Avian Monitoring on Camp Guernsey

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ROCKY MOUNTAIN BIRD OBSERVATORY

***Mission**: To conserve birds and their habitats*

***Vision**: Native bird populations are sustained in healthy ecosystems*

***Core Values**:*

1. ***Science** provides the foundation for effective bird conservation.*
2. ***Education** is critical to the success of bird conservation.*
3. ***Stewardship** of birds and their habitats is a shared responsibility.*

RMBO accomplishes its mission by:

- ***Monitoring** long-term bird population trends to provide a scientific foundation for conservation action.*
- ***Researching** bird ecology and population response to anthropogenic and natural processes to evaluate and adjust management and conservation strategies using the best available science.*
- ***Educating** people of all ages through active, experiential programs that create an awareness and appreciation for birds.*
- ***Fostering** good stewardship on private and public lands through voluntary, cooperative partnerships that create win-win situations for wildlife and people.*
- ***Partnering** with state and federal natural resource agencies, private citizens, schools, universities, and other non-governmental organizations to build synergy and consensus for bird conservation.*
- ***Sharing** the latest information on bird populations, land management and conservation practices to create informed publics.*
- ***Delivering** bird conservation at biologically relevant scales by working across political and jurisdictional boundaries in western North America.*

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Introduction

Birds can be excellent indicators of biological integrity and ecosystem health (Morrison 1986, Hutto 1998, O'Connell et al. 2000, Rich 2002, U.S. EPA 2002). Birds comprise a diverse group of niche specialists, occupy a broad range of habitats, are relatively easy to monitor and are sensitive to both physical and chemical impacts on the environment. They are useful barometers for environmental change and measuring the sustainability of ecosystems impacted by human activities.

Monitoring is an essential component of wildlife management and conservation science (Witmer 2005, Marsh and Trenham 2008). Common goals of population monitoring are to estimate the population status of target species and to detect changes in populations over time (Thompson et al. 1998, Sauer and Knutson 2008). Effective monitoring programs can identify species that are at-risk due to small or declining populations (Dreitz et al. 2006), provide an understanding of how management actions affect populations (Alexander et al. 2008, Lyons et al. 2008), evaluate population responses to landscape alteration and climate change (Baron et al. 2008, Lindenmayer and Likens 2009) as well as provide basic information on species distributions.

The Rocky Mountain Bird Observatory (RMBO), in collaboration with the Wyoming Army National Guard, has created an avian monitoring plan specifically for the Camp Guernsey military installation to assist staff in obtaining robust monitoring data. This avian monitoring plan includes recommended survey methodology and sampling designs to assist Camp Guernsey staff in collecting and analyzing rigorous avian monitoring data for a wide range of species that may occur on the installation throughout the year (Appendix A). Included in this report are designs and monitoring recommendations for the following:

1) Breeding Songbird Surveys
    1. Grid-based point count surveys
    2. Area searches in riparian corridors
2) Breeding Diurnal Raptor Surveys
3) Breeding Nocturnal Raptor Species Surveys
4) Wintering Songbird Surveys
5) Identifying Potentially Important Migratory Stop-over Areas

Study Area

This avian monitoring plan is written and designed specifically for the Camp Guernsey installation located near the town of Guernsey in eastern Wyoming. The installation spans more than 79,000 acres of habitat dominated by mixed-grass prairie interspersed with small stands of Ponderosa Pine (*Pinus ponderosa*) and isolated stretches of riparian habitat. At the time of this report, much of Camp Guernsey is leased for grazing by private entities.

Recommendations in this avian monitoring plan involve sampling within the boundary of Camp Guernsey (provided by the Wyoming Army and National Guard in 2013) with a few exceptions. Range areas and the impact area within Camp Guernsey were made unavailable for sampling to minimize conflict between bird surveys and military operations. The remaining extent within the Camp Guernsey is therefore the area for which inferences can be made on bird populations while using the recommendations in this plan (Figure 1).

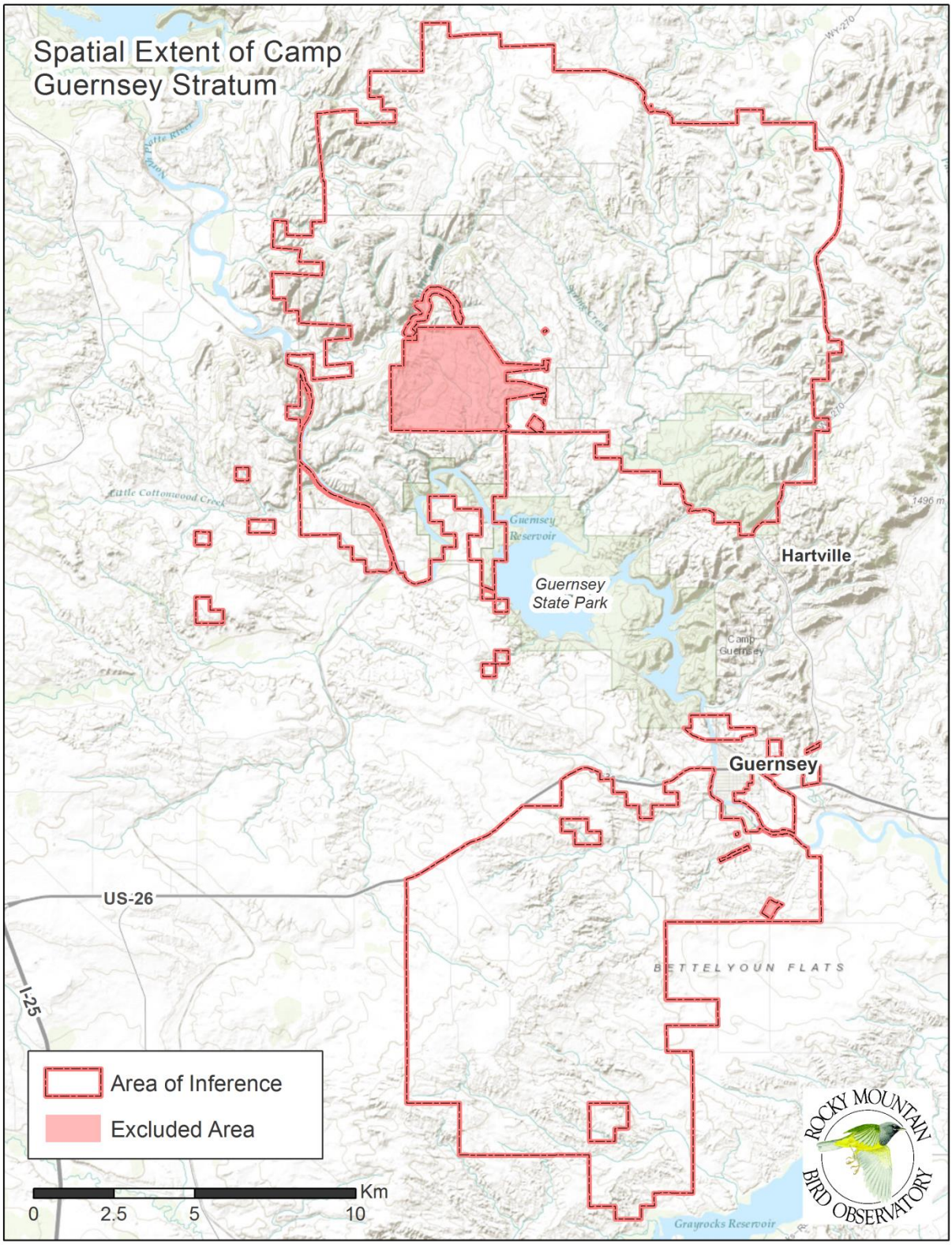

Figure 1. Geographic area recommended for sampling on Camp Guernsey.

Camp Guernsey lies within Bird Conservation Region 17 (BCR 17), Badlands and Prairies. The Badlands and Prairies Bird Conservation Region is characterized by rolling plains and mixed-grass prairie that contain large, continuous tracts of intact dry grassland managed predominately as ranchland (US North American Bird Conservation Initiative 2000). The western portion of BCR 17 contains pine and spruce forests at higher elevations. BCR 17 covers portions of five states: Montana, North Dakota, South Dakota, Wyoming, and Nebraska.

Breeding Songbird Surveys

Grid-based Point Count Surveys

RMBO recommends that Camp Guernsey implement breeding landbird surveys in a manner consistent with the Integrated Monitoring in Bird Conservation Regions (IMBCR) program for two reasons: 1) IMBCR surveys utilize methods preventing road bias and account for incomplete detection of individuals on the landscape and 2) the IMBCR program provides regional density and occupancy estimates for numerous species. Comparisons between Camp Guernsey populations and regional populations can help managers determine if changes to Camp Guernsey populations are a result of local management actions or ecological processes instead of large-scale population drivers such as climate change, migratory and wintering stop-over habitat alteration, large-scale application of chemicals, etc. IMBCR estimates for BCR 17 and the Wyoming portion of BCR 17 represent biologically and geographically appropriate regions for comparison to the Camp Guernsey installation.

Sampling Design

Using a design consistent with the IMBCR program, RMBO has identified Camp Guernsey as a single and distinct stratum. The spatial extent of the stratum was determined by the installation boundary, provided by Camp Guernsey staff. At the request of Camp Guernsey's staff, the impact area and range areas within the installation boundary were made unavailable for sampling to reduce conflicts with military operations. The remaining extent of Camp Guernsey therefore represents the Camp Guernsey stratum (Figure 1.)

Within the Camp Guernsey stratum, RMBO followed the IMBCR design, in which generalized random-tessellation stratification (GRTS), a spatially-balanced sampling algorithm, was used to randomly select sample units (Stevens and Olsen 2004). The GRTS design has several appealing properties with respect to long-term monitoring of birds at large spatial scales:

- Spatially-balanced sampling is generally more efficient than simple random sampling of natural resources (Stevens and Olsen 2004). Incorporating information about spatial autocorrelation in the data can increase precision in density estimates;

All sample units in the sampling frame are ordered such that any set of consecutively numbered units is a spatially well-balanced sample (Stevens and Olsen 2004). In the case of fluctuating budgets, IMBCR partners can adjust the sampling effort among years within each stratum while still preserving a random, spatially-balanced sampling design.

The IMBCR design defines sampling units as 1-km^2 cells that were used to create a uniform grid over the Camp Guernsey stratum. Within each grid cell there is a 4 x 4 grid of 16 points spaced 250 m apart (Figure 2). All spatial data were compiled using ArcGIS 10.0 (Environmental Systems Research Institute 2011). RMBO has provided Camp Guernsey staff with a GIS shapefile containing UTM locations of the center points and point count stations within these grids for use in the future. The 25 highest-ranked grid cells selected using the sampling design described above are shown in Figure 3. RMBO recommends a minimum of 20 grid cells be sampled annually to allow for the production of robust density estimates and to determine trends in the density estimates over time. RMBO anticipates that a minimum of 10 samples may be adequate if occupancy estimates are sufficient for Camp Guernsey managers. Sampling intensity may vary across years; however, we recommend at least the minimum suggested sampling of 20 sites be conducted for years in which robust estimates are desired. Additionally, by surveying at least 20 of the 280 grid cells making up the Camp Guernsey stratum, managers can reasonably assume that sampling is occurring across habitats in proportion to their availability on the landscape.

