National Park Service
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Natural Resource Stewardship and Science

Lewis and Clark National Historical Park
Elk Monitoring Program Annual Report 2010

Natural Resource Technical Report NPS/NCCN/NRTR—2012/531

ON THE COVER
Roosevelt elk, *Cervus elaphus roosevelti*, in the vicinity of the Fort Clatsop unit of Lewis and Clark National Historical Park.
Photograph by: Paul Griffin, US Geological Survey

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Carla Cole

National Park Service
Lewis and Clark National Historical Park
92343 Fort Clatsop Road
Astoria, OR 97103

Paul Griffin, Kurt Jenkins

US Geological Survey
Forest and Rangeland Ecosystem Science Center
Olympic Field Station
600 East Park Avenue
Port Angeles, WA 98362

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This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data. Data in this report were collected and analyzed using methods based on a protocol that is currently in peer review, and were analyzed and interpreted within the guidelines of that protocol.

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Executive Summary

Fiscal year 2010 was the second full year of elk monitoring protocol implementation at Lewis and Clark National Historical Park (LEWI), part of the North Coast and Cascades Network (NCCN) Inventory and Monitoring program. Elk monitoring at Lewis and Clark NHP includes two components. Fecal pellet surveys at a systematic sample of points in the Fort Clatsop unit are intended to give quantitative estimates of relative use by elk in that unit. Driving surveys on specified routes in and near the Fort Clatsop unit are intended to provide an index of elk viewing opportunities on those roads.

Fecal pellet surveys include a fall clearing session and a late winter sampling session. Fall clearing from November 9 to November 17, 2009 included visits to 67 survey points. Late winter sampling from March 1 to March 8 2010 included repeat visits to 65 of those same points, but not to two others that had hazardous access or were under water. We detected elk fecal pellets in 30 points in the fall and at 30 points in the late winter.

Three to four road surveys per month were conducted in each of the 12 months of fiscal year 2010 (i.e., October-December 2009 and January-September 2010). Data from those surveys will be entered, validated, certified, and analyzed following the acceptance of the peer-reviewed protocol and associated database.

Data from FY09, FY10, and FY11 will be useful in the formal analyses of trend. Those three years of data will contribute to the preparation of a four-year analysis and report after only one more year. Quantitative estimates of relative use by elk throughout the Fort Clatsop unit will be provided in the four-year report in 2012. Those estimates will account for detection bias, which comes from an incomplete count of elk pellets that were present in the subplots at the time of survey.

Acknowledgments

We thank the 2010 crew members for their help in collecting the data that contributed to this report: S. Bishop, Z. Bolitho, J. Smith, R. Stokeld, B. Gerttula, M. Holmgren, M. Huff, N. Eid, L. Johnson, D. Graham. We thank K. Beirne for assistance and technical support with GIS and J. Boetsch for help with data management. We thank M. Liang for photography and videography during February and March 2010.

Introduction

Monitoring trends in the use of Lewis and Clark National Historical Park by elk (*Cervus elaphus*) is a high priority of the North Coast and Cascades Network (NCCN) Inventory and Monitoring program. The preservation of elk herds that frequent Lewis and Clark NHP is central to the park's purpose "to preserve… the historic, cultural, scenic, and natural resources associated with the arrival of the Lewis and Clark Expedition in the lower Columbia River area, and … 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…" (Public Law 108-387). 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 schoolchildren participated in interpretive education at the Fort Clatsop unit in 2008; 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.

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. These latter 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.

Broadly stated, 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 (Griffin et al. in review).

The specific objectives of the Lewis and Clark NHP elk monitoring protocol are:

- **Objective 1**: Monitor trends in relative use by elk in the Fort Clatsop unit. The protocol quantifies the amount of relative use by elk in winter through the estimation of pellet group density, as measured during late winter surveys each year

- **Objective 2**: Monitor the proportion of area occupied by elk in the Fort Clatsop unit. The protocol monitors the proportion of area occupied (PAO), based on fecal pellet groups detected during late winter surveys each year.

- **Objective 3**: Monitor viewing opportunities, in terms of the rate at which elk groups are sighted during roadside surveys.

