Occupancy of beaver (*Castor canadensis*) in Rocky Mountain National Park: the second field season

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Introduction

Historic data indicate that the population of beaver in Rocky Mountain National Park (ROMO) has declined considerably since the 1940s (Baker 2003). Packard (1947) estimated that the population of beaver in ROMO in 1940 was comprised of greater than 1,800 individuals in approximately 200 colonies. Data collected over the last 10 to 15 years, however, indicate that beaver are currently rare (e.g., Scherer et al. 2010). The activities of beaver have important impacts on ecosystem structure and function and influence plant and animal diversity (Naiman et al. 1988, Baker 2003, Collen and Gibson 2004, Westbrook et al. 2006). Consequently, management at ROMO is interested in increasing the abundance and spatial distribution of beaver in the park.

In 2009, the first year of park-wide surveys for beaver was completed. The field and analytical methods that were used in 2009, as well as the results of the surveys, are presented in the report by Scherer et al. (2010). In 2010, the survey effort was expanded, and this report describes the methods and results for 2010. The primary objectives of this research are to characterize the current state of the beaver population in ROMO and facilitate the identification of areas where active management of beaver and the landscape are more likely to promote an increase in the beaver population. Other objectives are to:

- Identify attributes of stream segments and their adjacent terrestrial environments that are correlated with current beaver occupancy, and
- Evaluate the utility of a map of suitable beaver habitat that was recently developed by Theobold et al. (2010).

Methods

<u>Overview of the suitability model</u>

Theobold et al. (2010) developed a map of suitable beaver habitat across ROMO based primarily on three spatial datasets: a vegetation dataset, data from a digital elevation model, and a stream gradient dataset. Relevant spatial data on other components of beaver habitat (e.g., the width of streams; Beier and Barrett 1987, Barnes and Mallik 1997) and movement data for beaver are sparse or not available. Therefore, Theobold et al. (2010) expressed concern that the map may overestimate the amount of suitable beaver habitat and, consequently, refer to it as a map of potentially suitable habitat. In this report, however, we will refer to it as the habitat suitability map.

The habitat suitability map is a grid-based representation of ROMO (i.e., a raster with approximately 9 x 9 m cells) (Fig. 1). The habitat suitability assigned to each cell in the map is a function of two elements:

i. The accessibility of the cell to beaver from a 'source' cell, and
ii. The composition of the vegetation in the cell.

Theobold et al. (2010) partitioned the network of streams in ROMO into segments that beaver would most likely select for dam-building (0 – 2% gradient) and segments that beaver would be unlikely to select (> 2% gradient). They assumed cells that were part of a long stretch (> 50 m) of stream of low gradient (0 – 2%) could serve as portions of a home range for individual beaver colonies and identified these cells as ‘source’ cells. Therefore, the map assumes that beaver activity is centered on stream segments. Since beaver are considered central-place foragers (Basey et al. 1988), this assumption is reasonable. Aside from source cells, cells in the final map fell into one of 3 categories: i) not accessible to beaver from a source cell (more than 1,000 cost-meters from a suitable stretch of stream), ii) accessible from a source cell but vegetation suitable for beaver is absent, and iii) accessible from a source cell and suitable vegetation is present. Cells in the first and second categories were assigned a habitat suitability value of 0. Cells in the latter category were assigned a value greater than 0 and less than 1 where cells with values nearer to 1 were more accessible from a source cell (Fig. 1). Cells that were highly accessible were near a source cell or separated from a source cell by relatively flat ground (i.e., had banks of relatively low gradient; Beier and Barrett 1987). Cells that were less accessible were far from a source cell or separated from a source cell by ground of high gradient. For details on the habitat suitability model, see Theobold et al. (2010).