The ability to detect trends is influenced by the magnitude of change in population estimates across years, the variability in year-to-year estimates, the precision of estimates each year, and the number of data points (years) for which estimates are available. The magnitude of change in population estimates and the variability of estimates across years should be a reflection of the biological system and cannot be impacted by sampling intensity or design. Increasing sampling intensity within years can increase the precision of estimates. Similarly, sampling each year will maximize the number of data points within a given timeframe and reduce the overall amount of time required to detect a trend. Using data from an avian monitoring program similar to the one described in this document, we estimated the precision of estimates needed to detect an annual 3% decline or increase in the population of a species within 25 years with 80% power. Results indicated that a density estimates with a Coefficient of Variation ≤ 40% would detect such a trend if data were collected annually (J. Blakesley, RMBO, unpublished).

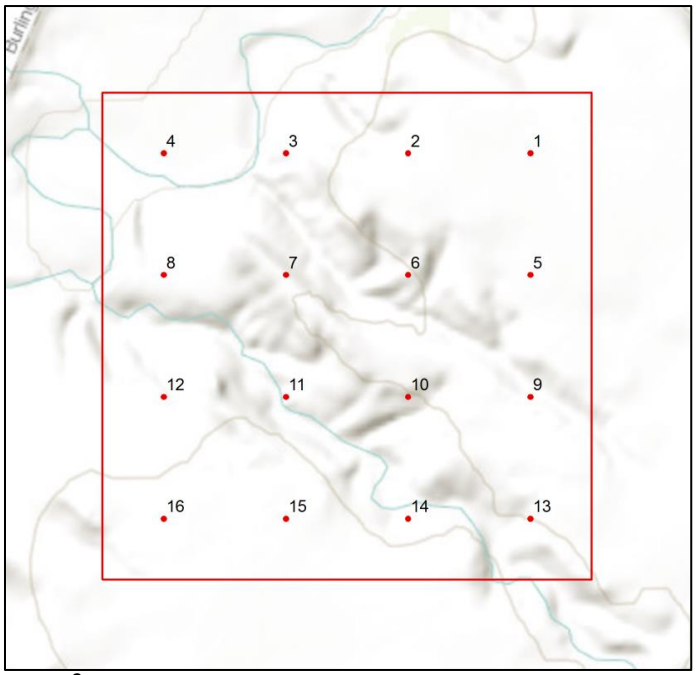

Figure 2. Example 1-km^2 grid cell with 16 point count stations based on the IMBCR design.

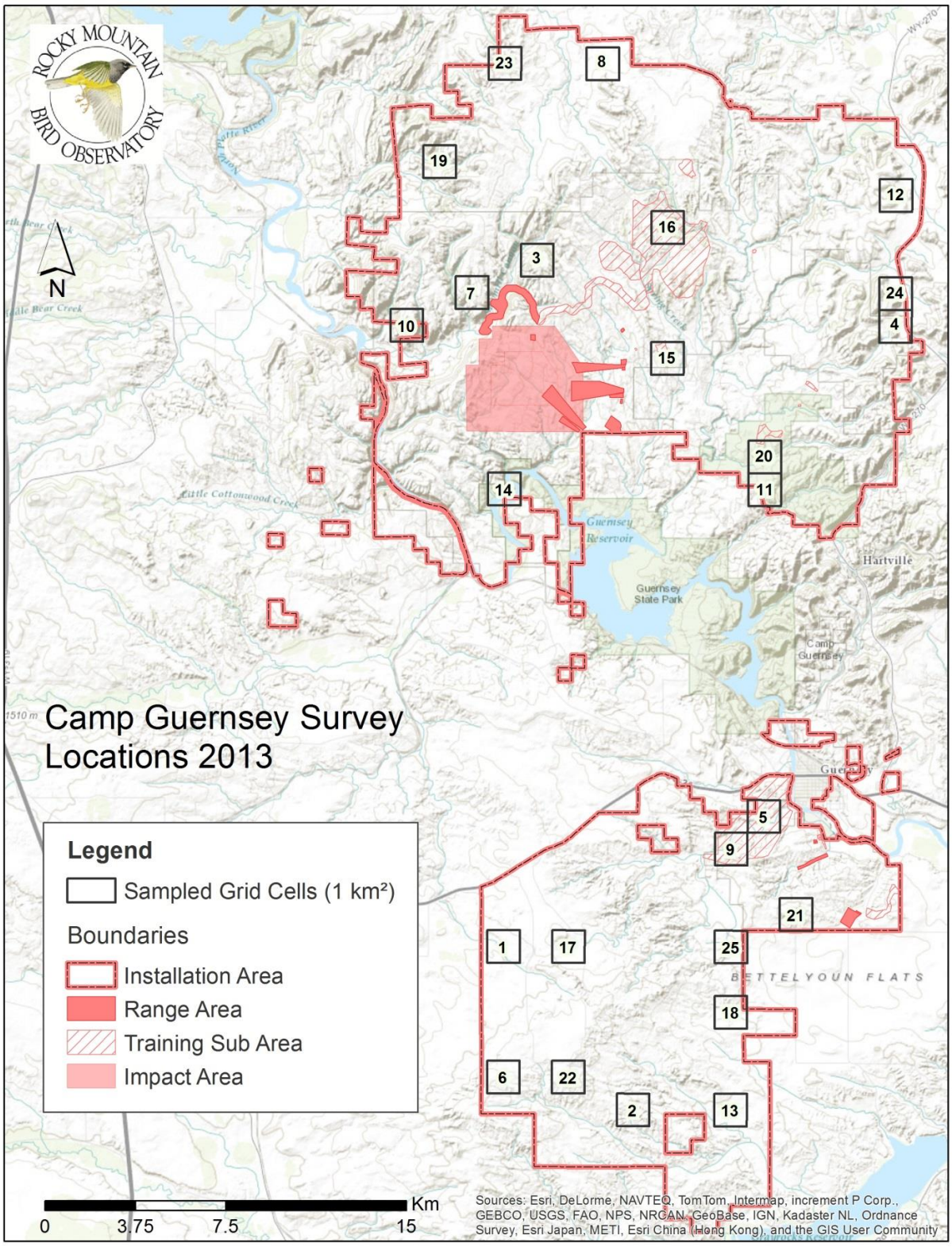

Figure 3. The 25 highest-ranked grid cells selected using GRTS sampling on Camp Guernsey.

Sampling Methods

Breeding landbird data should be collected using point count methodology (Buckland et al. 2001) consistent with that of the IMBCR program (White et al. 2013). RMBO recommends that Camp Guernsey staff visit the Rocky Mountain Avian Data Center (http://rmbo.org/v3/avian/DataCollection.aspx) to download the latest IMBCR field protocol and datasheets (Appendix B).

Staff and/or biological technicians with excellent aural and visual bird-identification skills should conduct the data collection each year between May 20th and June 20th to ensure that surveys are completed when birds detected during the surveys represent locally-breeding individuals and when breeding individuals are still readily vocalizing. Prior to conducting surveys, technicians should be trained to ensure they have a complete understanding of field protocols and sufficient knowledge of bird identification. RMBO typically holds a seven-day training to ensure data are collected properly. An abbreviated training session may be sufficient if individuals possess substantial knowledge of avian identification and/or have previous experience conducting point count surveys.

Observers should survey in the morning, beginning one-half hour before sunrise and concluding their survey no later than five hours after sunrise. The complete sampling interval at each point should be six minutes. For every bird detected during each of the six minute counts, data collectors should record species, sex, horizontal distance from the observer, the minute they detected the bird, and type of detection (e.g., call, song, visual). Observers should measure distances using laser rangefinders. When it is not possible to measure the distance to a bird, observers estimated distance by measuring to some nearby object. Observers should record birds flying over but not using the immediate surrounding landscape. The "flyover" detections should not be included in density or occupancy analyses because it is unclear whether these birds actively occupy the site. Data collectors should consider all non-independent detections of birds (i.e., flocks or pairs of conspecific birds together in close proximity) as part of a 'cluster' rather than as independent observations. Observers should record the number of birds detected within the cluster along with a unique letter code to keep track of each distinct cluster.

At the start and end of each survey data collectors should record the time, ambient temperature, cloud cover, precipitation, and wind speed. Data collectors should navigate to each point using hand-held Global Positioning System (GPS) units. Before beginning each count, data collectors should record the following vegetation data (within a 50 m radius): dominant habitat type; relative abundance and percent cover by species, mean height of trees and shrubs; and percent cover of several groundcover categories (e.g., herbaceous, bare/litter, woody, grass). Vegetation data should be recorded quietly to allow birds, potentially disturbed during the approach to the point, time to return to their normal habits prior to the beginning of each count.

Field technicians should attempt to survey all points within a grid cell each morning. Occasionally, terrain, weather conditions, or private landownership may prohibit the technician from completing all 16 point count surveys in a morning. If a technician cannot collect data at a minimum of six points during a particular survey because of inclement weather then the grid cell should be revisited on another day when data can be collected at a minimum of six point count stations. If a technician cannot navigate to a minimum of six points because of terrain, then the survey site should be replaced with the next highest ranked grid cell.

Data Analysis

At the most fundamental level, reliable knowledge about the status of avian populations requires accounting for spatial variation and incomplete detection of the target species (Pollock et al. 2002, Rosenstock et al. 2002, Thompson 2002). We recommend that density estimates are produced using methods that incorporate distance sampling theory and removal modeling be used in the creation of occupancy estimates to account for incomplete detection. The IMBCR survey protocol incorporates the principles of removal modeling and distance sampling theory. Data collected using this protocol will therefore allow Camp Guernsey managers to account for incomplete detection.

Distance Analysis

Distance sampling theory was developed to account for the decreasing probability of detecting an object of interest (e.g., a bird) with increasing distance from the observer to the object (Buckland et al. 2001). The detection probability is used to adjust the count of birds to account for birds that were present but undetected. Application of distance theory requires that three critical assumptions be met: 1) all birds at and near the sampling location (distance = 0) are detected, 2) distances to birds are measured accurately, and 3) birds do not move in response to the observer's presence (Buckland et al. 2001, Thomas et al. 2010).

Analysis of distance data includes fitting a detection function to the distribution of recorded distances (Buckland et al. 2001). The distribution of distances can be a function of characteristics of the object (e.g., for birds, size and color, movement, volume of song or call and frequency of call), the surrounding environment (e.g., density of vegetation) and observer ability. Because detectability varies among species, we recommend analyzing the data separately for each species. We recommend Camp Guernsey estimate breeding bird densities of all species for which there is a sufficient number of independent detections ($n \geq 80$) pooled across all years where data were collected. If there are a sufficient number of detections ($n \geq 80$) within a single year then data do not need to be pooled across years. Bird detections should not be pooled across seasons. Therefore breeding bird detections collected between May 20th and June 20th should not be combined with detections during non-breeding (fall or winter) surveys. This is because territorial breeding birds are expected to be much more detectable than non-breeding birds due to increased singing rates. Birds flying over, but not using the immediate surrounding landscape, juveniles, suspected migrants, and birds detected between points should be excluded from analyses.

