THREATENED, ENDANGERED, AND NONGAME BIRD AND MAMMAL INVESTIGATIONS

Wyoming Game and Fish Department
Nongame Program
Biological Services Section
Wildlife Division

Annual Completion Report

Period Covered:
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Funding for the Wyoming Game and Fish Department Nongame Program comes from a variety of agencies, entities, and programs. We wish to credit the following funding sources for their generous contributions, which enable us to complete necessary inventory and monitoring efforts for numerous Species of Greatest Conservation Need in Wyoming.

Bureau of Land Management
United States Fish and Wildlife Service Cooperative Agreements
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Wyoming Game and Fish Department
Wyoming Governor's Big Game License Coalition
Wyoming Governor's Endangered Species Account Funds
Wyoming Landscape Conservation Initiative
Wyoming State Legislature General Fund Appropriations

PREFACE

Diversity of wildlife species is highly valued among residents and visitors to Wyoming. There is strong public interest in wildlife conservation and high expectations for the future. A 2006 national survey by the US Fish and Wildlife Service (http://library.fws.gov/pubs/wildlifewatching_natsurvey06.pdf) found that, in addition to $138.5 million associated with hunting and $373.6 million with fishing, $392.5 million was added to Wyoming's economy by wildlife watchers. The State is also rich in other natural resources that contribute to Wyoming's economy, such as livestock range, timber, a variety of minerals, and energy. However, sometimes the best management of one or more resources can conflict with the needs of another.

Over the past few decades, public expectations of wildlife managers have diversified. Unfortunately, traditional funding sources were not sufficient to meet these new expectations. Beginning in 2008, Wyoming's Legislature and former Governor D. Freudenthal agreed to increase funding in order to boost collection of data and strengthen management for Wyoming's nongame species, particularly those classified as Species of Greatest Conservation Need. In the past three biennium budget sessions, the Legislature and the Governor have funded the Department's Veterinarian Services, Sage-Grouse, and Terrestrial Nongame Programs and the Wyoming Natural Resources and Wildlife Trust. Funding of nongame efforts is a significant and progressive expansion of the Legislature's support for natural resources in Wyoming. The expectation that accompanies such funding is to develop the information base and expertise to allow for effective decision making associated with resource management and to avoid unnecessary conflicts and restrictions.

These expectations are similar to those associated with the Department's past portfolio of funding sources for nongame, but they are more targeted. In the past, the Department's nongame efforts were funded primarily by user fees collected from hunting and fishing. Many of the hunting and fishing public recognizes that sound management of nongame fish and wildlife helps provide additional support for maintaining functioning ecosystems for game species. Yet, for most of us, there is a limit to how user's fees should be spent on management of these non-target wildlife.

Over the past two decades, at both the national and state level, a number of efforts have been attempted to secure alternate funding for nongame species conservation. Many of the same individuals contributing to Wyoming's economy through expenditures associated with hunting, fishing, and wildlife watching were, no doubt, involved in intense national lobbying efforts to develop nongame funding.

In response, Congress established the federally funded State Wildlife Grants (SWG) program in 2000. Since then, the Department has received nearly $6 million of SWG funds to address data needs for nongame and to collect information that may provide an early warning of species heading for a potential listing under the Endangered Species Act. Most states tended to focus SWG projects on species that would grab the attention of supporters and Congress who debate federal budgets on an annual basis. But the expectations associated with SWG also

extend to species like the American pika or Harlequin Duck that are high on the interest scale for wildlife watchers but have little potential for conflict with other resource users because of the habitats they occupy in the state.

During the early years of SWG funding, we tended to focus on planning efforts that produced documents such as the Trumpeter Swan Habitat Enhancement Project, Wyoming Bird Conservation Plan, A Plan for Bird and Mammal Species of Greatest Conservation Need in Eastern Wyoming Grasslands, and A Comprehensive Wildlife Conservation Strategy in Wyoming. The latter planning document, approved in 2005, provides guidance for development of more recent SWG proposals and was the foundation for State Wildlife Action Plan 2010. We have used SWG funding to develop and implement inventory methods for sensitive species, such as Harlequin Duck, black-tailed prairie dog, and white-tailed prairie dog. We have also used SWG funds to collect additional information on several species of bats, Canada lynx, pygmy rabbit, swift fox, wolverine, and Mountain Plover. Recent SWG projects also include initial inventories of raptors in the Wyoming Range and small mammals in southwest Wyoming.

The funding provided by the Wyoming State Legislature has greatly enhanced our ability to collect information on Species of Greatest Conservation Need. Not only has funding from the state allowed us to greatly increase our knowledge of distribution and abundance of these species, it has also allowed us to increase our understanding of what is needed for effective and proactive management of those species. This funding has also allowed us to work closely with other entities, such as the University of Wyoming, Wyoming Natural Diversity Database, Audubon Wyoming, the Rocky Mountain Bird Observatory, and private contractors, as well as interested volunteers to implement projects that will provide population status and trend information on additional Species of Greatest Conservation Need, such as the Ferruginous Hawk, Preble's meadow jumping mouse, and Wyoming pocket gopher. Finally, we have also had the opportunity to implement funds provided by the US Fish and Wildlife Service for several additional projects, including a collaborative survey effort for Northern Goshawks in the Wyoming Range and a study to determine the potential effects of energy development on raptor populations in Wyoming.

The future remains uncertain as we progress through difficult economic times. Anthropogenic, climatic, and other environmental stressors will undoubtedly continue to put a strain on the Department's ability to effectively meet our statutory mandate to manage all wildlife in Wyoming. In conjunction with our partners, we will continue this collaborative endeavor to conserve this unique and diverse resource on behalf of the citizens of Wyoming.

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INTRODUCTION

The Nongame Program of the Wyoming Game and Fish Department (Department) was initiated in July 1977. This report summarizes data collected from 15 April 2011 to 14 April 2012on various nongame bird and mammal surveys and projects conducted by Department personnel, other government agencies, non-governmental organizations, and individuals in cooperation with the Department. Cooperating agencies and individuals are listed in the individual completion reports, but we recognize that the listing does not completely credit the valuable contributions of the many cooperators, including Wyoming Game and Fish Department District personnel and members of the public.

In October of 1987, a Nongame Strategic Plan was distributed; this plan was updated and renamed in May of 1996. The 1996 Nongame Bird and Mammal Plan (Plan) presents objectives and strategies for the management and study of nongame birds and mammals in Wyoming. As part of the State Wildlife Grants funding program to provide long-term conservation planning for those species most in need, information was gleaned from the Plan and other pertinent sources and compiled into A Comprehensive Wildlife Conservation Strategy for Wyoming, which was approved by the Wyoming Game and Fish Commission on 12 July 2005. This Nongame Annual Completion Report presents information in four major sections similar to these planning efforts: threatened and endangered species, species of greatest conservation need, raptors taken for falconry, and other nongame surveys.

Legislative funding has allowed the Department to significantly expand nongame and sensitive species conservation efforts, enhancing our ability to inventory, initiate monitoring, and assess the status of many species of wildlife classified as sensitive in 2005. The FY09/10 biennium budget provided general fund appropriations to the Department for the first time for all aspects of its nongame/sensitive species program: $1.2 Million Maintenance and Operations (M&O) budget for existing personnel and administrative support and $609,000 in direct general fund appropriations for sensitive species program projects. In addition, $1,300,000 from the Governor's endangered species administration general fund appropriation was provided to the Department to supplement sensitive species project work. We also used several sources of federal funding for specific projects. General fund appropriations for M&O were essential for normal duties and for personnel to manage all of the special projects in this report. Specific funding sources in addition to M&O budgets are identified for each specific report.

This proactive approach is Wyoming's most effective strategy in reducing the chance that a species will be listed as threatened or endangered under the Endangered Species Act. The Department's Nongame Program is geared toward collecting information that has practical application for understanding the status of each species as well as identifying potential risks and management actions that may be needed to secure the healthy status of those species needing some help.

This report serves several purposes. First, it provides summaries of nongame surveys for the benefit of the Department, other agencies, and individuals that need this information for management purposes. Second, it provides a permanent record of summarized data for future

use. Although some of this information is in lengthy tables, it was felt that these data should be published rather than kept in the files of the Nongame Program staff. Some information, such as Bald Eagle and Ferruginous Hawk nest sites and bat roost locations, is sensitive and is not provided in this document. Those needing this information for purposes that will lead to better management of these species can request the data from Nongame Program staff.

Common bird names used in this report follow the most recent American Ornithologists' Union guidelines and supplements. Mammal names follow the "Revised checklist of North American mammals north of Mexico, 2003".

THREATENED AND ENDANGERED SPECIES

POPULATION INVENTORIES OF JUMPING MICE (*ZAPUS* SPP.) IN AREAS PREVIOUSLY DESIGNATED AS PREBLE'S MEADOW JUMPING MICE (*Z. HUDSONIUS PREBLEI*) CRITICAL HABITAT IN SOUTHEASTERN WYOMING

STATE OF WYOMING

NONGAME MAMMALS: Species of Greatest Conservation Need – Preble's Meadow Jumping Mouse

FUNDING SOURCE: United States Fish and Wildlife Service Cooperative Agreements, Wyoming Governor's Endangered Species Account Funds, Wyoming State Legislature General Fund Appropriations

PROJECT DURATION: 1 July 2009 – 30 June 2012

PERIOD COVERED: 15 April 2011 – 14 April 2012

PREPARED BY: Joel Thompson, Western EcoSystems Technology, Inc.
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ABSTRACT

The subspecies designation for the Preble's meadow jumping mouse (*Zapus hudsonius preblei*) was validated in 2006 through the use of genetic testing; however, the subspecies is nearly indistinguishable from the western jumping mouse (*Z. princeps*) in the field. The Preble's meadow jumping mouse was removed from the Endangered Species List in 2008, but was subsequently relisted in 2011 following a court decision that the species must be listed throughout the entire portion of its range. In addition, the Wyoming Game and Fish Department classifies the Preble's meadow jumping mouse as a Tier II Species of Greatest Conservation Need with a Native Species Status of 4. To evaluate population distribution, the Wyoming Game and Fish Department contracted Western Ecosystems Technology, Inc. to sample areas previously designated as Critical Habitat in Wyoming by the US Fish and Wildlife Service prior to the delisting in 2008. Western Ecosystems Technology Inc. captured 62 *Zapus* and 152 non-target individuals in 2011. Catch per unit effort varied from 0–2.3 *Zapus* individuals per 100 trap nights across 9 sites. Genetic samples were collected from 46 individuals. Genetic analysis is pending and will be conducted by US Geological Survey; consequently, implications for these results will be included in a subsequent report.

INTRODUCTION

Definitive records of Preble's meadow jumping mouse (*Zapus hudsonius preblei*; PMJM) are lacking in Wyoming. Many of the existing records are suspected to be PMJM; however, the subspecies is nearly indistinguishable from the closely related western jumping mouse (*Z. princeps*) in the field. Furthermore, the genetic validity of the subspecies has been in dispute since the species was first petitioned for listing in 1998. Consequently, the Wyoming Game and Fish Department (Department) tabled all field activities until taxonomy issues were clarified. King et al. (2006) has since resolved the taxonomic debate and concluded that the PMJM warrants subspecific status.

In July 2008, the PMJM was removed from protection under the Endangered Species Act in Wyoming, but was subsequently reclassified as Threatened in the state in 2011 following a lawsuit challenging the use of the 'significant portion of range' used to originally remove the Wyoming population (USFWS 2011). Currently, the Department classifies the PMJM as a Tier II Species of Greatest Conservation Need with a Native Species Status of 4 (WGFD 2010). In Wyoming, the species is restricted to the southeastern portion of the state and occupies structurally diverse plains riparian vegetation and grasslands near water at elevations below 2,440 m.

The Department contracted Western Ecosystems Technology, Inc. (WEST) to conduct population inventories for PMJM throughout southeastern Wyoming from 2009-2011. In 2011, the objective was to survey suitable habitats along the eastern side of the Laramie Mountain Range, with an emphasis on areas previously designated as Critical Habitat by the US Fish and Wildlife Service (USFWS 2003), to document occurrence of PMJM through photographs and genetic sampling.

METHODS

We targeted our surveys in areas originally described as Critical Habitat for PMJM in Wyoming prior to the delisting in 2008. When we were unable to obtain access within previously designated Critical Habitat, we targeted the closest accessible stream reach within the drainage and with suitable habitat (i.e., heavily vegetated riparian areas at elevations of 1,420-2,320 m; WYGAP 1996). This resulted in survey sites in three primary drainages located in Laramie, Platte, and Albany Counties (Fig. 1). We surveyed sites according to methods described in the USFWS guidelines (USFWS 2004). We arranged Sherman live-traps in parallel transects through suitable habitat. Typically, we positioned one transect on each side of the creek channel, with transects spaced approximately 10 m apart. We spaced traps 5 m apart along individual transects and baited traps with livestock feed (Ranchway Feeds, Inc. Laramie 3-Way) and a 2.54-cm ball of polyester fiber for bedding material. We set traps in late afternoon, within 3 hrs of sunset, and checked traps early morning, within 3 hrs of sunrise. Each set of paired transects consisted of 225 traps. We trapped for four nights, except for one location at which we were only able to trap for three nights.

We recorded data nightly, including location of each transect (i.e., start and stop UTMs), survey date, surveyor, and demographic and morphometric data for captured individuals. We also recorded general descriptions of survey sites. We recorded UTMs in NAD27 in the field, which we then converted to NAD83. We documented trap mortalities with detailed information on location, species, age, sex, and reproductive status; specimens were double-bagged, frozen, and delivered to the Department with the final report.

Because PMJM are easily confused with the western jumping mouse, we photographed each captured *Zapus* individual against a sheet of white paper for identification, including ventral and lateral views. We recorded date and UTM location with each photo on the white background. We recorded digital photos on compact disc, which we delivered to the Department with the final report.

We also collected biological samples, including tissue and blood, from each captured *Zapus* individual for use in future genetic analyses. We used a 2-mm diameter ear punch to collect tissue samples from one ear. We disinfected the ear punch with a 10% bleach solution between samples and stored ear punch samples in 2.5-ml vials containing 95% ethyl alcohol. Samples were clearly labeled with appropriate capture details (e.g., date, location, specimen number), stored in a cool dry environment, and delivered to the Department with the final report. We used Whatman FTA Cards to collect blood samples. We pressed FTA cards against the wound created by the ear punch to collect a blood sample and labeled each card with appropriate capture details. Samples were stored in clear, re-sealable plastic bags and kept in a cool, dry environment until delivered to the Department with the final report.

We summarized and presented data separately for each *Zapus* and non-target species at each survey location. We reported total numbers of captures and catch per unit effort (i.e., captures per 100 trap nights); we subtracted empty, closed traps from the total number of traps to determine number of trap nights. We also reported demographic and morphometric data for captured individuals (*Zapus* and non-target species), including age, sex, weight, and reproductive status. Copies of original datasheets and an Excel spreadsheet with all capture data, summarized for each survey, have been submitted to the Department with the final report.

RESULTS

We sampled 9 sites for PMJM between 13 June and 26 August 2011; we captured *Zapus* individuals at 7 of the 9 sites (Table 1; Fig. 1). At sites where we captured *Zapus* individuals, capture success varied from 0–7 individuals per night. Catch per unit effort varied from 0–2.3 *Zapus* individuals per 100 trap nights across all 9 sites (Table 1), with an overall capture rate of 0.8 *Zapus* individuals per 100 trap nights. We captured 62 *Zapus* and 152 non-target individuals during the course of all trapping and collected biological samples from 44 individuals. Non-target species included shrews (*Sorex* spp.), rabbits (*Sylvilagus* spp.), chipmunks (*Neotamias* spp.), kangaroo rats (*Dipodomys* spp.), deer mice (*Peromyscus* spp.), voles (*Microtus* spp.), and weasels (*Mustela* spp.). We observed seven trap mortalities for non-target species, all of which were shrews. We also observed two *Zapus* mortalities. One individual was found pinned under the door of the trap, and the other individual was in a trap that flooded because of an overnight

thunderstorm that caused the stream to rise significantly. We collected genetic samples from both individuals, bringing the total number of individuals with biological samples to 46.

DISCUSSION

Zapus appear to be fairly well-distributed in the Cottonwood Creek and North Fork Lodgepole Creek drainages, where individuals were captured at all six sites. Surveys at Chugwater Creek, however, resulted in captures of *Zapus* at only one of three trapping sites. Habitat along Chugwater Creek at the two lower trap sites (Fig. 1), where we did not capture *Zapus*, were characterized by larger trees, primarily cottonwood (*Populus* spp.) and birch (*Betula* spp.), with dense understories of tall grasses and sedges. Conversely, sites where *Zapus* were captured tended to have low-growing or immature trees or brush species (e.g., willow [*Salix* spp.]) with dense grasses. Evidence of grazing was present at the majority of trapping sites, and a few sites appear to be managed for grass hay production. We captured *Zapus* at one site following a recent cutting for hay, suggesting that *Zapus* perhaps can coexist with at least some degree of haying activities.

Previous surveys documented only three PMJM out of 40 *Zapus* spp. samples collected over the last 2 years (Cudworth and Grenier 2011). Although we trapped fewer sites in 2011 than either 2009 or 2010, we captured more *Zapus* overall and had a greater capture success than either year (Thompson and Grenier 2010, Thompson et al. 2011). This is not unexpected, as we focused our trapping efforts on areas previously defined as Critical Habitat for the PMJM in Wyoming. These results are encouraging, although genetic results were pending when this report was written (refer to Cudworth and Grenier 2012 for results), thus limiting possible inferences. Results from this and previous analyses will help shape future surveys designed to investigate habitat components that contribute to presence and allopatry of PJMJ and western jumping mice in southeastern Wyoming.

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Table 1. Locations of sites trapped and results of trapping for jumping mice (*Zapus* spp.) in southeastern Wyoming between 13 June and 26 August 2011. All sites were trapped for four consecutive nights, with the exception of N Chugwater Cr 1, which was trapped for three nights. 'No. of trap nights' is the total number of traps set throughout the survey excluding the number of traps that were found closed and empty.

Site	General location (T, R, S)	County	No. of trap nights	No. of *Zapus* captures	No. of *Zapus* per 100 trap nights
NF Lodgepole Cr	15N, 71W, S 8	Albany	878	20	2.3
NF Lodgepole Cr 2	15N, 71W, S 10	Albany	883	11	1.2
NF Lodgepole Cr 3	15N, 71W, S 11	Albany	880	8	0.9
Cottonwood Cr	26N, 71W, S 8	Albany	879	8	0.9
N Cottonwood Cr	27N, 71W, S 28	Albany	880	8	0.9
Cottonwood Cr 3	27N, 71W, S 22	Albany	879	3	0.3
Chugwater Cr	21N, 66W, S 16	Platte	828	0	0.0
N Chugwater Cr1	20N, 68W, S 27	Platte	642	0	0.0
Chugwater Cr 2	19N, 69W, S 9	Laramie	883	4	0.5

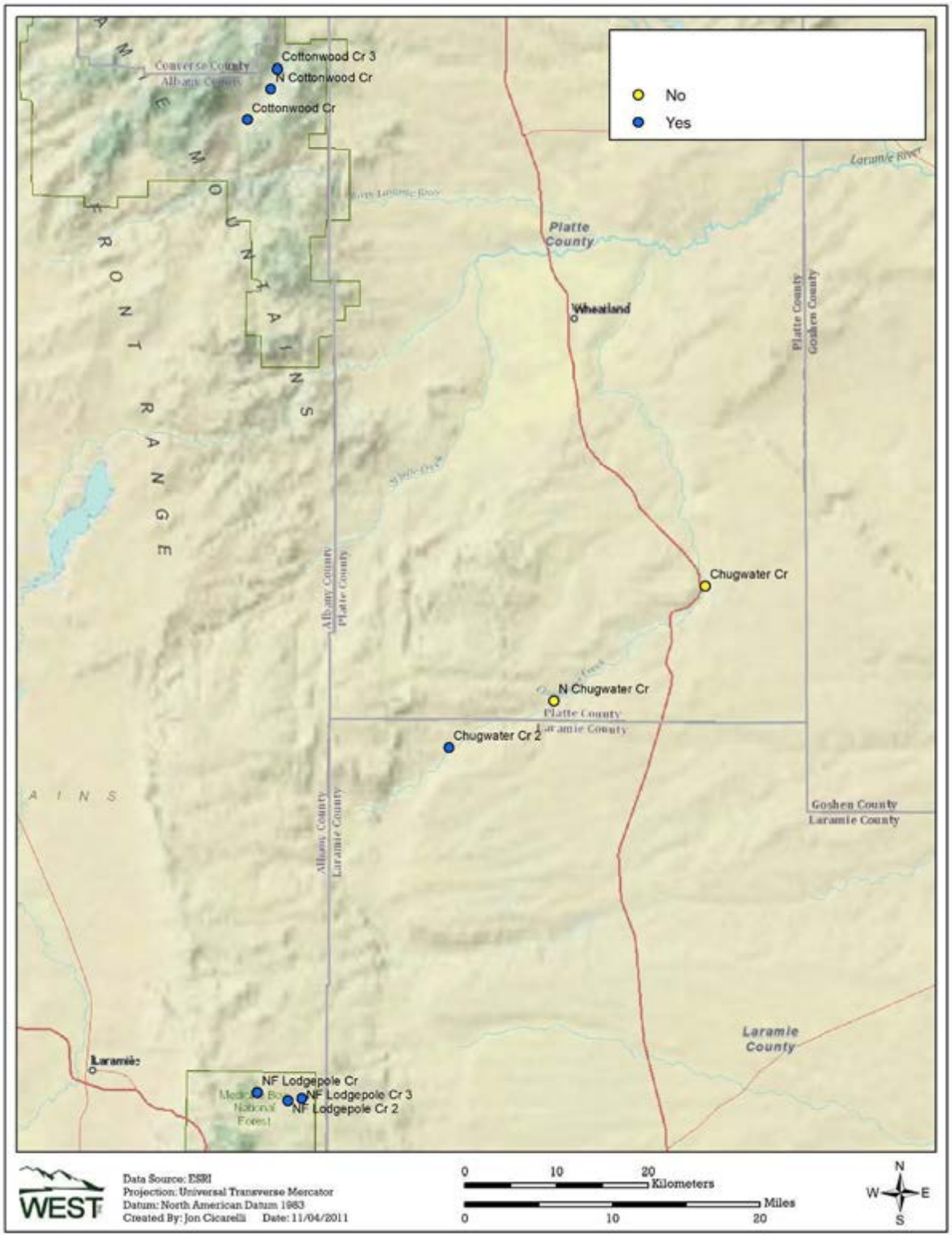

Figure 1. Locations of sites trapped for jumping mice (*Zapus* spp.) in southeastern Wyoming between 13 June and 26 August 2011. Successful sites had ≥1 *Zapus* capture.

GENETIC DIFFERENTIATION AND DISTRIBUTION OF *ZAPUS* SPP. CAPTURED IN AREAS PREVIOUSLY DESIGNATED AS PREBLE'S MEADOW JUMPING MICE (*Z. HUDSONIUS PREBLEI*) CRITICAL HABITAT IN SOUTHEASTERN WYOMING

STATE OF WYOMING

NONGAME MAMMALS: Species of Greatest Conservation Need – Preble's meadow jumping mouse

FUNDING SOURCE: United States Fish and Wildlife Service Cooperative Agreements, Wyoming Governor's Endangered Species Account Funds, and Wyoming State Legislature General Fund Appropriations

PROJECT DURATION: 1 July 2009 – 30 June 2012

PERIOD COVERED: 1 June 2011 – 14 April 2012

PREPARED BY: Nichole Cudworth, Nongame Biologist
Martin Grenier, Nongame Mammal Biologist

ABSTRACT

The Preble's meadow jumping mouse (*Zapus hudsonius preblei*) is classified as a federally Threatened subspecies and a Species of Greatest Conservation Need by the Wyoming Game and Fish Department; however, definitive records of the subspecies in the state are lacking. Identification is further complicated by the sympatric western jumping mouse (*Z. princeps*), which is nearly indistinguishable in the field. To remedy this dearth of information, the Wyoming Game and Fish Department contracted Western Ecosystems Technology, Inc. to collect samples from *Zapus* spp. throughout southeastern Wyoming and the US Geological Survey to conduct genetic analysis. Trapping efforts in 2011 focused on the previously designated Critical Habitat in Wyoming. Of 46 individuals captured, 19 individuals were classified as *Z. h. preblei*, all of which occurred in Cottonwood and Chugwater Creeks. The 27 individuals captured in Lodgepole Creek were classified as *Z. princeps*, supporting previous documentation of *Z. princeps* in the area and suggesting that Lodgepole Creek is likely not inhabited by *Z. h. preblei* despite the previous designation as Critical Habitat. Although *Zapus* spp. appear to be common and widespread throughout southeastern Wyoming, the low numbers of captures classified as *Z. h. preblei* suggest the species may be less common or has a more restricted distribution than originally expected, especially outside areas of Critical Habitat. Consequently, future survey efforts should focus on further refining the known and predicted distribution of *Z. h. preblei* in Wyoming.

INTRODUCTION

Definitive records of the Preble's meadow jumping mouse (*Zapus hudsonius preblei*; PMJM) are lacking in Wyoming. Many of the existing records are suspected to be PMJM; however, the subspecies is nearly impossible to distinguish from the sympatric and closely related western jumping mouse (*Z. princeps*; WJM) in the field. Furthermore, the genetic validity of the subspecies had been in dispute since the species was petitioned for listing in 1998. Consequently, the Wyoming Game and Fish Department (Department) tabled all field activities until taxonomy issues were clarified. King et al. (2006) resolved the taxonomic debate and concluded that PMJM deserved subspecific status. Although the US Fish and Wildlife Service (USFWS) removed the Wyoming portion of the PMJM population from protection under the Endangered Species Act in 2008 (USFWS 2011*b*), Threatened status was reinstated in 2011 following a lawsuit challenging the use of the 'significant portion of range' originally used to remove the Wyoming population (USFWS 2011*a*). The PMJM also remains classified as a Species of Greatest Conservation Need in Wyoming, where the subspecies is restricted to marshy areas and moist riparian corridors in the southeastern portion of the state (WGFD 2010, USFWS 2011*b*).

In order to determine the current distribution and population structure of PMJM in Wyoming, the Department contracted Western Ecosystems Technology, Inc. (WEST) to collect genetic samples from *Zapus* individuals throughout the predicted range and core distribution of PMJM in southeastern Wyoming. In 2009 and 2010, we surveyed broadly throughout the known range of the subspecies. In 2011, however, we focused survey efforts on suitable habitats along the eastern side of the Laramie Mountain Range, with an emphasis on areas previously designated as Critical Habitat by the USFWS (2003). Objectives were to document and verify locations of captured PMJM in order to update current maps of range and distribution. Trapping results are presented in an additional report (Thompson et al. 2012); here we provide the results from genetic analysis of individuals collected from 2011 and summarize all results from the 2009-2011 trapping effort.

METHODS

We described live-trapping and genetic sampling procedures in this and previous annual completion reports (Thompson and Grenier 2010; Thompson et al. 2011, 2012). WEST collected a combination of hair and blood samples from 46 *Zapus* individuals from 13 June to 26 August 2011. The lab of Dr. Tim King, US Geological Survey (USGS), conducted both nuclear and mtDNA genetic analysis for each sample following protocol outlined by King et al. (2006).

RESULTS

The nuclear and mtDNA variation in each specimen were identical for each genome in all compared samples. Of 46 samples submitted for genetic analysis, 19 individuals (42.2%) were positively identified as PMJM; the remaining individuals were identified as WJM (Table 1). All *Zapus* spp. captures from Chugwater and Cottonwood Creeks were classified as PMJM; all

captures from the North Fork of Lodgepole Creek were classified as WJM (Fig. 1). Results from all *Zapus* spp. captures from 2009-2011 are presented in Figure 2.

DISCUSSION

Critical Habitat for PMJM in Wyoming was originally separated into three distinct river sections and their associated tributaries in Converse, Albany, Platte, and Laramie Counties: Cottonwood Creek, Chugwater Creek, and Lodgepole Creek (USFWS 2003). Focusing trapping efforts in these previously designated areas resulted in the greatest number of verified PMJM captures since the initiation of the survey effort in 2009 (see Cudworth and Grenier 2011). All *Zapus* spp. captures in Cottonwood and Chugwater Creeks were classified as PMJM, supporting the previous classification of these areas as Critical Habitat. Despite 27 *Zapus* spp. captures in the North Fork of Lodgepole Creek, no individuals were classified as PMJM. These results, coupled with previous WJM captures in South Lodgepole Creek in 2009 (Cudworth and Grenier 2011), suggest that Lodgepole Creek is likely not inhabited by PMJM despite previous designation as Critical Habitat. In fact, only one historical record of PMJM occurs in Lodgepole Creek, but this record is not definitive since it was not verified through genetic analyses (G. Beauvais, Wyoming Natural Diversity Database, unpubl. data).

All sampling locations from 2009-2011 were based on previously known or suspected PMJM locations from the Wyoming Natural Diversity Database (unpubl. data) or previous Critical Habitat designations (USFWS 2003). Based upon these surveys, *Zapus* spp. appear to be common and widespread throughout southeastern Wyoming. However, we documented PMJM at only two of three areas previously designated as Critical Habitat and two additional sites outside these areas (Cudworth and Grenier 2011). The low number of captures classified as PMJM suggests that the subspecies may be less common than originally expected, especially outside the Critical Habitat. Additionally, the complete lack of overlap between PMJM and WJM suggests that although their ranges overlap in Wyoming, PMJM and WJM are likely not using specific creeks and drainages sympatrically. Consequently, future trapping efforts should focus on further refining the predicted range of PMJM as well as looking at habitat factors that may influence allopatry of PMJM and WJM in order to better understand presence and distribution of PMJM in southeastern Wyoming.

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Table 1. Individual identification numbers, capture location, and species designation for *Zapus* spp. captured in drainages in southeastern Wyoming, 2011.

Individual ID number	Location	Species
4b11c	Chugwater Creek 2	*Z. hudsonius*
4b13c	Chugwater Creek 2	*Z. hudsonius*
4b6d	Chugwater Creek 2	*Z. hudsonius*
1a21a	Cottonwood Creek	*Z. hudsonius*
1a25c	Cottonwood Creek	*Z. hudsonius*
1a3b	Cottonwood Creek	*Z. hudsonius*
1a7d	Cottonwood Creek	*Z. hudsonius*
1b23c	Cottonwood Creek	*Z. hudsonius*
2a7b	Cottonwood Creek	*Z. hudsonius*
2b19c	Cottonwood Creek 3	*Z. hudsonius*
2b4b	Cottonwood Creek 3	*Z. hudsonius*
4b1a	Cottonwood Creek 3	*Z. hudsonius*
1a14b	North Cottonwood Creek	*Z. hudsonius*
1b11c	North Cottonwood Creek	*Z. hudsonius*
1b6c	North Cottonwood Creek	*Z. hudsonius*
2b13c	North Cottonwood Creek	*Z. hudsonius*
4a21d	North Cottonwood Creek	*Z. hudsonius*
4b18c	North Cottonwood Creek	*Z. hudsonius*
5a23c	North Cottonwood Creek	*Z. hudsonius*
1a16b	North Fork Lodgepole Creek	*Z. princeps*
1a18d	North Fork Lodgepole Creek	*Z. princeps*
1a22b	North Fork Lodgepole Creek	*Z. princeps*
1a2c	North Fork Lodgepole Creek	*Z. princeps*
1b21d	North Fork Lodgepole Creek	*Z. princeps*
1b5c	North Fork Lodgepole Creek	*Z. princeps*
4a3d	North Fork Lodgepole Creek	*Z. princeps*
4a8d	North Fork Lodgepole Creek	*Z. princeps*
4b18a	North Fork Lodgepole Creek	*Z. princeps*
5a10d	North Fork Lodgepole Creek	*Z. princeps*
5a17b	North Fork Lodgepole Creek	*Z. princeps*
5a19a	North Fork Lodgepole Creek	*Z. princeps*
5a7c	North Fork Lodgepole Creek	*Z. princeps*
6a23a	North Fork Lodgepole Creek	*Z. princeps*
1b25d	North Fork Lodgepole Creek 2	*Z. princeps*
3a11c	North Fork Lodgepole Creek 2	*Z. princeps*
4a24a	North Fork Lodgepole Creek 2	*Z. princeps*
4a3c	North Fork Lodgepole Creek 2	*Z. princeps*

Table 1. Continued.