This report and subsequent annual reports for the Lewis and Clark NHP elk monitoring program are intended as administrative reports, in which raw data from the year are presented without extensive analysis. Four-year reports provide more comprehensive analysis of the data, including quantified estimates of relative use that accounts for detection bias, and estimates of trend over time in PAO and viewing opportunities. The next four-year report is expected to be completed along with the annual report for 2012.

Study Area

Lewis and Clark National Historical Park was created by an act of Congress in 2004. This NHP includes several units that are primarily administered by the National Park Service or by the Oregon Department of Parks and Recreation. Historical place, artifacts, and activities related to the Corps of Discovery play an important role in the park's mission.

The natural context of Lewis and Clark NHP are the coastal ecosystems of northwest Oregon and southwest Washington, near the mouth of the Columbia River. These ecosystems include sandy and rocky beaches, estuaries, coastal uplands, tidal wetlands, freshwater wetlands and forest. Almost all forests in the region have been harvested one or more times since 1805. A significant windstorm in fall 2007 caused widespread areas of windthrown trees (also known as 'blowdown') on much of the Fort Clatsop unit and on commercial and private lands nearby. The park has a forest management plan that aims to restore historical forest structure and function (NPS 2011).

Pellet survey and road survey activities in this protocol center on the Fort Clatsop unit of the park. This unit includes a reconstruction of the original Fort Clatsop and was a central point for the Corps' elk hunting activities. Elk continue to be active in the forests, wetlands, and meadows of the Fort Clatsop unit and the nearby environs.