The SPSURVEY package (Kincaid 2008) can be used in Program R (R Development Core Team, 2010) to estimate density, population size and confidence intervals for each species. For each species, a global detection function should be fit for all years as well as a detection function which models year as a covariate (when there is sufficient detection data within a given year). Akaike's Information Criterion (AIC) corrected for small sample size (AIC_c) and model selection theory can be used to select the most parsimonious detection function for each species (Burnham and Anderson 2002). The SPSURVEY package uses spatial information from the survey locations to improve estimates of the variance of density.

Occupancy Analysis

Occupancy estimation is most commonly used to quantify the proportion of sample units (i.e., 1-km^2 cells) occupied by an organism (MacKenzie et al. 2002). The application of occupancy modeling requires multiple surveys of the sample unit in space or time to estimate a detection probability (MacKenzie et al. 2006). The detection probability adjusts the proportion of sites occupied to account for species that were present but undetected (MacKenzie et al. 2002). The assumptions of occupancy modeling are: 1) the probabilities of detection and occupancy are constant across the sample units, 2) each point is closed to changes in occupancy over the sampling season, 3) the detection of species at each point are independent and 4) the target species are never falsely identified (MacKenzie et al. 2006).

Removal modeling is based on mark-recapture theory where detection probability is estimated based on the number of birds detected during consecutive sampling intervals (Farnsworth et al. 2002). We recommend a removal design (MacKenzie et al. 2006) to estimate a detection probability for each species by partitioning the six-minute count into three sequential two-minute sampling intervals. After the target species is detected at a point, all subsequent sampling intervals at that point should be set to "missing data" (MacKenzie et al. 2006). The 16 points in each grid cell can serve as spatial replicates for estimating the proportion of points occupied within the sampled grid cells. We recommend a multi-scale occupancy model (Nichols et al. 2008, Pavlacky et al. 2012) to estimate 1) the probability of detecting a species given presence (*p*), 2) the proportion of points occupied by a species given presence within sampled grid cells (Theta), and 3) the proportion of grid cells occupied by a species (Psi).

We expect that regional differences in the behavior, habitat use and local abundance of species will correspond to regional variation in detection and the fraction of occupied points. Therefore, if Camp Guernsey data will be analyzed in concert with a dataset collected over a larger geographic region, we recommend estimating the proportion of grid cells occupied (Psi) for each stratum by evaluating four models with different structure for detection (*p*) and the proportion of points occupied (Theta). Within these models, the estimates of *p* and Theta can be held constant across the BCRs and/or allowed to vary by BCR. Models are defined as follows:

Model 1: Constrain *p* and Theta by holding these parameters constant;
Model 2: Hold *p* constant, but allow Theta to vary across BCRs;
Model 3: Allow *p* to vary across BCRs, but hold Theta constant;
Model 4: Allow both *p* and Theta to vary across BCRs.

We recommend model averaging the estimates of Psi from models 1 through 4 and calculating unconditional standard errors and 90% confidence intervals for the estimates (Burnham and Anderson 2002). By allowing *p* and Theta to vary by BCR, regional variation in detection and availability is accounted for, which can be important for generating robust estimates of the proportion of grid cells occupied (Psi). If Camp Guernsey conducts analyses in the future with only the data collected on site, running a single model, which estimates p, Theta and Psi for Camp Guernsey data, will be sufficient.

The described application of the multi-scale model is analogous to a within-season robust design (Pollock 1982) where the two-minute intervals at each point serve as the secondary samples for estimating *p* and the points are the primary samples for estimating Theta (Nichols et al. 2008, Pavlacky et al. 2012). Both *p* and Theta can be considered nuisance variables that are important for generating unbiased estimates of Psi. Theta can be considered an availability parameter or the probability a species

was present and available for sampling at the points (Nichols et al. 2008, Pavlacky et al. 2012). As mentioned above, we recommend estimating the probability of detection (*p*) using a removal design with three sampling intervals. Using the six one-minute intervals recorded during sampling, bin minutes one and two, minutes three and four, and minutes five and six to meet the assumption of a monotonic decline in the detection rates through time. Data should be truncated, using only detections ≤124 m from the sample points. Truncating these data at 124 m ensures that bird detections are occurring within a consistent plot size and ensures that the points are independent (points were spread 250 m apart), which in turn allows for the estimation of Theta (the proportion of points occupied within each grid cell) (Pavlacky et al. 2012). Lastly, only using detections from within 124 m of the point count station ensures that all detections occurred within the 1-km^2 grid cell.

The proportion of grid cells occupied should be estimated for all species that are detected on a minimum of 5 points after removing detections beyond 124 m of each point. Occupancy estimates for species occurring on fewer than five points should not be reported because of unreliable model convergence.

Riparian Area Searches

Avian diversity was found to be relatively high in the riparian habitats of Camp Guernsey during the 2013 breeding season. The majority of observed species were also adequately monitored via the IMBCR grid-based point count surveys (Van Lanen and Hanni 2014). We were able to produce occupancy and/or density estimates for 46 of the 54 (85%) species that were detected during the riparian area searches via the grid-based sampling effort. We believe this adequately monitors the breeding riparian species and reduces the need for continued area searches in Camp Guernsey, provided the grid-based landbird sampling program continues in the future. The following species were detected during riparian area searches but their density and/or occupancy rates were not estimated from the grid-based sampling effort: Common Raven, Eastern Bluebird, European Starling, Great-horned Owl, Mallard, Red-winged Blackbird, Wood Duck, and Yellow-breasted Chat. If monitoring these species' presence on Camp Guernsey is of importance to managers then continued riparian area searches is advised regardless of whether the grid-based sampling effort continues.

In the event that Camp Guernsey managers wish to continue riparian area searches, we have included an area search datasheet in Appendix B. Area searches should follow the same seasonal and daily timing recommendations and weather restrictions as the grid-based point counts. Figure 4 shows riparian areas that were surveyed in 2013. UTM coordinates of the start and end of these surveys are shown in Table 1. If continued riparian area searches are desired, we recommend that surveys are conducted in the regions displayed in Figure 4 and that searches are restricted to the riparian stretches between the start and end UTM coordinates shown in Table 1. Additional riparian area searches may be added if other areas are thought to represent suitable habitat by Camp Guernsey managers. UTM coordinates of start and end points of the additional surveys should be taken to allow for the searches to be repeatable within and across years.

Table 1. UTM coordinates of start and end points during area searches in riparian habitat in Camp Guernsey. UTM coordinates are projected in NAD83, Zone 13.

Area Search Location	Start UTM (Easting)	Start UTM (Northing)	End UTM (Easting)	End UTM (Northing)
Broom Creek Canyon	518650	4692800	518270	4696000
Patten Creek	522152	4698892	521882	4698719
S. Broom Creek Canyon	517493	4689103	517636	4690390
S of Impact Area	513558	4689837	512572	4689228

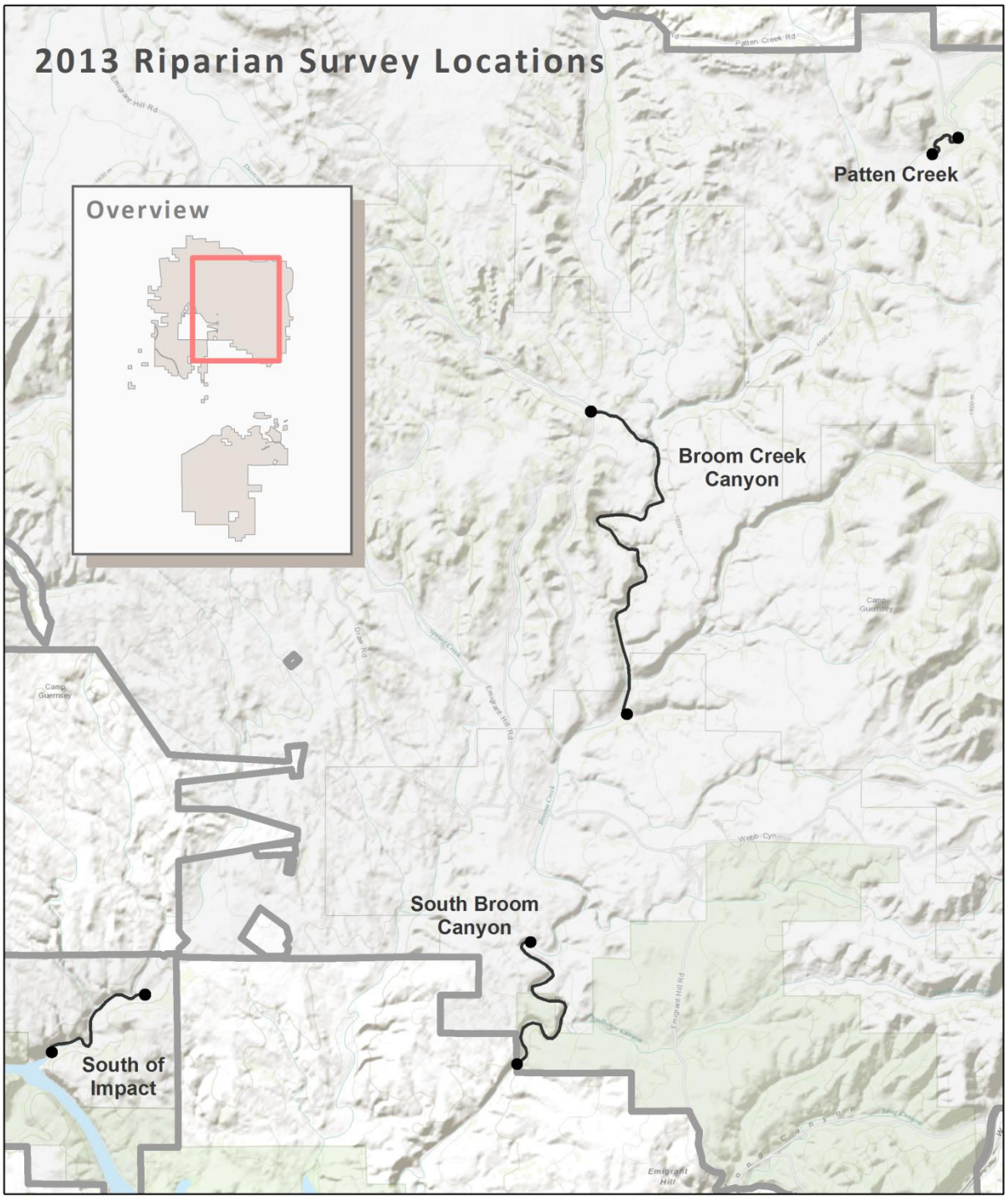

Figure 4. Locations of 2013 area searches conducted in riparian habitat on Camp Guernsey.

Breeding Raptor Surveys

Rigorous monitoring of raptors requires several different methodologies in order to adequately detect various species. Some raptor species may be monitored utilizing the songbird monitoring methodology discussed earlier in this document, assuming enough detections are recorded. Other species can be monitored using aerial surveys, road-based surveys, or broadcast/playback surveys (Fuller and Mosher 1987; Ethier 1997). Table 2 represents raptor species that may occur on Camp Guernsey and the recommended method for detecting them. Managers should utilize the methods described in the following sections to supplement the grid-based monitoring effort and to determine which raptor species are present. Camp Guernsey managers can then determine if there is a need for more detailed information for particular species which are known to occur on Camp Guernsey.

Table 2. Raptor species potentially occurring on Camp Guernsey, the likelihood of occurrence and the recommended survey methodology to survey for each species.

