCCN project code.

Each major subfolder is described as follows:

- Analysis – Contains working files associated with data analysis
- Data – Contains the front-end database application file for the season. The back-end database for the project is maintained in Microsoft SQL Server. Database exports and other intermediate summary information can be stored here as well; these files are most effectively managed within subfolders named by calendar year
- Documents – Contains subfolders to categorize documents as needed for various stages of project implementation. Additional folders and subfolders may be created as needed to arrange information in a way that is useful to project staff

- GPS data – Contains GPS data dictionaries, and raw and processed GPS data files. This folder contains subfolders to arrange files by year. Each of these subfolders also contains the project code to make it easier to select the correct project folder within the GPS processing software
- Images – For storing images associated with the project. This folder has subfolders named by calendar year to make it easier to identify and move files to the project archives at the end of each season. Photographs are not a central part of this protocol, but organizing them in this structure is useful for project records
- Spatial info – Contains files related to visualizing and interacting with GIS data
    - GIS data – Geodatabase for relational spatial data, plus new working shapefiles and coverages specific to the project
    - GIS layers – Pointer files to centralized GIS base themes and coverages
    - Map documents – Map composition files (.mxd)

Seasonal Workspace

In addition to these permanent folders, a temporary seasonal workspace is established at the beginning of each field season (e.g., "2011_field_crew"). This temporary workspace provides a place for field crew members to create and modify files while limiting access privileges for the remainder of the project workspace. Subfolders are created for Images and GPS data to allow field crew members to process incoming files as needed. Temporary workspaces may also be established on other servers to provide local access to crews stationed at other parks. At the end of the season, files in these temporary workspaces are then filed in the appropriate permanent folder(s).

Folder Naming Standards

In all cases, folder names should follow these guidelines:

- No spaces or special characters in the folder name
- Use the underbar ("_") character to separate words in folder names
- Try to limit folder names to 20 characters or fewer
- Dates should be formatted as YYYYMMDD (this leads to better sorting than other date naming conventions)

File Naming Standards

Unless otherwise specified, file names should follow these guidelines:

- No spaces or special characters in the file name
- Use the underbar ("_") character to separate file name components
- Try to limit file names to 30 characters or fewer, up to a maximum of 50 characters
- Dates should be formatted as YYYYMMDD
- Correspondence files should be named as YYYYMMDD_AuthorName_subject.ext
- Files with spatial information should follow the naming conventions listed in **SOP 10: Geospatial Data Management**

Workspace Maintenance Procedures

Prior to each season, the Project Lead should:

1. Make sure that network accounts are established for each new staff member, or reactivated for returning staff members. By default, the IT staff puts new user accounts into a group that has read-only access to all files.
2. Create new folders named by year under the Images and GPS data sections.
3. Create the seasonal workspace, with subfolders for Images and GPS data.
4. Add user logins for the seasonal crew members to the seasonal workspace, with modify privileges. This can be done by right-clicking on the seasonal workspace folder, selecting Properties > Security, then adding users one at a time and checking the box in the Allow column for Modify privileges.
5. Provide the Data Manager with a list of user logins that need access to the database.

After each season, the Project Lead should:

1. Review the workspace organization and clean up any temporary files and subfolders that are no longer needed.
2. Move files from the seasonal workspace folders into the appropriate permanent folder(s), and archive or delete the seasonal workspace folders as desired.
3. Compare older files against the retention schedule in NPS Director's Order 19 (available at: http://data2.itc.nps.gov/npspolicy/DOrders.cfm). Dispose of files that are beyond their retention schedule if they are no longer needed. As a long-term project, many files associated with this project are likely to be scheduled for permanent retention. This makes it all the more imperative to clean out unneeded files before they accumulate and make it harder to distinguish the truly useful and meaningful ones.
4. Convert older files to current standard formats as needed to maintain their usefulness.
5. Identify files that may contain sensitive information (as defined in Section 4I of the narrative). Such files should be named and filed in a way that will allow quick and clear identification as sensitive by others.
6. Post final documents and files to the NCCN Digital Library for long-term storage. See **SOP 13: Product Delivery, Posting and Distribution**.
7. Send analog (non-digital) materials to the park collections for archiving.

SOP 2: Before Each Pellet Group Sampling Session

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Overview

This SOP provides guidance for planning pellet count surveys.

Personnel Planning

The Project Lead / Field Lead for this protocol is responsible for many aspects of planning, personnel supervision, training, data collection, data entry and certification and reporting (See **Project Roles and Responsibilities**). In planning for personnel needs, the Project lead must identify personnel that are capable of data collection in the field. In addition to the requirements of pellet survey technicians, listed below, the Project Lead / Field Lead is also required to have:

- Leadership experience
- Strong organizational skills
- Familiarity with databases
- Ability to write clearly
- Facility with GPS navigation, including the ability to train others

Pellet survey technicians and volunteers have the following requirements:

- Physically fit
- Excellent balance
- Comfort in hiking off trail
- Experience with formal data collection
- Familiarity with Fort Clatsop unit is desirable but not necessary
- Familiarity with common trees and understory plants of Lewis and Clark NHP
- Knowledge of first aid
- Ability to navigate using GPS, or to be trained in this skill

At least two of the people conducting surveys must have the necessary training to use kayaks or other boats, for accessing pellet survey sites on the East side of the river.

Scheduling Training and Field Work

Fall pellet sampling sessions should be scheduled to take place starting in the last week of October or first week of November. The subsequent late winter sampling session should begin ~110 days after the first day of the fall sampling session. To have consistent pellet group

accumulation intervals, it is critical to maintain a consistent length of time between fall and late winter sampling sessions.

If three teams of two observers are working, then sampling will require approximately five field days (30 person-days). Sampling sessions should conclude as fast as possible, to minimize the variation in time that different plots accumulate pellets. Sampling sessions should always conclude no more than 14 days after starting. New personnel should be trained (**SOP 3: Training Observers**), and should be informed about the supplies needed for field work (**SOP 6: Conducting Pellet Counts**).

Preparing Equipment

The Project Lead should review the personal and project equipment list required for pellet surveys (**SOP 6: Conducting Pellet Counts**) and should arrange to purchase or procure any needed items. The Project Lead should coordinate with the GIS Specialist to ensure that enough GPS units will be ready for the surveys, with appropriate background maps loaded into memory.

Making a 3-m Measuring Stick

One item of equipment used in pellet surveys that may break as a result of heavy use is the 3-m measuring stick. These are essential for accurately measuring the distance from subplot centers to the edge of the subplot. Any 3-m measuring pole can be used to find the margins of pellet subplots, but it should be lightweight, collapsible, and durable. Below are instructions for making the current design, which is of polyvinyl chloride (PVC) ½ inch (1.25 cm) internal diameter pipe.

Supply list:

Safety glasses, leather gloves
One 10 foot (3 m) section of ½ inch PVC pipe, cold water plumbing grade.
Two straight connections for ½ inch to ½ inch PVC pipe
Two end caps for ½ inch PVC pipe
3.4 meters (about 10 feet) lightweight (1/8 inch diameter) bungee elastic cord
Duct tape
PVC pipe cutter, or fine-toothed saw
Electric drill with 1/8” or 3/16” bit
Clamp

Important: the exact length of PVC needed for each of the three sections will depend on how deeply the pipe sections go into the connections and the end caps. Therefore, some careful measurements and tinkering are required to result in a PVC pole that is exactly 3 m.

1. Use safety glasses and gloves.
2. Cut three sections of ½ inch PVC plumbing pipe, sections A, B, and C.
3. Fit connections for ½ inch PVC pipe onto sections A and B. Firmly press the PVC pipe into the connections. Duct tape the connection.
4. Thread the bungee cord through all three sections.

5. Use the clamp to secure an end cap, so that it will not spin during drilling. Drill two holes into the end of the end cap. The holes must be large enough to fit the bungee cord, but be separated by at least ¼ inch.
6. Repeat the drilling for the other end cap, so that it also has two holes.
7. Using the end of the bungee cord that protrudes out of section A, thread the bungee cord out one hole of a cap, then back down the other hole. Tie the end of the bungee cord so that it will be inside the PVC pipe. Push the knot and bungee cord back into the PVC pipe.
8. Attach the cap firmly onto the end of section A.
9. Thread the bungee out of an end cap for section C, but do not tie it off yet.
10. Attach the end cap firmly onto section C, with the bungee still hanging out. Also attach all sections together, so that you can test the total length of the PVC pole.
    a. If the assembled pole is too long, trim it slightly, until the total length of endcaps, connectors, and pipe sections is 3 m when all parts are firmly pressed in place into a pole.
    b. If the pole is less than ~ 1 cm too short, you may thread a metal nut or other similar object through the bungee cord on the outside of the end cap, so that the total length of the assembled pole extends to the required 3-m length.
11. Remove the end cap on section C, thread the bungee cord back through the other end cap hole (as in step 5), and tie the bungee cord so that it will be within the PVC pipe of section C (as in step 7).
12. Duct tape both end caps into place.

SOP 3: Training Observers

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Overview

This SOP describes the training that should be provided to observers that will take part in elk pellet surveys, or road surveys.

Training New Elk Pellet Survey Observers

Before any field work begins, trainees should read **SOP 6: Conducting Pellet Counts** and the job safety analysis that is on file at the park for off-trail work (**Appendix D: Supplementary Documents**). The Project Lead should discuss off-trail safety issues with trainees, the associated job safety analysis, and required footwear and behavioral guidelines. The Project Lead (or other qualified trainer) should have detailed discussions with trainees about the methods that are detailed on the 2-page laminated Instructions for Elk Pellet Surveys. Trainees should be shown completed Walking Time Data Sheets and Elk Pellet Survey Forms, to see examples of proper recording. If further questions about the purpose of different types of data arise, plain explanations are in **Appendix C: Explanation of Terms on Field Forms**.

Trainees should practice the methods for survey work at one or more mock-up survey points, preferably at a practice location that includes actual elk pellet groups. Trainees should practice thorough search technique, as outlined in **SOP 6: Conducting Pellet Counts.** At the practice survey points, the Project Lead should provide feedback to trainees about their pellet search technique in terms of search pattern and completeness, and feedback about data recording.

Because the form and decay class of fecal pellet groups as well as the number of pellets in a pellet group may all influence detection probabilities, it is important to train new observers to identify fecal groups that are in pellet versus clumped form, and to estimate the different classes of pellet decay that will be used in subsequent analyses. As much as possible before field work begins, trainees should be shown actual elk pellets and clumps from different decay classes, and photographs of the same. Trainers should check that trainees' diagnosis of decay class and the number of clumps and pellets in a pellet group is consistent with counts made by experienced observers. If there is room in a freezer, a set of clearly labeled elk pellets and clumps in each of the decay classes should be kept in a hard-sided container (to avoid crushing). Some deer pellets should also be kept in the collection to provide examples of the size differences between elk and deer pellets. Trainers and trainees should go through the extensive library of elk pellet group photographs (stored in the project folder: MaA19_Elk_LEWI\Images) so that the trainee can see elk pellet groups from the range of possible sizes, arrangements, and decay classes.

Trainees and trainers should examine the library of plant browse severity photographs (stored in the project folder: MaA19_Elk_LEWI\Images) and examine browsed plants in the field together, so that the trainee can distinguish plants that have not been browsed, that have evidence of light browsing, and those with evidence of heavy browsing.

For the first session of pellet survey in which a trainee participates, he / she should be paired with an experienced observer, and all of the trainee's diagnoses of pellet decay class and the number of clumps should be checked by the experienced observer. Field forms from new trainees should be closely inspected for completeness by the experienced observer.

Training New Road Survey Observers

Trainees should read **SOP 7: Conducting Road Surveys**. The Project Lead (or other qualified trainer) should discuss safe driving technique, hazards associated with these surveys, required safety equipment, methods used for observation and data recording, and pecific routes that are driven. Trainees should be shown several completed Driving Survey Data Forms from past surveys. Trainees should be instructed in the proper use of the laser rangefinder and the sighting compass, and in identifying sex and age groups of elk. If questions about the purpose of different types of data arise, explanations may be found in **Appendix C: Explanation of Terms on Field Forms**.

In surveys, at least one observer who is experienced in this road survey method should accompany the trainee. Ideally, the trainee would initially be the third person on several surveys, learning from a trained driver and a trained observer. If a trained driver and observer are not available, the trainee may serve as a driver on several surveys, so that that the trainee gets to observe and participate in road survey methods before acting as the non-driver observer. As noted in **SOP 7: Conducting Road Surveys**, the driver must always concentrate his or her attention on driving and road safety.

SOP 4: GPS Use

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Overview

This SOP provides guidance for use of GPS in navigation and in determining approximate observer locations. GPS technology is changing rapidly, so users should consult current NCCN guidelines for a general guide to GPS use for specific instructions for GPS unit models, at http://www.nccn.nps.gov/im/dm/Guidance%20Documents/NCCN_GPS_Guidelines.pdf.

Recording Observer Location

Accuracy to less than 30 m is not necessary for locating observer position in the context of road surveys, because such elk observations are not interpreted as precise locations. For road surveys, therefore, it is not necessary to differentially correct GPS signals. The coordinate position estimated by a GPS unit can be recorded directly onto field forms, so long as "position dilution of precision" (PDOP) values are suitably low (e.g., PDOP < 8) and approximately two minutes of data from five or more satellites have been collected at that location. All locations in this protocol are in the Universal Transverse Mercator system of coordinates (UTM), using the 1983 North American Datum (NAD 83) geographic projection.

Navigation

In almost all instances, pellet survey points will already be established and clearly marked with pin flags. GPS use in these cases is required only for navigation to the vicinity of the pellet survey points. The GIS Specialist or other capable NPS staff should upload the pellet survey points as a background map to any GPS unit that will be used during surveys. At least one person in each 2-person pellet survey crew team should be trained to navigate to survey points with the specific models of GPS units that are in use. Although GPS units indicate the straight-line distance and compass bearing to a survey point, observers should consult maps of the area they are to pass through, to determine a safe and efficient route. SOP 6: Conducting Pellet Counts calls for observers to carry laminated copies of the maps shown therein, with recent air photos, topography, roads and trails.

GPS Data Collection and Downloading

For any newly established points (**SOP 5: Establishing and Marking Permanent Monitoring Points**), the coordinate position should be recorded with high accuracy so that future pellet count observers can navigate to the point. GPS data should be recorded directly above the central flag at the pellet survey point in a way that allows for post-processing to improve the accuracy of the coordinate location. The exact procedures for data collection that allow for differential correction

depend on the GPS unit model. In all cases, however: the GPS unit should collect at least two minutes of GPS data into a data file; that data file should be later downloaded to a computer; software that processes the data file and data from a GPS base station estimates the most accurate coordinates for the point; the coordinates should go through Quality Assurance steps; and finally, the coordinates of the point can be updated in the project database and geodatabase, and used in mapping or future navigation to the point.

Instructions for GPS data collection, downloading, and processing specific to the GPS unit models currently used by NCCN I&M staff are provided in the document Global Positioning System Data Acquisition and Processing (http://www.nccn.nps.gov/im/dm/Guidance%20Documents/NCCN_GPS_Guidelines.pdf).

SOP 5: Establishing and Marking Permanent Monitoring Points

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Overview

This SOP gives step-by-step instructions for establishing and marking the center point of fecal pellet survey plots, and the associated centers of subplots. It is to be used in the event that all markers at a point have been lost, or if new survey points are to be established.

Establishing the Point Center

Permanent pellet survey points are systematically located throughout the Fort Clatsop park unit. The coordinates of these points come from a regular hexagonal grid, with 250 m between any two adjacent points. The target coordinates of that grid are stored in the project database, and the actual coordinates of survey points are in **SOP 6: Conducting Pellet Counts**.

If you must establish a new point, first use a handheld GPS unit to navigate to within 1 meter of the exact target coordinates of the point that you are establishing. GPS signals must be of good quality, with low PDOP values (PDOP < 8), and at least five satellites providing data (see **SOP 4: GPS Use**). Hold the GPS unit in place for two minutes, to confirm that your location corresponds to the target coordinates. If necessary, adjust your position and reevaluate your location until you are confident that you are within +/- 1 meter of the target coordinates. Place a ~1 m length of steel rebar or of ½" PVC pipe at this point. The choice of materials may depend on how potentially visible the point is from a trail or road; use rebar, in particular, if the point may be visible from a trail or road. Place a flag at the same point by inserting a 61 cm (24 inch) white PVC pin attached to a 10 cm x 10 cm (4 inch x 4 inch) square red flag (Figure SOP 5.1). Use permanent ink or a grease pencil to number the flag with the number of the point.

Figure SOP 5.1. Flag marking the center of a survey point. Photo credit: Michael Liang.

Use the handheld GPS unit to record GPS ephemera data directly above the point for at least two minutes, so that the GPS record can be post-processed, and accurate coordinates for the center flag can be associated with the actual point location (**SOP 4: GPS Use**).

Establishing Four Subplots

The centers of four subplots are located 6 m from the point center, exactly to the north, south, east, and west (Figure SOP 5.2). Use a sighting compass to determine 0, 90, 180, and 270 degrees. The sighting compass should account for declination; at Astoria, Oregon, magnetic north is 16.5 degrees east of true north in 2010, but that value is changing by 0.15 degrees per year. The NOAA National Geophysical Data Center (www.ngdc.noaa.gov) is a reference for determining future magnetic pole declination estimates. Use two lengths of a 3-m measuring stick to find the center point of each subplot. Mark each subplot center with the same type of flag as used at the point center. Use permanent ink to label subplot center flags with the Point number and the subplot code (N, E, S, or W). For example, the west subplot at point 52 should be labeled "52W." When labeling, use large numerals and letters at the flag center, and also use small numerals and letters at a point very close to the white PVC stake; if the flag center is chewed by an animal, the small letters may still indicate what flag it is.

In the event that one or more flags is knocked down or missing at a pellet survey point, observers can use the rebar or PVC at the point center, and any flags that remain standing, to reconstruct the location of any of the four subplots.

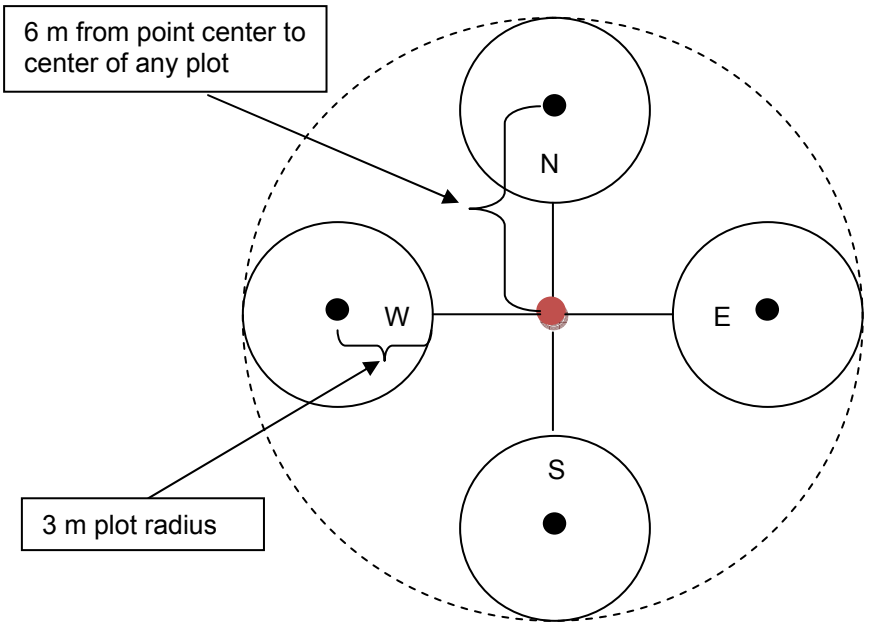

Figure SOP 5.2. Schematic diagram of a pellet survey point. The permanent point is at the center of the 9-m radius plot. Four subplots, each of 3-m radius, are centered 6 m from the point.

SOP 6: Conducting Pellet Counts

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Figures

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Overview

The purpose of this SOP is to provide detailed instructions for conducting pellet surveys as part of elk monitoring in Lewis and Clark National Historical Park. The points that define the survey units are located throughout the Fort Clatsop unit. En route to survey points, the Walking Time Data Sheet is filled out. Each point includes a 9-m radius plot, with four 3-m radius subplots in the plot. Teams of two observers characterize the plot, and search for elk pellet groups in the subplots. Pellet groups are described in terms of their pellet decay class and pellet group size. Two of the subplots are randomly selected for a second round of searching for elk pellets; pellet groups in the recounted subplots are coded as having been seen by the first observer, the recount observer, or both. During the survey at each point, each observer fills out one Elk Pellet Survey Form.

Introduction

The purpose of elk fecal pellet surveys at Lewis and Clark NHP is to use consistent methods to search for evidence of elk relative use at a systematic sample of survey points in the Fort Clatsop unit. In this survey, a "Point" is a numbered sample location. Points for pellet sampling are systematically placed, with 250 m between point target coordinates. There are 82 numbered points in or near the Fort Clatsop unit, but some are excluded because they are unsafe to access or they are frequently submerged under water. Each point is the center of a 9-m plot, and the point has four subplots in which intensive searches for elk pellet groups take place (**SOP 5: Establishing and Marking Permanent Monitoring Points**). A "subplot" is a single 3-m radius circular counting unit. Estimates of elk use are based on elk pellets found in the subplots, not the plot as a whole. The methods detailed here include independent recounts on half of the subplots. Recounts provide data that can be used to estimate the probability of pellet groups not being seen, which is called detection bias.

Safety Off Trail

Much of the pellet survey includes off-trail travel. Conducting this fecal pellet group survey requires working in forest stands with blown-down trees, where risks to personnel may be greater than in typical forest conditions. The Great Coastal Gale of 2007 occurred December 1 – 3, 2007; this natural disturbance substantially changed forest stand structure in many parts of the Fort Clatsop unit, and throughout coastal Oregon and Washington. Travel is relatively dangerous in places where wind from the Great Coastal Gale of 2007 caused 'jackstraw' conditions of windthrown, uprooted trees (also known as 'blowdown') stacked high on top of one another; future storms may cause similar forest conditions.

For information about safe hiking practices, refer to current job hazard analysis guidelines (**Appendix D: Supplementary Documents**) for jobs that require off-trail hiking. In addition to those general guidelines, additional care is advised while traveling through, under, and over areas of blown down forest, including these suggestions:

- Wear sturdy boots with at least 6" ankles, and good soles
- At all times, pay close attention that your footing is secure
- Stow all items possible in pockets or a backpack. Keep at least one hand free at all times
- Never cross on a log if serious injury could result from a fall off the log. Be extremely cautious any time that you walk along the top of a fallen log
- Do not travel under logs that are precariously perched

- Do not walk across logs with loose bark
- Be extremely cautious when stepping on wet logs
- If you must use fallen logs as bridges, choose low logs to minimize the distance you would fall if you slip
- When possible, choose to visit any sites with blowdown on days when the weather is projected to be relatively dry
- Test the soundness of any wood before giving it your full weight or using it for balance

Daily Preparations and Supplies

Before the field day begins, plan what points will be visited by whom; all field personnel should be aware of each team's intended route (Figure SOP 6.1). The Project Lead should post a compiled list of Navigation Notes from past pellet surveys, so that observer teams may plan their most efficient route to survey points. The **Checklist of Pellet Survey Points** (see below) should be posted in the office. On that form, points should be checked off, dated, and initialed at the end of the day they are surveyed, so it is clear to everyone which points have already been surveyed. In pairing personnel into teams, the Project Lead should try to pair one person with experience conducting the survey with any newly trained or relatively inexperienced person. Also, when possible, any volunteer should be paired with NPS staff.

Figure SOP 6.1. Daily preparations should include a review of the points that will be visited by each survey team. Photo credit: Michael Liang.

Each person should carry all of the following every day of field work:

- Backpack with 10 essentials for safe hiking (map, compass, extra food and water, extra clothing, flashlight, waterproof matches, candle, first aid kit, knife, space blanket)
- 3-m collapsible PVC measuring stick
- Watch, preferably with a stopwatch
- Clipboard, Pencils
- 10 Elk Pellet Survey Forms

- Laminated field reference sheet with abbreviated instructions
- Large bag for clearing pellets from recounted subplots (i.e. 1 gallon Ziploc bag)
- Latex gloves, hand sanitizer
- Ziploc bags for collecting pellets if species is unknown
- Headlamp or other flashlight for use if lighting is dim

In addition, each two-person team should carry:

- Park radio, appropriately programmed; one per person
- Walking Time Data Sheets (one per team per start location)
- Maps and coordinate lists of all points, laminated, including:
    - One map of all field points in the Fort Clatsop unit per person (1:17,000 scale)
    - NE, SE, and SW close-up maps (1:8,500 scale)
- Sighting compass, with declination corrected (Magnetic N is 16.5° E of true north)
- GPS unit with spare batteries and survey points loaded as a background map
- Pin flags, for marking points and subplot centers that may have missing flags
- Sharpie or grease pencil
- A coin, for randomization
- Knowledge of local understory plants, or field guide

Field Procedures

General instructions for conducting surveys are listed here, with more detailed directions below. Data recording is simpler for fall clearing than for late winter pellet surveys, but the search for pellet groups must be careful and thorough in both seasons. One Walking Time Data Sheet is to be used per team per day. The Walking Time Data Sheet is used to record the start and stop time of travel to survey points, and to record whether or not any elk fecal pellets or other animal signs of note were observed while the observers were travelling. The "Navigation notes" section of the sheet allows observers to give tips to future observers about routes to take or avoid in future travel. Detailed directions for completing the Walking Time Data Sheets are below, in **Completing the Walking Time Data Sheet**.

Fall Pellet Clearing

One Fall Elk Pellet Clearing Form (Figure SOP 6.15) is needed per four points visited. For the fall, the general course of events after the two-person team arrives at a survey point is as follows. Each observer searches two 3-m subplots for elk pellet groups (see **Defining Pellet Groups**, below). The observer follows a thorough search pattern that ensures there are no gaps in the area visually searched. Guidelines for that pattern are as follows: the observer lays the 3-m stick so that one point is at the subplot center and the other is toward the point center (center of the 9-m radius plot), noting where the outer boundary of the subplot is (point "a" in Figure SOP 6.2). If there is no suitable natural marker to indicate the starting point of the plot (i.e., a stump or tree to mark point "a"), then the observer may temporarily insert a pin flag in the ground, to mark that point. Then the observer moves the stick clockwise at a right angle, with one point still at the subplot center, and the other end at point "b" (Figure SOP 6.2). The 3-m stick is made of three 1-m segments. The observer focuses attention on the three 1-m wide concentric belts within that ¼ circle. The stick gives a reference point for the outer edge of the circular subplot, but the observer should search for pellets in an area that is slightly more than 3-m. The observer should

use the stick to measure whether any pellet groups that are detected fall within the subplot, or are outside of the subplot. For a group to be counted, the center of mass of the group must fall within the 3-m radius subplot.

After thoroughly searching in the three 1-m wide belts of the first ¼ circle, the observer moves the stick and searches the three 1-m belts in the next ¼ circle. The observer repeats this two more times, until each quarter of the subplot has been searched. Obstacles may prevent the observer from using this exact search pattern, but it is essential that the entirely of the subplot be thoroughly searched. The observer counts the number of elk pellet groups, and removes all the pellets from the plot, leaving them at least 5 m away from any subplot. The observers record the number of elk pellet groups found in the subplot.

Next, the two observers recount the subplots that were first counted by the other observer. They follow the same careful search pattern, counting the number of pellet groups that the first observer did not detect, and clearing away any elk pellets that are found. The observers record the number of elk pellet groups found in the recount of each subplot.

At the end of the day, observers return all Walking Time Data Sheets and Fall Elk Pellet Clearing Forms from the day to the Project Lead.

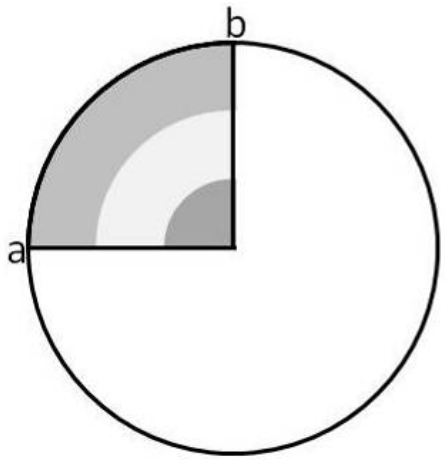


Figure SOP 6.2. Search pattern in the initial quarter of the subplot. The 3-m stick is first laid with one end at the subplot center, and the other at point a, in the direction of the plot center. Then the stick is moved 90 degrees, so that the outside end is at b. Those two lines define two edges of a ¼ circle. The observer thoroughly searches three 1-m belts (shown in different shades of gray). After completing search within one quarter of the subplot, the observer moves to each of the next quarters of the subplot, in turn, until the entire subplot has been surveyed.

Late Winter Pellet Surveys

Two Elk Pellet Survey Forms (Figure SOP 6.13) are needed per point. Each person on a pellet survey team records his or her own observation on a single form per point. The general course of events after the two-person team arrives at a survey point is as follows. The 9-m radius circle centered at the point is also called the plot. At the scale of the plot, the team records vegetation overstory type, the proportion of windthrown trees, the most common understory plants, browsing level, and light level descriptions. Of these data, only light level and blowdown level

descriptions will be used to model detection probabilities of fecal pellet groups in analyses of relative use or proportion of area occupied (**SOP 11: Data Summary, Analysis, and Reporting**). The other data on general vegetation and blowdown conditions are recorded to provide context that may prove useful in the future to suggest possible causes or effects of large changes in elk use or occupancy in the future.

Next, each observer proceeds to search two 3-m subplots for pellets. The observers do not talk during these searches, and should not pay any attention to the other observer's activities. Each person is the 'first observer' at two of the four subplots searched.

Within each subplot, the first observer records as a percentage value the amount of understory cover that might obscure any pellets. Then, the observer follows a thorough search pattern described above in **Fall Pellet Clearing**, to ensure that the entire subplot is thoroughly searched.

For each discrete group of elk pellets that is found, the first observer records the pellet decay class (see **Defining Pellet Decay Class**, below) and the number of individual pellets and pellet 'clumps' in the group (see **Defining Group Size**, below). These variables are recorded because they influence the probabilities of detection (Jenkins and Manly 2008), and they will be used to model fecal pellet detection probabilities and to adjust for observational biases in subsequent analyses of the data.

After all four subplots have been searched once, the observers flip a coin to determine which two of the subplots will be recounted by the opposite observer. The 'recount observer' searches independently and records the same types of data about any pellet groups found. Only after the recounted subplots have been searched do the two observers compare notes about where they found elk pellet groups in any of the subplots. The observers confer to determine which pellet groups in the recounted subplots were seen by the first, the second, or both observers; this information is recorded with a lettered 'recount code' (see instruction 8 in **Completing the Elk Pellet Survey Form**). After this reconciliation, all pellet groups in all of the subplots are cleared of pellets. The observers then proceed to the next survey point. Detailed directions for completing the Elk Pellet Survey Forms are below, in **Completing the Elk Pellet Survey Form**.

At the end of the day, observers return all Walking Time Data Sheets and Elk Pellet Survey Forms from the day to the Project Lead.

Defining Pellet Groups

An elk pellet group is the collection of one or more elk pellets or other elk fecal material coming from one elk in a single defecation. A single pellet group may trail out over many meters, if the elk was defecating while walking. Hence, it is very important to search a wide area if only a single or few pellets is found. The most typical pellet group is a pile of pellets that accumulated as an elk stood in one spot, with some additional pellets of the same age and condition nearby. Pellet groups vary in size, but each group is counted only as a single observation in this protocol. For that reason it is important to correctly differentiate pellet groups that came from different defecations into separate pellet group observations. Likewise it is important to group together those pellets that came from a single excretion event into a single pellet group observation. Separate pellet groups can generally be distinguished on the basis of location and differences in appearance (size, age, condition). It is important to only count elk pellets in this protocol, and to

not count deer pellets. Elk pellets are almost always more than 1.2 cm wide and 1.5 cm long. It is not uncommon for groups of elk pellets to be more than 1 liter in volume. Deer pellets are thinner, typically 1 cm wide or less and ~ 1 cm long. (Figure SOP 6.3)

Figure SOP 6.3. Photographs of elk pellets (left) and deer pellets (right).

Defining Pellet Decay Class

Observers are asked to describe each pellet group that they find, in terms of the decay class, which is an index of pellet group decomposition. The decay class is related to the elapsed time since the pellet group was deposited (Jenkins and Manly 2008). These data are collected for use during the analysis of factors that influence pellet group detection probabilities.

Assigning a pellet group into a decay class should not take much deliberation. The freshest pellets are in decay class 1 (Figure SOP 6.4), with progressively more decayed pellets in class 2 (Figure SOP 6.5), class 3 (Figure SOP 6.6) and class 4 (Figure SOP 6.7). The appearance of fungal or plant growth are signals of age, as are surface texture and internal consistency. Diagnostic signs of each decay class are as follows.

- Decay class 1= Freshest class; Pellet surface smooth, possibly shiny, green/brown or brown. Pellet interior consistently same color as surface; firm to the touch or slightly spongy, but not crumbly (Figure SOP 6.4)
- Decay class 2= Pellet surfaces may be slightly rough or pitted. Pellet interior starting to get crumbly / friable when squeezed, but less than 10% of individual pellets are partially decomposed. “Decomposed” here means that the margin of the pellet is eroding, or crumbling. The very first signs of fungal growth may be present, but smaller than ~ 1 mm per spot of beginning growth (Figure SOP 6.5)
- Decay class 3= Some pellet surfaces may be cracked or fissured. Pellets crumbly / friable when squeezed. 10-50% of individual pellets may be partially decomposed. The first signs of plant growth (i.e. tiny cotyledons) may be visible, as may be larger fungal growth (Figure SOP 6.6)
- Decay class 4= Like Class 3, but >50% of pellets partially or completely decomposed. Differentiating individual pellets may be difficult. Plant growth may be advanced, growing through and breaking up individual pellets (Figure SOP 6.7)

These guidelines include reference to what percentage of the group is visibly decomposed. In this context, 'decomposed' means falling apart due to physical, chemical, and biological weathering, or otherwise breaking apart due to processes that take time. This decomposition is in contrast to the flattening or breakup that would come from being stepped upon. Observers are asked to record decay class, regardless of pellet shape – a fresh pellet may be flat, just as a very decayed pellet may still be rounded.

Defining Pellet Group Size

Observers are also asked to record the number of pellets and 'clumps' in a given pellet group, so that there is a quantitative measure of pellet group size. These data, like pellet decay class, are collected because they are used to model fecal pellet detection probabilities and to adjust for observational biases. Observers are asked to count the number of pellets that can be seen from above, i.e. without disturbing the pellet group. In this way, the group will be undisturbed if the other observer recounts that particular subplot.

Most elk pellets have a consistent shape and size, which is a rounded cylinder the size of a "Milk Dud" ™. There is, however, a wide variety of shapes and sizes to elk feces that are not fully formed into fully rounded, single pellets. In particular, elk feces may look like aggregated 'clumps' that may vary in size and texture. To standardize a measure of pellet group size for each pellet group, what is called a 'clump' in these surveys should be consistent. When deciding how many clumps to record for a given fecal mass, observers should estimate the volume that 10 distinct pellets would represent, no matter how mashed they may be. In analyses (**Appendix E: Analysis of Detection Bias**), pellet group size is defined as the number of elk pellets plus 10 times the number of clumps.

Figure SOP 6.4. Photographs decay class 1 elk pellet groups. A group of class 1 pellets is shown in the picture at left, while the picture at right shows a group of class 1 pellets made up of two clumps.

Figure SOP 6.5. Photographs of decay class 2 pellet groups. A group of class 2 pellets is shown in the picture at left, while the picture at right includes approximately four class 2 clumps, with compass for scale.

Figure SOP 6.6. Photographs of decay class 3 pellet groups. A group of class 3 pellets is shown in the picture at left, while the picture at right shows some class 3 pellets and approximately two class 3 clumps.

Figure SOP 6.7. Photographs of decay class 4 elk pellet groups. A group of Class 4 pellets is shown in the picture at left, while the picture at right is of a class 4 clump, with ½ inch PVC stick for scale.

Completing the Walking Time Data Sheet

The Walking Time Data Sheet is used to describe travel times, notes on travel routes, and any observations of elk fecal pellets observed while traveling between pellet survey points (Figure SOP 6.14). An abbreviated set of instructions is also printed at the end of this SOP for use in the field (Figure SOP 6.8). In instructions below, bolded text refers to items that the Observers should fill in.

Before leaving for the field, determine which survey points you might visit on that day. Consult the "Checklist of Fort Clatsop Pellet Survey Points" to determine whether any of those points have less than four subplots and, if so, which subplots are to be omitted from survey.

1. Use one new Walking Time Data Sheet for each new Start Location. At the beginning of the day, before travelling to the first point, fill out the top of a Walking Time Data sheet as follows:

> **Start Loc'n:** Circle the parking area where foot travel begins. If parking area is not described, circle "Other" and write a description of the start location on the blank line.
> **Date:** Enter the date as mm/dd/yyyy
> **Observer(s):** Enter the first and last names of all observers

2. One row of the form is for a single route walked between points, or between a point and the start location. At the beginning of each travel session, fill in the specific information below:

> **From Point #:** For the first point of the day write "START' to indicate that travel started from the parking area circled above. For subsequent points, record the point number from where you will begin traveling.
> **To Point#:** Write the point number you walked to. If you are returning to the vehicle, write END.
> **Start Time:** Write the time of day when you left the "From Point." Enter the time as hh:mm. Use 24 hour time.

3. While walking between points, observers should speak to each other when they first see elk pellets or other notable animal sightings. When you arrive at the To Point, fill in the specific information below:

> **Stop Time:** Write the time of day when you arrived at the "To Point." Enter the time as hh:mm. Use 24 hour time.
> **% Off Trail:** Circle the one category (0-24, 25-49, 50-74, 75-100) that best matches your estimate of the percentage of the distance you traveled which was off of any trail or road.
> **Severity of Blowdown:** Circle the one category (0, 1-4, 5-24, 25-75, 75-100) that best matches your estimate of the percentage of trees that were broken, based on the trees you saw along the route you walked.
> **Navigation Notes:** Write any guidance that could help future survey crews as they navigate to this point. This could include cautions or helpful suggestions.
> **Elk pellet(s):** Check this box with an X if either observer saw any elk pellets while en route between the From Point and the To Point.
> **Animal notes:** Record information about any other wildlife sightings of note here, including elk-related sign (i.e., antlers, carcasses), or other species of note, such as reptiles or amphibians.

4. At the end of the day, give the Project Lead the Walking Time Data Sheet along with all associated Pellet Survey Forms. Check off, date, and initial the points that were completed that day on the **Checklist of Pellet Survey Points** posted in the office. This step makes it clear what points remain.

Completing the Fall Elk Pellet Clearing Form

The Fall Elk Pellet Clearing Form is used to record which survey points have had pellet points cleared from subplots, and to record the number of elk pellet groups that were cleared from the subplots (Figures SOP 6.15 and 6.16). Elk pellets should be cleared at least 5 m away from the edge of any subplot. Only one form is used per two-person team of observers. Each form may be used to record data for up to four points. An abbreviated set of instructions is on the back of the form (Figure SOP 6.16). In the instructions below, bolded text refers to items that the Observers should fill in.

1. At the start of the day, and on each sheet of the form, fill in the following:

> **Date:** Enter the date as mm/dd/yyyy
> **Observer #1 Name:** Write the first and last name.
> **Observer #2 Name:** Write the first and last name.

2. Upon arrival at the point, fill in:

> **Point #:** Record the point number. This is a value between 0 and 80.

3. Observer #1 searches the north and west subplots, counting the number of elk pellet groups in each, and clearing all of the pellets detected out of the subplots. Observer #2 searches the south and east subplots, counting the number of elk pellet groups in each, and clearing all of the pellets detected out of the subplots. Use a 3-m stick to determine whether there are any pellet groups in

the subplot. Only record pellet groups for which the center of mass of the group is inside the 3-m radius circle. If more than half of a pellet group's mass is out of the subplot, *do not record* that pellet group, but *do clear* the pellet from that group. For each pellet group that is found, the observer who found it must record that pellet group in several ways. Each pellet group is considered to be one observation; this includes all the pellets or clumps from the same defecation (see ***Defining Pellet Groups***, above). Fill in the following:

Observer #1 North, # of Pellet Groups: Fill in the number of elk pellet groups that Observer #1found in the North subplot
Observer #1 West, # of Pellet Groups: Fill in the number of elk pellet groups that Observer #1found in the west subplot
Observer #2 South, # of Pellet Groups: Fill in the number of elk pellet groups that Observer #2 found in the south subplot
Observer #2 East, # of Pellet Groups: Fill in the number of elk pellet groups that Observer #2 found in the east subplot

4. Next, each observer searches both of the subplots that had just been checked by the other observer. This step is taken to ensure that all elk pellets are cleared from the subplot, and to count the number of elk pellet groups that were missed on the first round of checking. For this re-count clearing, consider an elk pellet group 'new' if the first count observer didn't count it. Observer #1 searches the south and east subplots, counting the number of elk pellet groups in each, and clearing all of the pellets detected out of the subplots. Observer #2 searches the north and west subplots, counting the number of elk pellet groups in each, and clearing all of the pellets detected out of the subplots. Fill in the following:

Observer #1 South, # New Pellet Groups: Fill in the number of elk pellet groups that Observer #1 found in the south subplot, which were not found already by Observer #2.
Observer #1 East, # New Pellet Groups: Fill in the number of elk pellet groups that Observer #1 found in the east subplot, which were not found already by Observer #2.
Observer #2 North, # New Pellet Groups: Fill in the number of elk pellet groups that Observer #2 found in the North subplot, which were not found already by Observer #1.
Observer #2 West, # New Pellet Groups: Fill in the number of elk pellet groups that Observer #2 found in the west subplot, which were not found already by Observer #1.

5. Before leaving the point, fill in any additional **Comments**. If you need more space, there is room for **Additional Comments** on the back of the form.

Completing the Elk Pellet Survey Form

The Elk Pellet Survey Form is used in late winter pellet surveys, to record conditions at a single survey point, and to record elk pellets found in subplots at that point (Figure SOP 6.8). Each observer fills out one form, but only one of the observer records point-level data. This is considered the 'main data sheet' for the point, and the person who records data on that sheet is called the main observer. An abbreviated set of instructions is also printed at the end of this SOP for use in the field (**Abbreviated Instructions for Elk Pellet Surveys**). In the instructions below, bolded text refers to items that the Observers should fill in.

1. Upon arrival at the point, both observers fill in the following items:

Point #: Record the point number. This is a value between 0 and 80.
Date: Enter the date as mm/dd/yyyy
Observer Name (only 1): Each observer should write his or her own first and last name only.

2. The main observer fills in the following:

POINT Start Time: Record the local time when you arrived at the point as hh:mm. Use 24 hour time.
POINT Stop Time: Record the local time when you have finished all aspects of survey at the point as hh:mm. This will usually be the time when you leave the point. Use 24 hour time.
Is there a recount observer?: Circle **Y** if there are two (or more) observers at the point. Circle **N** if there is only one observer at this point.
POINT Veg type Overstory, 9m: Circle the dominant vegetation type of the forest overstory (tall, dominant and subdominant trees), at the scale of the 9-m radius plot. Abbreviations are:

- CON – Coniferous forest. These are forests (>25% tree cover) where more than 75% of the standing trees are conifers (evergreens with needles), such as hemlock, spruce, Douglas-fir
- DEC – Deciduous forest. These are forests (>25% tree cover) where more than 75% of the standing trees are broadleaf species such as alder, maple, or holly
- MIX – Mixed forest. There is >25% tree cover, but conifer trees and broadleaf trees each are between 25% and 75% of the overstory
- WET – Wetland. These are areas with few trees (< 25% tree cover), and with wet ground dominated by rushes, wet grasses, sedges, reeds
- MEAD – Meadows, pastures, lawns. These are grassy areas that are not frequently inundated under water
- SHR – Shrubfields. These are areas with few trees (< 25% tree cover) and where shrubs or brambles predominate

POINT Lighting: Lighting is based on the level of light perceived by a person standing near the center of the plot. Circle the lighting category (Dim, Medium, or Bright) based on these criteria; Circle Bright if there is sunlight enough that you can see any shadows. Circle Medium if the light level is adequate for seeing clearly, although there are no shadows evident. Circle Dim if it it dark to the point that the low light levels might prevent you from easily seeing pellets; one indicator of this would be that it is difficult to read. If the lighting is Dim, you should use headlamps for the survey.
POINT Blowdown, % trees broken: Circle the category (0, 1-4, 5-24, 25-74, 75-100) that approximates the percentage of trees within the 9-m radius plot that are broken. This is the number of broken trees in the plot, divided by the total number of standing and broken trees in the plot.

3. Both observers work together to make the **Top 5 understory species table** that is at the right of the form, and to identify the level of browsing by herbivores, for each species. These five understory plant species to list are those that are most common within the 9-m radius plot, at heights of under 2 m. In the table, each species gets one row. Understory plants should only be

included if they make up 1% or more of understory vegetative cover in the plot, so some plots will have less than five species. Teams may choose to characterize the understory plants before they search subplots for pellets, or after pellet counting is done.

Evidence of browsing on shrubs will be on lead stems from the current or previous years, where the stems may appear nipped by ungulate bites. Evidence of browsing on ferns are fronds that have had leaves stripped, or leaves which are torn or removed in ungulate bite-sizes, or larger. In contrast, trampled leaves may still be seen dangling from the frond, or on the ground nearby.

Fill in each of the following for each plant species:

> **Species:** Write the common name or scientific name of the plant species
> **% of total area:** Write the estimate of the percentage (1 -100%) of the area of the 9-m radius circle that this species occupies. It may help to approximate the area of the plot that the plant would occupy if it were all together, then to use the proportion of the total circle as the estimate of the % of total area.
> **% browsed:** Write the percentage of the individual plants of that species that have any evidence of having been browsed by an herbivore. Consider an individual plant to be all the rooted stems that all come from more or less the same source. For example, all the fronds coming from one base of a fern are part of a single plant; all the elderberry stems coming from a single rooting area are part of a single plant.
> **Browse severity:** Circle the most common level of browse severity (none, light, heavy) that is seen on plants of that species. Light browse severity is such that the architecture of the plant overall does not seem to have been severely changed – some branches or fronds have been partially eaten. Heavy browse severity is such that the plant appears stunted by the herbivory, compared to an unbrowsed plant of the same species.
> **Additional comments:** The back of the form has a space for Additional Comments. Either observer should note any additional observations made at the point. Write here if there are less than four subplots to be surveyed at the point.

4. The observers should work together to re-label or replace damaged flags at the point center or at the centers of the subplots. Use a sighting compass and 3-m measuring sticks to measure 6 m from the center, to find the North, South, East, or West subplot centers, if needed.

The main observer does not need to fill in anything for the following five fields unless the team needs to use GPS to establish the point center (see **SOP 5: Establishing and Marking Permanent Monitoring Points**). This would only be the case if the point is new, or if flags at the point center and all four subplots are uprooted or missing. If the team did need to establish or reestablish the point, the main observer should fill in the following:

> **Updated Coordinates?** Circle **Y** only if you needed to establish or reestablish the point, using a GPS unit to locate the new point center.
> **If Yes, UTM (NAD 83) E:** Write down the Easting coordinate. This is a 6-digit number starting with 4. The "4" is already written down on the form, so you only need to write the last five digits. The datum that the GPS unit uses should be set to the NAD83 projection (see **SOP 4: GPS Use**).

N: Write down the Northing coordinate. This sis a 7-digit number beginning with 510. The "510" is already written down on the form, so you only need to write the last four digits.
GPS Unit type and ID: Write down the GPS unit model, and unit ID if there is one (for example, "MobileMapper O").
Error (m): Write down the estimated error that the GPS unit provides. This distance is the likely range of error in the location of the coordinates.

5. All four subplots are surveyed at least once. Each First Count subplot has its own table for recording any pellet groups seen there.