Sampling design

We chose occupancy as the metric for characterizing the state of beaver in ROMO. Broadly, occupancy is the proportion of sampling units occupied by a species of interest (MacKenzie et al. 2006). For example, occupancy might be the proportion of aspen patches in ROMO occupied by a particular bird species or the proportion of grid cells in Moraine Park occupied by a plant species. Utilizing occupancy as the metric allows for investigations into the relationships of beaver with habitat and landscape change and provides some guidance for next steps. In this study, the sampling units were plots (approximately 200 x 200 m), and a primary objective of the study was to estimate the proportion of plots currently occupied by beaver. We aligned the plots with cells from a raster dataset of the world (hereafter, the global raster). The global raster is being used as the basis for other monitoring projects in ROMO and the Rocky Mountain Network of the NPS’s Vital Signs Monitoring Program. Consequently, managers at ROMO will be able to combine data from this project and other monitoring projects more easily. Cells in the global raster are too large (600 x 600 m) to conduct ground-based surveys for sign of beaver in a reasonable amount of time. Therefore, we used the ‘Resample’ tool in ArcGIS 9.2 (ESRI 1999-2006) to create a raster dataset in which cells were approximately 200 x 200 m (see Appendix 1 in Scherer et al. [2010] for additional details). To develop a sampling frame of plots, we removed all cells that did not contain a portion of stream. The final sampling frame contained 6,917 plots.

Another objective of this project was to evaluate the utility of the map of suitable beaver habitat of Theobold et al. (2010). In order to evaluate the map, we needed to collect data on occupancy from plots across a range of habitat suitability values. If occupancy was similar across a broad range of suitability values, that pattern would suggest the map was not useful for predicting suitable beaver habitat in ROMO. Each plot in the sampling frame contained approximately 400 cells from the map of suitable beaver habitat (Fig. 1). We used the ‘Zonal Statistics’ tool in ArcGIS 9.2 (ESRI 1999-2006) to calculate the average and total suitability value across habitat suitability cells within each plot (Fig. 1). We used the average suitability values for each plot to place the plots into one of four strata (similar to Beck et al. 2009):

- Stratum 1 - average suitability value = 0 (5,532 plots)
- Stratum 2 - average suitability value greater than 0 but less than or equal to 0.1 (757 plots)

- Stratum 3 - average suitability value greater than 0.1 but less than or equal to 0.3 (416 plots)
- Stratum 4 - average suitability value greater than 0.3 (212 plots)

0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.9	0.9	0.8	0.8	
0	0	0	0	0	0	0	0	0	0	0	0	0.6	0.9	0.9				0
0	0	0	0	0	0	0	0	0	0	0	0.5	0.8	0.9		0.9	0.8	0.9	0
0	0	0	0	0	0	0	0	0	0	0.3	0.5	0.8		0.8	0.8	0.6	0	0
0	0	0	0	0	0.1	0.2	0.2	0.3	0	0	0	0.8		0.7	0	0	0	0
0	0	0	0	0.1	0.4	0	0	0.5	0	0.8	0.9		0	0	0	0	0	0
0	0	0.1	0.3	0.3	0.5	0.6	0.7	0.7	0.8			0	0	0	0	0	0	0
0	0	0.3	0.7	0.8	0.7	0.7	0.8	0.9	X	0.8	0.9	0	0	0	0	0	0	0
0	0.2	0.6	0.8	0.9					0.8	0.7	0.7	0	0	0	0	0	0	0
0.2	0.5	0.7			0.9	0.9	0.9	0.8	0.8	0	0	0	0	0	0	0	0	0
0.7	0.7		0.9	0.9	0.7	0	0	0	0	0	0	0	0	0	0	0	0	0
		0.8	0.5	0.3	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 1: A sample plot (dotted, black square) superimposed over the habitat suitability map of Theobold et al. (2010). Black cells represent a stretch of stream of low gradient (0 – 2%; i.e., source cells), while cells with numeric values represent adjacent terrestrial areas. The gray cells are inaccessible to beaver from source cells, and these cells were assigned habitat suitability values of 0. The white cells are accessible to beaver. Some of the white cells contain a 0 (accessible to beaver but suitable vegetation is not present in the cell), while other white cells contain a positive numeric value (accessible to beaver and suitable vegetation is present in the cell). The positive numeric values nearer to 1 were more accessible from a source cell than values nearer to 0. The dotted square represents a plot that was surveyed for beaver or sign of beaver and is included in the figure to show that plots contained many cells from the habitat suitability map. Each plot contains approximately 400 cells from the habitat suitability map, rather than the 49 cells shown in the figure. The average and total habitat suitability value was calculated for each plot by averaging or summing across cells in the habitat suitability map.