Species	Likelihood of Occurrence	Grid-based	Aerial Transect	Road-based Survey	Diurnal Playback	Nocturnal Playback
American Kestrel	Confirmed	X				
Bald Eagle	Confirmed	X	X	X		
Burrowing Owl	Confirmed	X			X	
Cooper's Hawk	Unlikely	X			X	
Eastern Screech-owl	Unlikely					X
Ferruginous Hawk	Confirmed	X	X	X		
Golden Eagle	Likely	X	X	X		
Great Horned Owl	Confirmed	X		X		X
Long-eared Owl	Possible					X
Merlin	Confirmed	X				
Northern Goshawk	Confirmed	X			X	
Northern Harrier	Likely	X				
Northern Saw-whet Owl	Unlikely					X
Osprey	Confirmed	X	X	X		
Prairie Falcon	Likely	X	X	X		
Red-tailed Hawk	Confirmed	X	X	X		
Sharp-shinned Hawk	Unlikely	X			X	
Short-eared Owl	Possible					X
Swainson's Hawk	Likely	X	X			

Determining Presence of Large-bodied Diurnal Raptors

Aerial Surveys

We recommend that Camp Guernsey staff fly aerial line transects to determine the presence and potential nesting locations for larger raptor species including Ferruginous and Red-tailed Hawks, Osprey, Great-horned Owls, Bald Eagles and Golden Eagles. UTM locations representing the east and west limits of each proposed aerial line transect are shown in Table 3 and a map of the aerial line transects is shown in Figure 5. We recommend that all transects be surveyed. Aerial surveys should be conducted between May 15 and June 10 to optimize the likelihood of detecting all of the large-bodied breeding raptors during a single survey window (Ethier 1997). If possible, all aerial line transects should be surveyed in the same day to reduce the possibility of double counting individuals. If it is necessary to conduct the aerial surveys over two days then we recommend surveys WY-DOD-CG-AT1 through WY-DOD-CG-AT8 be flown together and WY-DOD-CG-AT9 through WY-DOD-CG-AT14 be flown together.

Table 3. UTM coordinates of aerial transect east and west end points for surveying large-bodied raptors on Camp Guernsey. UTM northing and easting coordinates are projected in NAD83, Zone 13.

Aerial Transect	West_Easting	West_Northing	East_Easting	East_Northing
WY-DOD-CG-AT1	511500	4701500	515500	4701500
WY-DOD-CG-AT2	508500	4699500	522500	4699500
WY-DOD-CG-AT3	508500	4697500	523500	4697500
WY-DOD-CG-AT4	508500	4695500	523500	4695500
WY-DOD-CG-AT5	508500	4693500	523500	4693500
WY-DOD-CG-AT6	508500	4691500	523500	4691500
WY-DOD-CG-AT7	508500	4689500	523500	4689500
WY-DOD-CG-AT8	508500	4687500	513500	4687500
WY-DOD-CG-AT9	515500	4678500	522500	4678500
WY-DOD-CG-AT10	511500	4676500	523500	4676500
WY-DOD-CG-AT11	511500	4674500	518500	4674500
WY-DOD-CG-AT12	511500	4672500	519500	4672500
WY-DOD-CG-AT13	511500	4670500	519500	4670500
WY-DOD-CG-AT14	512500	4668500	519500	4668500

Aerial surveys should be conducted from a small plane or helicopter with adequate viewing windows between sunrise and 1300 hours MDT. Flights should occur on days when visibility is not impeded and weather conditions are fair. Early morning surveys should be flown in an east to west fashion to improve observers' ability to detect raptors. Surveys occurring between approximately 1000 hours and 1300 hours will therefore be the most efficient as transects can be flown both east to west and west to east. The aircraft should maintain an altitude of 80 to 100 m above ground level and a flight velocity between 50 and 75 km per hour during the surveys. The survey speeds and height of aircraft are based loosely off of recommendations by Fuller and Mosher (1987).

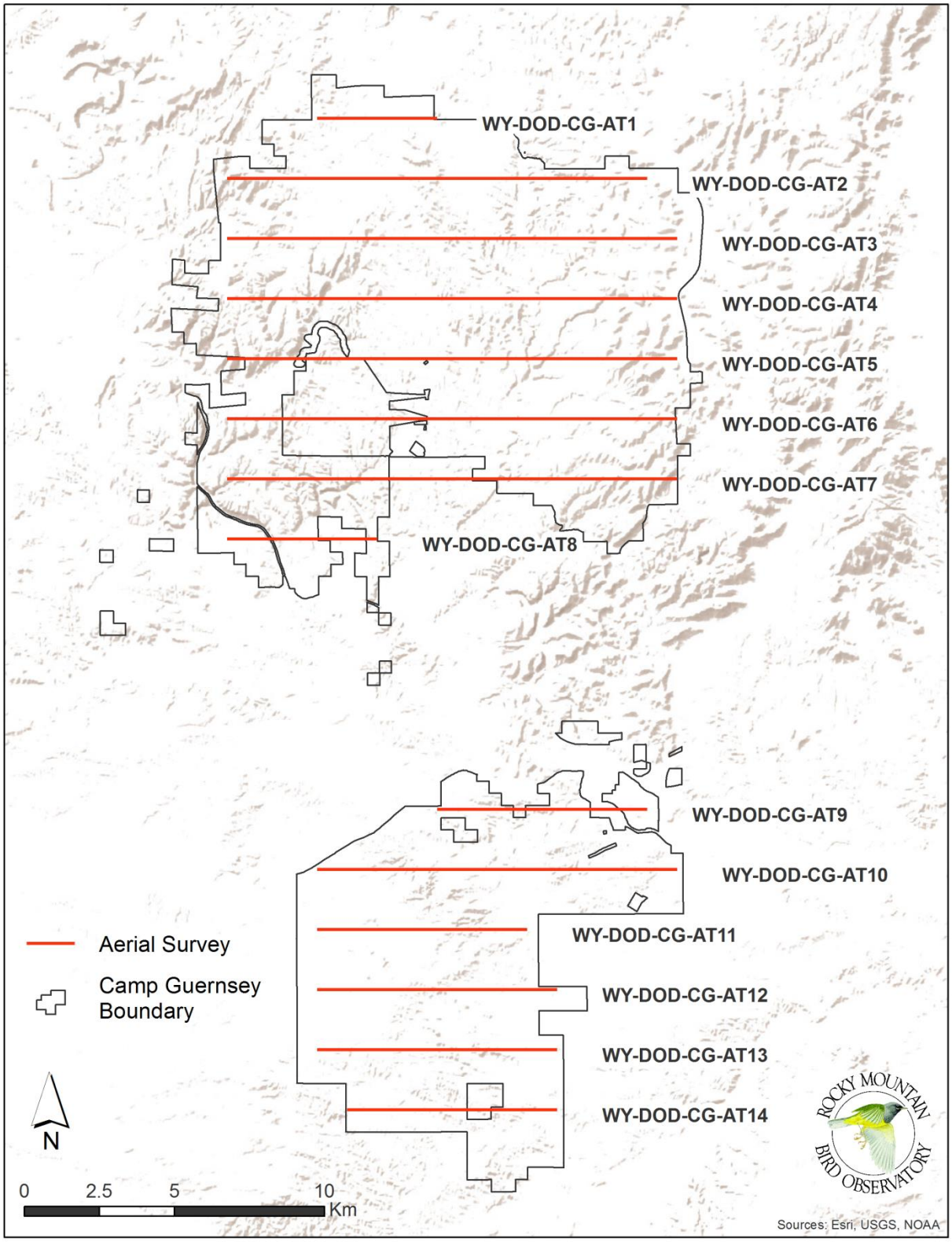

Figure 5. Locations of 14 aerial transect line survey routes for determining presence of breeding raptors on Camp Guernsey.

Two observers (in addition to the pilot) should conduct the surveys to facilitate the detection of raptors both north and south of the transect line. Observers should focus on locating raptors flying or perched within 1 km of the aircraft. Once a raptor is spotted the aircraft should approach the location where it was first seen and a GPS position should be recorded. Raptors should be aged and sexed when possible. Record notes if raptors are observed at or near a nest site. Observers should make every effort to prevent the double counting of raptors. Upon obtaining coordinates of the position, the aircraft should return to the location on the transect line from which the raptor was observed and continue the survey.

Diurnal Road-based Surveys

In the event that aerial based surveys are not possible, Camp Guernsey managers may consider surveying raptors using diurnal road-based surveys. We recommend raptor count stations be created at 1-km intervals along existing roadways. Surveyors should visit these count stations between 1000 and 1700 hours MDT when thermals are well developed and raptors are most visible. Surveys should be conducted between May 15 and June 10. Surveyors should scan the surrounding landscape and sky for five minutes at each count station, record all raptors detected and note any potential raptor nests. Additionally, raptors seen while driving between points should also be recorded.

If locating active raptor nests is a priority for Camp Guernsey managers, surveyors should walk concentric circles around survey locations where raptors are observed and are repeatedly calling if the nest is not within sight from the survey location. Concentric circles should be 20 m apart from each other. For example, the surveyor would walk a circle 20 m away from the survey point. If no nest is found they should walk another circle 40 m away from the survey point. Raptors will typically increase the intensity and frequency of vocalizations as an observer approaches a nest.

Diurnal Playback Surveys

Diurnal playback surveys are recommended for determining the presence of *accipiters*: Sharp-shinned Hawks, Cooper's Hawks and Northern Goshawks. They can also be effective in determining the presence of Burrowing Owls. In the following section we outline and recommend methods for detecting the presence of all *accipiters* and separate methods for identifying the presence of Burrowing Owls.

Determining Presence of *Accipiters*

To maximize survey efficiency while determining the presence of *accipiters*, we recommend surveys be restricted to the 1-km^2 grid cells used in the grid-based monitoring section which contain a minimum of 35% forested habitat based on the LandFire Existing Vegetation Layer. Specifically, grid cells for sampling should be restricted to those containing a minimum of 35% cover of "Northwest Great Plains_Black Hills_Ponderosa Pine Woodland Savannah" and/or "Southern Rocky Mountain Ponderosa Pine Woodland" cover types (LANDFIRE 2013). The 38 grid cells meeting the expected cover requirement are shown in ranked order of survey preference in Table 4. Ideally, all 38 grid cells will be sampled; however, if that is not possible, we recommend a minimum of 20 cells be surveyed. If less than the full 38 grid cells are surveyed, the rank order should be followed to maintain a probability sample rather than manually picking specific sites. For example, if 20 cells are to be surveyed, sites ranked 1 – 20 should be visited.

Surveys should be conducted between July 1st and August 15th to ensure that all three species of *accipiters* are detectable during the survey window. This timeframe coincides with the nestling and fledgling phase for these three species which is when they are most detectable and not as sensitive to disturbance caused by the survey method recommended in this plan (Rosenfield et al. 1988; Kennedy and Stahlecker 1993, and McClaren 2003). Surveys can be conducted beginning ½ hour before official sunrise and ending no later than ½ hour after official sunset. Surveys should not be conducted on days with high winds, poor visibility, and/or precipitation.

Table 4. Wooded grid cells available for sampling during broadcast surveys for *accipiters* and nocturnal owls. Transectnum is the transect number associated with the grid cell. Rank indicates the priority ranking for conducting surveys.