Individual ID number	Location	Species
4b20d	North Fork Lodgepole Creek 2	*Z. princeps*
5b13d	North Fork Lodgepole Creek 2	*Z. princeps*
6a3c	North Fork Lodgepole Creek 2	*Z. princeps*
2b19d	North Fork Lodgepole Creek 3	*Z. princeps*
3b15c	North Fork Lodgepole Creek 3	*Z. princeps*
4b3d	North Fork Lodgepole Creek 3	*Z. princeps*
6a22c	North Fork Lodgepole Creek 3	*Z. princeps*
6a25d	North Fork Lodgepole Creek 3	*Z. princeps*
6a5d	North Fork Lodgepole Creek 3	*Z. princeps*

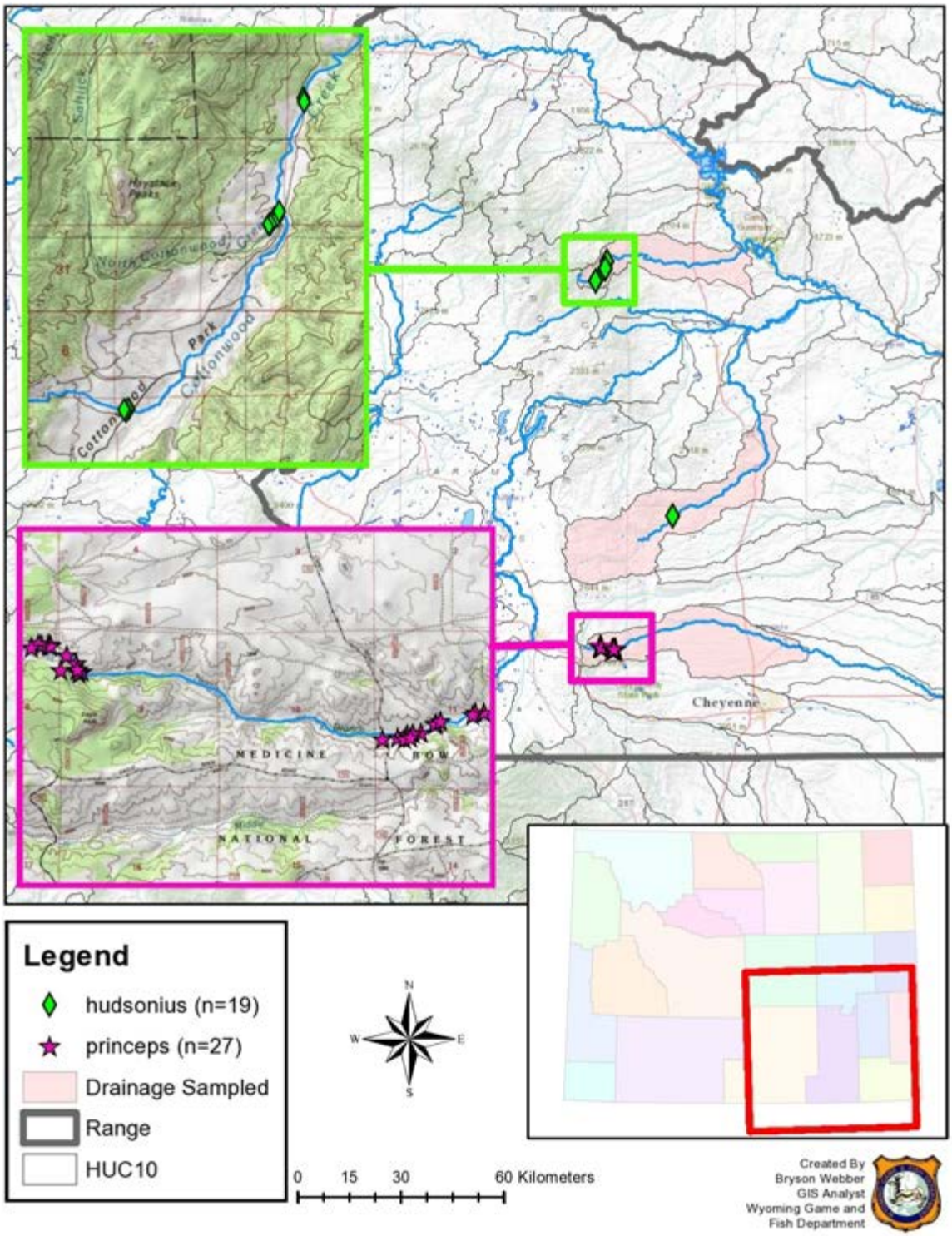

Figure 1. Major rivers, Hydrological Unit Codes (HUCs), and locations of Preble's meadow jumping mice (*Zapus hudsonius preblei*; green diamonds) and western jumping mice (*Z. princeps*; pink stars) captures by species in southeastern Wyoming, 2011. Surveyed HUCs are represented in light pink.

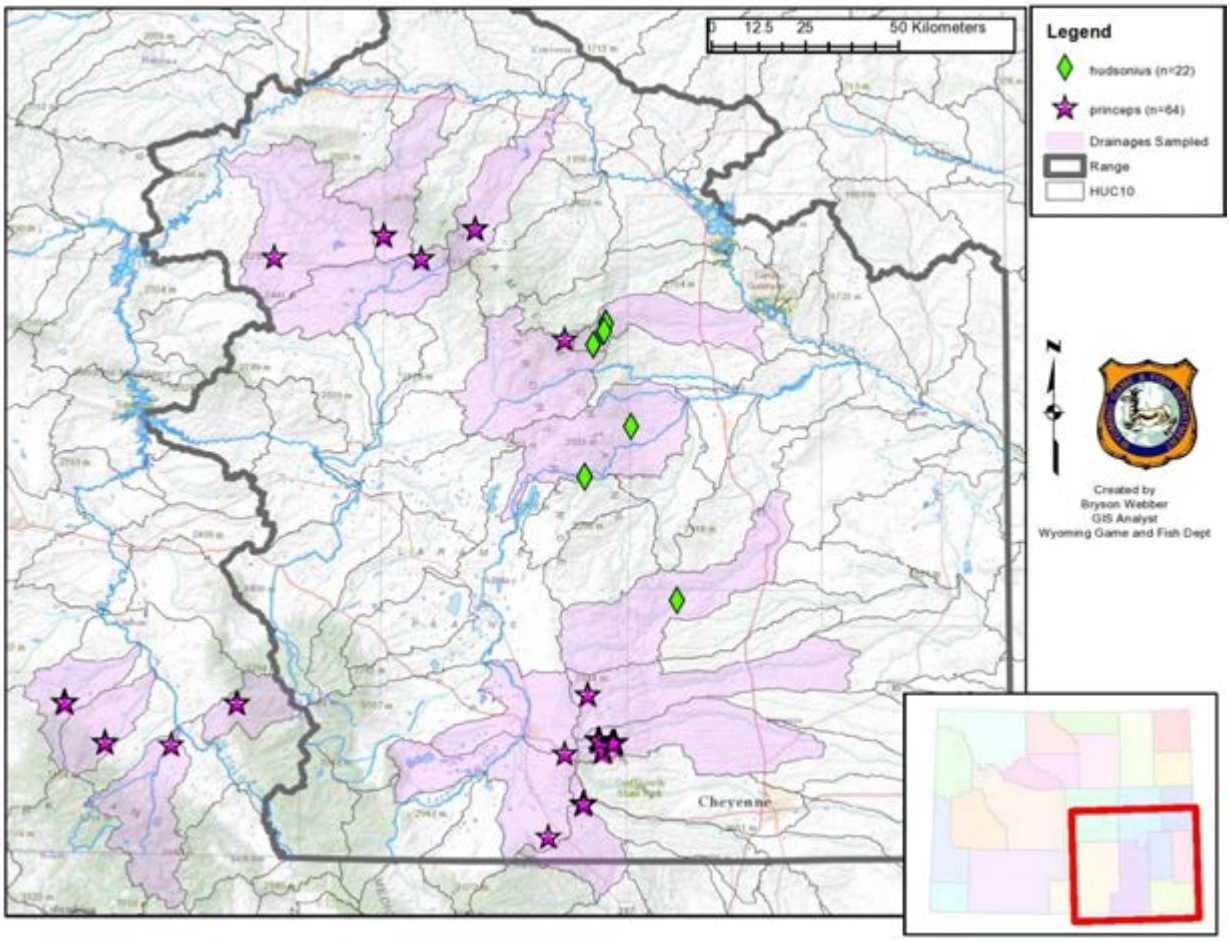

Figure 2. Major rivers, Hydrological Unit Codes (HUCs), and locations of Preble's meadow jumping mice (*Zapus hudsonius preblei*; green diamonds) and western jumping mice (*Z. princeps*; pink stars) captures by species in southeastern Wyoming, 2009-2011. Surveyed HUCs are represented in light pink. The predicted range of *Z. h. preblei* in Wyoming is outlined in gray.

SPOTLIGHTING FOR BLACK-FOOTED FERRETS IN THE SHIRLEY BASIN/MEDICINE BOW MANAGEMENT AREA

STATE OF WYOMING

NONGAME MAMMALS: Species of Greatest Conservation Need, Endangered Species – Black-footed Ferret

FUNDING SOURCE: United States Fish and Wildlife Service Section 6 Funds, Wyoming State Legislature General Fund Appropriations

PROJECTION DURATION: Annual

PERIOD COVERED: 15 April 2011 – 14 April 2012

PREPARED BY: Laurie Van Fleet, Nongame Biologist
Martin Grenier, Nongame Mammal Biologist

ABSTRACT

In 2011, we commemorated the 20th anniversary of the reintroduction of the black-footed ferret (*Mustela nigripes*) into Shirley Basin, Wyoming. During this time the ferret has faced numerous challenges to its recovery, however diseases continue to remain the biggest threat to their persistence in Shirley Basin. Releases of ferrets were terminated in 1994 as a result of sylvatic plague and disease epizootics, which reduced abundance of its prey, the white-tailed prairie dog (*Cynomys leucurus*) within Shirley Basin. During this period, the reintroduced population was characterized by slow population growth. However, the black-footed ferret survived this bottleneck, and the population increased exponentially from 2000-2006. Since 2006, demographic data spanning six years for ferrets shows strong evidence of the population transitioning from exponential growth to logistical growth within the study area. As such, we suspect ferrets are dispersing and colonizing new areas. In 2011, we focused our efforts in two areas outside the study area to document ferret distribution and production. Efforts were made to capture and mark all ferrets located during surveys in August and September, 2011. A minimum of 17 black-footed ferrets and 5 litters were located during these surveys. Ten ferrets were captured and 9 were marked. We collected blood samples from 6 captured black-footed ferrets. One adult female tested positive for tularemia. All ferrets were negative for canine distemper and sylvatic plague. Our results suggest that ferrets in Shirley Basin are expanding and reproducing into areas outside of the study area.

INTRODUCTION

This year, we celebrated two major milestones in recovery of the black-footed ferret (*Mustela nigripes*; ferret): the 30th anniversary of rediscovery of the species in Meeteetse, Wyoming, and the 20th anniversary of their reintroduction at Shirley Basin, Wyoming. Shirley Basin was selected as the first reintroduction site for ferrets due to the wide range of white-tailed prairie dogs (*Cynomys leucurus*; WTPD) and the overwhelming support from private landowners in the area. Between 1991 and 1994, we released 228 ferrets at Shirley Basin. We terminated ferret releases in 1994 due to canine distemper epizootics in ferrets and decreased abundance of WTPD within the reintroduction area due to sylvatic plague and canine distemper epizootics, which decreased abundance of the WTPD within the reintroduction area. During this period, the population of ferrets was characterized by slow population growth and ≤20 individuals were located annually prior to 2000 (Grenier et al. 2007). Spotlight surveys conducted after 2003 documented an increasing population of ferrets within the Shirley Basin (Grenier et al. 2006*a*). Because WTPD abundance had increased in other areas of Shirley Basin where ferrets were believed to be absent, an additional 250 ferrets were released into areas north and south of Shirley Basin during fall and winter from 2005 to 2007 (Grenier et al. 2006*b*, Grenier et al. 2008, and Schell and Grenier 2008).

In recent years we began conducting biennial surveys in WTPD colonies outside the area we monitor to evaluate distribution and reproductive status of the ferret in those areas (Grenier et al. 2008, Van Fleet and Grenier 2010). Accordingly, our survey objectives in 2011 were to document the distribution of ferrets southeast of the monitoring area in Shirley Basin in a portion of the management area not previously surveyed, and to revisit an area previously surveyed in 2007. We discuss the implications of our findings for recovery of the ferret in Shirley Basin, Wyoming.

METHODS

We conducted surveys in 2011 on both public and private land at two locations: northeast of Rock River and south of Shirley Rim in the Shirley Basin, where we previously surveyed in 2007 (Figure 1). Total acreage of WTPD colonies northeast of Rock River was not determined prior to spotlight surveys. Approximately 19,222 ha of colonies of WTPD occur in the area south of Shirley Rim.

We contacted all landowners for permission to access their land prior to surveys. We established areas to spotlight prior to the start of surveys based on available personnel and the interspersion of roads. We surveyed areas with high density of roads either entirely or partially by vehicle, while we accessed areas without roads by foot. We provided surveyors with a 7.5-min USGS map and a copy of the 2006 National Agriculture Imagery Program color aerial photographs with the colony boundary and UTMs to facilitate their orientation.

We surveyed from 2000-2300 hrs and 0100-0600 hrs in blocks of three consecutive nights (Grenier 2008, Grenier et al. 2009). To locate ferrets, we drove vehicles equipped with roof-mounted spotlights (Model RM 240 Blitz, Lightforce Professional Lighting Systems,

Orofino, ID) along existing roads or used a backpack spotlight unit (Walkabout Kit, Lightforce Professional Lighting Systems, Orofino, ID) to traverse portions of the colony that could not be surveyed from a vehicle (i.e., portions with low density of roads).

After we located ferrets, we used an unbaited live trap and attempted to capture observed individuals (Sheets 1972). We checked traps hourly throughout the night, and removed all traps at sunrise. We transported captured ferrets to a mobile processing trailer, where we used isoflurane gas to anesthetize individuals (Kreeger et al. 1998). We assigned age class as juvenile or adult by palpation of the sagittal crest, examination of dentition and tooth wear, and reproductive status (Thorne et al. 1985). We marked ferrets with passive integrated transponders (AVID Microchip I.D. Systems, Folsom, LA; PIT tags) and hair dye (Grenier 2008). We collected blood samples when possible. Following a brief recovery period, we returned the ferret to the burrow from which it was captured. We sent blood samples to the Wyoming Game and Fish Department Wildlife Veterinary Laboratory to test for the presence of antibodies of tularemia (*Francisella tularemia*), canine distemper virus (CDV), and sylvatic plague.

RESULTS

We spent 336.5 person • hrs, during 6 nights, spotlighting for ferrets in August and September (Table 1). We captured 10 ferrets, including 4 adults and 6 juveniles (Table 2). We released one adult male without processing due to time constraints. We collected blood samples from six of the captured ferrets for blood serology. One adult female tested positive for antibodies of tularemia (Table 3). Blood samples were negative for all other pathogens. We detected no abnormalities and very few (i.e., ≤10) ectoparasites on most ferrets we handled in 2011.

We observed 10 individual ferrets, including 2 litters, and we captured 2 juveniles during 170.8 hours of spotlighting near Rock River, Wyoming in August. Because WTPD colony size was not previously determined at this site, we surveyed eight colonies where WTPD were abundant. We observed 7 individual ferrets 15 times, captured 2 lactating females, and observed 3 litters (Table 1, Figure 2) during 165.8 hours of spotlighting south of Shirley Rim in September. We surveyed five WTPD colonies south of Shirley Rim, totaling 1,757 ha (Figure 2). During both survey weeks, we observed a total of 17 individual ferrets, 32 times, including 5 litters and a discrete ferret was observed about every 19.8 person • hrs (Figure 2, Table 4).

Observations of species other than ferrets are not presented in this completion report; however, they were entered into the Wyoming Game and Fish Department's Wildlife Observation System and are also available from the Nongame Mammal Biologist, Wyoming Game and Fish Department, 260 Buena Vista, Lander, WY 82520.

DISCUSSION

Results of the surveys indicated that ferrets were in good physical and reproductive condition. All adult females that we captured and observed showed signs of lactation or were in

the presence of juveniles. One adult female tested positive for tularemia, however, we do not believe these results to be a major concern. Many diseases such as Tularemia are common in Shirley Basin; therefore it is not surprising that a small fraction of individuals show titers. We do not believe these results indicate major epizootics in Shirley Basin, nor do they present threats to the persistence of the population.

The number of ferrets observed south of Shirley Rim this year was approximately a third of that observed during previous surveys conducted in 2007 (Grenier et al 2008). Remarkably, all ferrets we captured had similar weights to those in 2007 (Van Fleet and Grenier 2011), suggesting we should have detected a similar number of individuals as in 2007. The fact that we detected a lower number may suggest other extrinsic factors such as weather, timing of surveys, or reproductive timing may have affected the survey. It is likely we simply failed to detect several individuals and litters in 2011 and have no reason to suspect that ferrets or WTPD are declining in this area. Notably, WTPD were present in the area and had abundances similar to previous years. Additionally, we did not detect any ferrets with positive titers for sylvatic plague or other diseases that would cause catastrophic declines. Consequently, the results of our surveillance effort in 2011 indicate that ferrets are persisting and continue to reproduce in the area.

We surveyed the area northeast of Rock River for the first time this year. Prior to spotlight surveys, we had observed several large colonies of WTPD with high abundance of individuals. We targeted these colonies for our surveys. We did not expect to find ferrets in this area prior to surveying. We now believe, given our results, that ferrets may have dispersed beyond this area and could easily be colonizing other available and suitable habitats that we have not quantified. To better understand the potential for dispersal in this area, we recommend mapping colonies to quantify hectares of available habitat in this area. The results may also be used to improve future spotlighting surveys.

Stochastic events such as disease epizootics that lead to the rapid decline of abundance of WTPD and ferrets remain a major concern. Mitigation of stochastic events is typically accomplished through management intervention (e.g., dusting, vaccination). However, Jachowski et al. 2011 suggested that if distribution and abundance of ferrets is widespread then perhaps no intervention is necessary. Shirley Basin is a vast area where management intervention can be cost-prohibitive in terms of personnel time and equipment, and may not be feasible on such a large scale. Our results indicate that ferrets continue to expand their distribution within the designated management area and now occupy more area than previously reported by Van Fleet and Grenier (2011). This broad distribution may help prevent complete extirpation of the population of ferrets in the event that an epizootic is documented. Stochastic events are unavoidable and only time will tell if this passive management strategy will be successful.

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Table 1. Survey effort, in person hrs, expended while spotlighting for black-footed ferrets (*Mustela nigripes*) in Shirley Basin, Wyoming during the summer of 2011. We surveyed near Rock River, Wyoming during the week of August 16 and near Shirley Rim during the week of Sep 6.

Survey Type	Aug. 16 - 18	Sept. 6 - 8	Total
Vehicle	82.25	134.00	216.25
Foot	88.50	31.75	120.25
Total	170.75	165.75	336.50

Table 2. Capture details for ten black-footed ferrets (*Mustela nigripes*) captured and processed in Shirley Basin, Wyoming 2011. Sex and age of capture number 3 was determined at the capture site and released without being processed. Blood samples were taken from six of the captured black-footed ferrets.

Capture no.	Transponder no. - head			Capture date	Colony no.	Observer	Stud book no.	Blood Drawn	Sex	Age
1	102	831	354	8/17/2011	113-1	D. Wilckens	SB1101		M	J
2	102	852	318	8/17/2011	113-1	D. Wilckens	SB1102	Yes	F	J
3				8/18/2011	114-4	N. Cudworth			M	A
4	102	822	265	9/06/2011	567-1	S. Cornell	SB1103	Yes	M	J
5	50	549	119	9/06/2011	549-2	K. Weber	SB1104		M	J
6	50	825	076	9/06/2011	549-1	N. Cudworth	SB1060	Yes	M	A
7	50	531	579	9/07/2011	549-2	K. Weber	SB1105	Yes	F	J
8	50	826	561	9/07/2011	549-2	K. Weber	SB1061	Yes	F	A
9	50	830	583	9/07/2011	546-1	M. Grenier	SB1062	Yes	F	A
10	50	832	363	9/07/2011	546-1	M. Grenier	SB1106		M	J

Table 3. Test results and their interpretation for six blood samples we collected from black-footed ferrets (*Mustela nigripes*) captured in Shirley Basin, Wyoming 2011.

Disease	Number tested	Number positive	Stud book no.	Titer level	Age	Sex	Previously vaccinated
Canine Distemper	6	0					
Sylvatic Plague	6	0					
Tularemia	6	1	SB1061	1:128	A	F	No

Table 4. Observations of black-footed ferrets (*Mustela nigripes*) we detected during spotlight surveys in the Shirley Basin/Medicine Bow Management Area, Wyoming, August and September, 2011. We observed 17 individual black-footed ferrets 32 times during the surveys. We determined discrete observations with guidelines developed by Grenier (2008). For methods, T represents truck and BP represents backpack.

Date	Species Code	Time	Method	Discrete	Observer	Age	Sex	SB#
8/16/2011	1BFF1	0208	T	Y	D. Wilkens			
8/16/2011	1BFF2	0243	T	Y	D. Wilkens			
8/17/2011	2BFF1	2105	T	N	D. Wilkens	J	M	SB1101
8/17/2011	2BFF2	2115	T	N	D. Wilkens	J	F	SB1102
8/17/2011	2BFF1	2144	BP	Y	N. Cudworth			
8/17/2011	2BFF3	0210	T	Y	D. Wilkens			
8/17/2011	2BFF1	0230	BP	Y	C. Atkinson			
8/18/2011	3BFF1	2054	T	Y	D. Wilkens			
8/18/2011	3BFF2	2054	T	Y	D. Wilkens			
8/18/2011	3BFF3	2104	BP	N	D. Wilkens			
8/18/2011	3BFF4	2119	BP	Y	D. Wilkens			
8/18/2011	3BFF5	0128	T	N	D. Wilkens			
8/18/2011	3BFF6	0138	T	N	D. Wilkens			
8/18/2011	3BFF1	0147	T	Y	N. Cudworth	A	M	NA
8/18/2011	3BFF1	0150	T	N	C. Atkinson			
8/18/2011	3BFF2	0255	BP	Y	N. Cudworth			
8/18/2011	3BFF1	0340	BP	N	S. Cornell			
9/6/2011	1BFF1	2100	T	Y	S. Cornell	J	M	SB1103
9/6/2011	1BFF1	0127	BP	Y	N. Cudworth	A	M	SB1060
9/6/2011	1BFF1	0135	T	Y	K. Leuenberger			
9/6/2011	1BFF2	0135	T	Y	K. Leuenberger			
9/6/2011	1BFF1	0441	T	Y	K. Weber	J	M	SB1104
9/7/2011	2BFF1	2019	BP	N	N. Cudworth			

Table 4. Continued.

Date	Species Code	Time	Method	Discrete	Observer	Age	Sex	SB#
9/7/2011	2BFF1	2155	T	Y	K. Weber	J	F	SB1105
9/7/2011	2BFF2	2224	T	N	K. Weber			
9/7/2011	2BFF3	2254	T	Y	K. Weber	A	F	SB1061
9/7/2011	2BFF4	2301	T	N	K. Weber			
9/7/2011	2BFF1	2310	T	N	M. Grenier	A	F	SB1062
9/7/2011	2BFF2	2350	T	N	M. Grenier	J	M	SB1106
9/7/2011	2BFF1	0345	BP	N	S. Cornell			
9/8/2011	3BFF1	2245	BP	N	K. Leuenberger			
9/8/2011	3BFF2	2245	BP	N	K. Leuenberger			

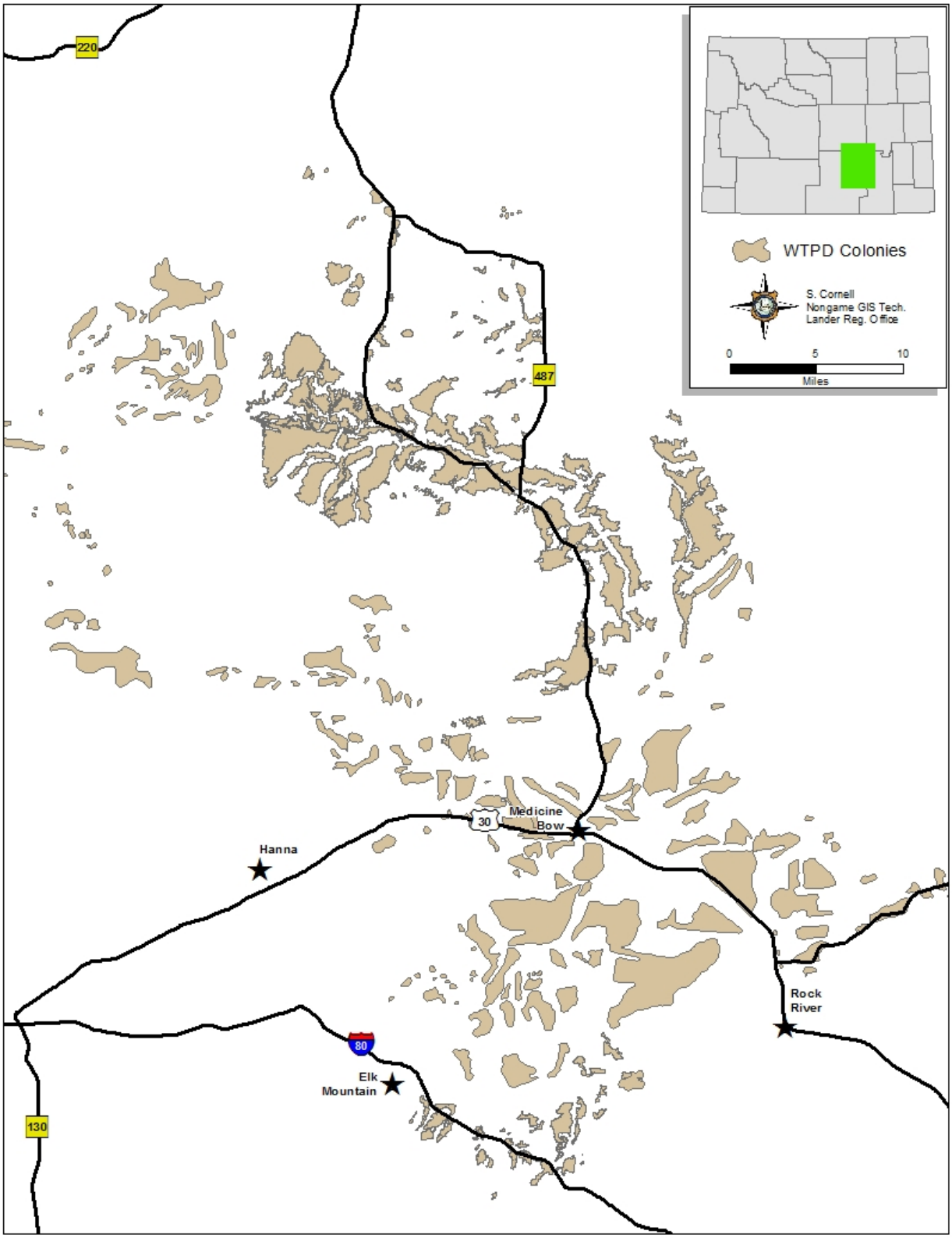

Figure 1. Spatial arrangement and distribution of white-tailed prairie dog (*Cynomys leucurus*) colonies in Shirley Basin/Medicine Bow Management Area, Wyoming, 2011.

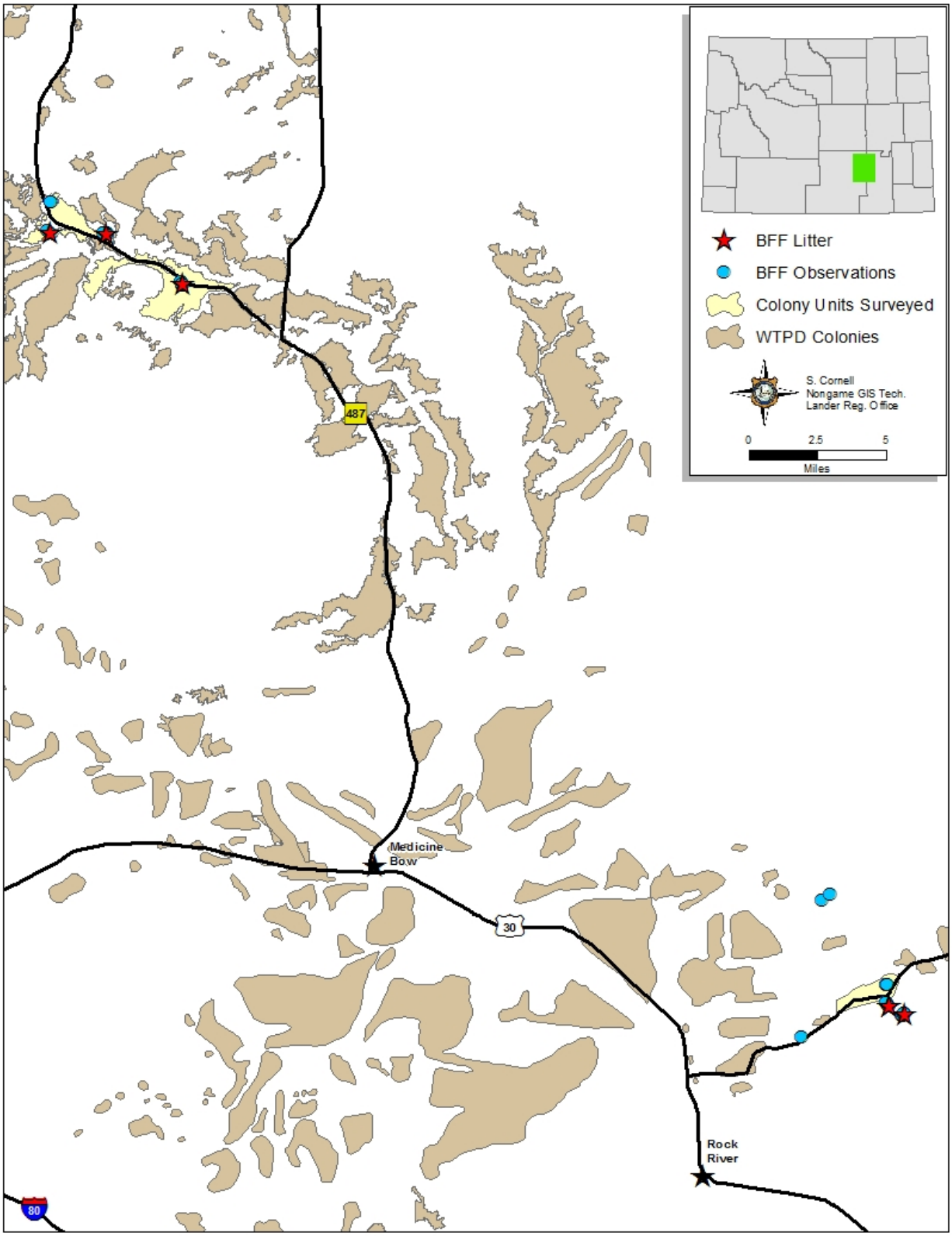

Figure 2. Locations of black-footed ferret (*Mustela nigripes*) individuals and litter that we detected in the Shirley Basin/Medicine Bow Management Area, 2011.