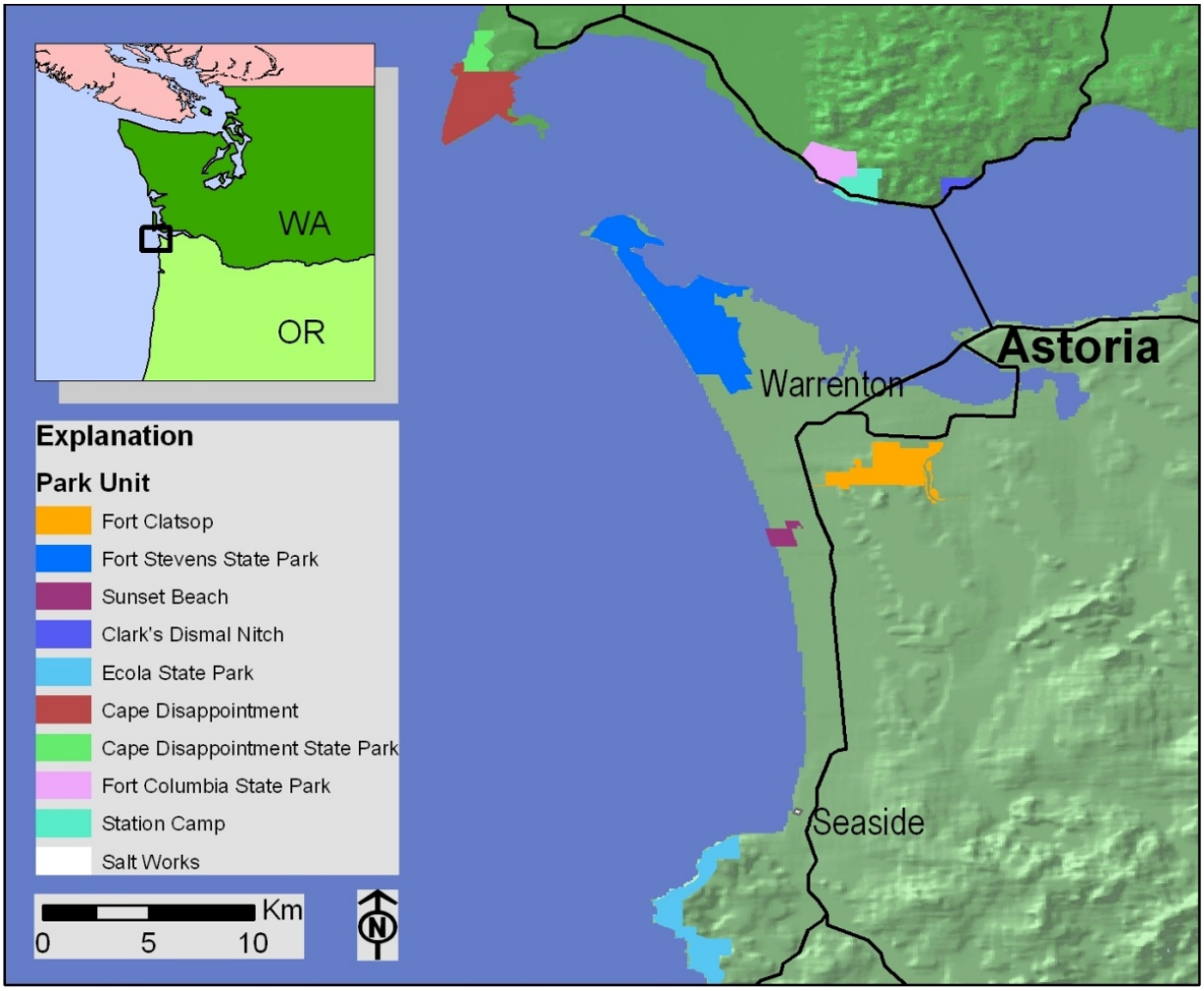

Figure 1. Map of Lewis and Clark National Historical Park units. The upper left inset map shows Lewis and Clark National Historical Park in the regional context of Oregon (OR, light green in inset), Washington (WA, dark green in inset), and Canada (light red in inset). The larger map shows Lewis and Clark National Historical Park units and nearby 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.

Methods

Sample Design

A legitimate sampling frame is required for valid inferences about trends in relative use or PAO estimated from fecal pellet surveys. The sample frame was designed so that we can make inferences about trends for the entire area of the Fort Clatsop unit of Lewis and Clark NHP: we sample pellet groups at a systematic grid of survey points, spaced 250 m apart (Figure 2).