TransectNum	Rank	% Cover	TransectNum	Rank	% Cover
WY-DOD-CG3	1	50%	WY-DOD-CG176	20	49%
WY-DOD-CG10	2	38%	WY-DOD-CG180	21	43%
WY-DOD-CG16	3	45%	WY-DOD-CG188	22	48%
WY-DOD-CG19	4	49%	WY-DOD-CG190	23	37%
WY-DOD-CG32	5	37%	WY-DOD-CG192	24	36%
WY-DOD-CG44	6	47%	WY-DOD-CG195	25	48%
WY-DOD-CG46	7	81%	WY-DOD-CG199	26	68%
WY-DOD-CG56	8	55%	WY-DOD-CG211	27	54%
WY-DOD-CG62	9	50%	WY-DOD-CG220	28	38%
WY-DOD-CG72	10	44%	WY-DOD-CG224	29	41%
WY-DOD-CG83	11	59%	WY-DOD-CG227	30	47%
WY-DOD-CG88	12	52%	WY-DOD-CG231	31	44%
WY-DOD-CG104	13	61%	WY-DOD-CG232	32	43%
WY-DOD-CG110	14	39%	WY-DOD-CG234	33	35%
WY-DOD-CG126	15	37%	WY-DOD-CG252	34	47%
WY-DOD-CG127	16	50%	WY-DOD-CG255	35	40%
WY-DOD-CG160	17	50%	WY-DOD-CG264	36	41%
WY-DOD-CG167	18	40%	WY-DOD-CG276	37	37%
WY-DOD-CG168	19	42%	WY-DOD-CG280	38	55%

Surveyors should visit all point count stations within a selected grid provided there is some suitable habitat (forested landscape) within 150 m of the point count station. Point count stations can be visited in any order to facilitate ease of travel. Once at a point count station, surveyors should play recordings for each of the three *accipiter* species in the following order: Sharp-shinned Hawk, Cooper's Hawk and Northern Goshawk. Broadcasting recordings in the order of smallest to largest species may help reduce the likelihood of non-response due to the risk of interspecific competition or predation (Call 1978).

Broadcast acoustical survey methodology at the point count stations should follow the protocol developed by Woodbridge and Hargis in 2006 (see page 55 of that document). This methodology calls for 10 seconds of broadcast vocalizations followed by 30 seconds of silent observation. The next round of vocalizations should be aimed 120 degrees from the direction of the last broadcast. After three bouts, a complete 360-degree circle is made and the process is repeated for a second round of three broadcasts. This entire process should then be repeated for the Cooper's Hawk and then the Northern

Goshawk. We recommend that a single audio file be created with the periods of silence and calls of all three species to maintain consistency throughout playback surveys.

Based on the suggested seasonal timing for surveys, the following call types should be broadcast during surveys: Sharp-shinned Hawk "kik-kik-kik" alarm call (Bildstein and Meyer 2000); Cooper's Hawk "kak-kak-kak" calls (Bent 1937; Rosenfield 1988); and Northern Goshawk juvenile food-begging and wail calls (Woodbridge and Hargis 2006). These vocalizations can be found, and likely used with permission, at: http://www.xeno-canto.org/. Alternatively, many bird vocalization compilations have been made and are sold; such as Peterson's "A Field Guide to Western Bird Songs" and "Stokes Field Guide to Bird Songs". Vocalizations should be broadcast by a speaker system producing at least 80 to 110 dB output 1 m from the speaker (Woodbridge and Hargis 2006). We recommend using Fox Pro NX Audio Playback Devices for broadcasting vocalizations.

If no detections occur, the observer should then travel to the next point count station. The observer should end the survey within a grid cell upon a detection of any of the three accipiter species. According to Woodbridge and Hargis (2006), detections may occur while walking between broadcast stations. Therefore, the observer should always walk between stations rather than use a motor vehicle and should scan for signs (droppings, prey feathers, etc.). Because Northern Goshawks may be aggressive during nest defense, we recommend that surveyors wear hard hats and eye protection during surveys.

Determining Presence of Burrowing Owls

As with *accipiters*, diurnal playback surveys are recommended for determining the presence of Burrowing Owls to maximize the probability of detecting individuals that are present (Haug and Didiuk 1993; Conway and Simon 2003; Conway et al. 2008). Given the strong association Burrowing Owls have with prairie dog colonies (Desmond et al. 2000; Orth and Kennedy 2001; Sidle et al. 2001; Tipton et al. 2009), we recommend all landbird grid cells containing a prairie dog colony be selected for Burrowing Owl surveys as well. Burrowing Owl point count stations should be established within 150 m of the colony and within the bounds of the grid cell where the colony is present.

Surveys should be conducted between June 20 and July 25 when the young of the year have left the nest. This is when detection probability is maximized (Conway and Simon 2003; Conway et al. 2008). Surveys should be conducted in the morning between sunrise and four hours after sunrise and in the evening during the four hours prior to sunset (Haug and Didiuk 1993). As with the other methods described, surveys should not be conducted during high winds, poor visibility, or precipitation. Ideally, temperatures will be between 21 and 33 degrees Celsius (70 and 92 degrees Fahrenheit) (Manning 2011).

Surveys at the point count stations should begin with a three-minute silent observation period in which the observer scans the landscape, paying particular attention in the direction of the prairie dog colony. Following the three minutes of silent scanning, the observer will alternate playing 30 seconds of the "coo-coo" male territorial Burrowing Owl call (Martin 1973; Haug and Didiuk 1993) with 30 seconds of silence. The playback portion of the survey should include three periods of playing calls and three periods of silence for a total of three minutes. Therefore, an entire survey at a point count station will last six minutes in duration. The survey can be discontinued upon determining the presence of one or more Burrowing Owls. We recommend that a single audio recording which includes the periods of silence is created to ensure repeatability of the playback procedures during the surveys.

Determining Presence of Nocturnal Owls

We recommend conducting nocturnal playback surveys to determine the presence of the following nocturnal owl species: Eastern Screech-owl, Great Horned Owl, Long-eared Owl, and Northern Saw-whet Owl. Due to these species' association with wooded habitat, we recommend surveys be restricted to the 1-km^2 grid cells used in the grid-based monitoring section which contain a minimum of 35% forested habitat based on the LandFire Existing Vegetation Layer. Specifically, grid cells for sampling should be restricted to those containing a minimum of 35% cover of "Northwest Great Plains_Black Hills_Ponderosa Pine Woodland Savannah" and/or "Southern Rocky Mountain Ponderosa Pine Woodland" cover types (LANDFIRE 2013). These 38 grid cells which meet the expected cover requirement are shown in ranked order of survey preference in Table 4. Additionally, surveys should be conducted at points designated at 250 m intervals along the riparian areas shown in Figure 4. Survey locations should be created and used repeatedly for consistency of survey effort and locations.

All four species of nocturnal owls may be responsive within the seasonal window of March 1 through May 1 (Bent 1938). As such, it may be possible to effectively survey for all four species during a single visit to a point count station. However, due to the number of species and the possibility of reducing detectability as a result of interference competition (Call 1978), we recommend that the four species be surveyed on two separate occasions. Therefore, we recommend that surveys be conducted for Eastern Screech-owls and Great Horned Owls from February 15 through March 15 and surveys be conducted for Northern Saw-whet Owls and Long-eared Owls from March 15 through April 15. These seasonal windows should result in surveys being conducted when each of these species are at, or near, the peak of their territorial behavior (Cramp 1985; Ritchison et al. 1988; Johnson 1992; Martínez et al. 2002). Surveys can be conducted beginning one-half hour after official sunset and concluding no later than midnight MDT (Takats et al 2001). Surveys should not be conducted on evenings with high winds, poor visibility, and/or precipitation.

Surveyors should visit all point count stations within a selected grid, provided there is some suitable habitat (forested or riparian habitat) within 150 m of the point count station. Point count stations can be visited in any order to facilitate ease of travel. Observers should walk between survey stations and record any detections observed while traveling between points. Once at a point count station, observers should begin the survey with a two-minute silent listening period. Following the two minutes of listening, owl vocalizations should be played for four minutes. Lastly, the survey should conclude with another two minutes of silent listening. Once playback procedures for the smaller of the two species (Northern Saw-whet Owl or Eastern Screech-owl) are complete, the observer can begin playback procedures for the larger of the two species (Long-eared Owl or Great Horned Owl). The complete survey for both species should take 16 minutes. If no detections occur, the observer should then travel to the next point count station. The observer should end the survey within a grid cell upon a detection of any nocturnal owl species.

Male territorial and/or mating calls should be used during broadcast surveys for the four nocturnal owl species: the "whoop" call of the Northern Saw-whet Owl (Bent 1938); the "warble" (bouncing) call for Eastern Screech-owls (Smith 1987; Ritchison et al. 1988); the "hoo" call of the Long-eared Owl (Johnsgard 1988); and the 4 to 7-note hoots of the Great Horned Owl (Johnsgard 1988). As with the accipiter recordings, these vocalizations can be found, and likely used with permission, at: http://www.xeno-canto.org/. Alternatively, many bird vocalization compilations have been made for purchase; such as Peterson's "A Field Guide to Western Bird Songs" and "Stokes Field Guide to Bird

Songs". A single recording should be made for the entire 16-minute survey, complete with silent intervals, to ensure consistency across all surveys. Playback equipment used for nocturnal playback surveys should meet the standards described above for diurnal playback surveys.

Estimating Raptor Population Sizes

Aerial Surveys for Large-bodied Raptors

Field methods for obtaining data to estimate large-bodied raptor populations are identical to those described in the aerial survey section for determining presence or absence of raptors. Due to the relatively small study area, we anticipate a low number of detections for each species. Because of this, we recommend Camp Guernsey managers attempt to conduct a census for the installation rather than attempt to estimate population sizes through distance analysis. In order to conduct the census, all proposed transects in Table 2 (see also Figure 3) should be flown during the proposed survey window in a given census year.

Diurnal Road-based Surveys for Large-bodied Raptors

As with the aerial surveys, we recommend a census be conducted for determining the number of large-bodied raptors on Camp Guernsey. To do this, managers should visit all road-based raptor count stations. Care should be taken to avoid double-counting of individuals.

Diurnal Playback Surveys

Accipiters
It is unlikely that Camp Guernsey managers will acquire enough detection data to accurately estimate detectability of the three *accipiter* species. Therefore, we recommend that managers seeking population sizes for these species attempt to conduct a complete census, or total count of individuals. It should be noted that this can be difficult because *accipiters* may limit vocalizations during seasons where they are not actively nesting (i.e., if they did not nest or if the nest failed). An alternative would be to conduct dawn acoustical surveys and intensive search surveys; however, these tend to be time consuming and may not be cost-effective (Woodbridge and Hargis 2006). Survey methods and timing for estimating populations sizes are identical to that described above for determining the presence of *accipiters*. We recommend that each grid cell be surveyed twice during the recommended window to increase the likelihood of *accipiter* detections.

Burrowing Owls
As with estimating population sizes for *accipiters*, we recommend a census be attempted for Burrowing Owls. The methods and timing for completing the census are identical to those described in the determining presence section. Completing a census will require that all landbird grid cells containing a prairie dog colony are visited. Repeat visits (two or more visits per site) will likely increase the number of detections and are recommended if a true census of the population is desired.