SPECIES OF GREATEST CONSERVATION NEED

SPECIES OF GREATEST CONSERVATION NEED – *BIRDS*

ENUMERATING THE ROCKY MOUNTAIN POPULATION OF TRUMPETER SWANS – WYOMING FLOCK

STATE OF WYOMING

NONGAME BIRDS: Species of Greatest Conservation Need – Trumpeter Swan

FUNDING SOURCE: Wyoming State Legislature General Fund Appropriations, Wyoming Governor's Endangered Species Account Funds, United States Fish and Wildlife Service Cooperative Agreements

PROJECT DURATION: Annual

PERIOD COVERED: 15 April 2011 – 14 April 2012

PREPARED BY: Susan Patla, Nongame Biologist

ABSTRACT

Since the late 1980s, the Wyoming Game and Fish Department has been actively involved in monitoring and managing Trumpeter Swans (*Cygnus buccinator*). Trumpeter Swans are one of the rarest avian species that nests in Wyoming and are classified as a Species of Greatest Conservation Need with Native Species Status of 2 by the Wyoming Game and Fish Department. Year-round resident Trumpeter Swans in Wyoming comprise part of the historic Tri-State population that nests in the Greater Yellowstone area. Monitoring efforts for this species are coordinated with US Fish and Wildlife Service, Pacific Flyway Council, and the state agencies in Idaho and Montana. We completed four survey flights during 2011 and winter 2012 to collect data on total number of adults and young detected in summer and winter and to document occupancy and productivity of all known nest sites. In the 2011 fall survey, we counted the second highest number of resident adult Trumpeter Swans in Wyoming outside of Yellowstone National Park (n = 124 adults) and also documented the highest number of occupied nest sites since we initiated surveys (n = 44). This included finding one pair at a new site in the Wind River Basin. Number of young fledged, however, was 23% lower compared to the previous year. Lower productivity likely resulted from the extremely late winter conditions that persisted in western Wyoming until early June that resulted in many pairs that were not in condition to initiate nesting and the extended high run-off period during which some active nests were flooded. In February 2012, we counted the second highest number of swans wintering in Wyoming (n = 1,007), with 55% of wintering swans located in the Snake River drainage. Growth of the resident population of Trumpeter Swans can be attributed to the Wyoming Game and Fish Department's range expansion efforts beginning in the late 1980s in the Salt and Green River Basins. To accommodate the growing number of nesting swans in the Green River Basin, we initiated a habitat project in 2004 that focused on cooperating with landowners to develop

shallow-water wetland ponds that provided additional summer habitat for this species and other wildlife associated with this rare habitat type. In fall 2011, the Department obtained a grant in partnership with The Nature Conservancy of Wyoming to conduct a 2-year assessment of wetland habitat in the Green River Basin, the first study of this kind in Wyoming. Field work for this grant will be initiated in June 2012.

INTRODUCTION

The Trumpeter Swan (*Cygnus buccinator*; swans) is designated a Species of Greatest Conservation Need (SGCN) in Wyoming with Native Species Status ranking 2 (WGFD 2010). Although swans were never listed under the Endangered Species Act of 1973, they have been a focal management species for federal and state agencies in the Greater Yellowstone Area (GYA) since the establishment of Red Rock Lakes National Wildlife Refuge in Montana in 1932. This refuge was created to conserve approximately 70 swans in the GYA, which were believed to be the last remaining Trumpeter Swans in the world. Due to conservation efforts, the number of swans in the GYA increased to >600 by the 1950s (USFWS 1998). However, the population has fluctuated since that time, and total number of adult birds is currently <400 (Olson 2011).

The Pacific Flyway Council coordinates management of this species and has designated swans that nest and reside year-round in the GYA, including western Wyoming, as the Tri-State Area Flocks (TSAF). The TSAF are managed as part of the US segment of the Rocky Mountain Population (RMP) of swans, which includes those that nest in interior Canada and migrate south to over-winter in the GYA (USFWS 1998). The Wyoming Game and Fish Department (Department) coordinates with the US Fish and Wildlife Service (USFWS) Mountain-Prairie Region Migratory Bird Office and the states of Idaho and Montana to census the number of mature swans and young of the year (i.e., cygnets) in the GYA. Since the late 1980s, the Department has worked to expand summer and winter distribution of swans in Wyoming (Patla and Oakleaf 2004). These efforts have established a new nesting population in the Green River Basin. Since 2004, the Department has cooperated with willing landowners to restore and create summer habitat in the Upper Green River Basin to accommodate this expanding population. The Department is a member of the Greater Yellowstone Trumpeter Swan Working Group, which consists of state and federal agencies, non-government organizations, and interested citizens. The working group meets annually in October to review and discuss productivity trends, as well as to coordinate management actions. Wyoming also participates on the Pacific Flyway RMP Trumpeter Swan Study Committee. This report summarizes management activities and monitoring data for swans in Wyoming for the 2011 nesting season and the 2011-2012 winter season.

METHODS

We conducted ≥4 surveys from a fixed- wing airplane to collect data on swans in western Wyoming. We used a Scout airplane to conduct all aerial surveys in 2011 in cooperation with Sky Aviation. Flying elevation averaged 30-70 m above ground level depending on terrain and surface winds; flight speed was between 135-160 kph. During the survey, the observer counted

white birds (i.e., adults and sub-adults) and gray cygnets. We surveyed all known nest sites on 3 June to determine occupancy and again on 12 July to count number of young hatched (i.e., cygnets) in the Snake River, Salt River, and Green River drainages. The fall and winter surveys were coordinated by USFWS in the Tri-State area of Wyoming, Montana, and Idaho. We flew the Wyoming portion of the fall survey on 14-16 September and the winter survey on 27-28 January 2012. We presented survey results to the Pacific Flyway Study Committee at their July and December meetings, and to the Greater Yellowstone Trumpeter Swan Working Group at the Trumpeter Swan Society meeting in Polson, Montana, in October 2011. The USFWS Mountain-Prairie Region Migratory Bird Office produced two reports summarizing results for the coordinated RMP surveys (Olson 2011, 2012).

We continued wetland project work to restore and enhance summer habitat for swans in the Green River Basin. Details are from S. Patla, Wyoming Game and Fish Department.

RESULTS

During February 2012, we counted a total of 1,007 swans wintering in Wyoming outside of Yellowstone National Park (YNP), which was lower than the record-breaking number counted the previous year (n=1041; Fig. 1, Table 1). However, this number includes swans wintering in the Central Flyway portion of Wyoming that are not included in the official USFWS RMP report. This represents the second highest winter count since surveys were initiated in 1967. The number of wintering swans in the Pacific Flyway area in Wyoming has increased 7.0% per year between 1972 and 2011 ($P < 0.01$; Olson 2012). Overall for the TSAF, number of wintering swans has increased 5.7% during this same time period.

In fall 2011, we counted the second highest number of adults since 1967 in Wyoming outside of YNP (n=124; Table 2). This represents a 13% decrease from the record-breaking number of 143 adults counted the previous survey year. Number of swans in Wyoming (1993-2010) has increased by 1.7% per year ($P < 0.01$) for white birds and 8.3% ($P < 0.001$) for cygnets (Olson 2011). However, in the traditional Snake River core area (1999-2010), number of swans appears to be stable or declining. Conversely, in the Green River expansion area the number of swans has increased by 10.6% ($P < 0.001$) over the past 12 years (Olson 2011). Overall, the total TSAF fall count represented a 8.1% decrease from the previous year. The TSAF have shown a slight annual increase of 2.0% for white birds ($P < 0.01$) and a slight, but not a significant increase in cygnets (2.6%, $P = 0.14$) between 1993 and 2010 (Olsen 2011).

The number of nest sites occupied in 2011 (n=44) represented a new record for Wyoming and greatly exceeded the 10-year mean (Table 3). This included a new site occupied at Martin Ponds in the Wind River Basin east of Dubois. The number of nesting pairs and number of young hatched and fledged in Wyoming outside YNP in 2011 also exceeded 10-year averages for 2001-2010 (Table 3). The total number of young hatched and fledged, however, declined compared to the previous year. Only 57% of pairs initiated nesting, and, because of very high run-off starting in mid-June, a number of nests adjacent to major rivers or streams flooded and were abandoned by adults. This included sites in Grand Teton National Park (GTNP) on the Snake River, the National Elk Refuge on Flat Creek, and along the Green River corridor.

Overall, swans in the Green River Basin accounted for 54% of all occupied sites and 60% of fledged young (Table 4). In the Green River Basin, the number of sites occupied was 33% higher than the Snake River, and the number of nesting pairs was 40% higher.

Site-specific occupancy and productivity results for all known swan nest sites in Wyoming outside of YNP are presented in Table 5. In the Snake River, many traditional sites continued to be unoccupied or have pairs that did not produce young. Notable exceptions in 2011 included two productive sites in the Buffalo Valley north of Jackson and a pair that hatched and fledged five young at Swan Lake in GTNP. The most productive site in the core area over the last three years is the Department's South Park Wildlife Management Area (WMA), which has produced an average of 4.7 young per year. This nest site is on a constructed wetland that was built in the 1990s with the objective of creating additional swan nesting habitat. Swans began nesting at this site in 2009. In the range expansion areas, a pair fledged one young at the Alpine wetland in the Salt River drainage for the first successful nesting attempt at that location. New nest site locations where pairs initiated nesting in the Green River expansion area in 2011 included Webb Draw near Daniel, the East Fork River south of Boulder, and a site along the Green River outside of Big Piney. A pair also molted for the first time on a wetland pond constructed for swans on the Rimfire Ranch south of Daniel. Seedskadee National Wildlife Refuge continues to be the leader in productivity of any management unit, with five successful pairs in 2011, which fledged a total 13 young. This represents 34% of total production for the state. A pair discovered in the Wind River drainage did not nest but occupied the Martin Pond site throughout the nesting season. A pair was documented this fall once again in eastern Wyoming near Colony, which likely originated from the High Plains Flock in LaCreek, South Dakota.

Summary of mortality data from 1991-2012 is presented in Table 6. Even though the winter of 2011-2012 had mild temperatures and below-average snowfall, we documented >30 mortalities in Wyoming. The highest number of mortalities was reported in late winter and spring. Multiple mortalities (5-6) were found at a few sites where swans tended to concentrate in winter or early spring. This included sites on private land in Wilson, Afton, and on the South Park WMA south of Jackson.

We submitted intact carcasses to the Wyoming State Veterinary Laboratory in Laramie when possible, although most mortalities were found as feather piles or in a decayed and scavenged state. At one private pond near the confluence of the Snake and Gros Ventre Rivers that has been used by <60 swans in winter as a resting site for the past decade, 6 adult and cygnets died. Analysis of four of these individuals indicated high levels of parasites or leeches and associated tissue damage and infections with swans in an emaciated condition. It could not be determined if poor condition was a primary or secondary cause of parasite loads and subsequent infections. Swans in a weak condition in late winter and early spring are, of course, at risk from multiple factors including disease, parasites, and predation. Overall, cause of mortality in most cases could not be determined. Where we were able to attribute a direct cause, collisions with wires, fences, or vehicles were the predominant factor. Additionally, one cygnet was shot by a duck hunter in September at the South Park WMA at a swan nest pond.

DISCUSSION

The observed stagnation or slow decline in numbers of nesting pairs in the Snake River area suggests that migratory swans are likely negatively impacting available habitat needed by resident swans prior to the onset of nesting later in spring. During the winter of 2011-2012, as in the previous winter, we documented a large number of swans in Wyoming. Fifty-five percent of the swans wintering in Wyoming used the Snake River Basin and associated wetlands. At a maximum, only 10.7% of these swans were residents of the Snake River area year-round (n = 63), with the majority being swans that migrated from Canada or elsewhere. The high number of swans wintering in the Jackson area remains a concern. Generally, most migrant swans depart by the end of March leaving resident swans to forage on remaining aquatic vegetation until additional wetlands thaw and open. Especially in cold, late springs such as 2011, when the thaw in some locations was delayed until late May or early June, available aquatic vegetation is in short supply. Access to supplemental food on private wetland ponds may be attracting and holding more swans in the Jackson area in winter also, exacerbating the problem. We hypothesize that the increase in number of wintering swans is negatively impacts resident pairs in the core area as a result of degraded and over-used foraging habitat that is in very limited supply during late winter and early spring.

In contrast, increasing productivity of swans in the Green River expansion area in Wyoming indicates that winter and early spring conditions provide adequate pre-nesting foraging habitat for the resident nesting population. Swans that winter along the Green River below Fontenelle Dam start to move north as soon as the river begins to thaw above the dam in early to mid-March. This provides access to a much larger extent of foraging habitat along the Green River corridor in the pre-nesting season compared to resident swans in the core area.

While the total number of resident swans in Wyoming in 2011 represents the second highest number on record since counts began in the late 1960s, the swan remains one of the rarest breeding birds in Wyoming. Swans in Wyoming now comprise between 35-40% of the total TSAF and therefore constitute an important portion of the current GYA resident population. Although, the success of the Green River range expansion program has resulted in increased numbers of swans in that area of the state, we remain concerned about declining numbers and productivity in northwestern Wyoming, including Yellowstone National Park. We will continue to work with members of the Greater Yellowstone Trumpeter Swan Working Group and the Pacific Flyway to monitor this situation and work towards the development of management projects and joint research proposals to investigate the reasons for this decline.

In future years, we will continue to focus management efforts on cooperative habitat projects with willing landowners to improve and restore wetland habitats in the Green River, Salt River, and Snake River drainages as opportunities arise (Lockman 2005, WGFD 2010). Given the increasing number and productivity of swans in the Green River Basin and possible long-term drought conditions, it is important that we continue to be a leader in habitat improvement projects for swans and other wildlife associated with wetland habitat. Recently, we cooperated with The Conservation Fund to obtain a capacity grant from the Intermountain Joint Venture to continue to build partnerships and develop new proposals for conserving and restoring wetland habitat in the Upper Green River Basin. We also obtained a state grant from the Environmental

Protection Agency, in partnership with The Nature Conservancy of Wyoming, to conduct the first basin-wide assessment of wetland habitat in the state for the Green River Basin. Completion of this 2-year study will provide a more complete understanding of the types and condition of wetlands in the basin and help to focus future conservation and restoration work. We have had excellent success obtaining funding since 2007 from the Wyoming Landscape Conservation Initiative and the Wyoming Wildlife Natural Resource Trust and will continue to develop grant proposals for individual wetland projects through these programs as well.

ACKNOWLEDGEMENTS

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Table 1. Number of Trumpeter Swan (*Cygnus buccinators*) adults and cygnets counted in Wyoming for the coordinated Tri-State winter survey in February, 2002-2012. Results are shown for specific survey areas in Wyoming where wintering swans have been found. Occasional swans observed in the Platte River drainage are not included. Data for entire Tri-State Area, which includes portions of southwestern Montana and southeastern Idaho, can be found in Olson 2012.

Year	Age group	Yellowstone National Park	Snake River	Green River	Salt River	Wind River	Wyoming total
	Adult	131	337	40	70		578
2002	Cygnet	13	61	6	5		85
	Total	144	398	46	75		663
	Adult	146	254	49	35	16	500
2003	Cygnet	34	45	4	7	2	92
	Total	180	299	53	42	18	592
	Adult	149	307	61	94	0	611
2004	Cygnet	33	18	17	23	0	91
	Total	182	325	78	117	0	702
	Adult	124	367	61	102	31	685
2005	Cygnet	30	109	20	35	2	196
	Total	154	476	81	137	33	881
	Adult	121	413	100	124	18	776
2006	Cygnet	14	58	13	37	3	125
	Total	135	471	113	161	21	901
	Adult	144	420	116	158	6	844
2007	Cygnet	25	84	30	35	6	180
	Total	169	504	146	193	12	1024

Table 1. Continued.

Year	Age group	Yellowstone National Park	Snake River	Green River	Salt River	Wind River	Wyoming total
	Adult	65	316	109	174	4	668
2008	Cygnet	7	63	30	43	6	149
	Total	72	379	139	217	10	817
	Adult	88	321	160	133	24	726
2009	Cygnet	2	63	27	8	12	112
	Total	90	384	187	141	36	838
2010	Adult	18	369	160	85	16	648
	Cygnet	5	56	30	12	8	111
	Total	23	425	190	97	24	759
2011	Adult	125	467	168	150	27	937
	Cygnet	42	138	51	32	8	271
	Total	167	605	219	182	35	1208
	Adult	51	488	210	109	27	885
2012	Cygnet	4	99	20	29	24	176
	Total	55	587	230	138	51	1061

Table 2. Fall survey results for the Rocky Mountain Population of Trumpeter Swans (*Cygnus buccinators*) that are resident year-round in the Tri-State Area (i.e., Idaho, Montana, and Wyoming), 2001-2011 (Olson 2011). [a] - Total does not include captive raised swans released by Wyoming Game and Fish Department and the Wyoming Wetland Society (i.e., three yearlings and five cygnets in 2001 and five yearlings in 2002). YNP represents Yellowstone National Park.

Year	Age group	Montana	Idaho	Wyoming YNP	Wyoming outside YNP	Tri-State total
2001	Adult	140	124	17	81	362
	Cygnet	9	23	0	22	54
	Total	149	147	17	103 [a]	416
2002	Adult	76	103	22	72	273
	Cygnet	18	14	4	17	53
	Total	94	117	26	89 [a]	326
2003	Adult	89	100	16	86	291
	Cygnet	29	27	4	35	95
	Total	118	127	20	121	386
2004	Adult	89	112	16	74	291
	Cygnet	32	23	2	37	94
	Total	121	135	18	111	385
2005	Adult	112	136	18	89	355
	Cygnet	40	22	1	35	98
	Total	152	158	19	124	453
2006	Adult	117	132	14	114	377
	Cygnet	17	39	0	26	82
	Total	134	171	14	140	459
2007	Adult	157	113	10	103	383
	Cygnet	41	15	0	59	115
	Total	198	128	10	162	498
2008	Adult	140	112	6	121	379
	Cygnet	7	5	2	34	48
	Total	147	117	8	155	427
2009	Adult	138	122	4	97	361
	Cygnet	21	21	0	33	75
	Total	159	143	4	130	436

Table 2. Continued

	Adult	129	101	2	143	375
2010	Cygnet	30	29	0	48	107
	Total	159	130	2	191	482
	Adult	123	98	9	124	354
2011	Cygnet	40	12	0	37	89
	Total	163	110	9	161	443

Table 3. Occupancy and productivity data for Trumpeter Swans (*Cygnus buccinator*) that nest in Wyoming, not including Yellowstone National Park, 1990-2011. Shown are number of sites occupied, number of nesting pairs, number of pairs that hatched cygnets, number of pairs with fledged cygnets (i.e., mature young in September), number of cygnets hatched, and number of cygnets fledged (counted in the fall survey) per year. The values shown in bold are ones that have been changed to reflect corrections in historic data. [a] – Production data includes a site in the Green River drainage where eggs were collected and five, 1-day-old young from Wyoming Wetlands Society's captive flock were grafted to a pair successfully in 2000, of which four fledged, and again in 2001, of which five fledged.

Year	Sites occupied (*n*)	Nesting pairs (*n*)	Pairs with hatchlings (*n*)	Pairs with fledglings (*n*)	Individuals hatched (*n*)	Individuals fledged (*n*)
1990	19	13	4	3	11	8
1991	22	8	2	2	3	2
1992	29	10	5	3	17	9
1993	24	11	7	5	15	8
1994	20	13	8	5	29	18
1995	22	12	7	5	25	15
1996	**23**	**12**	**7**	4	**17**	**6**
1997	26	**14**	**6**	4	**19**	17
1998	**23**	18	10	7	26	15
1999	**21**	15	6	6	19	12
2000 [a]	26	16	**11**	**10**	**42**	**31**
2001 [a]	28	17	**11**	**10**	**34**	**27**
2002	24	**11**	9	8	23	17
2003	26	18	13	11	42	35
2004	22	17	14	11	54	37
2005	24	16	11	10	38	35
2006	24	18	12	8	33	26
2007	35	26	20	18	74	59
2008	35	16	12	11	39	34
2009	32	24	15	11	50	33
2010	37	24	18	12	66	48
2011	44	25	18	15	51	38

Table 4. Comparison of Trumpeter Swan (*Cygnus buccinator*) nest-site occupancy and productivity data for core and expansion areas in Wyoming outside of Yellowstone National Park, 2007-2011. Expansion areas include drainages where Wyoming Game and Fish Department worked to expand both summer and winter distribution by translocation of wild swans or release of captive-raised swans from 1986-2003 (Patla and Oakleaf 2004). Core area is where swans nested in the Snake River drainage and its tributaries prior to range expansion efforts. Number of young fledged refers to the number of mature young counted on the September aerial survey conducted annually. Successful pair refers to those nesting pairs that hatched young.

Drainage and year	Occupied Sites (n)	Nesting pairs (n)	Broods hatched (n)	Individuals hatched (n)	Individuals fledged (n)	Individuals hatched per successful pair ($\bar{x}$)
Snake River Core						
2007	17	11	9	37	31	4.11
2008	15	7	4	13	13	3.25
2009	14	10	6	21	12	2.33
2010	15	8	6	24	12	4.00
2011	18	10	7	22	14	3.14
Green River Expansion						
2007	16	13	11	37	28	3.36
2008	18	9	8	26	21	2.62
2009	18	14	9	29	21	2.08
2010	21	15	12	42	36	3.50
2011	24	14	10	27	23	2.70
Salt River Expansion						
2007	2	1	0	0	0	0
2008	1	0	0	0	0	0
2009	1	1	0	0	0	0
2010	1	1	0	0	0	0
2011	1	1	1	2	1	2.00

Table 5. Annual summary of occupancy and production status for all known Trumpeter Swan (*Cygnus buccinator*) nests in Wyoming outside Yellowstone National Park, 2001-2011 by area. Sites include: CTNF-Caribou Targhee National Forest; GTNP-Grand Teton National Park; NER-National Elk Refuge; and Seedskadee NWR-National Wildlife Refuge. Key to the table codes includes: O - pair occupied site through nest period, did not attempt to nest, did not molt on site; OM - pair occupied territory through nest period, did not attempt to nest, molted on site; OL - pair occupied site late after nest initiation period; Nxy - pair nested, x = number of young hatched, y = number of mature young in September; OUID - pair reported on site but status not determined; NB - nonbreeding swans present, likely subadults; F - swans observed on fall (September) flight only; 1A - only one adult present; NS - not surveyed; --- - no swans observed all season.

Site	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
CTNF											
Ernest Lake	---	NB	NB	---	NB	---	---	---	---	---	---
Bergman Marsh	N00	---	NB	---	---	---	---	---	---	---	---
Indian Lake	---	N33	N33	N55	N00	N10	N44	O	N40	N30	N30
Widget Lake	---	---	F	---	---	---	---	---	---	---	---
Winegar Creek									N30	N20	N30
Fall River Slough							N00	---	---	---	---
Loon Lake	---	---	F	---	---	---	---	---	---	OL	---
Rock Lake	---	---	---	OL	OM	N00	---	O	---	---	---
Rock Lake slough										N41	---
Junco Lake	---	---	---	---	---	N00	---	---	O	---	---
Fish Lake	---	---	---	---	---	---	---	---	---	---	---
Squirrel Meadows	OL	NB	---	---	OL	---	---	---	---	---	---
Moose Lake		NB	---	---	---	---	---	---	---	---	---
GTNP											
Upper Glade					N00	OM	---	---	---	---	---
Steamboat Mountain		N43	OM	---	N00	---	N43	O	O	OL	O
Glade Cliff Slough						N00	N10	O	N00	O	O
Glade South	N22	OM	N00	N10	N22	N00	O	O	---	---	---
Christian Pond	OM	1A	---	---	---	---	---	---	---	---	---
Arizona Lake	---	---	---	---	OM	N20	N40	N00	N00	N30	N20
Emma Matilda	OM	1A	NB	---	---	NB	NB	---	1A	OL	OL

Table 5. Continued.

Site	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
GTNP (cntd.)											
Two Ocean Lake	N53	N32	N30	N00	OM	OM	---	---	---	---	1A
Swan Lake	N00	O	N00	N33	NB	OL	OM	N22	O	OM	N55
Hedrick Pond	N20C	O	O	---	NB	1A	O	---	---	---	---
Elk Ranch	OM	OM	OM	OM	OM	OM	O	O	O	OL	OL
Cow Lake	---	---	---	---	---	---	---	---	---	---	---
Spread Creek Ponds	---	NB	---	---	---	---	---	---	---	---	---
Cygnet Lake	---	---	---	---	---	---	---	---	---	---	---
Polecat Slough	---	---	---	---	---	---	---	1A	1A	---	---
NER											
Highway Pond NER	N32	N11	N10	---	N00	---	N55	---	---	N00	---
NE Marsh NER	N00	N42	N33	N44	---	N32	NB	O	---	---	O
Flat Cr. Island NER									N00	N10	N00
SE Marsh NER	OM	N00	N11	N43	O	N11	N42	N00	N11	---	O
Central Marsh NER	N33	N00	---	N22	N44	N33	N57	N33	O	N55	N00
Pierre's Ponds	OM	N11	N33	OM	O	OM	---	---	---	NB	O
Romney Ponds				OM	OL	NB	N44	N44	N43	NB	O
Jackson area											
Skyline/Puzzleface	N30	OM	OM	O	NB	---	---	---	---	NB	NB
WGF South Park	---	---	---	---	1A	OL	OM	OM	N44	N66	N44
Buffalo Valley											
Pinto/Halfmoon	N44	N11	O	N31	N55	N33	N66	N44	N54	OM	N11
Halfmoon BV											N44
Tracy Lake								OL	OL	OL	OL
Lily Lake	OM	N00	N20	---	---	---	---	---	---	---	---
Teton Wilderness											
Enos Lake	OM	OM	N44	---	---	NB	NB	NB-3	---	NB	NB
Bridger Lake	OL	---	---	---	---	---	---	---	nc	---	---
Atlantic Cr.	O	---	---	---	---	---	---	---	nc	OUID	O

Table 5. Continued.

Site	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Salt River											
Kibby/Salt R Cove	N00	N00	N00	N00	NB	---	---	---	---	---	---
Alpine Wetland North	OL	1A	NB	NB	NB	NB	N00	---	NB	NB	NB
Alpine Wetland South							NB	O	N00	N00	N21
Gros Ventre											
Lower Slide Lake	---	---		---		---	---	---	---	NB	NB
Upper Slide Lake	N22	NB	OM	N11	N22	N00	OM	OM	OM	OM	O
Grizzly L pothole	---	---	---	---	---	Dry	Dry		---	---	---
Burnt Fork	---	---	---	---	---	---	---	---	NB	---	---
Soda Lake	---	---	---	---	---	---	---	---	---	---	---
Green River											
Wagon Creek Lake	O	NB	O	O	---	---	---	NB	---	---	---
Rock Crib	---	---	O	---	---	---	---	NB	---	---	---
Wagon Cr Pothole							N00	---	---	N42	O
Mosquito Lake	N00	OM	1A	OL	---	NB	N32	N00	N00	O	OL
Roaring Fork P.	O	---	---	---	---	---	---	---	---	---	---
Mud Lake	---	N20	---	N50	N20	N20	N52	OE	---	OL	O
Circle S slough										N00	---
Carney oxbow				N55	N22	N00	N44	N00	N00	N22	N00
Carney pond									N30	---	---
Marsh Creek Pothole							N22	---	---	---	---
Kendall Wetland	OL	OM	N00	N00	NB	NB	OL	N11	N33	OM	O
Q Y Bar Reservoir							O	O	---	---	---
Kitchen Main	N55 graft	N44	N54	N44	N22	N33	N54	N53	N11	N22	N32
Kitchen Middle	NB	NB	NB	NB	OM	OM	OM	O	N22	N55	N43
Vichory Pond										F	NB
Webb Draw										F	N00
Fayette						NB	N33	N40	N00	---	N33
Swift New Fork								N54	OL	N33	OL

Table 5. Continued.

Site	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Green River (cntd.)											
Barden Slough	N00	---	N00	OM	OM	OM	---		---	---	---
Swift Reservoir		OM	NB	NB	---	OL	OL	NB	NB	OL	O
East Fork Hunt Club											N11
Jensen Slough								OL	O	N22	O
Ferry Island							N22	N33	N00	N44	OL
Shafer Slough	OM	---	NB	---	---	NB	---	---	NB	NB	---
Reardon Draw											N11
Voorhees Pond		---	---	---	---	---	---	OL	---	N00	O
LaBarge Cr Pond											O
Big Sandy Reservoir		---	---	---	---	NS	---	nc	---	---	---
Eden Res.										1A	1A
Farson area										N22	O
Seedskadee NWR											
Hamp Unit				N33	N44	N53	O	N00	N00	N42	N42
Hawley 1	N11	NB	N44	N60	N65	N54	N22	N33	N43	NB	O
Hawley 2			N44	N54	N00	N66	N33	N66	N44	N55	N44
Hawley 2 S										N43	N33
Hawley 3			N43	---	N33	---	NB	NB	---	NB	O
Hawley 5									N33	NB	NB
Hawley 6	N44	Dry	N44	N65	N77	N00	NB	NB	---	N44	N22
Hawley 7									N10	---	---
Sage Pools							N31	N33	N75	N42	N22
Dunkle Wetland										O	0
South OMC										O	---
Other Wyoming											
Swamp Lake, Cody	1A	1A	1A	---	---	---	---	NC	NC	NC	---
Trail Lake, Dubois					OM	OM	---	---	---	---	---
Dinwoody Lake										F	---

Table 5. Continued.

Site	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Other Wyoming (cntd.)											
Lake Julia										O	1A
Martens Pond											O
Colony eastern WY	OUID	1A	NB	NB	NS	NS	---	---	NC	NC	OL

Table 6. Summary of Trumpeter Swan (*Cygnus buccinator*) annual mortalities in Wyoming, showing age class and probable cause of death, 1991 through May 2012. Mortality of cygnets includes only those lost following fledge counts in September, so does not include brood reduction during the nesting season. [a] - Mortality total for years 1991-1995 is not broken out by individual years; the following years' data are recorded for 15 April through 14 April for each period, but also includes carcasses and remains found after snow melt in May. [b] - Swans with all white plumage over one year of age; likely some yearlings are included in this group. [c]- Age not determined for 11 reported mortalities this period; necropsy reports not completed on 14 specimens submitted to lab. [d]-.Summary statistics are calculated only for the years 1998-2011.