During the first count surveys, the observers work independently, without commenting to one another. One observer should conduct first counts on the North and West subplots, while the other should conduct first counts on the South and East subplots. Unless there are less than four subplots, each observer will complete two First Count tables per Pellet Survey Form. Observers should start with subplots that are not adjacent, so that they will tend not to notice what the other observer is doing; for example, the two observers might start on the North and South subplots. Each should start a stopwatch, to count the amount of time needed to complete the first count for each subplot. All of the following information should be filled in separately for each first count subplot:

FIRST COUNT (circle which subplot): Circle the subplot (North, South, West, or East) to which this First Count table refers. Note that the top First Count table is for either the North or South subplot, and the second First Count table is for either the West or East subplot.
Subplot Veg: Circle one choice for the type of understory vegetation within the subplot. For the purposes of this definition, "understory" is below ~2 m tall. This is the type of understory vegetation that is most prevalent within the subplot. These only include types that could make elk pellet detection less likely, so mosses are not included. The choices for most common understory type are:

- Shrub – shrubs, i.e., elderberry, salal, huckleberry, etc.
- Open – unvegetated, open understory, i.e. forest litter or bare ground
- Grass – grasses, including lawns, rushes, sedges, and reeds
- Fern – ferns, i.e., sword fern, deer fern, lady fern, etc.
- Forb – herbaceous plants, i.e., sunk cabbage, buttercup, foxglove, etc.
- Sapling – young trees with branches in the understory
- Bramble – thorny plants, i.e., roses, blackberries, etc.
- Blowdown – wind thrown trees

Subplot, obscuring veg cover % below 1 m (0-100): Fill in a percentage value (0-100) that is your approximation of the amount of understory cover that could obstruct the *view* of the ground, from directly overhead. Do not include features that make parts of the plot inaccessible (rootwads, steep terrain) unless they also block the view of the ground. "Cover" here is defined as vegetation or windthrown debris that is less than 1 m high, and which could obscure elk pellets. The percent cover for the subplot is the proportion of the subplot that has some form of cover over the ground. Moss is not counted in this total, because pellets lie on top of moss.

Time to count this subplot: Fill in the time, in minutes ("min" on the form) and seconds ("sec" on the form) that it took to complete the first count of the subplot.

6. Use a 3-m stick to determine whether there are any pellet groups in the subplot. Only record pellet groups for which the center of mass of the group is inside the 3-m radius circle. If more than half of a pellet group's mass is out of the subplot, do not record that pellet group. For each pellet group that is found, the observer who found it must record that pellet group in several ways. Each pellet group is considered to be one observation; this includes all the pellets or clumps from the same defecation (see ***Defining Pellet Groups***, above). The observer categorizes the pellet group according to decay class (see ***Defining Pellet Decay Class***, above) and the number of pellets and clumps (see ***Defining Pellet Group Size***, above). The observer also maps the location of each pellet group within the subplot, so that it will be easy to find again, and to compare notes with the recount observer. On the subplot data table and map, the data to record for each pellet group are:

OBS#: Give a new observation number to each pellet group, starting at 1, then 2 for the next group, then 3, etc…). Start at observation number 1 for each subplot, if there are any pellet groups in that subplot.
Class 1-4: Fill in the decay class for that pellet group, as 1, 2, 3, or 4.
 # clumps: Fill in the number of clumps found within the pellet group (see ***Defining Pellet Groups Size***, above)
 # pellets: Fill in the number of pellets in the pellet group that can be counted without disturbing the pile of pellets.
Location within the subplot: Use the sketch circular map of the subplot to note where the pellet group was. Write the OBS number on that place. The sketch circle represents the outside of the 3-m radius subplot. The center of the circle is the center of the subplot. The arrow pointing up on the page symbolizes the direction of the Point center. An accurate sketch of the locations of the pellet groups found in the subplot helps when it comes time to compare which pellet groups were seen by each observer, because it makes those groups easier to find again.

If you find no pellets in a subplot, write "NONE" in the Obs# column. If there are more than eight pellet groups in a single subplot, use the tables with extra rows for data on the back of the form to record data about the additional pellet groups. If you do this, be sure to circle which subplot (N, S, E, or W) the extra table refers to.

7. After observers have finished first surveys in all subplots, an observer flips a coin to determine randomly which of the subplots is to be recounted. If the coin comes up 'heads,' then the North and South subplots get recounted. If the coin comes up 'tails,' then the east and west subplots get recounted. Each observer recounts the subplot that the other observer first counted. During these recounts, the observers work independently, without comment to one another. Each observer should start a stopwatch to record the time it takes to conduct the subplot recount.

The recount observer uses the RECOUNT table at the lower left of the form to record information about the subplot recount, and about any pellet groups that the recount observer finds. The recount observer should fill in the following:

RECOUNT N S W E (circle one): Circle the subplot (N=North, S=South, W=West, E=East) to which this recount table refers.
Time to count this subplot: Fill in the time, in minutes ("min" on the form) and seconds ("sec" on the form) that it took to complete the recount of the subplot. This time does include the time needed to consult with the other observer, to determine which pellets were seen by both observers, or only one observer (see below).

For any pellet groups that the recount observer finds, the observer records **OBS#**, **Class**, **# clumps**, and **# pellets**, and should record the position of those pellet groups on the circular map, just the same as for first counts.

8. After both observers have completed the recount surveys, they reconcile the data; that is, they compare notes to see which of the two saw each pellet group in the recounted subplots. Both observers should take a look at each pellet group that either one found in the subplots that were recounted. Based on that information, the recount observer may need to add one or more pellet group observations to the recount table if one or more pellet groups were found by the first count observer, but not the recount observer.

The main purpose of recounting subplots is to collect data related to the probability of detecting pellet groups. For that reason, it is vital that the recount observer fill in the recount code for each pellet group that either observer saw, in the Code column, as follows:

Code: The code is 'B' (seen by both observers) if the pellet group was seen during the first count and during the recount. The code is 'R' (seen only by second observer) if the pellet group was not seen during the first count, but was seen during the recount. The code is 'F' (seen only by first observer) if the pellet group was seen during the first count, but was not seen during the recount. The code is 'X' (not seen by either observer) if it was not seen during the first count or during the recount, but was subsequently noticed, i.e., when the two observers were looking over the subplot after the recount was done.

If, after re-examining a pellet group, the observers decide that the number of pellet groups, or the decay class or number of pellets and clumps of a single group, is different than the values recorded on the Recount observer's data table, then they should adjust those numbers on the recount data table. For example, if the recount observer identified two separate pellet groups, but the observers decided jointly that those were really part of a single pellet group, then the recount observer should change the data to show just one observation number, with the combined total number of pellets. The final values for decay class and pellet group size will be taken from the recount observer's table.

9. After all the pellets in the recount subplots have a recount code, the observers should remove all the elk pellets and clumps that they saw from the surveyed subplots. The observers should carry or throw all elk pellets and clumps at least five meters away from the point center or from any subplot, so that there is no chance that those pellets will be counted in the next round of survey.

10. The main observer should record the **POINT Stop time** when the pellet clearing is done, and should hold both observers' forms until the end of the day. At the end of the day, all forms from

the day are given to the Project Lead. Check off, date, and initial the points that were completed that day on the **Checklist of Pellet Survey Points** posted in the office. This step makes it clear what points remain.

After Pellet Surveys

The Project Lead should compile all field forms for data entry. Walking Time Data Sheets should be organized chronologically by date. Elk Pellet Survey Forms should be organized numerically by survey point number. Store pellet survey equipment in the Resource Building garage on the designated shelf. Return any borrowed NCCN equipment, such as GPS units.

The Project Lead should prepare a Field Report (**SOP 11: Data Summary, Analysis, and Reporting**) shortly after the completion of each survey session, for a total of two field reports per year.

Materials to be Printed for Pellet Surveys

The last pages of this SOP include: the checklist of the survey points; the Instructions for Elk Pellet Surveys; maps of the survey points for use in the field Figures SOP 6.8, 6.9, 6.10, and 6.11); the Walking Time Data Sheet (Figure SOP 6.12); the Elk Pellet Survey Form (Figure SOP 6.13 and 6.14), and the Fall Elk Pellet Clearing Form (Figure SOP 6.15 and 6.16).

Field Reference Sheets

In the field, each person should carry a laminated copy of the two-page Instructions for Elk Pellet Surveys, which has abbreviated reminders of the field procedures. These short instructions are printed on two pages. The intent of the tight spacing and concise wording is that each person on the pellet survey crew can have a copy of these instructions with them in the field, on a single, two-sided, plastic-laminated sheet.

Survey Point Maps

Figures SOP 6.8, 6.9, 6.10, and 6.11 are a map of all survey points and three close-up maps of areas within the Fort Clatsop unit. The GIS specialist maintains the specifications for formatting these maps within the geodatabase (**SOP 10: Geospatial Data Management**). If copies are needed, the Project Lead or GIS Specialist should print and laminate these maps, as well as tables of the estimated actual coordinate locations of the survey points, to be used if the GPS units do not have the points loaded as a target layer. This table is not included in the SOP, however, because those coordinates are considered to be Sensitive Information (See **SOP 12: Sensitive Information Procedures**).

The Project Lead should periodically consider whether points that were previously thought to be unsafe for pellet surveys may have become safe enough to access. For points with severe blowdown, the project lead should revisit those points approximately every decade. For points that are inaccessible due to extensive blackberry patches, the Project Lead should revisit those points after any exotic plant eradication projects take place in those locations, or approximately every decade.

Pellet Point Checklist and Field Data Forms

The pellet point checklist should be posted in the Resources building. The checklist can be used to organize the completion of pellet surveys. After each day of survey, observers place a check by each point they completed, along with their initials and the date. The Project Leader can use

the checklist to plan the routes and teams for the next day or days of survey. Pellet Point Checklists from previous survey sessions can also be posted, to help with planning the logistics of the current sampling session. Similarly, the printed Navigation Notes from previous surveys should be posted near the checklist, so that observers can assess the most efficient path between points that they are to visit. Copies of the Walking Time Data Sheet and the Elk Pellet Survey Form should be printed on Rite-in-the-Rain™ paper or on similar paper.

CHECKLIST OF FORT CLATSOP PELLET SURVEY POINTS

Check the box and write the date done when the point was counted. Each Point has notes about whether it is accessible, if any subplots were counted but flags were not left ("no flag") or if certain points should not counted, e.g., "No 8S" means do not count the south subplot for point 8).

POINT#....DATE COUNTED	POINT#...DATE COUNTED	POINT#....DATE COUNTED
0☐_____	31☐_____	61☐_____
1☐_____	32 Too Steep	62☐_____
2☐_____	33☐_____	63 Deep Water
3 Out of the park	34☐_____	64☐_____
4 Out of the park	35☐_____	65☐_____
5 Severe blowdown	36 Severe blowdown	66☐_____
6☐_____	37☐_____	67☐_____Only flag @center
7☐_____	38 Deep water	68 Severe blowdown
8☐_____No 8S	39☐_____	69 Too Steep
9☐_____	40☐_____	70☐_____
10☐_____	41 Deep water	71☐_____
11☐_____No 11S,11E; no flags left	42☐_____	72☐_____
12☐_____	43☐_____	73☐_____
13 Severe blackberry	44☐_____	74☐_____
14☐_____	45☐_____	75☐_____
15☐_____	46☐_____	76☐_____
16 Too Steep + blown-down	47☐_____	77☐_____
17☐_____	48☐_____	78☐_____
18☐_____No 18S,18W,18N	49☐_____	79☐_____
19☐_____No flag @ 19W	50 Tidally flushed	80☐_____
20 Tidally flushed	51☐_____	81 Out of park + blackberry
21☐_____No 21N	52☐_____	
22 Too Steep + blown-down	53☐_____	
23☐_____Pink flag on S plot	54☐_____	
24☐_____	55☐_____	
25☐_____	56☐_____	
26☐_____	57☐_____No 57N	
27 Under water / blackberry	58☐_____	
28☐_____Kayak @ hi tide	59☐_____	
29☐_____No center flag	60☐_____	
30☐_____		

Fort_Clatsop_pellet_survey_points_2010.doc Updated March 2010

For UTM coordinates, see "LEWI pellet point coordinates 2010.xls"

Abbreviated Field Instructions for Elk Pellet Surveys

1. Fill out "Walking Time Data Sheet" to record times & observations while walking
Record **Date**, **Observer(s),** and circle an appropriate **Start location** (or "Other," and describe it). Record the **From Point#** and **To Point#,** and **Start time**. For first point of the day (or first point after driving to a new start point), write "Start" under **From Point#**. When you go back to the start, write "End" for **To Point#**. When you get to the point (or the End), write the **Stop time**. Circle your guess for the **% Off-trail** walking, in terms of the % of the total distance walked. Circle the **Severity of blowdown**: the % of the path length you walked through blowdown. Write **Navigation notes** to help future crews find the best route for going from point to point. Check the box if you saw any **elk pellet(s)** as you came. Record other **Animal notes**, such as elk antlers, or other species of note (amphibians, fungi, birds...).

2. Fill out Point-level data on the "Elk Pellet Survey Form"
Note **POINT#, Date,** & **Observer** on all sheets. Only record one observer name per sheet; your name goes on the sheet for the subplots you counted first. Only one person's data sheet has point-level data recorded. This is considered the 'main data sheet' for the point. Use this to record **Point Start time, Point Stop time, Point Lighting, Point Veg type**, and **Point blowdown.**
For "**Is there a recount observer?**" circle Y if this is a 2-person team.
Record **UTM E, UTM N, GPS Unit type, Error** only if you are establishing this point.
At the scale of a 9- m radius circle, **POINT Veg type** is based on overstory. Forest means >25% trees. Codes: CON= >75% of forest conifer; DEC= >75% of forest deciduous; MIX= Mixed forest, con+deciduous; WET= wetland, wet grasses, sedges, <25% trees; MEAD= meadow, pasture, grasses, lawn; SHR= shrubfield. **Lighting**: 'Bright' if you see shadows, 'Dim' if it's hard to read. 'Medium' if light level is OK, but no shadows.
Record what **5 understory species** are most common (Scientific or common name), what % of the total area each covers (totals need not sum to 100%), what **% of single plants for each species is browsed**, and what is the most **common severity of browsing** (none /light / heavy) per plant of that species. Consider rooted stems that all come from more or less the same source, or a fern clump, to be a single plant.

3A. Count pellets in four subplots, recording data on the "Elk Pellet Survey Form"
Re-label or replace damaged flags. Measure 6 m from the center to find N,S, E, or W subplot centers, if needed. For first counts, one person should count the N & W subplots; the other person counts the S & E subplots. During subplot first counting and recounting, do not talk about results! Confer only after recounting.
Each subplot gets pellet groups counted separately. For each table, circle which subplot it is for. Circle only one **Subplot Veg** type; this is understory cover up to 1 m tall ***that could obscure pellets (not moss)*** Record **Subplot obscuring veg cover % below 1 m** to nearest %; this is the understory cover up to 1 m tall ***that could obscure pellets*** (i.e., moss is not included).
Pellet counting should be thorough, with good view of the ground…walking at a stoop, not hands and knees. Search for pellets above leaf litter; don't rake. **Time to count this subplot** Use a stopwatch. Use a 3-m stick to determine whether pellets are in the subplot. Only record pellet groups that are **in** a subplot. Pellet group is ***in*** if the "center of mass" is in the 3 m radius circle. If more than ½ of a group is out, it's ***out***. If you find no pellets in a subplot, write "NONE" in the Obs column. Note any **Comments** about the subplot.

3B. Each pellet group found in a subplot is an "Obs." What to record for each group:
Give it a new **Obs#** in the subplot data table. Start at Obs # 1 separately for each subplot. Record how many **clumps,** and how many **pellets** are visible in the group, as seen without disturbing the group. Consider a clump to be a mashed together blob / aggregate of pellets that are not distinct. Count each volume of pellet-mash that is the size of 10 or so pellets as one clump. If it's a little "mini-clump" the size of 3 (or 5) pellets, just write "3" (or "5") in the pellets column. Pellets and clumps are a measure of how big the group was.
Put a number on the sketch circle of the subplot, to show the location of each Obs #. The sketch circle arrow points to the point center, for reference. An accurate sketch of the Obs # within the subplot will help you compare the pellet groups you saw against those the other observer saw.
Record what pellet decay **Class** the group is in, from 1 to 4. Definitions of pellet classes:
1= Freshest class; Pellet surface smooth, possibly shiny, green/brown or brown. Pellet interior consistently same color as surface; firm to the touch or slightly spongy, but not crumbly.
2= Pellet surfaces may be slightly rough or pitted. Pellet interior starting to get crumbly / friable when squeezed, but less than 10% of individual pellets are partially decomposed. "Decomposed" here means that the margin of the pellet is eroding, or crumbling. The very first signs of fungal growth may be present, but smaller than ~ 1 mm per spot of beginning growth.
3= Some pellet surfaces may be cracked, fissured. Pellets crumbly / friable when squeezed. 10-50% of individual pellets may be partially decomposed. The first signs of plant growth (i.e. tiny cotyledons) may be visible, as may be larger fungal growth.
4=Like Class 3, but >50% of pellets partially or completely decomposed. Differentiating individual pellets may be difficult. Plant growth may be advanced, growing through and breaking up individual pellets.

4. Randomly choose what subplots to Re-count
At all points, half of the subplots get recounted. After first counting of all subplots, flip a coin. If the coin comes up heads, recount the N-S pair; if tails, recount the E-W pair.
Circle what subplot (N, S, W, or E) you are recounting at the top of the "RECOUNT" table.
The recount observer repeats steps 3A and 3B. Compare notes and adjust the RECOUNT data table, putting a **Post-recount code** in front of each Obs #. The goal is to identify who saw each pellet group. You may need to go together to each subplot to confirm this.
Write "B" after of Obs# for pellet groups that were found by Both counters (5 becomes 5B)
Write "R" after of Obs# for groups found by the Recounter but not the first counter (5 => 5R)
Add new Obs# for groups found by First counter but not recounter, with code "F" (5=> 5F)
If you go back and happen to see a group that both missed, make a new Obs# coded with "X"
If you add Obs numbers to the list, make the Obs numbers increase…don't start over at "1"
When each pellet group in recount subplots has a Post-recount codes, **Clear All 4 Subplots**.
Remove all found pellets at least 5 meters away from the plot center or from any subplot.

5. After pellet counts and recounts, one person takes both Pellet data sheets for that point.
Record **Point Stop Time** on the main data sheet. Go to Step 1, Walking Time Data Sheet.
Notes: **UTM coordinates**: Record 3+ minutes of GPS data recording with 5 or more satellites (NAD 83 datum). **Start and Stop Times**: Hours:Minutes in 24-hour (military) time.
Subplot Veg types describe the understory type that predominates the subplot: Shrub, Open, Grass, Fern, Forb (herbaceous), Sapling, Bramble, Blowdown
Elk pellets: 1.3 cm long or longer, but also generally 1.3 cm wide. Piles up to a liter's-worth or more per pile. **Deer: pellets** ~1 cm long (but can be 1.3 cm); Deer pellets ~1 cm wide or less. Piles up to a ½ liter or so. If you're unsure, collect in a bag, with point and subplot # labeled.

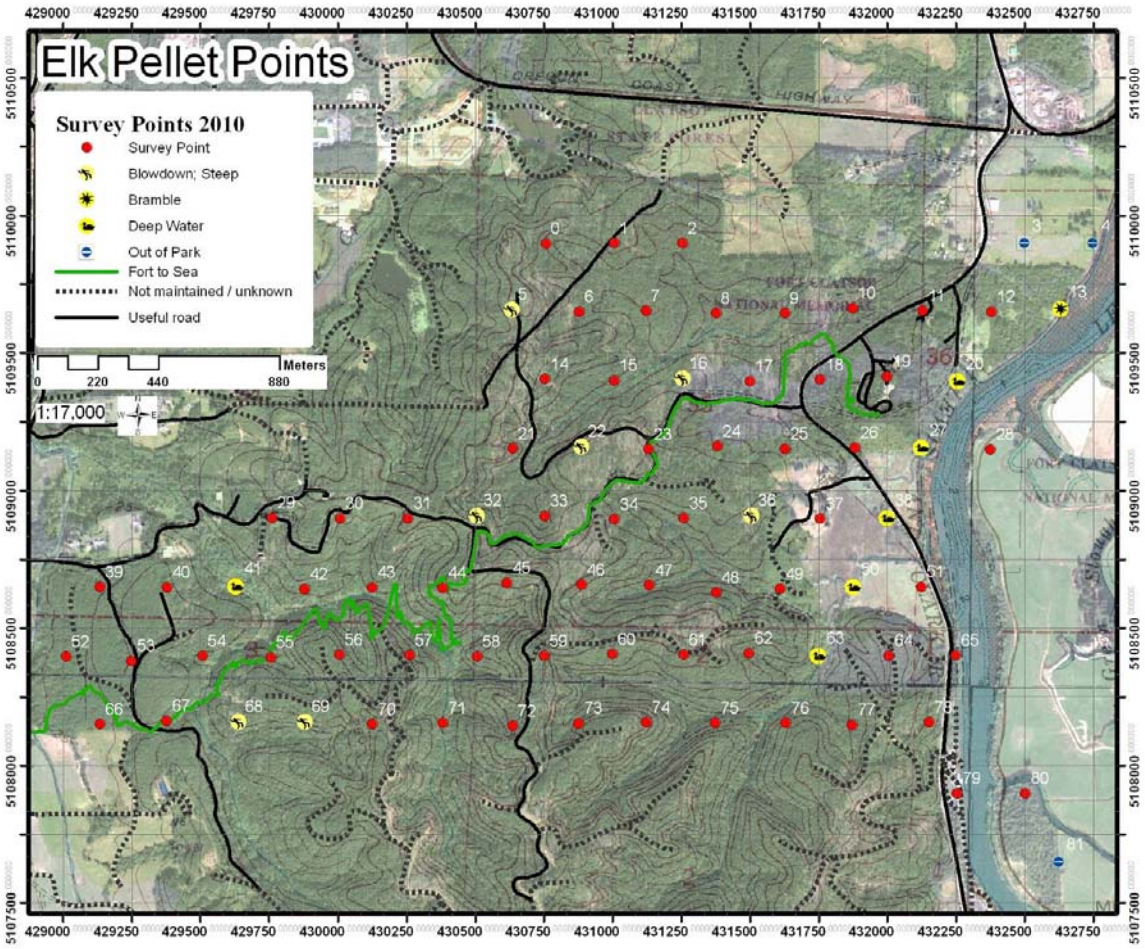


Figure SOP 6.8. Map of all survey points in the Fort Clatsop unit.

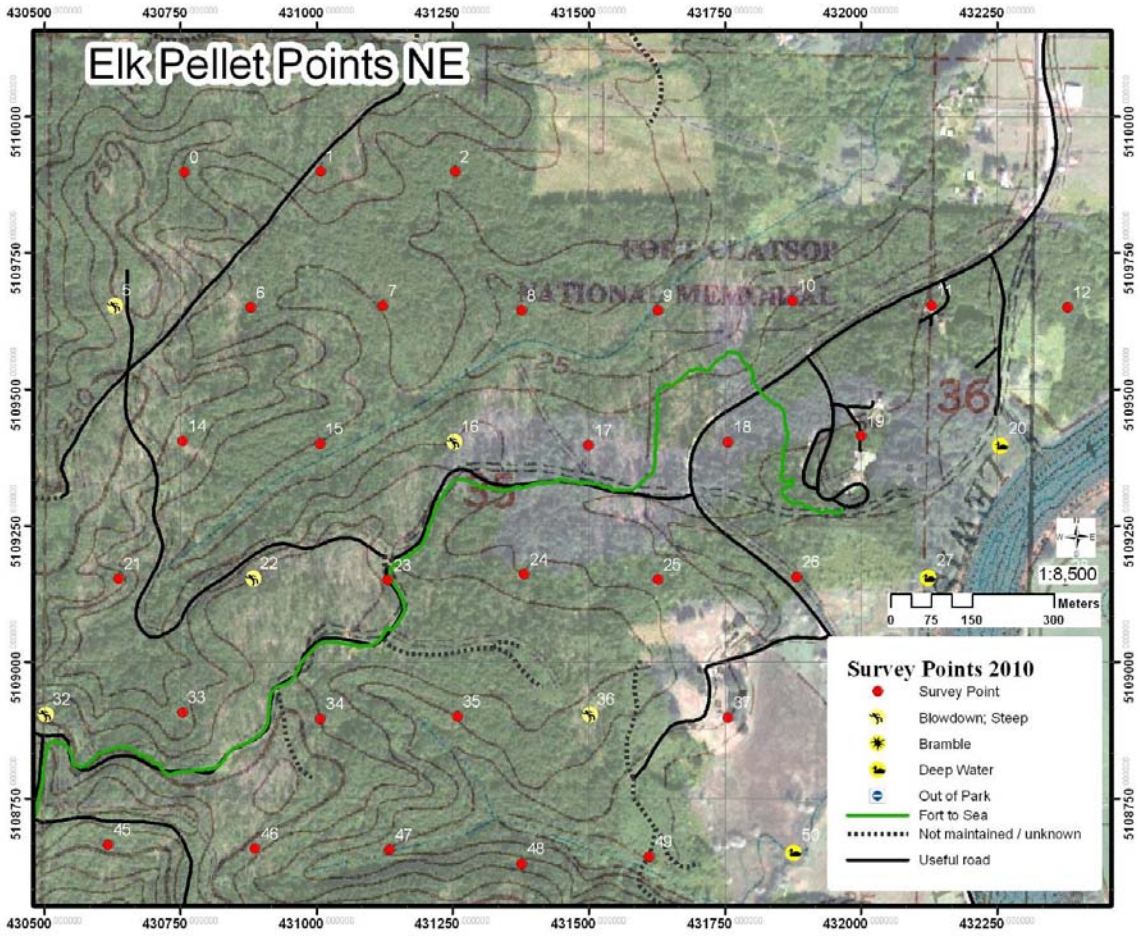


Figure SOP 6.9. Close-up map of survey points in the northeast of the Fort Clatsop unit.

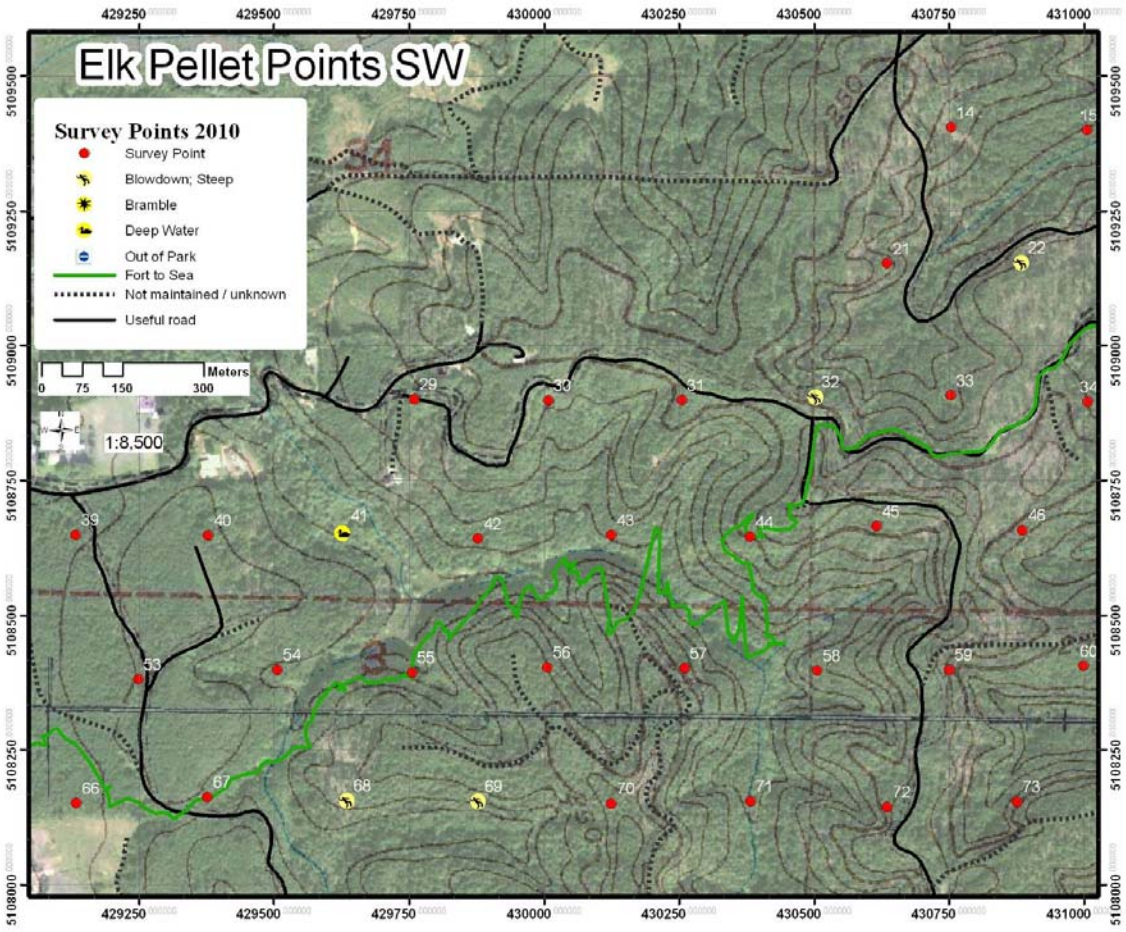


Figure SOP 6.10. Close-up map of survey points in the southwest of the Fort Clatsop unit.

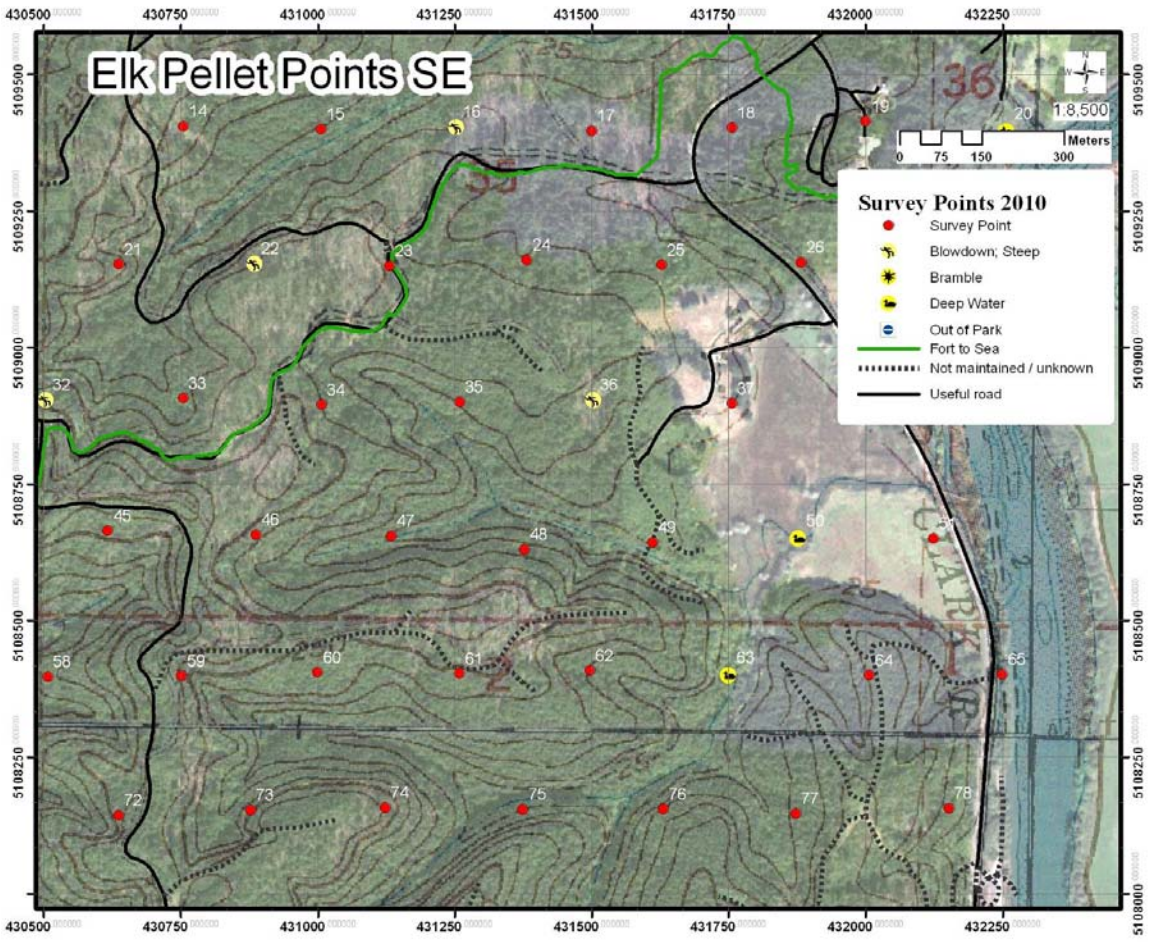


Figure SOP 6.11. Close-up map of survey points in the southeast of the Fort Clatsop unit.

Lewis and Clark N.H.P. elk pellet survey, Walking Time Data sheet

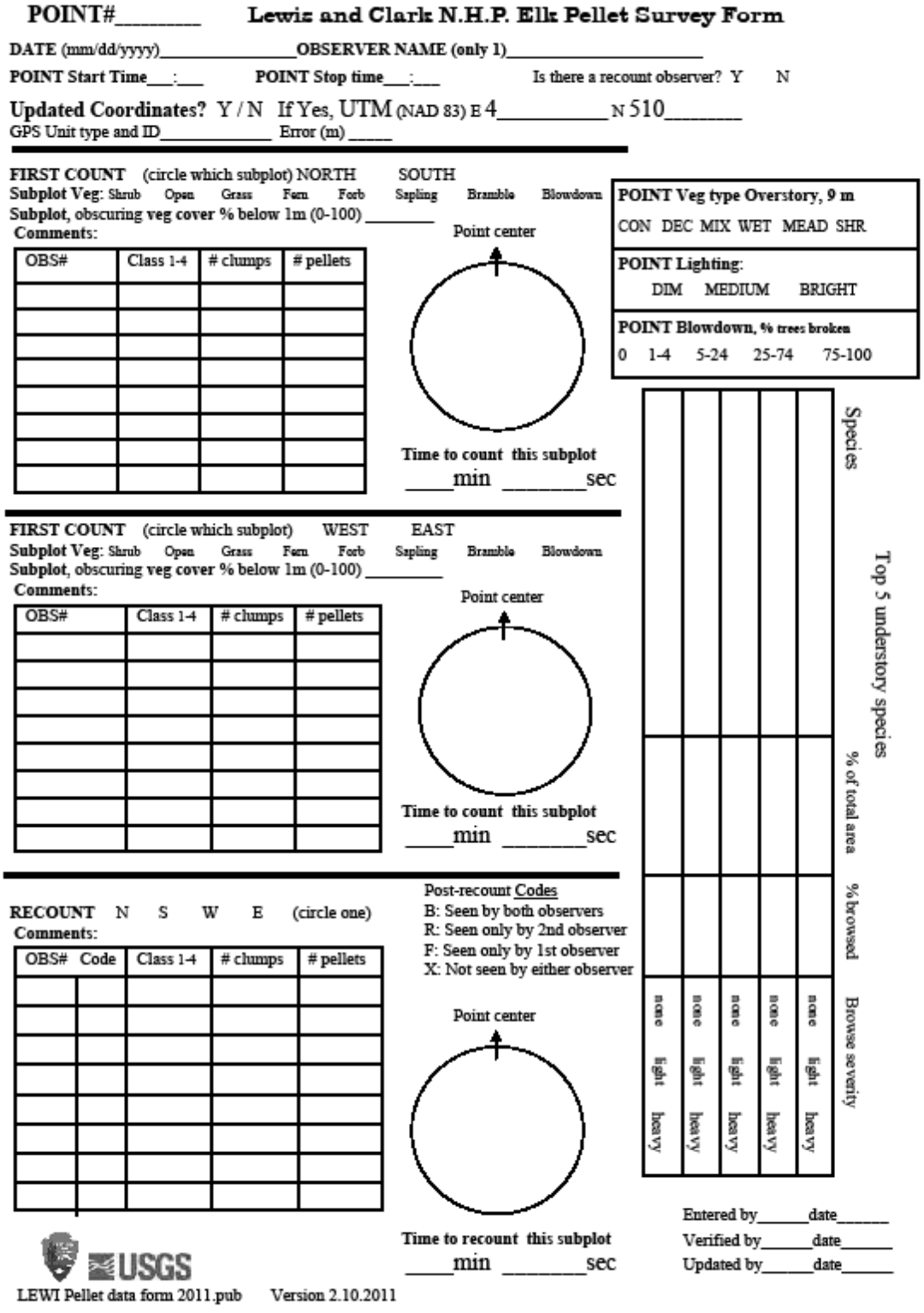
Start Loc'n: Handicap parking / Resource bldg. / Overlook / Ft Clatsop Rd / Barn / Netul / Perkins upper gate / Perkins lower gate / S. Clatsop slough / Other ___________
Date (mm/dd/yyyy)____________________ **Observer(s)**:____

From Point#	**To Point#**	**Start Time**	**Stop Time**	**% Off Trail**	**Severity of Blowdown** % of trees broken	Navigation Notes	Elk pellet(s)	Animal notes
				0-24 25-49 50-74 75-100	0 1-4 5-24 25-74 75-100		☐	
				0-24 25-49 50-74 75-100	0 1-4 5-24 25-74 75-100		☐	
				0-24 25-49 50-74 75-100	0 1-4 5-24 25-74 75-100		☐	
				0-24 25-49 50-74 75-100	0 1-4 5-24 25-74 75-100		☐	
				0-24 25-49 50-74 75-100	0 1-4 5-24 25-74 75-100		☐	
				0-24 25-49 50-74 75-100	0 1-4 5-24 25-74 75-100		☐	
				0-24 25-49 50-74 75-100	0 1-4 5-24 25-74 75-100		☐	
				0-24 25-49 50-74 75-100	0 1-4 5-24 25-74 75-100		☐	
				0-24 25-49 50-74 75-100	0 1-4 5-24 25-74 75-100		☐	
				0-24 25-49 50-74 75-100	0 1-4 5-24 25-74 75-100		☐	

Start Location: Circle best choice, or circle Other and write in the start location. **Date**: today's date, mm/dd/yyyy. **Observer(s)**: names of people conducting this survey.
From Point#: For first point of the day, or first point walked after driving to a new parking spot write "START" All other times, write the point number you walked from.
To Point#: Write the point number you walked to. If you are done for the day, or are walking back to our start location, write "END." **Start Time and End Time**: 24-hour time, to the nearest minute (i.e. 14:45). **% Off Trail**: Estimate what percentage of the distance you walked between these two points was Off Trail (and off road). Circle one category.
Severity of Blowdown: Circle one category that describes what % of trees you passed were blown down. **Navigation Notes**: Not necessary, but if there is something you want future crews to know about getting from place to place, note it here. **Elk Pellet**(s): Check the box only if you saw elk pellets on the way.
Animal Notes: This is a space where you can note, if you saw any, other elk signs (i.e., shed antlers, prints...) or other species (reptiles, amphibians…)

Version 2.10.2011 Entered by________date____ Verified by________date____ Updated by________date____

Figure SOP 6.12. Walking Time Data Sheet for use in pellet surveys.



POINT#_____ **Lewis and Clark N.H.P. Elk Pellet Survey Form**

DATE (mm/dd/yyyy)_____OBSERVER NAME (only 1)_____

POINT Start Time___:___ POINT Stop time___:___ Is there a recount observer? Y N

Updated Coordinates? Y / N If Yes, UTM (NAD 83) E 4_____ N 510_____

GPS Unit type and ID_____ Error (m) _____

FIRST COUNT (circle which subplot) NORTH SOUTH

Subplot Veg: Shrub Open Grass Fern Forb Sapling Bramble Blowdown

Subplot, obscuring veg cover % below 1m (0-100) _____

Comments:

OBS#	Class 1-4	# clumps	# pellets

Point center

Time to count this subplot

____min _____sec

POINT Veg type Overstory, 9 m

CON DEC MIX WET MEAD SHR

POINT Lighting:

DIM MEDIUM BRIGHT

POINT Blowdown, % trees broken

0 1-4 5-24 25-74 75-100

FIRST COUNT (circle which subplot) WEST EAST

Subplot Veg: Shrub Open Grass Fern Forb Sapling Bramble Blowdown

Subplot, obscuring veg cover % below 1m (0-100) _____

Comments:

OBS#	Class 1-4	# clumps	# pellets

Point center

Time to count this subplot

____min _____sec

RECOUNT N S W E (circle one)

Comments:

OBS#	Code	Class 1-4	# clumps	# pellets

Post-recount Codes

B: Seen by both observers

R: Seen only by 2nd observer

F: Seen only by 1st observer

X: Not seen by either observer

Point center

Time to recount this subplot

____min _____sec

Species	% of total area	% browsed	Browse severity
			none light heavy
			none light heavy
			none light heavy
			none light heavy
			none light heavy

Top 5 understory species

Entered by_____date_____

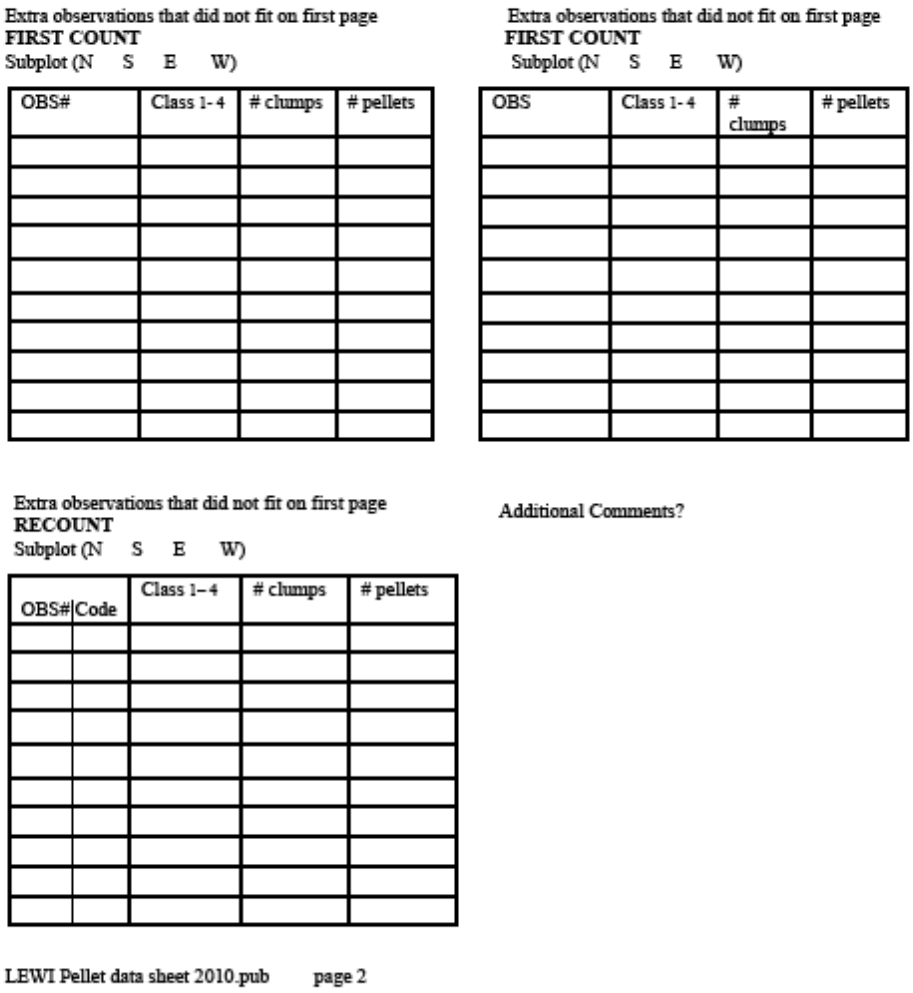
Verified by_____date_____

Updated by_____date_____

USGS

LEWI Pellet data form 2011.pub Version 2.10.2011

Figure SOP 6.13. Elk Pellet Survey Form, page 1, to be printed on the front of the page.



Extra observations that did not fit on first page
FIRST COUNT
Subplot (N S E W)

OBS#	Class 1-4	# clumps	# pellets

Extra observations that did not fit on first page
FIRST COUNT
Subplot (N S E W)

OBS	Class 1-4	# clumps	# pellets

Extra observations that did not fit on first page
RECOUNT
Subplot (N S E W)

OBS#	Code	Class 1–4	# clumps	# pellets

Additional Comments?

LEWI Pellet data sheet 2010.pub page 2

Figure SOP 6.14. Elk Pellet Survey Form, page 2, to be printed on the back of the page.

Lewis and Clark N. H.P. Fall Elk Pellet Clearing Form

Date (mm/dd/yyyy): ____________

Observer #1 Name:____________________ Observer#2 Name: ____________________

POINT # ______ First Count Clearing:

Observer #1 NORTH, # of Pellet Groups:_______ **Observer #2** SOUTH, # of Pellet Groups:_______

Observer #1 WEST, # of Pellet Groups:________ **Observer #2** EAST, # of Pellet Groups:_________

Recount Clearing:

Observer #1 SOUTH, # New Pellet Groups:______ **Observer #2** NORTH, # of New Pellet Groups:_______

Observer #1 EAST, # New Pellet Groups:________ **Observer #2** WEST, # of New Pellet Groups:________

Comments:

____

POINT # ______ First Count Clearing:

Observer #1 NORTH, # of Pellet Groups:_______ **Observer #2** SOUTH, # of Pellet Groups:_______

Observer #1 WEST, # of Pellet Groups:________ **Observer #2** EAST, # of Pellet Groups:_________

Recount Clearing:

Observer #1 SOUTH, # New Pellet Groups:______ **Observer #2** NORTH, # of New Pellet Groups:_______

Observer #1 EAST, # New Pellet Groups:________ **Observer #2** WEST, # of New Pellet Groups:________

Comments:

____

POINT # ______ First Count Clearing:

Observer #1 NORTH, # of Pellet Groups:_______ **Observer #2** SOUTH, # of Pellet Groups:_______

Observer #1 WEST, # of Pellet Groups:________ **Observer #2** EAST, # of Pellet Groups:_________

Recount Clearing:

Observer #1 SOUTH, # New Pellet Groups:______ **Observer #2** NORTH, # of New Pellet Groups:_______

Observer #1 EAST, # New Pellet Groups:________ **Observer #2** WEST, # of New Pellet Groups:________

Comments:

____

POINT # ______ First Count Clearing:

Observer #1 NORTH, # of Pellet Groups:_______ **Observer #2** SOUTH, # of Pellet Groups:_______

Observer #1 WEST, # of Pellet Groups:________ **Observer #2** EAST, # of Pellet Groups:_________

Recount Clearing:

Observer #1 SOUTH, # New Pellet Groups:______ **Observer #2** NORTH, # of New Pellet Groups:_______

Observer #1 EAST, # New Pellet Groups:________ **Observer #2** WEST, # of New Pellet Groups:________

Comments:

____

Entered by______ date_______ Verified by______ date_______ Updated by______ date_______

LEWI Fall Clearing Form.docx Feb 17, 2011

Figure SOP 6.15. Fall Elk Pellet Clearing Form, page 1.

Field instructions for Fall Elk Pellet Clearing Form, Lewis and Clark NHP

The primary purpose of fall surveys is to make sure that all pellets are taken out of all the subplots.
At the top of the page, record **Date**, **Observer #1** name and **Observer #2** name.
All four subplots get cleared by both observers (each subplot is first-counted once, then re-counted once).
In the fall, each time you search a subplot, count the number of pellet groups, and clear all the pellets.
Observer #1 will be the first counter for all North and West subplots all day.
Observer#2 will be the first counter for all South and East subplots all day.
After the first counting is done, Observer #1 will be the recounter for both South and East subplots.
After the first counting is done, Observer #2 will be the recounter for both North and West subplots.

The team of observers fills out one box of data for each surveyed pellet point:

Write down the **POINT #** (a number from 0 – 81, written on the center flag and on the map of points).
During subplot first counting and recounting, do not talk about results.
Confer only after recounting is done.
Each subplot gets pellet groups counted separately.
Record the number of pellet groups that you found in each subplot, and clear all the pellets out of it.
If you find no pellets in the first count at a subplot, or the recount at a subplot, write "NONE."
Record any comments about the Point or any subplot after "Comments."

Notes on how and what to count

- Pellet counting should be thorough, with good view of the ground…walk at a stoop, not hands & knees.
- Search for pellets above leaf litter; don't rake.
- Use a 3-m stick to determine whether pellets are in the subplot. Only record the number of pellet groups that are in a subplot. A pellet group is in if the "center of mass" is within the 3 m radius circle. If more than ½ of a group is out, it's out.
- If you find no pellets in a subplot, write "NONE," whether you are first counter or recounter.
- Gather up (in a bag) all pellets that you find in the subplot, or within another 1 m wide strip around the subplot. Only record the number of elk pellet groups that were in the subplot, but clear elk pellets within that wider area.
- Elk pellets: 1.3 cm long or longer, but also generally 1.3 cm wide. Piles up to a liter's-worth or more Deer: pellets ~1 cm long (but can be 1.3 cm); Deer pellets ~1 cm wide or less. Piles up to a ½ liter or so.
- If you're unsure about what species made a pellet, collect in a bag, with point # labeled…get clarification from an experienced crew member.