Finally, we used the Reversed Randomized Quadrant-Recursive Raster algorithm (RRQRR; Theobold and Norman 2006) to select a spatially-balanced sample from each stratum. We did not know how many field workers would be available; therefore, we could only estimate the number of plots that could be surveyed. The primary benefit of using RRQRR is the flexibility it provides in terms of the number of sites that are surveyed. The output from RRQR was an ordered list of 50 plots from each stratum. With other sampling designs (e.g., random sampling), failure to survey all of the plots in the sample would complicate inference to the population of interest. With RRQRR, the key is to survey the plots in the order they appear in the list. Even if all 50 plots in each stratum were not surveyed, inference to the population of plots would not be compromised as long as plots were surveyed in order.

Field protocol

We used a double sampling design to collect data on occupancy across plots (MacKenzie et al. 2006). Under the double sampling design, some plots are surveyed twice (to allow estimation of the probability of detecting beaver sign, *p*) while the remaining plots are surveyed once. MacKenzie et al. (2006) provide guidelines for the appropriate allocation of sampling units between 1- and 2-survey plots. Generally, more plots should be surveyed twice for species that are highly detectable but occupy a low proportion of plots. We used the estimates of detection (0.79) and occupancy probability (0.12) from 2009 to determine the number of 1- and 2-survey plots. Based on these estimates, MacKenzie et al. (2006: page 174) suggested that 33% of the survey effort should be used on plots surveyed once. Since our goal was to survey 80 plots in 2010 (20 plots in each stratum), we chose to conduct a single survey at 40 plots and two surveys at 40 plots (2 surveys * 40 plots + 1 survey * 40 plots = 120 surveys; 40 surveys at 1-survey plots /120 total surveys = 33% of survey effort).

We used volunteers and staff at ROMO (hereafter, field workers) to conduct the surveys. Field workers were organized into teams of at least two people. The protocol used for the field work, as well as sample data sheets, is provided in Appendix 1. Each team of field workers was provided a map of a plot's location that included spatial coordinates of the corners of the plot and the points where the stream entered (upstream) and exited (downstream) the plot. They traveled to the plot using a GPS unit and located the point where the stream exited the plot (Fig. 2). Once at this point, field workers slowly walked along the stream looking for beaver, as well as signs of current and historic presence by beaver. If beaver or signs of beaver were not detected along the stream, field workers searched marshy areas and areas of aspen (*Populus tremuloides*) and willow (*Salix* spp.) within the plot. Signs of beaver included dams, lodges, food caches, scent mounds, tracks, trails, and cut stems and trees. Field workers used the color of stems that had been cut (a yellowish tone to the wood indicated recent beaver activity; Basey et al. [1998]) and the presence of a food cache or other recent activity (e.g., newly cut stems incorporated into a dam) to distinguish between current and historic occupancy. In addition to surveying for beaver, field workers were instructed to do the following while at the plot (see Appendix 1 for a copy of the data sheet used by field workers):

- Provide a brief description of the plot.
- Record the stream channel as single or braided and estimate its width using one of three categories (see Appendix 2).
- Take digital photographs of the plot and the stream where it entered and exited the plot. Field workers were provided a placard with the plot's identification number and a 6-foot nylon strap. They were instructed to include the placard in all photographs to identify the plot. The strap was partitioned into six, 1-foot long segments of alternating color (e.g., a 1-foot long black segment, followed by a 1-foot long yellow segment, followed by a 1-foot long black segment… etc.). Field workers were instructed to include the strap in photographs when practical. After the field season,

we derived continuous measurements of stream width (to supplement the categorical measurements provided by field workers) using the known dimensions of the placard or strap in each photograph.

- Describe the willow in the plot as clumped, continuous, rare or none. Field workers were also required to estimate the height of five individual willow shrubs (using four height categories as shown on the data sheet in Appendix 2) beginning with the shrub nearest the point where the stream exited the plot. For clumped willows, every other shrub along the side of the stream was measured until estimates of the heights of five shrubs were provided (Fig. 2). For continuous willows, heights were measured every five paces (two-step pace) along the side of the stream until estimates of the heights of five shrubs were provided. For rare willows, field workers were directed to estimate the height of five representative willows.
- Take photographs of each of the willow shrubs for which heights were estimated (Fig. 2). As with the photographs of the stream, field workers were instructed to include the placard and, if possible, hold the strap next to each willow to assist with estimating the heights of willow shrubs after the field season.
- Finally, field workers determined whether aspen (*Populus tremuloides*) was present in the plot.