Year	Total mortality (*n*)	Adult mortalities[b] (*n*)	Yearling mortalities (*n*)	Cygnet mortalities (*n*)	Collision mortalities (*n*)	Predation mortalities (*n*)	Shot or trapping mortalities (*n*)	Infection mortalities (*n*)	Unknown mortalities (*n*)
1991-1995[a]	38	21	0	17	12	4	10	1	11
1995-1996	11	9	0	2	5	0	2	0	4
1996-1997	8	3	0	5	4	0	0	0	4
1997-1998	5								
1998-1999	10	8	0	2	2	1	0	1	6
1999-2000	10	7	0	3	6	5	0	0	23
2000-2001	34	18	4	12	6	5	0	0	9
2001-2002	14	8	3	3	3	2	0	0	9
2002-2003	12	6	2	4	1	1	2	0	8
2003-2004	38	21	7	10	3	5	0	5	25
2004-2005	9	3	2	4	0	6	0	0	3
2005-2006[c]	49	27		11	1	0	1	0	47
2006-2007	10	8	0	2	0	0	0	0	10
2007-2008	11	7	1	3	4	1	2	1	3
2008-2009	16	11	3	2	4	1	0	0	11
2009-2010	6	4	1	1	1	1	0	0	4
2010-2011	7	6	0	1	4	0	1	0	2
2011-2012	32	21	3	8	5	1	1	4	21
Total[d]	258	155	26	66	40	26	8	11	173
Percent (%)		63	10	27	16	10	3	4	67

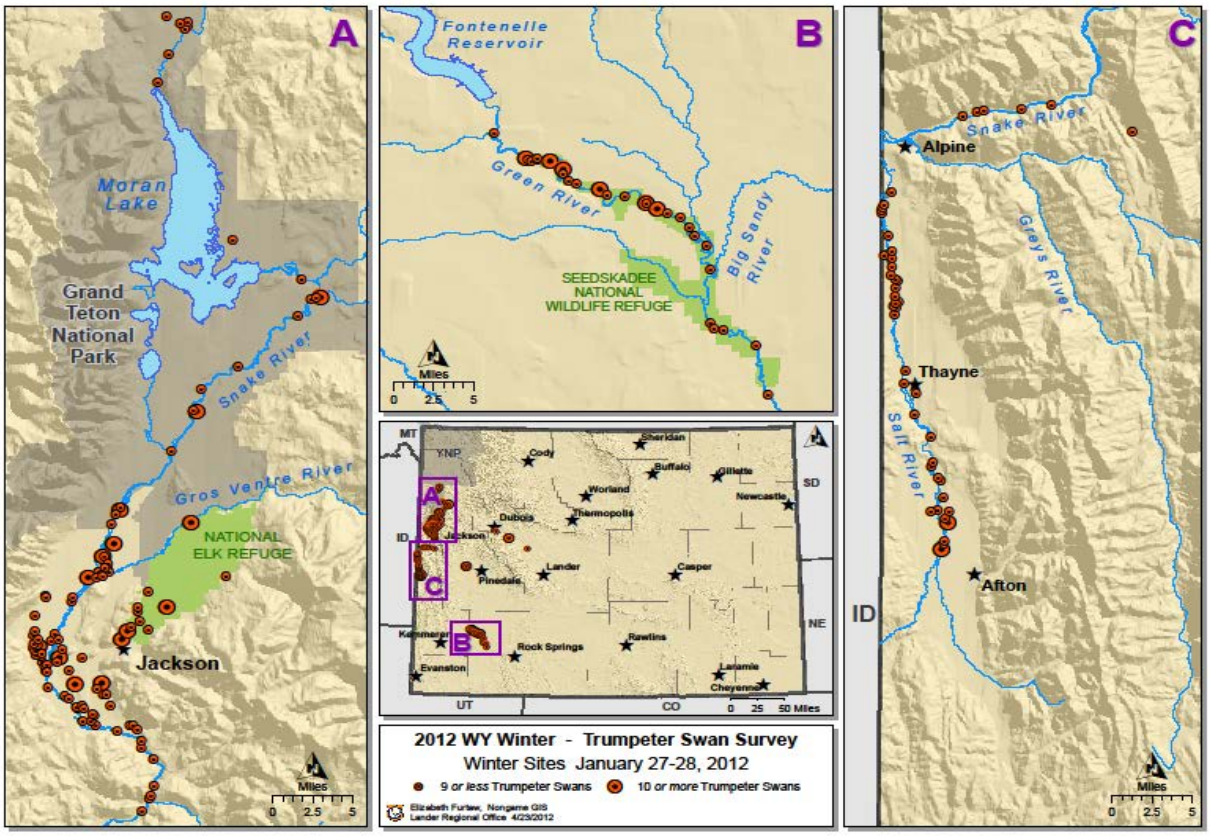

Figure 1. Locations of wintering Trumpeter Swans (*Cygnus buccinator*) in Wyoming documented during the annual winter aerial survey flown January 27-28, 2011. The state map in the lower center shows all wintering locations with the three main wintering areas labeled to correspond to the expanded sub-area maps including: A-Snake River core area, B-Green River range expansion area, and C-Salt River range expansion area. Prior to management efforts beginning in the late 1980s to increase the distribution of swans in the Tri-State area, all swans wintered in the Jackson core area.

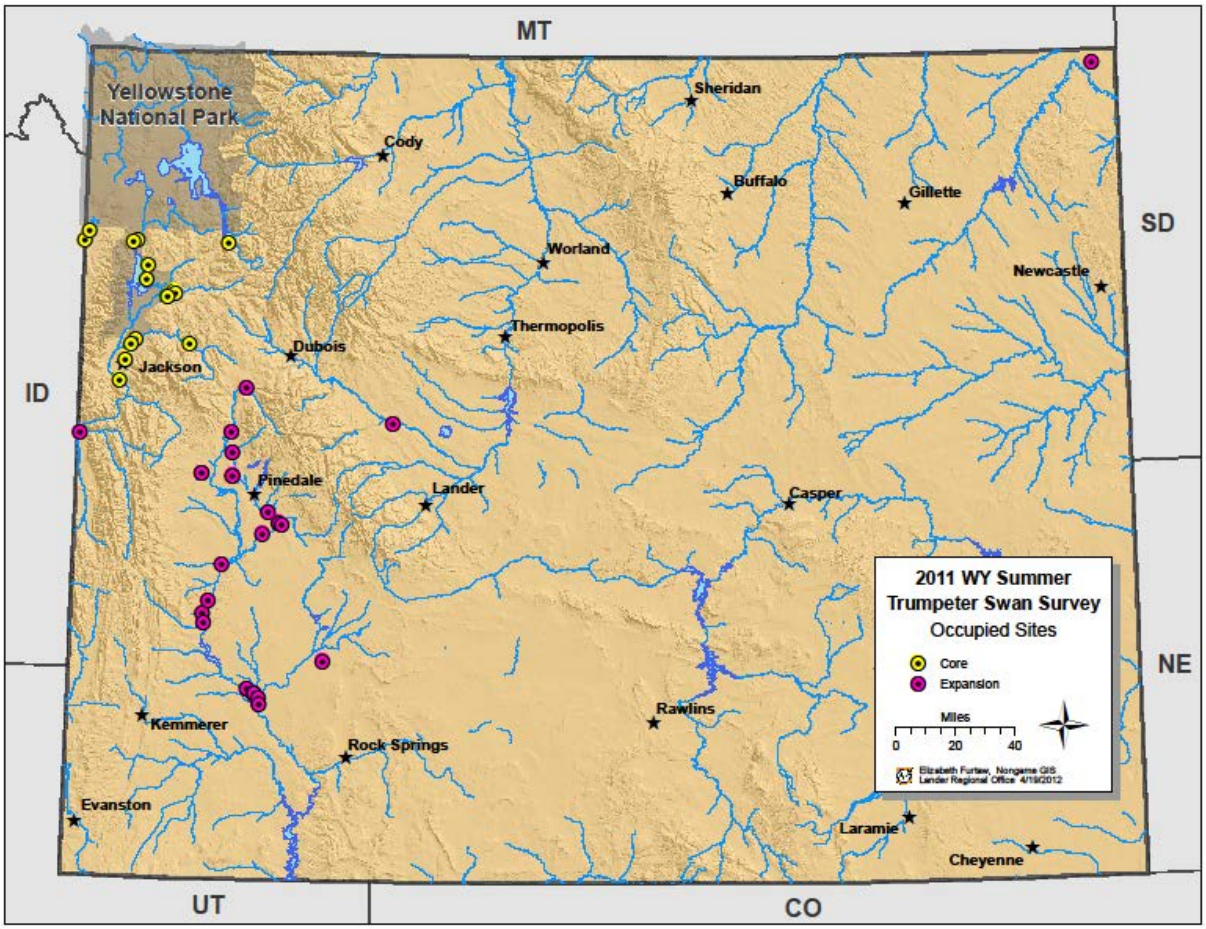

Figure 2. Locations of nest sites occupied by pairs of Trumpeter Swans (*Cygnus buccinator*) in Wyoming in the 2011 nesting season. Shown are nests in the core Snake River area (yellow dots) and nests in the range expansion areas (pink dots). In a few cases, a single dot represents >1 occupied site for sites located in close proximity to each other. Pairs did not lay eggs at all occupied sites.

COMMON LOON

STATE OF WYOMING

NONGAME MAMMALS: Species of Greatest Conservation Need – Common Loon

FUNDING SOURCE: General Fund Appropriation and/or Governor's ESA Dollars

PROJECT DURATION: 15 May 1987 – 30 August 2011

PERIOD COVERED: 15 April 2010 – 14 April 2012

PREPARED BY: Susan Patla, Nongame Biologist
Andrea Orabona, Nongame Bird Biologist

ABSTRACT

The Common Loon (*Gavia immer*) has the smallest nesting population and most restricted breeding distribution of any bird species in Wyoming. It is the only bird species ranked as Native Species Status 1 in the State Wildlife Action Plan (WGFD 2010). The Common Loon is one of five loon species that occur worldwide. Common Loons that nest in Wyoming comprise the most southern breeding population and are disjunct from other populations that nest in North America. The loon has a life history characterized by high longevity, low fecundity, and delayed sexual maturation. There is a great deal of public interest in Common Loons resulting from their size, beauty and haunting vocalizations. They remain in the forefront of many aquatic-based conservation efforts as a symbol of northern wilderness. The need to conserve isolated and peripheral populations of Common Loons has been recognized by the Fish and Wildlife Service in their current status and conservation plan and in the State Wildlife Action Plan for Wyoming (Evers 2004, WGFD 2010). Wyoming Game and Fish Department has monitored Common Loons since 1987 to collect data on number of breeding pairs and their productivity. Pairs of Common Loons occupy < 30 lakes in the Greater Yellowstone area with approximately a third located outside of Yellowstone National Park, where the Wyoming Game and Fish Department has focused its surveillance monitoring efforts. This report presents data from the 2010 and 2011 nesting seasons. We are planning to pursue additional funding sources in 2013-2014 to conduct a more intensive monitoring and research program in cooperation with Yellowstone National Park. We plan to develop a management and monitoring plan focused on the long-term persistence of Common Loons in Wyoming.

INTRODUCTION

The Wyoming Game and Fish Department (Department) classifies the Common Loon (*Gavia immer*; loon) as a Species of Greatest Conservation Need with a Native Species Status 1 because of its limited abundance and restricted distribution in Wyoming, its vulnerability to human disturbance during the nesting season, and its sensitivity to environmental degradation and climate change (WGFD 2010). Although loons can be observed statewide during spring and fall migration, and nonbreeding loons can be found throughout the state during the summer, traditional breeding habitat is restricted to < 30 lakes in the northwestern corner of Wyoming. Loons in Wyoming are the southern-most nesting population in North America and are disjunct from other nesting populations (FWS 2004).

In 2010, we surveyed known nesting areas of loons to document occupancy at each lake, productivity of nesting pairs, and survival of young using both aerial and ground surveys. In 2011, we conducted only aerial surveys at most sites. Biologists from Yellowstone National Park (YNP) and Grand Teton National Park (GTNP) contributed data for sites located within their jurisdictions. In addition, we asked Department personnel, biologists from other agencies, non-governmental organizations, and the public to report all sightings of loons to assist us in determining status of loons on these historical nesting lakes, as well as for other locations in Wyoming.

METHODS

Since 1987, we have focused monitoring efforts for loons at seven lakes located in northwest Wyoming outside of YNP. These include six lakes on the Caribou-Targhee National Forest (CTNF), and one lake on the border between GTNP and the Bridger Teton National Forest (BTNF). Two additional lakes in GTNP were added to the monitoring schedule in recent years. These included Emma Matilda Lake and Leigh Lake. In August 2007, a photographer documented an adult loon with a young in the southwestern bay of Emma Matilda Lake. In August of 2009, we observed a pair of loons on Leigh Lake, and learned from park volunteers that a pair had occupied the lake in previous years. Also in September 2009, a GTNP biologist observed an adult with a small young on Leigh Lake.

In most years, we conducted surveys of potential nesting lakes three times during the year: late-May to mid-June to document presence of adults; mid-to late July to document number of young hatched; and mid-to late August to count number of mature young. Surveys included a combination of ground and aerial surveys, and not all sites were surveyed three times each year. We also searched for additional occurrence of loons opportunistically at other lakes in the area in conjunction with other field surveys.

Although loons forage most intensively during early morning and early evening hours, they continue to forage between resting bouts throughout the day so surveys can be conducted any time during daylight hours. For ground surveys, we sat quietly at vantage points that provided the most optimal view and used binoculars and spotting scopes to search the lake and shoreline for activity or nest sites. Each survey lasted a ≥45 min or until adults or young were detected.

At some lakes, more than one vantage point was needed to observe the entire lake area. We recorded the number of adult and young loons detected, loon activity and behavior (i.e., diving, foraging, feeding self or young, calling, flying, loafing, agitation), and other bird and mammal species observed or heard. We also recorded additional information on human activity , potential disturbances, impacts or degradation to habitat, developments of new two-track roads or trails, and condition of shoreline habitat.

We conducted aerial surveys of lakes where loons were known to nest in conjunction with surveys for Trumpeter Swan in late May/early June and early July. We used a fixed-wing aircraft which flew at an average elevation of 50-100 m above ground level depending on terrain and surface winds and at air speeds between 135-160 kph. We circled each lake one to three times and recorded number of adults and young seen. Additional observations were recorded by biologists who flew grizzly bear surveys in mid-August.

RESULTS

In 2010, we surveyed all nine historic lakes that were known to be used by loons in Wyoming outside of YNP. We documented two adults at three lakes on the CTNF and at two lakes in GTNP (Table 1). We also recorded single loons on Rock Lake (CTNF) and on Emma Matilda (GTNP) in June. Loons produced young at two sites, Indian Lake and Arizona Lake. In YNP, biologists surveyed 11 sites primarily via fixed-winged aircraft in conjunction with other surveys (Baril et. al. 2011). Pairs in YNP occupied eight lakes and a single loon was observed at one other lake. Three pairs produced one young each. For all sites in Wyoming combined in 2010, loons produced seven young at five lakes, for an average of 1.4 young per pair.

In 2011, survey effort was minimal at lakes outside of YNP as most were checked only via aerial surveys for Trumpeter Swan. Additional ground observations were made at Indian Lake and Arizona Lake. GTNP staff reported seeing one young loon at Arizona Lake but this was not observed on subsequent visits. In YNP, a total of 26 sites were surveyed by aircraft for loons. Of these, 12 lakes were occupied by ≥2 loons, and 6 lakes by a single loon. Only one young was reported for the year on lakes in YNP. Considering all sites surveyed in Wyoming in 2012, 14 lakes were occupied by pairs of loons. Loons produced young at only two of these lakes. Winter-like conditions extended through the end of May in 2011 and likely affected productivity of loons.

DISCUSSION

Loons occupy traditional nesting lakes every year in Wyoming but at low numbers and in a very restricted range. From 1987-2011, we observed a total number of 9-18 pairs of loons per year during the breeding season in western Wyoming, excluding the six years for which data were unavailable (Table 2). The maximum number of pairs reported in any one year during this period was 14 in YNP, and 6 pairs for lakes outside of YNP. The maximum number of young produced in a single year was 12 in YNP (reported in 1994) and 10 outside of YNP (reported in

1988). Over the most recent 10-year period from 2002 through 2011, we observed a mean of 8.8 pairs per year in YNP and 3.4 young per year. For Wyoming outside of YNP, we observed a mean of 4.4 pairs and 2.8 young per year. Combining data from all sites in the state over this same ten-year period, we observed a mean of 12.9 pairs and 4.5 young per year.

Although data indicate that a decline in number of pairs and productivity has occurred in Wyoming, monitoring effort has been inconsistent between years and survey methods have not been standardized between YNP and the Department. The State Wildlife Action Plan recommends that survey methods be standardized and that a species specific management plan be developed (WGFD 2010).

YNP obtained funds in 2012 from the Yellowstone Park Foundation to initiate a monitoring project in partnership with Biodiversity Research Institute (BRI). The objective of this project is to evaluate habitat, disturbance factors, and nest success of loons to provide data for development of a site specific management plan for loons in YNP. The Department will seek additional funding for a complementary project with BRI focused on loons that occur outside of YNP in 2013-2014. The results of both projects will provide a basis for coordinated management and monitoring to ensure the conservation of loons that nest in Wyoming.

ACKNOWLEDGEMENTS

We would like to acknowledge the following Wyoming Game and Fish Department personnel for their contributions in 2010 and 2011: J. Longobardi and D. Brimeyer. We would also like to thank the staff from GTNP including S. Wolff, W. Scherer, A. May, and J. and P. Reagan (volunteers at Leigh Lake). D. Smith and L. Baril provided data for birds in YNP.

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Table 1. Annual summary of observations of Common Loons at lakes we surveyed 1997-2011 where nesting is known to occur in Wyoming outside Yellowstone National Park. These data represent the greatest number of adults and young observed at each location any time during the nesting season. Key to the table codes includes: CTNF - Caribou Targhee National Forest; GTNP - Grand Teton National Park; 0 – no loons of any age class were observed during the season. The remaining codes are comprised of two parts a number (*n*) followed by a letter. The number of adults is denoted by *n*A; and the number of young observed for nesting pairs is denoted by *n*N. When no survey was conducted it is represented by "*ns*". Bergman Marsh and Indian Lake are a multi-lake nesting area; adults nest on Indian but move between these two sites to forage so loons documented on Bergman Marsh most likely represent birds from Indian Lake in most cases. Observations of adults at Fish Lake occur after June in most years so no nesting attempts have been documented. Data from 1987-1996 can be found in previous Annual Completion reports.

Site	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
CTNF															
Bergman Marsh	0	0	0	1A	0	1A	1A	2A	1A	2A	1A	0	2A	0	ns
Indian Lake	2N	2N	2N	2N	1N	1N	1N	4A	2N	2N	1N	1N	1N	2N	2A
Moose Lake	1N	1N	2A	2A	1N	1A	2N	2A	2A	2A	2A	3A	2A	1A	0
Loon Lake	2N	1A	2A	1N	1N	1N	2A	2N	2A	2N	2A	3A	2A	2A	2A
Junco Lake	0	0	0	1N	1N	2A	1A	1A	0	0	2A	0	0	0	ns
Fish Lake	1A	0	2A	2A	2A	1A	1A	3A	2A	3A	1A	0	2A	2A	ns
GTNP															
Arizona Lake	1N	0	2N	1N	0	1A	1N	2A	2A	2A	2N	1A	2N	2N	1N
Emma Matilda Lake	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	N1	2A	2A	1A	1A
Leigh Lake													1N	2A	0

Table 2. Data for Common Loon representing nesting, productivity, and production for sites surveyed in Wyoming, 1987-2011. Data for some years are incomplete and total surveillance effort has not been consistent for all years reported. Key to table codes: "*na*" - not available, "*in*"- incomplete, "*ns*" - not surveyed. The number of young reported does not represent the number of young that survived to fledging in all cases but only the highest number of young that were observed during a nesting season in a particular year.

	Outside Yellowstone Nat'l Park			Yellowstone National Park			Total		
Year	No. of pairs	No. of young	No. of lakes with young	No. of pairs	No. of young	No. of lakes with young	No. of pairs	No. of young	No. of lakes with young
1987	6	9	6	*na*	*na*	*na*	*in*	*in*	*in*
1988	6	10	6	*na*	*na*	*na*	*in*	*in*	*in*
1989	6	4	3	*na*	*na*	*na*	*in*	*in*	*in*
1990	6	6	4	11	9	9	17	15	13
1991	*ns*	*ns*	*ns*	9	*na*	*na*	*in*	*in*	*in*
1992	6	*ns*	*ns*	11	6	4	17	*in*	*in*
1993	5	*ns*	*ns*	12	6	4	17	*in*	*in*
1994	5	3	3	12	12	8	17	15	11
1995	3	3	2	13	8	12	16	11	14
1996	5	3	2	5	4	4	10	7	6
1997	4	6	4	5	6	5	9	12	9
1998	2	3	2	12	8	6	14	11	8
1999	4	4	2	14	2	2	18	6	4
2000	5	5	4	9	8	9	14	13	13

Table 2. Continued.

Year	Outside Yellowstone Nat'l Park			Yellowstone National Park			Total		
	No. of pairs	No. of young	No. of lakes with young	No. of pairs	No. of young	No. of lakes with young	No. of pairs	No. of young	No. of lakes with young
2001	4	3	3	9	7	9	13	10	12
2002	3	2	2	9	5	4	12	7	6
2003	4	4	4	8	1	1	12	4	5
2004	5	2	1	9	3	2	14	5	3
2005	5	2	1	8	4	3	13	6	4
2006	4	4	2	9	6	4	13	10	6
2007	6	4	3	*na*	*na*	*na*	*in*	*in*	*in*
2008	5	1	1	*na*	*na*	*na*	*in*	*in*	*in*
2009	4	3	2	7	4	3	11	8	5
2010	5	4	2	8	3	3	13	7	5
2011	3	2	1	12	1	1	15	3	2

POPULATION TRENDS OF AMERICAN BITTERNS AT COKEVILLE MEADOWS NATIONAL WILDLIFE REFUGE, WESTERN WYOMING

STATE OF WYOMING

NONGAME BIRDS: Species of Greatest Conservation Need – American Bittern

FUNDING SOURCE: Wyoming State Legislature General Fund Appropriations and Wyoming Governor's Endangered Species Account Funds

PROJECT DURATION: Annual

PERIOD COVERED: 15 April 2011 – 14 April 2012

PREPARED BY: Nichole Cudworth, Nongame Biologist
Andrea Orabona, Nongame Bird Biologist

ABSTRACT

American Bitterns (*Botaurus lentiginosus*) are classified as a Species of Greatest Conservation Need by the Wyoming Game and Fish Department because of severely limited wetland habitat necessary for reproduction and survival. Because of their secretive behavior, American Bitterns require a species-specific call-playback technique to document presence. In 2011, we used this survey technique to continue annual monitoring along four transects in the Cokeville Meadows National Wildlife Refuge in western Wyoming in an attempt to develop population trends. Although one of the transects demonstrated declining populations, two others demonstrated an increase in American Bitterns we detected. We had insufficient data to develop a population trend for the final transect, but data suggests American Bitterns are likely increasing on this transect as well. Although results should be interpreted cautiously until additional data can be accumulated and analyzed, current trends suggest habitat improvements are likely leading to increases in the number of nesting American Bitterns on the Cokeville Meadows National Wildlife Refuge.

INTRODUCTION

The American Bittern (*Botaurus lentiginosus*; bittern) is 1 of 12 species of colonial-nesting waterbirds that is classified as a Species of Greatest Conservation Need (SGCN) by the Wyoming Game and Fish Department (WGFD 2010). The bittern is a wetland-obligate species that prefers tall, emergent vegetation, and nests on a platform made of reeds, sedges, or cattails that is suspended approximately 6 cm over the water surface (Gibbs et al. 1992, Desgranges et al. 2006, Dechant et al. 1999). Bitterns are typically found in large wetlands ≥3 ha in size and have

been observed in wetlands up to 180 ha (Brown and Dinsmore 1986, Dechant et al. 1999). Stability of wetlands can be threatened by fluctuating water levels, changes in land use practices, and desiccation due to climate change (McMenamin et al. 2008, WGFD 2010), which may negatively impact bittern populations (Steen et al. 2006). Bitterns are entirely dependent upon marshes and wetlands for reproduction and survival. Although bitterns are found scattered throughout Wyoming's marshes, they are only known to breed in nine latilong degree blocks (Orabona et al. 2009). Bitterns are a summer resident in Wyoming and are classified as a Tier 2 SGCN with a Native Species Status of 3 (NSS3; WGFD 2010).

We have conducted surveys for colonial waterbirds a minimum of every three years to determine presence and index the number of nesting pairs at important breeding sites in Wyoming (Orabona 2010). However, bitterns are loosely colonial, secretive, and seldom detected during these surveys. Additionally, bitterns have been shown to co-occur with other species of waterbirds less often than would be expected (Bolenbaugh et al. 2011). Consequently, we use a species-specific survey to determine presence and density of bitterns annually in breeding habitat in western Wyoming. Our objectives in 2011 were to continue annual surveys along pre-defined transects and evaluate population trends.

METHODS

We surveyed four transects for bitterns in the Cokeville Meadows National Wildlife Refuge (Refuge) in western Wyoming: Thornock transect (1.6 km), Bartlett transect (2.0 km), Diamond transect (2.8 km), and Peterson transect (3.2 km). Transect location and length was based upon the amount of suitable bittern habitat present and known locations of bitterns from previous passive-listening surveys. We designed our survey methods following recommendations by the USFWS and USGS (1999) and Conway (2005). Detections of secretive marsh birds, including bitterns, have been shown to increase when surveys include a mixture of passive listening and call-playback techniques (Conway and Nadeau 2006). Consequently, we conducted annual surveys of bitterns during the breeding season between 13 May and 30 June when they were most vocal and responsive to this survey technique. We surveyed each transect three times, with a minimum of two weeks between replicates. All surveys were conducted between 1800 and 2200 hrs to coincide with the peak of bittern vocalization activity; however, if individuals were heard calling before or after this timeframe, we adjusted surveys accordingly. We spaced our survey locations every 400 m along each transect. At each location, we initiated the survey by passively listening for bittern vocalizations for 5 min. We then played a recorded bittern call for 1 min and finished the survey by listening for a response for 1 min. We recorded all bitterns heard or seen during all phases of the survey, and marked the approximate location of each individual bittern on a transect map. To index number of breeding pairs we divided the number of individuals detected by two. We also noted other species observed or heard at each location.

For each transect, we tallied the total number of bitterns recorded for each survey. If more than one survey was conducted, we used data from the survey that detected the greatest number of bitterns for analyses, since individuals may not vocalize consistently among surveys. Survey techniques have varied since the first bittern-specific transects were established in 2004

(Orabona and Cudworth 2011); consequently, we only use data from surveys with consistent techniques (i.e., 2007 to present). Due to small sample sizes resulting from flooding, we only analyzed data for transects with a minimum of three years of survey data (i.e., Thornock, Bartlett, and Peterson transects). For these transects, we conducted a regression analysis and report the slope and R^2 value of trend lines to investigate population trends.

RESULTS

We attempted to survey all routes three times, however, we were only able to survey the Thornock and Bartlett transects twice because of high water along the routes. As in 2010, we detected bitterns on all four survey routes (Table 1). Detections of bitterns varied from a low of 0.5 individuals detected per km on the Bartlett transect to a high of 6.3 individuals detected per km on the Thornock transect. Route locations and the number of bitterns we detected at each stop are depicted in Figure 1.

The number of detections of bitterns has increased slightly on the Thornock transect since the initiation of species-specific surveys in 2007, with an increase of 0.26 individuals per km per year ($R^2 = 0.032$; Fig. 2). Detections of bitterns have also increased on the Peterson transect by an average of 2.65 individuals per km per year ($R^2 = 0.79$; Fig. 3). On the Bartlett transect detections of bitterns have continued to decrease by 0.45 individuals per km per year ($R^2 = 0.72$; Fig. 4). The Diamond transect has only been surveyed for two years and was not included in these analyses.

DISCUSSION

Although the Thornock transect shows a slightly positive trend overall, we detected fewer bitterns on both the Thornock and Bartlett transects compared to previous years. However, we were only able to survey both of these transects twice due to high water conditions that made the road inaccessible for the first survey. Bitterns nest only 6 cm above the water surface and are negatively impacted by rapid or even moderate flooding (Desgranges et. al 2006). The low number of bitterns we detected on these transects may simply have been a response to local conditions. This decrease in detections of bitterns has had a disproportional impact on the trend for the Thornock transect, where we reported an increase of 1.51 individuals per km per year ($R^2 = 0.73$) in 2010 to an increase of only 0.26 individuals per km per year ($R^2 = 0.03$) in this survey (Orabona and Cudworth 2011). The Bartlett transect demonstrates an even sharper decline following the 2011 survey than in previous years (Orabona and Cudworth 2011). Results may have been different if we had been able to conduct all replicates along these transects.

For the Peterson and Diamond transects, we reported an increase in the number of bitterns we detected, although a limited number of surveys preclude analysis of the Diamond transect. Our ability to survey these transects in previous years was impacted by unfavorable weather conditions, time constraints, available personnel, and access issues. However, on occasions when we surveyed the Diamond and Peterson transects prior to 2010, we detected few bitterns, which we hypothesized was due to a limited availability of nesting habitat. Since 2006,

personnel at the Cokeville Meadows National Wildlife Refuge have actively improved habitat for bitterns by controlling flooding, which has expanded the amount of suitable habitat available to bitterns for nesting.

It is difficult to monitor trends of bitterns with only three to five years of data, so results should be interpreted with caution. Small sample sizes make these trends especially susceptible to stochastic fluctuations, as observed for the Thornock transect, which can obscure overall trends. However, bittern detections appear to be increasing, likely reflecting the current habitat improvement and expansion projects in place on the Refuge. Our efforts to continue annual surveys for bitterns will increase the precision of trend analyses, allow for better trend estimation, and will help elucidate how habitat projects are influencing distribution and abundance of bitterns on the Cokeville Meadows National Wildlife Refuge.

ACKNOWLEDGEMENTS

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Table 1. Total and number per km of American Bitterns (*Botaurus lentiginosus*) detected during surveys conducted May-June 2011 on the Cokeville Meadows National Wildlife Refuge, western Wyoming. Transect length for each route is reported in parentheses.

Thornock Transect (1.6 km)		Bartlett Transect (2.0 km)		Diamond Transect (2.8 km)		Peterson Transect (3.2 km)	
Total no. detected	No. per km	Total no. detected	No. per km	Total no. detected	No. per km	Total no. detected	No. per km
10	6.3	1	0.5	10	3.6	17	5.3

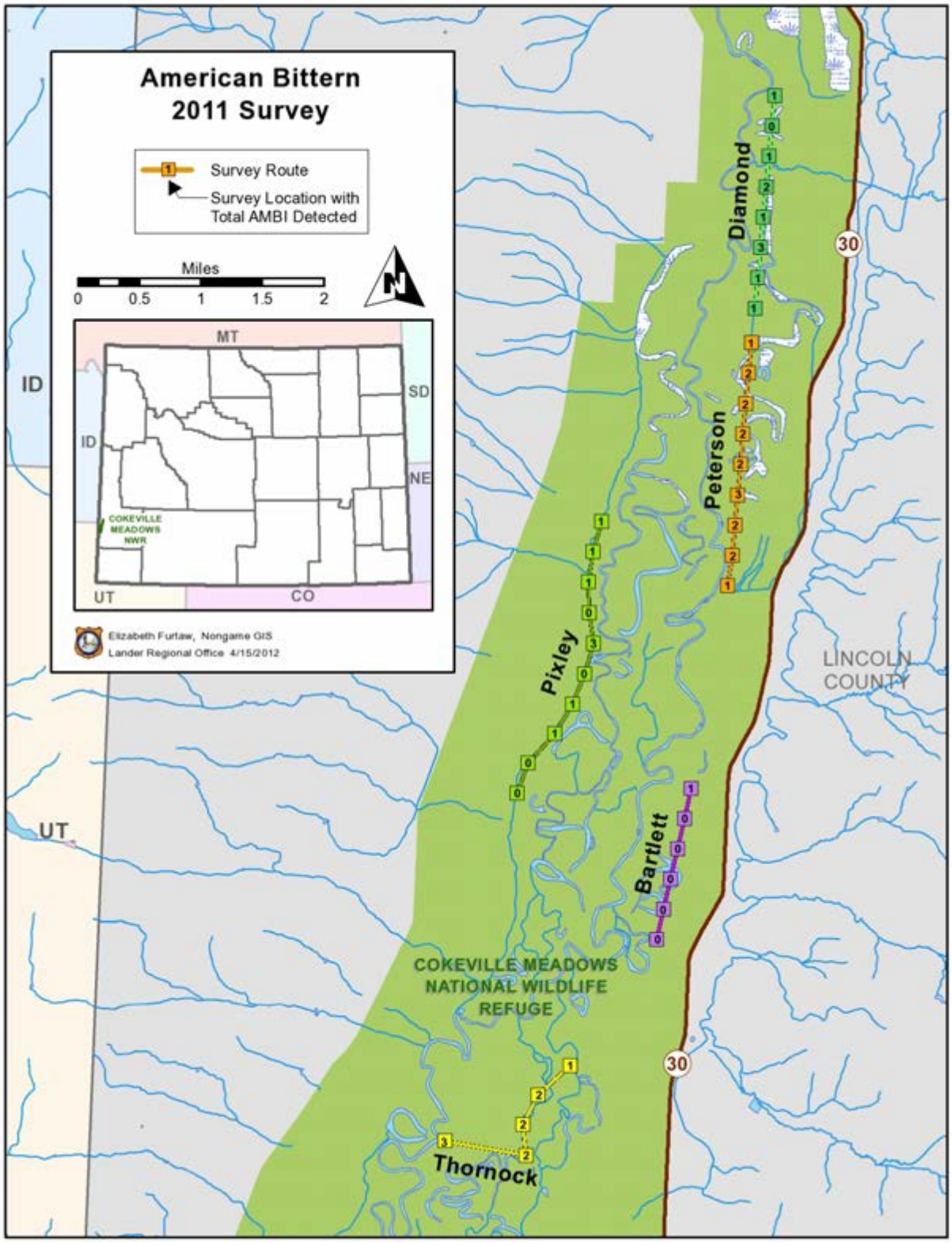

Figure 1. American Bittern (*Botaurus lentiginosus*) transect locations and numbers detected during the 2011 surveys on the Cokeville Meadows National Wildlife Refuge.