Figure SOP 6.16. Fall Elk Pellet Clearing Form, Page 2.

SOP 7: Conducting Road Surveys

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Figures

Page

Overview
This SOP contains instructions for conducting elk road surveys along designated routes.

Introduction
The purpose of road surveys at Lewis and Clark NHP is to use consistent methods to count the number of elk groups and the total number of elk seen along standardized survey routes. The numbers of groups and of total elk seen in surveys are indices to the visibility of elk encountered by park visitors near the Fort Clatsop park unit. The distance and direction from observers to elk groups can be used to approximate elk group locations, which will be mapped in four-year reports. The routes that are driven are a collection of public roads that are closest to the Fort Clatsop unit. A Driver and one or more Observers survey each of the routes at sunrise three to four times per month every second month beginning February each year.

Safety Considerations
All precautions should be taken to reduce the risk of a vehicle collision. Surveys are only conducted on roads where relatively slow speeds do not pose a safety hazard to other drivers. The Driver should drive slowly – 15 mph where possible, and no faster than 25 mph. The Driver's attention should be entirely on driving; pull over where safe to allow divers behind to pass. Drivers in this protocol are not Observers; the Driver's attention must be focused on safe driving. Drivers must have the appropriate safety training for NPS vehicle operation even if, for some reason, a private vehicle is used for this purpose. It is only the Observer's role to look for elk during every part of the surveys.

The Driver and Observer(s) should wear NPS approved personal protection equipment (PPE) for roadside work. This includes high visibility vests with reflective surfaces. Caution should be taken when choosing a place to pull over, and any parked vehicle should be well off the road. Seatbelts must be worn at all times when personnel are in a vehicle, whether driving or parked. When they are out of the vehicle, the Driver and Observer(s) should stand safely off the road away from traffic, and should be highly aware of vehicles. There should be a first aid kit in the vehicle, and a working park radio to call for help in the event of an emergency.

No section of Highway 101 is part of any survey route. Highway 101 is not 'on survey' because braking quickly and pulling over suddenly to the highway shoulder may cause a driving hazard. The Observer may note an elk group that is seen while driving along Highway 101, but the Driver should not make any sudden changes for the sake of the survey.

Daily Preparations and Supplies
The survey requires one Driver and one Observer in the front passenger seat. If there is one more passenger acting as an Observer, that person should sit in the rear seat on the Driver's side. Clean the inside and outside of the windshield and side windows with paper towels or a squeegee.

Before you leave the Resource Building, determine the order of travel for the different routes. Be sure to have and follow a clear plan to vary the order of routes on different days of the month, so that no one route is consistently driven soonest after sunrise. One possible way to schedule the order of driving is to drive route 1 first on the first survey in a given month, route 2 first on the second survey of the month, route 3 first on the third survey of the month, and route 4 first on the fourth survey of the month.

Each Driver and Observer team should bring the following supplies:

- PPE for each person in the vehicle (high visibility vest)
- First aid kit in vehicle
- Park radio
- Clipboard and pencils
- Road Survey Data Forms (at least two copies)
- Watch, or vehicle clock with correct local time
- Thermometer, for air temperature
- Binoculars of 8X or greater magnification (one pair per Observer)
- Printed maps of survey routes
- Laser Rangefinder
- Sighting Compass

Instructions for Surveys

Defining Elk Groups

For the purposes of this protocol, an elk group is any group of one or more elk that seem to be part of the same social unit. Generally, all elk that are visible at the same time in a single field would be considered to be part of a single group.

Visually Identifying Elk, as Compared to Deer

Roosevelt elk (*Cervus elaphus roosevelti*) and Columbian black-tailed deer (*Odocoileus hemionus columbianus*) are wild grazing animals that are native and widespread in the region of Lewis and Clark NHP. Columbian white-tailed deer (*Odocoileus virginianus leucurus*) may also be seen in some areas of western Oregon and Washington. This protocol is *not* for deer observations. These three species are similar, but can be differentiated by size and color markings.

In general terms, adult elk are larger than deer – elk may be the size of a pony or small horse, while the size of deer could be likened to a tall sheep. Elk have a shaggy dark brown mane (Figure SOP 7.1) that deer do not. Elk have a dark belly and dark legs, while the bellies and the inside of the legs are typically lighter colored for both species of deer. Elk have a large, cream-colored patch on their rump and a short cream-colored tail.

Black-tailed deer have a small white rump patch and tail that is grey or brown on top, but white beneath (Figure SOP 7.2). Columbian White-tailed deer have notable white rings around the eyes and a tail that is light brown on top and white beneath – the deer tail may be raised, as a signal, with the conspicuous white underneath plainly visible (Figure SOP 7.3).

Figure SOP 7.1. Photographs of elk cow and calf (left) and bull elk with cow elk (right). Photo credit: Kim Sager / Anita McMillan.

Figure SOP 7.2. Photographs of black-tailed deer doe (left) and black-tailed deer buck (right). Photo credit: Chuck Bartlett.

Figure SOP 7.3. Photographs of Columbian white-tailed deer doe (left) and Columbian white-tailed deer buck (right) (photo credit: US Fish and Wildlife Service).

Classifying Elk by Age and Antlers

When possible, observers will categorize individual elk according to their age and the presence or absence of antlers. Calves, or young of the year, are generally born in late May to early June and will be distinguished from adults on the basis of body size. Calves have no antlers, and are notably smaller than adults. Male and female calves are generally not distinguishable from a distance; therefore the number of calves of both sexes present in each group will be recorded collectively.

For most of the year, male elk (i.e. bulls) are most easily distinguished from females (i.e., cows) by the presence of antlers. Yearling bulls typically grow antlers consisting of a single spike approximately 30-50 cm long, although branching is possible. Two-year-old bulls most often grow relatively small antlers consisting of 3-5 points, and bulls older than three years generally grow antlers consisting of 5-6 points, although >6 points is possible. Males generally shed their antlers as early as mid-January, but more typically between February to mid-April, and so may be difficult to distinguish from adult females until antler regrowth is obvious, typically by May.

For this protocol, adult elk (i.e., > 1 yr old) will be classified as Branched Antler Bulls (Branch Bulls), Spike bulls (Spikes), or Antlerless Adults. Branched antler bulls have antlers that fork at least once. Spike bulls have antlers with no forking.

The category of Antlerless Adults includes both adult cows and adult bulls that have no antlers. We use this category because cows can be difficult to distinguish from bulls during those months when bulls have no antlers.

It is not required to categorize all the elk that are counted in an elk group. In some seasons and under some conditions, it will not be possible to determine the age or sex category for some part or all of an elk group. Field crews must use care to record any elk that cannot be identified with certainty as ‘unknown’ on the field form.

Completing the Elk Road Survey Form

One Elk Road Survey Form (Figure SOP 7.5) is used per day of survey; extra sheets of the form may be used if there are more than five elk groups observed during a single morning’s survey. Directions for conducting a survey and completing the associated Elk Road Survey Form are below. In addition, there is an abbreviated set of instructions provided for convenient field use (Figure SOP 7.6) Bolded text refers to items on the form that are to be filled in by the Observer.

1. Before beginning each day of survey, the Observer should fill in the following general information that applies to all survey routes:

> **Date:** Fill in the date, using the mm/dd/yyyy format.
> **Driver:** Fill in the first and last name of the Driver.
> **Observer(s):** Fill in the first and last name of any Observers in the vehicle. This does not include the Driver.
> **Coordinate Source:** Circle the one type of coordinate source that is used to define the vehicle locations at the time of elk group sightings. Circle “Route Map” if you will refer to the distance in miles and tenths of a mile, along the routes, as defined by the printed Route Maps. Circle “GPS Unit” if you will refer to a GPS unit in hand to get the vehicle’s Easting and Northing coordinates.

Page ___ of ____: In the blank underlined space after the word Page, fill in the number "1" for the first form that you use every day. After the last survey route has been completely surveyed, the blank underlined space at right should be filled in with the total number of data form pages that were used over the entire course of the morning's survey.

2. The upper table of the Elk Road Survey data form has spaces for information about the time and environmental conditions for each route that was fully or partially surveyed. If you did not attempt to survey a route, then you should not write that route number on the form. For each route that you survey, environmental conditions listed below should be noted at the time when you are about to start surveying that route. Weather data should be recorded to ensure that road surveys were done under the proper conditions, and because the data may be used in exploratory analyses in the future. For each Route that you survey, record the following:

Route #: Fill in the one-digit Route number: 1 (Airport), 2 (East Side), 3 (Dolphin to Perkins), or 4 (SE19th to Willow).
Start time: Fill in the local time, as hh:mm, when you started to survey this route.
Stop Time: Fill in the local time, as hh:mm, when you completed survey of this route.
Temp, °C: Use the thermometer to determine the outside air temperature, in degrees Celsius at the start of the survey.
Wind (0-6): Choose one number from the following list of Beaufort wind scale codes (NOAA 2011) to describe the wind strength at the start of the survey. Do not conduct the survey if the wind is blowing at or stronger than at a level corresponding to number 6, below.

- 0 = Calm; smoke rises vertically (<2 km/h)
- 1 = Light air; smoke drifts (2-5 km/h)
- 2 = Light breeze; wind felt on face; leaves rustle (6-12 km/h)
- 3 = Gentle breeze; leaves and twigs in constant motion (13-19 km/h)
- 4 = Moderate breeze; small branches move; raises loose paper; dust rises (20-29 km/h)
- 5 = Fresh breeze; small trees sway (30-39 km/h)
- 6 = Strong breeze; large branches moving; wind whistling (40-50 km/h)

Wind Direction: Fill in the direction that the wind was coming from at the start of the survey. Write down one of the following eight compass bearings: N, NE, E, SE, S, SW, W, or NW
Sky Code: Choose one number from the following list to describe the condition of the sky at the start of the survey. Do not conduct the survey when there is heavy rain (6), sleet or hail (7), or snow (8) coming down from the sky.

- 0 = Clear, or few clouds
- 1 = Partly cloudy (scattered) or variable sky
- 2 = Cloudy or overcast
- 3 = Fog
- 4 = Mist or drizzle
- 5 = Showers or light rain
- 6 = Heavy rain
- 7 = Sleet or hail
- 8 = Snow

Survey Completed?: Circle Yes or No for each route. Circle No if you began to survey a route, but did not finish the survey of that route.
Any Elk Seen?: Circle Yes or No for each route. Circle Yes if you saw any elk while driving that route. Circle No if you did not see any elk while driving that route.
Survey Comments: Record any comments about the conditions of driving that are not specific to an elk observation in the "Survey Comments" area.

3. Use the lower table to record any elk group that was seen. If an elk group is seen, the Driver should pull over safely to the side of the road, allowing a good view of the group. If possible, both Driver and Observer should stay in the vehicle until all data have been filled in about the group, except the Azimuth.

For each elk group that is seen, fill in the following items on the form:

Route #: Write down the Route number that you are on
Obs #: Write down a new Observation number (Obs #) for each new elk group seen over the course of the morning. Observation numbers start at 1 and increase sequentially (2, 3, 4…) throughout the morning, across all routes. Example: if the second elk group seen is on the last route surveyed, the Obs# is 2.
Time: Fill in the local time when you first saw the elk group, using the hh:mm format.
UTM East and UTM North: If your coordinate source is a GPS unit, record the UTM East and UTM North coordinates. These coordinates should be for your location (at the vehicle).
Mile.tenth: If you are using a route map as the coordinate source, record the closest Mile.tenth of a mile; to do this, you need to locate where you are on the map, and choose the mile and tenth of a mile that is closest to your location (at the vehicle). Note that the vehicle odometer should not be used as a source for **Mile.tenth** values, because the direction of travel on a route may not be reversed, compared to the direction that was used to define Mile.tenth values on the maps.
Total # Elk: After you have counted all the elk in the group that you can see, record that number as the "Total # Elk." This total includes all individual elk in the group, whether or not they can be categorized.
If you can distinguish the age and sex classes of group members (see above, **Classifying Elk by Age and Antlers**), you may note the number counted within each of the following categories:
Branch Bulls: Fill in the number of branched antler bulls.
Spikes: Fill in the number of spike bulls.
Antlerless Adults: Fill in the number of antlerless adults. This category may include adult cows and may include adult bulls with no antlers.
Calves: Fill in the number of calves.
Unknown: Fill in the number of animals in the group that you were unable to classify. The total number of elk in the group should be equal to the sum of Branch Bulls, Spikes, Antlerless Adults, Calves, and Unknowns.

The numbers seen in the separate age and sex classes may add up to less than the total number of elk in the group – any remaining elk will be considered to be of unknown sex or age class. For

example, if you see a group that totals 20 animals, of which you can be sure three are branch-antlered bulls, two are spikes, and four are calves, you would record:

Total # Elk	#Branch Bulls	#Spikes	#Antlerless Adult	#Calves
20	3	2		4

Azimuth: Record the Azimuth, which is the exact direction, in degrees, from you to the elk group, based on a sighting compass. For example, if the elk group is due SW, write 225. Azimuth is the compass bearing, in degrees (0-360) from the observer to the elk group. This should be measured with a compass (Figure SOP 7.4) that has been corrected for the local declination; near Astoria, true north is 16^{o} 45' East of magnetic North in 2010, but note that this value is changing by approximately nine minutes per year (National Geophysical Data Center, www.ngdc.noaa.gov). To measure the azimuth you must go a few steps away from the vehicle. The metal of the vehicle can influence the magnetic field measured by the compass. While keeping the direction of travel arrow pointed at the elk group, rotate the compass housing by hand until the red part of the floating magnetic needle lines up with the red orienting arrow. The azimuth value to write down on the form is the compass bearing, in degrees, that lines up with the index mark on the compass. Note that stopping and exiting from the vehicle too close to an elk group could cause the elk to flee, although that has not been a problem for most groups because they are generally viewed from a distance (>100 m). In the case of elk groups close to roads, the observers should attempt to use other viewing points where it is safe to stop and exit the vehicle and where elk can be viewed from a distance that will not affect their behavior.

Distance: Fill in the Distance from you to the elk group, in meters. Use the laser rangefinder to find the distance to an animal roughly in the center of the group. At this time the model of rangefinder used is a Bushnell 1500 Elite. Look through the eyepiece and adjust it so that the elk are clearly visible and focused. Press the power button on top of the rangefinder once to activate the liquid crystal display; this will cause an aiming circle to appear in the center of the view. Be sure that the center crosshairs of the rangefinder area on an object that will reflect the laser, such as a tree, stone, the ground, or an animal. After one or more elk in the group is in focus and centered in the aiming circle, press the power button once more and hold it down; this will cause the rangefinder to transmit a laser. The distance to the target will appear. The distance in meters should appear as a number followed by the letter "M." If the rangefinder is providing distances in yards, press the power button once to activate the LCD, then hold down the "mode" button near the eyepiece for five or more seconds, until "M" is illuminated.

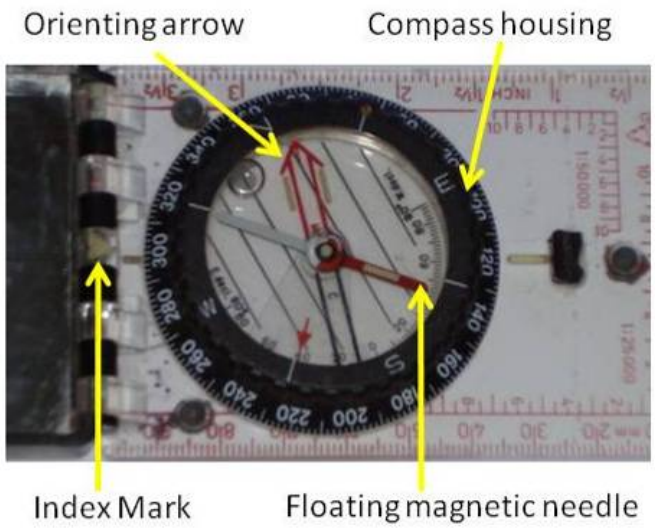


Figure SOP 7.4. Compass, with arrows pointing to parts that are used in determining azimuth.

Habitat type: Fill in the Habitat type category in which you first saw the elk group, choosing from the following list:

- MEAD = Meadow, pasture, hayfield, open field
- LAWN = Mowed lawn, i.e. near houses
- CON = Coniferous forest. More than 25% tree cover, and >75% of trees are coniferous
- DEC = Deciduous forest. More than 25% tree cover, and >75% of trees area deciduous
- MIX = Mixed forest. More than 25% tree cover and 25-75% are coniferous and deciduous
- SHR = Shrubs. Less than 25% tree cover, and the area is dominated (>50% of the area) by shrubs and / or brambles
- WET = Wetland. Wetlands, including marsh, sedges, rushes, or tidal habitats
- DUN = Dune sands, dune grassland, dune shrubfield
- Other = Other habitat; Write the word "Other" in the Habitat type column, and describe the habitat in the Comments section just below

Comments: Note any additional comments about this elk group.

After observing the elk group and finishing the data collection for that elk group, pull back onto the road and continue driving on the route until you have completed the route. Use additional data sheets, if necessary. After you have completed the last survey route, review the Elk Road Survey Form, for completeness.

Driving Directions and Maps for Numbered Road Survey Routes

The four road survey routes are described below. The tables of directions have turns or observation points listed to the nearest tenth of a mile, based on the printed map of the route – those mile markers do not necessarily match an odometer reading from a vehicle, particularly if the route is not driven in the order listed below. It is not required to drive each route in the order listed below, but it is required that the entire set of routes be driven each survey morning. Other

routes that might be added to future revisions of this protocol could include a route through Fort Stevens, and a route that includes Pioneer Farm Lane, if access to that road could be granted.

Route 1: This route includes good views of the northern margin of the park, and the airport area. A map of the mile and tenth of mile markers along Route 1 is shown in Figure SOP 7.7.

Start point is Clatsop Airport Rd., going north, at intersection with Hwy 105	0.0
Note: stay to the south of the elk exclusion fencing	0.7
At intersection with Airport Rd., turn left	1.2
Intersection with Hwy 105	1.9
Stop vehicle, to get good view of open fields to the north and south	3.4
Intersection with Fort Clatsop road. End of survey.	3.7

Route 2: This route includes good views of the eastern margin of the park which is across the river. The section of this route through commercial properties is not "on survey", but the section of the route that goes past residential properties *is* "on survey." A map of the mile and tenth of mile markers along Route 2 is shown in Figure SOP 7.8.

Start point is at Resources Building, turning right (North) onto Fort Clatsop Rd.	0.0
From Fort Clatsop Road, Turn right (E) onto Hwy 105, Warrenton Astoria Hwy	0.5
From the bridge over the Lewis and Clark river to Lewis and Clark road is OFF SURVEY	1.6 – 2.7
Turn right (south) onto Lewis and Clark Road; from here on is all ON SURVEY	2.7
At hilltop by Lyngstad heights, park and view pastures to the west	3.7
Pull over just past Reith Larson Lane for a view across fields to the west and south	5.6
Turn right, to cross bridge over Lewis and Clark River	6.5
Turn right (north) on Fort Clatsop Road, back toward the park	6.6
The turn back into the Resources building parking lot is the end of the survey.	9.9

Route 3: This route includes some good views of property along the park's northwest margins. A map of the mile and tenth of mile markers along Route 3 is shown in Figure SOP 7.9.

Start point is Dolphin Ave and Hwy 101, going south on Dolphin.	0.0
Pull in to the Oregon Department of Transportation parking lot, and take a view to the east	0.1
Continue south on Dolphin and turn left onto Rainbow's End Lane	0.7
Go to the end of the mowed field the, turn around	1.0
Turn left (south) onto Dolphin, crossing bridge	1.6
Turn left (east) onto Perkins Lane	1.9
Drive to O'Casey property, looking in orchard area of yard; turn around	2.5
Drive out to Highway 101 via Perkins Rd. End of the survey is at Perkins Rd & Railroad Rd. From this direction of Route 3, you may access Route 4 by driving North on Hwy 101, turn right on Hwy 105, and turn right onto SE 19th St.	3.6

Route 4: This route includes some good views of the park's northwest margins. A map of the mile and tenth of mile markers along Route 4 is shown in Figure SOP 7.10.

Start point is intersection of Hwy 101 and SE 19th, toward the Industrial Park	0.0
Stop, or drive very slowly, at viewpoint along the powerline right-of-way	0.1
Go past the animal shelter, turning right on Chokeberry Rd.	1.1
At intersection of Chokeberry and Willow, turn right onto Willow	1.2
Continue on Willow, beyond the end of pavement, onto the gravel / dirt road that extends out to the middle of a filed, as of November 2008. Use this view of fields.	1.9
Return to pavement. Turn right onto Salal	2.0
From Salal, turn Right onto Willow	2.3
Turn right on SE Honeysuckle, then Right on SE Willow Dr.	2.5
Survey ends at the intersection of SE Willow Dr. and Highway 105	2.7

After the Survey

When you finish the survey, record Stop time, Temperature, Wind, Wind direction, and Sky code for the last route you completed. Enter the data into the database (**SOP 8: Data Entry and Verification**) and file the original data form(s) with the Project Lead.

Data Form, Instructions, and Route Maps

On the following pages are the Road Survey Data Form (Figure SOP 7.5), road survey instructions (Figure SOP 7.6), and one map for each of the four routes (Figures SOP 7.7, 7.8, 7.9, and 7.10).

References Cited

NOAA. 2011. The Beaufort Wind Scale. USDC National Oceanic and Atmospheric Administration. Internet document: http://www.hpc.ncep.noaa.gov/html/beaufort.shtml

Lewis and Clark N.H.P. Elk Road Survey Form, for use with designated routes

USGS

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Date (mm/dd/yyyy):___/___/_____ Driver_____ Observer(s):_____ Coordinate Source *(circle)* Route Map GPS unit

Route#	Start Time	Stop Time	Temp, °C	Wind (0-6)	Wind Direction	Sky Code (0-8)	Survey Completed?	Any Elk Seen?
							Yes No	Yes No
							Yes No	Yes No
							Yes No	Yes No
							Yes No	Yes No

Survey Comments:

Route#	OBS#	Time	UTM East	UTM North	Mile.tenth	Total # Elk	Branch Bulls	Spikes	Antler-less adults	Calves	Unknown	Azimuth (degrees)	Distance (meters)	Habitat type
			4_____	5_____										
Comments														
			4_____	5_____										
Comments														
			4_____	5_____										
Comments														
			4_____	5_____										
Comments														
			4_____	5_____										
Comments														

LEWI Road Survey Data form 2010.docVersion 4.13.2010 Entered by_____ date_____ Verified by_____ date_____ Updated by_____ date_____

Figure SOP 7.5. Elk Road Survey Data Form. This is the front page of a two-sided sheet.

Lewis and Clark N.H.P. Elk Road Survey Form, for use with designated routes

Field Instructions: fill out one form per morning of survey. If you observe > 5 elk groups use a 2nd sheet…write the date and "Page 2 of 2."
Date is mm/dd/yyyy **Driver:** Write last name. **Observer:** Write last name of the person or people in the vehicle who are not driving
Coordinate Source: Circle "Route Map" if your locations are miles.tenths-of-a-mile, or "GPS Unit" if your locations are in UTM coordinates.

Fill in one row per surveyed Route in the table of start time, stop time, and weather. Weather may be copied downward if there is no change.
Even if you only record weather conditions at the start of the morning, write down weather values for all routes (for clear data entry).
Route #: Use a numbered route. 1=Airport; 2=East Side; 3=Dolphin to Perkins; 4=SE19th to Willow
Follow a clear plan to vary the order of routes on different days, so that no one route is consistently driven soonest after sunrise.
Start time and Stop Times for each route: Write hour:minute, in 24-hour time. **Temperature:** Write temperature, in degrees Celsius.
Wind code and **Sky code**: choose from the table below. **Wind Direction**: Where the wind is coming from; choose N, NE, E, SE, S, SW, W, or NW.
If you see no elk during the entire morning of survey, check the box at the upper right of the form…this confirms why the rows below are blank.
Survey Completed? Circle Yes or No for each route. **Any Elk Seen?** Circle Yes if any elk were seen on the route, No if no elk were seen.

For each observed elk group, fill in one row of the following data:

Route: Write the route number you are on when you see each observed elk group.
OBS#: Start the numbering at 1 only once per day -- give an increased Observation number to each group of elk seen, regardless of route .
UTM East and North: Record these coordinates for where you are, based on GPS unit – or leave these blank and record miles and tenths of miles in the next box to the right. **Mile.tenth:** The closest mile and tenth of mile to your location, based on the route map.
Total # elk: the sum total number of elk seen in that group; sum of all age / sex types.
Branch-bulls: # of Bulls with more than just a 'spike' antler. **Spikes** # of bulls whose antlers have single beams; no tines.
Antlerless adult: # of animals with no apparent antlers; adult size. **Calves**: # of animals with no apparent antlers that appear to be young-of the year.
Unknown: # of unclassified animals that were in the group. Total # should be the same as the sum of bulls, spikes, antlerless, calves, and unknown
Azimuth (direction): Write the angular direction from the vehicle to the group, in degrees, based on a declination-corrected sighting compass.
Distance (m) Use a laser rangefinder and write down exact distance from you to the group.
Habitat type: record the abbreviation code that best describes habitat for the majority of the elk group, from the table below.

Wind code (Beaufort scale)	**Sky codes**	**Habitat type** Choose from these codes.
0 = Calm; smoke rises vertically (<2 km/h)	0 = Clear, or few clouds	MEAD = Meadow, pasture, hayfield, open field
1 = Light air; smoke drifts (2-5 km/h)	1 = Partly cloudy (scattered) or variable sky	LAWN = Mowed lawn, i.e. near houses
2 = Light breeze; wind felt on face; leaves rustle (6-12 km/h)	2 = Cloudy or overcast	CON = Coniferous forest (>75% of trees coniferous)
3 = Gentle breeze; leaves and twigs in constant motion (13-19 km/h)	3 = Fog	DEC = Deciduous forest (>75% of trees deciduous)
4 = Moderate breeze; small branches move; raises loose paper; dust rises (20-29 km/h)	4 = Mist or drizzle	MIX = Mixed forest (25-75% conifer and deciduous)
5 = Fresh breeze; small trees sway (30-39 km/h)	5 = Showers or light rain	SHR = Shrubs
6* = Strong breeze; large branches moving;	6* = Heavy rain	WET = Wetland; marsh; sedges; rushes in / near water
	7*= Sleet or hail	DUN = Dune sands, dune grassland, dune shrubfield
	8*= Snow	Other = Other; note what it is_____

Figure SOP 7.6. Abbreviated instructions for the Elk Road Survey Data Form. This is the back page of a two-sided sheet.

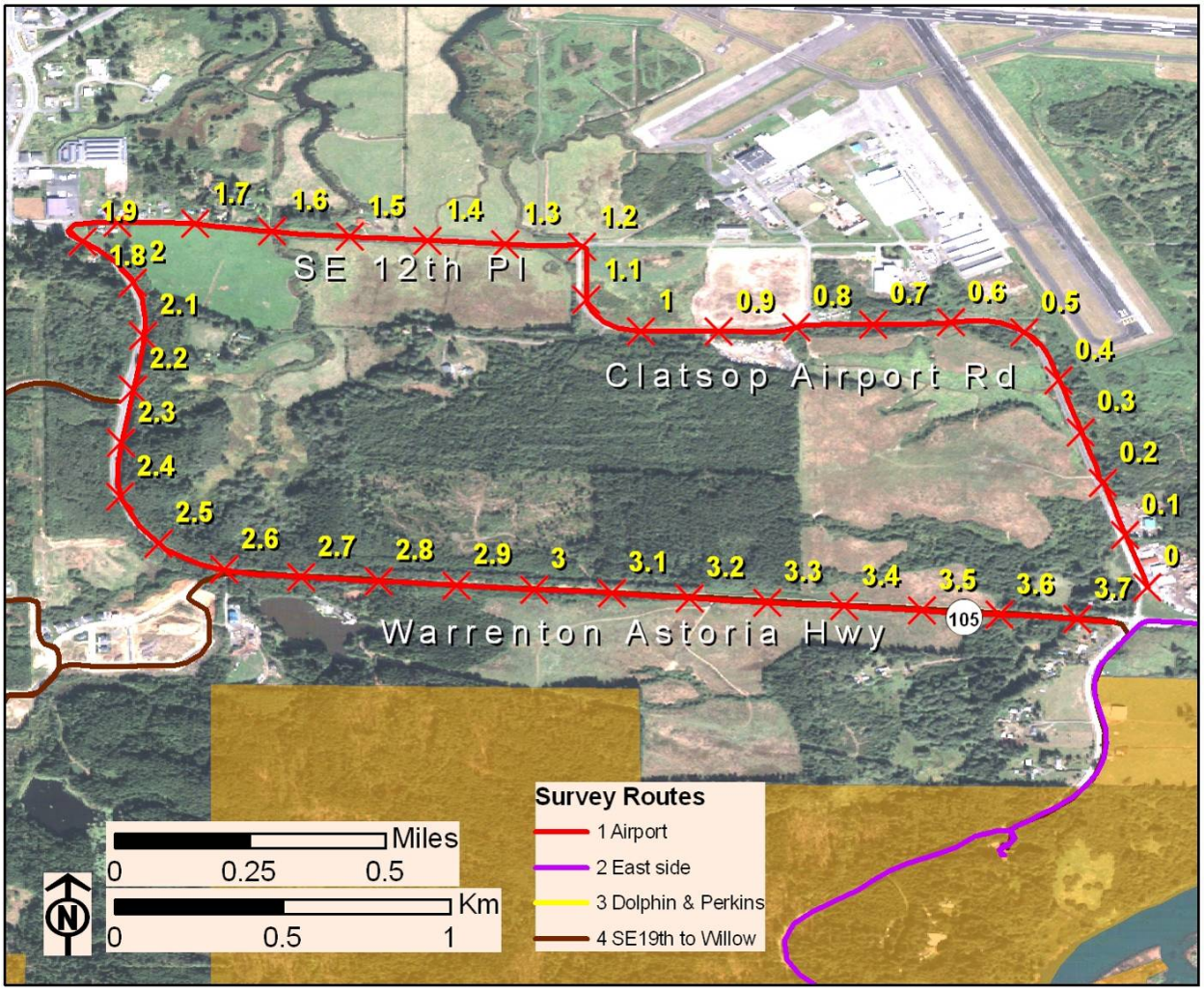


Figure SOP 7.7. Elk Road Survey Route 1. The satellite imagery is from September 2008 (Digital Globe Inc.).

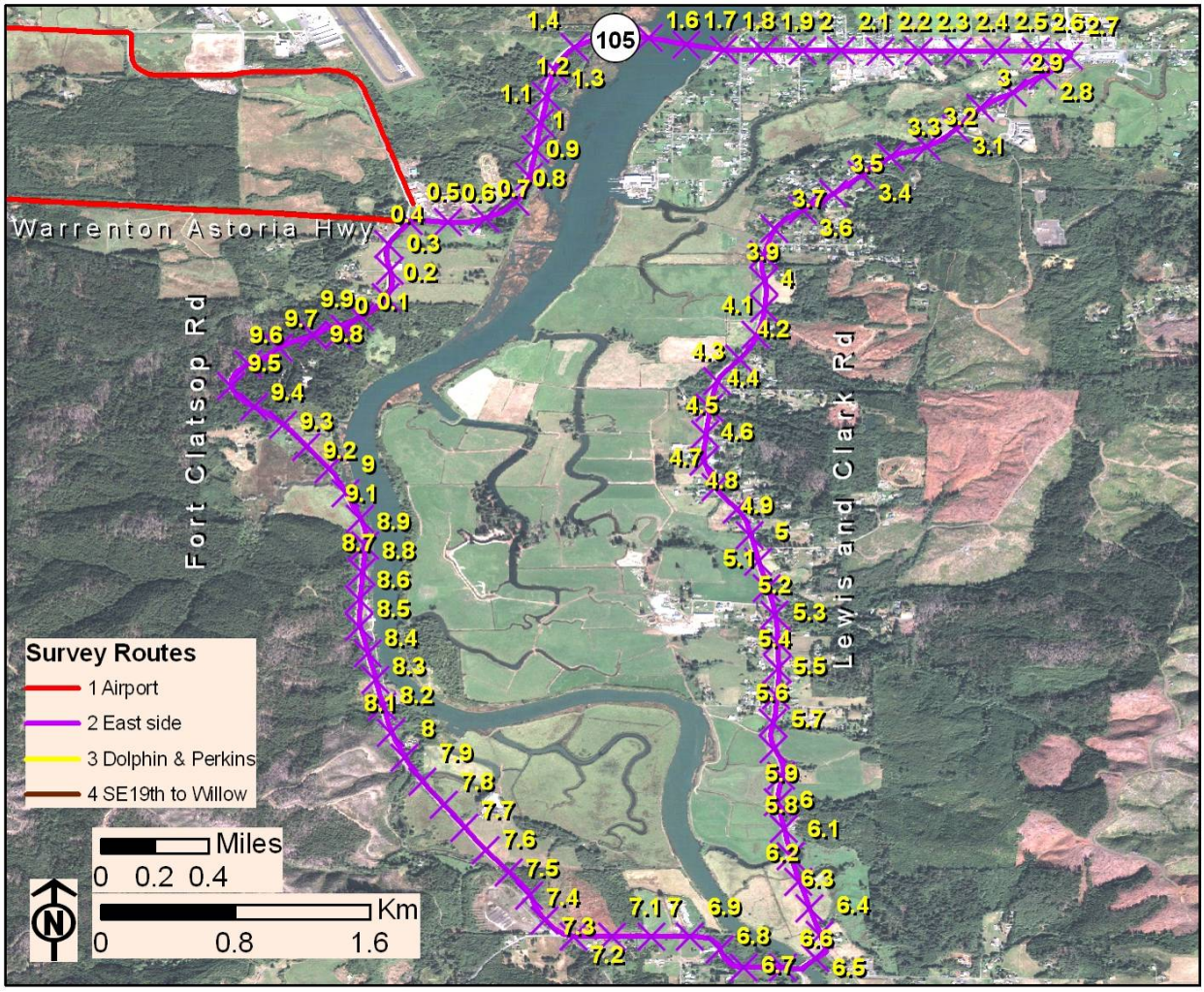


Figure SOP 7.8. Elk Road Survey Route 2. The satellite imagery is from September 2008 (Digital Globe Inc.).

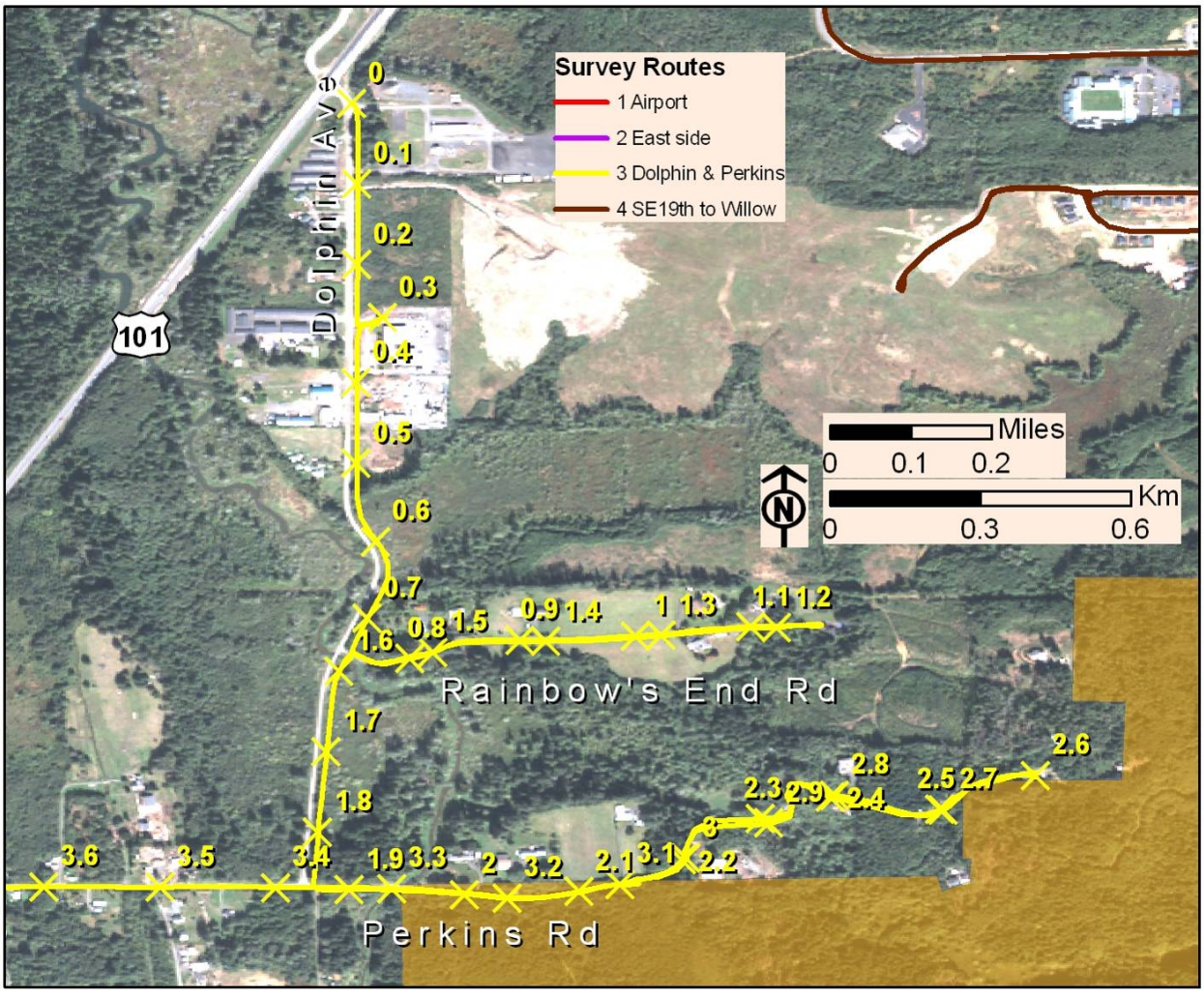


Figure SOP 7.9. Elk Road Survey Route 3. The satellite imagery is from September 2008 (Digital Globe Inc.).

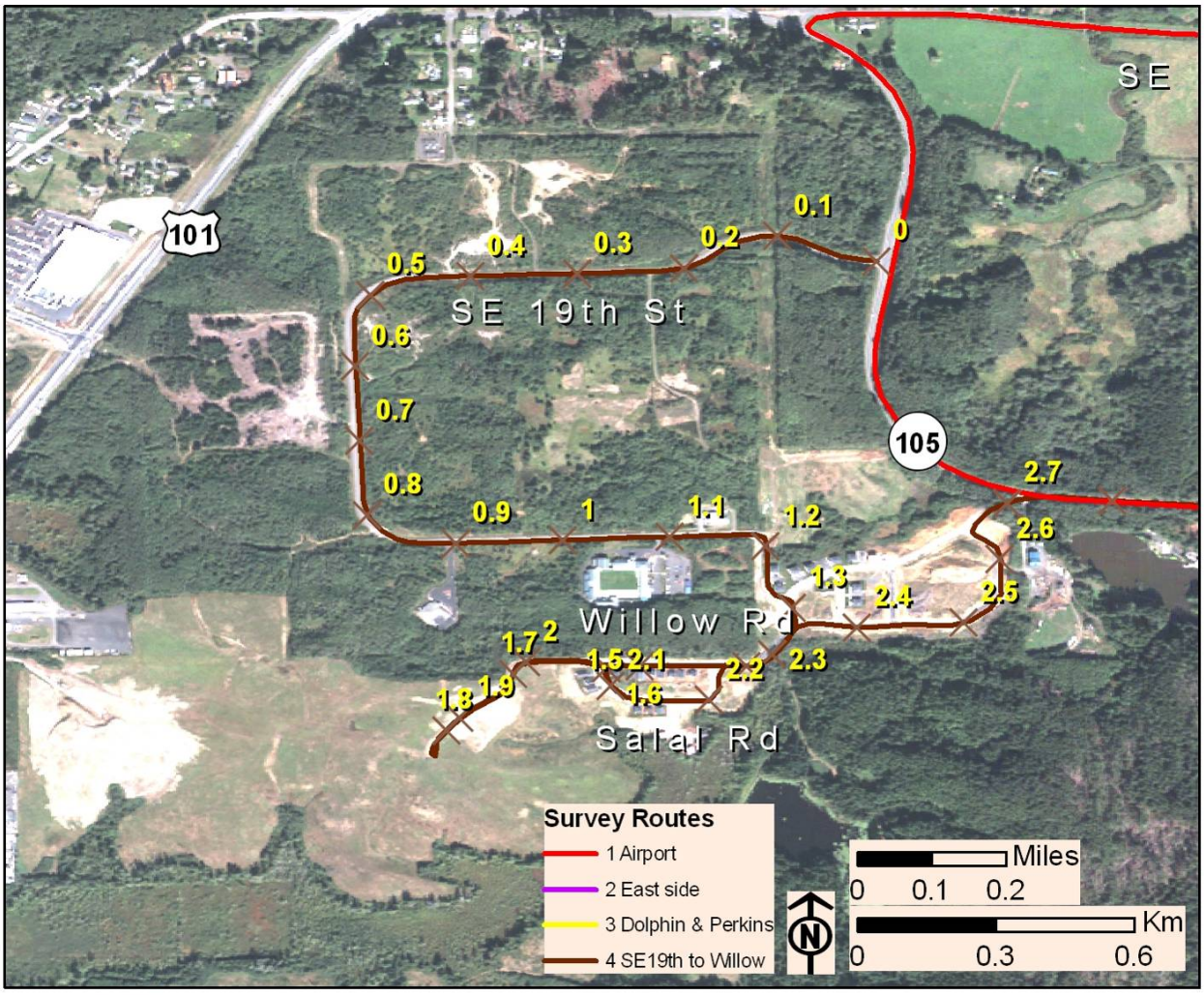


Figure SOP 7.10. Elk Road Survey Route 4. The satellite imagery is from September 2008 (Digital Globe Inc.).

SOP 8: Data Entry and Verification

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Overview

This SOP describes the general procedures for entry and verification of field data in the project database application. For related guidance, refer to **Section 4C, Overview of Database Design**, and **Section 4D, Data Entry and Processing**. The following are general guidelines:

1. Data should be entered as soon after data collection as possible so that field crews remain current with data entry tasks, and identify any errors or problems as close to the time of data collection as possible.
2. The front-end database application is a Microsoft Access file maintained in the project workspace (see **SOP 1: Project Workspace and Records Management**). This front-end copy may be considered "disposable" because it does not contain any data, but rather acts as an interface with data residing in the back-end database. It contains the forms, queries, and formatted report objects for interacting with the data in the back-end.
3. The back-end database for this project is implemented in Microsoft SQL Server to take advantage of the automated backup and transaction logging capabilities of this enterprise database software.
4. Each data entry form is patterned after the layout of the field form, and has built-in quality assurance components such as pick lists and validation rules to test for missing data or illogical combinations. Although the database permits users to view the raw data tables and other database objects, users are strongly encouraged only to use the pre-built forms as a way of ensuring the maximum level of quality assurance.
5. As data are being entered, the person entering the data should visually review each data form to make sure that the data on screen match the field forms. This should either be done for each record prior to moving to the next form for data entry, or preferably as a separate step after all of the data for a sampling trip has been entered. Important: It is a requirement that all events must be entered and verified at the end of the field season.

At regular intervals and at the end of the field season the Crew Lead should inspect the data that have been entered to check for completeness and perhaps identify avoidable errors. The Crew Lead may also periodically run the Quality Assurance Tools that are built into the front-end application to check for logical inconsistencies and data outliers (this step is described in greater detail in **Section 4E, Data Quality Review** and also in **SOP 9: Data Quality Review and Certification**).

Database Instructions

Getting Started

The first action to be taken is to make sure the project workspace is set up properly on a networked drive. Refer to **SOP 1: Project Workspace and Records Management** for instructions on how to set up and access the project workspace.

Important Reminders for Daily Database Use

1. If accessing the database from a remote park (i.e., other than OLYM), do not open and use the front-end application outside the remote desktop environment as it will run very slowly and likely stall. Instead, refer to the following instructions on remote access before using the application.
2. If accessing the database from OLYM, do not open and use the front-end application on the network as this makes it run more slowly. Instead, copy the front-end file from the project workspace to your local desktop and open it there. This copy can be replaced with new versions as they are released.
3. New versions of the front-end application may be released as needed through the course of the field season. When this happens, you may see a notification about a new release when opening the current or older versions of the front-end. Copies of the outdated version of the front-end file should be deleted and replaced with the new version, which will be named in a manner reflecting the update (e.g., LEWI_Elk_2010_v2.mdb).
4. Upon opening the front-end application for the first time, there may be a need to reconnect the front-end to the back-end, depending on how the project workspace is mapped on your computer. This database connection update should only need to be done once for each new release of the front-end database.

Remote Connections for Data Entry and Database Access

Most of our project databases are hosted on a server at OLYM. Due to bandwidth limitations, project database users accessing these databases from other parks (or from remote locations at OLYM) may encounter slow performance or application errors when accessing the database directly via a networked drive or a local front-end file. Therefore, to make data entry as smooth and efficient as possible, such users will typically need to use a remote desktop connection each time they need to access the database.

Remote desktop connections access what is called a "terminal server" at OLYM. In doing so, all of the processing is occurring on a server collocated with the database server, thus minimizing the negative effects of bandwidth on application performance. Through such a connection, the remote user is essentially sending mouse moves and keystrokes to the terminal server, and receiving screen updates in return. There may be some noticeable lag time in mouse moves and screen updates, but the performance is often much better than when accessing the data through other means.

Instructions for Using Remote Desktop

1. From the Start menu, go to: All Programs > Accessories > Communications > Remote Desktop Connection. You may wish to create a desktop shortcut by right clicking on the Remote Desktop Connection icon in the menu and selecting Send To > Desktop.
2. With the Remote Desktop window open, type in the terminal server name: "inpolymts1".

3. Click on the Connect button.
4. Enter your NPS login and password. Note that the login must be preceded by "NPS\", for example: "NPS\gwashington".
5. The remote desktop session will open and you will see a blank desktop that represents what you would see if you were sitting at the computer at OLYM. The first time you use it you may need to map network drives you use frequently and create other useful shortcuts (e.g., to the project workspace), and you will need to use the Access 2010 first-time setup instructions (see the following section) so that the project database functions properly. These initial setup steps should only need to be done once, however.
6. You may switch back and forth between your remote session and your local session (i.e., on your local workstation) using the connection bar across the top of the remote desktop screen.
7. When using the project database, you may need to make a copy of the front-end application if someone else is already using the file (evidenced by a ".ldb" lock file with the same name and in the same folder as the front-end file). You may also want to create your own subfolder in the project workspace for your own front-end copy to avoid these conflicts with other users.
8. When you are finished with your remote session, log off by clicking on Start > Log Off.

The first time you use Remote Desktop, you may wish to select Options from the first Remote Desktop Connection screen to enter more specific information for your frequent remote desktop sessions (e.g., enter "inpolymts1" for the computer, your NPS login, and "NPS" for the domain so you don't have to enter "NPS\" in front of your login each time). Do NOT enter your password or check the box to save your password, as this may present a security risk.

Special Instructions for Access 2010

If you are going to be using Access 2010, make sure the security settings will allow the database to function properly. This is necessary because Access 2010 may have been installed in a very restrictive security mode that disables the functionality built into the project database. Note: This setting change should only need to be performed once. However, if you move to a different workstation, these steps may need to be repeated to allow the database to perform properly. You will know the difference if none of the buttons or form functions on the main database switchboard form work properly, or if you get the following warning message across the top of the window:

To enable the database content to run properly on a consistent basis, do the following:

1. Prior to using the front-end database, open Access 2010 from the Start menu.
2. Go to Start > All Programs > Microsoft Office > Microsoft Office Access 2010.
3. In the upper left corner, click on the Office Button.
4. At the bottom of the menu page, click the Access Options button.
5. Select the Trust Center category on the left panel.
6. In the lower right, click the Trust Center Settings button.
7. Select the Macro Settings category on the left panel.
8. Select the option “Enable all macros”. Then hit OK, and exit Access.
9. From this point forward the project database application should function properly on that computer.

User Roles and Privileges

The database application provides different levels of access privileges: read-only, data entry, power user, and administrator. These privileges are assigned based on user login by the Project Lead or a designee at the beginning of each field season. Most field crew users will be granted "data entry" rights, which allow one to enter and edit data for the current field season only. Certified data and lookup domains may only be edited by users with power user or administrator privileges. If a user name is not granted explicit rights to the database, the application will open in "read-only" mode.