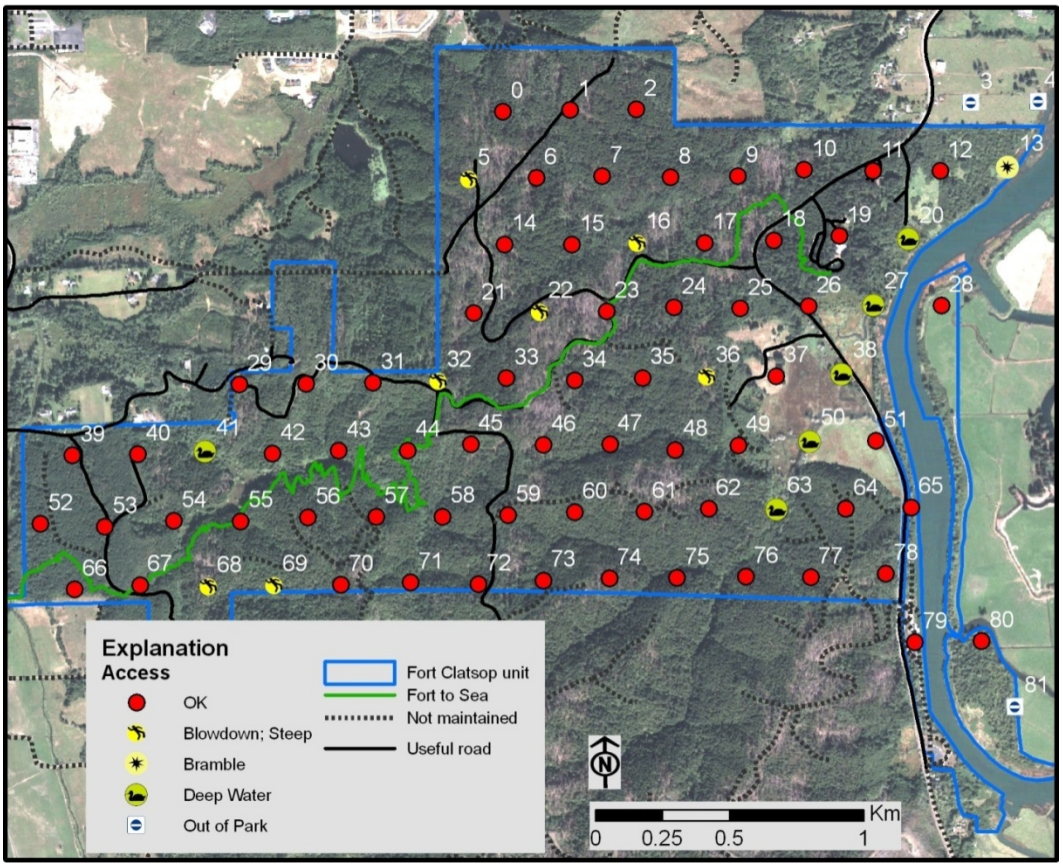

Figure 2. Map of pellet points sampled in FY2010 in the Fort Clatsop Unit. Points labeled with a red dot are accessible and should be visited once per survey session. Points with yellow symbols are inaccessible, unsafe, or under water. The satellite imagery is from September 2008 (Digital Globe Inc.); mottled brownish areas within the forested part of the Fort Clatsop unit indicate areas of windthrown trees caused by a windstorm in 2007.

There are 82 points in the sample frame, numbered zero to 81, however several have been excluded due to access constraints. Eight points have been excluded because they have slopes over 35 degrees, and/or have extreme tree blowdown or blackberry brambles, five because they are always submerged or are tidally submerged, and three are actually outside the park boundaries. One of the blowdown points (#68) and one of the submerged points (#27) were visited in fall 2009, but were excluded from the sample frame after that visit. As a result, 65 points comprise the current sample (Figure 2), 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. At each point there are four 3-m radius subplots in which pellet groups are counted.

Pellet Surveys

In each fiscal year there is a fall clearing session in early November, and a late winter survey session during late winter, in late February to early March. The fall clearing session is necessary, so that all the subplots are cleared of pellets. We will not make conclusions about relative use or PAO based on data from the fall clearing session. The reason that any inference from the fall is limited is that 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. For example, during the ~200 day time between the preceding late winter survey session and the fall clearing session, pellets might have a tendency to decay rapidly on some points (i.e., in warm, wet places) more than others (i.e., dry places). As a result, pellets that are present in the fall clearing session are a result of 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.

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 clearing session. Pellets are cleared in the late winter session, so that there is no chance that they will be counted again in the future.

Sampling methods in FY 2010 were identical for fall and late winter pellet group sampling sessions. Two-person teams conduct pellet surveys at points throughout the Fort Clatsop unit. Team members record their departure time from a vehicle or building on the Walking Time Data Sheet. This sheet is also where they 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. Starting in FY2012, methods used in fall clearing sessions are less time consuming than in late winter sampling sessions (Griffin et al. in review).

The team navigates to the survey points. Four 3-m radius subplots are centered 6 m from the point, at the cardinal directions (Figure 3). Team members record general attributes that might influence elk use or pellet detectability within the 9-m radius plot such as vegetation characteristics, lighting conditions, and the amount of blowdown. 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). Within the four 3-m radius subplots, observers record subplot attributes that are potentially related to pellet group detection, such as vegetation cover below 1 m height that would obscure views of pellets.