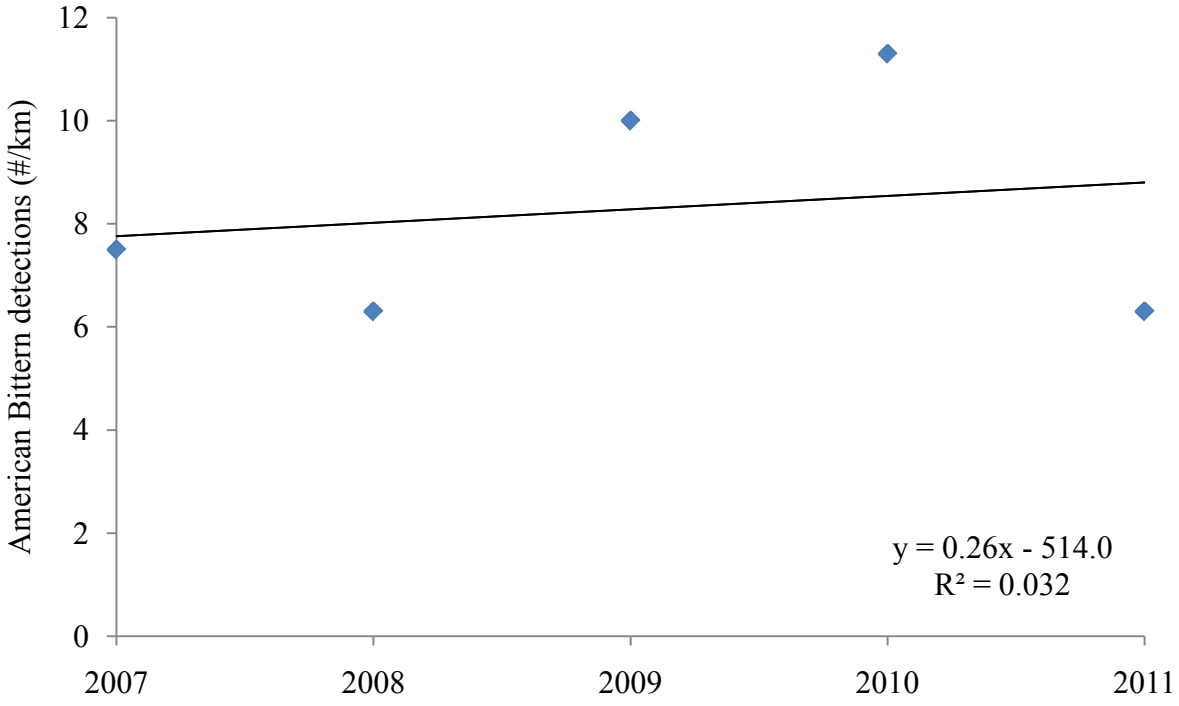

Figure 2. Number of American Bittern (*Botaurus lentiginosus*) detections per km on the Thornock transect (1.6 km) in the Cokeville Meadows National Wildlife Refuge, western Wyoming, 2007-2011. The trendline is shown for reference.

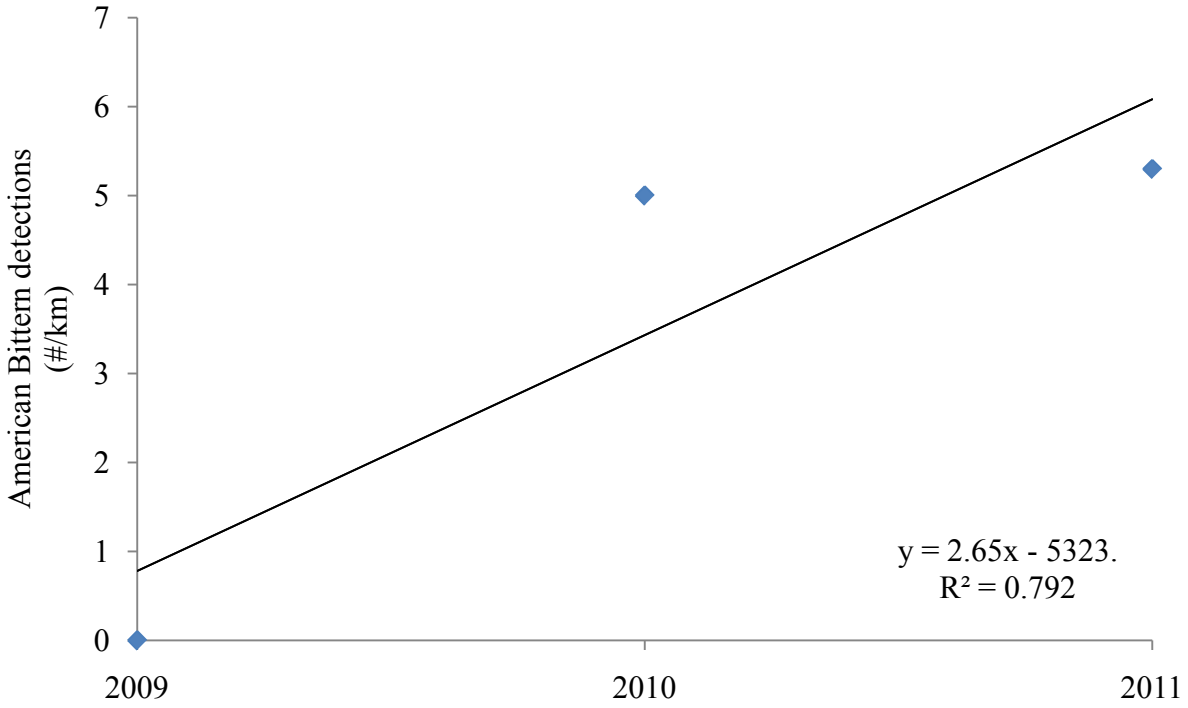

Figure 3. Number of American Bittern (*Botaurus lentiginosus*) detections per km on the Peterson transect (3.2 km) in the Cokeville Meadows National Wildlife Refuge, western Wyoming, 2009-2011. The trendline is shown for reference.

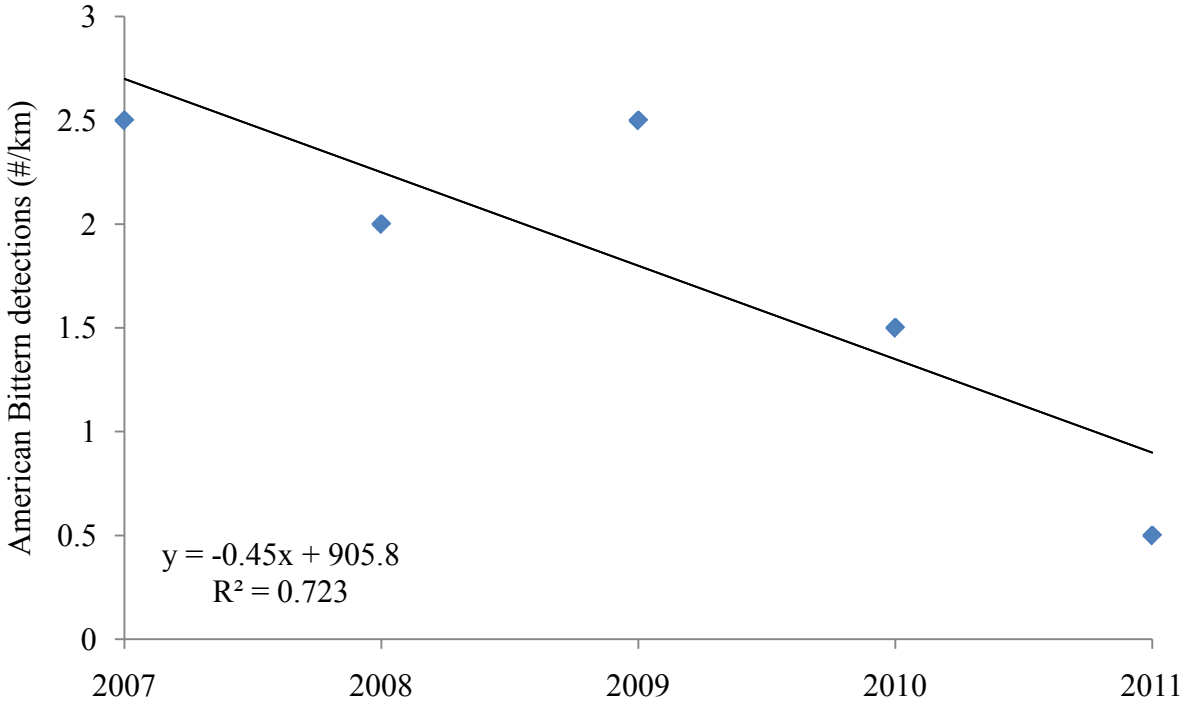

Figure 4. Number of American Bittern (*Botaurus lentiginosus*) detections per km on the Bartlett transect (2.0 km) in the Cokeville Meadows National Wildlife Refuge, western Wyoming, 2007-2011. The trendline is shown for reference.

BALD EAGLE

STATE OF WYOMING

NONGAME BIRDS: Species of Greatest Conservation Need – Bald Eagle

FUNDING SOURCE: United States Army Corp of Engineers, Bridger-Teton National Forest and Wyoming State Legislature General Fund Appropriations

PROJECT DURATION: Annual

PERIOD COVERED: 15 April 2011 – 14 April 2012

PREPARED BY: Susan Patla, Nongame Biologist
Bob Oakleaf, Nongame Coordinator

ABSTRACT

The Bald Eagle (*Haliaeetus leucocephalus*) occurs throughout most of North America from Alaska to central Mexico, wintering generally throughout the breeding range except in the far north. It nests along major river drainages and lakes throughout Wyoming, with the most significant concentrations in Teton, Sublette, and Carbon counties, including a significant number of nesting pairs in Grand Teton and Yellowstone National Parks. We initiated monitoring for Bald Eagle statewide in 1978. The Bald Eagle, although no longer designated as a Threatened species under the Endangered Species Act, remains protected under the Bald and Golden Eagle Protection Act and is classified as a Species of Greatest Conservation Need with Native Species Status of 2 in Wyoming. We currently monitor the population of Bald Eagles that nest in the western portion of the state (i.e., Snake and Green River drainages) annually and obtain data when available from other areas of the state. We have detected a minimum of 139 nest sites to date. However, we believe there is potential habitat for ≥200 territories to occur statewide. In 2011, we obtained occupancy data for 104 territories and productivity data for 68 nest sites. We did not obtain data from many known sites in the eastern portion of the state. As in previous years, Bald Eagles occupied a high proportion (i.e., ≥80%) of nesting territories we monitored, but only 55% of nests we monitored for productivity in the Greater Yellowstone Area produced young compared to 75% in the Green River Basin. We hypothesized that these results were due in large part to cold and wet weather conditions in March-May, especially in the Snake River drainage where a majority of nests are located. We documented a total of 56 mature young during our surveys in western Wyoming. Bald Eagles that nest in Wyoming continue to experience some site-specific risks due to increasing energy development, rural development, recreational activities, and environmental contaminants. We continue to receive and process numerous requests for information and management recommendations for Bald Eagle nest and roost sites.

INTRODUCTION

The Bald Eagle (*Haliaeetus leucocephalus*) nests along all major river systems in Wyoming, but the largest number of nesting pairs is found in northwestern Wyoming in the Greater Yellowstone Area (GYA) along the Snake River drainage and its tributaries. Bald Eagles in the northwestern part of the state have long been recognized as part of a distinct population that nests in the Rocky Mountain West. This genetically distinct population extends into Idaho and Montana (Swenson et al. 1986). Recovery of the species in Wyoming centered on the Jackson area beginning in the 1980s. The numerous territories located along the Snake River continue to serve as a source of Bald Eagles for other areas of the GYA and other parts of Wyoming (Harmata and Oakleaf 1992). Since 2000, we have also documented a substantial increase in the number of pairs that nest in the Green River Basin. Bald Eagles that nest in Wyoming continue to experience some site-specific risks from increasing energy development, rural development, recreational activities, and environmental contaminants. The US Fish and Wildlife Service (USFWS) released guidelines recently to assist developers of land-based wind energy projects in identifying risks to wildlife species including Bald Eagles (USFWS 2012).

The USFWS removed the Bald Eagle from protection under the Endangered Species Act in the western US in July 2007. However, the species continues to be protected under the Bald and Golden Eagle Protection Act. The Wyoming Game and Fish Department (Department) initiated monitoring for Bald Eagles statewide in 1978. Currently, program objectives include monitoring occupancy and productivity at nesting territories in the Snake River and Green River Basin, south to Seedskadee National Wildlife Refuge. Additional surveillance data are collected at a number of other sites around the state by Department personnel. We continue to receive numerous requests by other state and federal agencies and the public for information on status of nests of Bald Eagles and provide recommendations on mitigation measures to conserve nest sites in Wyoming. Management guidelines have been developed for the GYA (Greater Yellowstone Bald Eagle Working Group 1996). We are also actively involved in reviewing new federal regulations through participation in the Pacific and Central Flyways' Nongame Technical Committees.

METHODS

We conducted aerial surveys at a majority of known Bald Eagle nest sites in western Wyoming to monitor nests for occupancy and productivity. Fixed-wing aircraft surveys were conducted in late March to document the number of occupied sites with incubating adults and again in early June to determine number of mature young produced per site. During aerial surveys, we recorded the number of adult and young Bald Eagles observed, UTM coordinates of nests, condition of nests, species of nest tree, and photographed new sites. We also recorded locations of other Species of Greatest Conservation Need (WGFD 2010).

In 2011, we conducted nest-occupancy surveys on 29 March and productivity surveys on 3 June, using a single observer and a Scout fixed-wing airplane that flew approximately 100-200 m above ground and at speeds of 120-160 kph. We combined the second flight in early June

with the occupancy survey flight for Trumpeter Swan (*Cygnus buccinator*) to reduce overall survey costs. We surveyed all known nest sites along the main stem and tributaries of the Snake River, Gros Ventre River, Salt River, New Fork River, and the Green River from Green River Lakes south to Fontenelle Dam.

Biologists from Grand Teton National Park, Seedskadee National Wildlife Refuge, National Elk Refuge, Bridger-Teton National Forest, and USFWS contributed data from their respective monitoring efforts. A few volunteers in Jackson also surveyed specific territories on a regular basis. In other parts of the state, Regional Wildlife Biologists collected data for a subset of known nests that were visible from the ground. For ground-based surveys, observers used spotting scopes or binoculars from observation points that were sufficiently far away to prevent disturbance to nesting Bald Eagles. Survey duration was typically ≤2 hrs depending on visibility, behavior of adult birds, and status of the nest. Department personnel that conducted aerial surveys for waterfowl provided additional data. Hayden-Wing Associates provided both winter and summer location data for Bald Eagles in the Anticline Project area near Pinedale. Other consultant groups provided nest observation data as well.

Craighead Beringia South (CBS), a nonprofit wildlife research organization, trapped and marked Bald Eagles in the Jackson area as part of their investigation into lead ingestion by scavenging eagles (Bedrosian and Craighead 2009). The Department and CBS also obtained funding through the Pinedale Anticline Project Office to initiate a study using satellite-radio transmitters on resident adult Bald Eagles in the Pinedale area. The objective of this project is to collect movement and habitat use data in relation to energy development sites in this area.

RESULTS

We present the results for surveys of Bald Eagles statewide in Table 1. In 2011, we evaluated occupancy status of 104 nest sites. Data collected from nest sites in Yellowstone National Park and by private consultant groups in other parts of Wyoming are not summarized here; consequently, this report represents a minimum count of nesting Bald Eagles that occur statewide. Monitoring effort was greatest in western Wyoming where the majority of nests are known to occur.

Bald Eagles occupied 84% of sites that we surveyed for occupancy statewide. Table 1 presents productivity data for nest sites in western Wyoming that were monitored consistently through repeated aerial or ground surveys. Although total number of occupied nests and nest site occupancy rate were higher in the Snake River area compared to the Green River sites, percent nest success, total number of young produced, and number of young produced per occupied territory were higher in the Green River Basin (Table 1). In 2011, only 1 out of 7 nest sites on Jackson Lake produced young, and only 55% of all occupied nests in the Snake River drainage produced young. Productivity was also lower in 2011 (0.82 mature young per occupied site) compared to 2009 (1.10 young per site). Cold weather persisted until early June in 2011 delaying ice out of lakes and overall growth of vegetation. Mean monthly temperature in May 2011 in Jackson was the coldest on record (3.6 ^{o} C compared to the historic May mean of 8.3° C;

Mountain Weather 2010). In contrast, the 2009 mean monthly temperature for May was 7.8° C (WRCC 2012).

Biologists from CBS continued to track three female adult Bald Eagles that were fitted with GPS backpack transmitters in August 2010. These individuals were believed to be resident birds from territories along the Snake River south of Wilson, Wyoming. One female did not nest in 2011 and moved down to the Green River near Big Piney where she died of unknown causes in June. The second female nested south of Jackson and produced two young. The third female did not nest but moved extensively around western Wyoming. To obtain more information and data on all Bald Eagles marked in the Jackson area through this program see: http://www.beringiasouth.org/.

DISCUSSION

Bald eagle productivity in the Snake River area and overall GYA has been shown to be positively correlated with temperature and negatively correlated with precipitation in March-May (Swenson et al. 1986, Harmata and Oakleaf 1992). Severe spring weather can affect nest building activities, availability of food, and can result in mortality of young birds. Effects of weather are greatest for Bald Eagles that nest at high elevations along lake shores compared to those that nest on rivers and streams. Typically, lakes remain frozen longer in cold years, decreasing the availability of prey. In 2011, an extremely cold spring appeared to result in reduced nest occupancy and productivity in the Snake River, especially for sites located adjacent to Jackson Lake. Cold weather persisted until early June in 2011 delaying ice out of lakes and overall growth of vegetation. In fact, mean monthly temperature in May 2011 in Jackson was the coldest on record. However, cold spring weather did not affect nesting in the Green River Basin to the same degree since most nest sites are associated with the main Green River, which iced out in March and provides more consistent spring conditions compared to the Snake River north of Jackson Lake Dam.

The number of nesting pairs of Bald Eagles appears to have stabilized in the Snake River drainage in Wyoming, but the nesting population is still increasing in the Green River Basin and likely at other locations in the state. Additional surveys are needed in areas where energy developments (i.e., oil, gas, and wind) occur or are proposed along major drainages or known migration routes and wintering areas. We hypothesize that in areas undergoing high levels of development, Bald Eagles could experience higher mortality rates, lower productivity, or loss of nest sites if adequate mitigation measures are not applied.

Having current information on nest sites, migration routes, and wintering areas will be needed to develop adequate mitigation measures in areas with intensive energy development in the future. Hopefully information on how the species responds to natural gas development during different seasons of the year from the recently initiated study in the Pinedale area in partnership with CBS will be useful for planning and mitigating future energy projects in Bald Eagle nesting habitat areas.

ACKNOWLEDGEMENTS

We greatly appreciate the efforts of the following individuals for providing data on nesting Bald Eagles in 2010: D. Smith and L. Baril (Yellowstone National Park), D. DeLong and S. Langston (Bridger-Teton National Forest), D. Patla (volunteer), B. Bedrosian (Craighead Beringia South), E. Cole (National Elk Refuge), H. Smith (Biota Research and Consultants, Inc.), J. Weinstein (Wyoming Department of Transportation), Walter Scherer and S. Wolff (Grand Teton National Park). In addition, we wish to thank the following Regional Wildlife Biologists from the Department for their assistance with the surveys: G. Anderson, J. Binfet, T. Easterly, S. Harter, M. Hicks, B. Kroger, W. Schultz, D. Thiele, and T. Thomas. We also thank A. Orabona who conducted aerial survey work this year in addition to her regular work load.

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Table 1. Summary of Bald Eagle (*Haliaeetus leucocephalus*) nesting data collected by the Wyoming Game and Fish Department in Wyoming 2011. We present data by major drainages and geographic boundaries in Wyoming. [a] GYA Greater Yellowstone Area does not include data for 3 pairs in Lincoln County (Salt River) or data from Yellowstone National Park. [b] Aerial surveys from Green River Lakes to Fontenelle Dam; ground surveys on the Seedskadee National Wildlife Refuge. [c] Includes the Wind River, the Popo Agie River, the Big Horn Basin, Casper, Sheridan, Cody, and Lusk areas. Not all nesting territories were checked. [d] Includes the North Platte and Little Snake Rivers. Not all known nesting territories were checked. [e] Percentage of occupied territories checked for productivity that produced mature young. [f] Mature young at most territories is the number of fully feathered nestlings counted prior to fledging in June and July.

	Wyoming portion of GYA [a]	Green River [b]	Bear River	Other Wyoming [c] (N of I-80)	Other Wyoming [d] (S of I-80)	Statewide total
Territories checked for occupancy (*n*)	38	30	1	23	12	104
Territories occupied (*n*)	33	24	1	18	11	87
Percent of territories occupied	87	80	100	78	92	84
Territories surveyed for productivity (*n*)	33	24				
Territories that produced young (*n*)	18	18				
Percent of successful nests [e]	55	75				
Mature young produced [f] (*n*)	27	29				
Mature young per occupied territory ($\bar{x}$)	0.82	1.21				

EFFECTS OF ENERGY DEVELOPMENT ON THE PRODUCTIVITY AND DISTRIBUTION OF FERRUGINOUS HAWKS AND GOLDEN EAGLES IN WYOMING BASED ON GPS TELEMETRY AND CONSERVATION GENETICS

STATE OF WYOMING

NONGAME BIRDS: Species of Greatest Conservation Need – Ferruginous Hawk and Golden Eagle

FUNDING SOURCE: Rocky Mountain Research Station, United States Forest Service; Bureau of Land Management; Wyoming Wildlife Heritage Foundation; PacifiCorp; Pathfinder Renewable Wind Energy, LLC; Wyoming Game and Fish Department; Wyoming Governor's Endangered Species Account Funds; Wyoming State Legislature General Fund Appropriations

PROJECT DURATION: 1 January 2010 – 31 December 2013

PERIOD COVERED: 15 April 2011 – 14 April 2012

PREPARED BY: Bob J. Oakleaf, Nongame Coordinator, Wyoming Game and Fish Department
Lucretia E. Olsen, Rocky Mountain Research Station, Forestry Science Lab
John R. Squires, Rocky Mountain Research Station, Forestry Science Lab

ABSTRACT

From 2000 to 2006, the number of oil wells in Wyoming increased by 73%, and the number of natural gas wells increased by 318%. Current energy development coincides almost entirely with the distribution of Ferruginous Hawks (*Buteo regalis*) and lowland-nesting Golden Eagles (*Aquila chrysaetos*) in Wyoming. The population status and potential effects of this energy development for both species is currently unknown. Consequently, in 2010 we implemented a range-wide survey of Ferruginous Hawks and Golden Eagles to evaluate the effects of energy development on occupancy and productivity, genetics, nest-site selection, and prey availability. Our three-year study will estimate Ferruginous Hawk and Golden Eagle abundance as well as the effects of energy development on population genetics, habitat, and key prey species on Ferruginous Hawks. This progress report presents results from the first two completed field season, and includes abundance estimates for Ferruginous Hawks and Golden Eagles in Wyoming. We also present preliminary data on genetic samples and prey species. We do not include an assessment of the effects of energy development in this progress report evaluations are ongoing for that analysis. We selected our study area by first estimating Ferruginous Hawk distribution across Wyoming using an updated nest database and modeled suitable habitat. Within that estimated distribution, we conducted a randomized, systematic

survey to locate nesting Ferruginous Hawks and Golden Eagles. We used two fixed-wing aircraft to search for hawk and eagle nests in April and May, 2010. Surveys were conducted in 60 randomly selected townships with 16 north-south transects spaced 600 m apart. An additional five townships were surveyed to address objectives of other projects. We also conducted duplicate surveys on randomly selected transects by helicopter in 2010 and located 50 Ferruginous Hawk and 19 Golden Eagle occupied nests during surveys of transects in randomly selected townships. We surveyed an additional 39 townships in April and May 2011, and detected 18 Ferruginous Hawk and 14 Golden Eagle occupied nests on transects in survey townships. We evaluated the probability of detecting nests using mark – recapture and DISTANCE programs on various combinations of species and nest status. Overall, we estimate that there are 1,165 (95% CI: 928-1,565) nesting pairs of Ferruginous Hawks in Wyoming and 701 (95% CI: 547-976) nesting pairs of Golden Eagles within the statewide distribution of Ferruginous Hawks.

INTRODUCTION

From 2000 to 2006, the number of oil wells in Wyoming increased by 73%, and the number of natural gas wells increased by 318%. Current energy development coincides almost entirely with the distribution of Ferruginous Hawks (*Buteo regalis*) and Golden Eagles (*Aquila chrysaetos*) in Wyoming. Ferruginous Hawks are one of the most sensitive raptors in North America to human disturbance, and Golden Eagles are sensitive to energy development, especially electrocution and collisions with power lines (Franson et al. 1995; Lehman et al. 2007, 2010). Consequently, both species may be negatively impacted by increasing development in Wyoming. Little work has been done, however, to understand the overall impact of energy development on these species.

A large proportion of the Ferruginous Hawk's historic range is still occupied, but range contractions have been reported in south-central Canada (Bechard and Schmutz 1995), Utah and eastern Nevada (Olendorff 1993), North Dakota (Stewart 1975), and Arizona (Glinski 1998). Ferruginous Hawks are only found in North America, and the continental population is estimated at 6,000-11,000 individuals (Olendorff 1993); Schmutz et al. (1992) estimated the Ferruginous Hawk population at 14,000 for the Great Plains. Thus, Ferruginous Hawk management in Wyoming, a state that may support over 800 nesting pairs (Oakleaf 1985), is central to the conservation of this species in the continental US and throughout North America.

Ferruginous Hawks prefer to nest in flat, rolling grasslands, deserts, and shrubsteppe regions; they generally avoid high elevations, interior forests, and narrow canyons (Bechard and Schmutz 1995). Ferruginous Hawks are sensitive to degradation and loss of grasslands (Olendorff 1993, Bechard and Schmutz 1995) and will avoid areas that have been largely converted from native prairie (Dechant et al. 2001), although they are tolerant of grazing and cattle ranching (Kantrud and Kologiski 1982, Bechard and Schmutz 1995).

Golden Eagles are afforded federal protection under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d), which prohibits the take of eagles, including killing, injuring, or disturbing eagles to a degree that results in a decrease in productivity or nest

abandonment. Despite this protection, populations of Golden Eagles may be in decline, and the overall health of Golden Eagle populations is unclear. Eagles are of potential concern because they are slow to mature and reproduce (Kochert et al. 2002), and, as such, eagle populations are particularly sensitive to the loss of adult birds. Some breeding surveys indicate stable populations, while some migration and post nesting counts report declining populations in the western US (Kochert and Steenhof 2002, Good et al. 2009). The number of nesting pairs of Golden Eagles in a California study declined from 85 in 1900 to 40 in 1999 due to increased urbanization (Bittner and Oakley 1999), and the number of nesting eagles in Idaho declined due to a loss of shrub habitat (Kochert et al. 1999). The lack of a clear understanding of Golden Eagle population status indicates the need for additional research to accurately assess long term population health and viability.

Our objectives in this study are four-fold. Firstly, we will determine distribution, abundance, occupancy, and productivity of Ferruginous Hawks in Wyoming relative to oil, gas, and wind-power development and provide a minimum abundance estimate for Golden Eagles in lowland habitats. Secondly, we will use genetic sampling to determine if population vital rates of Ferruginous Hawks are negatively impacted by increased energy development. Thirdly, we will determine spatial and habitat use relationships of Ferruginous Hawks when selecting nest and foraging sites adjacent to energy disturbance, including oil and gas wells, roads, wind turbines, and buildings. Finally, we will determine the relative density of key prey at Ferruginous Hawk nest sites that are representative across Wyoming and assess how energy development affects the abundance of key prey species. We have thus far completed two of three field seasons. Herein, we provide preliminary results for the first, second, and fourth objectives. We do not include an assessment of energy development in this progress report because we collected additional data in 2012 and are still working on the analyses.

METHODS

Terminology

Raptor studies have been plagued by a long history of ambiguous terms that sometimes preclude the comparison of data over time and space. In this study, we used terminology and associated definitions provided by Steenhof and Newton (2007). A nest is defined as the structure where eggs are laid and young sheltered, and a nesting territory is defined as an area that contains, or historically contained, one or more nests of a mated raptor pair and where no more than one pair is known to have bred at one time. We are aware of the many different terms that have been used synonymously and the more restricted ethological definition of a territory as a defended area but agree with Steenhof and Newton (2007) as to the appropriateness of this term. In order to classify a nest as occupied, one or more of the following observations were necessary: one adult associated with a freshly repaired nest, two adults associated with a nest, one adult incubating or brooding, or the presence of eggs or young. A nesting territory was classified as occupied if it contained an occupied nest. We often use the term nesting pair interchangeably with the term occupied nest.

We further defined a nesting territory as the area that included all nests within 1 km of a nest or the centroid of a cluster of nests. This radius was selected based on our experience during past Ferruginous Hawk and Golden Eagle studies but was tested with data collected in 2010 and an earlier study conducted in 2009 (Young et al. 2010). To determine the minimum distance between Ferruginous Hawk nests, we analyzed only Ferruginous Hawk nests classified as occupied and used the "Near" analysis in ArcMap. This tool calculates the distance from each nest in the data set to its nearest neighbor, with the maximum search limit set at 12 km.

Study Area

The area of overlap between energy development and the distribution of nesting Ferruginous Hawks included most of the state, excluding forested areas and intensively farmed areas (Fig. 1). Thus, our study included an inference area that was statewide, and our sampling approach extended across Wyoming within Ferruginous Hawk distribution. Although Golden Eagles nest in most habitat types statewide, the study area defined by Ferruginous Hawk distribution represented a significant portion (~50%) of nesting habitat for eagles in Wyoming (Phillips et al. 1984). These habitats are also the most likely to be subject to a fluctuating prey base and anthropogenic changes. Assessing the population status of eagles in these lowland habitats likely targets the most vulnerable segment of the statewide nesting population as opposed to the numerous nesting pairs recorded during Peregrine Falcon (*Falco peregrinus*) inventory efforts in a stable environment of northwestern Wyoming, 1978 – 1995 (Oakleaf and Graig 2003).

Occupancy and Productivity

In 2010, we updated the Ferruginous Hawk and Golden Eagle nest database maintained by the Wyoming Game and Fish Department (WGFD) since the 1970s. Many locations were already present in this database, but we also incorporated results from nest surveys that were conducted by other agencies. Although historic nest records represent varying levels of quality, search, and monitoring effort, identifying any subsets of nest territories that received consistent monitoring over time was important in order to provide anecdotal evidence of changes in occupancy relative to increased development.

We used the updated nest database and modeling completed by the Wyoming Natural Diversity Database to determine Ferruginous Hawk distribution across Wyoming (Keinath et al. 2010). Within that distribution, we conducted an aerial survey of nesting Ferruginous Hawks and Golden Eagles. Aerial surveys allowed us to avoid biases associated with surveying from roads, which are strongly influenced by the locations of proposed development and limited to only a portion of the state (Smith et al. 2010). We used 2 fixed-wing aircraft (Bellanca Scout and Piper PA 18) to search for raptor nests in April and May 2010 in 60 townships. In 2011, we used 1 fixed-wing aircraft to survey an additional 39 townships in April and May. We randomly selected townships (93.3 km^2, 9.66 km on a side) from a stratified sample based on degree of energy development, and surveyed 16 transects running the length of the township and spaced 600 m apart, thus allowing complete coverage of each township (Fig. 2). Only townships with centroids contained within the known distribution of Ferruginous Hawks were considered for selection (n = 1230), as well as any additional townships containing Ferruginous Hawk nest

records. An additional five townships were surveyed to address objectives of other projects. While these townships were included in efforts to calculate detection probabilities, we only include results from randomly selected townships in abundance estimates.