Overview of Database Components

The front-end application has multiple functional components, which are accessed from the main application switchboard form that opens automatically when the application starts. Several buttons are found on the form to provide access to different components of the application, and are arranged in functional categories:

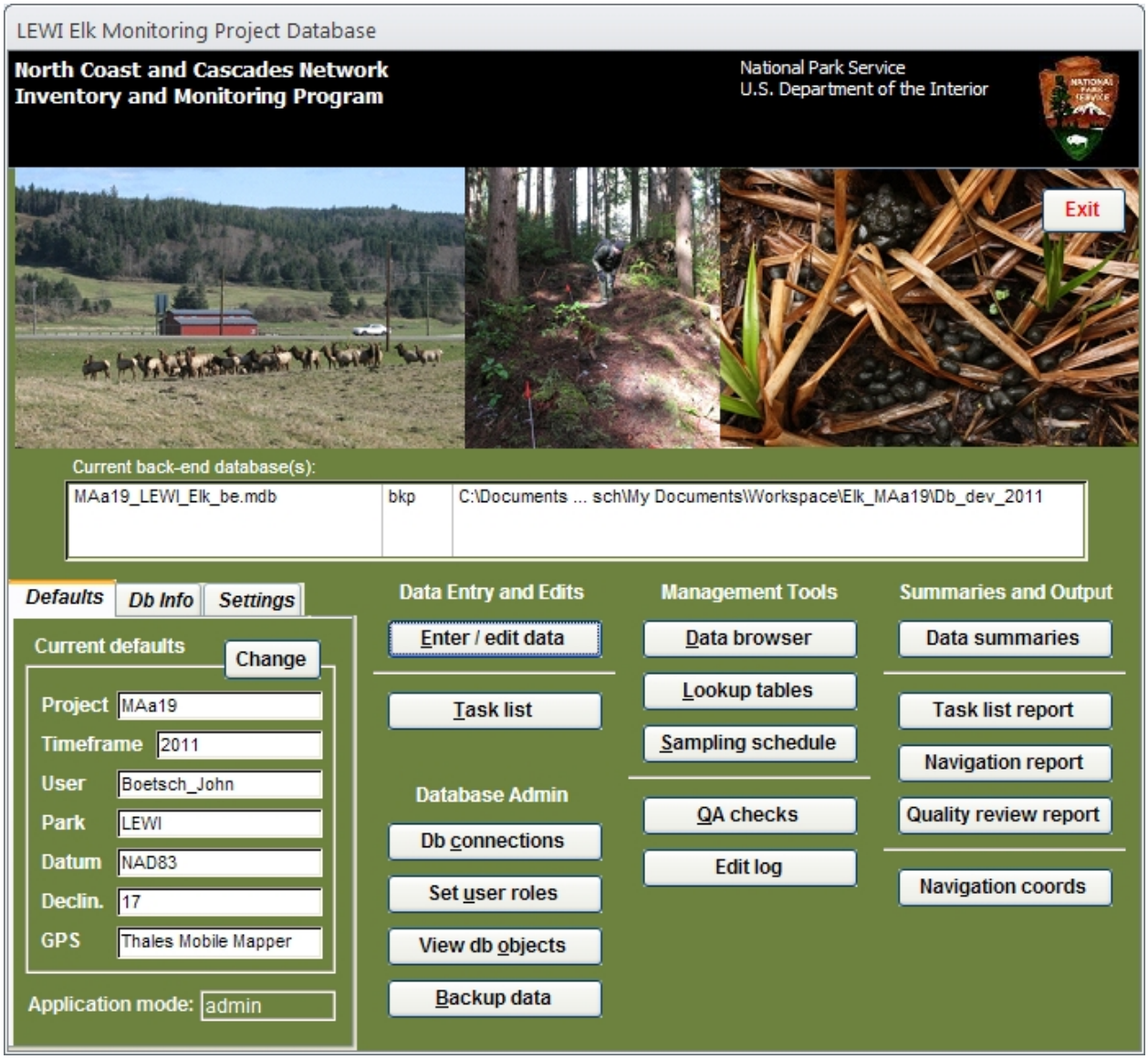
- Data Entry and Edits
    - Enter / edit data – Opens a form to confirm default settings (e.g., park, coordinate datum) prior to continuing to the project-specific data entry screens.
    - Task list – Keeps track of unfinished tasks associated with sample locations (for example, forgotten equipment, unfinished data collection) that one field crew can use to communicate with a future field crew.

- Database Admin
    - Db connections – Manage and update the connections to the back-end database(s).
    - Set user roles – Manage the list of users who may view, enter and edit the database. Provides four levels of access: read-only, data entry, power user, and admin. This button is only enabled for power users and administrators.
    - View db objects – Allows the user to view and edit database objects (tables, queries and forms). This button is only enabled for power users and administrators.

- Management Tools
    - Data browser – Opens a tabbed form that provides comprehensive access to data arranged by sampling location. This form has headers for filtering by park, location code, location type and status.
    - Lookup tables – Opens a tool for managing the lookup values for the project data set (e.g., species list, list of project personnel).
    - Sampling schedule – Opens a form to view and edit the sampling schedule.
    - QA checks – Opens the data validation and quality review tool, which shows the results of pre-built queries that check for data integrity, missing data, and illogical values, and allows the user to fix these problems and document the fixes. See **SOP 9: Data Quality Review and Certification**.
    - Edit log – Opens a form for documenting edits to certified data records.

- Summaries and Output
    - Data summaries – Opens a form for viewing and exporting summary queries for data exploration, analysis and reporting.
    - Task list report – Generates a report of tasks that need to be accomplished for a specified park or sample location (default is for all locations).
    - Navigation report – Generates the field season Navigation Report used to relocate sample locations and brief the crew on tasks that need to be accomplished.
    - Quality review report – Generates the data quality review results for a selected year or all years.
    - Navigation coords – Provides current, best navigation target coordinates for sample locations so these can be loaded into GPS units for navigation, or GIS for display and map production.

Below is a view of the main startup menu / switchboard form.



The lower left portion of the main startup menu has tabs for user defaults, database version release information, and run-time settings.

- Defaults – Default values for the application. User name, park, datum, declination, and GPS model type can all be changed by the user. To change user defaults, click on the 'Change' button. This will open up a new window where the user can update the default values. This window also appears each time the user selects the path for data entry or review to ensure that the correct user and park are indicated.
- Db Info – Contains the release information, technical support contact information, and buttons for reporting a bug or issue.
- Settings – Contains checkboxes for run-time application settings:
    - Prompt for backup on startup – The user will be prompted to make a data backup when the application opens.

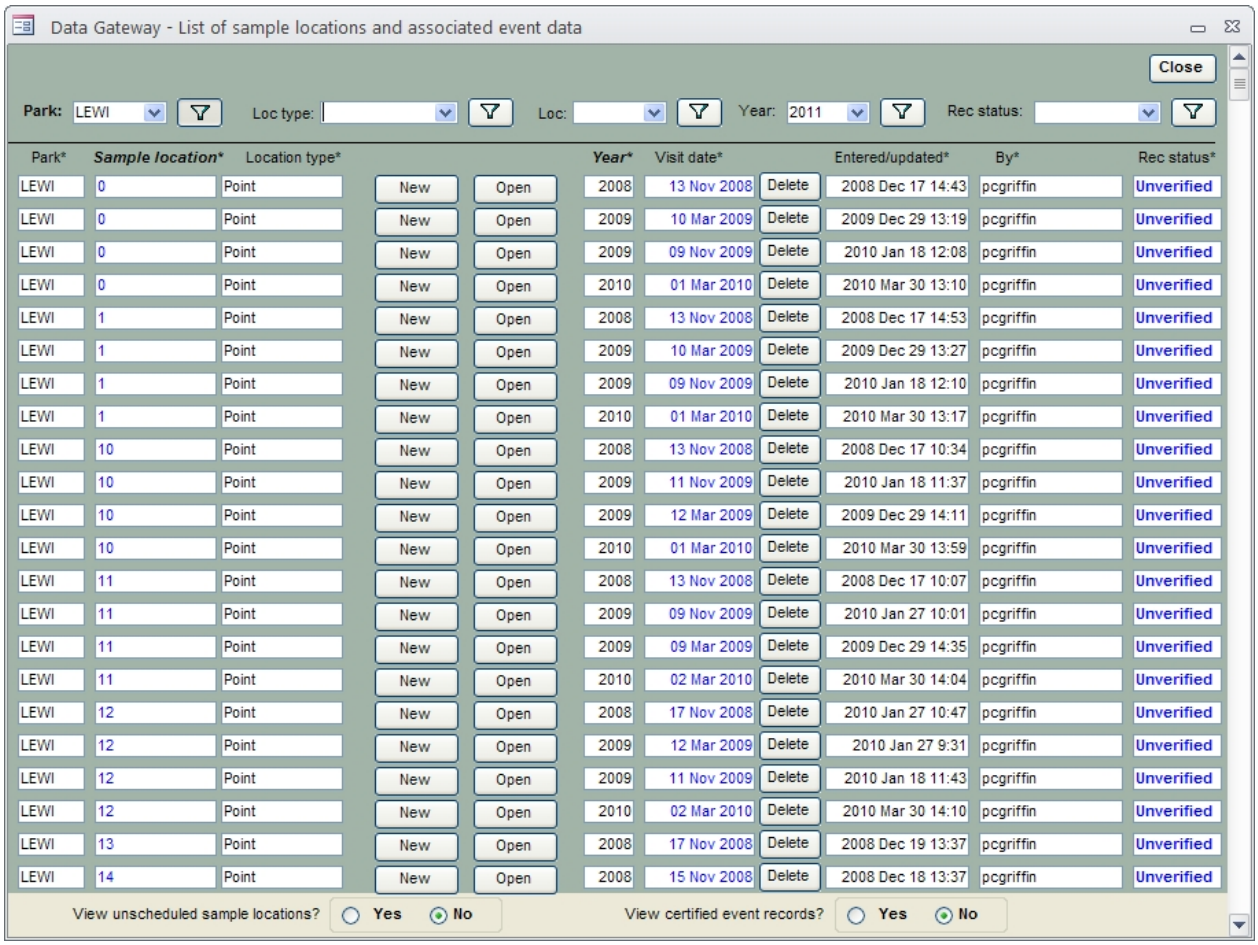
- Prompt for backup on exit – The user will be prompted to make a data backup when the application closes. Default is on, which means that the user will be prompted each time the application closes if there is at least one Access back-end for which backups are specified.
- Compact back-end on exit – Compacts the back-end database when it the application closes. This helps to manage the size of the back-end, which improves performance over the network.
- Test all connections on startup – Ensures that each of the back-end tables is linked properly. Default is on, which means that the user will be prompted on startup if there is at least one Access back-end.

Entering and Verifying Event Data

When you select the "Enter / edit data" button, you will have a chance to change the default user name, park, datum, declination, and GPS model. Make sure this information is correct each time you enter data. Note: These defaults are properties of the front-end application, so different users reusing the same front-end file will need to change this information frequently. To avoid this, make copies of the front-end file for each user.

Data Gateway Form

Next you will see the Data Gateway Form, which is where you will see a list of sample locations that are already present in the back-end database. This list is automatically filtered by the selected park (upper left corner), and to show only scheduled sample locations for the current sampling year. There is also the capability to filter by park, sample location, location type (road survey routes vs. pellet points), sampling event year, and record status. Filters can be changed at any time, and records can be sorted by double-clicking on the field label above each column.



At the bottom of the form are radio buttons to allow the user to view unscheduled sampling locations if needed (e.g., an unscheduled site was visited after the sampling plan was made at the beginning of the season). Another set of radio buttons allows the user to view certified records from previous seasons (power users only).

Verifying Data Records

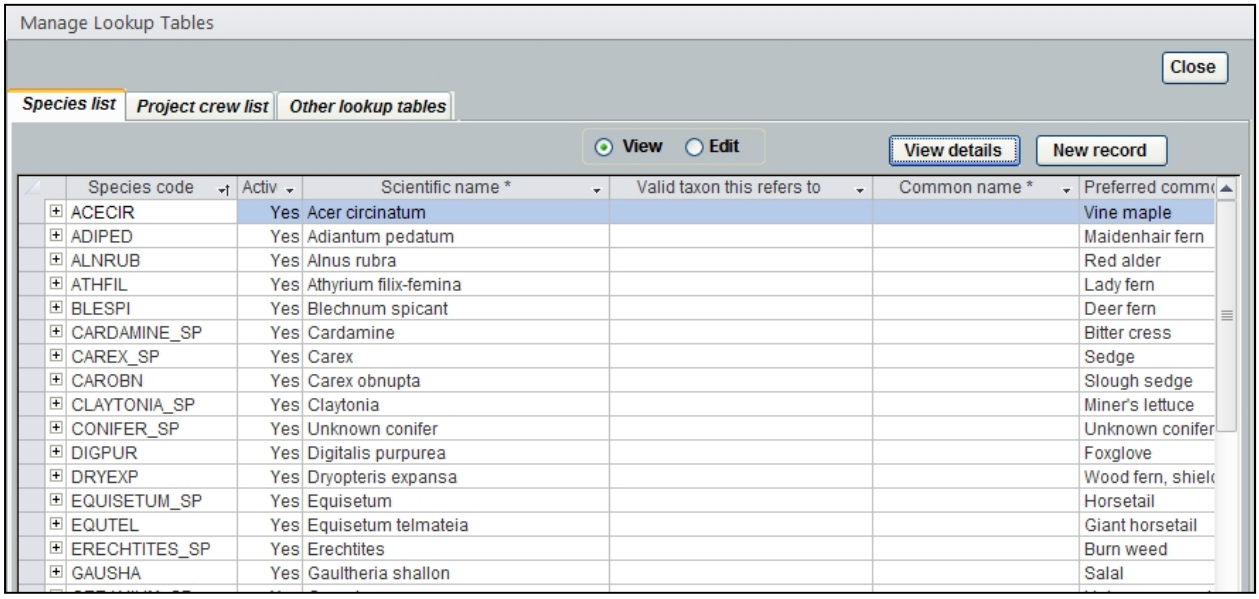
Field crews must verify all sampling events throughout the field season. The recommended approach is for one crew member to do all of the data entry for one sample location, then have another crew member review and verify records for that location. The current record status for each sampling event is shown in the Data Gateway Form. To see all of the sampling events in the database, be sure to turn off the filters to show all of the sampling points and events. By double-clicking on the record status field in the Data Gateway Form, the appropriate data entry form will be opened for verification.

To complete the verification step: After all data for a given transect have been entered completely, the database entries should be compared against the original field forms. Each of the main data entry screens – Walking Survey, Pellet Survey, and Road Survey – has a footer containing fields for storing quality assurance information about the event, and information on who created the sampling event record, who last updated it, etc. When all data for the sampling location has been verified, click on the button that says "Verify this sampling event" to indicate

that the event record is complete and accurately reflects the field forms. Clicking this button instantly updates the record status in the Data Gateway for that sampling event. Remember that subplot data will need to be verified before clicking the "Verify" button on the main Event Log form.

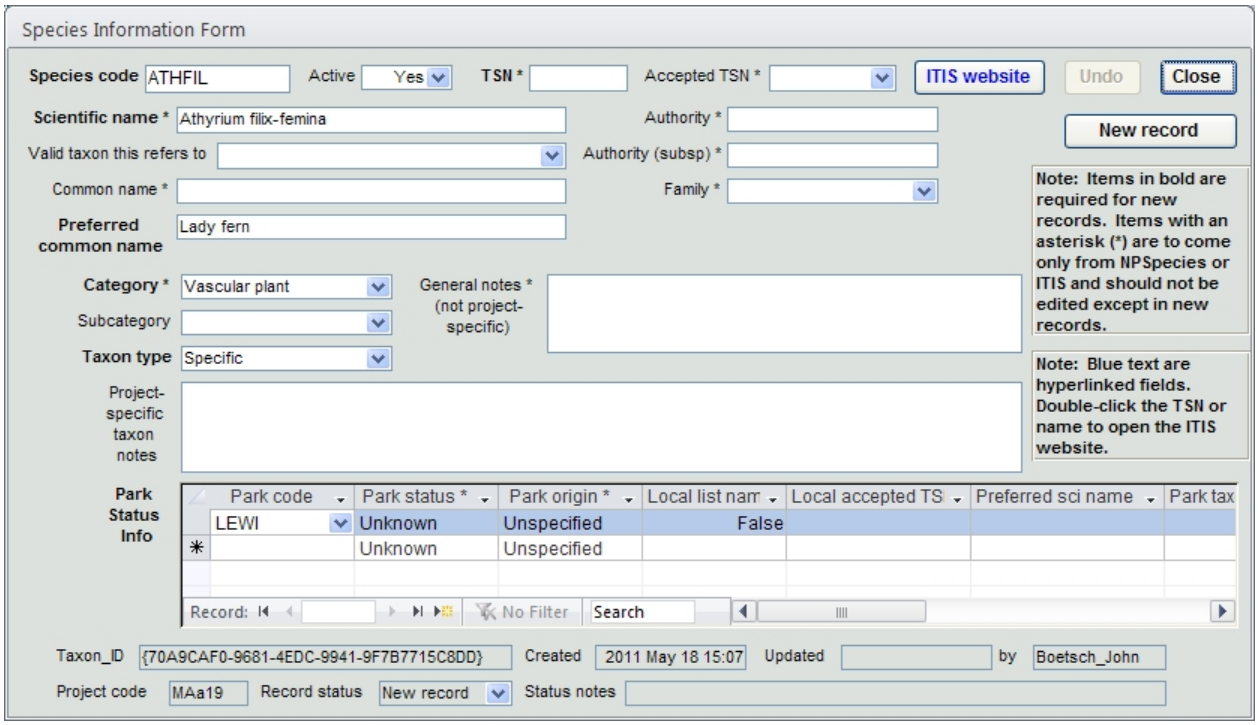
Manage Lookup Tables

From the main startup menu, click on 'Lookup tables' to open the Manage Lookup Tables Form. This form has three tabs – one for the project species list, another for the project crew list, and a third for viewing the contents of all other lookup tables. Minor edits may be made on the species list tab by putting the form into Edit mode. By selecting a record and clicking on "View details", or by double-clicking on any record selector (the gray box to the left of each record), the Species Information Form will open. To add a new record click on 'New record'.

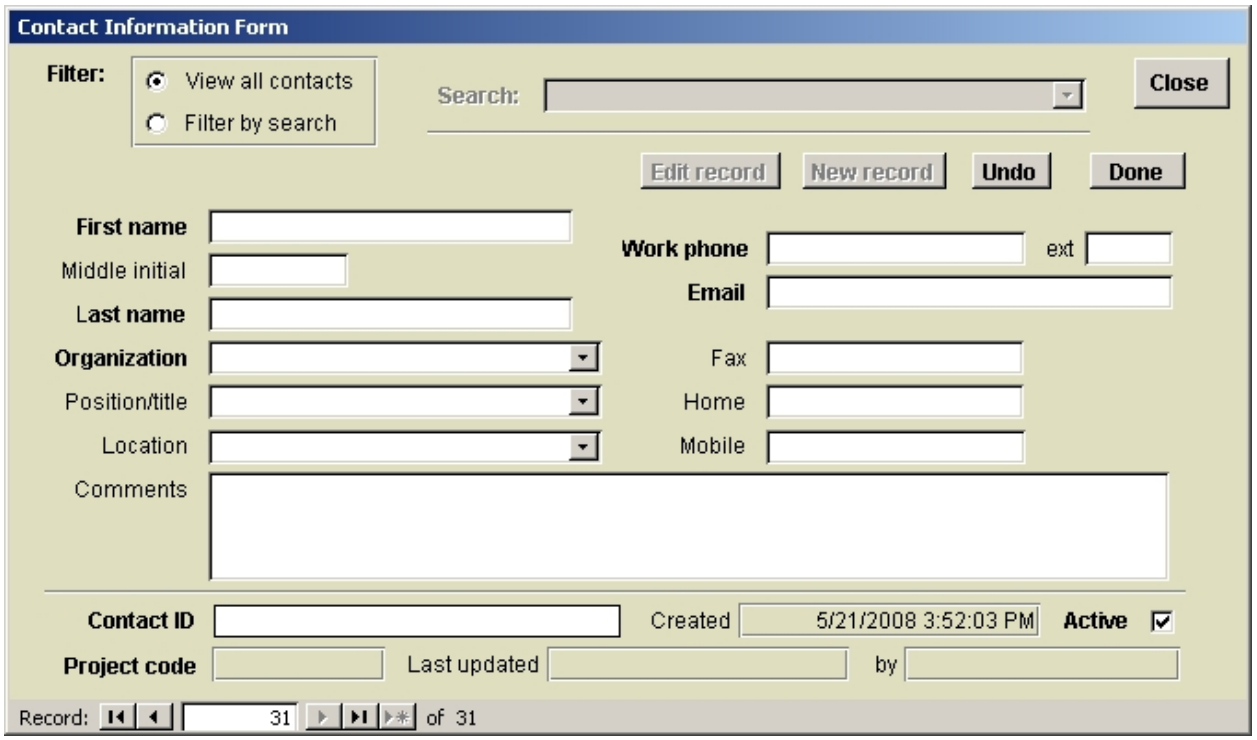


Species code	Activ	Scientific name *	Valid taxon this refers to	Common name *	Preferred comm
ACECIR	Yes	Acer circinatum			Vine maple
ADIPED	Yes	Adiantum pedatum			Maidenhair fern
ALNRUB	Yes	Alnus rubra			Red alder
ATHFIL	Yes	Athyrium filix-femina			Lady fern
BLESPI	Yes	Blechnum spicant			Deer fern
CARDAMINE_SP	Yes	Cardamine			Bitter cress
CAREX_SP	Yes	Carex			Sedge
CAROBN	Yes	Carex obnupta			Slough sedge
CLAYTONIA_SP	Yes	Claytonia			Miner's lettuce
CONIFER_SP	Yes	Unknown conifer			Unknown conifer
DIGPUR	Yes	Digitalis purpurea			Foxglove
DRYEXP	Yes	Dryopteris expansa			Wood fern, shiel
EQUISETUM_SP	Yes	Equisetum			Horsetail
EQUTEL	Yes	Equisetum telmateia			Giant horsetail
ERECHTITES_SP	Yes	Erechtites			Burn weed
GAUSHA	Yes	Gaultheria shallon			Salal

The Species Information Form can be used for adding or editing species records. Required fields are shown in bold, and items with an asterisk (*) next to the name are not to be edited except by the Data Manager (these come from either ITIS or the NPSpecies application). The Integrated Taxonomic Information System (ITIS) website may be accessed by clicking on the button labeled 'ITIS website', or by clicking on either the Taxonomic Serial Number (TSN) or scientific name if either of these fields is already populated. All new records – except for unknown taxa or temporary names – should have TSN entered if it exists on the ITIS website.



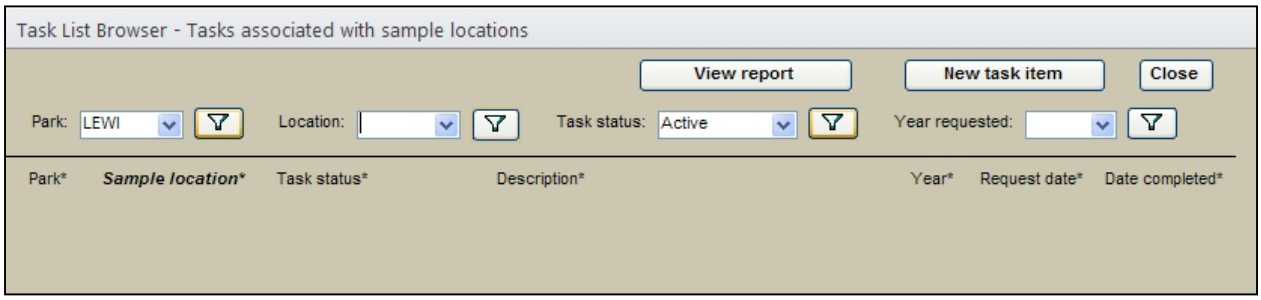
The second tab of the lookups module is a list of contacts for the project. By selecting a contact record and clicking on the "View / edit" button, or by double-clicking on a contact record, the Contact Information Form is opened in edit mode. Once edits are accepted with the "Done" button, the user may either page through the records using the record navigator at the bottom of the form, or may search for a particular name in the drop-down pick list.



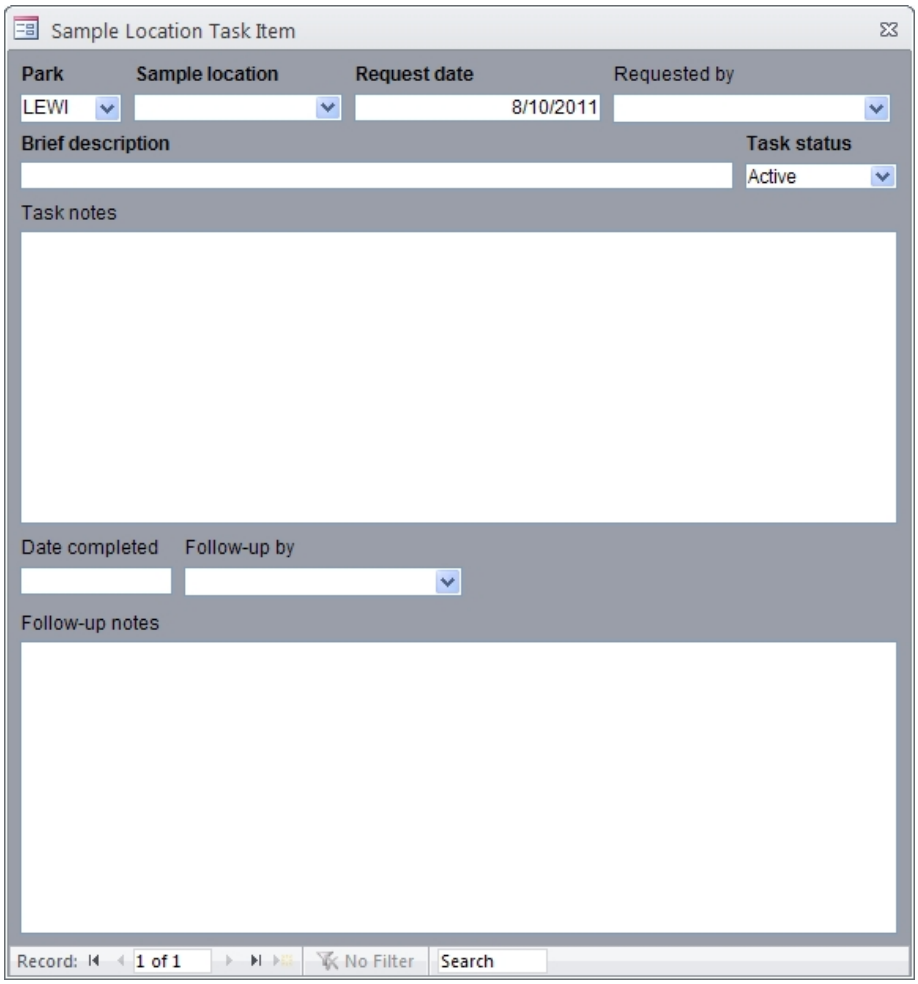
The third tab in the Manage Lookups Form has a dropdown pick list for selecting other lookup tables in the database. This can be useful when a user needs to learn more about the domain values and definitions for the project. These lookups may be edited only by power users and administrators.

Task List

The Task List Browser Form functions in much the same way as the Data Gateway Form, and can be sorted or filtered by park, location type, task status or request year. Click on the "Closeup" button to view or edit information for that record.

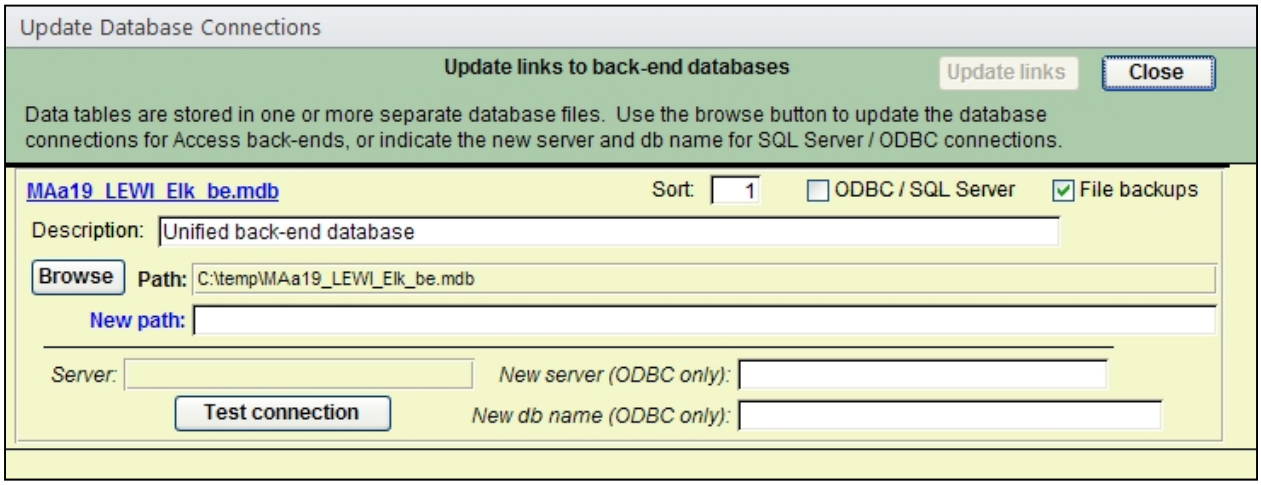


Close-up view for entering/editing location task items:



Update Database Connections

When first using the front-end application, the user may need to establish the connections to the back-end database(s). Database connections can be updated using the Update Database Connections form, available by clicking on the 'Db connections' button on the main switchboard menu. A separate record will be shown for each back-end database. For SQL Server databases, specify the server and database name. For Access back-ends, browse to the desired back-end file. To complete the connection updates, click on 'Update links'.



SOP 9: Data Quality Review and Certification

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Overview

This SOP describes the procedures for validation and certification of data in the project database. Refer also to protocol narrative **Section 4C, Overview of Database Design**, **Section 4E Quality Review**, and **Section 4G, Data Certification and Delivery** for related guidance.

Introduction

A critical part of project quality assurance is the year-end data quality review and certification. After the season's field data have been entered and processed, they need to be reviewed and certified by the Project Lead before they can be used for analysis and reporting. Data validation is the process of rigorously testing data for completeness, structural integrity, and logical consistency. Although the front-end data entry forms have built-in quality assurance measures – such as domain lookup pick lists, defined range limits for numeric data, and checks for missing values – not all errors can be caught during the data entry step. The following are a few of the general sources of data problems that might be identified during the validation:

1. The response design is ambiguous or insufficiently documented to prevent data gaps and logical inconsistencies.
2. There were logistics problems or a change of plans that prevented a complete sample (e.g., weather conditions, staffing changes).
3. Field crew members did not collect or properly record one or more data elements in the field.
4. Data were entered incorrectly or incompletely.
5. Database records were edited incorrectly or deleted after entry.
6. There is a design flaw in the front-end application that causes data errors during or after data entry.

Given the varied sources of data problems, there is a need for a thorough check of data quality on a regular basis as a means of ensuring continued data quality throughout the span of the project. The front-end database application includes a Quality Review Tool to facilitate the review process by showing the results of pre-built queries that check for data integrity, data outliers, missing values, and illogical values. The user may then fix these problems and document the fixes. Not all errors and inconsistencies can be fixed (e.g., missing response variable values), in which case documentation of the resulting errors and why records were not fixed is included in the metadata and certification report.

Once the data have been through the validation process and metadata have been developed for them, the Project Lead should certify the data by completing the NCCN Project Data Certification Form, available on the NCCN website.

Data Quality Review

Validation Queries

Table 13.1 shows the set of validation checks that are performed on the data set. Each line represents a pre-built database query that checks for potential problems in the data set, including data outliers, missing values, and illogical values. The set of queries is customized to match project requirements and the structure of the underlying data model. Each query is classified in one of three categories:

1. Critical – These queries check for structural integrity problems or gaps in critical information. This category might include queries that check for missing primary key values, mismatches between data values and lookup domain values, duplicate records, or illogical data combinations. Records returned by these queries fail to meet basic project requirements or structural requirements of the data model, and must be fixed so that they do not return any records before the data can be certified.
2. Warning – These queries represent problems that range in importance, but in any case have the potential to compromise data usability or representativeness if they are not addressed or at least made known to the end user. This category might include queries that check for missing response variables (e.g., tallies of individuals observed) or values that are beyond a reasonable range; alternatively, it may include queries that require follow-up on data records that can only be done after the field season (e.g., changing status of a monitoring location from "Proposed" to "Active"). The person performing the quality review should make efforts to fix as many of these records as possible by reviewing hard-copy data forms or otherwise following up. However, it may frequently be the case that records in this category cannot be fixed because the reviewer does not have the information needed to fix the record. In such cases the reviewer should provide documentation about which records were not fixed and why using the space provided in the quality review tool (see below). If there are numerous records that cannot be fixed, a general description such as "80 records" or "all pellet survey sites, 65 records", along with a statement of why these were not fixed, will suffice. Documentation will help future data users to know that reasonable efforts were made to address the problems.
3. Information – These queries provide information that can be used to evaluate the completeness and logical consistency of the data set – for example, the number of plots visited per park in a given season, the range of dates for sampling visits, or the number of pellet groups recorded during a sampling event. This category may also include checks for missing values in less-vital or optional fields, where a large number of missing values may be anticipated on a regular basis (i.e., as an alternative to making these Warning queries that require follow-through and documentation).

The queries are named and numbered hierarchically so that high-order information – for example, from tables on the parent side of a parent-child relationship such as sample locations – is addressed before low-order information (e.g., individual pellet group observation records). The

rationale for this is that one change in a high-order table affects many downstream records, and so proceeding in this fashion is the most efficient way to isolate and treat errors.

The set of queries may need to be augmented or changed as project requirements shift. The Data Manager is also available to revise queries or construct new database queries as needed. Throughout the quality review, the person performing the review should remain vigilant for problems that may not be caught by the validation queries. One task that cannot be automated is the process of making sure that all of the data for the current season are in fact entered into the database. This will often involve manual comparisons between field forms or other lists of the sites visited against the results of queries showing the sites for which data exist.

Using the Quality Review Tool

Open the front-end database application and hit the button labeled "QA checks" to open the quality review form. Upon opening, the quality review form automatically runs the validation queries and stores the results in a back-end database table (tbl_QA_Results). Each time the query results are refreshed, the number of records returned and the run times are updated so that the most recent result set is always available. Reviewer name and remedy descriptions are retained between query runs. Together, these results form the basis of documentation in the certification report output as shown below.

Across the very top of the form are indicators of the time frame (i.e., sample year) and scope of the data being validated. Data scope has three options:

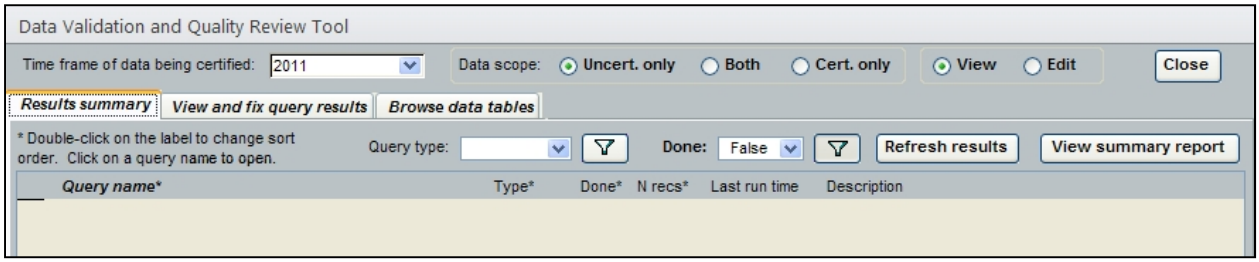
- Uncertified data only (default) – Only uncertified events (i.e., those from the current sampling year) will be considered in validation queries. Note that by design, certain queries will evaluate for problems in records are associated with certified data anyway – for example, all location records are evaluated for duplicate location codes, even those associated only with certified sampling events.
- Both uncertified and certified data – All database records will be included, including certified event data from previous years.
- Certified data only – Only certified events from previous seasons will be considered in the validation queries.

Changing the data scope will show only results for that scope – in other words, results and fixes associated with one scope will be retained even if the scope is changed and the results are refreshed.

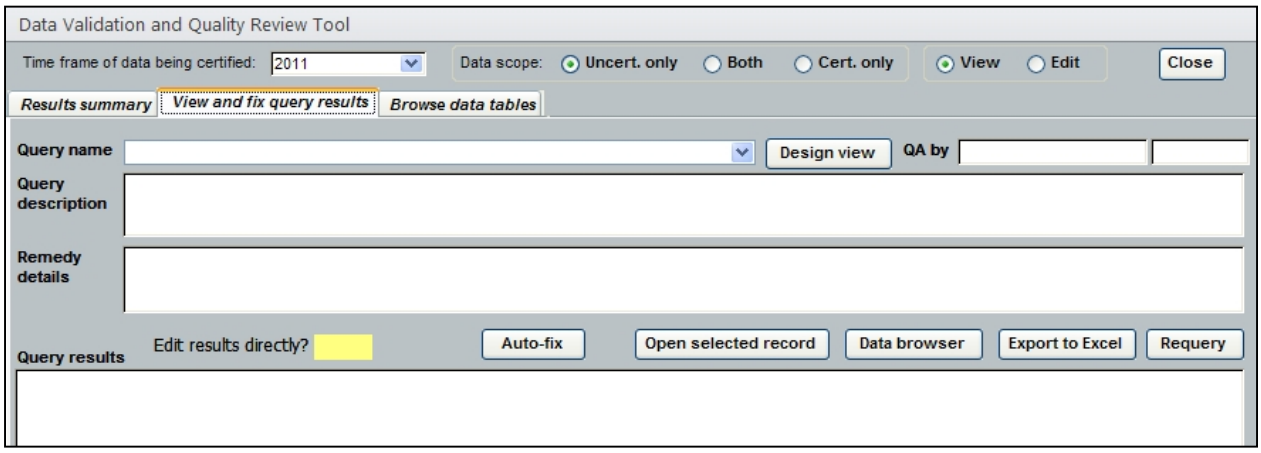
The first tab of the quality review form contains a results summary showing each validation query, the type of query (i.e., Critical, Warning or Information), the number of records returned by the query, the most recent query run time, and the description. At the top of the page, there is a button for refreshing the full set of results, which may need to be done periodically as changes in one part of the data structure may change the number of records returned by other queries. Records default to sort by query name, but can be sorted by double-clicking on any of the column headings indicated with an asterisk.

There is also a "Done" checkbox that the reviewer can use as an indicator that they are finished looking at that particular query. Critical and Warning queries that return zero records from the

start are automatically set to "Done". The results records may be filtered by query type and/or by whether or not the query has been marked as "Done". Note that updating records in one query may change the number of records returned by another query; if the number of records returned by a query changes, the "Done" indicator will be switched off automatically.



Upon double-clicking a particular query name, the second page will open up to show the results from that query. The "Query description" field will indicate the kind of records returned, and may also include a suggested remedy.



In the upper-right is a switch that allows the user to put the form in either view mode (default) or edit mode. Upon changing to edit mode, the form changes color to provide a visual reminder that edits are possible. At this point the query results may be modified and any documentation may be entered in the "Remedy details" section. If certain records in a query result set are not to be fixed for whatever reason, this is also the place to document that. Reviewer name is automatically filled in (if it was blank) once the user updates the documentation. If the reviewer does not have sufficient information to fix one or more records returned by a query, s/he should describe which records were not fixed and why. If there are numerous records that cannot be fixed, a general description such as "80 records" or "All pellet plots, 43 records", along with a statement of why these were not fixed, will suffice. Documentation will help future data users to know that reasonable efforts were made to address the problems.

Some of the other functions of this second page of the Quality Review Tool:

- Edit results directly? – A flag to indicate whether the results for the selected query can be edited directly inside the query results subform. Queries that contain complex joins,

subqueries, or grouping functions cannot be edited directly, and instead must be edited in the original data entry form.
- Auto-fix – A button that runs an action query for bulk updates if such a solution is appropriate and available (e.g., replacing all missing values with a code for "Unknown"). Not all validation queries contain references to a bulk update query.
- Open selected record – Opens the selected record returned by the query in the appropriate form. This is useful for quickly moving to the place where the fix can be made most efficiently, and taking advantage of existing quality assurance functionality.
- Data browser – Opens the Data Browser form, which provides comprehensive access to data arranged by sampling location.
- Export to Excel – Exports the validation query results to Excel. This can be helpful when there is a need to follow up on complex problems or to verify that all data have been entered.
- Requery – Reruns the validation query and updates the results set.

On this page is also a button labeled “Design view”, which will open the currently selected query in the design interface in Access. In this manner, the user can verify that the query is in fact filtering records appropriately. Note: Please contact the Data Manager before making any changes to query structure or names.

Finally, the third page of the Quality Review Tool is for viewing and editing data tables directly if needed. This page is only available for those with power user or administrator privileges to the database. Important: As with all edits performed during the quality review, these types of direct edits in the data tables should be made with extreme care as many of the quality assurance measures built into the data entry forms are not present in the tables themselves. It is possible, therefore, to make edits to the tables that may result in a loss of data integrity and quality.

Completing Data Certification

Data certification is a benchmark in the project information management process that indicates that: 1) the data are complete for the period of record; 2) they have undergone and passed the quality assurance checks outlined above; and 3) they are appropriately documented and in a condition for archiving, posting and distribution as appropriate. Certification is not intended to imply that the data are completely free of errors or inconsistencies that may or may not have been detected during quality assurance reviews.

To ensure that only quality data are included in reports and other project deliverables, the data certification step is an annual requirement for all tabular and spatial data. The Project Lead is the primary person responsible for completing an NCCN Project Data Certification Form, available at: http://www1.nature.nps.gov/im/units/nccn/datamgmt_guide.cfm. This brief form should be submitted with the certified data according to the timeline in **Appendix A: Yearly Project Task List**. Refer to **SOP 13: Product Delivery, Posting and Distribution** for delivery instructions.

Generating Output for the Certification Report

The first page of the Quality Review Tool has a button labeled “View summary report”. This button opens the formatted information for each query, the last run time, the number of records returned at last run time, a description and any remedy details that were typed in by the user.

This report can be exported from the database and included as an attachment to the certification report.

SOP 10: Geospatial Data Management

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Overview

This SOP provides guidance for creation and management of geospatial data.. The project database remains the central tool for data entry, QA/QC procedures, and maintaining certified data records (**Appendix B: Lewis and Clark NHP Elk Monitoring Protocol Database Documentation**). Many tasks in analysis and reporting require work with spatial data. The project database will serve spatial data to a geodatabase (.gdb) (ESRI, Redlands, California) hosted at the NCCN server. The geodatabase will contain relationships to the spatial data in the project database and it will represent features that are not easily maintained in a non-spatial format, such as line transects along roads. The geodatabase will be used to query spatial data and provide maps or other information for analysis and reporting. The organizational structure of folders and files for this project are described in **SOP 1: Project Workspace and Records Management**. GIS staff will provide Project Leads with an ArcGIS project (.mxd) and all associated layer files needed for analyses and mapping.

File Naming Standards for Spatial Data

File names for spatial data should follow these guidelines:

- No spaces or special characters in the file name
- Use the underbar ("_") character to separate file name components
- The file name should include the four character park name, the project code, a three character description of the contents, and the four digit year

Example file names for pellet results or road survey observations could be as follows:

LEWI_MAa19_Pel_2011.shp LEWI_MAa19_Roa_2011.shp

Project Geodatabase

The geodatabase includes tables of spatially referenced features (points, lines, polygons, or raster datasets) and the relationships among those features with the project database's data records and with other GIS layers that can be used for display and analysis.

Spatial features in the geodatabase include many feature classes. Each feature class has a unique set of attributes. Below are some of the core feature classes that will become part of a

geodatabase (included are notes about associated database records in the project database and using some of the attributes).

Point features:

- **Pellet_Survey_Locs**
  - The target coordinates of survey points are documented in the table tbl_Coordinates. These were used for initial navigation and mapping actual coordinates in the field.
  - Fields with the actual coordinates of the survey points, as determined by post-processed GPS, are UTME and UTMN (tbl_Coordinates). They are indexed according to Point number in the field Location_code. These coordinates should be used in background maps for navigating to existing pellet survey points, and as coordinates for all spatial analyses involving pellet survey results.
  - The Location_status field in tbl_Locations indicates whether a survey point is active or not. "Active" points are to be surveyed and should be represented by a different symbol on GPS background maps than "Rejected" points.
  - Evaluation_Notes field in the database table tbl_Locations is used to determine the symbols for navigational maps of survey points such as those in **SOP 7: Conducting Pellet Counts**.
- **Drive_Route_Locs**
  - The coordinates of points every 0.10 mile are stored as UTME and UTMN in tbl_Route_markers. Each coordinate is indexed in the Location_ID field (Route 1, Route 2, Route 3, Route 4) and the Mile_marker field.
- **Drive_Route_Obs**
  - In the table called tbl_Route_Obs the observer's position is stored in fields called Obs_UTME and Obs_UTMN. In that same table, the location of the elk group is stored in fields called Final_UTME and Final_UTMN. The total number of elk associated with the group is in a field of the same table called Total_elk.
- **Extra_Sample_Points**
  - Target coordinates for pellet survey in other LEWI units are saved in the shapefile LEWI_Extra_Sample_Points.shp. These could be used if pellet survey expands to other units in the future.

Line Features:

- **Walk_Rte**
  - The database serves a start point coordinate and an end point coordinate for each walked line segment. GIS is used to create line features between the start and end points. The walked line features are related to their associated database records, such as whether elk pellets were seen while the observers were en route.
- **LEWI_Trails**
  - The Fort to Sea trail, the Netul trail, and the South Slough Loop trail are stored as linear features. These are all trails in the Fort Clatsop park unit.
- **LEWI_Rds**

  - Paved and unpaved roads near the Fort Clatsop unit are stored as linear features. Road name, and condition (paved, unpaved) area attributes that are associated with each segment of those features.

Polygon Features

- **LEWI_Boundary**
  - The boundaries of the Lewis and Clark NHP park units are stored as polygon features.

Raster Features:

- **Spatial interpolation analyses**
  - Interpolation analyses are used to infer the value of estimated relative use, Gi, and the trend in standardized relative use, Ui. The geodatabase stores raster type spatial coverages that result when point values for Gi or Ui at the pellet survey points are interpolated across the Fort Clatsop unit, using an inverse square weighting, based on the 12 closest sampled points, with a cell size of 250 m (**SOP 11: Data Summary, Analysis, and Reporting**).

Standards for Map Creation

Maps for biennial reports and four-year reports should follow guidelines for the NPS Natural Resource Technical Report series (http://www.nature.nps.gov/publications/NRPM/), and should contain, at a minimum, a legend that identifies symbols used in the map, a scale bar, and a north arrow. Maps that are intended for field trip use by project personnel, such as those in **SOP 7: Conducting Road Surveys**, may omit some of these requirements. Completed maps may be saved in .jpg, .pdf, or other graphical format.

The Project Lead is responsible for informing the GIS Specialist about any mapping needs for field work. The GIS specialist is responsible for maintaining and updating the geodatabase (**Appendix A: Yearly Project Task List**), and for coordinating those efforts with the Data Manager.

SOP 11: Data Summary, Analysis, and Reporting

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Overview

This SOP lists contents of three types of reports, and describes data summaries and analyses necessary for biennial and four-year reports. Field reports are brief descriptions of each pellet survey session. Biennial reports summarize raw data from pellet surveys, and road surveys from each year of reporting. Data summaries and analyses for biennial reports are tabular outputs of the database, or are outputs from the database that are mapped via the geodatabase. Four-year reports present trend estimates for the three measures that are monitored by this protocol. Four-year reports also include associated analyses that lead to those estimates of trend, as well as maps showing the distribution of elk observations recorded via pellet surveys, and road surveys. If more frequent analyses of trend are desired, those can be made following guidelines presented for four-year analyses. Queries of the database provide some tabular output that is used in four-year analyses; other four-year analyses require additional steps outlined in **Appendix E: Analysis of Detection Bias**. Estimates made during four-year analyses are kept in a table in the database, for use in trend estimation in future four-year analyses.