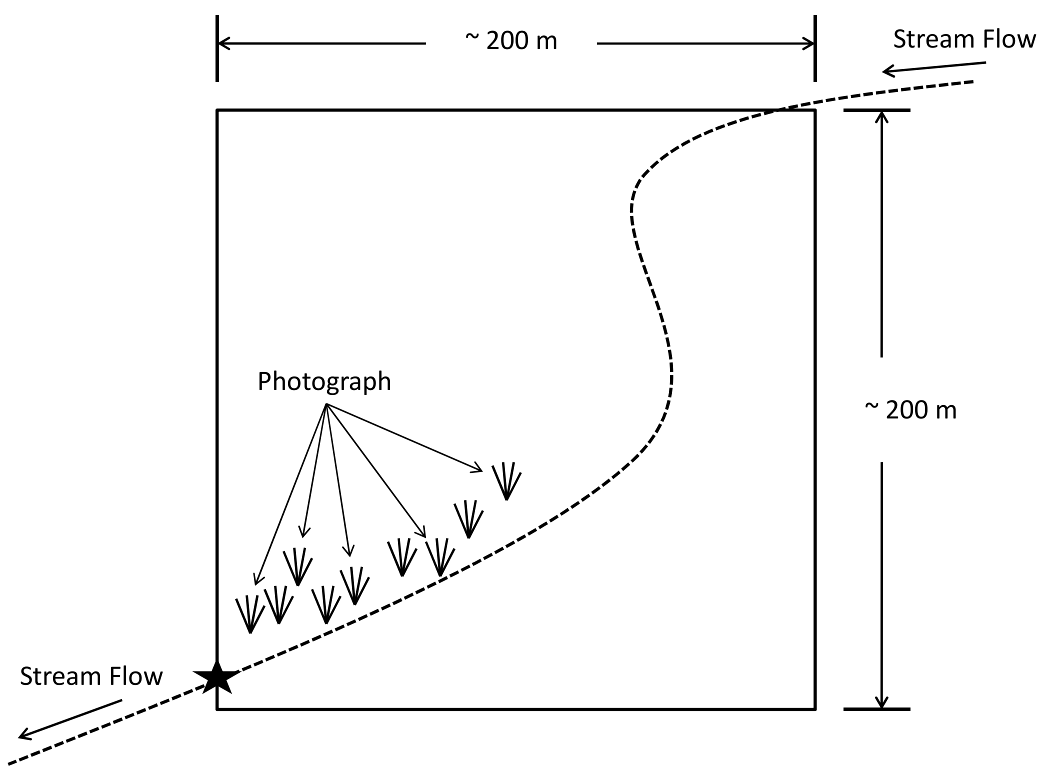

Figure 2: Schematic showing a sampling plot (black square) with a stream (dashed line). The stream flows from right to left in this example. Field workers started the survey where the stream

intersected with the plot boundary on the downstream side (denoted by a star). They took a photograph of the stream at this point. They also took a photograph of the nearest willow to this point and every other willow thereafter (a total of five photographs of willow).

The description of the field methods and the schematic in Fig. 2 provide an idealized view of the field work and do not account for the complications experienced by field workers. In particular, field workers reported confusion associated with the descriptions and measurements of the stream and willow. These complications are discussed below in the section on suggestions for subsequent field seasons.

Analytical approach

Our plan was to use the single-season occupancy model of MacKenzie et al. (2002) and Program PRESENCE (Hines 2006) to analyze the data of current beaver occupancy. However, the sparseness of the data (detections of current beaver presence only occurred in 4 plots) precluded a formal statistical analysis. Therefore, we computed basic summary statistics from the data.

Results

A total of 100 surveys were conducted at 73 plots from 17 August 2010 to 21 October 2010 (Table 1). We completed a single survey at 47 plots (64%) and two surveys at 26 plots (36%). In 2009, we were only able to complete surveys at four plots in Stratum 1 primarily due to early snowfall at higher elevations. In 2010, we started surveys earlier in the year and placed greater emphasis on surveying plots in Stratum 1. As a consequence, we completed 15 surveys in Stratum 1, though only 3 plots were surveyed twice (Table 1). We also increased the number of plots surveyed in Strata 2 and 3 by two plots each.