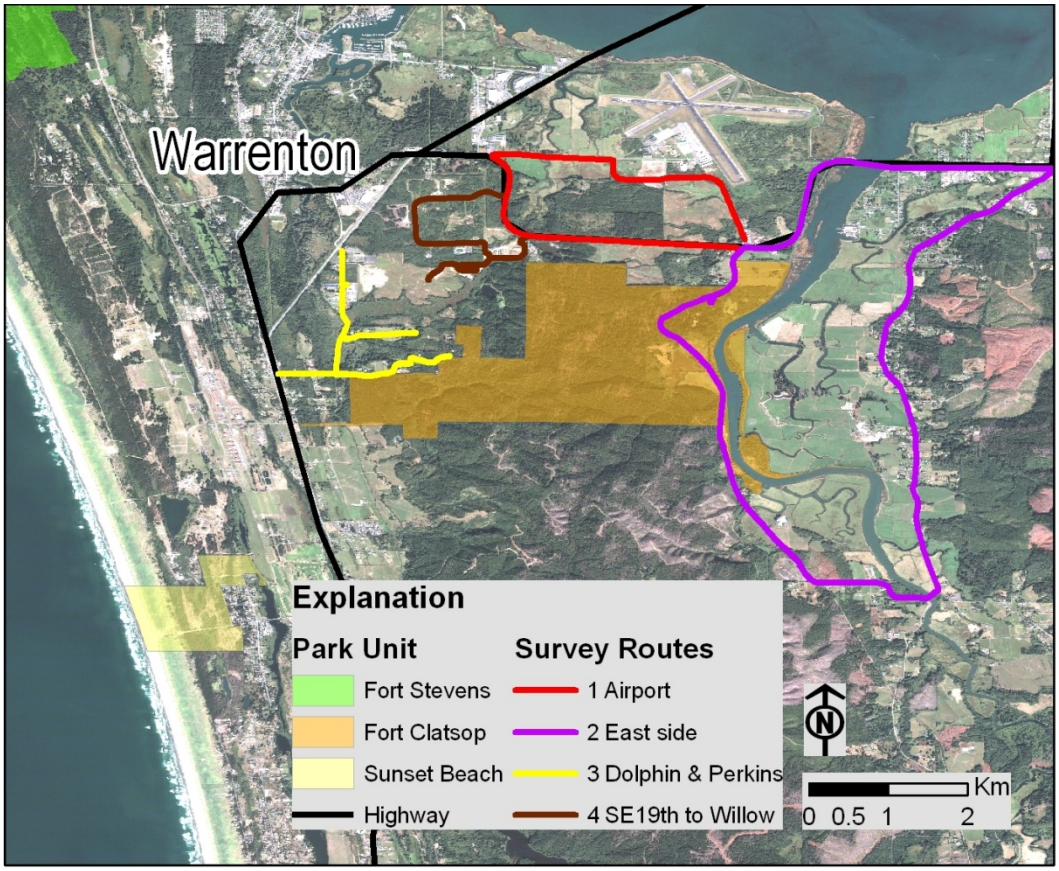

Figure 3. Map of four established survey routes for elk road surveys in the vicinity of the Fort Clatsop unit, which is shaded in orange. The Clatsop Plain includes areas to the north, west, and southwest of the unit, including areas not shown on this map. Satellite imagery is from September 2008 (Digital Globe Inc.). Major highways are shown as black lines.

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. Observers record the number of pellets or pellet clumps per group, and note the decay class for each pellet group. 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.

Road Surveys

The roads included in numbered, regularly surveyed routes 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.

Surveys require two people. 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.

Surveys start no later than 15 minutes after sunrise. 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.

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 notes 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).

After completing one route, the observer and driver can proceed to another route. A new form should be started for each 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.

Data Entry and Validation

Pellet survey data were entered into a prototype of the Lewis and Clark NHP elk monitoring program Access database. Data entry procedures followed guidelines in Griffin et al. (in review). The database includes quality assurance components such as pick lists and error messages that help to identify incorrect data at the time of data entry. After the data were entered, we inspected the records in the database for completeness and accuracy.

Data from road surveys have not yet been entered into the project database. Data from those surveys will be entered, validated, certified, and analyzed following the acceptance of the peer-reviewed protocol and associated database.

Data Analysis

We summarized data according to the template provided in Griffin et al. (in review). Results of pellet surveys are presented here without detailed analysis. Results of the road surveys, along with more complete analyses of relative use, occupancy, and trends in the measures that are monitored, will be part of four-year analysis.

Results

Field Crew

Carla Cole served as the Project Lead in this study. Field crew that took part in fall and late winter pellet sampling sessions are listed in Table 1. Field crew that took part in road surveys are listed in Table 2.

Table 1. Observers that participated in pellet surveys in November 2009 and March 2010. Lewis and Clark NHP Staff are identified by the division with which they are affiliated.

Affiliation	Names
Resources Division	Sarah Bishop, Zach Bolitho, Carla Cole, Nancy Eid, Jason Smith, Rachel Stokeld
Maintenance Division	Blake Gertulla, Doug Graham
Interpretive Division	Will George
Other Observers	Mark Huff (NCCN), Paul Griffin (USGS), Mandy Holmgren (volunteer)

Table 2. Observers that participated in road surveys during the time period of this annual report. Lewis and Clark NHP Staff are identified by the division with which they are affiliated.