Field Reports

Within three weeks of the end of each pellet survey session, the Project Lead should complete a brief field report, which should not exceed three pages. This Field report is intended largely as a synopsis of events and notes of the session, to be written while those events are still fresh in memory. The items to include in field reports include:

- Weather conditions
- Number of person-days required to complete the pellet sampling
- Number of volunteer days contributed
- Number of pellet points visited – were all target points visited?
- Which points were not visited?
- Unusual species sighted notes
- General notes about other conditions of the park area visited
- Other notes that the Project Lead deems appropriate

Biennial Reports

Biennial reports present data summaries for a one-year period from October 1 through the following September 30; for the purposes of this SOP, we refer to that time frame as "the year." The year will include one fall pellet-clearing and one late winter pellet sampling session, and up

to 12 months of road surveys. A template for biennial reports is provided in a project workspace folder (MaA19_Elk_LEWI\Documents\Reports). The contents of the biennial report should include:

- **Pellet Surveys**
  - General comments about the surveys, survey conditions, and observations
  - Names and roles of project personnel
  - Number of points surveyed
  - Observed number of pellet groups per subplot, $R_{i,t}$, for each point
  - Fraction, for each sampling session, of points with any elk pellets found
  - Map, for each sampling session, of pellet detection at surveyed points
- **Road Surveys**
  - General comments about conditions and observations
  - Names and roles of project personnel
  - Number of road surveys conducted per route per month
  - Sighting rate: Monthly mean and SD of number of elk group observations per survey, separate for each route
  - Monthly mean and SD of total number of elk
  - Monthly median, and range, of calf:cow ratio and bull:cow ratio

Other ancillary data that may influence the interpretation of biennial results may be described in the discussion, as appropriate (for example, weather conditions or vegetation conditions including blowdown or browsing levels).

Biennial Data Summarization and Analysis

Names of Observers

The database query (qs_1_Names_Pellets) yields a table of people that participated in pellet surveys during the year. The database query (qs_2_Names_Roads) yields a table of people who contributed to road surveys during the year.

Pellet Survey Summaries

The database query (qs_3_Surveyed_Points) yields the total number of survey points that were searched for pellets in the fall survey session and in the late winter survey session. A second query, (qs_4_Pellets_per_Point_Ri) outputs a table of the raw average number of pellet groups detected per subplot for each point, *i*, in year *t* ($R_{i,t}$). The value of $R_{i,t}$ for each of the points, indexed with the subscript *i* to indicate point number and *t* to indicate year, is the total number of pellet groups detected at the subplots of that survey point, divided by the number of subplots surveyed at that point.

Maps of Elk Pellet Detections

The database query (qs_5_Point_Detections) produces a table of elk pellet detections or non-detections for each surveyed point, for each pellet survey session. The fields of the table include the point number and a text field indicating whether or not pellets were detected there. This table is brought into the geodatabase, which has settings for map production using the results of the query. Figure 6 (see **5.0 Analysis and Reporting**, in the protocol narrative) depicts an example map. Detection maps should be prepared for the fall and late winter survey sessions in biennial reports.

Monthly Road Survey Summaries

The database query (qs_6_Observations_Road) can be used to output biennial summary tables for each of the four routes, and their combined totals. The rows in each output table are for the months of the year in which surveys took place. Columns in the table are for the following fields: the number of road surveys conducted; the mean number of elk groups seen per survey for each route separately (four columns); the mean number of elk groups seen per morning of survey, pooling all four routes (one column); the standard deviation of the number of elk groups seen in that month for each route separately (four columns) and summed across the four routes (one column); the maximum number of elk seen on any single morning of survey, summed across the four routes (one column); the average total number of elk, bulls, cows, and calves seen per morning of survey (four columns), pooled across the four routes; the median value of the observed calf:cow and bull:cow ratio (two columns); the highest and lowest values of observed calf:cow ratio (two columns) and bull:cow ratio (two columns); and the standard deviation of the average total number of elk seen per survey.

Four-year Reports

Each four-year report includes analysis of trends in the proportion of area occupied by elk, elk relative use, and road survey results. The contents of four-year reports should include:

- **Pellet Survey**
  - Estimates of the proportion of area occupied for each year, $\widehat{PAO}_t$, and associated detection probabilities for each year, $\hat{p}_{\text{detection}}$
  - Estimates of average relative use for each year, in terms of $\hat{G}_{mean,t}$ and the equation for the associated detection probability function describing $\hat{p}_{\text{group}}$
  - Separate maps for each year's estimates of $\widehat{\text{G}}_{\text{i,t}}$ at sampled points, interpolated across the Fort Clatsop unit
  - Trends in mean relative use, $\hat{G}_{mean,t}$
  - Trends in standardized relative use at each point $\widehat{\text{U}}_{\text{i,t}}$, mapped and interpolated
  - Map that shows line segments, where elk pellets were either seen or not seen by survey teams walking *en route* to survey points
- **Road Surveys**
  - Monthly trends in the number of elk groups seen per survey
  - Monthly trends in average total number of elk seen per survey
  - Monthly trends in the median observed bull:cow and calf:cow ratios
  - Map of all elk locations recorded during road surveys, grouped into three 4-month periods

Four-year Data Summarization and Analysis: Pellet Surveys

Estimating Proportion of Area Occupied for Single Years

The goal of this analysis is to estimate, for each year *t*, a single value of PAO for the Fort Clatsop unit, $\widehat{PAO}_t$. Detection by each observer is a binary outcome – detected or not detected. At most points, each observer surveys three out of the four subplots, and two of those subplots are surveyed by both observers (**SOP 6: Conducting Pellet Counts**). Estimating the $\widehat{PAO}_t$ parameter also requires estimating a function for, $\hat{p}_{detection,t}$, which is the probability that an observer sees any elk pellets at all at a point, given that there was one or more pellet groups in

those subplots to be seen. In **Appendix E: Analysis of Detection Bias** we describe the analysis of PAO in more detail.

PAO is analyzed separately from data collected each late winter, yielding a separate estimate for $\widehat{PAO}_t$ for each year, with year subscripted as *t*. The general analytical approach is to fit several different occupancy models (MacKenzie et al. 2006) to the two-observer detection data from each late winter survey. Estimates of $\widehat{PAO}_t$ are then based on the model or models that best fit the observed data.

As a result of either including or excluding each of three covariates that could affect detection probability (percentage of blowdown, light level, and survey effort), there will be eight models in the candidate set that will be fitted to the occupancy data (Table 11.1). Conceptually, the covariates are potentially included in the detection function because the prevalence of blown down trees, light level, or survey effort might influence either observer's probability of detecting any pellets that are present in surveyed subplots.

Table 11.1 Candidate set of occupancy models to be fit to observed detection and nondetection data from a single year. In all model names, PAO(.) indicates that the estimate for $\widehat{PAO}_t$ will be a single value that is not a function of any covariate. The covariates included in parentheses after the "p" are included as additive effects for the function that estimates $\hat{p}_{detection,t}$, except that model PAO(.)p(.) has no influence of any covariate on $\hat{p}_{detection,t}$.

Model name	Number of parameters
PAO(.)p(.)	2
PAO(.)p(blowdown)	3
PAO(.)p(light)	3
PAO(.)p(effort)	3
PAO(.)p(blowdown+light)	4
PAO(.)p(blowdown+effort)	4
PAO(.)p(light+effort)	4
PAO(.)p(blowdown+light+effort)	5

PAO Estimates for the Fort Clatsop Unit

Estimates for $\widehat{PAO}_t$ should be taken from the highest ranked occupancy model, along with estimates of variance for those parameters. We will choose the occupancy model that most parsimoniously fits the data, based on AICc values (Burnham and Anderson 2002). In the event that there are one or more models with AICc scores within 4.0 of the highest ranked model, then those same models will be included in model averaging. The parameter of interest, $\widehat{PAO}_t$, is estimated for each of the models that is included in the averaged set, and the parameter value and variance estimate from each of those models are multiplied by the model's Akaike weight (Burnham and Anderson 2002).

$\widehat{PAO}_t$ estimates and associated standard error estimates for each of the four years in the reporting period should be presented in a stand-alone table in the four-year report, following the format suggested in **Appendix E: Analysis of Detection Bias**, Table F.2

Testing for Trends in Occupancy over Time

All available estimates of $\widehat{PAO}_t$ should be graphed with estimates of logarithm of $(\widehat{PAO}_t)$ on the y-axis and year on the x-axis. An estimate of trend should estimate the slope of the regression line through these points using weighted least squares regression, where each point is weighted according to the inverse of the variance for that year's $\widehat{PAO}_t$ value (Gerrodette 1991). The results of the regression analysis will be estimates for the intercept and slope of the regression line, along with an estimate of the variance in the slope (i.e., Skalski et al. 2005, p. 303).

To test for the significance of a trend over time, the Data Analyst should assess whether the estimate of the slope is 'significantly' non-zero, based on the estimates for the slope and the variance of that slope. The test statistic for significance of the slope should be assessed using a type one error rate (α) of 0.10.

Estimating Relative Use

The units of relative use, *G*, are the number of pellet groups per surveyed subplot. When estimated at the scale of single points, relative use is subscripted with the letter *i* to signify point number, $\hat{G}_i$. In a given year, *t*, the value of relative use at point *i* is $\hat{G}_{i,t}$. At the scale of the Fort Clatsop unit, the value of relative use is symbolized as $\hat{G}_{mean,t}$, which is the arithmetic mean of all the $\hat{G}_{i,t}$ values estimated for year *t*.

Estimating a Function for Pellet Group Detection Probability

The expected probability that a single observer will detect a given pellet group, *j*, is $\hat{p}_{group,j}$. Calculating $\hat{G}_{i,t}$ for each of the survey points requires first estimating the detection probability of each pellet group, $\hat{p}_{group,j}$, and the associated adjustment weight for each pellet group, $\widehat{w}_j$ (see below, *Adjusting the Pellet Group Counts to Account for Detection Bias*).

Estimating the function that most parsimoniously describes $\hat{p}_{group,j}$ can only be done using those pellet groups that were observed in recounted subplots. Based on the recount codes, each recorded pellet group from recounted subplots is taken as an individual observation that was seen by the first observer, the second observer, or both observers. Covariate data that are potentially related to $\hat{p}_{group,j}$ are associated with each such observed pellet group. These covariates include the size of the fecal pellet group, the percentage of obscuring cover in the subplot, the light level at the time the point was surveyed, and the pellet decay class of the pellet group. Four years of data are pooled for the analysis of pellet group detection probabilities (see **Appendix E: Analysis of Detection Bias**), so a single pellet group detection function will be estimated for the four-year reporting period, and then will be applied to all pellet groups within that reporting period.

Selecting a Model for Pellet Group Detection Probability as a Function of Covariates

As a result of either including or excluding each of the four covariates, there will be 15 models in the candidate set that will be fitted to the pellet data from recounted subplots (Table 11.2). Each covariate is modeled as an additive effect in a logistic regression that describes the per-observer probability, between zero and one, that pellet group *j* is detected, given the covariate values recorded: group_size_j, cover_j, light_j, and decayed_j. The first covariate, "group_size," is an integer which is the number of pellets in the group, plus ten times the number of clumps in the group. The second covariate, "cover," is an integer value from 0 –100 describing the percentage of

cover below 1-m in height that could obscure the view of a pellet group; this is a single value recorded for the subplot. The third covariate, "light," is a dummy variable (zero or one) that indicates light levels measured at the level of the point. *A priori* we will only test for an effect of 'dim' light; that is to say that pellet groups found under 'medium' and 'bright' light levels will be lumped together and will have a value for light of 1, as opposed to pellet groups found under 'dim' light levels, which will have a value for light of 0. Similarly, the final covariate, "decayed," will be a dummy variable where only the most decayed pellet groups (decay class 4) will be contrasted with all other decay classes (1, 2, and 3). Class 4 pellet groups will have a value of 1 for the "decayed" covariate, while all other decay classes of pellet groups will have a value of 0 for the 'decayed" covariate.

As with PAO, we will choose the most parsimonious model for detection probability, based on AICc values (Burnham and Anderson 2002). In the event that there are one or more models with AICc scores within 4.0 of the highest ranked model, then those models are included in 'model averaging' to determine the function that describes a given pellet group's detection probability.

Table 11.2 Model structure of 15 candidate Huggins models to test in identifying which of the candidate models best fits the data for pellet groups seen by one or both of the observers. In each model name, the p refers to $\hat{p}_{group,j}$, that is the per-observer probability of detection by either observer, given the covariates specific to pellet group *j*.

Model Name	Number of parameters
p(.)	1
p(group_size)	2
p(cover)	2
p(light)	2
p(decayed)	2
p(group_size +cover)	3
p(group_size +light)	3
p(group_size +decayed)	3
p(cover+light)	3
p(cover+decayed)	3
p(light+decayed)	3
p(group_size +cover+light)	4
p(group_size +light+decayed)	4
p(cover+light+decayed)	4
p(group_size +cover+light+decayed)	5

Adjusting the Pellet Group Counts to Account for Detection Bias

Based on all surveyed subplots at all surveyed points, a database query will yield the covariate information for each observed pellet group found in late winter surveys in the four-year reporting period. The covariate information for each observed pellet group will be used to compute the per-observer detection probabilities for each individual pellet group, $\hat{p}_{group,j}$, based on the most parsimonious model or model-averaged set of models, and the variance estimate for that detection probability, $Var(\hat{p}_{group,j})$. Because some pellet groups are not detected by any observer, weighting each observed pellet group as a function of the pellet-group-specific detection probabilities will provide a less biased estimate of actual numbers of pellet groups present than would unweighted, raw counts. For subplots that are counted by a single observer

(i.e., generally two of the four subplots at a point), each observed pellet group is weighted by $\widehat{w}_{j1}$, which is the inverse of its detection probability (Equation 12.1).

Equation 12.1

$$\widehat{w}_{j1} = \frac{1}{\hat{p}_{group,j}}$$

For example, a pellet group observed under conditions in which $\hat{p}_{group,j}$ = 0.5 would be weighted by a factor of 2.0 to account for pellet groups of comparable size and environmental conditions that were presumably missed (Jenkins and Manly 2008). This type of weighting has been applied widely to account for missed observations of large mammals in aerial surveys (Samuel et al. 1987) and to weight pellet group observations to reduce detection biases (Jenkins and Manly 2008).

Weightings are slightly more involved for plots that are searched by two observers because the weighting must account for the probability of being observed by at least one of the two observers. The expected probability that a pellet group was *not* detected by one observer is (1 - $\hat{p}_{group,j}$). Because the two observers are independent, it follows that the expected probability that both observers did *not* detect a given pellet group is (1 - $\hat{p}_{group,j}$)^2. This means that the expected probability that at least one of the observers *did* detect the pellet groups is 1 - (1 - $\hat{p}_{group,j}$)^2. For subplots that are surveyed by both observers, each observed pellet group is weighted by the inverse of the probability that it was detected by at least one observer; the formula for that weighting factor, $\widehat{w}_{j2}$, is shown in Equation 12.2.

Equation 12.2

$$\widehat{w}_{j2} = \frac{1}{1 - (1 - \hat{p}_{group,j})^2}$$

For example, for a pellet group in which $\hat{p}_{group,j}$ = 0.5, the probability that at least one of the two observers saw the pellet group would be 0.75 and the associated weighting would be 1/0.75, or 1.33, to account for groups missed under similar conditions. This example shows that, for any two pellet groups with identical covariates, $\widehat{w}_{j2}$ will always be closer to one than will $\widehat{w}_{j1}$. The only source of that difference is that the pellet group in a recounted subplot will have had more opportunity to have been seen by at least one observer.

Variance estimates for individual pellet group weighted observations reflect uncertainty in the estimation of the detection probability, $\hat{p}_{group,j}$. The variance of the inverse of an estimated parameter (i.e., 1/$\hat{p}_{group,j}$) may be approximated using the delta method (Casella and Berger 1990, Thompson 2002; see **Appendix E: Analysis of Detection Bias**). The variance for the one-observer weight, $Var(\widehat{w}_{j1})$, is calculated using Equation 12.3.

Equation 12.3

$$Var(\widehat{w}_{j1}) = \frac{Var(\hat{p}_{group,j})}{(\hat{p}_{group,j})^4}$$

Using the same example of a pellet group with a per-observer detection probability of $\hat{p}_{group,j}$ = 0.5, and a corresponding value of 2.0 for $\widehat{w}_{j1}$, we can estimate the variance for $\widehat{w}_{j1}$using the estimates for $\hat{p}_{group,j}$ and $Var(\hat{p}_{group,j})$. Supposing that $Var(\hat{p}_{group,j})$ = 0.2, then the variance of that estimate for $\widehat{w}_{j1}$ would be 0.2 / $(0.5)^4$ = 3.2

For pellet groups in subplots that are searched by two observers, the variance of the resulting weightings is shown in Equation 12.4 (see **Appendix E: Analysis of Detection Bias)**. As with $Var(\widehat{w}_{j1})$, $Var(\widehat{w}_{j2})$ reflects the uncertainty in the estimate of $\hat{p}_{group,j}$.

Equation 12.4

$$Var(\widehat{w}_{j2}) = \frac{4(1-\hat{p}_{group,j})^2 Var(\hat{p}_{group,j})}{\left[1-(1-\hat{p}_{group,j})^2\right]^4}$$

Again using the same example of a pellet group with a per-observer detection probability of $\hat{p}_{group,j}$ = 0.5, if we supposing that $Var(\hat{p}_{group,j})$ = 0.2, then the variance of that estimate for $\widehat{w}_{j2}$ would be 4*(1-0.5)^2*(0.2) / [1-(1-0.5)^2]^4 = 0.2 / 0.3164 = 0.632. As this example shows, for any two pellet groups with identical covariates, $Var(\widehat{w}_{j2})$ will be smaller than $Var(\widehat{w}_{j1})$. The reason for this is that there is a higher overall probability of such a pellet group being detected in the recounted subplot than in a subplot that is only counted once. As a result, the denominator in the equation for $Var(\widehat{w}_{j2})$ will always be bigger (closer to 1) than the denominator in $Var(\widehat{w}_{j1})$.

Relative Use Estimates for Each Point, and for the Fort Clatsop Unit

After computing the group specific weighting factors, $\widehat{w}_{j1}$ or $\widehat{w}_{j2}$, for each of the observed pellet groups, along with the associated variance estimates, $Var(\widehat{w}_{j1})$ or $Var(\widehat{w}_{j2})$, the analyst will estimate the number of pellet groups present at each survey point *i* each year *t* (i.e., $\hat{G}_{i,t}$) adjusted for detection biases.

The expected estimate of $\hat{G}_{i,t}$ for a survey point in year t is the sum of the estimated values of $\widehat{w}_{j1}$ or $\widehat{w}_{j2}$ for all pellet groups that were detected in surveyed subplots, divided by the number of subplots surveyed at that point. For each year, the Data Analyst uses the estimated values of $\hat{p}_{group,j}$ and $Var(\hat{p}_{group,j})$ for all pellet groups found in the late winter survey, along with Equations 12.1, 12.2, 12.3, and 12.4 to determine the weights ($\widehat{w}_{j1}$ or $\widehat{w}_{j2}$) and associated variance estimates for each observed pellet group.

The estimated sampling variance for $\hat{G}_{i,t}$, $Var(\hat{G}_{i,t})$, is the sum of the sampling variance for the weights from pellet groups at that point, divided by the number of subplots surveyed at that point. Each pellet group is an independent observation, so the contributions of each pellet group to total variance are additive. Estimates of $\hat{G}_{i,t}$ and $Var(\hat{G}_{i,t})$ should be recorded for each point, and for each year, in the results table of the database, (tbl_Analysis_Results).

The arithmetic mean value of $\hat{G}_{i,t}$ across all *n* = 65 surveyed points is $\hat{G}_{mean,t}$ the mean number of pellet groups per subplot for the Fort Clatsop Unit in year *t*. Total variance for this mean of

relative use in year *t*, $Var(\hat{G}_{mean,t})$, is the sum of two components of variance: the variance of the mean due to sampling 65 $\hat{G}_{i,t}$ values, and the mean of the variance due to uncertainty in the estimates for each of those $\hat{G}_{i,t}$ values (Equation12.5).

Equation 12.5

$$Var(\hat{G}_{mean,t}) = \frac{\sum_{i=0}^{n}(\hat{G}_{i,t} - \hat{G}_{mean,t})^2}{n} + \frac{\sum_{i=0}^{n} Var(\hat{G}_{i,t})}{n}$$

In the above equation (*after* Link et al. 1994, p. 1098), the first additive term is the average of the squared differences between each $\hat{G}_{i,t}$value and the mean; this is the sample variance of the mean. The second term is the average of the $Var(\hat{G}_{i,t})$ values from each of the *n* sampled points for year *t*; this is the mean of the within-point variance values.

$\hat{G}_{mean,t}$ and $Var(\hat{G}_{mean,t})$ estimates for each of the four years in the reporting period should be presented in a stand-alone table in the four-year report, following the format suggested in **Appendix E: Analysis of Detection Bias**, Table F.5. Estimates of $\hat{G}_{mean,t}$ and $Var(\hat{G}_{mean,t})$ should be recorded in the results table of the database, (tbl_Analysis_Results).

Testing for Trends in Relative Use over Time

The four-year analysis should include a test for increasing or decreasing trend in $\hat{G}_{mean,t}$. As with PAO, the regression line to fit to the $\hat{G}_{mean,t}$ values should be weighted according to the inverse of the variance for each year's point estimate, $Var(\hat{G}_{mean,t})$ (Gerrodette 1991).

Interpolating and Mapping Estimated Relative Use

Point estimates for $\hat{G}_{i,t}$ will be interpolated across the Fort Clatsop unit to map the prevalence of elk use across the unit in year *t*. Interpolation calculates values for unsurveyed spaces, based on weighted contributions from surrounding, surveyed points where values for $\hat{G}_{i,t}$ are estimated . An example of interpolated relative use, based on preliminary estimates of relative use is shown in **Appendix E: Analysis of Detection Bias**, Figure F.5.

Quantifying and Mapping Trends in Standardized Relative Use

Both the absolute value and the spatial distribution of relative use may change over time. Each point's value of $\hat{G}_{i,t}$ for year *t* can be standardized into a unitless measure of standardized relative use, $\hat{U}_{i,t}$ by subtracting the mean relative use for year *t*, $\hat{G}_{mean,t}$, and dividing by the standard deviation of the $\hat{G}_{i,t}$ values. Values for $\hat{U}_{i,t}$ for each point and year can be calculated based on values for $\hat{G}_{mean,t}$ and $\hat{G}_{i,t}$in the results table (tbl_Analysis_Results).

The mean value of $\hat{U}_{i,t}$ is always 0, but mapping changes in the spatial distribution of $\hat{U}_{i,t}$ would indicate the positive or negative shifts in the spatial pattern of elk use within the Fort Clatsop unit. To visualize those changes, trends in $\hat{U}_{i,t}$ over time may be calculated at each point, then mapped and interpolated across the Fort Clatsop Unit. The trend in any change in standardized use at each surveyed point is the slope of the linear regression of $\hat{U}_{i,t}$values for that point, over time. The linear regression analysis that leads to the estimate of that regression slope for each

surveyed point will use as data a table of $\widehat{U}_{i,t}$ values, where each row is the series of all $\widehat{U}_{i,t}$ values for a single point, and each column is for a year.

Values for the estimated slope of the regression line for each point, Slope_U_i, can be imported into the geodatabase for interpolation across the Fort Clatsop unit. Spatial shifts in use would appear as regional increases or decreases in the interpolated surface of Slope_U_i.

Mapping Walking Line Segments where Elk Pellets have been Detected

The GIS Specialist should use output of a database query (qs_Walking_Segments), which is imported to the geospatial database, to create maps of line segments associated with the Walking Time Data Sheets. These line segments represent the approximate paths taken by observers to reach survey points. Individual lines are defined by one "From Point" and one "To Point," and are a single row of data in the database table tbl_Walking_Surveys. Also associated with each of the line segments are the other fields recorded in the Walking Time Data Sheets, including information about whether elk pellets were seen en route. The GIS Specialist should create a map of the line segments traveled, color coded according to whether elk pellets were detected en route, or not. These observations are not used directly to measure trend, but are simply a supplemental, approximate spatial representation of where elk pellets have been seen between surveyed points.

Four-year Data Summarization and Analysis: Road Surveys

Testing for Trends in Road Survey Sightings

For each month of survey, the Data Analyst should test for any trend in the number of elk groups seen per survey, the average total number of elk seen per survey, the median observed calf:cow ratio, and the median observed bull:cow ratio. The first measure reflects the total number of groups seen on all four routes, and the other measures reflect the total number of elk counted and classified on all four routes. Although the analyses will be conducted for each month of surveys, any trends in composition ratios will be most informative for the June-December months, when sex and age characteristics of elk are most reliably discerned.

In testing for trends, the data analyst should weight the monthly averages from each year by the inverse of their sampling variances. Three, or in some cases four, mornings of survey take place in each month of survey. For each month, the Data Analyst should assess whether the slope of the regression line fit through the data is significantly non-zero, based on a Type-I error rate (α) of 0.10. To guard against a high probability for Type-I error in any tests that involve multiple months, the Data Analyst may choose to use a smaller experiment-wide error rate.

Although the total number of elk groups seen and the total number of elk seen will be assessed collectively for all four routes, future analysis could also assess changes in the distribution of elk and elk groups over time, with respect to each of the four driving routes. Additional exploratory analyses that could be conducted in the future include testing for an influence of weather on elk road sighting rate. Such an analysis is beyond the scope of the four-year report.

Mapping the Locations of Elk Detected on Road Surveys

It can be informative to map the locations where elk have been seen during Road Surveys, despite the imprecision with which some of those locations may be recorded. Four-year reporting

should include maps of all locations where elk groups have been seen in road surveys, with one map for each of three four-month periods.

For each elk group observed during road surveys, a database query will return the date, group size, and sex and age composition, and will use the observers' location, the distance to the elk group, and the azimuth direction to the elk group to yield the estimated coordinate locations. The Data Manager passes these query results to the GIS Analyst, who uses map templates in the geodatabase to map Road Survey observations. These observations are grouped according to four month periods: October 1 – January 31, February 1 – May 31, and June 1 – September 30. For example, based on data from all four years of the reporting period, all observations from October 1 – January 31 are presented together. There are no specific plans to map variations in distributions of sightings of bull groups, as opposed to groups of calves and cows, but that could be done if exploratory analyses reveal suggestive patterns.

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SOP 12: Sensitive Information Procedures

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Overview

Although it is the general NPS policy to share information widely, the NPS also realizes that providing information about the location of park resources may sometimes place those resources at risk of harm, theft, or destruction. This can occur, for example, with regard to caves, archeological sites, tribal information, and rare plant and animal species. Therefore, information will be withheld when the NPS foresees that disclosure would be harmful to an interest protected by an exemption under the Freedom of Information Act (FOIA). The National Parks Omnibus Management Act, Section 207, 16 U.S.C. 5937, is interpreted to prohibit the release of information regarding the "nature or specific location" of certain cultural and natural resources in the national park system. Additional details and information about the legal basis for this policy are in the NPS Management Policies (National Park Service 2006), and in Director's Order #66.

These guidelines apply to all NCCN staff, cooperators, contractors, and other partners who are likely to acquire or otherwise have access to information about protected NPS resources. The NPS Lead has primary responsibility for ensuring adequate protection of sensitive information related to this project.

The following are highlights of our strategy for protecting this information:

- *Protected resources*, in the context of the NCCN Inventory and Monitoring Program, include species that have State- or Federally-listed status, and other species deemed rare or sensitive by local park taxa experts.
- *Sensitive information* is defined as information about protected resources that may reveal the "nature or specific location" of protected resources. Such information must not be shared outside the National Park Service, unless a signed confidentiality agreement is in place.
- In general, if information is withheld from one requesting party, it must be withheld from anyone else who requests it, and if information is provided to one requesting party without a confidentiality agreement, it must be provided to anyone else who requests it.
- To share information as broadly as legally possible, and to provide a consistent, tractable approach for handling sensitive information, the following shall apply if a project is likely to collect and store sensitive information:
    - Random coordinate offsets of up to 2 km for data collection locations, and

- Removal of data fields likely to contain sensitive information from released data set copies.

What Kinds of Information Can and Cannot Be Shared?

Do not share: Project staff and cooperators should not share any information outside NPS that reveals details about the "nature or specific location" of protected resources, unless a confidentiality agreement is in place. Specifically, the following information should be omitted from shared copies of all data, presentations, reports, or other published forms of information.

- *Exact coordinates* – Instead, public coordinates are to be generated that include a random offset azimuth and distance. These offset coordinates can be shared freely.
- *Other descriptive location data* – Examples may include travel descriptions, location descriptions, or other fields containing information that may reveal the specific location of the protected resource(s).
- *Specific dates of elk observations in an area* – Instead, provide dates only within the 4-month time windows specified in **SOP 11: Data Summary, Analysis, and Reporting** (January to April, May to August, or September to December).
- *Protected resource observations at disclosed locations* – If specific location information has already been made publicly available, the occurrence of protected resources at that location cannot be shared outside NPS without a confidentiality agreement. For example, if the exact coordinates for a monitoring station location are posted to a website or put into a publication, then at a later point in time a spotted owl nest is observed at that monitoring station, that nest cannot be mentioned or referred to in any report, presentation, data set, or publication that will be shared outside NPS.

Do share: All other information about the protected resource(s) may be freely shared, so long as the information does not reveal details about the "nature or specific location" of the protected resource(s) that are not already readily available to the general public in some form (e.g., other published material). Species tallies and other types of data presentations that do not disclose the precise locations of protected resources may be shared, unless by indicating the presence of the species the specific location is also revealed (e.g., in the case of a small park).

Details for Specific Products

Whenever products such as databases and reports are being generated, handled and stored, they should be created explicitly for one of the following purposes:

1. *Public or general-use* – Intended for general distribution, sharing with cooperators, or posting to public websites. They may be derived from products that contain sensitive information so long as the sensitive information is either removed or otherwise rendered in a manner consistent with other guidance in this document.
2. *Internal NPS use* – These are products that contain sensitive information and should be stored and distributed only in a manner that ensures their continued protection. These products should clearly indicate that they are solely for internal NPS use by containing the phrase: "Internal NPS Use Only – Not For Release." These products can only be shared within NPS or in cases where a confidentiality agreement is in place. They do not need to be revised in a way that conceals the location of protected resources.

Data Sets

To create a copy of a data set that will be posted or shared outside NPS:

1. Make sure the public offset coordinates have been populated for each sample or observation location in tbl_Locations.
2. Delete all data from the following database objects to ensure consistent omission of fields that may contain specific, identifying information about locations of protected resources:
    a. tbl_Coordinates – delete all records
    b. tbl_GPS_Info – delete all records
    c. tbl_Locations – Travel_notes, Location_desc, and Location_notes
    d. tbl_Route_Obs – Mile_marker, Obs_UTME, Obs_UTMN, Final_UTME and Final_UTMN
    e. tbl_Route_Markers – delete all records

The local, master copy of the database contains the exact coordinates and all data fields. The Data Manager and/or GIS Specialist can provide technical assistance as needed to apply coordinate offsets or otherwise edit data products for sensitive information.

Maps and Other GIS Output

General-use maps and other geographic representations of observation data that will be released or shared outside NPS should be rendered using offset coordinates, and should only be rendered at a scale that does not reveal their exact position (e.g., 1:100,000 maximum scale).

If a large-scale, close-up map is to be created using exact coordinates (e.g., for field crew navigation, etc.), the map should be clearly marked with the following phrase: "Internal NPS Use Only – Not For Release."

The Data Manager and/or GIS Specialist can provide technical assistance as needed to apply coordinate offsets or otherwise edit data products for sensitive information.

Presentations and Reports

Public or general-use reports and presentations should adhere to the following guidelines:

1. Do not list exact coordinates or specific location information in any text, figure, table, or graphic in the report or presentation. If a list of coordinates is necessary, use only offset coordinates and clearly indicate that coordinates have been purposely offset to protect the resource(s) as required by law and NPS policy.
2. Use only general-use maps as specified in the section on maps and other GIS output.

If a report is intended for internal use only, these restrictions do not apply. However, each page of the report should be clearly marked with the following phrase: "Internal NPS Use Only – Not For Release."

Procedures for Coordinate Offsets

1. Process GPS data, upload into the database, and finalize coordinate data records. Update tbl_Coordinates.Is_best as appropriate, especially where there is more than one set of coordinates per sample location.
2. Set the minimum and maximum offset distances (project-specific, typically up to 2 km).

3. Apply a random offset and random azimuth to each unique set of coordinates.
4. Coordinates may then be either rounded or truncated so the UTM values end in zeros to give a visual cue that the values are not actual coordinates.
5. Do not apply independent offsets to clustered or otherwise linked sample locations (e.g., multiple sample points along a transect). Instead, either apply a single offset to the cluster so they all remain clustered after the offset is applied, or apply an offset to only one of the points in the cluster (e.g., the transect origin) and store the result in the public coordinates for each point in that cluster.
6. These "public" coordinates are then the only ones to be shared outside NPS – including all published maps, reports, publications, presentations, and distribution copies of the data set – in the absence of a confidentiality agreement.

The following components can be used to create individual offsets rounded to the nearest 100 meters in Microsoft Excel:

- Angle = rand() * 359
- Distance = ((Max_offset – Min_offset) * rand() + Min_offset)
- Public_UTME = Round(UTME_final + (Distance * cos(radians(Angle – 90)), -2)
- Public_UTMN = Round(UTMN_final + (Distance * sin(radians(Angle + 90))), -2)

Sharing Sensitive Information

Note: Refer to **SOP 13: Product Delivery, Posting and Distribution** for a more complete description of how to post and distribute products, and to keep a log of data requests.

No sensitive information (e.g., information about the specific nature or location of protected resources) may be posted to NRInfo or another publicly-accessible website, or otherwise shared or distributed outside NPS without a confidentiality agreement between NPS and the agency, organization, or person(s) with whom the sensitive information is to be shared. Only products that are intended for public/general-use may be posted to public websites and clearinghouses – these may not contain sensitive information.

Responding to Data Requests

If requests for distribution of products containing sensitive information are initiated by the NPS, by another federal agency, or by another partner organization (e.g., a research scientist at a university), the unedited product (e.g., the full data set that includes sensitive information) may only be shared after a confidentiality agreement is established between NPS and the agency, organization, or person(s) with whom the sensitive information is to be shared. All data requests will be tracked according to procedures in **SOP 13: Product Delivery, Posting and Distribution**.

Once a confidentiality agreement is in place, products containing sensitive information may be shared following these guidelines:

1. Always clearly indicate in accompanying correspondence that the products contain sensitive information, and specify which products contain sensitive information.

2. Indicate in all correspondence that products containing sensitive information should be stored and maintained separately from non-sensitive information, and protected from accidental release or re-distribution.
3. Indicate that NPS retains all distribution rights; copies of the data should not be redistributed by anyone but NPS.
4. Include the following standard disclaimer in a text file with all digital media upon distribution: "The following files contain protected information. This information was provided by the National Park Service under a confidentiality agreement. It is not to be published, handled, re-distributed or used in a manner inconsistent with that agreement." The text file should also specify the file(s) containing sensitive information.
5. If the products are being sent on physical media (e.g., CD or DVD), the media should be marked in such a way that clearly indicates that media contains sensitive information provided by the National Park Service.

Confidentiality Agreements

Confidentiality agreements may be created between NPS and another organization or individual to ensure that protected information is not inadvertently released. When contracts or other agreements with a non-federal partner do not include a specific provision to prevent the release of protected information, the written document must include the following standard Confidentiality Agreement:

> **Confidentiality Agreement** - I agree to keep confidential any protected information that I may develop or otherwise acquire as part of my work with the National Park Service. I understand that with regard to protected information, I am an agent of the National Park Service and must not release that information. I also understand that by law I may not share protected information with anyone through any means except as specifically authorized by the National Park Service. I understand that protected information concerns the nature and specific location of endangered, threatened, rare, commercially valuable, mineral, paleontological, or cultural patrimony resources such as threatened or endangered species, rare features, archeological sites, museum collections, caves, fossil sites, gemstones, and sacred ceremonial sites. Lastly, I understand that protected information must not be inadvertently disclosed through any means including websites, maps, scientific articles, presentation, and speeches.

Note: Certain states, including the State of Washington, have sunshine laws that do not have exemptions for sensitive information. NPS should not create confidentiality agreements or share sensitive information with these states without first seeking the advice of an NPS solicitor.

Freedom of Information (FOIA) Requests

All official FOIA requests will be handled according to NPS policy. The NPS Lead will work with the Data Manager and the park FOIA representative(s) of the park(s) for which the request applies.

References Cited

National Park Service. 2006. Management Policies. Internet document: http://www.nps.gov/policy/mp/policies.html (accessed May 5, 2010).

SOP 13: Product Delivery, Posting, and Distribution

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Overview

This SOP provides a schedule, product specifications, and instructions for delivering completed data sets, reports and other project deliverables for long-term storage (Table 13.1). Details are also provided on posting products to websites and clearinghouses, and on responding to data requests.

Product Delivery Schedule and Specifications

Table 13.1 Schedule and instructions for project deliverables. This schedule is for years with NCCN I&M elk pellet surveys.

Deliverable Product	Primary Responsibility	Target Date	Instructions
Field season reports	Project Lead	November 31 and March 31	Upload digital files in Microsoft Word format to the NCCN Digital Library.
Certified back-end database	Project Lead	May 30 of the same year; data are not posted to public sites until June of the second year	Refer to the section in this SOP on delivering certified data and related materials.
Certified geospatial data	Project Lead with GIS Specialist		
Data certification report	Project Lead		
Metadata interview form	Project Lead		
Full metadata (parsed XML)	Data Manager and GIS Specialist	October 30 of the following year	Upload the parsed XML record to NRInfo [1], and the NCCN Digital Library.
Biennial I&M report	Project Lead	August 31 of the following year	Refer to the section in this SOP on reports and publications.
4-year analysis report	Project Lead, Data Analyst	Every four years of NCCN I&M data collection, by August 31	
Other publications	Project Lead, Data Analyst	as completed	
Field data forms	Project Lead	August 30	Scan original, marked-up field forms as PDF files, zip and upload to the NCCN Digital Library. Hard copy originals go to the Park Curator for archiving four years after data collection.

Deliverable Product	Primary Responsibility	Target Date	Instructions
Other records	Project Lead	review for retention every May	Retain or dispose of records following NPS Director's Order 19 [2]. Organize and send analog files to Park Curator for archiving. Digital files that are slated for permanent retention should be uploaded to the NCCN Digital Library.

[1] NRInfo is the agency's internet clearinghouse for natural resource data and metadata (http://nrinfo/home.mvc). Only non-sensitive information is posted to NRInfo. Refer to the section on sensitive information in **Section 4I, Identifying and Handling Sensitive Information** for more information.
[2] NPS Director's Order 19 provides a schedule indicating the amount of time that the various kinds of records should be retained. Available at: http://data2.itc.nps.gov/npspolicy/DOrders.cfm

NCCN Digital Library

The NCCN Digital Library is a hierarchical document management system maintained on the NCCN servers. NPS users have read-only access to these files, except where information sensitivity may preclude general access.

Contents of the NCCN Digital Library can be viewed from within the NPS firewall at: http://www.nccn.nps.gov/im/library/index.aspx. Documents may be uploaded by network users through the NCCN team site: http://www.nccn.nps.gov/im/library/documents1.aspx.

Upon uploading files to the Digital Library, the upload page will request the following information about the uploaded files to enable filing and searching:

- Document title
- Project code (e.g., "MAa19" for Elk Monitoring at LEWI)
- Park(s) to which the file(s) apply; multiple parks may be selected for each upload
- Document type (e.g., formal report, database, protocol, etc.)
- Document topic (e.g., Wildlife)
- Date of publication or last revision
- Author name(s)
- Sensitivity: Sensitive, NPS Only, or Public. Sensitive files will not be viewable without permission. For a definition of sensitive information, see **Section 4I, Identifying and Handling Sensitive Information**.
- Description - Document abstract, additional authors and credits, special use instructions, etc.

For project staff without access to the NPS intranet, files may be sent by email or CD/DVD to the NPS Lead or Data Manager for upload, along with the above information in a text file or accompanying email.

Park Collections

The collections at OLYM will serve as the park of record for the Forest Vegetation Monitoring Project. Voucher specimens, hardcopy field forms, and printouts of biennial reports, technical

reports, and other publications will be filed there. In addition, other hard copy project records should be reviewed and organized on an annual basis (or at the conclusion of a project), and sent to park collections for long-term storage.

The Project Lead should contact the Park Curator during the project planning if voucher specimens will be collected. All specimens must be labeled with NPS accession and catalog numbers, and with advance notice the Park Curator can help to provide these numbers ahead of time so they can be included in label printouts. Specimen label information will be entered by the Park Curator into the ANCS+ database. The Park Curator will help to decide which and how many specimens can be maintained at the park versus sent to another institution or collection. Collected materials remain NPS property even if they later reside in a non-NPS collection (e.g., university herbarium).

Delivering Certified Data and Related Materials

Data certification is a benchmark in the project information management process that indicates that the data: 1) are complete for the period of record; 2) have undergone and passed the quality assurance checks; and 3) are appropriately documented and in a condition for archiving, posting and distribution as appropriate. To ensure that only quality data are included in reports and other project deliverables, the data certification step is an annual requirement for all tabular and spatial data. For more information refer to **SOP 9: Data Quality Review and Certification**.

The following deliverables should be delivered as a package:

- *Certified back-end database* – Database containing data for the current season that has been through the quality assurance checks documented in **SOP 9: Data Quality Review and Certification**. Delivery of this item is only applicable in cases where the back-end database is implemented in Microsoft Access and/or is deployed outside the NPS firewall during the quality review. In all other cases, the Data Manager will already have access to the certified data.
- *Certified geospatial data* – GIS themes in ESRI coverage or shapefile format. Refer to NCCN GIS Development Guidelines (NCCN 2007a) and NCCN GIS Product Specifications (NCCN 2007b) for more information.
- *Data certification report* – A brief questionnaire in Microsoft Word that describes the certified data product(s) being delivered. A template form is available on the NCCN website at: http://science.nature.nps.gov/im/units/nccn/datamgmt_guide.cfm.
- *Metadata interview form* – The metadata interview form is a Microsoft Word questionnaire that greatly facilitates metadata creation. It is available on the NCCN website at: http://science.nature.nps.gov/im/units/nccn/datamgmt_guide.cfm. For more information, refer to **Section 4F, Metadata Procedures**.

After the quality review is completed, the Project Lead should package the certification materials for delivery as follows:

1. Create a compression file (using WinZip® or similar software, or by right-clicking in Windows Explorer). This file should be named in accordance with general file naming standards, and the name should include the project code ("MAa19") and the year or span of years for the data being certified. For example: MAa19_2010_certification_pkg.zip.

2. In cases where the back-end database is implemented in Microsoft Access and/or is deployed outside the NPS firewall during the quality review:
   a. Open the certified back-end database file and compact it (in Microsoft Access version 2003 and earlier, Tools > Database Utilities > Compact and Repair Database). This will make the file size much smaller. Back-end files are typically indicated with the letters "_be" in the name (e.g., MAa19_LEWI_Elk_be.mdb).
   b. Add the back-end database file to the compression file.
   c. Note: The front-end application does not contain project data and as such should not be included in the delivery file.
3. Add the completed metadata interview and data certification forms to the compressed file. Both files should be named in a manner consistent with the file naming standards described in **SOP 1: Project Workspace and Records Management**.
4. Add any geospatial data files that are not already in the possession of the GIS Specialist. Geospatial data files should be developed and named according to NCCN GIS Naming Conventions (NCCN 2007c).
5. Deliver the compressed file containing all certification materials to the Data Manager by placing it in the Data folder of the project workspace and notifying the Data Manager by email. If the Project Lead does not have network access, then certification materials should be delivered as follows:
   a. If the compressed file is under 9.5 mb in size, it may be delivered directly to the Data Manager by email.
   b. If the compressed file is larger than 9.5 mb, it should be copied to a CD or DVD and delivered in this manner. Under no circumstances should products containing sensitive information be posted to an FTP site or other unsecured web portal (refer to **Section 4I, Identifying and Handling Sensitive Information**).

Upon receiving the certification materials, the Data Manager will:

1. Review them for completeness and work with the Project Lead if there are any questions.
2. Check in the delivered products using the NCCN project tracking application.
3. Notify the GIS Specialist if any geospatial data are delivered. The GIS Specialist will then review the data, and update any project GIS data sets and metadata accordingly, and post those products to the NCCN Digital Library.
4. Work with the GIS Specialist to finalize coordinate data in the database, generate public coordinates (as applicable – see **Section 4I, Identifying and Handling Sensitive Information**), and update any GIS-derived data fields therein (e.g., elevation, slope, aspect).
5. Upload the certified products to the NCCN Digital Library.
6. Merge the certified data into the master project database, if applicable.
7. Notify the Project Lead that the year's data have been successfully reviewed and processed. The Project Lead may then proceed with data summarization, analysis and reporting.
8. Develop, parse and post the XML metadata record to NRInfo.
9. After a holding period of two years, the Data Manager will upload the certified data to NRInfo. This holding period is to protect professional authorship priority and to provide sufficient time to catch any undetected data quality problems.

No sensitive information (e.g., information about the specific nature or location of protected resources) may be posted to NRInfo or another publicly-accessible website, or otherwise shared or distributed outside NPS without a confidentiality agreement between NPS and the agency, organization, or person(s) with whom the sensitive information is to be shared. Only products that are intended for public/general-use may be posted to public websites and clearinghouses – these may not contain sensitive information.

Instructions for Reports and Publications

Biennial reports and trend analysis reports will use the NPS Natural Resource Publications template, a pre-formatted Microsoft Word template document based on current NPS formatting standards. Biennial reports will use the Natural Resource Report template, and trend analysis and other peer-reviewed technical reports will use the Natural Resource Technical Report template. These templates and documentation of the NPS publication standards are available at: http://www.nature.nps.gov/publications/NRPM/index.cfm.

The procedures for biennial reports, technical reports, and publications are as follows. (Note: This is optional for field season reports, which are intended to be internal communications only.)

1. The Project Lead or Data Analyst formats the document according to the NPS Natural Resource Publications standards.
    a. Formatting according to NPS standards is easiest when using the report template from the very beginning, as opposed to reformatting an existing document.
    b. When creating the file, use appropriate naming standards (described in this document), and add "DRAFT" to the file name.
    c. Open the document and add "DRAFT" to the header or document watermark as appropriate.
2. The document should be peer reviewed at the appropriate level. For example, I&M biennial reports should be reviewed by other members of the project work group. The Network Coordinator will also review all biennial reports for completeness and compliance with I&M standards and expectations. Before sending the document for review, rename the document by adding a date stamp to the end of the file name using the YYYYMMDD format.
3. Upon completing the peer review, the Project Lead should acquire a publication series number from the appropriate regional or national key official. Instructions for acquiring a series number are available at: http://www.nature.nps.gov/publications/NRPM/index.cfm.
4. The Project Lead should finalize the document:
    a. Ensure that the publication/version date (last saved date field code in the document header, if used) and file name (field code in the document footer, if used) are updated properly throughout the document.
    b. Remove the word "DRAFT" from watermarks, document headers, and file name.
    c. Remove any previous date stamp from the file name.
    d. To avoid unplanned edits to the document, reset the document to read-only by right-clicking on the document in Windows Explorer and checking the appropriate box in the Properties popup.
    e. Create a PDF version of the document and upload the PDF copy to the NCCN Digital Library at: http://www.nccn.nps.gov/im/library/documents1.aspx.

f. Store both the Word document and PDF copy in the appropriate section of the project workspace (see **SOP 1: Project Workspace and Records Management**).

5. Notify the Park Curator and Data Manager that the report is available, and send a printout to the Park Curator to add to the host park collections.
6. The Data Manager (or a designee) will create a bibliographic record and upload the PDF copy to Reference according to document sensitivity.

File Naming Standards

Prior to delivering or uploading digital products, files should be named according to the naming conventions appropriate to each product type.

Reports and Publications

- No spaces or special characters in the file name.
- Use the underbar ("_") character to separate file name components.
- Try to limit file names to 30 characters or fewer, up to a maximum of 50 characters.
- Dates should be formatted as YYYYMMDD.
- As appropriate, include the project code (e.g., "MAa19"), network code ("NCCN") or park code ("LEWI"), and year in the file name.

Examples:

- LEWI_MAa19_2010_Biennial_report.pdf
- LEWI_MAa19_2010_Field_season_report.doc
- LEWI_MAa19_2010_Certification_report.doc

Other Files

General naming standards as described in **SOP 1: Project Workspace and Records Management** apply to all deliverables. When delivering files to the Digital Library, file names should be modified as needed to include the project code (e.g., "MAa19"), network code ("NCCN") or park code, and year as appropriate (e.g., LEWI_MAa19_2010_cert_package.zip). Specific standards are described in **SOP 14: Revising the Protocol** for protocol documents.