Stratum	# Plots surveyed in 2010	# Plots surveyed twice in 2010	# Plots with detections of current occupancy		# Plots with detections of historic occupancy	
			2009	2010	2009	2010
1	15	3	0	0	0	2
2	18	7	1	0	7	3
3	20	8	3	2	15	12
4	20	8	3	2	20	15

Table 1: The distribution of survey effort across strata, the number of 1- and 2-survey plots in 2010, and the number of plots with detections of current and historic beaver occupancy across strata in 2009 and 2010.

Evidence of current beaver presence was detected at 4 plots, two plots in Stratum 3 (plots # 313 and 315) and two plots in Stratum 4 (409 and 415; Tables 1 & 2, Fig. 3). Therefore, evidence of current beaver presence was detected in 0% of plots in Strata 1 and 2 and 10% of plots in Strata 3 and 4. In two of the four plots, evidence of current beaver presence was also detected in 2009 (plots #313 and 409; Table 2), which indicates that beaver have been active in those plots for at least one year. Evidence of current beaver activity was not detected in the other two plots during surveys in 2009 (plots #315 and 415). Therefore, beaver have recently moved into these plots or signs of beaver were missed during the surveys in 2009. In three plots with detections of current beaver presence in 2009, signs of current beaver presence were not detected in 2010 (#302, 408 and 410). Beaver have either abandoned these plots or evidence of their presence was missed during surveys in 2010. Finally, two of the plots in which evidence of current beaver presence was detected in 2009 were not surveyed in 2010 (plots # 226 and 328; Table 2).

Plots with detections of current beaver presence	
2009	***2010***
226	313
302	315
313	409
328	415
408	
409	
410	

Table 2: The plots in which signs of current beaver presence were detected in 2009 and 2010. Note: plots 226 and 328 were not surveyed in 2010.

Evidence of historic beaver presence was detected at 32 plots (44%) in 2010, and 27 of these plots (84%) were in Stratum 3 or 4 (Table 1). These results are nearly identical to the results from 2009 (83% of the plots where evidence of historic beaver presence was detected were in Stratum 3 or 4).