Affiliation	Names
Resources Division	Zach Bolitho, Carla Cole, Nancy Eid, Lynn Johnson, Jason Smith.

Data Collection

Pellet surveys took place in the fall from November 9 to November 17, 2009. We cleared pellets from 67 points in the fall. Late winter pellet surveys took place from March 1 to March 8 2010. We surveyed at 65 points in the late winter. There were two points where pellets were cleared in the fall, but which were deemed unsuitable for survey: point #27 was deemed unsuitable because there was persistent, standing water at the point, and point #68 was deemed unsafe, because of hazardous blowdown. Three or four road surveys took place in each of the 12 months from October 2009 to September 2010.

Pellet Survey

We conducted pellet surveys at 65 points in the late winter, where pellets had been cleared in the fall. The observed average number of pellet groups per subplot at each point, i, in year t, is called $R_{i,t}$. This measure is based on the pellet groups found in the late winter pellet survey session. These values for FY2010 are presented in Table 4. These values are not corrected to account for detection bias. Estimates of relative use, and of elk occupancy, will be presented in the next four-year report.

Table 3. Average number of pellet groups per subplot observed in late winter 2010 at each pellet survey point, $R_{i,2010}$. The value for each point is the total number of pellet groups observed divided by the number of subplots surveyed at that point.

Point	$R_{i,2010}$	Point	$R_{i,2010}$	Point	$R_{i,2010}$	Point	$R_{i,2010}$	Point	$R_{i,2010}$
0	1.75	**18**	0	**35**	0.5	**52**	0.75	**66**	0.25
1	0	**19**	0	**37**	0.75	**53**	0	**67**	0
2	0	**21**	0	**39**	0	**54**	0.75	**70**	0
6	0.25	**23**	0	**40**	0.25	**55**	0	**71**	0.25
7	0.25	**24**	0	**42**	1.25	**56**	0.5	**72**	0
8	0	**25**	0	**43**	0.25	**57**	0	**73**	0
9	0.25	**26**	0	**44**	0	**58**	0.5	**74**	0.25
10	0	**28**	0	**45**	0.25	**59**	0	**75**	0.25
11	0	**29**	0	**46**	0	**60**	0	**76**	0
12	0	**30**	0	**47**	0.25	**61**	1.75	**77**	0.5
14	0.75	**31**	0.25	**48**	1.0	**62**	1.25	**78**	1.5
15	0.5	**33**	0	**49**	0.5	**64**	3.0	**79**	0
17	0	**34**	0	**51**	1.25	**65**	0	**80**	0

Of the 67 points sampled in the fall, 30 had one or more elk pellet groups detected in any of the subplots (Figure 4). Of the 65 points sampled in the late winter, 30 had one or more elk pellet groups detected in any of the subplots (Figure 5). Of these two sampling sessions, only the late winter session is associated with a known pellet deposition time period.