We instructed pilots to maintain an air speed of 129 kph and remain precisely on established transects. Observers used GPS to map the exact flight route within each survey township and to plot all nest locations. We viewed each aircraft as a survey team and included nests observed by the pilot in addition to the observer. In 2010, we assigned every other township to a survey team, with team one (Z. Wallace and pilot) starting in the southwestern part of the state and rotating east and north, and team two (M. Wilson and pilot) starting in the central and northern part of the state and rotating south and west. In 2011, only Z. Wallace and pilot performed surveys. Although Ferruginous Hawks and eagles were the primary focal species, we also recorded all raptor stick nests, whether occupied or unoccupied. In addition to focal species, these nests included primairly Red-tailed Hawks (*Buteo jamaicensis)*, some Swainson's Hawks (*Buteo swainsoni*), and Bald Eagles (*Haliaeetus leucocephalis*). We also recorded Prairie Falcons (*Falco mexicanos)* and Great Horned Owls (*Bubo virginianus*) that were using nests built by Red-tailed Hawks, Swainson's Hawks, and Bald Eagles, but we did not record Corvid nests. Following completion of all transects in a township, survey teams flew to waypoints of historic nest locations listed in the updated nest database and recorded information that allowed us to evaluate the historic data and determine whether these nests had been recorded or missed during transect surveys. We also recorded all nests located during flights within and between townships. These nests were not used to calculate detection probabilities or population estimates.

Some survey protocols (e.g., transect spacing, aircraft speed, minimum qualifications or experience of observers, and timing surveys to correspond with peak nesting) were similar to techniques evaluated and recommended by Ayers and Anderson (1999). However, they used two observers in addition to the pilot to develop a detection index. We modified this protocol due to the difficulites of finding enough qualified observers during peak nesting periods for all years of the study. We used only one observer and the pilot in fixed-wing planes and resampled a subset of transects by helicopter with a separate observer to develop a detection index.

In 2010, we conducted helicopter (Bell 47 Soloy; Team 3 – B. Oakleaf) flight surveys on 58 townships to determine variation in detection probability among observers and species (MacKenzie et al. 2002, Pollock et al. 2002, Royle and Nichols 2003). Each helicopter survey followed 3 of the 9.66-km transects per township already in place for the fixed-wing aerial survey. We randomly selected one transect for helicopter survey and flew this and adjacent transects to the east and west. The helicopter flew at an approximate speed of 80 kph.

We used an independent observer mark-recapture technique (DOBSERV) to estimate detection probability and bird abundance (Pollock and Kendall 1987, Nichols et al. 2000). This method provides an estimate of absolute detection probability for each observer or species (Laake et al. 2008). We used the methods detailed in Nichols et al. (2000) to estimate detection probabilities for each species (Ferruginous Hawks and Golden Eagles) and for observation teams one and two in fixed-wing planes. We then used this estimate to calculate the number of km^2 of survey area per occupied nests for each species.

We also used program DISTANCE v. 6.0 (Thomas et al. 2009) to provide a comparative estimate of detection probabilities and nest density. Distance methods provide a relative measure of detection probability, since they use the distribution of nest locations within transects to infer the number of nests likely missed by observers (Laake et al. 2008). We selected half-normal or hazard-rate key functions and cosine or hermite polynomial series expansion terms as possible models. We fit these models to the data and used AIC to determine the model with the best fit. We used only occupied Ferruginous Hawk and Golden Eagle nests for this analysis and truncated the highest 5% of the data to avoid problems fitting the model to a long-tailed distribution (Thomas et al. 2010).

We flew fixed-wing surveys of all nests occupied by Ferruginous Hawks (Jun 23-26, 2010 and Jun 21-24, 2011) to document nesting chronology and number of young. Results provided information for ground crews to prioritize and schedule efforts to complete productivity surveys and additional field work. Young were not included in production calculations until they were ≥80% of fledged age.

We used a fixed-wing aircraft to perform visual occupancy surveys in 2011 of 74 Ferruginous Hawk nesting territories that were recorded as occupied in 2010. We surveyed all potential habitat within a 1.5-km radius of each known nest in each territory ≥3 times, or until it became occupied, to meet the assumptions of an occupancy model that used removal sampling. We considered all nests within a 1-km radius and overlapping buffers to be the same territory. We also noted whether there was a continuum of potential nesting structures allowing for larger nesting territories and included these continuums in our evaluation of occupancy.

In 2011, we also surveyed 68 putative Ferruginous Hawk nesting territories that were located during 2010 random surveys but recorded as not occupied and 51 putative territories located during 2011 random surveys but recorded as not occupied.

Genetic Analysis

We searched occupied nests encountered in surveys for molt feathers in June-August, 2010. When possible, we augmented this sample with blood and tissue collected from 2-3-week-old nestlings, or adult or nestling carcasses located near nests. All feathers and other genetic samples were labeled by territory or UTM location and sent to the Rocky Mountain Research Station (RMRS) Wildlife Genetics Laboratory in Missoula, Montana, to extract and catalogue DNA.

Nest-site Selection

We used all occupied Ferruginous Hawk nests detected during 2010 and 2011 to determine nest-site selection relative to energy and gas disturbance. We used a handheld GPS to map the location of each nest from the air during fixed-wing surveys or during ground visits of the nest to achieve high spatial accuracy. We then used environmental covariates to calculate a resource selection function (RSF) of preferred Ferruginous Hawk nesting habitat. The environmental covariates we considered included topographic, vegetative, climatic, and

anthropogenic variables. Topographic variables included ground surface roughness as an index of the availability of nesting structures in an area and topographic position index as a measure of land curvature (ridges versus drainages). Vegetative variables included percent of sagebrush (*Artemisia* spp.) landcover (assessed by the USGS), availability of irrigated land, type of agricultural land (row crops vs. hay or range), and an index of vegetation productivity (normalized difference vegetation index derived from MODIS imagery). Climatic variables included average spring precipitation and temperature and were obtained from the Prism Climate Group. Finally, anthropogenic variables included gas and oil well density, distance to nearest gas or oil well, and distance and density of roads.

We used ArcGIS software to determine the values of each of the covariates at all of the known occupied Ferruginous Hawk nests and at a random sample (n = 1000) of locations distributed throughout Ferruginous Hawk distribution. We then used logistic regression to determine significant correlates of Ferruginous Hawk nest-site selection.

Prey Availability

We monitored prey abundance at occupied nesting territories of Ferruginous Hawks throughout Wyoming. We indexed the abundance of key prey species by taxa, including prairie dogs (*Cynomys* spp.), ground squirrels (*Spermophilus* spp.), jackrabbits (*Lepus* spp.), and cottontails (*Sylvilagus* spp.) in home ranges throughout the study. Within nest territories, we used line and point counts and distance sampling methods to index prey abundance (Buckland et al. 1993). To determine whether differences in prey abundance account for differences in nesting activity, we used the same methods as used in occupied sites, but with a random center point, to index prey abundance at random sites where no hawk nests were found. To confirm these taxa comprise the diet of Ferruginous Hawks in Wyoming, we collected any pellet and prey remains that were present whenever we visited nest sites.

Two technicians sampled relative prey abundance on transects located >0.5 km from the nest site to reduce disturbance, but within a 2-km radius of the nest to ensure that sampling was representative of prey availability within a putative foraging area. Each observer walked 4, 1-km line transects, stopping to conduct a point count at the transect origin, terminus, and 3, 250-m intervals along each transect. We used GIS to plot random start points and azimuths for transects; we conducted sampling of transects per site with a sequence that minimized disturbance to nesting birds.

We used line transects to index abundance of jackrabbits and cottontails (lagomorphs), since these species must be flushed to be detected (Wywialowski and Stoddart 1988). Observers used point-counts to index ground squirrel and prairie dog (squirrels) abundance since these species are active above-ground and visible (Andelt 2007, Schmutz et al. 2008, McDonald et al. 2010). Point counts entailed standing in a fixed location for 5 min and using binoculars to survey the surrounding area in a circle about the point. We used a laser rangefinder (accurate to ±1 m) to measure the perpendicular distance from prey species to the transect line or point (Morrison and Kennedy 1989). We also noted detections of minor prey species such as Greater Sage-grouse (*Centrocercus urophasianus*) or pocket gophers (*Geomys lutescens* and *Thomomys*

spp.) on transects. We sampled transects between 0700 and 1000 hrs when lagomorphs are generally sedentary and squirrels are active.

We used GPS units to map the spatial extent of black-tailed (*Cynomys ludovicianus*) or white-tailed prairie dog (*C. leucurus*) colonies within a 2-km circle around nest sites. In addition, we counted burrows on 2, 3-m wide strip transects that were parallel to and a random distance from the major and minor axes of each colony, following the recommended methods for monitoring prairie dogs (McDonald et al. 2010). We used the ratio of active burrows (as defined by visual observation of a prairie dog, fresh scat within 1.5 m of a burrow entrance, or fresh digging) to inactive burrows as an index of abundance (Young et al. 2010).

RESULTS

Occupancy and Productivity

We compiled >9,000 nest records of Ferruginous Hawks and >5,000 nest records of Golden Eagles in Wyoming. We are continuing analysis of these data to eliminate duplicate data and identify nest territories and repeated observations of the same territory over >1 year. In addition, we are continuing to add new data and edit questionable records.

In 2010, we recorded 50 Ferruginous Hawk and 19 Golden Eagle occupied nests during surveys of transects in randomly selected townships (Fig. 3) that were eligible for calculation of detection rates and estimates of statewide abundance. We surveyed an additional 39 townships in 2011, and detected 18 Ferruginous Hawk and 14 Golden Eagle occupied nests while surveying transects in random townships (Fig. 4). We combined the two years for a total of 68 Ferruginous Hawk and 33 Golden Eagle nesting pairs in 99 townships for a naïve density of 136 km^2 per occupied Ferruginous Hawk nest and 272 km^2 per occupied Golden Eagle nest. We also identified additional occupied nests, not previously recorded, while conducting surveys of historical nest locations, occupancy, and productivity and while flying within and between randomly selected townships. We are evaluating the utility of using these data, which include 118 Ferruginous Hawk and 59 Golden Eagle territories that contained an occupied nest in ≥1 years of the study.

Most Ferruginous Hawks observed during 2010 surveys were associated with nesting territories, with the exception of 13 individuals observed soaring or perched away from a nest. In contrast, we recorded 101 Golden Eagles soaring or perched and not associated with nests.

In 2010, we used the double-observer method to survey 58 townships (174 transects). On transects that were inventoried by survey teams 1 and 3, 79 total stick nests of any raptor species were detected by 1 or both teams, and 17 of these nests were determined to be occupied at some point during the season. On transects that were surveyed by teams 2 and 3, 111 total raptor stick nests were detected, and 32 were determined to be occupied. When all stick nests of any species or occupancy status were included in the analysis, the probability of detection for survey team 1 was 0.48 (95% CI: 0.36–0.6), survey team 2 was 0.32 (95% CI: 0.21–0.72), and survey team 3 was 0.74 (95% CI: 0.6–0.87). When we restricted the dataset to only occupied nests of any

raptor species, the detection probability for survey team 1 was 0.47 (95% CI: 0.23–0.72), survey team 2 was 0.50 (95% CI: 0.31–0.69), and survey team 3 was 0.73 (95% CI: 0.5–0.95).

We used the double observer data collected in 2010 to revise the probability of detection calculated for each observer and each species. We did this to account for potential differences in detection probability based on species (Diefenbach et al. 2003), which we did not account for in 2010. For teams 1 and 2, we used only occupied Ferruginous Hawk or Golden Eagle nests that were found on transects surveyed by both fixed-wing and helicopter in 2010. Using this dataset, the estimated detection probability for team 1 was 0.82 (95% CI: 0.72–0.92) for Ferruginous Hawks and 0.50 (95% CI: 0.22–0.78) for Golden Eagles. For team 2, we estimated a detection probability of 0.63 (95% CI: 0.6–0.66) for Ferruginous Hawks and 0.67 (95% CI: 0.58–0.76) for Golden Eagles. We then used these estimates of detection probability averaged over both observers (hawks: 0.725, 95% CI: 0.54–0.91; eagles: 0.585, 95% CI: 0.42–0.75) to determine the density of these species for each year as well as an overall estimate of density of 98 km^2 (95% CI: 73–123) and 163 km^2 (95% CI: 117–209) per occupied nest of Ferruginous Hawks and Golden Eagles, respectively (Table 1).

Using program DISTANCE, our truncated data set resulted in 43 and 29 occupied nests of Ferruginous Hawks and Golden Eagles respectively. Using this method we estimated 107.2 km^2 (95% CI: 63.1–182.1) and 230 km^2 (95% CI: 138.7–381.7) per occupied nest of Ferruginous Hawks and Golden Eagles, respectively (Table 2).

We used density estimates from both distance-sampling methods (Buckland et al. 1993) and the DOBSERV density calculation of number of nests found over area surveyed, weighted by probability of detection as determined by the double observer survey, to evaluate statewide abundance (Table 3). We calculated statewide abundance based on the total number of townships we considered Ferruginous Hawk habitat (consisting of 1,230 townships, each approximately 93 km^2; 114,390 km^2 total), as determined by the species distribution model performed by the Wyoming Natural Diversity Database (Keinath et al. 2010). The mark–recapture calculations provided smaller confidence intervals and probably more reliable abundance estimates. Overall, based on the density calculation, we estimate that there are 1,165 (95% CI: 928-1654) nesting pairs of Ferruginous Hawks in Wyoming and 701 (95% CI: 547-976) nesting pairs of Golden Eagles within the statewide distribution of Ferruginous Hawks (Table 3). To account for differences in population density based on location, we also divided the state into ecoregions, as defined by the USGS (Chapman et al. 2004), and calculated density separately for each ecoregion (Fig. 6) using the area divided by the number of occupied nests and weighted by probability of detection (Table 4).

Results of the nearest neighbor analysis from the 2010 statewide study indicated a minimum distance of 1.5 km and a mean distance of 4.3 km between occupied nests. Young et al. (2010) results from the 2009 survey in the area near Medicine Bow, Wyoming, showed that the minimum distance between two occupied Ferruginous Hawk nests was 1.0 km, while the mean was 4.2 km. We were unable to complete this analysis for Golden Eagles because of small sample size. Extensive data sets of other studies, however, document that occupied eagle nests are typically >2 km apart and alternate nests within a 1.8-km radius (Phillips et al. 1984, Kochert and Steenhof 2010). These results support a 1-km radius for defining nest territories for

calculations of occupancy rates and assure that we are not including more than one nesting territory when determining occupancy.

In 2011, we conducted occupancy surveys of 74 Ferruginous Hawk nesting territories that were known to be occupied in 2010. We classified forty five of these territories as occupied in 2011. We also determined that 17 of 68 putative territories surveyed in 2010, which were classified as not occupied, were occupied by Ferruginous Hawk nesting pairs in 2011. We detected 51 new nests in 2011 which we classified as not occupied during the aerial transect surveys. Follow up aerial surveys determined that 5 of these 51 putative territories were also occupied.

We monitored productivity of Ferruginous Hawks, but not Golden Eagles. June 2010 aerial surveys of 74 occupied Ferruginous Hawk nests documented a wide range of age in nestlings, varying from small downy to completely feathered young, and a high number of failed nests (n = 36). Nest surveys were not adequate to document the outcome of 4 nests, while 70 nests were adequately monitored. Twenty-one (30%) of these 70 nests were successful and fledged 60 young (0.9 young per occupied nest). We adequately monitored productivity of 79 nesting pairs in 2011. Forty-three (54.4%) of those nests were successful and fledged 102 young (1.29 young per occupied nest).

Genetic Analysis

We recovered carcasses of two juveniles and two adults from separate nests. The causes of mortality are unknown for the juveniles and one adult, due to the non-diagnostic state of the carcasses. The precise cause of mortality for the diagnosable adult carcass is also unknown; however, it tested positive for West Nile virus.

In 2010, we visited 32 occupied nests to search for feathers and prey remains. We successfully recovered genetic samples, including feather, carcass, egg shell, and blood draw, from 27 nests. The remaining 17 nests either contained no molt feathers at the time of our visit (n = 11) or were inaccessible (n = 6). In 2011, we visited 98 occupied nests and collected samples from 63 nests. Multiple samples were collected from some nests, resulting in 101 total samples. Samples included feathers, castings, or animal remains.

We collected 12 blood draw or tissue samples for genetic primer development (Table 5). We attempted to collect primer samples only from active nests outside study townships, but three of the samples came from study townships due to widespread nest failure and access issues in non-study townships, and three came from other contributors around the state. At present, we have extracted the DNA from these samples and sent them to Genetic Identification Services for primer development. The samples from 2011 are presently being analyzed in the genetics lab at the RMRS in Missoula, MT.

Nest-site Selection

In 2010, we performed distance sampling for prey species in putative nesting territories for 26 occupied nests and 10 randomly generated territories. We have recently compiled all the

necessary environmental covariates needed for the RSF analysis and are completing the logistic regression modeling procedure to determine habitat selection for Ferruginous Hawk nest sites.

Prey Availability

We surveyed prey availability at 66 occupied nests and 19 randomly generated territories on 2 separate sampling occasions during the 2011 season. We surveyed 510 line transects and 2032 point transects 2 times each. During the first sampling session, which occurred from 10 June to 7 Aug 2011, we counted a total of 32 lagomorphs and 5,642 squirrels on point transects. During the second sampling session, which occurred from 14 July to 11 Aug, we counted 17 lagomorphs and 4,244 squirrels on point transects. On line transects, which were aimed at detecting lagomorphs, we counted 48 individuals during the first sampling session and 69 individuals during the second. We also counted 26 and 63 squirrels during the first and second sampling sessions, respectively, on line transects. White-tailed prairie dogs were the most numerous prey species, with an average of 50 individuals counted per prey sampling area (range 0 to 440).

DISCUSSION

This is the second year of a study designed for three to four years, and progress reports should be considered preliminary until data collection and evaluations are complete. In this report we summarize statewide findings and are in the process of evaluating subsets of the data relative to energy development in Wyoming.

Our initial goal was to locate ≥ 60 – 100 occupied nests that were spatially distributed across energy development strata for both ferruginous hawks and golden eagles. We assumed surveys of 60 randomly selected townships would be adequate to secure this sample based on previous studies (Phillips et al. 1984, Ayers and Anderson 1999, Young et al. 2010). However, we only located 50 Ferruginous Hawk and 19 Golden Eagle nesting pairs during fixedwing surveys of township transects in 2010. Therefore, we conducted surveys in an additional 39 townships in 2011. We located 18 additional occupied Ferruginous Hawk and 14 Golden Eagle nests, resulting in a total of 68 and 33 occupied nests of Ferruginous Hawks and Golden Eagles, respectively. However, if we include occupied nests located during additional surveys within random townships and aerial routes between townships, we located a total of 118 and 59 occupied Ferruginous Hawk and Golden Eagle nests, respectively, for 2010 and 2011 combined.

We compared two methods of calculating density and estimating statewide abundance of both species. Both methods produced similar results for Ferruginous Hawks but appeared to diverge with Golden Eagle due to low sample sizes and large confidence intervals. We believe that estimates from mark-recapture calculations are more reliable than estimates from distance sampling due to tighter confidence-interval estimates of both species. We used the mark-recapture estimates of detection probability averaged over both observers (hawks: 0.725, 95% CI: 0.54–0.91; eagles: 0.585, 95% CI: 0.42–0.75) to determine the density of these species for each year, as well as an overall estimate of density for each species. Using this dataset and the

naïve densities of 136 km^2 and 280 km^2 per occupied hawk and eagle nest, respectively, we estimate that there are 1,165 (95% CI: 928-1,565) nesting pairs of Ferruginous Hawks in Wyoming and 722 (95% CI: 563-1006) nesting pairs of Golden Eagles within the statewide distribution of Ferruginous Hawks.

Comparing survey results across studies is difficult due to small study areas, different survey techniques, and a general failure of researchers to develop detection probabilities. However, our estimate of 98.2 km^2 per occupied Ferruginous Hawk nest falls between unpublished data (collected by B. Oakleaf) of 1997-2002 studies in the Medicine Bow area of 126 km^2 per occupied nest and 2009 results of 73 km^2 per occupied nest (Young et al. 2010). In our study, 30% of the occupied nests were successful and fledged 0.9 young per occupied nest in 2010, while 51% were successful and produced 1.2 young per occupied nest in 2011. This is somewhat lower than the 1.5 young per occupied nest reported during the 1990s phase of the Medicine Bow study, but similar to the 1.0 young per occupied nest observed in 2009 (Young et al. 2010). Low productivity in 2010 may have been associated with spring snow storms that occurred in early May. We observed nests with unattended clutches between 5-15 May and documented 12 nesting failures during that period. We documented a total of 36 nesting failures by the end of June. None of the occupied nests north of T36N, R71W were successful in 2010 or 2011. Similar failure rates and location were reported by other monitoring efforts in northeast Wyoming (G. McKee, pers. comm.; T. Byers, pers. comm.).

We calculated an average density of 163.2 km^2 per occupied Golden Eagle nest in 2010 and 2011, which is substantially below the average of 60 km^2 reported by Phillips et al. (1984). Studies in the Medicine Bow area found Golden Eagle densities of 64 km^2 per occupied nest in 1978, 112 km^2 per occupied nest between 1995 and 2005, and 119 km^2 per occupied nest in 2009. However, we stress that our sample size for Golden Eagles was low (n = 33), and our estimates should be used with caution.

To account for differences in population density based on location, we divided the state into ecoregions, as defined by the USGS (Chapman et al. 2004), and calculated density separately for each ecoregion (Fig. 6). Ferruginous Hawk habitat occurs mainly in four of the six ecoregions in Wyoming. The ratio of townships surveyed to the total townships available in each of these four ecoregions is approximately equal to the ratio of total townships available for random sampling in an ecoregion to the total available statewide. Large portions of the Northwestern Great Plains and the Wyoming Basin Ecoregions contain townships with centroids in Ferruginous Hawk habitat and therefore make up approximately 27% and 58%, respectively, of the statewide total available for sampling. We surveyed 30% and 56% of the available townships in the Northwestern Great Plains and the Wyoming Basin, respectively. We sampled townships using a spatially balanced approach, for example townships in Bighorn Basin comprise approximately 7% of the statewide total in our sampling frame; consequently the Bighorn Basin represented approximately 7% of our survey sample. Our estimate of 24 nesting pairs of Ferruginous Hawks in Bighorn Basin certainly corresponds to our impression of the species abundance in this ecoregion based on the nest record data base (Fig. 1) and our experience of >35 years of extensive travels in the area.

Potential Ferruginous Hawk habitat corresponds with large portions of Golden Eagle nesting habitat in the Northwestern Great Plains, High Plains, and Wyoming Basin, and we suspect estimates of abundance of nesting eagles in 2010 and 2011 are reliable for these areas during those years. However, sampling is largely inadequate for nesting eagles in the other three ecoregions. We have observed some of the highest density of nesting eagles in the Bighorn Basin and, especially, the ecotone with the Middle Rockies ecoregion.

Phillips et al. (1984) conducted surveys for nesting Golden Eagles in Wyoming from 1976 to 1982. Their study focused on 12 areas scattered over the state and collectively represented 8.0% of the state. They recorded 320 locations of occupied nesting territories or pairs of Golden Eagles and calculated a mean naive density of 60 km^2 per pair, for an estimate of 3,381 to >4,174 breeding pairs in Wyoming. They also reported high occupancy rates during this time period, varying from 88% to 100%, and concluded that available eagle habitat was saturated. Young et al. (2010) reported nearly twice as many nesting pairs of Golden Eagles in their Medicine Bow study area during 1978 (n = 50) compared to surveys in the 1990s and 2009 (n= 27). Boeker (1974) studied Golden Eagles nesting along the front range of the Rocky Mountains in Wyoming, Colorado, and New Mexico from 1964 to 1973. He reported an average of 44.9% of nests active in any given year but did not define the term "active". Many of his study nests are located in the Medicine Bow area and are still occupied periodically. These data sets suggest Golden Eagle abundance in Wyoming being greatest in the late 1970s and early 1980s.

We suspect that 2010-2011 was a low period of nest occupancy for Ferruginous Hawks and Golden Eagles. Fedy and Doherty (2011) found that potential prey populations of Greater Sage-grouse and cottontails were cycling on an approximate 8-year cycle in Wyoming. Their evaluations and recent hunter harvest survey results indicate these cycles are again at population lows in many parts of the state, especially in northeastern Wyoming (WGFD 2011). Long-term monitoring data on nesting raptors and lagomorphs have been collected in areas associated with coal mines in northeast Wyoming and compiled by G. McKee. These data show highs of nesting Ferruginous Hawks and Golden Eagles in 2006-2007 and lows in 2010, corresponding with lagomorph highs in 2006-2007 and lows in 2010 (Thunderbird Wildlife Consulting 2010; ICF International 2010a, b).

Additional surveys, evaluations of prey abundance and weather variables are planned to place our statewide abundance estimates in better temporal perspective.

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helpful critique with recommendations for improvement. Z. Wallace and M. Wilson served as primary observers for fixed-wing aerial surveys of transects and leaders of the field crews. Other field crew leaders include A. Larned, R. Buchheit and P. Mahoney. Field crews augmented production data and collected genetic samples and data on prey abundance.

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Table 1. Number of nests (*n*), density (km^2 per nest), 95% confidence intervals (95% CI), and number of nests per township of occupied Ferruginous Hawk (*Buteo regalis*) and Golden Eagle (*Aquila chrysaetos*) nests found on random survey transects throughout Wyoming, 2010-2011. Density was calculated by using the probability of detection as calculated with program DOBSERV.

	Ferruginous Hawks				Golden Eagles			
Year	*n*	Density	95% CI	Nests per township	*n*	Density	95% CI	Nests per township
2010	50	80.9	60.3–101.6	0.83	19	171.8	102.8–297.0	0.32
2011	18	165.2	145.5–185.0	0.46	14	129.5	57.7–201.4	0.36
Total	68	98.2	73.1–123.2	0.69	33	163.2	117.2–209.3	0.33

Table 2. Number of nests (*n*), density (km^2 per nest), and 95% confidence interval (95% CI) of occupied Ferruginous Hawk (*Buteo regalis*) and Golden Eagle (*Aquilus chrysaetos*) nests throughout Wyoming, 2010-2011, as determined with distance sampling. Number of nests reflects the number used in analysis, which was truncated at 300 m.

	Ferruginous Hawks			Golden Eagles		
Year	*n*	Density	95% CI	*n*	Density	95% CI
2010	33	167.8	119.0 - 236.6	18	172.2	95.3 - 311.2
2011	10	136.8	58.1 - 321.8	11	265.7	183.0 - 577.5
Total	43	107.2	63.1 - 182.1	29	230.1	138.7 - 381.7

Table 3. Comparison of estimates calculated via distance sampling and mark-recapture (DOBSERV) for density (km^2 per nest) ,abundance (number of pairs), and 95% confidence interval (95% CI) for Ferruginous Hawks (*Buteo regalis*) and Golden Eagles (*Aquilus chrysaetos*) throughout Wyoming, 2010-2011.

	Ferruginous Hawks			Golden Eagles		
	Density	Abundance	95% CI	Density	Abundance	95% CI
Distance sampling	107.2	1067.3	628.1-1813.4	230.1	497.1	299.7-824.6
DOBSERV	98.2	1165.0	928.4-1564.5	163.2	700.9	546.7–976.2

Table 4. Number of townships surveyed (*n*), total number of townships within Ferruginous Hawk (*Buteo reglais*) distribution (total *n*), total area of townships (km^2), number of nests, density (km^2 per nest), number of nests per township, and abundance (number of pairs) of Ferruginous Hawks and Golden Eagles (*Aquilus chrysaetos*) throughout Wyoming by ecoregion, 2010-2011.

Ecoregion	*n*	Total *n*	Township area	No. of nests	Density	Nests per township	Abundance
Ferruginous Hawk							
Bighorn Basin	5	88	8184	1	337.1	0.2	24
High Plains	7	99	9207	5	94.4	0.7	98
NW Great Plains	30	315	29295	14	144.5	0.5	203
Wyoming Basin	55	682	63426	48	77.3	0.9	821
Southern Rockies	2			0			
Middle Rockies	0						
Golden Eagle							
Bighorn Basin	5	88	8184	1	272.03	0.2	30
High Plains	7	99	9207	4	95.21	0.6	97
NW Great Plains	30	315	29295	17	96.00	0.6	305
Wyoming Basin	55	682	63426	11	272.03	0.2	233
Southern Rockies	2			0			
Middle Rockies	0						

Table 5. List of Ferruginous Hawk (*Buteo regalis*) genetic samples collected throughout Wyoming, 2010, and used for primer development. Information includes date the sample was collected, initials of the collector, identification number used by the genetics lab, unique identifier of the sample, sample type, and township number, UTM coordinates of the location the sample was collected (NAD83, Zone 12 and 13).

Date	Collector	Genetics Lab ID	Unique ID	Sample type	Township	UTM E	UTM N
8/24/2009	JB	FEHA 1	1506431001	Tissue	1564		
10/19/2009	TK	FEHA 2	1506621001	Tissue	1566		
6/25/2010	ZW	FEHA 3	1609302001	Blood draw	1693	4585471	263287
6/24/2010	ZW, MW	FEHA 4	1710404001	Blood draw	17104	4594171	654064
6/25/2010	ZW	FEHA 5	2109028001	Blood draw	2190	4626372	285452
7/21/2010	ZW	FEHA 6	2109028002	Tissue	2190	4626372	285452
5/14/2009	BO	FEHA 7	2510502001	Tissue	25105	4670801	640565
6/26/2010	ZW	FEHA 8	2609036004	Blood draw	2690	4673187	291622
6/24/2010	MW, ZW	FEHA 9	2710327001	Blood draw	27103	4683412	656775
6/23/2010	MW, ZW, BO	FEHA 10	3009528001	Blood draw	3095	4714255	729871
7/1/2010	ZW, MW, RB, JL	FEHA 11	3208636001	Blood draw	3286	4729355	330161
8/4/2010	ZW, MW	FEHA 12	4810130001	Blood draw	48101	4885079	658674

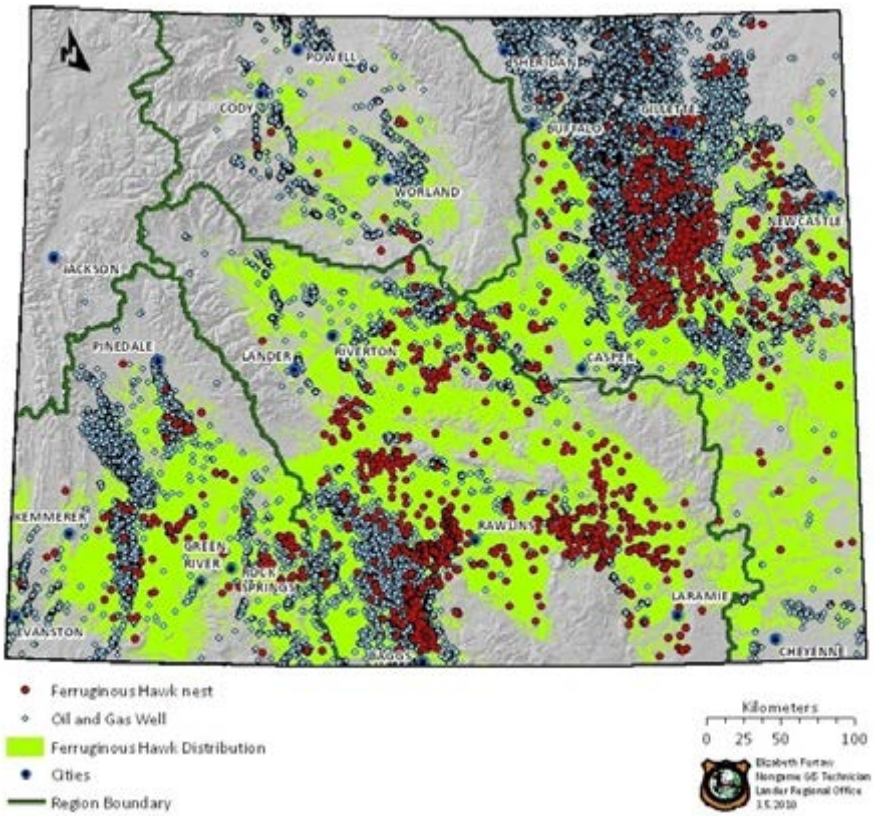

Figure 1. Ferruginous hawk (*Buteo regalis*) distribution in Wyoming, 2010-2011. Red dots indicate hawk nests; blue dots are oil and gas wells.