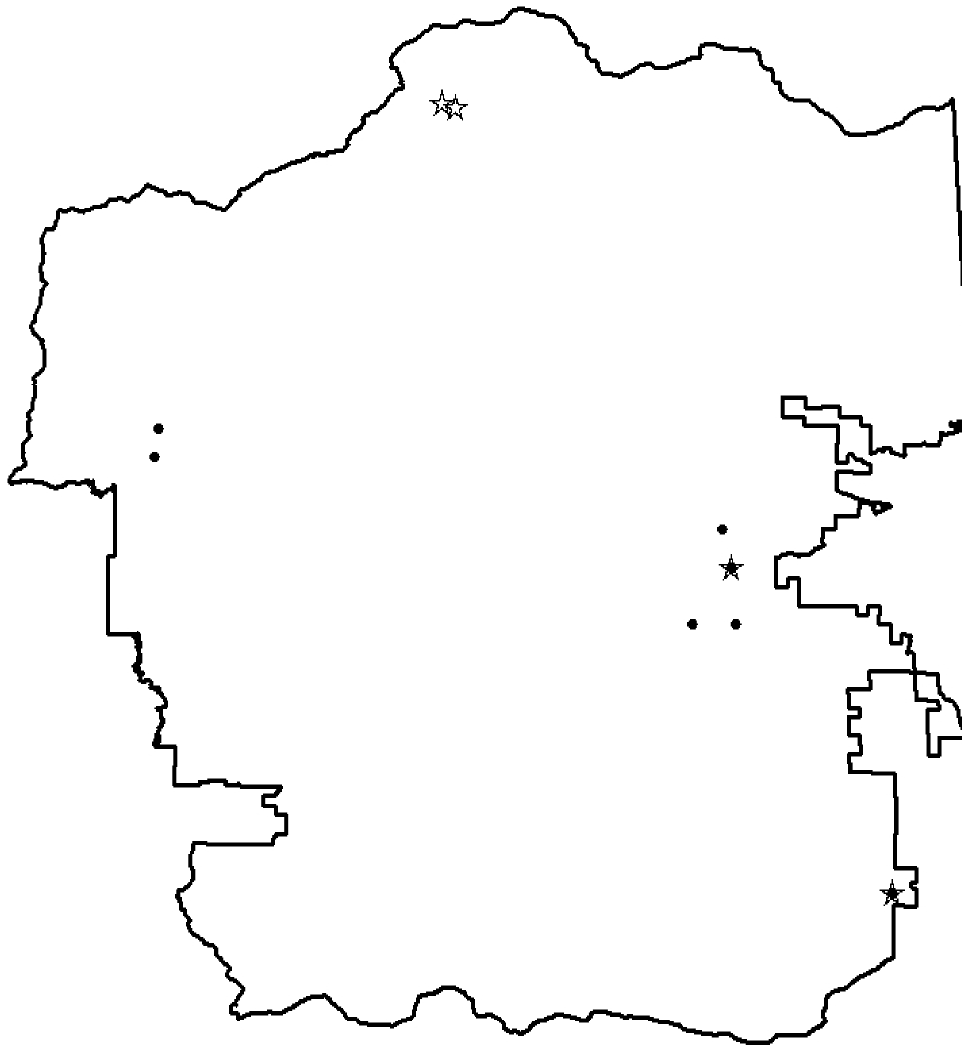

Figure 3: Plots in ROMO where evidence of current beaver occupancy was detected during surveys in 2009 (solid, black circles) and 2010 (hollow stars). The two plots marked by stars with solid, black circles in their centers represent plots in which evidence of current beaver occupancy was detected in 2009 and 2010.

Discussion

As recently as 1940, beaver were abundant in many parts of Rocky Mountain National Park (Packard 1947). Beaver have been declining in the park since the 1940s (Peinetti et al. 2002, Baker 2003), however, and available data suggest they are currently rare. We detected evidence of current presence by beaver in no plots in Strata 1 and 2 and 4 plots (10%) in strata 3 and 4 in 2010. These results suggest that beaver occupy only 10% of the most suitable streamside habitat in ROMO. This estimate comes with an important caveat. Beaver appear to require willow of at least 3 m in height (Baker 2003). The habitat suitability map was based only on the presence or absence of deciduous shrubs and trees and did not consider the height or abundance of shrubs and trees (data on shrub and tree height and abundance were not available for most of ROMO; Theobold et al. 2010). The data on willow heights collected during the beaver surveys indicates that over 60% of the plots of high suitability (Strata 3 or 4) had no willow, few willow or willow less than 3 m in height. Therefore, the habitat suitability map appears to provide estimates of the amount of suitable beaver habitat in ROMO that are much too high.

Evidence of historic occupancy, on the other hand, was detected at 32 of 73 plots (44%) in 2010 and 42 of 58 plots (72%) in 2009. While it may be tempting to cite these estimates as evidence that historic occupancy was much higher than current occupancy, the comparison should be accompanied by an important caveat. Unlike signs of current beaver occupancy, signs of historic beaver occupancy can persist on the landscape for long periods of time. Therefore, the estimate of historic occupancy reflects an integration of occupancy patterns by beaver over decades. Based on that fact alone, historic occupancy is expected to be greater than current occupancy. The spatial patterns of historic occupancy are consistent with predictions made by the map of suitable beaver habitat (Theobold et al. 2010). A high proportion of the plots in which evidence of historic beaver presence was detected are in the high suitability strata (Strata 3 and 4).

From the data collected in 2009, we found that current occupancy by beaver was positively correlated with the average height of willow in a plot (Scherer et al. 2010). We detected evidence of current occupancy by beaver in too few plots in 2010 to conduct formal statistical analyses and summary statistics provide few insights. Willow in two of the four plots in which current occupancy by beaver was detected in 2010 was > 3 m on average, while willow in the other two plots was much shorter than 3 m. The lack of data also prevents a rigorous evaluation of the habitat suitability map of Theobold et al. (2010). However, the fact that all four plots with evidence of current occupancy are in high suitability suggests the map has some predictive power. Of course, the fact that it may strongly overestimate the amount of suitable beaver habitat is cause for concern.