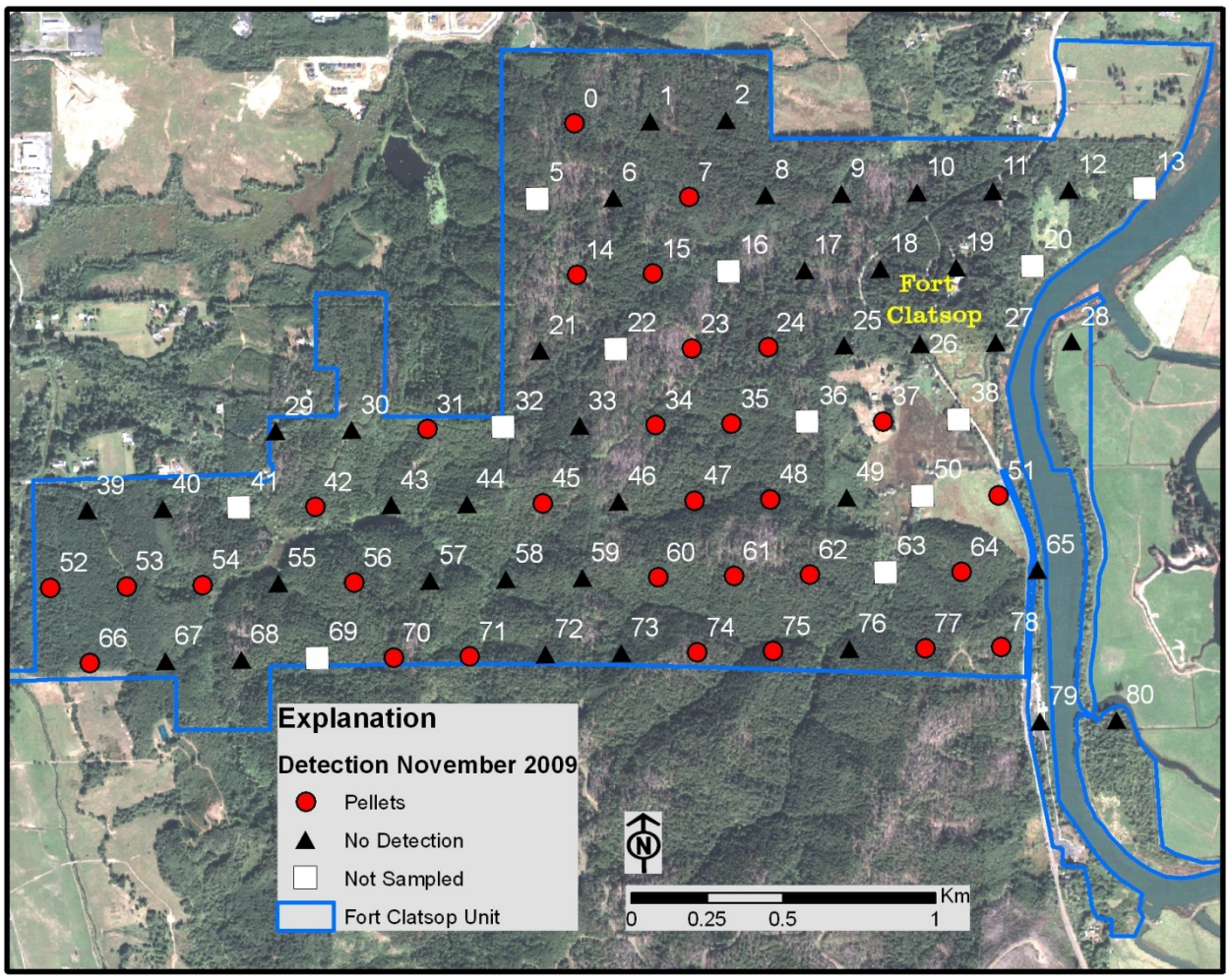

Figure 4. Map of elk pellet detections in subplots of surveyed points, fall 2009. Points at which elk pellets were detected in any subplot are shown as red circles. Points at which no elk pellets were detected are shown with black triangles. Points that were not sampled are shown as white squares. Satellite imagery is from September 2008 (Digital Globe Inc.).