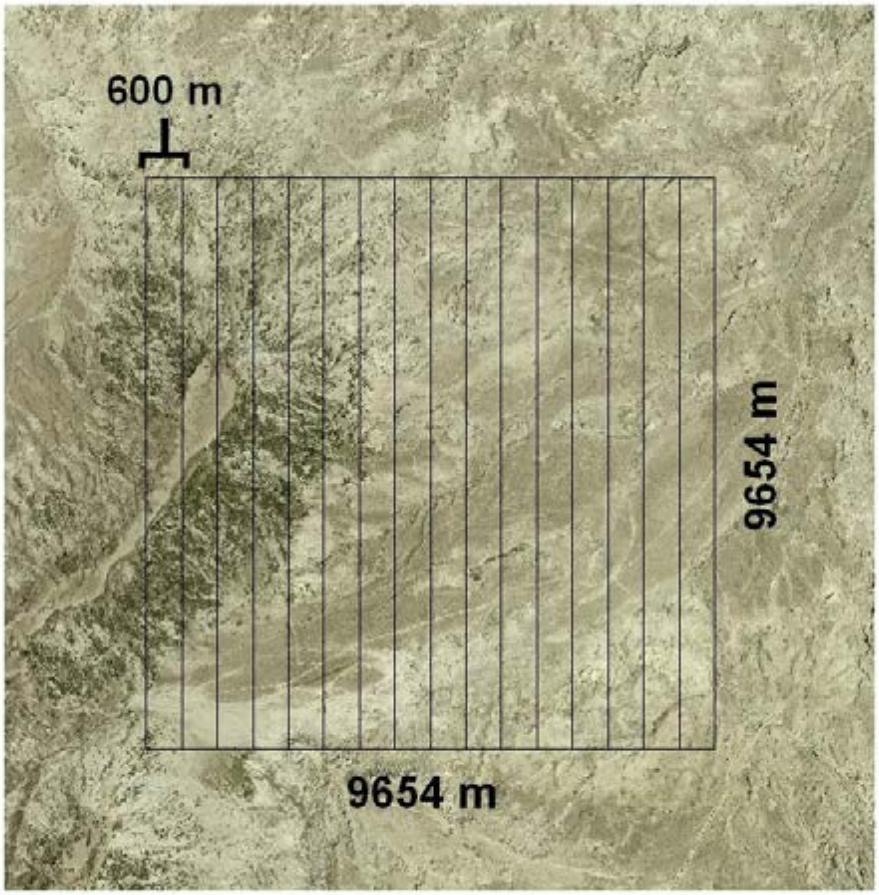

Figure 2. Aerial survey flight lines for Ferruginous Hawk (*Buteo regalis*) and Golden Eagle (*Aquila chrysaetos*) nests in Wyoming, 2010-2011, depicted in a survey township (9654 m = 6 mi).

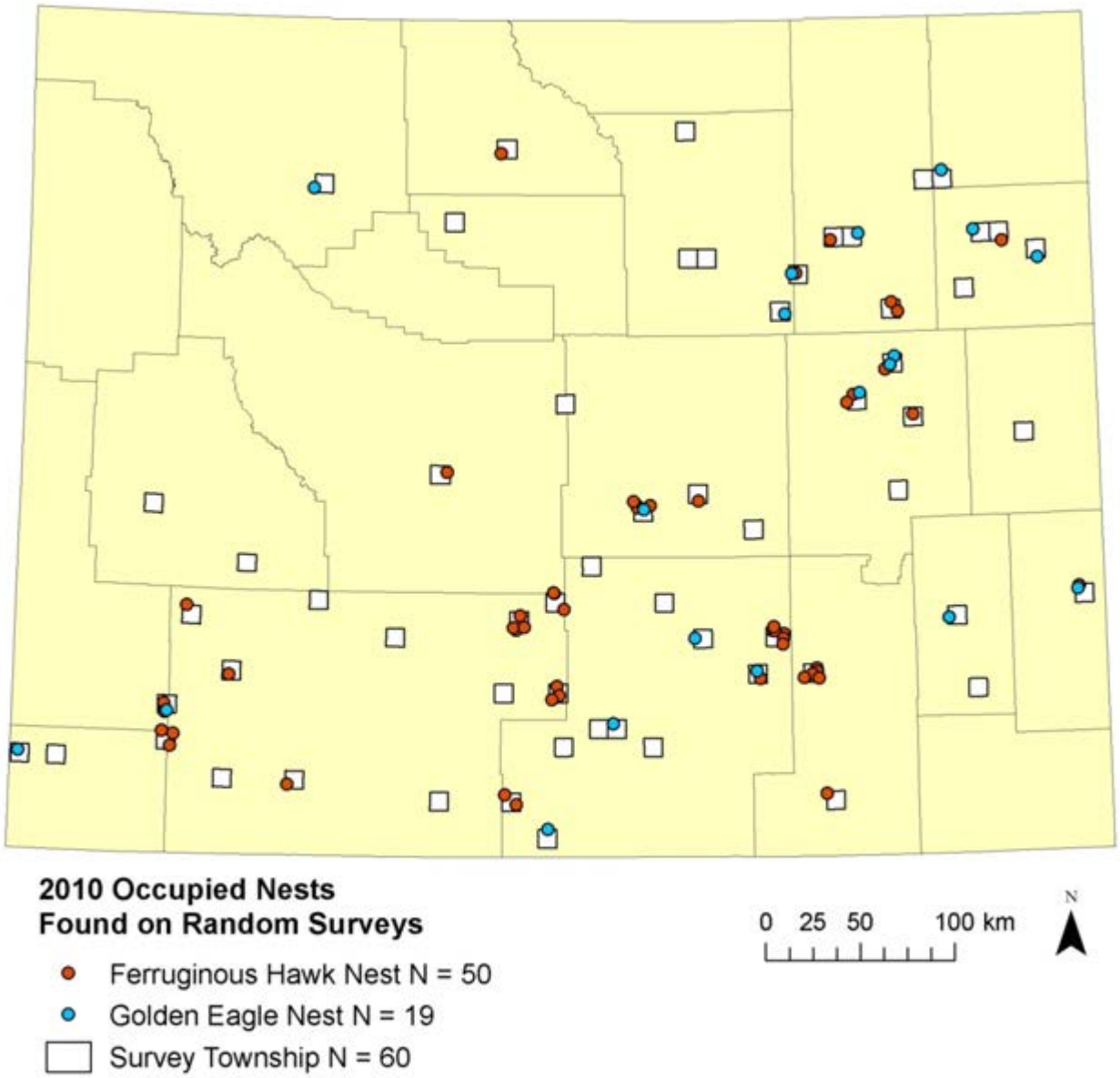

Figure 3. Locations of occupied nests of Ferruginous Hawks (*Buteo regalis*; red dots) and Golden Eagles (*Aquila chrysaetos*; blue dots) detected during transect surveys in Wyoming, 2010. Surveyed townships are shown in white.

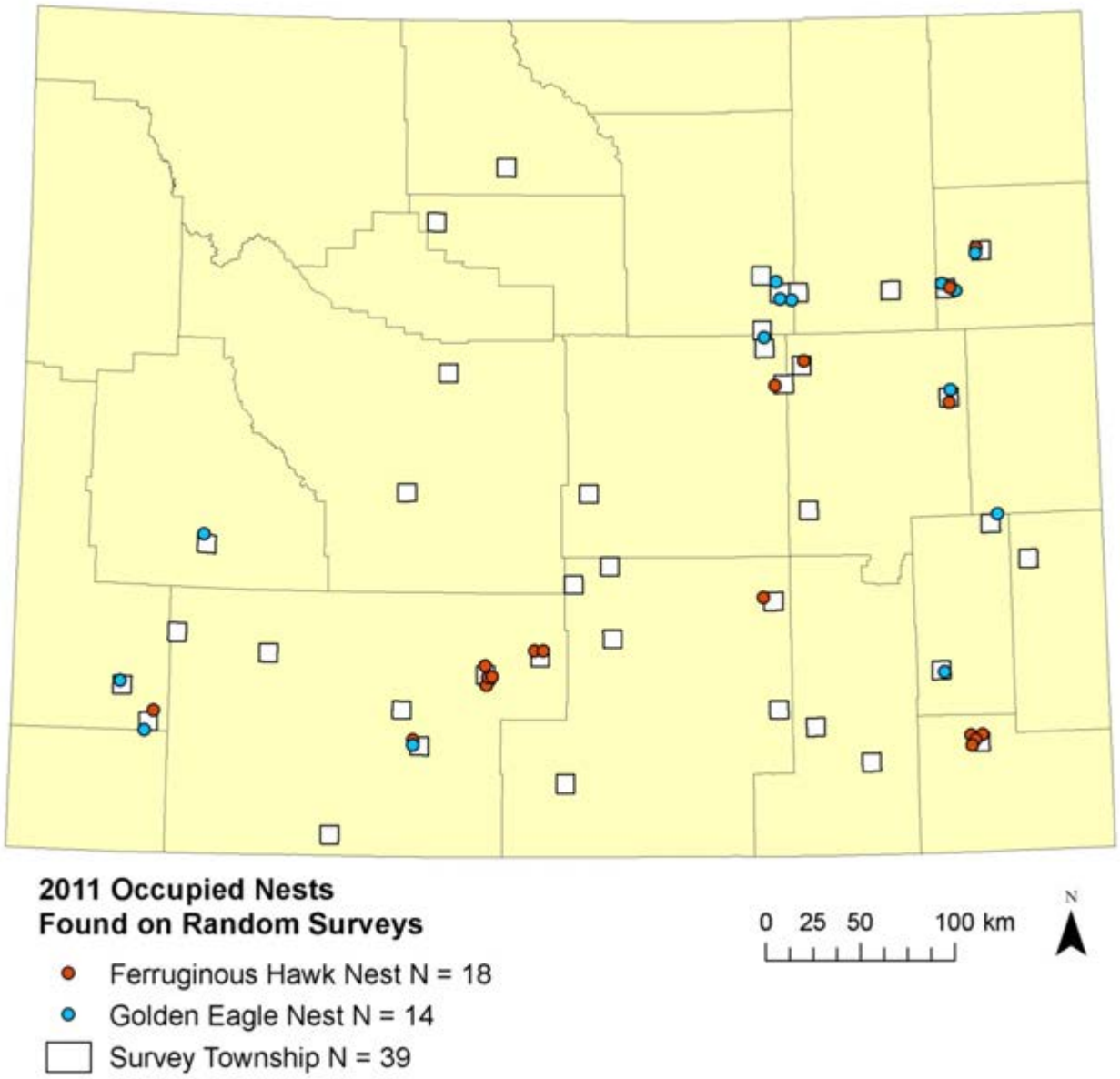

Figure 4. Locations of occupied nests of Ferruginous Hawks (*Buteo regalis*; red dots) and Golden Eagles (*Aquila chrysaetos*; blue dots) detected during transect surveys in Wyoming, 2011. Surveyed townships are shown in white.

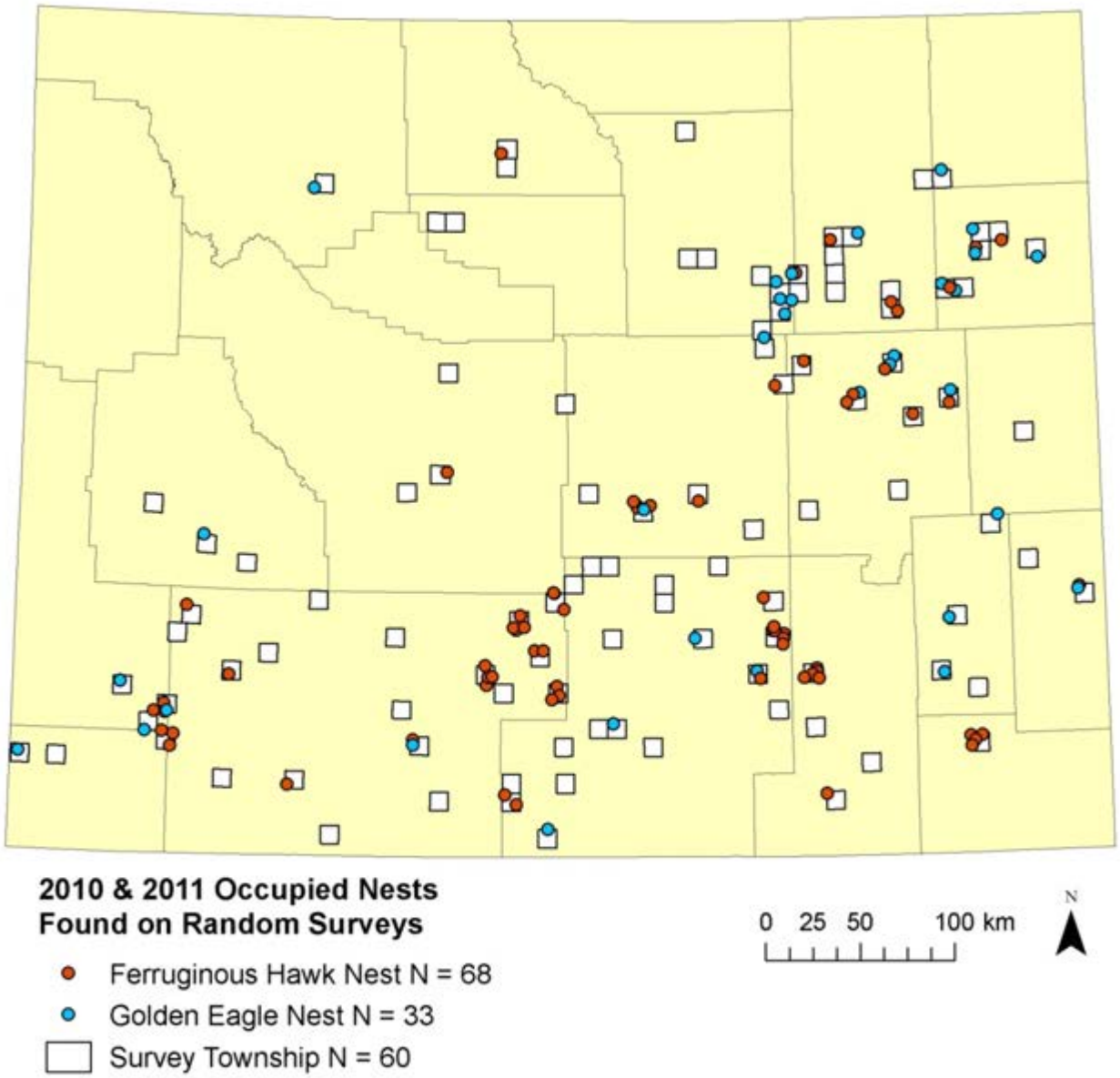

Figure 5. Locations of occupied Ferruginous Hawk (*Buteo regalis*; red dots) and Golden Eagle (*Aquilus chrysaetos*; blue dots) nests detected during transect surveys in Wyoming, 2010-2011. Surveyed townships are shown in white.

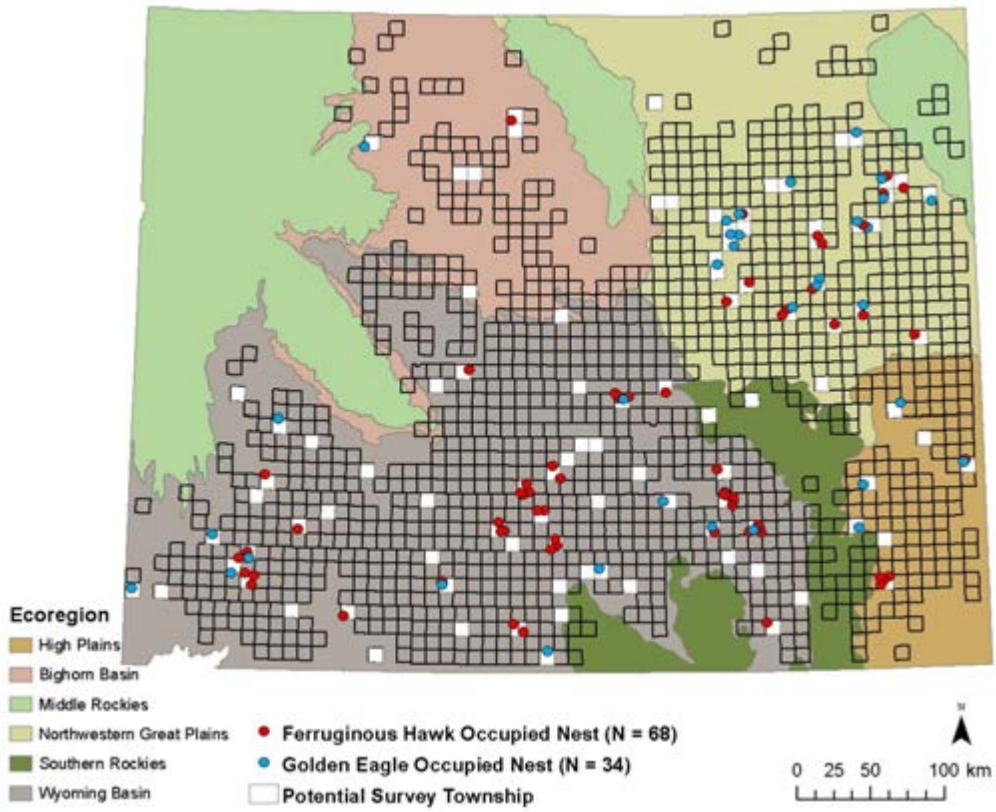

Figure 6. Locations of occupied Ferruginous Hawk (*Buteo regalis*; red dots) and Golden Eagle (*Aquilus chrysaetos*; blue dots) nests detected during transect surveys in Wyoming, 2010-2011. Surveyed townships are shown in white and overlay ecoregions as defined by the USGS (Chapman et al. 2004).

PRODUCTIVITY OF PEREGRINE FALCON

STATE OF WYOMING

NONGAME BIRDS: Species of Greatest Conservation Need – Peregrine Falcon

FUNDING SOURCE: General Fund Appropriation

PROJECT DURATION: Annual

PERIOD COVERED: 15 April 2011 – 14 April 2012

PREPARED BY: Bob Oakleaf, Nongame Coordinator
Susan Patla, Nongame Biologist
Doug Smith, Senior Wildlife Biologist, Yellowstone National Park

ABSTRACT

We continued monitoring of nesting Peregrine Falcons (*Falco peregrinus*) in Wyoming since the species was removed from protection under the Endangered Species Act in 1999. In 2011, we adequately monitored 33 nesting pairs to determine that 26 pairs (79%) were successful and produced 50 young, for 1.5 young per pair. These results are similar to long term averages and remain well above recovery goals, suggesting Peregrine Falcons are maintaining stable populations in Wyoming.

INTRODUCTION

In cooperation with The Peregrine Fund, Inc., the Wyoming Game and Fish Department developed plans from 1978-1980 to re-establish Peregrine Falcons (*Falco peregrinus*; peregrines) in Wyoming based on analysis of historical distribution and evaluation of potential habitat during survey work. Our goal of reintroduction was to establish and maintain a self-sustaining breeding nucleus in the wild. We set objectives to annually release approximately 15 peregrines and establish 30 breeding pairs in Wyoming by 1996. We coordinated the program with Idaho and Montana to ensure maximum results to re-establish this species. Peregrine reintroduction and monitoring efforts are detailed in previous Wyoming Game and Fish Department Nongame Annual Completion Reports and annual reports completed by The Peregrine Fund, Inc. In Wyoming, we released 384 peregrines from 1980-1995, with at least 325 (85%) surviving to dispersal (i.e., 1 month post-release). We have not released peregrines since 1995 because we attained objectives in 1994-1995 and the species was subsequently delisted at the national level in 1999. We do, however, continue monitoring efforts as populations are

relatively limited. In cooperation with the US Fish and Wildlife Service (USFWS), Wyoming also participated in the National Monitoring Plan for delisting of the American Peregrine Falcon every 3 years with supplemental funding from the USFWS (Agreement #60181G446) in 2003, 2006, and again in 2009 (Table 1). We have also monitored nesting performance of peregrines in Wyoming on an annual basis between these USFWS-sponsored surveys. Our objectives in 2011 were to continue annual monitoring at 30 randomly selected nesting sites throughout Wyoming to assess occupancy and productivity.

METHODS

We recorded potential peregrine nesting cliffs in Wyoming during baseline surveys from 1978-1980 and periodically checked them for occupancy during ground surveys. We collected data on occupancy and fledging from as many of the known peregrine territories as possible from 1984-2004. Since 2005, we have randomly selected 30 territories to survey. . Ten sites were selected for each of three areas: Yellowstone National Park, west of the continental divide outside of Yellowstone National Park, and the rest of Wyoming east of the continental divide. During the years of the National Monitoring Plan, 15 previously selected sites were automatically selected, and an additional 15 were randomly chosen so that we attempt to annually monitor at least 30 territories. We included additional sites that we observed as time allowed during travels to selected territories and sites observed by cooperators with interest in specific sites.

We determined occupancy for each of the selected territories during early season visits and recorded productivity during ≥1 observations of adults feeding young later in the season. Territories where we failed to locate a breeding pair (i.e., not occupied) were selected for repeated visits. These visits ≥2 visits each of ≥4 hrs before the territory could be classified as not occupied. We determined nest success by ≥2 visits with the last visit timed to observe chicks ≥28 days old. We visited eyries that were situated in areas where it was difficult to observe young after the young were fledged to assure a more complete count.

RESULTS AND DISCUSSION

In 2011, we were able to survey only 24 of the 30 randomly selected nesting territories; 21 of these territories were classified as occupied. Occupied territories fledged 33 young, for a total of 1.6 young per occupied territory (Table 2). We also checked an additional 15 nesting territories in 2011, for a statewide total of 39 territories, 33 of which were occupied by breeding adults (Table 3). These 33 pairs produced 50 young, for a total of 1.5 young per occupied territory. When we added survey data from 2011 to cumulative data collected since 1984, we have recorded ≥908 nesting attempts at 93 territories. These attempts have resulted in ≥1,387 young, and a mean of 1.6 young fledged per nesting attempt.

We conduct surveys in accordance with the Monitoring plan for the American Peregrine Falcon every 3 years. However, we also conduct monitoring for peregrines in the off years to monitor annual production for this relatively rare species. Following extirpation and subsequent

reintroductions of peregrines, we first documented nesting in 1984. Since that time, we have recorded over 900 nesting attempts resulting in nearly 1,400 young. Although we did not survey all available habitat for nesting peregrines, 33 territories were known to be occupied in 2011, suggesting Wyoming remains well above recovery goals of a minimum of 30 breeding pairs statewide. Production indices among territories were similar, and, in 2011, were similar to long-term mean. These results appear to be above what is necessary to maintain a stable population of peregrines in Wyoming.

ACKNOWLEDGEMENTS

S. Langston, L. Van Fleet, and M. Wilson assisted peregrine surveys during 2011. M. Ruehmann, C. Paige, K. Gura, and S. Wolff assisted surveys in Grand Teton National Park. Peregrine monitoring in Yellowstone National Park was conducted by J. Pagel, L. Henry, L. Baril, N. Bowersock, B. Cassidy, and J. Parker.

Table 1. Peregrine Falcon (*Falco peregrinus*) productivity throughout Wyoming at National Survey Sites established by the US Fish and Wildlife Service. Percent of successful territories were the number of territories that produced young to fledging divided by the total number of territories checked.

Year	No. territories checked	No. territories occupied	No. successful territories (%)	No. young fledged	No. young per occupied territory
2003	15	15	12 (80)	28	1.9
2006	14	14	11 (79)	26	1.9
2009	15	14	7 (54)	14	1.0

Table 2. Peregrine Falcon *(Falco peregrinus)* productivity of 30 randomly selected sites in Wyoming, 2005-2011. Percent of successful territories were the number of territories that produced young to fledging divided by the total number of territories checked.

Year	No. territories checked	No. territories occupied	No. successful territories (%)	No. young fledged	No. young per occupied territory
2005	30	30	21 (70)	51	1.7
2006	30	30	22 (73)	49	1.6
2007	30	27	19 (70)	40	1.5
2008	22	22	13 (59)	30	1.4
2009	30	25	15 (60)	36	1.4
2010	28	24	19 (79)	42	1.7
2011	24	21	14 (68)	33	1.6
Mean	27.7	25.6	17.6 (68.4)	40.1	1.6
SD	3.3	3.6	3.6 (7.0)	7.9	0.1

Table 3. Peregrine Falcon *(Falco peregrinus)* productivity for all monitored sites in Wyoming, 1998-2011. Percent of successful territories were the number of territories that produced young to fledging divided by the total number of territories checked.

Year	No. territories checked	No. territories occupied	No. successful territories (%)	No. young fledged	No. young per occupied territory
1998	44	44	35 (79)	84	1.9
1999	42	42	25 (59)	57	1.4
2000	46	46	40 (87)	83	1.8
2001	42	42	39 (93)	81	1.9
2002	60	59	49 (83)	97	1.6
2003	58	58	50 (86)	107	1.8
2004	66	65	56 (86)	130	2.0
2005	64	64	45 (70)	99	1.6
2006	61	61	44 (72)	101	1.7
2007	54	51	36 (71)	75	1.5
2008	29	29	19 (65)	45	1.5
2009	46	41	28 (68)	58	1.4
2010	42	36	30 (83)	66	1.8
2011	39	33	26 (79)	50	1.5
Mean	49.5	47.9	37.3 (77.2)	80.9	1.67
SD	10.9	11.8	10.8 (9.8)	24.3	0.20

EVALUATING POPULATION TRENDS OF LONG-BILLED CURLEWS IN WESTERN WYOMING

STATE OF WYOMING

NONGAME BIRDS: Species of Greatest Conservation Need – Long-billed Curlew

FUNDING SOURCE: Wyoming State Legislature General Fund Appropriation and/or Wyoming Governor's Endangered Species Account Funds

PROJECT DURATION: Annual

PERIOD COVERED: 15 April 2011 – 14 April 2012

PREPARED BY: Nichole Cudworth, Nongame Biologist
Andrea Orabona, Nongame Bird Biologist

ABSTRACT

Long-billed Curlew (*Numenius americanus*) populations declined in Wyoming in the late 19th and early 20th centuries due to uncontrolled hunting, habitat conversion, and pesticides, all of which have contributed to their classification as a Species of Greatest Conservation Need by the Wyoming Game and Fish Department. To monitor curlew populations, the Wyoming Game and Fish Department initiated annual roadside surveys in 1991 in western Wyoming during the breeding season. In 2011, we detected 97 unique individuals on 5 pre-determined survey routes in addition to 6 individuals recorded by Breeding Bird Survey participants. In general, curlew numbers have remained relatively stable among survey years, with only two of the five routes displaying decreasing populations, although the relatively poor fit of trendlines and high variability among years suggests these results should be interpreted cautiously. We are currently revising protocols that would include measures of detection probability in order to increase precision of trend estimates, estimate abundance, and allow for inclusion of site and survey specific variables that may be influencing trends of curlews.

INTRODUCTION

Long-billed Curlews (*Numenius americanus*; curlews) are found throughout much of Wyoming during migration. However, curlews only breed in areas with suitable habitat, which includes a variety of grasslands with short vegetative structure, typically near water (Cochrane and Anderson 1987, WGFD 2010). Uncontrolled hunting in the late 19th and early 20th centuries, widespread conversion of prairie to agricultural fields in the 1930s, and the use of organochlorine pesticides resulted in significant declines in curlew populations throughout the

state (Nicholoff 2003). As a result, the Long-billed Curlew is classified as a Species of Greatest Conservation Need by the Wyoming Game and Fish Department (Department; WGFD 2010).

Our objective for surveys of curlews in 2011 was to continue to accumulate annual count data for curlews along five survey routes in western Wyoming where breeding populations are known to occur. We then added these data to data collected since 1991 to further evaluate trends over time and investigate any changes in curlew populations.

METHODS

We conducted surveys for curlews along five pre-defined routes in northwestern Wyoming. Although the length of each route was dependent upon the amount of available habitat, survey protocol generally followed that of the Breeding Bird Survey (Robbins and VanVelzen 1967). We initiated surveys 20 min before sunrise and observed curlews at stops located every 0.8 km. At each stop, we recorded the number of curlews seen and heard during a 3-min period, but did not recount individuals observed at previous stops. We also recorded the number of individuals observed while driving between stops. We divided the total number of curlews detected by distance driven to estimate the number of curlews per km for each survey route. For routes that were surveyed more than once, we used data from the survey that detected the most curlews. This differs from analyses in previous reports; however, we feel that using the maximum number of recorded individuals, as opposed to the mean number of curlews between surveys, is a more appropriate analysis. We believe that averaging values between surveys under-represents the number of curlews that are known to occur at a site and tends to introduce more variation in data resulting from variation in survey conditions. Using the maximum number of curlews detected in analyses tended to be more susceptible to years with outliers, but did not change the direction of trends and increased the precision of the estimate overall (i.e., larger R^2 value) for over half of the analyses.

We attempted to conduct surveys between 21 April and 15 May to correspond with the US Fish and Wildlife Service (USFWS) and US Geological Survey (USGS) range-wide survey and monitoring guidelines for curlews (Jones et al. 2003, Stanley and Skagen 2007). However, surveys were not attempted when observers were unavailable or weather conditions were not conducive (e.g., rain).

Four of the survey routes, Horse Creek, New Fork, Chapman Bench, and Grand Teton National Park (GTNP) Hayfields, have been surveyed since the early 1990s; the National Elk Refuge (NER) route was initiated in 2008. To evaluate trends, we developed a 3-year average of curlew detections per km for each route with a minimum of 15 years of data in order to account for variability in survey results. We excluded the 1987 survey, which only recorded the number of curlews seen, and the 2004 survey that was conducted by the USFWS from our analysis. This ensured that only those years in which methods of detection were consistent were used in analyses. We report the slope and R^2 value of trendlines to investigate population trends for each survey route.

The Breeding Bird Survey (BBS) is used to monitor trends of breeding birds across North America. The BBS is sponsored jointly by the USGS – Biological Resources Division (USGS-BRD; formerly the USFWS) and the Canadian Wildlife Service. The USGS-BRD has reviewed and analyzed data collected from the BBS since the survey's inception in 1966 in the East and 1968 in the West. Volunteers typically conduct BBS routes in June, when most species of birds are breeding and most vocal. To evaluate trends of curlews statewide, we plotted the mean number of curlew detections per BBS route (27 total routes) since 1991 and reported the slope and R^2 value for BBS data in Wyoming. Only routes that were surveyed in a given year are included in analyses.

RESULTS

In 2011, we surveyed three of the five Long-billed Curlew routes twice during the breeding season; the remaining two routes were each surveyed once (Table 1). All curlew survey data (number of curlews seen, heard, as well as comments made during each survey) are located in the Nongame Bird Biologist's files at the Department's Lander Regional Office.

Horse Creek demonstrated a decline of 0.49 individuals per km per year ($R^2 = 0.59$; Fig. 1) and Chapman Bench had a decline of 0.22 individuals per km per year ($R^2 = 0.30$; Fig. 2). New Fork curlew populations appear to be stable, with a slight increase of 0.07 individuals per km per year ($R^2 = 0.02$; Fig. 3). GTNP Hayfields also demonstrates a slight increase of 0.01 individuals per km per year ($R^2 = 0.05$; Fig. 4). The NER has not been surveyed for a sufficient amount of time to allow for trend comparison, although results to date are presented in Table 2.

Participants detected curlews on 27 BBS routes since initiation of the BBS in Wyoming in 1968. Observers surveyed 11 of these routes in 2011 and detected 6 curlews on 2 routes. Counts in previous years have fluctuated from a low of 1 curlew detected on 1 of 15 routes surveyed in 1998 to a high of 19 curlews detected on 8 of 16 routes surveyed in 1999. Overall, BBS routes have shown a slight increase of 0.03 individuals per route per year ($R^2 = 0.14$; Fig. 5) since 1991.