Nocturnal Playback Surveys
As with the other raptor surveys, we recommend that a complete census be attempted in the event that Camp Guernsey managers would like to estimate population sizes of nocturnal raptor species. The methods and timing for completing the census are identical to those described in the determining presence section. Completing a census for Camp Guernsey will require that all grid cells in Table 4 and established point count stations spaced 250 m apart within riparian corridors are surveyed. Repeat visits (two or more visits per site) will likely increase the number of detections and are recommended if a true census of the population is desired.

Wintering Songbird Surveys

Determining Presence of Wintering Songbirds

To establish an inventory of wintering songbirds on Camp Guernsey, resource managers should follow methods similar to those of the Christmas Bird Count (CBC) with several minor adjustments. The winter surveys should be restricted to within the boundaries of Camp Guernsey but a defined CBC count circle is not necessary. Similarly, winter surveys do not need to be conducted during the CBC survey window. Surveys conducted between December 1 and February 1 on Camp Guernsey should ensure that birds detected represent wintering birds, not actively-migrating individuals. A survey team could be assembled with Camp Guernsey natural resource staff, volunteers from local Audubon chapters, and/or recruits from WYOBIRDS listserv. Winter inventories should include surveys in grassland, ponderosa pine, and riparian habitats to fully capture the diversity of winter residents on Camp Guernsey.

Estimating Population Sizes for Wintering Songbirds

Line-transect count methodology is recommended for estimating winter songbird populations. The IMBCR survey plots can be easily adapted into two 750-m long line transect segments by having the observer walk from point 1 to point 4 and then from point 12 to point 9 (or vice versa). Bird data should not be collected while walking from point 4 to point 12 to ensure that birds are not double-counted. Data collection should mimic that of the IMBCR protocol; however, the observer(s) should record perpendicular distance between the transect line and the point where the bird was first detected rather than radial distance from the observer. Line-transect surveys should occur between sunrise and 1300 MST. Given the large daily survey window, it is possible that an observer will be able to survey multiple IMBCR grids in a single day. As with the wintering songbird inventory, surveys should be conducted between December 1 and February 1.

Populations can be estimated from these line transect data in DISTANCE as described in the Distance Analysis section for grid-based point count surveys. It is important to note that in DISTANCE, the analyst should indicate that a line transect was used instead of a point transect. This will adjust the survey area and subsequent estimates to account for the difference in methodology.

Migration Stop-over Habitat

Numerous factors have been identified in driving migration and stop-over ecology of bird species. Many studies indicate the ultimate driving force in habitat use during migration is food availability (Hutto 1985, Petit 2000, and Buler et al. 2007). Raptors have been shown to avoid open water, travel along ridgelines, and concentrate in areas where thermals become well developed (Bildstein 2006). Waterfowl and shorebirds may be particularly sensitive to water depth (Isola et al. 2000). Insectivorous neo-tropical migrants have been shown to utilize areas with high percentages of hardwood canopy cover which is usually associated with high arthropod abundance (Buler et al. 2007). Without conducting rigorous bird monitoring on Camp Guernsey during both fall and spring migration, we are left to make recommendations regarding potentially important migration stop-over sites based on general ecological and migratory patterns.

We hypothesize that substantial riparian areas within Camp Guernsey will represent important stop-over habitat (Figure 6) based on hardwood canopy cover, increased levels of insect abundance, potential for fruiting trees and shrubs, and heterogeneity of the vegetation structure typically associated with riparian areas (Buler et al. 2007). Additionally, we suggest that north-south oriented ridgelines with some exposed bare rock may represent important raptor movement corridors during migration (Figure 6). North-south oriented ridgelines can produce updrafts when subjected to winds prevailing from the east or west. The orientation of these ridges, and their updrafts, also facilitates the north-south or south-north direction of travel for migrating raptors. The bare rock atop these ridges is more likely to absorb sunlight and aid in the development of thermals which are readily used by raptors throughout the year, particularly during migration (Bildstein 2006).

In addition to the areas identified in Figure 6, we suggest that early successional Ponderosa Pine habitat within Camp Guernsey may be important as well. Rodewald and Brittinham (2004) found consistently high use of edge-dominated and early successional forests by numerous land bird species during fall migration. Therefore, disturbance during the migratory seasons should be minimized in early successional stage forested areas. Lastly, habitat alterations within the areas in Figure 6, early successional stage forests, and within the recently burned habitat, which will soon transition into early successional forest should be avoided.

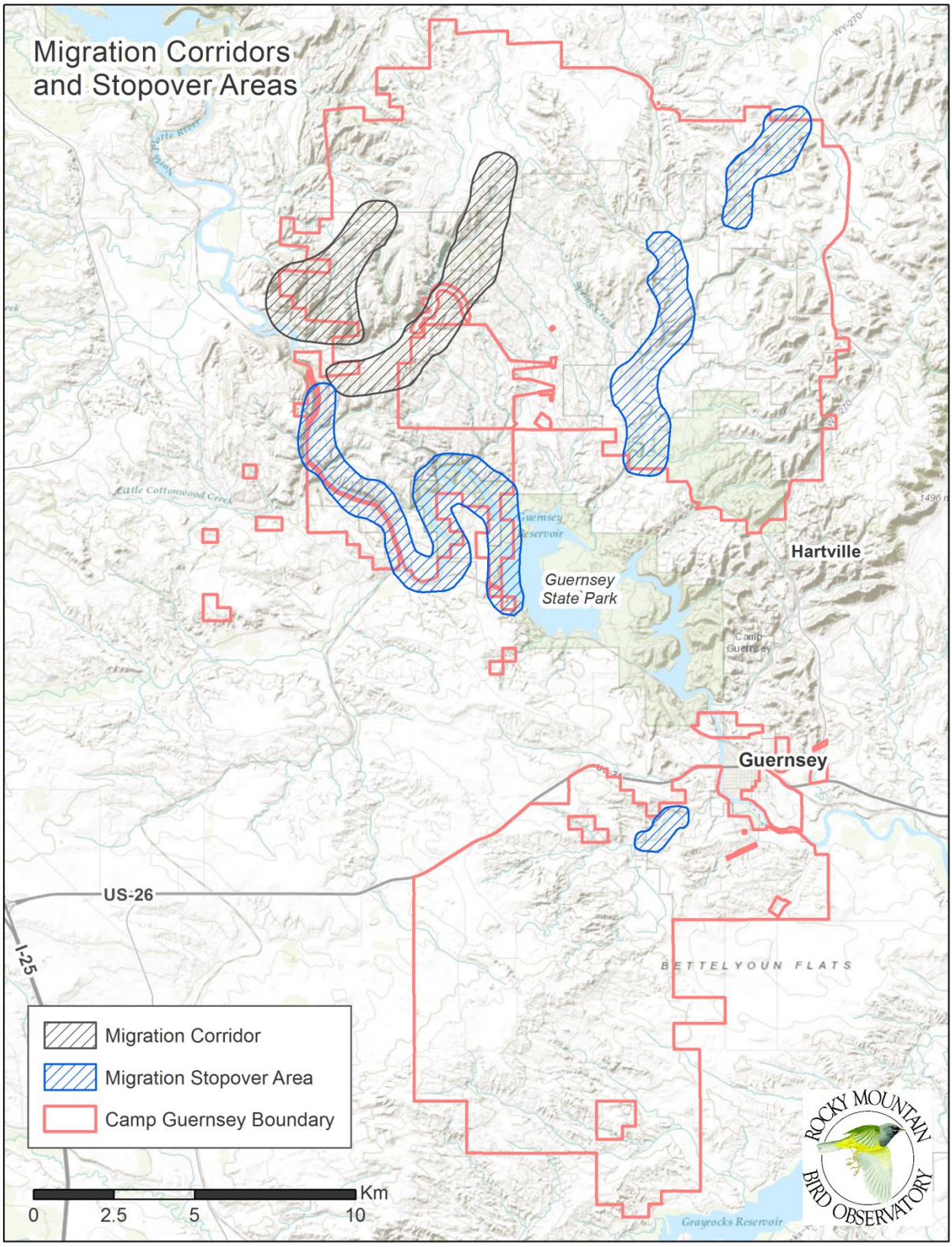

Figure 6. Potentially important bird migration routes and stop-over sites within Camp Guernsey.

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Appendix A: Bird Species Potentially Occurring on Camp Guernsey

Species, likelihood of occurrence, likely season of occurrence and link to natural history information for birds on Camp Guernsey. † Partners in Flight priority species for BCR17 are bolded. M = migration, S = summer, W = winter in the Season column.

Species	Likelihood of Occurrence	Season	Link to Natural History Information
American Avocet	Possible	M,S	http://www.allaboutbirds.org/guide/American_Avocet/lifehistory
American Coot	Unlikely	All	http://www.allaboutbirds.org/guide/american_coot/lifehistory
American Crow	Likely	All	http://www.allaboutbirds.org/guide/american_crow/lifehistory
American Goldfinch	Likely	All	http://www.allaboutbirds.org/guide/American_Goldfinch/lifehistory
American Kestrel	Likely	All	http://www.allaboutbirds.org/guide/american_kestrel/lifehistory
American Redstart	Possible	M,S	http://www.allaboutbirds.org/guide/american_redstart/lifehistory
American Robin	Likely	All	http://www.allaboutbirds.org/guide/american_robin/lifehistory
American White Pelican	Unlikely	M,S	http://www.allaboutbirds.org/guide/american_white_Pelican/lifehistory
American Wigeon	Unlikely	All	http://www.allaboutbirds.org/guide/american_wigeon/lifehistory
Ash-throated Flycatcher	Confirmed	M,S	http://www.allaboutbirds.org/guide/Ash-throated_Flycatcher/lifehistory
Bald Eagle	Confirmed	All	http://www.allaboutbirds.org/guide/Bald_Eagle/lifehistory
Bank Swallow	Possible	M,S	http://www.allaboutbirds.org/guide/bank_swallow/lifehistory
Barn Swallow	Confirmed	M,S	http://www.allaboutbirds.org/guide/barn_swallow/lifehistory
Black-billed Magpie	Confirmed	All	http://www.allaboutbirds.org/guide/black-billed_magpie/lifehistory
Black-capped Chickadee	Confirmed	All	http://www.allaboutbirds.org/guide/black-capped_chickadee/lifehistory
Black-headed Grosbeak	Confirmed	M,S	http://www.allaboutbirds.org/guide/black-headed_grosbeak/lifehistory
Blue Grosbeak	Unlikely	S	http://www.allaboutbirds.org/guide/blue_grosbeak/lifehistory
Blue Jay	Confirmed	All	http://www.allaboutbirds.org/guide/blue_jay/lifehistory
Blue-gray Gnatcatcher	Confirmed	M,S	http://www.allaboutbirds.org/guide/Blue-gray_Gnatcatcher/lifehistory
Blue-winged Teal	Unlikely	All	http://www.allaboutbirds.org/guide/blue-winged_teal/lifehistory
Brewer's Blackbird	Confirmed	M,S	http://www.allaboutbirds.org/guide/brewers_blackbird/lifehistory
Brewer's Sparrow	Confirmed	M,S	http://birds.audubon.org/species/brespa