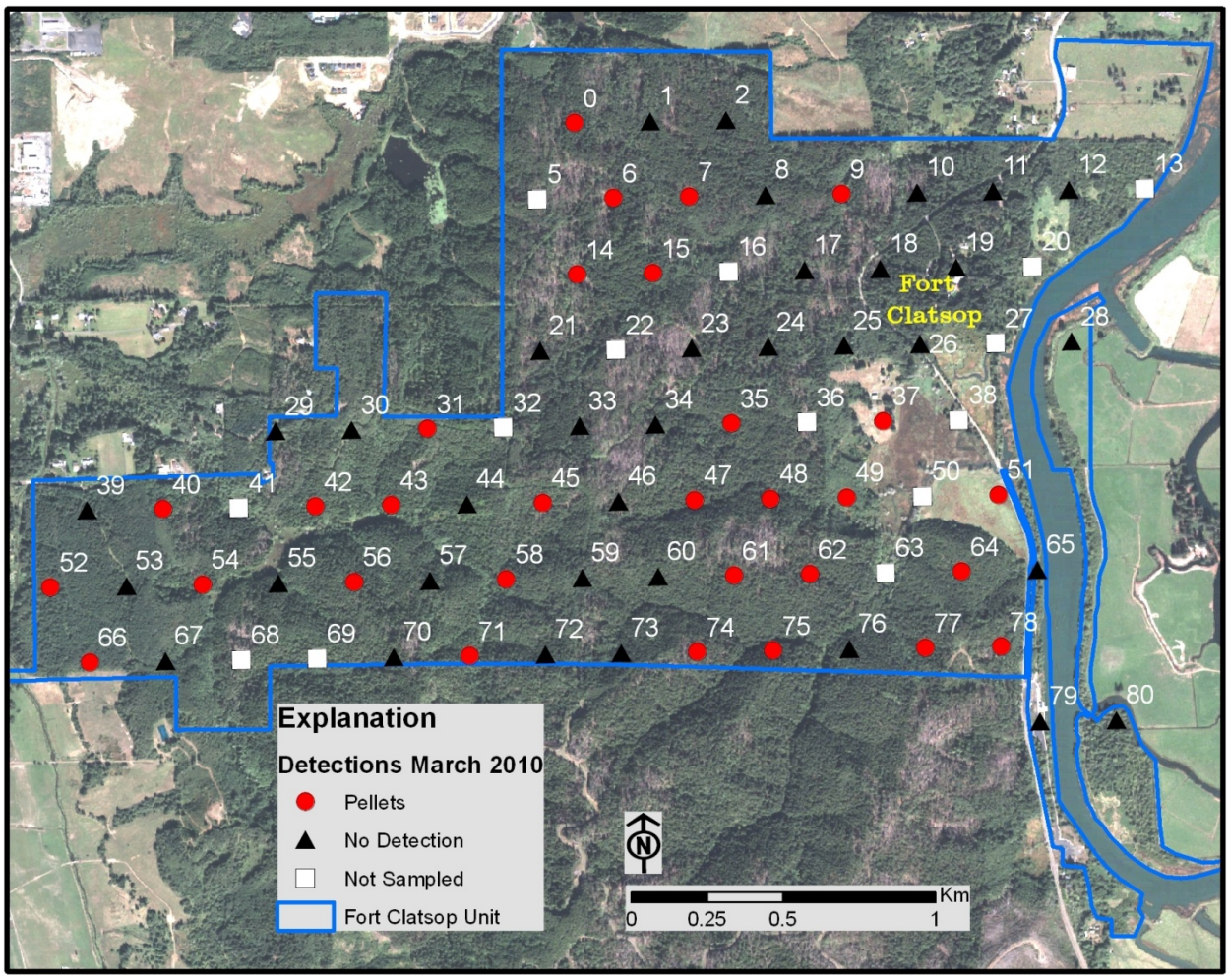

Figure 5. Map of elk pellet detections in subplots of surveyed points, late winter 2010. Points at which elk pellets were detected in any subplot are shown as red circles. Points at which no elk pellets were detected are shown with black triangles. Points that were not sampled are shown as white squares. Satellite imagery is from September 2008 (Digital Globe Inc.).

Road Surveys

Road surveys were conducted three or four times per month in each of the 12 months of fiscal year 2010. Summary statistics from each driving survey route are not included in this report because the database needed to enter and process those data was not available for use prior to the preparation of this report. We will present results from road surveys in the next four-year report.

Discussion and Conclusions

This was the second year of elk monitoring at Lewis and Clark NHP using the current methods for data collection and analysis. This time period was part of the protocol development phase of the monitoring program, but the data were collected in a manner that is in line with methods outlined in the protocol (Griffin et al. in review). Data from FY09, FY10, and FY11 will be useful in the formal analyses of trend. Those three years of data will contribute to the preparation of a four-year analysis and report after only one more year.

FY10 was a successful year for project implementation in both pellet and road surveys. Field data forms have been refined, with the result that the forms used in the protocol have been thoroughly field tested. Conditions for fieldwork this year were adequate for data collection.

It would be premature to interpret the patterns of elk pellet group observations until the detection bias of single pellet groups is accounted for in estimates of relative use, and until the proportion of the area occupied (PAO) in the Fort Clatsop unit is estimated using occupancy modeling. The Four-year report will account for detection bias in estimates of relative use and PAO.

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Natural Resource Stewardship and Science
1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525

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