Suggestions for subsequent field seasons

While we increased sampling effort in 2010 and made several improvements to field methods, several aspects of the field methods still need improvement. The purpose of this section is to highlight the positive and negative aspects of the field season and suggest actions for addressing those aspects that did not meet our expectations.

i. The use of occupancy of 200 x 200 m plots needs to be discussed prior to any future field seasons.
    - Advantages of the current plot size are:
        - They can be surveyed for sign of current beaver presence in a relatively short amount of time, and consequently, field workers can survey multiple plots in a day.
        - The size is consistent with estimates of fall home range sizes for beaver (Wheatley 1997).
    - An important disadvantage is:
        - Evidence of current occupancy is being detected in too few plots, which can cause problems in estimating occupancy and evaluating hypothesized relationships between occupancy and environmental variables. By expanding plot sizes, we may observe an increase in the number of plots in which evidence of current beaver presence is detected. Larger plot sizes

may make more sense ecologically, as estimates of summer home range sizes for beaver are larger than the current plot sizes (Wheatley 1997).

ii. We did not conduct as many repeat surveys as intended, and none of the plots at which we detected signs of current beaver presence were surveyed twice. Therefore, we could not derive an estimate of detection probability for current beaver sign. Our goal was to conduct two surveys at 50% of the plots. While the percentage of 2-survey plots in Strata 2, 3, and 4 was close to 50%, we need to increase the number of 2-survey plots in Stratum 1. Alternatively, based on the lack of evidence of current or historic beaver occupancy in Stratum 1 from surveys in 2009 and 2010, we may choose to remove plots in Stratum 1 in future field seasons.

iii. Two adjustment to the protocols for 2009 resulted in improved photographs for willow height and stream width. Using the straps as a reference for inferring willow height resulted in the biggest improvement. In addition, due to the emphasis in training, field workers did a much better job of identifying the willow being measured in each photograph. However, we encountered a number of other problems in using photographs to collect data on stream width and willow height.

- The three most common problems were:
  - The placement of field workers' hands or equipment and the presence of vegetation obstructed the view of the bottom and top portion of the strap. Consequently, it was difficult to determine the segment of strap that was visible in the photograph.
  - The demarcation between the black and yellow segments was blurred in some photographs. Perhaps, precipitation or wet vegetation caused the line that separated the segments to be blurred.
  - In photographs for stream width, both banks of the stream were often not visible, and in photographs of willow height, the top of the willow was not visible.
- Possible improvements are:
  - Require field workers to orient the strap in the same direction every time (e.g., yellow segment at the bottom and black segment at the top or vice-versa).
  - Write a unique number in each of the yellow sections of the strap in dark marker (e.g., a "1" in the first section, a "2" in the second section… etc.). The numbers will allow users of the photographs to determine the amount of strap that is not visible.
  - Replace straps at one or more points during the field season.
  - In general, the photographers need to stand farther from their subjects.

iv. Field workers commonly reported uncertainty regarding the appropriate category to select for the stream channel and willow descriptions (Appendix 2). In some cases, field workers were unable to find a well-defined stream in the plot and, therefore, could not record the stream as "Single" or "Braided." Rather, they found wetlands, a dry channel, or no evidence of a stream. Similarly, the categories for describing the distribution and abundance of willow were a source of uncertainty in some plots. The first question to consider is whether these fields are needed on the data sheet. While these fields are certainly useful for generally describing the plot, the information they provide may be available in the general plot photographs. Our primary interests with respect to the stream and willow in each plot are:

- An estimate of the width of the stream - Previous studies have reported correlations between stream width and occupancy in beaver (Beier and Barrett 1987, Barnes and Mallik 1997). In some cases, the correlation was positive (Beier and Barrett 1987) and, in other cases, it was negative (Curtis and Jensen 2004).
- Information on the availability of tall willow – In locations where willow is the dominant woody species, it is the primary food source of beaver (Boyle and Owens 2007), and Beck et al. (2009) reported that active beaver lodges in the Black Hills National Forest were located near aspen and willow.

v. With respect to stream width and willow height, two other issues warrant additional discussion. Field workers expressed confusion over the width or height to measure, and therefore, more explicit protocols for measuring stream width and willow height need to be developed. For stream width, the protocol should include a description of the boundaries of the stream. For example, should we use the presence of water to delineate the boundaries of the stream, or another definition of boundary (e.g., width of the channel)? For willow height, the protocol should provide guidance for determining a height that is relevant to beaver. For example, should dead stems be considered in measurements of willow height? Our primary interest in obtaining measurements of willow height is to assess the availability of food and building material for beaver. Therefore, if the surveys are repeated in the future, these topics should be addressed in meetings prior to training and fieldwork.

vi. We are still concerned that field workers are not surveying the same plot on repeat visits. Planning for the field season in 2011 should include a discussion of potential solutions to this problem. For example the first field workers to survey a plot could use flagging to mark the point at which the stream leaves the plot.

vii. Several problems were encountered related to field logistics and utilization of park staff and volunteers to complete the surveys. There were administrative conflicts due to the end of the NPS fiscal year and the late summer sampling.