Product Posting

Once digital products have been delivered and processed, the Data Manager or a designee will post them to or otherwise update the following applications to make them generally available:

1. NRInfo is the agency's internet clearinghouse for natural resource data and metadata (http://nrinfo/home.mvc). Only non-sensitive information is posted to NRInfo. Refer to the section on sensitive information in **Section 4I, Identifying and Handling Sensitive Information** for more information. Full metadata records will be posted to NRInfo as they are created; data sets will be posted after a two-year hold to protect professional authorship priority and to provide sufficient time to catch any undetected quality assurance problems.
2. Reference is the component of NRInfo that contains NPS bibliographic data related to natural resources (http://nrinfo/home.mvc). This application has the capability of storing and providing public access to image data (e.g., PDF files) associated with each record. For reports and other publications, a record will be created after first verifying that a

record does not already exist. The digital report file in PDF format will then be uploaded and linked to the Reference record.

3. NPSpecies is the NPS database and application for maintaining park-specific species lists and observation data (http://science.nature.nps.gov/im/apps/npspp/index.htm). Species observations will be extracted from project data sets and uploaded into NPSpecies.
4. NCCN Web Site is maintained by NCCN staff as part of the NPS Inventory and Monitoring web site (http://science.nature.nps.gov/im/units/nccn) to describe our program, the vital signs selected for monitoring, and to highlight certain products and information derived from inventory and monitoring work at NCCN. The site has both internet and intranet components. Select products such as biennial reports and technical reports will be posted to the web site.

These applications serve as the primary mechanisms for sharing reports, data, and other project deliverables with other agencies, organizations, and the general public.

Holding Period for Project Data

To protect professional authorship priority and to provide sufficient time to complete quality assurance measures, there is a two-year holding period before posting or otherwise distributing certified project data. This means that certified data sets are first posted to publicly-accessible websites (i.e., NRInfo) approximately 24 months after they are collected (e.g., data collected in June 2010 becomes generally available through NRInfo in June 2012). In certain circumstances, and at the discretion of the NPS Lead and Park Biologists, data may be shared before a full two years have elapsed.

Note: This hold only applies to raw data, and not to metadata, reports or other products which are posted to NPS clearinghouses immediately after being received and processed.

Responding to Data Requests

Occasionally, a park or project staff member may be contacted directly regarding a specific data request from another agency, organization, scientist, or from a member of the general public. The following points should be considered when responding to data requests:

- For all Inventory and Monitoring projects in NCCN, NPS is the originator and steward of the data, and the NPS Inventory and Monitoring Program should be acknowledged in any professional publication using the data.
- NPS retains distribution rights; copies of the data should not be redistributed by anyone but NPS.
- The data that project staff members and cooperators collect using public funds are public records and as such cannot be considered personal or professional intellectual property.
- No sensitive information (e.g., information about the specific nature or location of protected resources) may be posted to NRInfo or another publicly-accessible website, or otherwise shared or distributed outside NPS without a confidentiality agreement between NPS and the agency, organization, or person(s) with whom the sensitive information is to be shared. Refer to **Section 4I, Identifying and Handling Sensitive Information**.

- For quality assurance, only certified, finalized versions of data sets should be shared with others. In exceptional cases where a provisional data set needs to be shared with others prior to certification:
    - Any accompanying communications should clearly indicate that the data set is provisional and subject to change according to our quality review process.
    - File names and the media it is sent on should be clearly labeled as containing provisional data not for distribution.

The Project Lead will handle all data requests as follows:

1. Discuss the request with other Park Biologists as necessary to make those with a need to know aware of the request and, if necessary, to work together on a response.
2. Notify the Data Manager if s/he is needed to facilitate fulfilling the request in some manner.
3. Respond to the request in an official email or memo.
4. In the response, refer the requestor to NRInfo (http://nrinfo/home.mvc), so they may download the necessary data and/or metadata. If the request can not be fulfilled in that manner – either because the data products have not been posted yet, or because the requested data include sensitive information – work with the Data Manager to discuss options for fulfilling the request directly (e.g., writing data to CD or DVD). Ordinarily, only certified data sets should be shared outside NPS.
5. It is recommended that documents and presentation files be converted to PDF format prior to distribution. This is to maximize portability and to reduce the ability for others to alter and redistribute files.
6. If the request is for data that may reveal the location of protected resources, refer to the next section in this document about sensitive information and also to **Section 4I, Identifying and Handling Sensitive Information**.
7. After responding, provide the following information to the Data Manager, who will maintain a log of all requests in the NCCN project tracking database:
    a. Name and affiliation of requestor
    b. Request date
    c. Nature of request
    d. Responder
    e. Response date
    f. Nature of response
    g. List of specific data sets and products sent (if any)

Freedom of Information (FOIA) Requests

All official FOIA requests will be handled according to NPS policy. The Project Lead will work with the Data Manager and the park FOIA representative(s) of the park(s) for which the request applies.

Special Procedures for Sensitive Information

Products that have been identified upon delivery by the Project Lead as containing sensitive information will normally be revised into a form that does not disclose the locations of protected resources – most often by removing specific coordinates and only providing coordinates that include a random offset to indicate the general locality of the occurrence. If this kind of measure

is not a sufficient safeguard given the nature of the product or the protected resource in question, the product(s) will withheld from posting and distribution.

If requests for distribution of products containing sensitive information are initiated by the NPS, by another federal agency, or by another partner organization (e.g., a research scientist at a university), the unedited product (i.e., the full data set that includes sensitive information) may be shared only after a confidentiality agreement has been established between NPS and the agency, organization, or person(s) with whom the sensitive information is to be shared. Refer to **Section 4I, Identifying and Handling Sensitive Information** for more information.

References Cited

NCCN – National Park Service. 2007a. GIS Development Guidelines. USDI National Park Service. Internet document: http://science.nature.nps.gov/im/units/nccn/datamgmt_guide.cfm.

NCCN – National Park Service. 2007b. GIS Product Specifications. USDI National Park Service. Internet document: http://science.nature.nps.gov/im/units/nccn/datamgmt_guide.cfm.

NCCN – National Park Service. 2007c. GIS Naming Conventions. USDI National Park Service. Internet document: http://science.nature.nps.gov/im/units/nccn/datamgmt_guide.cfm.

SOP 14: Revising the Protocol

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Overview

This SOP describes how to make and track changes to the NCCN Elk Monitoring Protocol, including its accompanying SOPs. Project staff should refer to this SOP whenever edits are necessary, and should be familiar with the protocol versioning conventions in order to identify and use the most current versions of the protocol documents. Required revisions should be made in a timely manner to minimize disruptions to project operations.

Peer Review

This protocol attempts to incorporate the best and most cost-effective methods for monitoring and information management. As new technologies, methods, and equipment become available, this protocol will be updated as appropriate, by balancing current best practices against the continuity of protocol information.

All edits require review for clarity and technical soundness. Small changes to existing documents – e.g., formatting, simple clarification of existing content, minor changes to the task schedule or project budget, or general updates to information management SOPs – may be reviewed in-house by project and NCCN staff. However, changes to data collection or analysis techniques, sampling design, or response design are usually more significant in scope and impact and will typically trigger an outside review to be coordinated by the Pacific West Regional Office of the National Park Service.

Document Life Cycle

Protocol documents may be maintained as separate files for each component (e.g., narrative, SOPs, appendices in separate document files) or unified into a single document file. During its life cycle, each document file can be classified in one of six life cycle stages:

1. Draft documents – Documents that have been drafted or revised but have not been reviewed and approved yet.
2. Review documents – Draft documents that have been sent out for peer review or administrative review.
3. Active documents – The current, reviewed and accepted version of each protocol component in Microsoft Word format. These documents have been reviewed and approved at the appropriate level, and are currently implemented for active monitoring projects.

4. Inactive documents – Older versions of approved protocol components that are no longer in active implementation.
5. Archived documents – Comprehensive set of active protocol components plus older, inactive versions of approved protocol components in Microsoft Word format. These are stored as read-only and have a date stamp to identify their approval date. The history of the protocol versions through time should be entirely traceable from within the document archive.
6. Distribution copies – PDF versions of approved, date-stamped protocol components, used to post to websites or otherwise share outside NPS.

Protocol documents are stored in the project workspace in separate subfolders named for each life cycle stage, except for inactive documents which are filed together with date-stamped copies of active documents in the archive folder. See **SOP 1: Project Workspace and Records Management** for additional details about the project workspace.

Document Versioning Conventions

Rather than using a sequential numeric versioning convention, we use date stamps to distinguish document versions because they are more intuitive and informative than version numbers. Date stamps are embedded within the document header, and also included in the document name.

Document Header

Within each document, the upper right section of the document header should show the date that the document was last saved. By using save date instead of current date, printouts and document previews will show the correct version number. The following is the field code to be used within the header to indicate the version number:

"{ SAVEDATE \@ "MMMM d, yyyy" * MERGEFORMAT }"

File Naming Conventions

All documents *except for active documents and draft documents* should include the last edit date as a suffix, using the YYYYMMDD format so that documents will sort by date rather than month or day (e.g., NCCN_LEWI_Elk_Protocol_DRAFT_20100430.doc for the review draft on 4/30/2010).

Active documents and draft documents that have not been shared with others (as review documents) should not include the date because – unlike documents in other life cycle stages – they are not "point in time" document snapshots. By omitting the date stamp from these documents, they can more easily be distinguished from review drafts and archive or distribution copies. Draft documents should clearly contain the word "DRAFT" in the file name.

Note: General file and folder naming conventions are described in **SOP 1: Project Workspace and Records Management**; these should be followed when naming protocol document files.

Revision Procedures

Proposed changes to protocol components should be discussed among project staff prior to making modifications. It is especially important to consult with the Data Manager prior to making changes because certain types of changes may jeopardize data set integrity unless they

are planned and executed with the continuity of the data set in mind. Because certain changes may require altering the database structure or functionality, advance notice of changes is important to minimize disruptions to project operations. Consensus should be reached on who will be making the agreed-upon changes and in what timeframe.

Note: A change in one document also may necessitate other changes elsewhere in the protocol. For example, a change in the narrative may require changes to several SOPs; similarly renumbering an SOP may mean changing document references in several other sections of the protocol. The project task list and other appendices also may need to be updated to reflect changes in timing or responsibilities for the various project tasks.

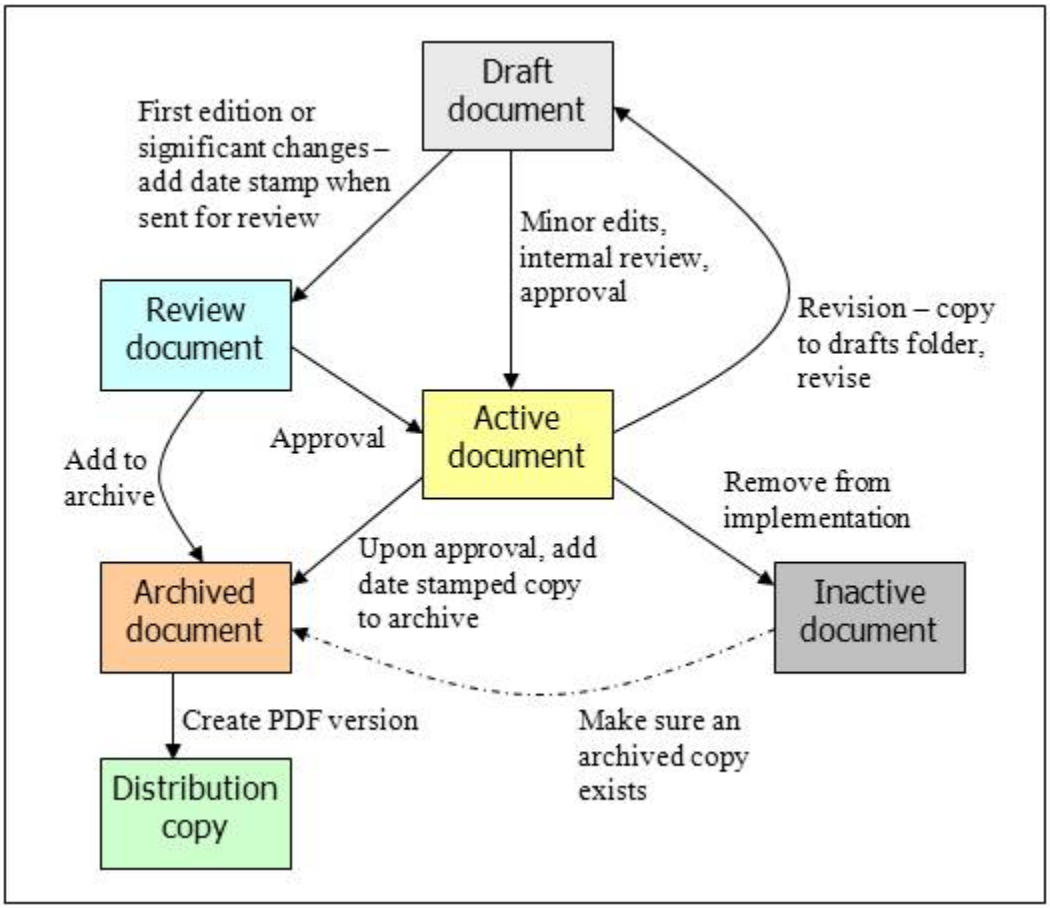


Figure SOP 14.1. Process for creating and revising protocol documents. Boxes represent document life cycle stages, and connecting arrows indicate procedures.

The Project Lead is the primarily responsible for making edits and ensuring document review at the appropriate level. The process for creating and revising protocol documents is shown in Figure SOP 14.1, and outlined below:

1. Create the draft document in Microsoft Word format. If modifying an existing document (usually an active document), copy the document to the draft document folder, remove any date stamp from the name. Add "DRAFT" to the file name. Open the document and add "DRAFT" to the header or document watermark as appropriate.

2. Track revision history. If modifying an existing document, document all edits in the Revision History Log embedded in the protocol narrative and each SOP. Log changes only for the section of the document being edited (i.e., if there is a change to an SOP, log those changes only in the revision history log for that SOP). Record the date of the changes (i.e., the date on which all changes were finalized), author of the revision, describe the change and cite the paragraph(s) and page(s) where changes are made, and briefly indicate the reason for making the changes.

3. Document review. Circulate the changed document for internal review among project staff and cooperators. If the changes are significant enough to trigger peer review (as defined above), create a review document by adding a date stamp to the end of the file name using the YYYYMMDD format, copy the file to the archive folder, and submit the document for peer review according to current instructions.

4. Finalize and archive. Upon approval and final changes:
   a. Ensure that the version date (last saved date field code in the document header) and file name (field code in the document footer, if used) are updated properly throughout the document.
   b. Move the approved document to the active folder. Remove the word "DRAFT" from watermarks, document headers, and file name. Remove any previous date stamp. This is now an active, implemented document.
   c. To avoid unplanned edits to the document, reset the document to read-only by right-clicking on the document in Windows Explorer and checking the appropriate box in the Properties popup.
   d. Create a copy of the file and add the revision date to the end of the file name using the YYYYMMDD format. Move this copy to the archive folder.
   e. Inform the Data Manager so the new version number can be incorporated into the project metadata.

5. Create distribution copies. As needed, create a PDF version of the archived document to post to the internet and share with others. These PDF versions should have the same date-stamped name as the archived Microsoft Word file. Post the distribution copy to the NCCN Digital Library (http://www.nccn.nps.gov/im/library/documents1.aspx) and forward copies to all individuals who had been using a previous version of the affected document.

6. Remove from implementation. If it is decided that a document needs to be removed from implementation – either because it is no longer necessary (e.g., an unneeded SOP), or because it has been superseded by a more recent version – this can be easily done by removing the document from the active document folder, after first checking that a copy of that version already exists in the archive folder.

Appendix A: Yearly Project Task List

Table A.1. This table identifies each task by project stage, indicates who is responsible, and establishes the timing for its execution. The task list is for years with NCCN I&M elk pellet surveys. Protocol sections and SOPs are referenced as appropriate.

Project Stage	Task Description	Responsibility	Timing
Preparation (*Section 3A, 3B, and 4B; SOP 1, 2, and 3*)	Meet (or conference call) to recap past field season, discuss the upcoming field season, and document any needed changes to field sampling protocols or the database	Project Lead, Data Manager, and GIS Specialist	Jul
	Ensure all project compliance needs are completed for the coming season	Project Lead	Jul-Aug
	Plan field season logistics and staffing, including training schedule and ordering any needed equipment and supplies (SOP 2)	Project Lead	Jul-Aug
	Initiate computer access and key requests	Project Lead	Jul-Aug
	Inform GIS Specialist and Data Manager of specific needs for upcoming field season	Project Lead	by Aug 1
	Generate list of any updated coordinates from the database, prepare and print field maps (SOP 2)	Project Lead	by Sep 15
	Provide field crew email addresses and user logins to Data Manager	Project Lead	by Sep 15
	Ensure that project workspace is ready for use (SOP 1)	Project Lead	by Oct 1
	Deliver GPS units with updated data dictionary, background maps, and target coordinates (SOP 2)	GIS Specialist	by Oct 1
	Update and deploy database application for data entry	Data Manager	by Oct 1, as needed
	Provide database/GPS training as needed	Data Manager and GIS Specialist	Oct, Feb
	Train field crew in elk pellet identification, sampling protocols, and safety (SOP 3)	Field Lead	Oct, Feb
Data Acquisition (*Section 3C; SOP 5, 6, and 7*)	Collect pellet observation data during field trips	Technicians	Oct, Feb
	Collect observation data during driving surveys	Technicians	Feb, Apr, Jun, Aug, Oct, Dec
	Review data forms for completeness and accuracy after each field day	Field Lead	Feb, Apr, Jun, Aug, Oct, Dec
Data Entry & Processing (*Section 4C and 4D; SOP 4, 8, and 13*)	Download GPS data and email files to GIS Specialist for correction (SOP 4)	Technicians	Oct, Feb
	Download and process digital images (Section 4D)	Technicians	Oct, Feb
	Enter data into the database (SOP 8)	Technicians	Oct, Feb
	Verify accurate transcription from field forms to database as data are entered (SOP 8)	Technicians	Oct, Feb
	Review database entries for completeness and accuracy	Field Lead	Oct, Feb
	Correct GPS data and report problems to Field Lead and Project Lead	GIS Specialist	Oct, Feb

Project Stage	Task Description	Responsibility	Timing
	Confirm that data entry for both sampling sessions is complete, and notify the Data Manager and the GIS Specialist	Project Lead	Mar
	Merge, correct, and export GPS data. Upload processed and verified coordinates to database. Deliver the database to the Project Lead for the quality review (SOP 13).	GIS Specialist	Mar
Product Development (*Section 4H*)	Complete field season reports (SOP 13)	Field Lead	by Mar 15
Product Delivery (*Section 4J*)	Send field season report to Park Biologists, Data Manager, and GIS Specialist (SOP 13)	Project Lead	by Apr 1
Quality Review (*Section 4E*)	Quality review and data validation using database tools (SOP 9)	Project Lead	Mar-Apr
Metadata (*Section 4F; SOP 12*)	Identify any sensitive information contained in the data set (SOP 12)	Project Lead	Apr
	Update project metadata interview form	Project Lead	Apr-May
Data Certification & Delivery (*Section 4G; SOP 9, 10 and 13*)	Certify the season's data and complete the certification report (SOP 9)	Project Lead	Apr-May
	Deliver certification report, certified data, and updated metadata to Data Manager and GIS Specialist (SOP 13)	Project Lead	by Jun 1
	Store certified data files in NCCN Digital Library [1] (SOP 13)	Data Manager	Jun-Jul
	Review and update project geodatabase and associated metadata records (SOP 10)	GIS Specialist	Jun-Jul
	Finalize and parse metadata records, store in NCCN Digital Library [1] (SOP 13)	Data Manager and GIS Specialist	by Aug 31
Data Analysis[2] (*Section 4H and Chapter 5; SOP 11*)	Analyze four years of data and test for trends. Prepare tables and maps of results for presentation in four-year report. Record results into project database (SOP 11)	Data Analyst, Data Manager, and GIS Specialist	Jun-Jul
Reporting & Product Development (*Section 4H; SOP 12*)	Export automated summary queries and reports from database	Data Analyst	Jun-Jul
	Refer to the proper report template from the NPS website (http://www.nature.nps.gov/publications/NRPM/index.cfm); create biennial report based on template (template will also be available in project workspace folder).	Data Analyst and Project Lead	Jun-Jul
	Screen all reports and data products for sensitive information (SOP 12)	Project Lead	Jun-Aug
Product Delivery (*Section 4J; SOP 13*)	Submit draft I&M report to Network Coordinator or review	Project Lead	by Aug 31
	Review report for formatting and completeness, notify Project Lead of approval or need for changes	Network Coordinator	Sep
	Upload completed report to NCCN Digital Library [1], notify Data Manager (SOP 13)	Project Lead	upon approval
	Deliver other products according to the delivery schedule and instructions (SOP 13)	Project Lead	upon completion

Project Stage	Task Description	Responsibility	Timing
	Product check-in	Data Manager	upon receipt
Posting & Distribution (*Section 4J; SOP 13*)	Submit metadata to NRInfo [3]	Data Manager	by Aug 31
	Create Reference [4] record, post reports to NPS clearinghouse	Data Manager	upon receipt
	Update NPSpecies [5] records according to data observations	Data Manager	Nov-Jan
	Submit certified data and GIS data sets to NRInfo [3]	Data Manager	Nov (after 2-year hold)
Archiving & Records Management (*Section 4K; SOP 1*)	Store finished products in NCCN Digital Library [1]	Data Manager	upon receipt
	Review, clean up and store and/or dispose of project files according to NPS Director's Order 19[6]	Project Lead	Jan
Season Close-out (*Section 4L*)	Inventory equipment and supplies	Field Lead	Feb, Oct
	Conference call to discuss recent field season (close out); discuss who needs to do what to get data ready for analysis	Project Lead, Data Manager, and GIS Specialist	Feb, Oct
	Discuss and document needed changes to analysis and reporting procedures	Project Lead and Data Manager	by Aug 31

[1] The NCCN Digital Library is a hierarchical document management system maintained on the NCCN servers. Network users have read-only access to these files, except where information sensitivity may preclude general access.
[2] The tasks in this section occur once per every four years of NCCN I&M elk pellet surveys.
[3] NRInfo is the agency's internet clearinghouse for natural resource data and metadata (http://nrinfo/home.mvc). Only non-sensitive information is posted to NRInfo. Refer to **SOP 12: Sensitive Information Procedures** for details.
[4] Reference is the NPS bibliographic database (http://nrinfo/home.mvc). This application has the capability of storing and providing public access to image data (e.g., PDF files) associated with each record.
[5] NPSpecies is the NPS database and application for maintaining park-specific species lists and observation data (http://science.nature.nps.gov/im/apps/npspp/index.htm).
[6] NPS Director's Order 19 provides a schedule indicating the amount of time that the various kinds of records should be retained. Available at: http://data2.itc.nps.gov/npspolicy/DOrders.cfm.

Appendix B: Lewis and Clark NHP Elk Monitoring Protocol Database Documentation

The database for this project consists of three types of tables: core tables describing the "who, where and when" of data collection, project-specific tables, and lookup tables that contain domain constraints for other tables. Although core tables are based on NCCN standards, they may contain fields, domains or descriptions that have been added or altered to meet project objectives.

The database includes the following standard tables:

tbl_Locations	Sample locations - places where data collection occurs
tbl_Schedule	Schedule for monitoring sites
tbl_Target_Coords	Target coordinates for sample locations
tbl_Analysis_Notes	Sample location-specific comments related to data analysis
tbl_Events	Data collection event for a given location
tbl_Coordinates	Coordinate data collected during sampling events
tbl_GPS_Info	GPS information associated with sampling event coordinates
tbl_Images	Images associated with sampling events
tbl_Markers	Markers placed at a sample location to facilitate relocation
tbl_Observers	Observers for each sampling event
tbl_QA_Results	Quality assurance query results for the working data set
tbl_Edit_Log	Edit log for changes made to data after certification
tbl_Task_List	Checklist of tasks to be completed at sampling locations

The following are project-specific data tables:

tbl_Pellet_Surveys	Pellet survey records for each plot/observer visit
tbl_Pellet_Obs	Pellet observations for each plot/observer visit
tbl_Route_Conditions	Driving survey conditions
tbl_Route_Markers	List of mile markers and associated coordinates for driving routes
tbl_Route_Obs	Driving survey observations
tbl_Results	Summary information derived from analysis of observation data
tbl_Understory_Species	Understory species observations made during pellet surveys
tbl_Walking_Times	Observations and time spent walking between pellet count plots

The following are a few of the more prominent, standard lookup tables:

tlu_Project_Crew	List of personnel associated with a project
tlu_Project_Taxa	List of species associated with project observations
tlu_Park_Taxa	Park-specific attributes for taxa

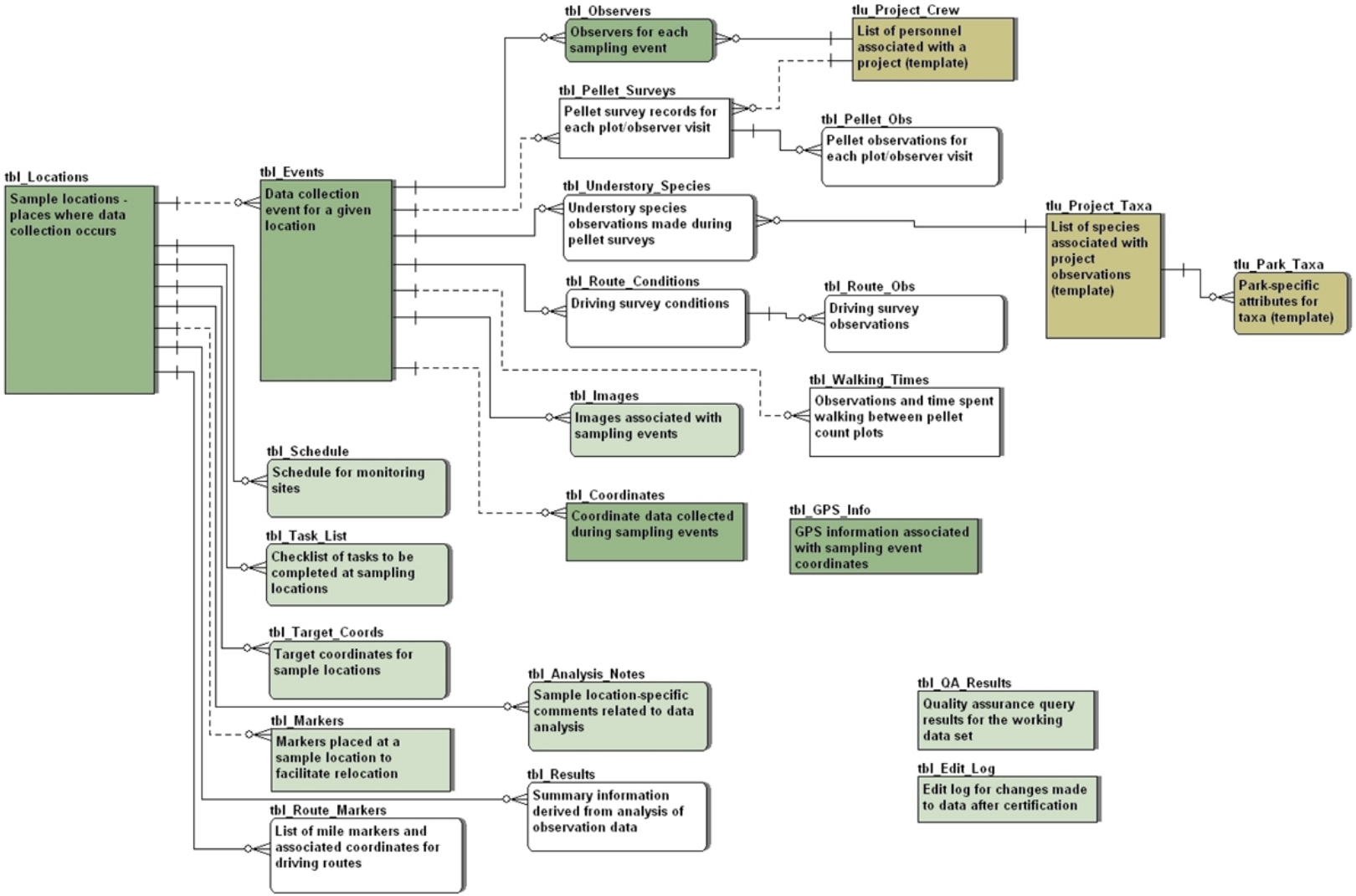


Figure B.1. Entity Relationship Diagram for the project database. Relationships between tables are represented by lines. Dark green tables represent core standard tables; light green represents extended standard tables; light brown are standard lookup tables. Project-specific tables are unshaded.

Data Dictionary

Required fields are denoted with an asterisk (*).

File name: MAa19_LEWI_Elk.dm1
Platform: Microsoft Access
Report date: 3/28/2011 5:08:43 PM

tbl_Analysis_Notes - Sample location-specific comments related to data analysis

Index	*Index columns*
Location_ID	Location_ID
pk_tbl_Analysis_Notes (primary)	Location_ID, Analysis_year

Field name	*Index/key*	*Data type*	*Description*
Location_ID	primary (FK)*	text (50)	Sampling location
Analysis_year	primary *	text (4)	Analysis year (e.g., 2010)
Analysis_notes		memo	Comments about this sample location related to the specified analysis year

tbl_Coordinates - Coordinate data collected during sampling events

Index	*Index columns*
Coord_label	Coord_label
Coord_type	Coord_type
Coord_updated	Coord_updated
Datum	Datum
Event_ID (unique)	Event_ID
Field_coord_source	Field_coord_source
pk_tbl_Coordinates (primary)	Coord_ID

Field name	*Index/key*	*Data type*	*Description*
Coord_ID	primary *	text (50)	Unique identifier for each coordinate record *Default*: =Format(Now(),"yyyymmddhhnnss") & '-' & 1000000000*Rnd(Now())
Event_ID	unique (FK)*	text (50)	Sampling event of coordinate data collection
Is_best		bit	Indicates whether this set of coordinates is the best available for this location
UTM_east		double	Final UTM easting (zone 10N, meters), including any offsets and corrections
UTM_north		double	Final UTM northing (zone 10N, meters), including any offsets and corrections
Coord_type	indexed	text (20)	Coordinate type stored in UTM_east and UTM_north: target, field, post-processed
Datumindexed	text (5)	Datum of UTM_east and UTM_north *Default*: "NAD83"	
Est_horiz_error		double	Estimated horizontal error (meters) of UTM_east and UTM_north
Elevation_m		single	Elevation in meters, derived from GIS using final UTMs
Slope_deg		single	Slope steepness in degrees, derived from GIS using final UTMs
Aspect_deg		single	Slope aspect in degrees, derived from GIS using final UTMs
Coord_label	indexed	text (25)	Name of the coordinate feature (e.g., plot center, NW corner)
Field_UTME		double	UTM easting (zone 10N) as recorded in the field
Field_UTMN		double	UTM northing (zone 10N) as recorded in the field

Field_datum		text (5)	Datum of field coordinates
Field_horiz_error		double	Field coordinate horizontal error (m)
Field_offset_m		double	Distance (meters) from the field coordinates to the target
	Constraint: Is Null Or >=0		
Field_offset_azimuth		smallint	Azimuth (degrees, declination corrected) from the coordinates to the target
	Constraint: Is Null Or (>=0 And <=360)		
Field_coord_source	indexed	text (12)	Field coordinate data source
GPS_file_name		text (50)	GPS rover file used for data downloads
GPS_model		text (25)	Make and model of GPS unit used to collect field coordinates
Source_citation		text (250)	Name, date and scale of the source map
Coordinate_notes		memo	Notes about this set of coordinates
Coord_created_date		datetime	Time stamp for record creation
	Default: Now()		
Coord_updated	indexed	datetime	Date of the last update to this record
Coord_updated_by		text (50)	Person who made the most recent edits

tbl_Edit_Log - Edit log for changes made to data after certification

Index	*Index columns*
Edit_date	Edit_date
Edit_type	Edit_type
pk_tbl_Edit_Log (primary)	Data_edit_ID
Project_code	Project_code
Table_affected	Table_affected
User_name	User_name

Field name	*Index/key*	*Data type*	*Description*
Data_edit_ID	primary *	text (50)	Unique identifier for each data edit record
	Default: =Format(Now(),"yyyymmddhhnnss") & '-' & 1000000000*Rnd(Now())		
Project_code	indexed *	text (10)	Project code, for linking information with other data sets and applications
Edit_date	indexed *	datetime	Date on which the edits took place
	Default: Now()		
Edit_type	indexed *	text (12)	Type of edits made: deletion, update, append, reformat, tbl design
Edit_reason	*	text (100)	Brief description of the reason for edits
User_name	indexed *	text (50)	Name of the person making data edits
Table_affected	indexed	text (50)	Table affected by edits
Fields_affected		text (200)	Description of the fields affected
Records_affected		text (200)	Description of the records affected
Data_edit_notes		memo	Comments about the data edits

tbl_Events - Data collection event for a given location
Constraints: : ([End_time] Is Null) Or ([Start_time] Is Null) Or ([End_time]>=[Start_time])

Index	*Index columns*
Certified_date	Certified_date
Entered_date	Entered_date
Location_ID	Location_ID
pk_tbl_Events (primary)	Event_ID
Start_date	Start_date
Start_loc	Start_loc
udx_tbl_Events (unique)	Location_ID, Start_date
Updated_date	Updated_date
Verified_date	Verified_date

Field name	*Index/key*	*Data type*	*Description*
Event_ID	primary *	text (50)	Unique identifier for each sampling event
	Default: =Format(Now(),"yyyymmddhhnnss") & '-' & 1000000000*Rnd(Now())		
Location_ID	unique (FK)*	text (50)	Sampling location for this event
Project_code	*	text (10)	Project code, for linking information with other data sets and applications
	Default: "MAa19"		
Start_date	unique *	datetime	Start date of the sampling event
Start_time		datetime	Start time of the sampling event
End_time		datetime	End time of the sampling event
Start_loc	indexed	text (50)	Walking survey start location (if 'Other' is indicated)
Dual_observers	*	bit	If a pellet survey, indicates whether there were dual observers doing plot recounts
	Default: No		
Veg_type		text (10)	Vegetation type observed at the sample location
Light_level		text (10)	Ambient light level during observations
Blowdown_severity		text (10)	Blowdown severity, expressed as percent of trees broken (i.e., from the 2007 blowdown)
Declination		text (25)	Declination correction factor for measurement of compass bearings
Logistics_notes		memo	Comments about logistics for reaching and sampling this location
Event_notes		memo	Comments about the sampling event
Entered_by		text (50)	Person who entered the data for this event
Entered_date	indexed	datetime	Date on which data entry occurred
	Default: Now()		
Updated_by		text (50)	Person who made the most recent updates
Updated_date	indexed	datetime	Date of the most recent edits
Verified_by		text (50)	Person who verified accurate data transcription
Verified_date	indexed	datetime	Date on which data were verified
Certified_by		text (50)	Person who certified data for accuracy and completeness
Certified_date	indexed	datetime	Date on which data were certified
Is_excluded		bit	Flag to exclude the sampling event from data summary output
	Default: False		
QA_notes		memo	Quality assurance comments for the selected sampling event

tbl_GPS_Info - GPS information associated with sampling event coordinates

Index	*Index columns*
Coord_ID	Coord_ID
Corr_type	Corr_type
Datum	GPS_datum
Feat_name	Feat_name
Feat_type	Feat_type
GPS_date	GPS_date
GPS_file	GPS_file
Location_ID	Location_ID
pk_tbl_GPS_Info (primary)	GPS_ID

Field name	*Index/key*	*Data type*	*Description*
GPS_ID	primary *	text (50)	Unique identifier for the GPS record
	Default: =Format(Now(),"yyyymmddhhnnss") & '-' & 1000000000*Rnd(Now())		
Coord_ID	indexed	text (50)	Coordinate identifier
Location_ID	indexed	text (50)	Sample location, used for temporary links
Feat_name	indexed	text (50)	Feature name in data dictionary
Flag	*	bit	Internal flag used to identify records while matching with tbl_Coordinates during post-season processing
	Default: False		
GPS_file	indexed	text (50)	GPS file name
GPS_date	indexed	datetime	Date GPS file was collected
GPS_time		datetime	Time GPS file was collected
Corr_type	indexed	text (50)	GPS file correction type
GPS_UTME		double	UTM easting in GPS unit
GPS_UTMN		double	UTM northing in GPS unit
UTM_zone		text (5)	UTM projection system zone
	Default: "10N"		
GPS_datum	indexed	text (5)	Datum of GPS coordinates
Feat_type	indexed	text (20)	Feature type (point, line, or polygon) collected with GPS
Data_dict_name		text (50)	Data dictionary name used to collect feature
Elev_m		double	Elevation (meters) in GPS unit
Num_sat		smallint	Number of satellites tracked by GPS unit during data collection
GPS_duration		text (25)	Length of time GPS file was open
Filt_pos		smallint	Number of GPS positions exported from GPS file
PDOP		double	Position dilution of precision scale
HDOP		double	Horizontal dilution of precision scale
H_err_m		double	Horizontal error (meters)
V_err_m		double	Vertical error (meters)
Std_dev_m		double	Standard deviation (meters)
GPS_process_notes		text (255)	GPS file processing notes
Is_better	*	bit	Indicates that the field crew thought this coordinate record to be an improvement over the current Is_best coordinate
	Default: False		

tbl_Images - Images associated with sampling events

Index	*Index columns*
Event_ID	Event_ID
Image_label	Image_label
Image_quality	Image_quality
Image_type	Image_type
pk_tbl_Images (primary)	Image_ID
Sort_order	Sort_order

Field name	*Index/key*	*Data type*	*Description*
Image_ID	primary (FK)*	text (50)	Unique identifier for each image record
	Default: =Format(Now(),"yyyymmddhhnnss") & '-' & 1000000000*Rnd(Now())		
Event_ID	indexed *	text (50)	Sampling event
Image_type	indexed	text (20)	Type of image
	Default: "Ground photo"		
Image_label	indexed	text (25)	Image caption or label
Image_desc		text (255)	Brief description of the image bearing, perspective, etc.
Frame_number		text (10)	Frame number for photographic images
Image_date		datetime	Date on which the image was created, if different from the sampling event date
Image_source		text (50)	Name of the person or organization that created the image
Image_quality	indexed	tinyint	Quality of the image
Is_edited_version		bit	Indicates whether this version of the image is the edited (originals = False)
Object_format		text (20)	Format of the image
Orig_format		text (20)	Format of the original image
Image_edit_notes		text (200)	Comments about the editing or processing performed on the image
Image_is_active		bit	Indicates whether the image is still being used for navigation or interpretation
	Default: True		
Image_root_path		text (100)	Drive space location of the main project folder or image library
Image_project_path		text (100)	Location of the image from the main project folder or image library
	Default: "Images\"		
Image_filename		text (100)	Name of the image including extention (.jpg) but without the image path
Image_notes		memo	Comments about the image
Sort_order	indexed *	int	Sort order for displaying records in the order they were entered

tbl_Locations - Sample locations - places where data collection occurs

Index	*Index columns*
Evaluation_code	Evaluation_code
Loc_updated	Loc_updated
Location_code	Location_code
Location_status	Location_status
Location_type	Location_type
Park_code	Park_code
Park_region	Park_region
pk_tbl_Locations (primary)	Location_ID
Public_offset	Public_offset
udx_tbl_Locations (unique)	Location_code

Field name	*Index/key*	*Data type*	*Description*
Location_ID	primary *	text (50)	Unique identifier for each sample location
	Default: =Format(Now(),"yyyymmddhhnnss") & '-' & 1000000000*Rnd(Now())		
Park_code	indexed *	text (4)	Park in which the sampling location is located
	Default: "LEWI"		
Location_code	unique *	text (10)	Alphanumeric code for the sample location
Location_type	indexed *	text (20)	Indicates the type of sample location
Location_status	indexed *	text (10)	Status of the sample location
	Default: "Active"		
Location_name		text (50)	Brief colloquial name of the sample location (optional)
UTME_public		double	UTM easting (zone 10N, meters). Note: in addition to any measurement error, these coordinates may have been offset up to 2 km from their actual position.
UTMN_public		double	UTM northing (zone 10N, meters). Note: in addition to any measurement error, these coordinates may have been offset up to 2 km from their actual position.
Public_offset	indexed	text (50)	Type of processing performed to make coordinates publishable
Park_region	indexed	text (25)	Region of the park in which the site is located
Evaluation_code	indexed	text (2)	Site evaluation status code
Evaluation_notes		text (100)	Brief comment about the site evaluation, rationale for not sampling, etc.
Travel_notes		memo	Directions for relocating the sample location
Location_desc		memo	Environmental description of the sampling location
Location_notes		memo	Other notes about the sample location
Loc_established		datetime	Date the sample location was established
Loc_discontinued		datetime	Date the sample location was discontinued
Loc_created_date		datetime	Time stamp for record creation
	Default: Now()		
Loc_updated	indexed	datetime	Date of the last update to this record
Loc_updated_by		text (50)	Person who made the most recent edits

tbl_Markers - Markers placed at a sample location to facilitate relocation

Index	*Index columns*
Location_ID	Location_ID
Marker_code	Marker_code
Marker_status	Marker_status
Marker_type	Marker_type
pk_tbl_Markers (primary)	Marker_ID
udx_tbl_Markers (unique)	Location_ID, Marker_code, Marker_status

Field name	*Index/key*	*Data type*	*Description*
Marker_ID	primary *	text (50)	Unique identifier for each marker record
	Default: =Format(Now(),"yyyymmddhhnnss") & '-' & 1000000000*Rnd(Now())		
Location_ID	unique (FK)*	text (50)	Sample location
Marker_code	unique *	text (12)	Field code given to the marker
Marker_type	indexed	text (20)	Type of marker used
Marker_substrate		text (50)	Substrate of the marker (e.g., tree, shrub, ground)
Height_cm		smallint	Height above ground level, in centimeters
	Constraint: Is Null Or >=0		
Offset_dist_m		double	Offset distance in meters
	Constraint: Is Null Or >=0		
Offset_azimuth		smallint	Azimuth (degrees, declination corrected) from the actual sampling point to the marker
	Constraint: Is Null Or (>=0 And <=360)		
Marker_status	unique *	text (12)	Current status of the marker
	Default: "Active"		
Marker_notes		memo	Comments about the marker
Marker_installed		datetime	Date the marker was first installed
Marker_updated		datetime	Date the marker record was last updated
Marker_removed		datetime	Date the marker was removed

tbl_Observers - Observers for each sampling event

Index	*Index columns*
Contact_ID	Contact_ID
Event_ID	Event_ID
Observer_role	Observer_role
pk_tbl_Observers (primary)	Event_ID, Contact_ID, Observer_role

Field name	*Index/key*	*Data type*	*Description*
Event_ID	primary (FK)*	text (50)	Sampling event identifier
Contact_ID	primary (FK)*	text (50)	Observer identifier
Observer_role	primary *	text (25)	Role of the observer during data collection (optional)
Observer_notes		text (200)	Comments about the observer specific to this sampling event

tbl_Pellet_Obs - Pellet observations for each plot/observer visit

Constraints: : ([N_clumps]=0 And [N_pellets]>0) Or ([N_clumps]>0 And [N_pellets]=0) Or ([N_clumps]>0 And [N_pellets]>0)

Index	*Index columns*
Obs_number	Obs_number
pk_tbl_Pellet_Obs (primary)	Survey_ID, Obs_number
Recount_code	Recount_code
Survey_ID	Survey_ID

Field name	*Index/key*	*Data type*	*Description*
Survey_ID	primary (FK)*	text (50)	Unique identifier for each survey record
Obs_number	primary *	tinyint	Observation number
Pellet_class		tinyint	Pellet decomposition class (1-4, where 1 is most intact)
	Constraint: Is Null Or (>=1 And <=4)		
N_clumps		tinyint	Number of pellet clumps observed
	Default: 0		
	Constraint: Is Null Or (>=0 And <=40)		
N_pellets		smallint	Number of pellets observed
	Default: 0		
	Constraint: Is Null Or (>=0 And <=300)		
Recount_code	indexed *	text (2)	Post-recount classification code, assigned after reconciling dual observations

tbl_Pellet_Surveys - Pellet survey records for each plot/observer visit

Index	*Index columns*
Event_ID	Event_ID
Observer	Observer
pk_tbl_Pellet_Surveys (primary)	Survey_ID
Plot_code	Plot_code
Survey_num	Survey_num
udx_tbl_Pellet_Surveys (unique)	Event_ID, Plot_code, Survey_num

Field name	*Index/key*	*Data type*	*Description*
Survey_ID	primary *	text (50)	Unique identifier for each survey record
	Default: =Format(Now(),"yyyymmddhhnnss") & '-' & 1000000000*Rnd(Now())		
Event_ID	unique (FK)*	text (50)	Sampling event
Plot_code	unique *	text (1)	Plot code
Survey_num	unique *	tinyint	Survey number: 1 (first count) or 2 (recount by second observer)
	Default: 1		
	Constraint: 1 Or 2		
Observer	indexed (FK)*	text (50)	Observer identifier
Plot_veg		text (10)	Vegetation type observed at the plot
Veg_cover		tinyint	Percent of the plot area obscured by vegetation under 1 m tall (i.e., obscuring pellet visibility)
	Constraint: Is Null Or (>=0 And <=100)		
Survey_mins		tinyint	Number of minutes it took to complete the plot survey
	Constraint: Is Null Or (>=0 And <=60)		
Survey_secs		tinyint	Number of seconds it took to complete the plot survey (added to minutes)
	Constraint: Is Null Or (>=0 And <60)		
Plot_notes		text (255)	Comments about the plot visit

tbl_QA_Results - Quality assurance query results for the working data set

Index	*Index columns*
Data_scope	Data_scope
pk_tbl_QA_Results (primary)	Query_name, Time_frame, Data_scope
Query_name	Query_name
Query_result	Query_result
Query_type	Query_type
Time_frame	Time_frame

Field name	*Index/key*	*Data type*	*Description*
Query_name	primary *	text (100)	Name of the quality assurance query
Data_scope	primary *	tinyint	Scope of the data included in queries: 0=Uncertified events only, 1=Both certified and uncertified, 2=Certified events only
Time_frame	primary *	text (30)	Field season year or range of dates for the data being passed through quality assurance checks
Query_type	indexed	text (20)	Severity of data errors being trapped: 1=Critical, 2=Warning, 3=Information
Query_result	indexed	text (50)	Query result as the number of records returned the last time the query was run
Query_run_time		datetime	Run time of the query results
Query_description		memo	Description of the query
Query_expression		memo	Evaluation expression built into the query
Remedy_desc		memo	Details about actions taken and/or not taken to resolve errors
Remedy_date		datetime	When the remedy description was last edited
QA_user		text (50)	Name of the person doing quality assurance
Is_done	*	bit	Temporary flag to indicate that the user is done reviewing this query even if some records remain

tbl_Results - Summary information derived from analysis of observation data

Index	*Index columns*
Calculation_date	Calculation_date
Contact_ID	Calculated_by
Location_ID	Location_ID
Parameter_code	Parameter_code
pk_tbl_Results (primary)	Sample_year, Calculation_date, Location_ID, Parameter_code
Sample_year	Sample_year

Field name	*Index/key*	*Data type*	*Description*
Sample_year	primary *	text (50)	Year to which results are applicable
Calculation_date	primary *	datetime	Date on which the results were calculated
Location_ID	primary (FK)*	text (50)	Sampling location
Parameter_code	primary *	text (50)	Calculated parameter
Parameter_value		double	Calculated parameter value
Calculated_by	indexed *	text (50)	Person who made the calculations
Record_notes		text (255)	Comments about the calculated value
Is_active		bit	Flag to indicate whether the current value is the active one used in output
		Default: True	

tbl_Route_Conditions - Driving survey conditions

Field name	*Index/key*	*Data type*	*Description*
Event_ID	primary (FK)*	text (50)	Sampling event
Travel_order		text (10)	Order traveled along the travel route: forward or reverse
Temp_C_start		single	Temperature observed at the start of the route survey, in Celsius