Species	Likelihood of Occurrence	Season	Link to Natural History Information
Brown Creeper	Likely	All	http://www.allaboutbirds.org/guide/brown_creeper/lifehistory
Brown Thrasher	Confirmed	M,S	http://www.allaboutbirds.org/guide/brown_thrasher/lifehistory
Brown-headed Cowbird	Confirmed	M,S	http://www.allaboutbirds.org/guide/brown-headed_cowbird/lifehistory
Bullock's Oriole	Confirmed	M,S	http://www.allaboutbirds.org/guide/bullocks_oriole/lifehistory
Burrowing Owl	Possible	M,S	http://www.allaboutbirds.org/guide/Burrowing_Owl/lifehistory
Canada Goose	Confirmed	All	http://www.allaboutbirds.org/guide/canada_goose/lifehistory
Canyon Wren	Confirmed	M,S	http://www.allaboutbirds.org/guide/canyon_wren/lifehistory
Cassin's Finch	Likely	All	http://www.allaboutbirds.org/guide/Cassins_Finch/lifehistory
Cassin's Kingbird	Confirmed	M,S	http://www.allaboutbirds.org/guide/cassins_kingbird/lifehistory
Cassin's Sparrow	Confirmed	M,S	http://www.allaboutbirds.org/guide/Cassins_Sparrow/lifehistory
Cedar Waxwing	Likely	All	http://www.allaboutbirds.org/guide/cedar_waxwing/lifehistory
Chestnut-collared Longspur	Unlikely	M,S	http://www.allaboutbirds.org/guide/Chestnut-collared_Longspur/lifehistory
Chipping Sparrow	Confirmed	M,S	http://www.allaboutbirds.org/guide/chipping_sparrow/lifehistory
Clark's Nutcracker	Possible	All	http://www.allaboutbirds.org/guide/clarks_nutcracker/lifehistory
Cliff Swallow	Confirmed	M,S	http://www.allaboutbirds.org/guide/Cliff_Swallow/lifehistory
Common Grackle	Confirmed	M,S	http://www.allaboutbirds.org/guide/common_grackle/lifehistory
Common Merganser	Confirmed	All	http://www.allaboutbirds.org/guide/common_merganser/lifehistory
Common Nighthawk	Confirmed	M,S	http://www.allaboutbirds.org/guide/common_nighthawk/lifehistory
Common Poorwill	Likely	M,S	http://www.allaboutbirds.org/guide/common_poorwill/lifehistory
Common Raven	Likely	All	http://www.allaboutbirds.org/guide/common_raven/lifehistory
Common Yellowthroat	Possible	M,S	http://www.allaboutbirds.org/guide/common_yellowthroat/lifehistory
Cordilleran Flycatcher	Confirmed	M,S	http://www.allaboutbirds.org/guide/cordilleran_flycatcher/lifehistory
Dark-eyed Junco	Confirmed	All	http://www.allaboutbirds.org/guide/dark-eyed_junco/lifehistory
Downy Woodpecker	Confirmed	All	http://www.allaboutbirds.org/guide/downy_woodpecker/lifehistory
Dusky Flycatcher	Confirmed	M,S	http://www.allaboutbirds.org/guide/dusky_flycatcher/lifehistory
Dusky Grouse	Unlikely	All	http://www.allaboutbirds.org/guide/dusky_grouse/lifehistory

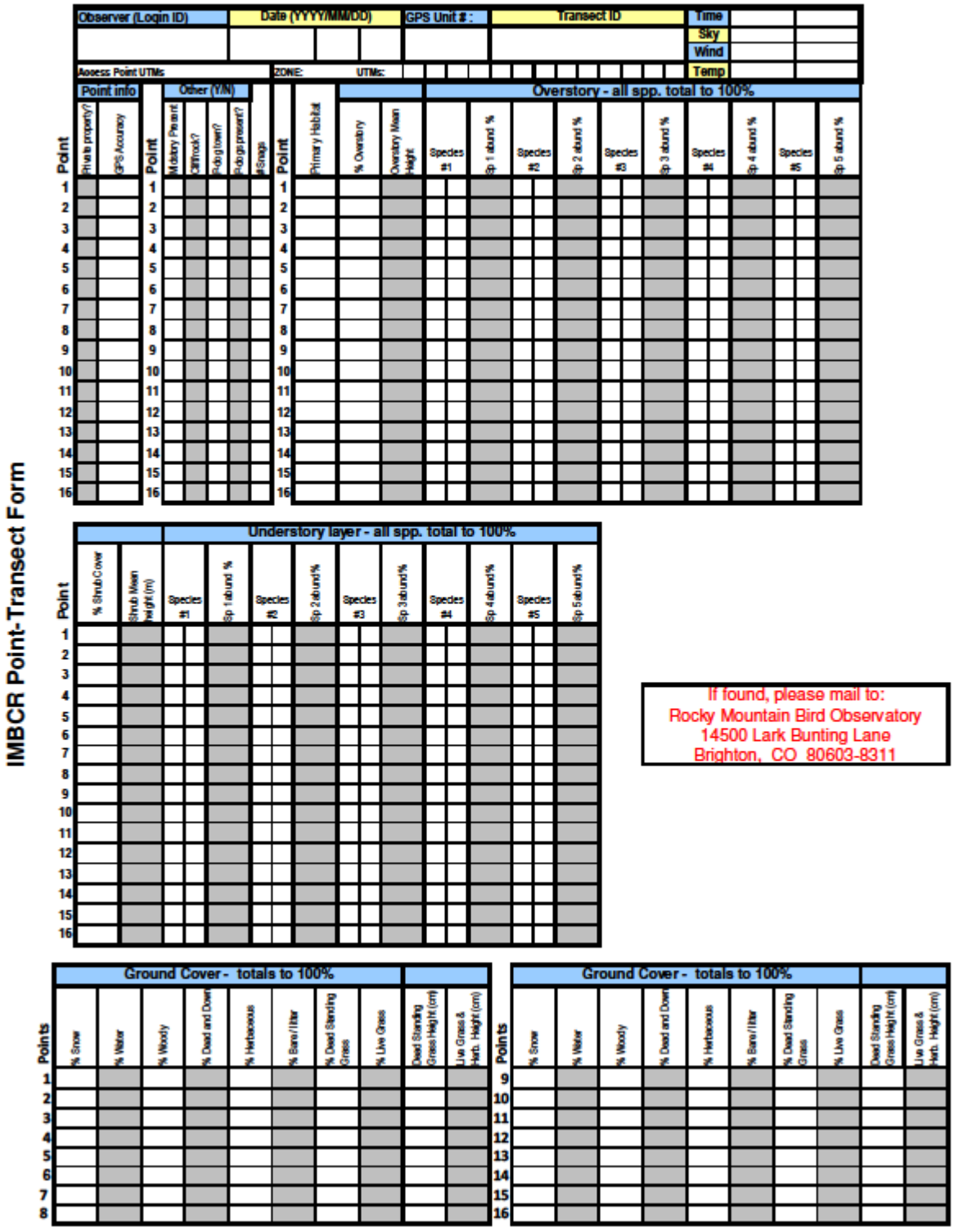
Species	Likelihood of Occurrence	Season	Link to Natural History Information
Eastern Bluebird	Possible	M,S	http://www.allaboutbirds.org/guide/eastern_bluebird/lifehistory
Eastern Kingbird	Confirmed	M,S	http://www.allaboutbirds.org/guide/eastern_kingbird/lifehistory
European Starling	Confirmed	All	http://www.allaboutbirds.org/guide/european_starling/lifehistory
Ferruginous Hawk	Confirmed	M,S	http://www.allaboutbirds.org/guide/Ferruginous_Hawk/lifehistory
Field Sparrow	Unlikely	M,S	http://www.allaboutbirds.org/guide/field_sparrow/lifehistory
Forster's Tern	Unlikely	M,S	http://www.allaboutbirds.org/guide/forsters_tern/lifehistory
Golden Eagle	Likely	All	http://www.allaboutbirds.org/guide/golden_eagle/lifehistory
Grasshopper Sparrow	Confirmed	M,S	http://www.allaboutbirds.org/guide/grasshopper_sparrow/lifehistory
Gray Catbird	Possible	M,S	http://www.allaboutbirds.org/guide/gray_catbird/lifehistory
Gray Flycatcher	Unlikely	S	http://www.allaboutbirds.org/guide/gray_flycatcher/lifehistory
Gray Jay	Possible	All	http://www.allaboutbirds.org/guide/gray_jay/lifehistory
Great Blue Heron	Unlikely	M,S	http://www.allaboutbirds.org/guide/great_blue_heron/lifehistory
Great Horned Owl	Confirmed	All	http://www.allaboutbirds.org/guide/great_horned_owl/lifehistory
Greater Sage-Grouse	Unlikely	All	http://www.allaboutbirds.org/guide/Greater_Sage-Grouse/lifehistory
Green-tailed Towhee	Likely	M,W	http://birds.audubon.org/birds/green-tailed-towhee
Green-winged Teal	Unlikely	All	http://www.allaboutbirds.org/guide/green-winged_teal/lifehistory
Hairy Woodpecker	Confirmed	All	http://www.allaboutbirds.org/guide/hairy_woodpecker/lifehistory
Horned Lark	Confirmed	All	http://www.allaboutbirds.org/guide/horned_lark/lifehistory
House Finch	Confirmed	All	http://www.allaboutbirds.org/guide/house_finch/lifehistory
House Sparrow	Possible	All	http://www.allaboutbirds.org/guide/house_sparrow/lifehistory
House Wren	Confirmed	M,S	http://www.allaboutbirds.org/guide/house_wren/lifehistory
Killdeer	Confirmed	All	http://www.allaboutbirds.org/guide/killdeer/lifehistory
Lark Bunting	Confirmed	M,S	http://www.allaboutbirds.org/guide/lark_bunting/lifehistory
Lark Sparrow	Confirmed	M,S	http://www.allaboutbirds.org/guide/lark_sparrow/lifehistory
Lazuli Bunting	Confirmed	M,S	http://www.allaboutbirds.org/guide/lazuli_bunting/lifehistory
Least Flycatcher	Possible	M,S	http://www.allaboutbirds.org/guide/least_flycatcher/lifehistory