- Possible improvements are:
    - Begin surveys earlier in the summer.
    - Utilize experience hikers and conduct a fitness assessment before assigning sites.
    - Avoid overnight trips. The increased demands for scheduling, paperwork, and logistics outweighs any possible advantage.
    - If overnight or backcountry trips are required, utilize park staff. This will reduce the overall logistics and improve overall safety.
    - Utilize safety as one of the selection criteria for sample sites. Consider: hazard trees, unpredictable weather, length of hike, physical fitness requirements, radio coverage, and overall risk management utilizing the NPS GAR method.

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Appendix 1: The field protocol and a sample data sheet for the beaver surveys in ROMO in 2010.

Sampling Protocol:

Maps will show the UTM coordinates of the site corners and the entry and exit points of the stream

- Utilize maps and GPS to navigate to site
- Assess site for Safety – What are potential risks? Can you safely survey the site?
- Start at the downstream entry of the stream into the site

Sample Protocol

1. Site pictures
    - Take a general site photograph (landscape view) looking upstream
    - Take a picture of the site looking upstream that includes the stream channel
    - When you get to the upstream end of the site, take a general site photograph (landscape view) looking downstream
2. Stream description, measurements and pictures
    - Describe stream characteristics
        - Take close up stream photo if appropriate
    - Estimate stream width
3. Willow description, measurements and pictures
    - Describe willow community – Use your best judgment to photograph representative willows – note any observations and changes from the sample method on the back of the data sheet
        - If clumps – take a picture of every other one
        - If continuous – take a photo then move 5 paces and take another photo
        - If rare – follow the stream channel taking photos of willows you find
    - Take photos of 5 representative willows –
        - Hold up the yellow measuring tape in the photos – fully extended, bottom touching ground
        - Point to or indicate the willow you are photographing
    - Estimate height of the willow you photograph
4. Aspen presence
    - Assess sample site for Aspen trees
5. Beaver sign
    - Assess stream channel for beaver sign
        - Record any sign on data sheet and take a photo of observed sign
    - If no sign near the stream channel assess rest of the sample area for beaver sign
6. Site description and notes

- Write a general site description based on your observations in the site. Note any unusual observations, animal sign, plant communities, safety issues, equipment needs…

7. Review - Before you leave the site
   - Review your pictures to ensure they are of sufficient quality
   - Make sure you have all of the equipment
   - CHECK THE DATA SHEET
   - Ensure that all appropriate boxes are checked
   - Unique site characteristics or changes from the sampling protocol should be noted on the data sheet

SHOW THE BLACK AND WHITE PLACARD IN ALL PHOTOS

Sample data sheet:

BEAVER BLITZ 2010 DATA SHEET

OBSERVERS NAMES:
SITE NUMBER:
SURVEY DATE:
SITE DESCRIPTION:

GENERAL SITE PHOTOGRAPH				UPSTREAM		DOWN		
CHANNEL PHOTOGRAPH								
STREAM CHANNEL								
SINGLE		PHOTO		BRAIDED		NO PHOTO		
WIDTH		0-3 ft		3-9 ft		> 9 ft		
WILLOW		CLUMPS		CONTINUOUS		RARE		NONE
	PHOTO	HEIGHT						
1		< 3 ft		3-6 ft		6-9 ft		> 9 ft
2		< 3 ft		3-6 ft		6-9 ft		> 9 ft
3		< 3 ft		3-6 ft		6-9 ft		> 9 ft
4		< 3 ft		3-6 ft		6-9 ft		> 9 ft
5		< 3 ft		3-6 ft		6-9 ft		> 9 ft
ASPEN		PRESENT		NOT PRESENT				
BEAVER PRESENCE				ACTIVE		INACTIVE		NO SIGN

SIGN

	FRESH	PHOTO	OLD	PHOTO
PEELED WOODY STEMS				
CUT STEMS/STUMPS				

FOOD CACHE				
DAM				
LODGE				
TRACKS				
SCENT MOUND				
ANIMAL SIGHTING				
OTHER (LIST ON BACK)				

WRITE ADDITIONAL NOTES AND COMMENTS ON THE BACK