	Constraint: Is Null Or (>=-20 And <=50)		
Temp_C_end		single	Temperature observed at the end of the route survey, in Celsius
	Constraint: Is Null Or (>=-20 And <=50)		
Wind_start		tinyint	Wind conditions at the start of the route survey
Wind_end		tinyint	Wind conditions at the end of the route survey
Direction_start		text (3)	Wind direction at the start of the route survey (i.e., direction wind was blowing from)
Direction_end		text (3)	Wind direction at the end of the route survey (i.e., direction wind was blowing from)
Sky_start		tinyint	Sky conditions at the start of the route survey
Sky_end		tinyint	Sky conditions at the end of the route survey

tbl_Route_Markers - List of mile markers and associated coordinates for driving routes

Index	*Index columns*
Location_ID	Location_ID
Mile_marker	Mile_marker
pk_tbl_Route_Markers (primary)	Location_ID, Mile_marker

Field name	*Index/key*	*Data type*	*Description*
Location_ID	primary (FK)*	text (50)	Fixed sampling route
Mile_marker	primary *	text (5)	Fixed route mile marker
UTME		int	Easting of the mile marker, in UTM NAD83
UTMN		int	Northing of the mile marker, in UTM NAD83

tbl_Route_Obs - Driving survey observations

Constraints: : ([Total_elk]>=([Branch_bulls]+[Spike_bulls]+[Antlerless_adults]+[Calves])) And ([Total_elk]>=[Branch_bulls]) And ([Total_elk]>=[Spike_bulls]) And ([Total_elk]>=[Antlerless_adults]) And ([Total_elk]>=[Calves])

Index	*Index columns*
pk_tbl_Route_Obs (primary)	Event_ID, Obs_number
Event_ID	Event_ID
Obs_number	Obs_number

Field name	*Index/key*	*Data type*	*Description*
Event_ID	primary (FK)*	text (50)	Sampling event
Obs_number	primary *	tinyint	Sequential observation number assigned for each group seen on the route
Obs_time	*	datetime	Observation time
Coord_source		text (10)	Source of observation point coordinates: GPS or route map
Mile_marker		text (5)	Nearest fixed route mile marker to the observation point, used as an alternative to GPS
Obs_UTME		int	Easting of the observation point, in UTM NAD83
Obs_UTMN		int	Northing of the observation point, in UTM NAD83
Azimuth		smallint	Azimuth (degrees, declination corrected) from the observation point to the elk group
	Constraint: Is Null Or (>=0 And <=360)		
Distance_m		double	Distance (meters) from the observation point to the elk group
	Constraint: Is Null Or (>=0 And <=5000)		
Final_UTME		int	Easting of the elk group, in UTM NAD83; derived from observation UTMs and offsets

Final_UTMN		int	Northing of the elk group, in UTM NAD83; derived from observation UTMs and offsets
Habitat		text (10)	Vegetation type where the majority of the group was observed
Total_elk	*	smallint	Total number of elk seen in the group
	Constraint: >0 And <=200		
Branch_bulls		smallint	Number of bulls with branched antlers
	Constraint: Is Null Or (>=0 And <=200)		
Spike_bulls		smallint	Number of bulls with single-beam antlers, no tines or branches
	Constraint: Is Null Or (>=0 And <=200)		
Antlerless_adults		smallint	Number of adult-sized animals with no apparent antlers
	Constraint: Is Null Or (>=0 And <=200)		
Calves		smallint	Number of young-of-the-year with no apparent antlers
	Constraint: Is Null Or (>=0 And <=200)		
Obs_notes		text (255)	Comments about the observation

tbl_Schedule - Schedule for monitoring sites

Index	*Index columns*
Calendar_year	Calendar_year
Location_ID	Location_ID
pk_tbl_Schedule (primary)	Calendar_year, Location_ID

Field name	*Index/key*	*Data type*	*Description*
Calendar_year	primary *	text (10)	Calendar year for scheduled sampling (not necessarily actually sampled)
Location_ID	primary (FK)*	text (50)	Sampling location
Schedule_notes		text (255)	Comments about this schedule item (especially for out-of-rotation sites)

tbl_Target_Coords - Target coordinates for sample locations

Index	*Index columns*
pk_tbl_Target_Coords (primary)	Location_ID
Target_updated	Target_updated

Field name	*Index/key*	*Data type*	*Description*
Location_ID	primary (FK)*	text (50)	Sample location
Target_UTME		double	Target UTM easting (zone 10N)
Target_UTMN		double	Target UTM northing (zone 10N)
Target_datum		text (5)	Target coordinate datum
	Default: "NAD83"		
Target_notes		memo	Notes about the target coordinates
Target_created_date		datetime	Time stamp for record creation
	Default: Now()		
Target_updated	indexed	datetime	Date of the last update to this record
Target_updated_by		text (50)	Person who made the most recent edits

tbl_Task_List - Checklist of tasks to be completed at sampling locations

Index	*Index columns*
Date_completed	Date_completed
pk_tbl_Task_List (primary)	Location_ID, Request_date, Task_desc
Task_status	Task_status

Field name	*Index/key*	*Data type*	*Description*
Location_ID	primary (FK)*	text (50)	Sampling location
Request_date	primary *	datetime	Date of the task request

	Default: Now()		
Task_desc	primary *	text (100)	Brief description of the task
Requested_by		text (50)	Name of the person making the initial request
Task_status	indexed *	text (50)	Status of the task
	Default: "Active"		
Date_completed	indexed	datetime	Date the task was completed
Followup_by		text (50)	Name of the person following up on or completing the task
Task_notes		memo	Notes about the task
Followup_notes		memo	Comments regarding what was done to follow-up on or complete this task

tbl_Understory_Species - Understory species observations made during pellet surveys

Index	*Index columns*
Event_ID	Event_ID
pk_tbl_Understory_Species (primary)	Event_ID, Taxon_ID
Sort_order	Sort_order
Taxon_ID	Taxon_ID

Field name	*Index/key*	*Data type*	*Description*
Event_ID	primary (FK)*	text (50)	Sampling event
Taxon_ID	primary (FK)*	text (50)	Taxon observed
Percent_cover		tinyint	Percent of the area covered by the species
	Constraint: Is Null Or (>=0 And <=100)		
Percent_browsed		tinyint	Percent of individuals or crowns browsed
	Constraint: Is Null Or (>=0 And <=100)		
Browse_severity		text (10)	Browse severity observed
	Default: "None"		
Obs_notes		text (200)	Comments about this observation
Sort_order	indexed *	int	Sort order for displaying records in the order they were entered

tbl_Walking_Times - Observations and time spent walking between pellet count plots

Constraints: : ([End_time] Is Null) Or ([Start_time] Is Null) Or ([End_time]>=[Start_time])

Index	*Index columns*
Event_ID	Event_ID
From_point	From_point
pk_tbl_Walking_Times (primary)	Record_ID
To_point	To_point

Field name	*Index/key*	*Data type*	*Description*
Record_ID	primary *	int	Unique identifier for each record
Event_ID	indexed (FK)*	text (50)	Sampling event
From_point	indexed *	text (50)	Start point (e.g., trailhead, last point sampled, etc.)
To_point	indexed *	text (50)	Destination point
Start_time		datetime	Start time at which observers left the start point
End_time		datetime	End time at which observers arrived at the destination point
Percent_off_trail		text (10)	Percent of the distance walked that was off-trail
Blowdown_severity		text (10)	Blowdown severity, expressed as percent of trees broken (i.e., from the 2007 blowdown)
Navigation_notes		text (255)	Comments about navigation that may help future crews
Elk_pellets	*	bit	Indicates whether elk pellets were observed along the travel route
	Default: False		
Animal_notes		text (255)	Comments about animal evidence along the travel route

tlu_Blowdown_Severity - List of blowdown severity codes

Field name	*Index/key*	*Data type*	*Description*
Blowdown_severity	primary *	text (10)	
Severity_desc		text (100)	
Sort_order		tinyint	

tlu_Coord_Source - List of coordinate data sources (standard)

Field name	*Index/key*	*Data type*	*Description*
Coord_source	primary *	text (12)	
Coord_source_desc		text (100)	
Sort_order		tinyint	

tlu_Coord_Type - List of coordinate types (standard)

Field name	*Index/key*	*Data type*	*Description*
Coord_type	primary *	text (20)	
Coord_type_desc		text (100)	
Sort_order		tinyint	

tlu_Datum - List of coordinate datum codes (standard)

Field name	*Index/key*	*Data type*	*Description*
Datumprimary *	text (5)		
Datum_desc		text (50)	
Sort_order		tinyint	

tlu_Direction_Code - List of direction codes for travel and plot naming

Field name	*Index/key*	*Data type*	*Description*
Direction_code	primary *	text (3)	
Direction_desc		text (100)	
Sort_order		tinyint	
Angle	smallint		

tlu_Edit_Type - List of the types of post-certification edits made to data (standard)

Field name	*Index/key*	*Data type*	*Description*
Edit_type	primary *	text (12)	
Edit_type_desc		text (100)	
Sort_order		tinyint	

tlu_Evaluation_Status - List of evaluation codes for sample sites (template)

Field name	*Index/key*	*Data type*	*Description*
Eval_code	primary *	text (2)	
Eval_status	*	text (20)	
Eval_status_desc		text (100)	
Sort_order		tinyint	

tlu_GPS_Model - List of GPS devices used to collect coordinate data (template)

Field name	*Index/key*	*Data type*	*Description*
GPS_model	primary *	text (25)	
Sort_order		tinyint	

tlu_Image_Format - List of image, map, and photographic formats (template)

Field name	*Index/key*	*Data type*	*Description*
Image_format	primary *	text (12)	
Image_format_desc		text (100)	
Sort_order		tinyint	

tlu_Image_Quality - List of quality ranks for images (template)

Field name	*Index/key*	*Data type*	*Description*
Quality_code	primary *	tinyint	
Image_quality	*	text (20)	
Image_quality_desc		text (100)	

tlu_Image_Type - List of image types (template)

Field name	*Index/key*	*Data type*	*Description*
Image_type	primary *	text (12)	
Image_type_desc		text (100)	
Sort_order		tinyint	

tlu_Light_Level - List of light level codes

Field name	*Index/key*	*Data type*	*Description*
Light_level	primary *	text (10)	
Light_level_desc		text (100)	
Sort_order		tinyint	

tlu_Location_Type - List of location type codes (template)

Field name	*Index/key*	*Data type*	*Description*
Location_type	primary *	text (20)	
Loc_type_desc		text (200)	
Sort_order		tinyint	

tlu_Marker_Status - List of status codes for site markers (template)

Field name	*Index/key*	*Data type*	*Description*
Marker_status	primary *	text (12)	
Marker_status_desc		text (100)	
Sort_order		tinyint	

tlu_Marker_Type - List of marker types used to facilitate site relocation (template)

Field name	*Index/key*	*Data type*	*Description*
Marker_type	primary *	text (20)	
Sort_order		tinyint	

tlu_Observer_Role - List of observer role assignments (template)

Field name	*Index/key*	*Data type*	*Description*
Observer_role	primary *	text (25)	
Role_desc		text (100)	
Sort_order		tinyint	

tlu_Obs_Distance - List of observation distance midpoints

Field name	*Index/key*	*Data type*	*Description*
Midpoint_m	primary *	smallint	
Distance_code	*	text (25)	

tlu_Origin_Code - List of origin codes for park taxa (standard)

Field name	*Index/key*	*Data type*	*Description*
Origin_code	primary *	text (16)	
Origin_desc		text (100)	
NPSpp_ID		smallint	
Sort_order		tinyint	

tlu_Parks - List of NCCN parks and park codes (standard)

Field name	*Index/key*	*Data type*	*Description*
Park_code	primary *	text (4)	
Park_name		text (50)	

tlu_Park_Taxa - Park-specific attributes for taxa (template)

Index	*Index columns*
Park_origin	Park_origin
Park_status	Park_status
pk_tlu_Park_Taxa (primary)	Taxon_ID, Park_code
Record_status	Record_status

Field name	*Index/key*	*Data type*	*Description*
Taxon_ID	primary (FK)*	text (50)	Taxon identifier
Park_code	primary *	text (4)	Park code
Park_status	indexed	text (16)	Status of the taxon in this park (from NPSpecies)
	Default: "Unknown"		
Park_origin	indexed	text (16)	Origin of the taxon in this park (from NPSpecies)
	Default: "Unspecified"		
Local_list		bit	Indicates that the taxon is the preferred one for use at the park (from NPSpecies)
Local_accepted_TSN		int	Taxonomic serial number of the local preferred taxon (from NPSpecies)
Preferred_sci_name		text (255)	Preferred scientific name of the taxon at the park (from NPSpecies)
Park_taxon_notes		memo	Comments about the taxon specific to this park
Record_status	indexed	text (16)	Indicates the status of the record in terms of synchrony with master databases
	Default: "New record"		
Created_date		datetime	Time stamp for record creation
	Default: Now()		
Updated_date		datetime	Date of the last update to this record
Updated_by		text (50)	Person who made the most recent edits

tlu_Park_Taxon_Status - List of codes for park species occurrence (standard)

Field name	*Index/key*	*Data type*	*Description*
Taxon_status_code	primary *	text (16)	
Taxon_status_desc		text (250)	
NPSpp_ID		smallint	
Sort_order		tinyint	

tlu_Percent_Off_Trail - List of codes for percent of walking distance that was off-trail

Field name	*Index/key*	*Data type*	*Description*
Percent_class	primary *	text (10)	
Class_desc		text (100)	
Sort_order		tinyint	

tlu_Plot_Veg - List of plot vegetation classes

Field name	*Index/key*	*Data type*	*Description*
Plot_veg	primary *	text (10)	
Veg_desc		text (100)	
Sort_order		tinyint	

tlu_Project_Crew - List of personnel associated with a project (template)

Index	*Index columns*
Contact_location	Contact_location
Contact_updated	Contact_updated
First_name	First_name
Last_name	Last_name
Organization	Organization
pk_tlu_Project_Crew (primary)	Contact_ID
Project_code	Project_code

Field name	*Index/key*	*Data type*	*Description*
Contact_ID	primary *	text (50)	Unique identifier for the individual (Lastname_Firstname_MI)
Project_code	indexed *	text (10)	Project code, for linking information with other data sets and applications
Last_name	indexed *	text (24)	Last name
First_name	indexed	text (20)	First name
Middle_init		text (4)	Middle initials
Organization	indexed	text (50)	Employer (e.g., NPS-MORA)
Position_title		text (50)	Position title held by the individual
Email		text (50)	Email address
Work_voice		text (25)	Work phone number
Work_ext		text (5)	Work extension number
Mobile_voice		text (25)	Mobile phone number
Home_voice		text (25)	Home phone number
Fax		text (25)	Fax number
Contact_location	indexed	text (255)	Where the individual is located
Contact_notes		memo	Notes about the contact
Contact_created		datetime	Time stamp for record creation
	Default: Now()		
Contact_updated	indexed	datetime	Date of the last update to this record
Contact_updated_by		text (50)	Person who made the most recent edits
Contact_is_active		bit	Indicates that the contact record is currently available for data entry pick lists
	Default: True		

tlu_Project_Taxa - List of species associated with project observations (template)
Constraints: : ([Taxon_is_active] And [Refers_to] Is Null) Or ([Taxon_is_active]=False And [Refers_to] Is Not Null)

Index	*Index columns*
Accepted_TSN	Accepted_TSN
Category	Category
pk_tlu_Project_Taxa (primary)	Taxon_ID
Project_code	Project_code
Record_status	Record_status
Scientific_name (unique)	Scientific_name
Species_code (unique)	Species_code
Subcategory	Subcategory
Taxon_type	Taxon_type
TSN	TSN

Field name	*Index/key*	*Data type*	*Description*
Taxon_ID	primary *	text (50)	Unique identifier for each taxon
	Default: =Format(Now(),"yyyymmddhhnnss") & '-' & 1000000000*Rnd(Now())		
Project_code	indexed *	text (10)	Project code, for linking information with other data sets and applications
Species_code	unique *	text (20)	Unique field code for each project taxon
Scientific_name	unique *	text (100)	Scientific name of the taxon (from ITIS/NPSpecies)
Common_name		text (100)	Common name for the taxon (from ITIS/NPSpecies)
Pref_com_name		text (100)	Preferred common name for this project
TSN	indexed	int	ITIS taxonomic serial number or a provisional number (from NPSpecies)
Accepted_TSN	indexed	int	ITIS taxonomic serial number of the accepted name for this taxon (from NPSpecies)
Category	indexed *	text (20)	General category of the taxon (from NPSpecies)
	Default: "Unspecified"		
Subcategory	indexed	text (20)	Subcategory specific to the needs of each taxonomic discipline (from NPSpecies)
Authority		text (60)	Taxonomic authority (from ITIS)
Authority_subsp		text (60)	Taxonomic authority for subspecific taxa (from ITIS)
Family		text (60)	Taxonomic family (from ITIS)
Taxon_type	indexed *	text (12)	Indicates the taxonomic resolution and certainty represented by this record
	Default: "Specific"		
Taxon_notes		memo	General notes about the taxon
Created_date		datetime	Time stamp for record creation
	Default: Now()		
Updated_date		datetime	Date of the last update to this record
Updated_by		text (50)	Person who made the most recent edits
Taxon_is_active		bit	Indicates that the record is currently available for data entry pick lists
	Default: True		
Record_status	indexed	text (16)	Indicates the status of the record in terms of synchrony with master databases
	Default: "New record"		
Refers_to		text (50)	Valid taxon the record should refer to for analysis and summaries
Rec_status_notes		text (255)	Notes about the disposition of the record
Project_taxon_notes		memo	Project-specific comments about the taxon

tlu_Recount_Code - List of pellet observation classification codes for dual observers

Field name	*Index/key*	*Data type*	*Description*
Recount_code	primary *	text (2)	
Code_desc		text (100)	
Sort_order		tinyint	

tlu_Site_Status - List of status codes for sampling stations (standard)

Field name	*Index/key*	*Data type*	*Description*
Site_status	primary *	text (10)	
Site_status_desc		text (200)	
Sort_order		tinyint	

tlu_Sky_Code - List of weather condition codes

Field name	*Index/key*	*Data type*	*Description*
Sky_code	primary *	tinyint	
Sky_desc		text (100)	

tlu_Taxon_Category - List of taxonomic categories (standard)

Field name	*Index/key*	*Data type*	*Description*
Category	primary *	text (20)	
Category_desc		text (100)	
NPSpp_ID		smallint	
Sort_order		tinyint	

tlu_Taxon_Rec_Status - List of status codes for taxon records (standard)

Field name	*Index/key*	*Data type*	*Description*
Record_status_code	primary *	text (16)	
Record_status_desc		text (200)	
Sort_order		tinyint	

tlu_Taxon_Type - List of taxon resolution codes (standard)

Field name	*Index/key*	*Data type*	*Description*
Taxon_type	primary *	text (12)	
Taxon_type_desc		text (200)	
Sort_order		tinyint	

tlu_Veg_Type - List of general vegetation types

Field name	*Index/key*	*Data type*	*Description*
Veg_type	primary *	text (10)	
Veg_desc		text (100)	
Sort_order		tinyint	

tlu_Wind_Code - List of wind condition codes

Field name	*Index/key*	*Data type*	*Description*
Wind_code	primary *	tinyint	
Wind_desc		text (100)	

tsys_App_Releases - Application table - Application release history

Index	*Index columns*
pk_tsys_App_Releases (primary)	Release_ID
udx_tsys_App_Releases (unique)	Release_date, Database_title, Version_number

Field name	*Index/key*	*Data type*	*Description*
Release_ID	primary *	text (50)	Unique identifier for the release
	Default: =Format(Now(),"yyyymmddhhnnss") & '-' & 1000000000*Rnd(Now())		
Release_date	unique *	datetime	Date of the release

Database_title	unique *	text (100)	Title of the database
Version_number	unique *	text (20)	Version control number
File_name		text (50)	Filename, used to identify older versions of the database
Release_by		text (50)	Person who issued the release
Release_notes		memo	Release notes, which may include a summary of revisions
Is_supported	*	tinyint	Indicates the support level of this release: 0=user must use a newer version; 1=supported but newer available; 2=full suport, current version
	Default: 2		

tsys_Bug_Reports - Application table - Application bugs and development history

Index	*Index columns*
Fix_date	Fix_date
pk_tsys_Bug_Reports (primary)	Bug_ID
Release_ID	Release_ID
Report_date	Report_date

Field name	*Index/key*	*Data type*	*Description*
Bug_ID	primary *	text (50)	Unique identifier for each bug record
	Default: =Format(Now(),"yyyymmddhhnnss") & '-' & 1000000000*Rnd(Now())		
Release_ID	indexed (FK)*	text (50)	Database release version of the report
Report_date	indexed *	datetime	Date the bug was reported
	Default: =Date()		
Found_by		text (50)	Person who found the bug
Reported_by		text (50)	Person who filled out this bug report
Report_details		memo	Nature of the bug report
Fix_date	indexed	datetime	Date the bug was fixed
Fixed_by		text (50)	Person who fixed the bug
Fix_details		memo	Notes on fix

tsys_Logins - Application table - Log of user access to the database through the front-end

Field name	*Index/key*	*Data type*	*Description*
Time_stamp	primary *	datetime	Time stamp of activity record
	Default: Now()		
User_name	primary *	text (50)	Login name of the user
Action_taken		text (50)	Action taken by the user

tsys_User_Roles - Application table - Determines user access privileges through the front-end

Field name	*Index/key*	*Data type*	*Description*
User_name	primary *	text (50)	Network login
User_role	*	text (50)	Database application role, used to determine the access level

Appendix C: Explanation of Terms on Field Forms

Measurements that are recorded on forms, and their intended use in analysis. For each of the bold-font measurements that staff (or volunteers) are asked to record, the goal of collecting those data is listed to the right, along with any special instructions on how to collect the data. Explanations in italics are meant to clarify possible misinterpretation or ambiguity. Measurements are arranged according to the field form on which they are collected.

Explanation of fields on Walking Time Data Sheet

Start Location	This gives a start point for the travel routes of the day. Circle the place you started walking to the first pellet survey point of the day.
Date	Essential to know what was the season and year of the work.
Observer(s)	Useful for cross-referencing which point data sheets should be associated with this day and these people. *Record the names of everyone in the team of observers here*; typically this is two names.
From point# and **To point#**	All the navigation notes, animals notes, and observations will be associated with a path that is defined by these two places. Observations made en route will not be pinpointed to a particular place. The overall pattern of where elk fecal pellets are recorded in the park does, however, act as a secondary source of data about elk distribution, in addition to the pellet survey points themselves.
Start time and **Stop time**	Planning staff workloads and park budgets requires knowing how long it takes to complete the pellet surveys. Traveling time is a major part of each day during elk pellet surveys, and it is useful to know the average travel time, and also which points require extra travel time. If you take a long break at a point, i.e. for lunch, don't include that break as part of the travel time between Start and Stop.
% Off trail	This measure gets associated with the line segment between the two points. You might choose a direct route between points that is all off trail, or one that is more circuitous but mostly on trail.
Severity of blowdown	This is useful to know for planning future routes to access pellet points. You should choose what percentage of trees were blown down, out of all the trees you passed.
Navigation notes	These can be printed out for future crews that will be traveling to the points, and can be useful for safety and route planning.
Elk pellets	These are signs of elk presence. Only record elk pellets if you are sure they are from elk – do not record deer pellets.
Animal Notes	Not exclusively for elk. You may note about any species of interest can be useful to park resource management, including elk, other mammals, reptiles, amphibians, birds, notable fungi & plants.
Entered by__date__ Verified by__date__ Updated by__date__	"Entered by" is filled in when a person enters the data into computer database. "Verified by" is filled in when a person has confirmed that the data on the sheet were correctly entered into the database. "Updated by" is filled in if a person needs to change values on the data form after the data have been entered in the database.

Explanation of fields on Pellet Data Form

Point #	Essential for associating the observations with the right place. This is the number of the survey point (between 0 and 80)
Date	Essential to know what was the season and year of the work.
Observer name	*Only one person per sheet* should put his / her name on each form. For 2-person teams, surveying a single point requires two data forms, with one form per person. With both sheets, it is clear what two people surveyed that point.
Point Start Time and **Point Stop time**	Planning staff workloads and park budgets requires knowing how long it takes to complete the pellet surveys. Time per point is an important part of those calculations.
Is there a recount observer?	Circling 'yes' means that there was a second person searching for pellets on the two other first count subplots (this is typical). If the observer circles 'no' then it means the other form for this point should have the same observer's name (this would be rare).
Updated Coordinate?	Circle "N" (no) if you are used GPS to navigate to point that already has flags. Circle "Y" (yes) only if you needed to establish the sampling point, including placing flags at the center and at each subplot. If you circle Yes, you should fill in the UTM coordinates, GPS Unit type and ID, and Error.
UTM coordinates	Observers use target UTM coordinates to find the center of the point, but longer GPS data collection usually yields coordinates that are a little different from the target (usually the difference is only several meters). The easting coordinate is a 6-digit number starting with "4." The northing coordinate is a seven digit number starting with "510."
GPS Unit type and ID	If a GPS unit was used to record a file for post-processing, then it is important to know which GPS unit has the file for each point.
Error	The estimated GPS unit precision gives some measure of confidence about the coordinate location for the point center. Different models of GPS unit calculate precision in different ways. Record this in meters.
Point veg type overstory, 9 m	This is used for park records, and to associate pellet counts with general habitat types in the park. It's a description of the overstory (canopy) of the forest, or other dominant vegetation outside of forest.
Point Lighting	This is recorded because lighting levels can pellet visibility. *Record the light level perceived while standing up at point center.*
Point Blowdown	This is useful for park records and because extreme blowdown could make it difficult or unsafe to count pellets that are on the ground.
Top 5 understory plants, species name	Data about understory plants are not used for the pellet counts directly. We collect these data because there might be an association between elk use and understory plant species composition.
Top 5 plants, % of area, % browsed, browse severity	The % of the total area of the point that each understory plant species covers gives some measure of that plant's abundance. The % of those individual plants that are browsed, and the severity of that browsing, give an incidental description of herbivory by ungulates.

SUBPLOT LEVEL RECORDS	
FIRST COUNT (circle which subplot)	The top table on each form is only for the north or south subplot. The middle table is only for the west or east subplot. In all cases, circle the subplot to which the table refers.
RECOUNT (circle one)	The bottom table is only for a recounted subplot. Circling which subplot gets recounted makes the record of which subplot got surveyed by the recount observer.
Subplot Veg	*Choose only one*. This refers to understory veg up to 1 m tall. Taller understory plants are not included, because at the subplot level vegetation type and cover % are recorded only to indicate their potential influence on seeing elk pellets.
Subplot, obscuring veg cover % below 1 m	This is recorded as a variable that may influence the probability of seeing elk pellets. *Do not include moss, lichen, litter, or other material on the forest floor*, because those types of ground cover do not obscure elk pellets.
Comments	A space for you to note other observations at the subplot.
Obs #	One observation is a group of pellets that seem to have come out of one elk at one occasion. Sometimes pellets from a single group can be spread over a wide area. *Do not include deer pellets.* You may note deer pellets in the "Additional Comments" area on the form.
Class 1-4	These classes are based on studies of decomposing elk pellets. Decay category can in some cases be used to bracket the time period from which the pellet s may have come. Class 1 is the freshest, Class 4 is the most decomposed – a full list of the categories is in **SOP 6: Conducting Pellet Counts**, and should be on the printed, laminated Instructions for Elk Pellet Survey. Stepped-upon pellets are harder to classify; remember that decal Class is a measure of *fresh*ness, not *flat*ness.
# clumps	"Clumps" is a term for the larger aggregations of not-fully-pelletized elk fecal matter. Usually clumps have some natural breaks between them, so that a pile might contain several clumps. In counting clumps, there is often no right answer to the question of 'how many?' Consider that clump is about as much volume of fecal matter as 10 pellets would occupy. In analysis, clumps will be given as much weight as 10 pellets. Flattened 'splats' of elk feces are usually best categorized as clumps, with the number of clumps depending on the approximate volume, if you can imagine how many 10-pellet equivalents that splat would represent.
# pellets	Only count the number of pellets that can be seen without disturbing the group. Counting the pellets under the surface layer would disturb the group, and this would change the recounter's chances of seeing the group. Even if you are working alone, only count the number of pellets visible without disturbing the pile.
Time to count this subplot	Include the subplot setup time, if any. For subplot recounts, include the time it takes for you to discuss with your partner what pellet groups were or were not seen.

Entered by__date__ Verified by__date__ Updated by__date__	These three spaces are not for se in the field. "Entered by" is filled in when a person enters the data into computer database. "Verified by" is filled in when a person has confirmed that the data on the sheet were correctly entered into the database. "Updated by" is filled in if a person needs to change values on the data form after the data have been entered in the database.

Explanation of fields on Fall Elk Pellet Clearing Form

Date	This is essential for ordering and organizing observations.
Observer #1 and #2 Name(s)	Name both observers. This can be helpful for later clarification, if there is some question about an observation.
Point #	The point number being cleared.
First Group Clearing, # of Pellet Groups:	For each subplot that gets searched on the first round of counting and clearing, this is the number of elk pellet groups found.
Recount Clearing, # New Pellet Groups:	For each subplot that gets searched on the recount round of counting and clearing, this is the number of elk pellet groups found which were not found by the first person who counted the subplot.
Comments	A space for you to note other observations at the subplot.

Explanation of fields on Driving Survey Data Form

Date	This is essential for ordering and organizing observations.
Driver	The name of the driver. The driver should focus on safe driving.
Observer(s)	List all non-driving observers in the vehicle. This can be helpful for later clarification, if there is some question about an observation.
Coordinate Source	If you are using the Route map, then the Miles.tenths of mile will contain the coordinates; if you are using a GPS unit, then you will need to record the UTM coordinates.
Upper Table, describing the conditions for each route	
Route	Route number here corresponds to the row of data that describe conditions and results of surveying one route.
Start Time and **Stop Time**	Knowing the start and stop time is helpful if there is a question about time for an elk group observation, and to calculate how long each route takes to survey.
Temperature, Wind, Wind Direction, and **Sky code**	These descriptions of the weather conditions have two potential uses. First, weather can influence the probability of seeing animals, so a record of conditions on days when animals are and are not seen is important. Also, they may be helpful for determining what weather patterns are associated with elk movements to various parts of Clatsop plain. Record temperature in degrees Celsius. Record Wind and Sky codes based on the codes listed on the back of the form. Record Wind direction as one of the 8 points of the compass. If weather is only recorded for one route, those values should be entered in the database for all other routes.

Survey completed?	Typically this will be "Yes" for all routes, but it might happen that weather or some other unforeseen incident prevents you from completing a survey. In that case, circle "No." for that route.
Any Elk Seen?	This Yes / No column is a separate place to confirm that elk were either seen or not seen on that route. You must record details about any elk seen in the larger table, below.
Survey Comments	This is a place to write comments that apply to the entire morning of driving, not necessarily specific to any single route or observation.
Lower table, describing single observations	
Route#	This is the route number along which you were driving when you saw the elk group
Obs#	Each elk group should have its own Obs#. All the other data for that group get associated with this identifier. Number these sequentially for the day.
Time	This is the time of day when you first saw the elk. Typically, elk move into cover more as the morning progresses. This record of time could be used in analysis of when elk are seen, relative to the time of sunrise.
UTM East and **UTM North**	Record values here if your "coordinate source" is a GPS unit. These coordinates define the observer's location. Along with azimuth and distance, the coordinates can be used to place the approximate location of the elk group.
Mile.tenth of mile, from map	Record a value here if your "coordinate source" is a Route Map. Along with Route number, the miles.tenth of mile is associated with a location. *Be sure to record the mile.tenth, based on the route map, not based on your odometer.* Odomoter readings may differ from the route map locations for tenths of a mile, and the direction of travel for the route would influence your odometer readings. Along with azimuth and distance, the coordinates can be used to place the approximate location of the elk group.
Total # Elk	This is the most important measure of group size. It includes all elk, including those that observers can put into one of the age / sex categories, and those that observers can not. *In other words, count every animal that you can see in the group.*
# Branch Bulls, **# Spikes** **# Antlerless Adults** **# Calves** **# Unknown**	Out of all the elk in the group, observers should, when possible, try to count how many elk there were in each of these categories. The total of all these categories should add up to the number under **Total # Elk**. Use the Unknown category for animals you aren't sure about. For example, observers might be certain that they saw two branch-antlered bulls in a group, and think that they might have seen three other bulls of unknown antler type. In this case, record "2" under Branch antlered bulls, and "3" under Unknown.
Azimuth and **Distance**	Along with the observers' coordinate location, the angle and distance from the observer to the elk group can lead to an approximate elk group location, based on trigonometry. Azimuth should be in degrees (0° is north, 90° is east, etc…); record azimuth to the nearest degree.

	Distance should be in meters, based on a laser range finder.
Habitat type	This is useful to record because habitat type can influence animal visibility, and also because it can be summarized to indicate the habitat types in which visitors might most frequently be able to see elk. Use one of the codes provided on the back of the form.
Comments	This space provides room for the observer(s) to note special circumstances about a particular observation.

Appendix D: Supplementary Documents

Job Safety Analysis for Off-Trail Field Work

RM-1

JOB SAFETY ANALYSIS: General Field Work Page 1 (inventory & monitoring, resource patrol, specimen collection, invasive species control, revegetation/restoration work), elk pellet surveys, remote camera monitoring	**JOB TITLE:** **DEPARTMENT:** Resource Management **ANALYSIS BY:** **Lynne Johnson, Nancy Eid**	☒ **NEW** 13 December 2000 ☐ **REVISED** **6 March 2009** ☒ **REVIEWED**

Required and/or Recommended Personal Protective Equipment:
Radio, rain gear, condition – appropriate footwear, gloves, head gear, safety vests during hunting seasons, tide table

Sequence of Basic Job Steps	Potential Hazards	Recommended Action or Procedure
• General foot travel	• Tripping, slipping, falling • Stream crossings • Steep terrain conditions • Extreme blowdown areas	• Use caution at all times. Walk carefully, watching footing; wear appropriate boots for conditions. • Avoid carrying excessive weight loads or unbalanced loads. • Carry radios for back-up; switch to LEWI-Megler during pellet surveys. • Avoid slopes >35%. • Use extreme caution traversing blowdown areas; avoid where possible.
• Walking and sampling in wetlands and along river	• Becoming trapped or overtaken by incoming tide • Becoming bogged down in deep mud	• Consult tide tables and plan trips accordingly. • Walk very cautiously on mudflats. • Work with another person as back-up or be in close contact via radio at all times.
• Working outdoors during storms	• Being struck by falling trees or branches • Being struck by lightning	• Be extra cautious in extreme weather conditions. • Postpone work if safety will be compromised by storm conditions. • Carry radio for back-up

Sequence of Basic Job Steps	Potential Hazards	Recommended Action or Procedure
• Working in cougar/bear territory	• General	• Carry a working radio at all times and maintain contact. • Avoid working solo, if possible. • Be especially alert near dawn or dusk.
	• Animal contact/ perceived threat	• Maintain eye contact, face the animal. • Appear larger by standing tall, waving arms. or jacket over your head. • Slowly back away – don't approach. • Radio for assistance.
	• Animal attack	• Never run from a cougar or bear. • Throw things and shout loudly. • Fight back aggressively, aim for eyes and nose.

Appendix E: Analysis of Detection Bias

Revision History Log

Revision Date	Author	Changes Made	Reason for Change

Purpose of this Appendix

This Appendix complements **SOP 11: Data Summary, Analysis, and Reporting**, in describing the analysis that will contribute to the completion of four-year reports. Four-year analysis of proportion of area occupied (PAO) and elk relative use require that monitoring data be prepared by the database for analysis in external software. It is the intent of this Appendix to provide details for certain aspects of the expected four year analysis, and to demonstrate the source of variance estimators for the pellet group detection weighting factors that are applied in the relative use analysis. This Appendix reflects P. Griffin's expectations for the structure of analysis, as of April 1, 2010.

Four-year Data Summarization and Analysis: Pellet Surveys

Estimating PAO for Single Years

As described in **SOP 11: Data Summary, Analysis, and Reporting**, one analytical goal is to estimate, for each year *t*, a single value of PAO for the Fort Clatsop unit, $\widehat{PAO}_t$. To do this, it is also necessary to estimate the function for detection probability, $\hat{p}_{detection,t}$, which is the probability that an observer sees any elk pellets at all in the area that s/he surveys at a point, given that there was one or more pellet groups in those subplots to be seen. Detection by each observer is a binary outcome – detected or not detected. Here we describe an occupancy analysis with use of program MARK (White and Burnham 1999). PAO is analyzed separately for data from each late winter, yielding a separate for $\widehat{PAO}_t$ for each year. The general analytical approach is to fit several different occupancy models (MacKenzie et al. 2006) to the two-observer detection data from each late winter's surveys. Estimates of $\widehat{PAO}_t$ are then based on the model or models that most parsimoniously fit the observed data, where relative parsimony is assessed based on AICc scores (Burnham and Anderson 2002). Software and documentation for program MARK are available at http://www.cnr.colostate.edu/~gwhite/mark/mark.htm.

Preparing Double-observer Occupancy Data for Analysis in MARK

Data from late winter pellet surveys should be formatted as a text file that program MARK can take as input. In that input file, survey data from each point are in a table in which rows correspond to surveyed points. Points that were not surveyed, or which only one observer visited, should not be included in this input file. A column offset by the marker symbols /* and */ encloses text that is not read by program MARK in the analysis, such as year and point number, but which is included in the input file for reference. The first data column read by the program is

of zeros and ones, where a one indicates that the main observer saw one or more pellets at a given point; this detection or non-detection by the main observer could have been in any of the subplots s/he surveyed. The second column is also of zeros and ones, also indicating detection or no detection, but for the second observer. There is no particular importance to the order of the two observers because only one detection function will be estimated collectively for all the observers. There should be no space between the first and second column. The first two data columns are followed by a space, and then a column of ones; this column indicates to MARK that the data in this row represent observations from one point.

Subsequent columns indicate values for covariates that could influence pellet detection at the point level. After a space, the third data column is the midpoint integer in the range of blowdown percentages recorded for the point. Covariate values 0, 2, 15, 50, and 87 correspond to blowdown percentage ranges 0, 1-4, 5-24, 25-75, and 76-100, respectively. After another space, the fourth data column should be a 0 if the point-level light value recorded was "dim" and a 1 is the point-level light value was 'medium' or 'bright.' After another space, the fifth data column should indicate the number of subplots that were counted at the point (1, 2, 3, or 4), which is a measure of survey effort at the point. The last character in each row of data is a semicolon. The names of the covariates described above should be "Blowdown", "Light," and "Effort," respectively. These covariate names are not listed as column headers in the input file itself, but are entered into MARK as covariate names when the input file is entered to create a .dbf file. A database query results in a text file that is in the format that is appropriate for input and analysis of occupancy with program MARK. Example lines from the input file are shown below.

```
/* 2011 0 */ 00        1       15      1       4;
/* 2011 1 */ 10        1       0       1       4;
/* 2011 2 */ 11        1       15      1       4;
/* 2011 6 */ 11        1       87      1       3;
/* 2011 7 */ 01        1       50      0       4;
```

No header text should be included in the input file. The input file should be saved as a text file with the .inp file extension.

Analysis in MARK

As a result of either including or excluding each of the three covariates, there will be eight models in the candidate set that will be fitted to the occupancy data (Table F.1). Each of the candidate models in Table F.1 estimates a single point estimate for $\widehat{PAO}_t$, but the models differ in their estimation of the function for the nuisance parameter, $\hat{p}_{detection,t}$. The covariates are potentially included in a logistic regression equation that describes the detection function because the prevalence of blown down trees, light level, or survey effort might influence either observer's probability of detecting any pellets that are present in surveyed subplots. Each covariate is modeled as an additive effect. There are no interactions between covariates modeled, but some models include more than one covariate.

The Data Analyst should structure the above candidate occupancy models in program MARK, using the parameter index matrix (PIM) and design matrix. Within the PIM, both values of p (detection probability) should be assigned to a single parameter indexing number, 1. Only one function for detection probability is estimated per model because there are such a high number of

observers that it is not feasible to estimate separate detection functions for each individual observer.

Table F.1 Candidate set of eight occupancy models to be fit to observed detection and nondetection data from a single year. In all model names, PAO(.) indicates that the estimate for $\widehat{PAO}_t$ will be a single value that is not a function of any covariate. The covariates included in parentheses after the "p" are included as additive effects for the function that estimates $\hat{p}_{detection,t}$, except that model PAO(.)p(.) has no influence of any covariate on $\hat{p}_{detection,t}$.

Model Number and Name	Number of parameters
1. PAO(.)p(.)	2
2. PAO(.)p(blowdown)	3
3. PAO(.)p(light)	3
4. PAO(.)p(effort)	3
5. PAO(.)p(blowdown+light)	4
6. PAO(.)p(blowdown+effort)	4
7. PAO(.)p(light+effort)	4
8. PAO(.)p(blowdown+light+effort)	5

Psi (ψ) is the Greek letter symbolizing the "occupancy" rate in MacKenzie et al. (2006) and related papers; this is synonymous with what we call PAO in this monitoring protocol. Also using the PIM, the parameter number for Psi should be set to 2. The single parameter for Psi in each model leads to a single point estimate for PAO that applies to the entire Fort Clatsop Unit. The PIM settings are shown in Figure F.1.

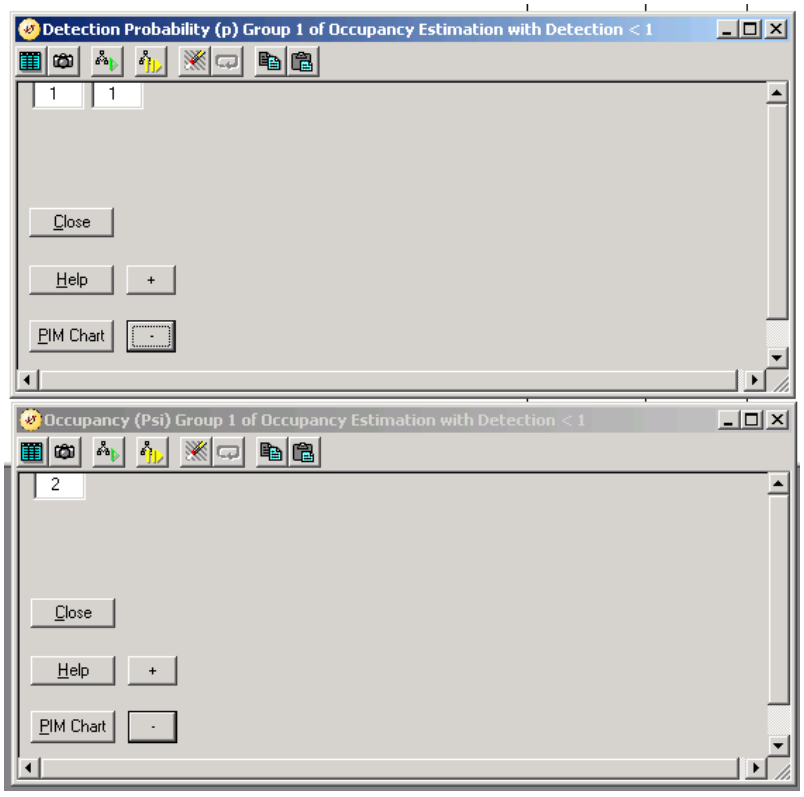


Figure F.1. Example of parameter index matrices to be completed in program MARK for single year occupancy models.

The design matrix window in the software allows the user to specify which covariates are to be included in the model. The Data Analyst should include one parameter column in the design matrix for each of the covariates that is included in the model. The text in that column of the design matrix should be the covariate name. For example, the design matrix for the most highly parameterized model is shown in Figure F.2.

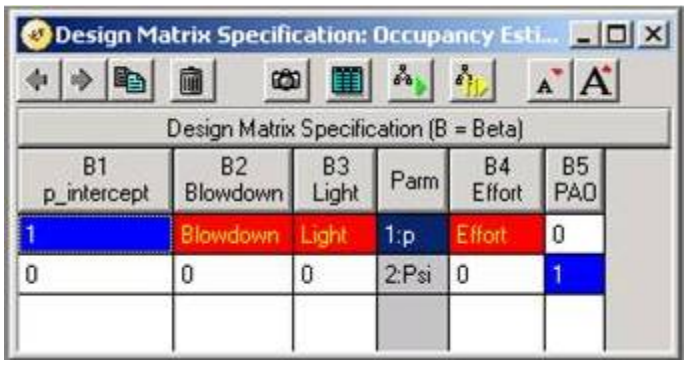
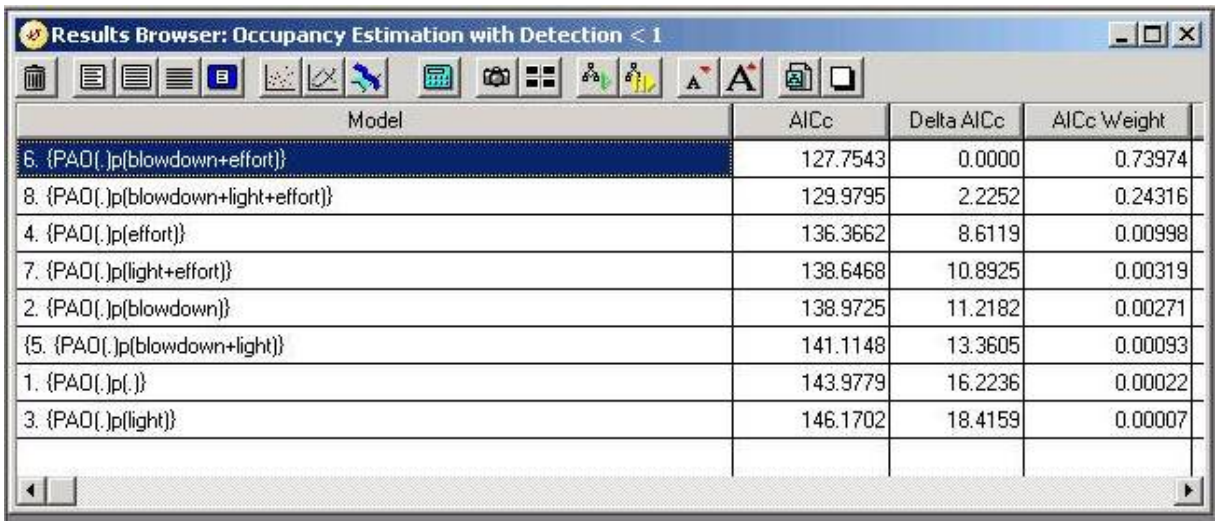


Figure F.2. Example of a design matrix structured in program MARK to reflect the most highly parameterized of the candidate models for occupancy.

Models with covariates should be run using the logit link, without standardizing covariates, and using the variance estimation option based on the second partial derivatives. The exception to those guidelines is that model PAO(.)p(.) should be run using the Sin link.

PAO Estimates for the Fort Clatsop Unit

Estimates for $\widehat{PAO}_t$ should be taken from the highest ranked occupancy model, along with estimates of variance for those parameters. We will choose the occupancy model that most parsimoniously fits the data, based on differences in AICc values (delta AICc, symbolized as ΔAICc), then use model averaging to find the estimate of $\widehat{PAO}_t$. In model averaging, the parameters of interest, including variance estimates, are estimated for each of the models that is included in the averaging, and the parameter values for each model are multiplied by the model's Akaike weight (Burnham and Anderson 2002). Akaike weight, calculated from model likelihood, is an indication of the relative support for each of the averaged models, given the set of models considered. For example, if the hypothetical MARK results table for the eight occupancy models might were as shown in Figure F.3, the low ΔAICc values lead models number 6 and 8 to have the greatest weights in model averaging, as indicated by their AICc Weights of 0.739 and 0.243.



Model	AICc	Delta AICc	AICc Weight
6. {PAO(.)p(blowdown+effort)}	127.7543	0.0000	0.73974
8. {PAO(.)p(blowdown+light+effort)}	129.9795	2.2252	0.24316
4. {PAO(.)p(effort)}	136.3662	8.6119	0.00998
7. {PAO(.)p(light+effort)}	138.6468	10.8925	0.00319
2. {PAO(.)p(blowdown)}	138.9725	11.2182	0.00271
{5. {PAO(.)p(blowdown+light)}	141.1148	13.3605	0.00093
1. {PAO(.)p(.)}	143.9779	16.2236	0.00022
3. {PAO(.)p(light)}	146.1702	18.4159	0.00007

Figure F.3. Example of occupancy model rankings AICc and ΔAICc scores, and AICc Weights. Higher ranked models are higher on the list.

Use the model averaging feature in program MARK to find the model-averaged estimate of $\widehat{PAO}_t$. Select Output => Model Averaging => Derived from the pull-down menu (Figure F.4). In the window that appears next, check the box next to "1" (this refers to the one derived parameter being estimated, namely $\widehat{PAO}_t$), then click on the OK button at the lower right of the window.