Species	Likelihood of Occurrence	Season	Link to Natural History Information
Lesser Goldfinch	Confirmed	M,S	http://www.allaboutbirds.org/guide/lesser_goldfinch/lifehistory
Lesser Scaup	Unlikely	All	http://www.allaboutbirds.org/guide/lesser_scaup/lifehistory
Lewis's Woodpecker	Possible	All	http://www.allaboutbirds.org/guide/lewiss_woodpecker/lifehistory
Loggerhead Shrike	Possible	M,S	http://www.allaboutbirds.org/guide/loggerhead_shrike/lifehistory
Long-eared Owl	Possible	All	http://www.allaboutbirds.org/guide/Long-eared_Owl/lifehistory
MacGillivray's Warbler	Likely	M,S	http://www.allaboutbirds.org/guide/MacGillivrays_Warbler/lifehistory
Mallard	Unlikely	All	http://www.allaboutbirds.org/guide/mallard/lifehistory
McCown's Longspur	Possible	M,S	http://www.allaboutbirds.org/guide/McCowns_Longspur/lifehistory
Mountain Bluebird	Confirmed	M,S	http://www.allaboutbirds.org/guide/mountain_bluebird/lifehistory
Mountain Chickadee	Confirmed	M,W	http://www.allaboutbirds.org/guide/mountain_chickadee/lifehistory
Mountain Plover	Possible	M,S	http://www.allaboutbirds.org/guide/mountain_plover/lifehistory
Mourning Dove	Confirmed	All	http://www.allaboutbirds.org/guide/mourning_dove/lifehistory
Northern Flicker	Confirmed	All	http://www.allaboutbirds.org/guide/northern_flicker/lifehistory
Northern Goshawk	Confirmed	All	http://www.allaboutbirds.org/guide/northern_goshawk/lifehistory
Northern Harrier	Likely	All	http://www.allaboutbirds.org/guide/northern_harrier/lifehistory
Northern Mockingbird	Unlikely	M,S	http://www.allaboutbirds.org/guide/northern_mockingbird/lifehistory
Northern Pintail	Unlikely	All	http://www.allaboutbirds.org/guide/northern_pintail/lifehistory
Northern Rough-winged Swallow	Confirmed	M,S	http://www.allaboutbirds.org/guide/Northern_Rough-winged_Swallow/lifehistory
Northern Saw-whet Owl	Unlikely	M,S	http://www.allaboutbirds.org/guide/Northern_Saw-whet_Owl/lifehistory
Northern Shoveler	Unlikely	All	http://www.allaboutbirds.org/guide/northern_shoveler/lifehistory
Olive-sided Flycatcher	Possible	M,S	http://www.allaboutbirds.org/guide/olive-sided_flycatcher/lifehistory
Orange-crowned Warbler	Possible	M,S	http://www.allaboutbirds.org/guide/orange-crowned_warbler/lifehistory
Orchard Oriole	Possible	M,S	http://www.allaboutbirds.org/guide/orchard_oriole/lifehistory
Osprey	Confirmed	M,S	http://www.allaboutbirds.org/guide/osprey/lifehistory
Ovenbird	Possible	M,S	http://www.allaboutbirds.org/guide/ovenbird/lifehistory
Pied-billed Grebe	Unlikely	All	http://www.allaboutbirds.org/guide/Pied-billed_Grebe/lifehistory

Species	Likelihood of Occurrence	Season	Link to Natural History Information
Pine Siskin	Confirmed	All	http://www.allaboutbirds.org/guide/pine_siskin/lifehistory
Pinyon Jay	Confirmed	All	http://www.allaboutbirds.org/guide/Pinyon_Jay/lifehistory
Plumbeous Vireo	Confirmed	M,S	http://www.allaboutbirds.org/guide/plumbeous_vireo/lifehistory
Prairie Falcon	Confirmed	All	http://www.allaboutbirds.org/guide/prairie_falcon/lifehistory
Pygmy Nuthatch	Confirmed	All	http://www.allaboutbirds.org/guide/Pygmy_Nuthatch/lifehistory
Red Crossbill	Confirmed	All	http://www.allaboutbirds.org/guide/red_crossbill/lifehistory
Red-breasted Nuthatch	Confirmed	All	http://www.allaboutbirds.org/guide/red-breasted_nuthatch/lifehistory
Red-eyed Vireo	Possible	M,S	http://www.allaboutbirds.org/guide/red-eyed_vireo/lifehistory
Red-headed Woodpecker	Confirmed	All	http://www.allaboutbirds.org/guide/red-headed_woodpecker/lifehistory
Red-naped Sapsucker	Possible	M,S	http://www.allaboutbirds.org/guide/red-naped_sapsucker/lifehistory
Red-tailed Hawk	Confirmed	All	http://www.allaboutbirds.org/guide/Red-tailed_Hawk/lifehistory
Red-winged Blackbird	Confirmed	M,S	http://www.allaboutbirds.org/guide/red-winged_blackbird/lifehistory
Ring-necked Pheasant	Possible	All	http://www.allaboutbirds.org/guide/ring-necked_pheasant/lifehistory
Rock Wren	Confirmed	M,S	http://www.allaboutbirds.org/guide/Rock_Wren/lifehistory
Ruby-crowned Kinglet	Possible	All	http://www.allaboutbirds.org/guide/ruby-crowned_kinglet/lifehistory
Ruddy Duck	Unlikely	All	http://www.allaboutbirds.org/guide/ruddy_duck/lifehistory
Ruffed Grouse	Unlikely	All	http://www.allaboutbirds.org/guide/ruffed_grouse/lifehistory
Sage Sparrow	Unlikely	M,S	http://www.allaboutbirds.org/guide/sage_sparrow/lifehistory
Sage Thrasher	Confirmed	M,S	http://www.allaboutbirds.org/guide/sage_thrasher/lifehistory
Savannah Sparrow	Confirmed	M,S	http://www.allaboutbirds.org/guide/savannah_sparrow/lifehistory
Say's Phoebe	Confirmed	M,S	http://www.allaboutbirds.org/guide/says_phoebe/lifehistory
Sharp-shinned Hawk	Likely	All	http://www.allaboutbirds.org/guide/Sharp-shinned_Hawk/lifehistory
Short-eared Owl	Possible	All	http://www.allaboutbirds.org/guide/short-eared_owl/lifehistory
Song Sparrow	Likely	All	http://www.allaboutbirds.org/guide/song_sparrow/lifehistory
Sora	Unlikely	M,S	http://www.allaboutbirds.org/guide/sora/lifehistory
Spotted Towhee	Confirmed	M,S	http://www.allaboutbirds.org/guide/spotted_towhee/lifehistory

Species	Likelihood of Occurrence	Season	Link to Natural History Information
Steller's Jay	Confirmed	All	http://www.allaboutbirds.org/guide/Stellers_Jay/lifehistory
Swainson's Hawk	Likely	M,S	http://www.allaboutbirds.org/guide/Swainsons_Hawk/lifehistory
Swainson's Thrush	Possible	M,S	http://www.allaboutbirds.org/guide/swainsons_thrush/lifehistory
Townsend's Solitaire	Likely	All	http://www.allaboutbirds.org/guide/townsends_solitaire/lifehistory
Tree Swallow	Confirmed	M,S	http://www.allaboutbirds.org/guide/tree_swallow/lifehistory
Turkey Vulture	Confirmed	M,S	http://www.allaboutbirds.org/guide/turkey_vulture/lifehistory
Upland Sandpiper	Likely	M,S	http://www.allaboutbirds.org/guide/upland_sandpiper/lifehistory
Vesper Sparrow	Confirmed	M,S	http://www.allaboutbirds.org/guide/vesper_sparrow/lifehistory
Violet-green Swallow	Confirmed	M,S	http://www.allaboutbirds.org/guide/Violet-green_Swallow/lifehistory
Warbling Vireo	Confirmed	M,S	http://www.allaboutbirds.org/guide/warbling_vireo/lifehistory
Western Kingbird	Confirmed	M,S	http://www.allaboutbirds.org/guide/western_kingbird/lifehistory
Western Meadowlark	Confirmed	All	http://www.allaboutbirds.org/guide/western_meadowlark/lifehistory
Western Tanager	Confirmed	M,S	http://www.allaboutbirds.org/guide/western_tanager/lifehistory
Western Wood-Pewee	Confirmed	M,S	http://www.allaboutbirds.org/guide/Western_Wood-Pewee/lifehistory
White-breasted Nuthatch	Confirmed	All	http://www.allaboutbirds.org/guide/White-breasted_Nuthatch/lifehistory
White-crowned Sparrow	Possible	M	http://www.allaboutbirds.org/guide/white-crowned_sparrow/lifehistory
White-throated Swift	Confirmed	M,S	http://www.allaboutbirds.org/guide/white-throated_swift/lifehistory
Wild Turkey	Confirmed	All	http://www.allaboutbirds.org/guide/wild_turkey/lifehistory
Willow Flycatcher	Possible	M,S	http://www.allaboutbirds.org/guide/willow_flycatcher/lifehistory
Wilson's Phalarope	Possible	M,S	http://birds.audubon.org/species/wilpha
Wilson's Snipe	Unlikely	All	http://www.allaboutbirds.org/guide/wilsons_snipe/lifehistory
Wood Duck	Unlikely	All	http://www.allaboutbirds.org/guide/wood_duck/lifehistory
Yellow Warbler	Confirmed	M,S	http://www.allaboutbirds.org/guide/yellow_warbler/lifehistory
Yellow-breasted Chat	Likely	M,S	http://www.allaboutbirds.org/guide/yellow-breasted_chat/lifehistory
Yellow-rumped Warbler	Confirmed	M,S	http://www.allaboutbirds.org/guide/Yellow-rumped_Warbler/lifehistory

Appendix B: Grid Based Point Count Survey Form



IMBCR Point-Transect Form

Observer (Login ID) | Date (YYYY/MM/DD) | GPS Unit # : | Transect ID | Time | Sky | Wind | Temp

Access Point UTMs: | ZONE: | UTMs:

Point info: Private property? | GPS Accuracy

Other (Y/N): Mobility Present | Cliff/rock? | Ridgetown? | Bridge present? | #Snags

Primary Habitat | % Overstory | Overstory Mean Height

Overstory - all spp. total to 100%: Species #1 | Sp 1 abund % | Species #2 | Sp 2 abund % | Species #3 | Sp 3 abund % | Species #4 | Sp 4 abund % | Species #5 | Sp 5 abund %

Understory layer - all spp. total to 100%: % Shrub Cover | Shrub Mean Height (m) | Species #1 | Sp 1 abund % | Species #2 | Sp 2 abund % | Species #3 | Sp 3 abund % | Species #4 | Sp 4 abund % | Species #5 | Sp 5 abund %

If found, please mail to:
Rocky Mountain Bird Observatory
14500 Lark Bunting Lane
Brighton, CO 80603-8311

Ground Cover - totals to 100%: % Snow | % Water | % Woody | % Dead and Down | % Herbaceous | % Bare / Litter | % Dead Standing Grass | % Live Grass | Dead Standing Grass Height (cm) | Live Grass & Herb. Height (cm)

IMBCR Point Transect Bird Form

Page ___ of ____

How: V=visual; S=singing; C=calling; F=flyover; D=drumming; O=other aural detection

Between points, point # = 88 Sex: M=male, F=female; U=unknown; J=juvenile

If found, please return to: Rocky Mountain Bird Observatory, 14500 Lark Bunting Lane, Brighton, CO 80603 or call (970) 482-1707 ext. 24

Start Time	Point #	Minute	Species	Radial Distance	HOW	SEX	Visual?	Migrating?	Cluster Size	Cluster Code	Start Time	Point #	Minute	Species	Radial Distance	HOW	SEX	Visual?	Migrating?	Cluster Size	Cluster Code

Notes:

Observer Login | Date | Transect ID

Appendix C: Camp Guernsey Area Search Form

CAMP GUERNSEY AREA SEARCH FORM

Observer Information		Census Information	
First Name	Last Name	Date	Visit #
		Site	Plot #/Itr

Begin Temp ____ End Temp____ F or °C (Circle one) Cloud Cover ____% Wind Speed ____ mph, knots, kmph (circle one) Wind Direction _____ Mag or True (circle one)

Number of Observers: _____ **Start Time:** _____ **End Time:** _____

Species	Tally of Individuals (Song, Visual, Call, one letter per individual)	TOTAL	Behavior (check if applicable)*								
			forag.	flock	copul.	displ.	pair	carry mater.	carry food	nest	fledg.

*Forag. = foraging, Copl. = copulation, Displ. = courtship or territorial display, Food carry includes fecal sack, Fledg. = fledgling.

Notes and flyovers: _____

Other Observers: _____