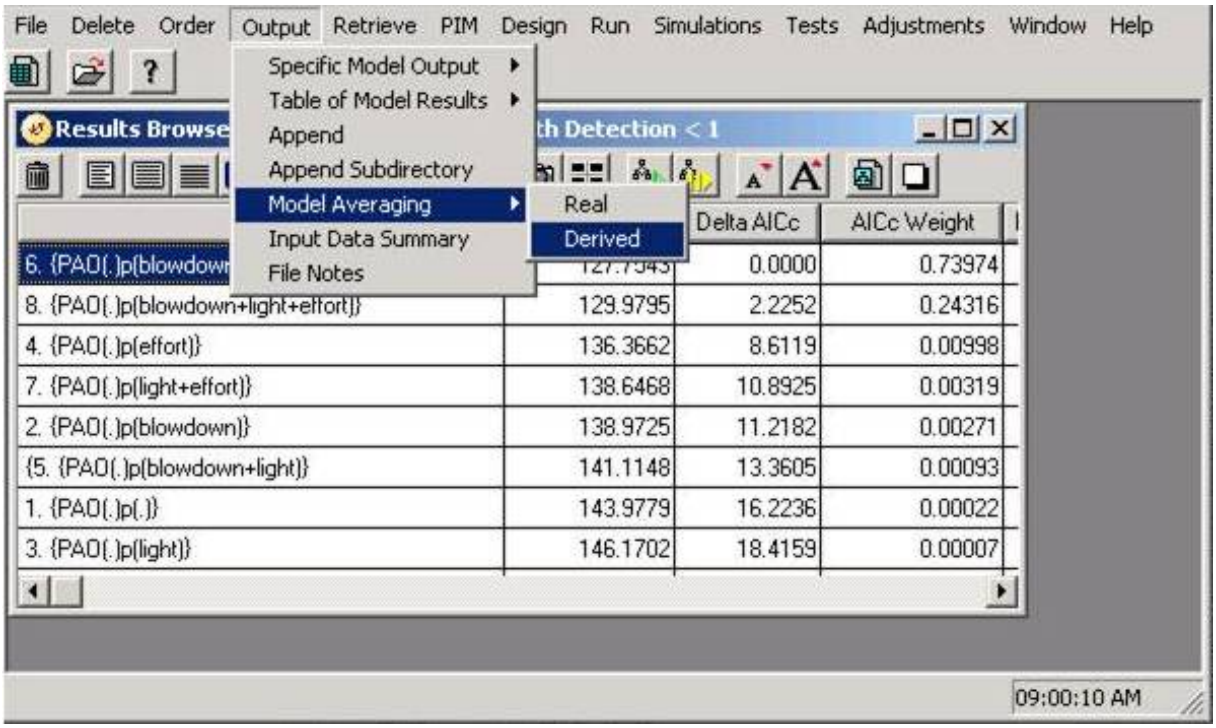


Figure F.4. Example of how to select model averaging to find the value of the derived parameter, $\widehat{\mathrm{PAO}}_t$.

A results window will open, showing the model averaged estimate of $\widehat{PAO}_t$ (Figure F.5). In this window, the value for the weighted average of "Estimate" is the value for $\widehat{PAO}_t$ that should be

recorded for year t; in Figure F.5, this value is in a blue box. The standard error of $\widehat{PAO}_t$ that should be recorded is shown in the results window as the unconditional Standard Error; in Figure F.5, this value is in a dashed black box.

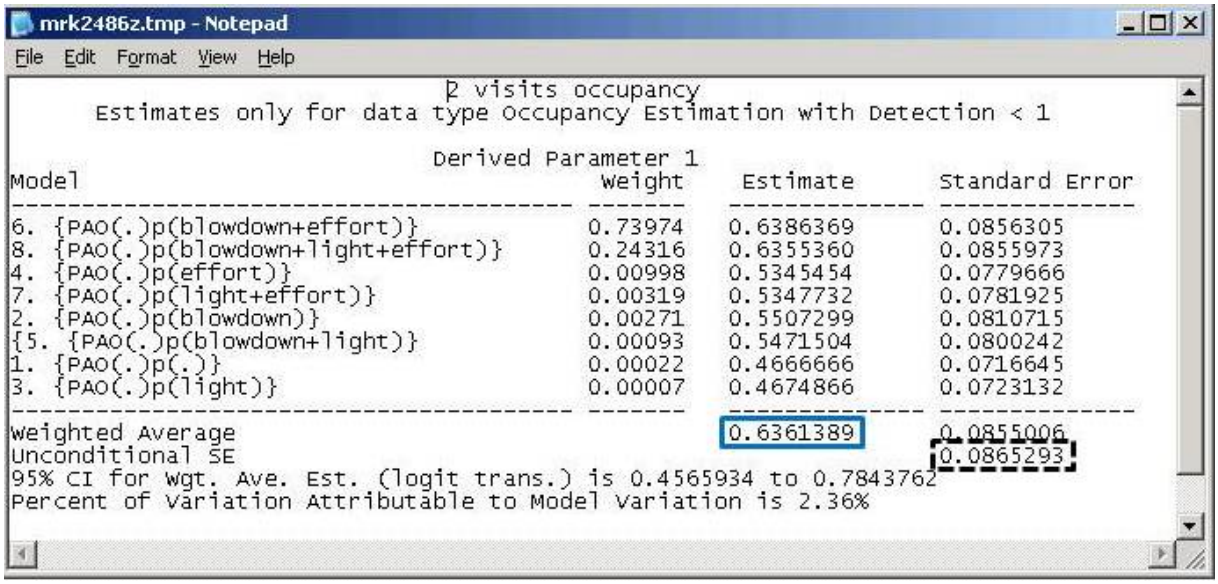


Figure F.5. Example of a results window showing the model averaged estimates of $\widehat{\text{PAO}}_t$ (outlined by a solid blue box) and the standard error of $\widehat{\text{PAO}}_t$ (outlined by a dashed box) .

$\widehat{PAO}_t$ estimates and associated standard error estimates for each of the four years in the reporting period should be presented in a stand-alone table in the four-year report, following the format suggested in Table F.2. The subscript *t* indicates year number. Standard error is the square root of estimated variance. Estimates of $\widehat{PAO}_t$ and $Var(\widehat{PAO}_t)$ should also be recorded in the results table of the database, (tbl_Analysis_Results).

Table F.2 Example of a table that reports estimated values for Proportion of Area Occupied in year t, $\widehat{\text{PAO}}_t$. Parentheses enclose the estimated standard error for $\widehat{\text{PAO}}_t$.

	$\widehat{\mathbf{PAO}}_t$
Late winter 2009	#.# (0.#)
Late winter 2010	#.# (0.#)
Late winter 2011	#.# (0.#)
Late winter 2012	#.# (0.#)

Testing for Trends in Occupancy over Time

All available estimates of $\widehat{PAO}_t$ should be graphed in a linear regression with estimates of ln ($\widehat{PAO}_t$) on the y-axis and year on the x-axis. An estimate of trend should use weighted least squares regression to estimate the slope of the regression line through these points, where each point is weighted according to the inverse of the variance for that year's $\widehat{PAO}_t$ value (Gerrodette 1991). The results of the regression analysis will be estimates for the intercept and slope of the regression line, with an estimate of the variance in the slope (i.e., Skalski et al. 2005, p. 303).

To test for the significance of a trend over time, the Data Analyst should assess whether the estimate of the slope is 'significantly' non-zero, based on the estimate for the slope and for variance of that slope. The test statistic is the quotient of the slope divided by its variance. This statistic should be compared against a t-distribution, with a type one error rate (α) of 0.10 and *n*-2 degrees of freedom, where *n* is the number of point estimates.

Estimating Relative Use

SOP 11: Data Summary, Analysis, and Reporting, describes the rationale for applying weighting factors to observed pellet groups, as well as equations for those weighting factors, in terms of the probability of detecting any given group of pellets, $\hat{p}_{group,j}$, and the variance of that probability, $Var(\hat{p}_{group,j})$. Here we describe the intended analysis that leads to the estimated function for expected values of $\hat{p}_{group,j}$and $Var(\hat{p}_{group,j})$.

Estimating Pellet Group Detection Probability

Estimating the function that most parsimoniously describes $\hat{p}_{group,j}$ can only be done using those pellet groups that were observed in recounted subplots. Four years of such data are pooled for this analysis, so a single pellet group detection function will be estimated for the four-year reporting period, then applied to all pellet groups observed within that reporting period.

Based on the recount codes, each recorded pellet group from recounted subplots is taken as an individual observation that was seen by the first observer, the second observer, or both observers. Also, other covariate data that are potentially related to $\hat{p}_{group,j}$ are associated with each observed pellet group, including the number of pellets and clumps in the group, the percentage of obscuring cover in the subplot, the light level at the time the point was surveyed, and the pellet decay class of the pellet group.

A database query provides the above information (as described in greater detail below) for each pellet group from recounted subplots, in a tabular form that is ready for use as an input file in program MARK. Within MARK, competing Huggins closed captures (1989) type models are structured and tested for parsimony against the recount subplot pellet data. Rather than compiling data at the level of the point, as was the case for estimates of PAO, individual pellet group data from pellet survey recount subplots are used as input for evaluating the competing models. The typical use of a closed population model is to estimate population size, but in this case we estimate the expected detection probability function for $\hat{p}_{group,j}$, then apply the expected values to account for detection bias.

In the text input file, each pellet group that was found in a recounted subplot in the previous four years has its own row of data. The pellet groups to include in this data set are from surveys conducted in either late winter or fall, because we have no *a priori* reason to believe that the function for detection probability would differ between these two time periods. A column, offset by the marker symbols /* and */, encloses descriptions of the pellet group (date, point number, subplot value, and observation number) that are not used in the analysis, but which are kept in the input file for reference.

As with the PAO analysis, the first data column is of zeros and ones, where a one indicates that the first observer did detect that pellet group, or a zero indicates that the first observer did not. The second column is also of zeros and ones, similarly with a one indicating that the recount observer did detect the pellet group or a zero indicates that the recount observer did not. There should be no space between the first column and second column. In terms of the 'recount codes' that observers write for each pellet group, the code B corresponds to values for the first and second columns of 11, the code F corresponds to 10, the code R corresponds to 01, and the code X corresponds to 00. Pellet groups with this last code are *not* included in the analysis; a pellet group must have been detected by at least one of the observers during the survey to be included in the analysis of detection probability. The first two data columns are followed by a space, and then a column of ones; this column indicates to MARK that the data in this row represent observations from one pellet group.

Subsequent columns of the input file are values for covariates that might influence pellet detection. The first covariate, "group_size," is an integer which is the number of pellets in the group, plus ten times the number of clumps in the group. The second covariate, "cover," is an integer value from 0 –100 describing the percentage of cover below 1-m in height that could obscure the view of a pellet group; this is a single value recorded for the subplot. The third covariate, "light," is a dummy variable (zero or one) that indicates light levels measured at the level of the point. *A priori* we will only test for an effect of 'dim' light; that is to say that pellet groups found under 'medium' and 'bright' light levels will be lumped together and will have a value for light of 1, as opposed to pellet groups found under 'dim' light levels, which will have a value for light of 0. Similarly, the final covariate, "decayed," will be a dummy variable where only the most decayed pellet groups (decay class 4) will be contrasted with all other decay classes (1, 2, and 3). Class 4 pellet groups will have a value of 1 for the "decayed" covariate, while all other decay classes of pellet groups will have a value of 0 for the 'decayed" covariate. Spaces separate each covariate in the input file, and there is a semicolon at the end of the data row for each pellet group. Example lines from the input file are shown below.

```
/* 20091101 23 N 1 */ 11     1      13     0      1      0;
/* 20091101 64 E 2 */ 10     1      8      86     1      1;
/* 20100301 06 W 1 */ 11     1      15     1      1      1;
/* 20100303 14 N 2 */ 11     1      87     55     1      0;
/* 20100304 40 S 1 */ 01     1      2      35     0      0;
```

No header text should be included in the input file. The file should be saved in the folder MAa19_elk_LEWI\Analysis\4_year_Relative_use as a text file with the .inp file extension.

Selecting a Model for Pellet Group Detection Probability as a Function of Covariates

As a result of either including or excluding each of the four covariates, there will be 15 models in the candidate set that will be fitted to the pellet data from recounted subplots (Table 12.3). Each covariate is modeled as an additive effect; there are no interactions between covariates modeled. The values of any covariates that are included in a model are multiplied by beta (β) coefficients in a logistic regression. The equation describing the structure of the most highly parameterized model, number 15, p(group_size+cover+light+decayed), includes beta coefficients that are multiplied by the covariate values recorded for each pellet group (Equation F.1). The expectation of this equation is the per-observer probability, between 0 – 1, that pellet group *j* is detected, given the covariate values recorded: group_size_j, cover_j, light_j, and decayed_j. The simpler models include less coefficients in the logit link of the equation, such that in the simplest model only the beta coefficient for the intercept, $\beta 1$, is included.

Equation F.1

$$\hat{p}_{group,j} = \frac{e^{(\beta 1 + \text{group\_size}_j * \beta 2 + \text{cover}_j * \beta 3 + \text{light}_j * \beta 4 + \text{decayed}_j * \beta 5)}}{(1 + e^{(\beta 1 + \text{group\_size}_j * \beta 2 + \text{cover}_j * \beta 3 + \text{light}_j * \beta 4 + \text{decayed}_j * \beta 5)})}$$

Table F.3 Model structure of 15 candidate models to test in identifying which of the candidate models best fits the data for pellet groups seen by one or both of the observers. In each model name, the p refers to $\hat{p}_{group,j}$, which is the per-observer probability of detection by either observer, given the covariates specific to pellet group *j*.

Model Number and Name	Number of parameters
1. p(.)	1
2. p(group_size)	2
3. p(cover)	2
4. p(light)	2
5. p(decayed)	2
6. p(group_size +cover)	3
7. p(group_size +light)	3
8. p(group_size +decayed)	3
9. p(cover+light)	3
10.p(cover+decayed)	3
11.p(light+decayed)	3
12.p(group_size +cover+light)	4
13.p(group_size +light+decayed)	4
14.p(cover+light+decayed)	4
15.p(group_size +cover+light+decayed)	5

The Data Analyst should structure all of the candidate models in program MARK using the software's parameter index matrix (PIM) and design matrix interface. Within the PIM, all values of *p* (initial capture probability) and *c* (re-capture probability) should be assigned to a single parameter indexing number, 1. Because *p*=c in all the models considered, only one function for detection probability is estimated per model. This constraint reflects the assumption that observers are independent, such that the order of survey has no effect on pellet group detection probability. The corresponding PIM windows for *p* and *c* for all models are shown in Figure F.6.

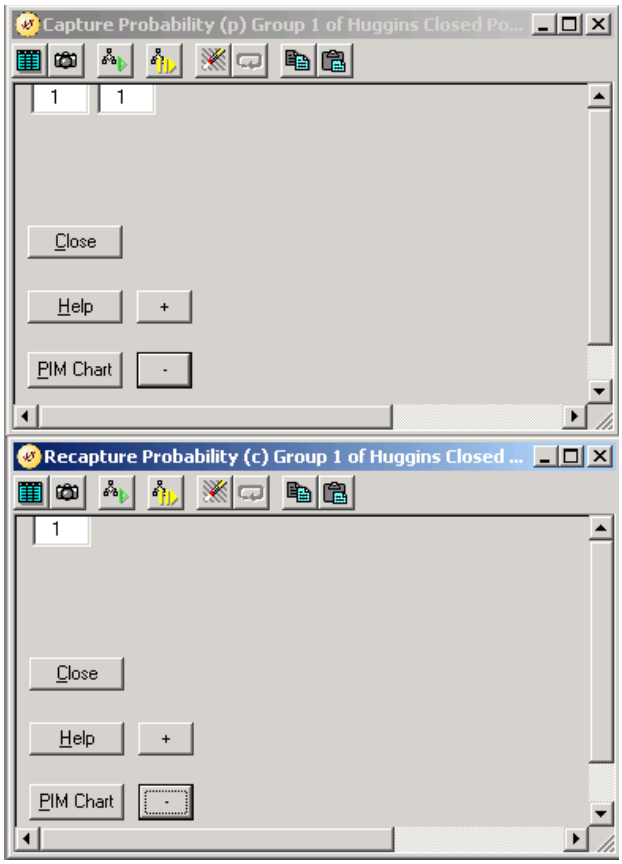


Figure F.6. Example of the parameter index matrices in program MARK for all the candidate models for pellet group detection probability.

The design matrix window in the software allows the user to specify which covariates are to be included in the model. Beta parameters are only estimated for covariates that are included in a model. The design matrix for the most highly parameterized model is shown in Figure F.7. The same column labeling of the design matrix should be included in every model specification, although without the columns for covariates for effects that are not included in the model. For example, Figure F.8 illustrates the design matrix for model number 6, p(group_size+cover)..

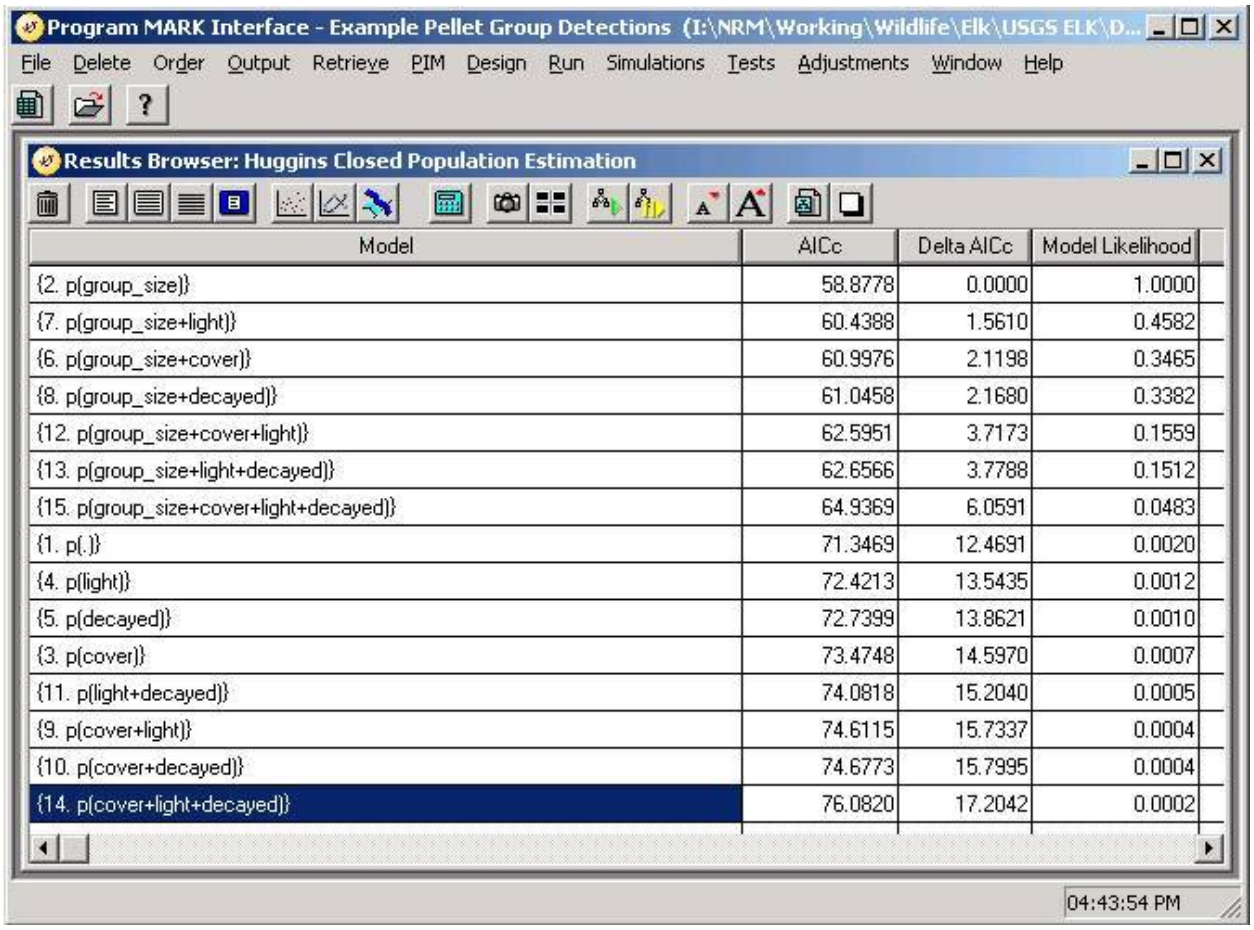
Figure F.7. Example of a design matrix structured in program MARK to reflect the most highly parameterized of the candidate models for pellet group detection probability.

Figure F.8. Example of a design matrix structured in program MARK to reflect the candidate model for pellet group detection probability that includes effects of group size and cover.

Models should be run using the logit link, without standardizing covariates, and using the variance estimation option based on the second partial derivatives. The exception to those guidelines is that model p(.) should be run using the Sin link.

Including all of the possible beta parameters in every model, with consistent numbering, will allow the data analyst to find the model-averaged beta parameter estimates, using program MARK's model averaging function. As with PAO, we use model averaging to estimate detection probability, based on AICc values (Burnham and Anderson 2002). In model averaging, the parameters of interest, including variance estimates, are estimated for each of the models that is included in the averaging, and the parameter values for each model are multiplied by the model's Akaike weight (Burnham and Anderson 2002).

For relative use, only models within ΔAICc values of 4.0 or less are considered when finding the model averaged estimates of the beta coefficients. In the example shown in Figure F.9, only models numbered 2, 7, 6, 8, 12, and 13 would be considered for model averaging. For a given model, *k*, the model's AICc weight is calculated as the model's own likelihood, divided by the sum of the model likelihoods for those models that have ΔAICc values of 4.0 or less. Using the example shown in Figure F.9, the model likelihood for model 7 is 0.4582, while the sum of the likelihoods for models 2, 7, 6, 8, and 12 is 2.8531; as a result, the AICc weight for model 7 in this example would be (0.4582 / 2.45 = 0.187).



Model	AICc	Delta AICc	Model Likelihood
{2. p(group_size)}	58.8778	0.0000	1.0000
{7. p(group_size+light)}	60.4388	1.5610	0.4582
{6. p(group_size+cover)}	60.9976	2.1198	0.3465
{8. p(group_size+decayed)}	61.0458	2.1680	0.3382
{12. p(group_size+cover+light)}	62.5951	3.7173	0.1559
{13. p(group_size+light+decayed)}	62.6566	3.7788	0.1512
{15. p(group_size+cover+light+decayed)}	64.9369	6.0591	0.0483
{1. p(.)}	71.3469	12.4691	0.0020
{4. p(light)}	72.4213	13.5435	0.0012
{5. p(decayed)}	72.7399	13.8621	0.0010
{3. p(cover)}	73.4748	14.5970	0.0007
{11. p(light+decayed)}	74.0818	15.2040	0.0005
{9. p(cover+light)}	74.6115	15.7337	0.0004
{10. p(cover+decayed)}	74.6773	15.7995	0.0004
{14. p(cover+light+decayed)}	76.0820	17.2042	0.0002

Figure F.9. Example of Huggins closed capture model rankings, AICc and ΔAICc scores, and model Likelihoods. In model averaging, model likelihoods are used to calculate Akaike weights for those models with ΔAICc scores less than 4.0.

Find the estimates of the beta coefficients ($\beta 1$, $\beta 2$, $\beta 3$, $\beta 4$, and $\beta 5$) for each of the models with ΔAICc < 4.0 in MARK by selecting Output => Model Averaging => Real from the pull-down menu (Figure F.10).

An example output in Excel showing beta parameter estimates for model number 2 is shown in Figure F.11. The data analyst should follow the same procedure to find the beta parameter estimates for each of the models that have ΔAICc scores of less than 4.0. Then, the values for each beta coefficient should be model-averaged, based on the model Akaike weights for those same models. The model-averaged beta coefficient estimates should be used to find each pellet group's estimated detection probability, according to Equation F.1.

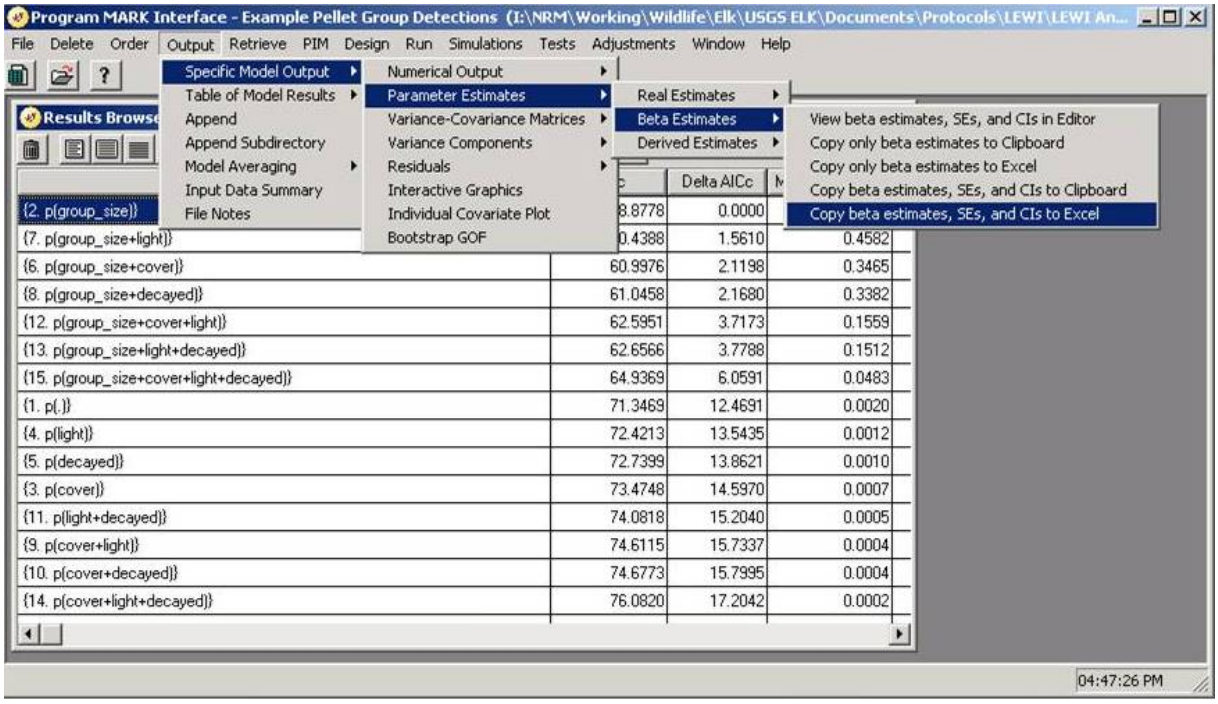


Figure F.10. Example of how to request beta parameter estimates for a selected model in MARK. In this example, model number 2 is selected.

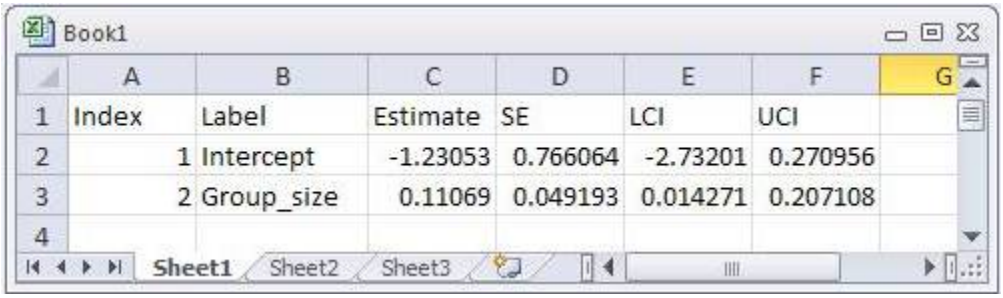


Figure F.11. Example of beta coefficient estimates for a given model, presented in Excel. In this example, the estimate for the intercept coefficient ($\boldsymbol{\beta 1}$) is -1.23053, and the estimate for the group_size coefficient ($\boldsymbol{\beta 2}$) is 0.11069.These parameters are included in model 2.

Adjusting the Pellet Group Counts to Account for Detection Bias

SOP 11: Data Summary, Analysis, and Reporting describes the conceptual justification for two separate weighting factors, one of which is applied to each pellet group, depending on whether the pellet group was found in a subplot that was surveyed by one observer, or by two observers. For subplots that are surveyed by only one observer, each observed pellet group is weighted by $\hat{w}_{j1}$, which is the inverse of its detection probability (Equation F.2).

Equation F.2

$$\hat{w}_{j1} = \frac{1}{\hat{p}_{group,j}}$$

For subplots that are surveyed by two observers, each observed pellet group is weighted by the inverse of the probability that it was detected by at least one observer; the formula for weighting factor $\hat{w}_{j2}$ is shown in Equation F.3.

Equation F.3

$$\hat{w}_{j2} = \frac{1}{1-(1-\hat{p}_{group,j})^2}$$

Delta Method Approximations of Variance for the Weighting Factors

For any continuous function, $u(v(x))$, where u is a function of v, and v is a function that is evaluated at the point x, the delta method (Casella and Berger 1990) approximates the variance of u based on the partial derivative of u, taken with respect to v, and based on the variance of v at point x. Variance at a point can be approximated as the product of the square of the partial derivative of u taken with respect to v, times the variance of v.

The logistic regression equation that describes $\hat{p}_{group,j}$ (Equation F.1) is a continuous function bounded by zero and one. The functions for pellet group weights $\hat{w}_{j1}$ (Equation F.2) and $\hat{w}_{j2}$ (Equation F.3) are also continuous for all non-zero values of $\hat{p}_{group,j}$. These functions are never evaluated at $\hat{p}_{group,j} = 0$, however, because any pellet group that is detected has, by definition, a non-zero detection probability. Therefore, the functions for $\hat{w}_{j1}$ and $\hat{w}_{j2}$ meet the necessary assumption for use of the delta method, in that they are continuous for all values of $\hat{p}_{group,j}$ of interest; we do not evaluate $\hat{w}_{j1}$ or $Var(\hat{w}_{j1})$ for any pellet groups with $\hat{p}_{group,j}$ equal to zero.

Variance estimates for individual pellet group weighting factors reflect uncertainty in the estimation of the detection probability, $\hat{p}_{group,j}$. Variance of the pellet group weight for pellet groups in subplots that are surveyed once is approximated by the delta method as shown in Equation F.4.

Equation F.4

$$Var(\hat{w}_{j1}) = \frac{Var(\hat{p}_{group,j})}{(\hat{p}_{group,j})^4}$$

Equation F.4, derivation

$$Var(\hat{w}_{j1}) = \left(\frac{\partial \hat{w}_{j1}}{\partial \hat{p}_{group,j}}\right)^2 Var(\hat{p}_{group,j}) = \left(\frac{-1}{\hat{p}_{group,j}^{\,2}}\right)^2 Var(\hat{p}_{group,j}) = \frac{Var(\hat{p}_{group,j})}{(\hat{p}_{group,j})^4}$$

Fieberg and Giudice (2008) demonstrated that the variance estimator in Equation F.4 is approximately unbiased unless both $\hat{p}_{group,j}$ is small (i.e., $\hat{p}_{group,j} << 0.5$) and n_s, the number of data points used to estimate $\hat{p}_{group,j}$, is also small (i.e., $n_s < 100$). Our preliminary data and supporting literature suggests that $\hat{p}_{group,j}$ will generally exceed 0.5 (Jenkins and Manly 2008). Moreover, during any four year analysis period, we will be working with sample sizes >100 observations.

Variance of the pellet group weight for pellet groups in subplots that are surveyed twice is approximated by the delta method as Equation F.5. The derivation of this variance estimator is presented in Table F.4.

Equation F.5

$$Var(\hat{w}_{j2}) = \frac{4(1-\hat{p}_{group,j})^2 Var(\hat{p}_{group,j})}{\left[1-(1-\hat{p}_{group,j})^2\right]^4}$$

Table F.4 The table below leads to the estimator for $Var(\hat{w}_{j2})$, based on the definition of $\hat{w}_{j2}$ in Equation F.3. Functions are listed in the left hand column, and variance for those functions are shown or derived at right. The function $p(\mathbf{x}_j)$ describes the detection probability of the *j*th group of pellets, $\hat{p}_{group,j}$, given a vector of associated covariates, $\mathbf{x}_j$. Expected values for $\hat{p}_{group,j}$and $Var(\hat{p}_{group,j})$ can be estimated directly from the highest ranked model (or model-averaged models) for pellet group detection probability, and are substituted into the final row of the table below to obtain $\hat{w}_{j2}$ and $Var(\hat{w}_{j2})$ in terms of $\hat{p}_{group,j}$and $Var(\hat{p}_{group,j})$.

Function	Variance
$p(\mathbf{x}) = \hat{p}_{group,j}$	$Var\left(p(\mathbf{x_j})\right) = Var(\hat{p}_{group,j})$
$f(p) = 1-p$	$Var(f(p)) = \left(\frac{\partial f}{\partial p}\right)^2 Var(p) = (-1)^2 * Var(p) = Var(p)$
$g(f) = f^2 = (1-p)^2$	$Var(g(f)) = \left(\frac{\partial g}{\partial f}\right)^2 Var(f) = (2f)^2 * Var(f) = 4(1-p)^2 Var(p)$
$h(g) = (1-g) = [1-(1-p)^2]$	$Var(h(g)) = \left(\frac{\partial h}{\partial g}\right)^2 Var(g) = (-1)^2 * Var(g) = 4(1-p)^2 Var(p)$
$w_{j2}(h) = \frac{1}{h} = \frac{1}{\left[1-(1-\hat{p}_{group,j})^2\right]}$	$Var\left(w_{j2}(h)\right) = \left(\frac{\partial w_{j2}}{\partial h}\right)^2 Var(h) = \left(\frac{-1}{h^2}\right)^2 Var(h) = \left(\frac{1}{[1-(1-p)^2]^2}\right)^2 * 4(1-p)^2 Var(p) = \frac{4(1-\hat{p}_{group,j})^2 Var(\hat{p}_{group,j})}{\left[1-(1-\hat{p}_{group,j})^2\right]^4}$

Relative Use Estimates for Each Point, and for the Fort Clatsop Unit

SOP 11: Data Summary, Analysis, and Reporting describes the conceptual approach to calculating the relative use estimates for each point, and for the Fort Clatsop unit. Estimates for relative use for the Fort Clatsop unit, $\hat{G}_{mean,t}$, and its associated variance, $Var(\hat{G}_{mean,t})$, should be presented in a stand-alone table in the four-year report after the format suggested in Table F.5. estimates of $\hat{G}_{mean,t}$ and $Var(\hat{G}_{mean,t})$ should also be recorded in the results table of the database, (tbl_Analysis_Results).

Table F.5 Example of a table that reports estimated values for the mean value of relative use in the Fort Clatsop unit in year t, $\hat{G}_{mean,t}$. Parentheses enclose the estimated standard error for $\hat{G}_{mean,t}$.

	$\hat{G}_{mean,t}$.
Late winter 2009	#.## (0.#)
Late winter 2010	#.## (0.#)
Late winter 2011	#.## (0.#)
Late winter 2012	#.## (0.#)

Testing for Trends in Relative Use over Time

The four-year analysis should include a test for increasing or decreasing trend in $\hat{G}_{mean,t}$. As with PAO, the regression line to fit to the $\hat{G}_{mean,t}$ values should be weighted according to the inverse of the variance for each year's point estimate (Gerrodette 1991), $Var(\hat{G}_{mean,t})$.

Interpolating Estimated Relative Use, and Trends in Standardized Relative Use

Point estimates for $\hat{G}_{i,t}$ will be interpolated across the Fort Clatsop unit to map the prevalence of elk use across the unit in year t. At this time, the intent is to interpolate using the inverse distance weighting (IDW) method calculates values for every pixel, *z*, based on the weighted contributions from surrounding points. For example, in the Equation F.6, the interpolated value for $\hat{G}(z)$ is given as a function of the k=12 closest surveyed points.

Equation F.6

$$\hat{G}(z) = \frac{\sum_{k=0}^{12} w_k(z)\hat{G}_{i,t}}{\sum_{k=0}^{12} w_k(z)}$$

The weights, w_k, for each of the 12 contributing point values are the inverse of the squared distance between the position of pixel *z* and point *i* (these weights have no relation to the pellet group weights that account for detection bias). For this equation, 250 meters is a 'distance' of one unit – therefore, a surveyed point that is 500 m away from pixel *x* contributes ¼ as much as a surveyed point that is only 250 m away. The IDW analysis in ArcGIS Spatial Analyst uses the $\hat{G}_{i,t}$ values as the z-value field of input points with known value. The power of the weighting should be set to 2, representing inverse squared weighting. Use a 50 m cell size, so that interpolated values apply to ¼ ha areas. The variable search radius of up to 1000 m should include the 12 closest points for which values of $\hat{G}_{i,t}$ are available. An example of interpolated relative use, based on preliminary estimates of relative use and based on the IDW method as described above is shown in Figure F.12.

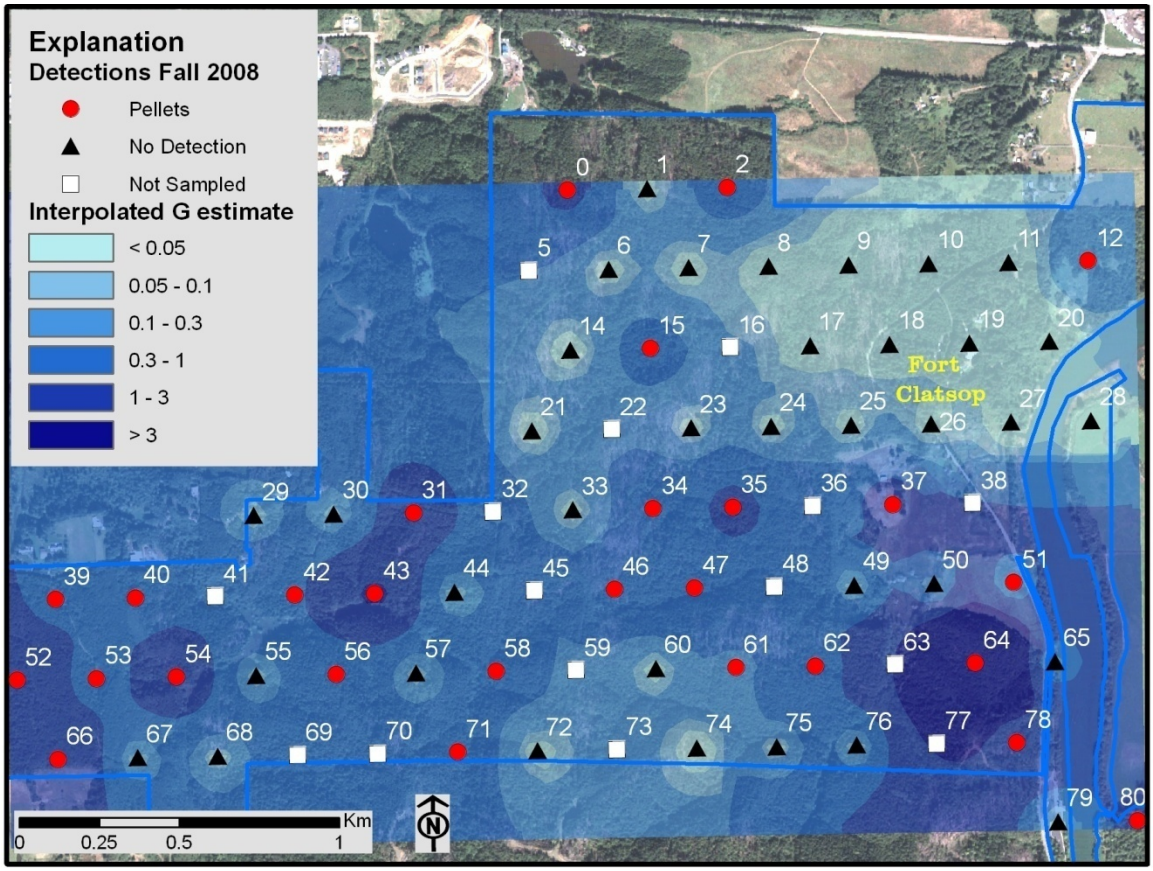


Figure F.12. Example figure of estimated number of pellets per subplot at intermediate points, $\widehat{\mathbf{G}}(z)$, interpolated from estimates of $\widehat{G}_{i,t}$ at the surveyed points. This figure was based on preliminary results from Fall 2008, and does not portray any results that would be in a four-year report. Symbols indicating pellet detection are overlaid for illustrative purposes. The intensity of blue color is a measure of the interpolated $\widehat{\mathbf{G}}(z)$ values. Yellow text indicates the vicinity Fort Clatsop and the visitor center.

SOP 11: Data Summary, Analysis, and Reporting includes guidelines for calculation of standardized relative use at each point, $\widehat{U}_{i,t}$, and for assessing spatial changes in that measure. The intended method of interpolation for the slope of trends in relative use, Slope_U_i, is the same as for interpolation of $\widehat{G}_{i,t}$; that is, using the 12 closest points, and weighting by the inverse square of distance. As part of the interpolated map of change in standardized relative use, the Data Analyst and GIS Specialist may choose to associate a layer that indicates the level of statistical significance (i.e., P-value) for each of the slope estimates for surveyed points.

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Appendix F: Administrative Record

Overview

The following administrative history briefly summarizes key steps, meetings, and documentation associated with the development of elk monitoring protocols for Lewis and Clark National Historical Park. The associated documents are stored in the project folder: \Documents\Protocols\Administrative_Record.

Choosing and Prioritizing Vital Signs for Long-Term Ecological Monitoring

In several stages, individual parks of the North Coast and Cascades Network (NCCN) identified topics (vital signs) and priorities for ecological monitoring. In the first stage, parks held 'Vital Signs' workshops during which each park identified and justified a list of potential vital signs and their associated monitoring questions. Three parks in the Network, including Lewis and Clark National Historical Park, Mount Rainier National Park, and Olympic National Park identified elk monitoring as a high monitoring priority. For a more complete summarization of the process used to identify and prioritize Vital Signs see Weber and others (2009).

Despite high ranking of elk monitoring by three individual parks, funding limitations, the expense of elk monitoring, and higher priorities delayed the initial development of elk monitoring protocols relative to others in the Network. Two critical reviews of the NCCN monitoring program provided impetus leading to the development of this elk monitoring program. On 24-25 May 2005, the Network convened a scientific panel to review the draft monitoring plan, and make recommendations on how to allocate available funding. The Panel recommended increasing funding for elk monitoring due to the high management concern, public interest, and strong ecological effects of elk in park ecosystems (Anonymous, 2005).

In 2007, the NPS Inventory and Monitoring Program and the USGS Status and Trends Program joined in conducting an interagency operational review of the Network's monitoring program to identify the status of ongoing monitoring programs funded by the Network, to review the status of USGS involvement working with the Network in developing monitoring protocols, and identify any unmet protocol development needs. One key outcome of the meeting was the recommendation to proceed with funding the development of elk monitoring within the Network (Anonymous, 2007). This protocol for monitoring elk in Olympic and Mount Rainier National Parks is a direct outcome of that decision and subsequent commitments of funding by both the USGS Status and Trends Program, the NCCN and tribal and state partners.

Also in 2007, the Network ranked all protocols as belonging to either a Tier-1 of protocols that would be guaranteed funding at the highest priority, or to Tier-2 protocols that would be funded provisionally as funding allowed. In April of 2008, the Network's Board of Directors approved elk monitoring as a Tier-2 protocol. Although this limited both the amount of funding available and the security of long-term funding, the NCCN made the decision to move forward in developing this monitoring protocol. The Wildlife working group of the NCCN decided to develop this ground-based pellet and road survey protocol for implementation in Lewis and Clark National Historical Park and an aerial survey protocol for implementation in Mount Rainier and Olympic National Parks.

Scientific Scoping and Proposals

In June 2007, the USGS and the National Park Service jointly hosted a workshop to review elk monitoring methods that have been used in NCCN parks, and to provide suggestions for future monitoring development. We invited a panel of six elk monitoring specialists and biometricians, as well as over 20 elk monitoring practitioners from the NCCN parks and cooperating Indian Tribes and Washington Department of Fish and Wildlife. Each of the workshop participants was provided general information on the Network's monitoring program and specific information on historical and current elk monitoring procedures used in each of the Network Parks. Each of the workshop participants provided a written set of recommendations for future elk monitoring in the Network Parks, which were summarized in a memo to the National Parks (Jenkins, 2007), and which provided the basis for proposal development.

In August 2007, we also submitted a proposal to the USGS Status and Trends Program, National Parks Monitoring Project, to support this protocol development from 2008 to 2010 (Jenkins et al., 2007). That proposal was awarded funding for Fiscal Years 2008-2010 which, combined with funding from the Network, fully funded this protocol development and testing beginning in 2008.

Protocol Development

Over July 8-9, 2008 we conducted a meeting at LEWI of USGS coauthors and LEWI superintendent and staff, to reach consensus on survey design and methodologies, and to coordinate logistics for upcoming fecal pellet surveys and road surveys. This was the first of many ongoing face-to-face meetings about survey design and method refinement; subsequent meetings at LEWI often took place coincident with pellet survey sessions (Table G.1). A much greater number of additional meetings between coauthors regarding survey design, methods, database design, and protocol drafting took place via telephone, electronic communication, and at Olympic National Park, where coauthors Boetsch, Griffin and Jenkins, and GIS Specialist Beirne work.

Table G.1 Dates of in-person meetings between protocol coauthors that took place at LEWI.

Dates	Activities
June 8-9, 2008	Initial meeting to discuss methods.
October 22 - 23, 2008	Preparation for first pellet session; field form refinement
November 12 - 19, 2008	Pellet survey; methods refinement
February 27 - March 5, 2009	Pellet survey; methods refinement
November 8 - 13, 2009	Pellet survey; methods refinement
February 28 - March 4, 2010	Pellet survey; methods refinement
October 24 - 26, 2010	Pellet survey; methods refinement

Key steps in chronicling the protocol development were the preparation of a protocol development summary (Anonymous, 2005), revision of the protocol development summary (Anonymous, 2010), a protocol monitoring brief (Anonymous, 2009), notes from biennial meetings with project participants, and annual progress reports submitted to the USGS Status and Trends Program, National Parks Monitoring Project (Jenkins and Griffin, 2008; Griffin and Jenkins, 2009, 2010).

Protocol Review and Revision

The protocol was reviewed by all of the authors, by Olympic National Park Wildlife Branch Chief Patti Happe, and by NCCN Inventory and Monitoring Program Manager Mark Huff before submission to peer review in June, 2010. Peer review was managed by the NPS Pacific West Region Protocol Review Coordinator James Agee, and included reviews by three anonymous independent peer reviewers and by the NPS Regional Inventory and Monitoring Program Manager Penelope Latham. Protocol authors received the review comments in January 2011 and resubmitted the revised protocol in March 2011. Protocol authors received review comments indicating that the protocol needed only minor revision in May 2011, and returned a letter listing those revisions in June 2011. The protocol was accepted by the Review Coordinator in July 2011.

References Cited and Associated Unpublished Documents

Most of the documents in the list below are not published references, but are stored in the project's \Documents\Protocols\Administrative_Record folder.

Anonymous. 2005. NCCN Draft monitoring protocol summary; Elk monitoring. Unpublished draft made by the NCCN Wildlife Working Group, on file at Olympic National Historical Park, Port Angeles, WA.

Anonymous. 2005. Recommendations of the Scientific Review Panel, May 25, 2005. Unpublished memo on file at Olympic National Park, Port Angeles, WA. Memo provided summary of panel recommendations.

Anonymous. 2007. 3-Year start-up review of the North Coast and Cascades Inventory and Monitoring Network: Report and recommendations by the interagency review panel. Unpublished report on file at Olympic National Park, Port Angeles, WA. Report provided summary of panel recommendations.

Anonymous. 2009. Elk populations resource monitoring brief. Internet document: http://science.nature.nps.gov/im/units/nccn/Reports/Resource_briefs/elk_brief.pdf (accessed February 10, 2011)

Anonymous. 2010. Protocol development summary—Lewis and Clark National Historical Park elk. Unpublished report on file at Lewis and Clark National Historical Park, Arcata, OR.

Griffin, P. and K. Jenkins. 2009. Protocol development for the North Coast and Cascades Network: Elk monitoring accomplishments FY09, Proposal FY10. Unpublished manuscript on file at Olympic National Park, Port Angeles, WA. Annual progress report provided to USGS Status and Trends Program, National Parks Monitoring Project.

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