DISCUSSION

Curlews have been detected on 27 BBS routes in Wyoming since 1980; however, the timing of the BBS during the month of June corresponds with the latter stages of the curlew breeding cycle. Consequently, detections of curlews during this time may reflect a clumped distribution, which could increase variance and decrease precision of trend estimates (Fellows and Jones 2009). Although the number of curlews detected on BBS routes appears to be increasing over time, this increase is slight, and the trend is masked by the high variance in number of detections and number of routes surveyed per year. These results suggest that surveys specifically designed for detecting and monitoring curlews are warranted, as we are unable to use BBS results alone to accurately determine population trends.

Cochrane (1983) first used BBS techniques (Robbins and VanVelzen 1967) to conduct species-specific, roadside surveys for curlews in 1982. Over time, we have made multiple modifications to the guidelines provided by Cochrane and Oakleaf (1982) to reflect updated survey techniques. Although the modifications to our survey methodology were intended to maximize detections of curlews and conform to range-wide recommendations, our results are confounded by variations in weather conditions, observer availability, modifications to the length of some survey routes, and noise levels, all of which influence our ability to locate curlews and determine population trends accurately. Additionally, an estimate of detection probability is needed to determine abundance or population size. We are currently developing protocols that will utilize an occupancy modeling approach to address issues of detection and allow for the inclusion of covariates, such as vegetation structure and composition, weather, and distance to important landscape features (Jones et al. 2003).

Although the trendline fit well for the Horse Creek route, with year explaining 58.7% of the variation in curlew numbers, the trendline did not fit the other survey routes as well. The New Fork and Chapman Bench routes in particular appear to be heavily influenced by one or two years of data. We recorded 10.6 individuals per km in 1997 on the New Fork route, which greatly increased our estimate as well as our variance for 1997-1999 (Fig. 3). Removing this point increases both our trend estimate and precision to an increase of 0.18 individuals per km per year ($R^2 = 0.26$). Chapman Bench is more problematic, with 3.6 and 1.9 individuals detected per km in 1992 and 1993, respectively (Fig. 2). These numbers are significantly higher than any surveys since. Removing these two years changes the direction of our trend estimate from a decreasing population to slight increases of 0.04 individuals per km per year ($R^2 = 0.30$). This drastic drop in detections between 1993 and 1994 along the Chapman Bench route may indicate a decrease in availability or suitability of nesting habitat, but the subsequent increases in curlew detections may be promising, although the low R^2 value still suggests this trend should be interpreted with caution.

Current threats to breeding populations of curlews primarily include habitat loss and fragmentation due to conversion to agriculture, urbanization, and encroachment of woody vegetation (Jones et al. 2003). In fact, productivity is often highest in areas with short-growing vegetation and lowest in areas with disturbances during the nesting season related to agricultural practices, including grazing, dragging hay meadows to break up manure, and field fertilization (Cochrane and Anderson 1987, Pampush and Anthony 1993). The Horse Creek route not only consistently records the greatest number of curlews annually, it also displays the steepest declines over time. This may result either from changes in timing of surveys, where surveys are occurring later in the nesting cycle and are consequently missing more birds over time, or changes in habitat. Incorporating these survey and habitat variables are likely critical to understanding the cause of this decline in curlew detections. Trend estimates of curlew populations can reflect changes in habitat availability or suitability, and recording and including variables pertaining to habitat in further surveys can help assess how these changes are currently impacting curlew occupancy and abundance.

ACKNOWLEDGEMENTS

We would like to acknowledge the following Wyoming Game and Fish Department personnel for their valuable contributions to the 2011 curlew monitoring effort: J. Bohne, D. Brimeyer, D. Clause, J. Randall, S. Smith, and D. McWhirter.

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Table 1. Survey information from five routes surveyed for Long-billed Curlews (*Numenius americanus*) in western Wyoming, 2011, including route name, length, and number of stops as well as survey dates and total number of curlews (LBCU) detected along each route. Two routes were only surveyed once in 2011. GTNP represents Grand Teton National Park; NER represents the National Elk Refuge.

			First survey		Second survey	
Route	Length (km)	Survey stops (*n*)	Date	LBCU detected (*n*)	Date	LBCU detected (*n*)
Horse Creek	12.8	17	21 May	35	28 May	40
New Fork	6.4	9	13 May	24	27 May	8
Chapman Bench	12.8	17	14 May	6		
GTNP Hayfields	15.2	20	27 May	5	31 May	9
NER	11.2	15	23 May	18		

Table 2. Total number of Long-billed Curlews (*Numenius americanus*; LBCU) detected and number detected per km along the National Elk Refuge survey route (11.2 km) in western Wyoming, 2008-2011.

Year	LBCU (*n*)	No ofLBCU per km
2008	6	0.5
2009	10	0.9
2010	6	0.5
2011	18	1.6

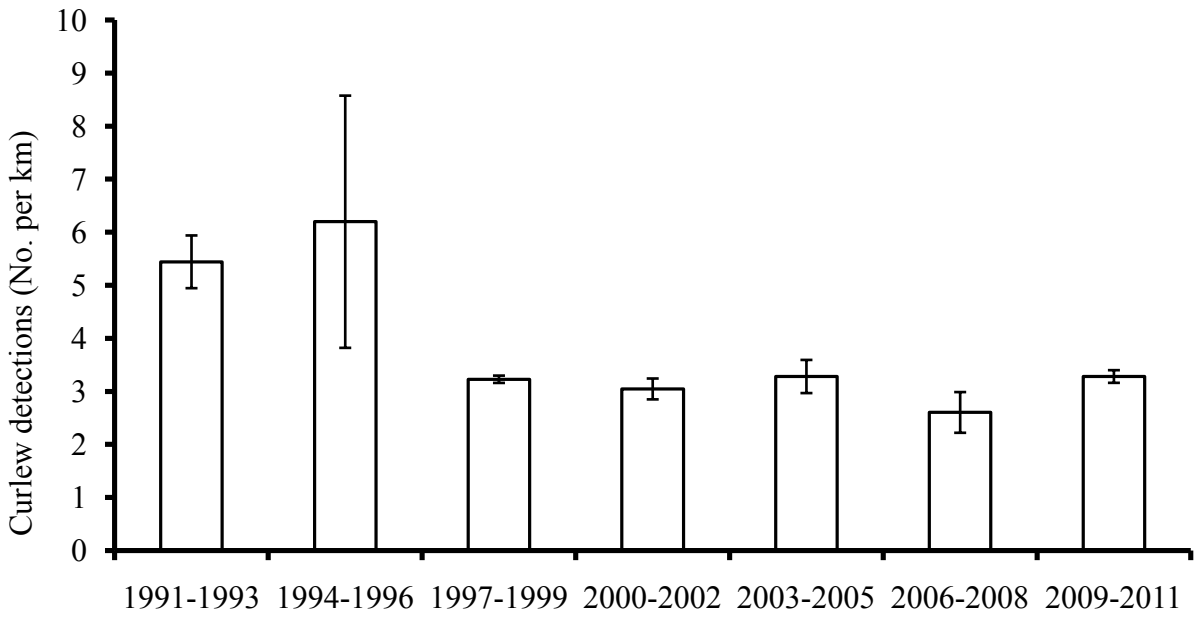

Figure 1. Three-year average (±SE) of number of Long-billed Curlews (*Numenius americanus*) detected per km along the Horse Creek survey route (12.8 km) in western Wyoming, 1991-2011.

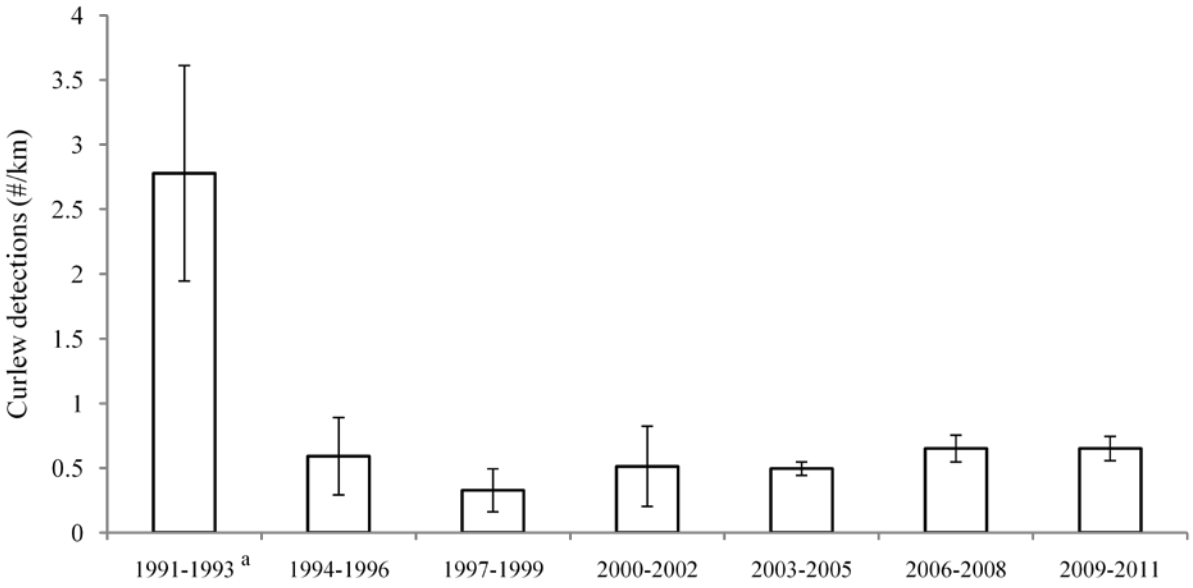

Figure 2. Three-year average (±SE) of number of Long-billed Curlews (*Numenius americanus*) detected per km along the Chapman Bench survey route (12.8 km) in western Wyoming, 1991-2011. [a] indicates an average over only two years.

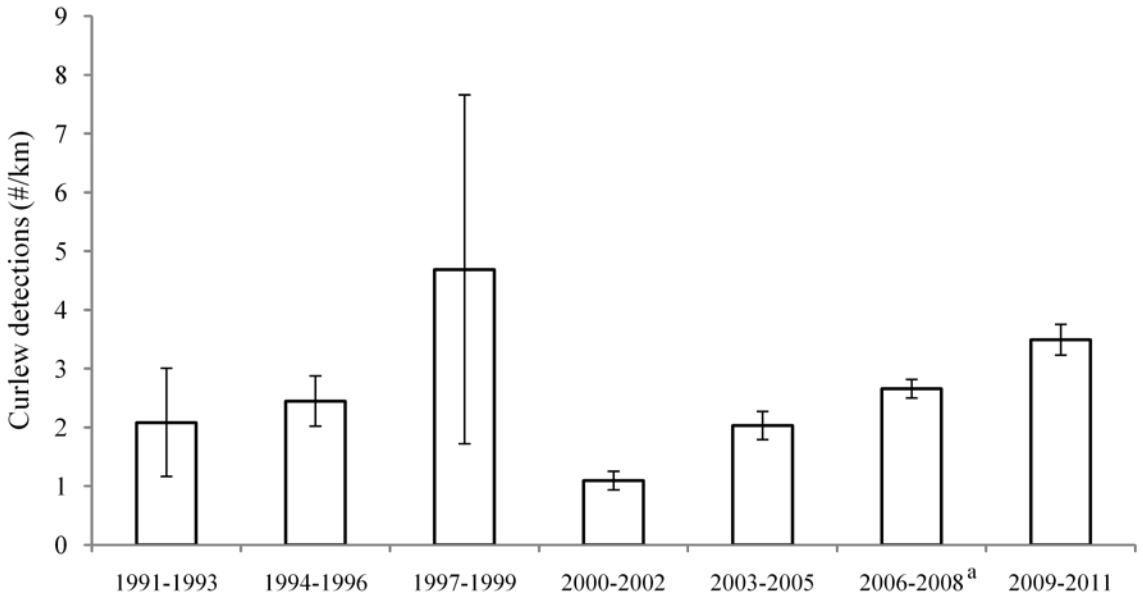

Figure 3. Three-year average (±SE) of number of Long-billed Curlews (*Numenius americanus*) detected per km along the New Fork survey route (6.4 km) in western Wyoming, 1991-2011. [a] indicates an average over only two years.

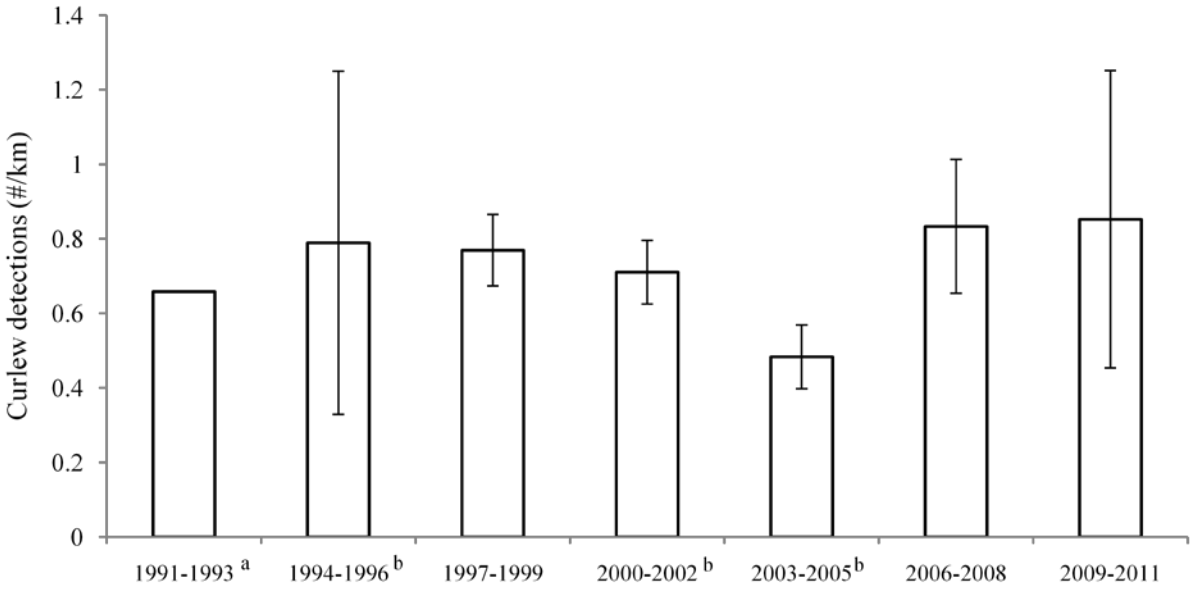

Figure 4. Three-year average (±SE) of number of Long-billed Curlews (*Numenius americanus*) detected per km along the Grand Teton National Park (GTNP) Hayfields survey route (15.2 km) in western Wyoming, 1991-2011. [a] indicates only one survey in the three-year span; [b] indicates an average over only two years.

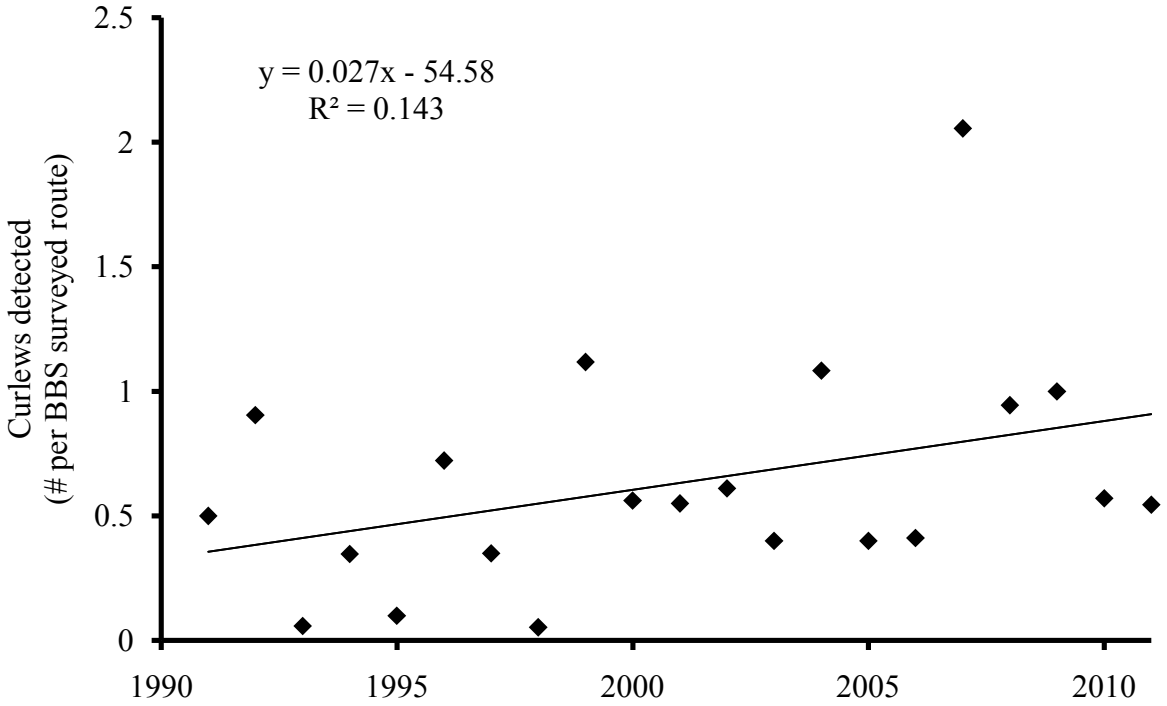

Figure 5. Average number of Long-billed Curlews (*Numenius americanus*) detected per Breeding Bird Survey (BBS) route in Wyoming, 1991-2011. Only routes that have resulted in a curlew detection since surveys were initiated in Wyoming in 1968 were included. The trendline is shown for reference.

EVALUATION OF IMPACTS OF WIND ENERGY DEVELOPMENT ON NESTING GRASSLAND BIRDS

NONGAME BIRDS: Species of Greatest Conservation Need – Grassland Birds

FUNDING SOURCE: United States Fish and Wildlife Service State Wildlife Grants

PROJECT DURATION: Master's Thesis Research

PERIOD COVERED: 1April 2011 – 31 March 2012

PREPARED BY: Anika Mahoney, Wyoming Cooperative Fish and Wildlife Research Unit
Anna Chalfoun, Wyoming Cooperative Fish and Wildlife Research Unit

SUMMARY

The following is a summary of a Master of Science thesis project from the Wyoming Cooperative Fish and Wildlife Research Unit. To access the entire thesis, contact the Department of Zoology and Physiology, Biological Science Building Room 419, 1000 East University Avenue, Department 3166, Laramie, WY, 82071, (307)-766-5415.

We conducted a total of 62 avian point-count transects consisting of 484 point locations across three wind farms, High Plains/McFadden Ridge, Seven Mile Hill, and Foote Creek Rim. We detected approximately 60 bird species, including Wyoming Species of Greatest Conservation Need (SGCN), which consisted of both migrants utilizing wind farms as migratory stop-over sites and local breeders. We also used nest searching methods such as rope-dragging, random and systematic walking, and behavioral observation at two wind farms. We observed 111 nests of 7 species of birds that reached the egg-laying stage at varying distances from wind turbines. Of the 111 nests, 103 nests belonging to 3 species including 1 SGCN were found in numbers adequate to facilitate analyses. We measured habitat characteristics at all nest sites and at half of the point count locations.

We conducted preliminary analyses and presented our results at the University of Wyoming student seminar series (Nov 2011), the national meeting of The Wildlife Society (Nov 2011), and the Wyoming Chapter meeting of The Wildlife Society (Dec 2011).

For the second season of field research, we worked to refine our study design to examine potential differences in the abundance, diversity, and nesting productivity of breeding grassland birds at sites with and without wind energy development and along a spatial gradient of proximity to wind energy development. We added an additional wind farm, Dunlap Ranch, to the three wind farms we surveyed previously. Based upon our results during the first field season, we will survey a greater distance from turbines (i.e., from 500 meters to 1km) during our

second field season. We will also incorporate two control sites using a deductive model based on habitat and geographical features in ArcGIS 10 (Environmental Systems Research Institute, Redlands, CA, USA). We plan to train four field technicians May 2012. We will conduct surveys during the first portion of the field season (i.e., May–June), and we will conduct nest searching and monitoring throughout the breeding season (i.e., May–early August). We will also conduct habitat sampling at nests and paired sites after nest fate has been established.

MECHANISTIC STUDY OF ENERGY DEVELOPMENT IMPACTS TO SONGBIRDS

STATE OF WYOMING

NONGAME BIRDS: Species of Greatest Conservation Need - Sagebrush Obligate Songbirds – Brewer's Sparrow, Sage Sparrow, Sage Thrasher

FUNDING SOURCE: United States Fish and Wildlife Service State Wildlife Grants

PROJECT DURATION: Master's Thesis Research

PERIOD COVERED: April 4 2011 – April 4 2012

PREPARED BY: Matthew G. Hethcoat, Wyoming Cooperative Fish and Wildlife Research Unit
Anna D. Chalfoun, Wyoming Cooperative Fish and Wildlife Research Unit

SUMMARY

The following is a summary of a Master of Science thesis project from the Wyoming Cooperative Fish and Wildlife Research Unit. To access the entire thesis, contact the Department of Zoology and Physiology, Biological Science Building Room 419, 1000 East University Avenue, Department 3166, Laramie, WY, 82071, (307)-766-5415.

In response to significant trends in sagebrush-obligate songbird nest predation identified in a Wyoming Game and Fish Department-funded project that was completed in 2010 (Gilbert and Chalfoun 2011). This project is a follow-up study to identify specific mechanisms driving the observed increases in nest predation associated with energy development proximity and density.

We conduct the first of two seasons of field research from 9 May 2011 to 15 August 2011. We established 12 plots for nest-searching that spanned the gradient of oil well densities (wells/km^2) within the study area. We monitored over 300 nests, 284 of which belonged to our 3 focal species, Brewer's sparrow (n =147), sage sparrow (n =59), and sage thrasher (n =78). Nest success decreased with increasing well densities for sage thrashers and sage sparrows, while nest survival for Brewer's sparrows remained constant. We deployed 60 nest cameras throughout the season and observed 7 predation events, including predators such as the Wyoming ground squirrel, unknown chipmunk species, badger, raccoon, and loggerhead shrike. We conducted nearly 400 avian predator point count surveys, 90 diurnal predator surveys, and we maintained 70 scent stations for nocturnal predators. We measured habitat metrics at nest sites and at a paired random site within each territory in order to address questions relating to which factors are important in affecting nest survival, as well as selection preferences for nest sites among our focal species.

In November 2011we presented our preliminary analyses in a poster presentation at the 2011 national meeting of The Wildlife Society in Kona, Hawaii. In addition, we gave an oral presentation at the Wyoming Wildlife Society chapter meeting in Jackson, Wyoming in December 2011. Most recently, we met with colleagues and collaborators to incorporate comments and suggestions into the 2012 methods.

In the coming months we will 1) hire field technicians to assist with data collection; 2) acquire necessary field equipment and procure housing for the 2012 field season; 3) update collaborators and colleagues at the Wyoming Landscape Conservation Initiative (WLCI) Science Workshop in May; and 4) present some of our initial result from 2011 at an international ornithological conference in Vancouver, British Columbia in August.

LITERATURE CITED

Gilbert, M.M. and A.D. Chalfoun. 2011. Energy development affects populations of sagebrush songbirds in Wyoming. Journal of Wildlife Management 75:816-824.

SPECIES OF GREATEST CONSERVATION NEED – *MAMMALS*

INVENTORY OF BATS IN FORESTS OF SOUTHEASTERN WYOMING: MIST NETTING

STATE OF WYOMING

NONGAME MAMMALS: Species of Greatest Conservation Need – Bats

FUNDING SOURCE: United States Fish and Wildlife Service State Wildlife Grant Projects and Wyoming State Legislature General Fund Appropriations

PROJECT DURATION: 1 July 2010 – 30 June 2012

PERIOD COVERED: 15 April 2011 – 14 April 2012

PREPARED BY: Becky Abel, Nongame Biologist
Martin Grenier, Nongame Mammal Biologist

ABSTRACT

Wyoming hosts 12 species of resident bats, 10 of which are recognized as Species of Greatest Conservation Need by the Wyoming Game and Fish Department. Prior to 2008, inventories for bats throughout forests of Wyoming were lacking, limiting our understanding and ability to effectively manage populations of and habitats for bats. Recently, however, the Wyoming Game and Fish Department has invested resources in inventorying forests of Wyoming for bats, which has resulted in novel data on several species. In 2011, we completed an inventory of bats that occur in forests of eastern Wyoming. We used mist nets to survey forests of southeastern Wyoming to document distribution, relative abundance, and diversity of bat species. We captured 427 individuals, representing 10 species, on 40 survey grids. In addition to eight resident species, our captures included two peripheral species, the eastern red bat (*Lasiurus borealis*) and Yuma myotis (*Myotis yumanensis*). Consistent with previous reports in Wyoming, male captures were overrepresented, likely due to sexual segregation during the reproductive season. Improving our understanding of distribution and abundance of bats associated with forests in Wyoming is essential for conservation planning, species status review, facilitating management responses to white-nose syndrome in Wyoming, and minimizing potential impacts to bats from large-scale habitat changes due to logging, fire suppression, bark beetle infestation, and energy development.

INTRODUCTION

Bats (Order: Chiroptera) comprise nearly 20% of mammalian species worldwide. Indeed, there are an estimated 1,232 species of bats occupying a variety of ecological niches (Kunz et al. 2011). There are at least 45 species of bats that occur in North America (O'Shea and Bogan 2003), and 18 insectivorous species of bats have been documented in Wyoming (Hester and Grenier 2005). Over half of North American bats either exclusively or opportunistically use forests for roosting (Kunz and Lumsden 2003, Barclay and Kurta 2007, Brigham 2007) and foraging (Abel 2011). Survival of bats in forests depends on the availability of suitable roosting sites such as caves, crevices, trees, and foliage and adequate foraging sites such as forest edges, interiors, and clearings (Lacki et al. 2007). Of equal importance are forested bodies of water with abundant insect prey (Grindal and Brigham 1999).

There is growing concern over the status of populations of bats within the United States (Ellison et al. 2003). Insectivorous bats are difficult to study due to their small size and nocturnal, volant behavior, thus making conservation and management of insectivorous bats more challenging (Kunz and Racey 1998). Additionally, bats are vulnerable to rapid declines in abundance due to low reproductive rates and specialized behaviors (O'Shea and Bogan 2003). Bats and their prey are potentially losing habitat throughout forests of Wyoming due to logging, fire suppression, and bark beetle infestation (Hester and Grenier 2005). Development of wind energy poses an even greater challenge to the conservation of some species of bats (Kunz et al. 2007, Baerwald et al. 2008). Additionally, the most recent threat to the survival of species of North American bats is the fatal white-nose syndrome (WNS), which is causing major declines in abundance of bats that hibernate in caves and abandoned mines in the eastern United States. Species of bats common in forests of Wyoming, such as the little brown bat (*Myotis lucifugus*) and big brown bat (*Eptesicus fuscus*), have been found to be susceptible to WNS (Abel and Grenier 2011). The decline in the abundance of bats could have far-reaching consequences, as bats are essential to maintaining functional ecosystems through the suppression of both naturally occurring and human-generated populations of pest insects (Kunz et al. 2011).

Of the 18 species of bats in Wyoming, 12 are considered residents for at least part of the year (Hester and Grenier 2005; Table 1). Ten resident species and one peripheral species have been designated as Species of Greatest Conservation Need (SGCN) by the Department (WGFD 2010; Table 1). Prior to 2008, inventories for bats throughout forests of Wyoming were lacking. This has constrained our ability to manage bats and their habitats effectively in previous years (Hester and Grenier 2005).

Our objectives in 2011 were to collect data on distribution, relative abundance, and diversity of bat species that occur in forests of southeastern Wyoming. This included collecting data on demography such as reproductive status, sex ratios, and age structure as well as morphometric measurements of individuals. This project was completed concurrently with an acoustic inventory of bats in southeastern Wyoming (Abel and Grenier 2012). This is the second year of a two-year project focused on surveying bats that are associated with forests of eastern Wyoming. In addition to the results from this year's efforts, we summarize findings from the previous four years of the statewide inventory project in Wyoming, spanning 2008 to 2011.

METHODS

We used Geographic Information Systems (ArcGIS v9.3, Environmental Systems Research Institute, Redlands, CA, USA) and the Bat Grid system (P. Ormsbee, pers. comm.) to identify potential survey grids in eastern Wyoming. To achieve this, we digitally overlaid 100 km^2 survey grids with ecological system vegetation layers (by NatureServe from existing GAP and ancillary data) and identified all survey grids that contained at least 40% forested habitat. We randomly selected 100 survey grids from all available survey grids in eastern Wyoming. In 2011, we focused our surveys on those grids in southeastern Wyoming. While in the field, we identified specific netting locations within each grid based on 1) habitat features that encouraged concentration of bats such as water sources, flyways, and roosting areas, 2) accessibility to site by personnel, and 3) the ability to effectively capture bats with mist nets at the site (Hester and Grenier 2005). If accessible and effective netting locations were not available in a pre-selected survey grid, we selected a suitable replacement site in an adjacent grid.

Personnel worked in crews of two and used mist nets (Avinet, Inc., Dryden, NY) to capture bats from late May to early September 2011. We used various configurations to position mist nets depending on the type, size, and configuration of targeted habitat and the surrounding landscape. Mist nets were set roughly 0.5 m above ground level and varied in length from 2.6 to 18 m. We used a combination of single, 2.6 m tall nets and triple-high nets that were 7.8 m tall to optimize the potential for bat captures. We opened nets ≤30 min after civil sunset and kept them open 2.5–3 hrs after sunset. If precipitation, lightning, or wind ≥7 mph was present, we closed nets and ended the survey. We developed the above methods in reference to those outlined by Abel and Grenier (in press).

We promptly removed all captured bats from nets and processed individuals at the site. We recorded species, sex, age, and reproductive status for all captured bats. We classified bats as adult or juvenile based on the ossification of epiphyseal plates in phalanges (Brunet-Rossinni and Wilkinson 2009). Reproductive status for females was determined by palpation of the abdomen to determine pregnancy and examination of mammary glands to determine lactation or post-lactation. We collected additional measurements on forearm length, ear length, and weight. We released bats at the netting site immediately after recording data, ≤30 min from time of capture.

We recorded additional information at each netting site regarding the location and conditions present during each nightly survey. We recorded our location and elevation with a GPS unit (GPSMap 76S, Garmin International, Inc., Olathe, KS, USA) in datum NAD 83. We recorded other survey characteristics: diagrams of net configurations, surrounding vegetation species and description, and weather conditions including temperature, wind speed, and cloud cover at the start and end of each survey. We adhered to all WNS decontamination protocols outlined in Abel and Grenier (2011).

RESULTS

We successfully surveyed 45 grids in southeastern Wyoming (Fig. 1). One survey grid (Grid 66) was inadvertently surveyed twice (Fig. 2). Two additional grids that were surveyed the

previous year in northeastern Wyoming (Grids 33 and 36) were surveyed a second time to maximize the potential of encountering and gathering data on the northern myotis (*Myotis septentrionalis*), for which the Department lacks records.

We conducted the majority of mist net surveys in montane and subalpine forest, consisting of lodgepole (*Pinus contorta*) and limber pine (*P. flexilis*), Engelmann spruce (*Picea engelmannii*), and subalpine (*Abies lasiocarpa*) and Douglas-fir (*Pseudotsuga menziesii*). Quaking aspen (*Populus tremuloides*) stands were also present in many survey grids. Less frequently, we conducted surveys in xeric and lower montane forests consisting of ponderosa (*Pin. ponderosa*) and limber pine with juniper (*Juniperus* spp.) and sagebrush (*Artemisia* spp.). The netting locations we chose had an average (±SE) elevation of 2,471 m (±71 m). In contrast, the netting locations in northeastern Wyoming in 2010 had an average elevation of 1,910 m (±96 m). We suspended nets in multiple configurations over a variety of ephemeral and perennial water bodies including artificial and natural ponds, creeks and rivers, and portions of lakes or reservoirs. Additionally, we suspended nets across flight corridors that were adjacent to bodies of water. We used an average of 38.3 m (±2.9 m) of mist nets for 3.2 hrs (±0.1 hrs) per survey to capture bats.

We captured 427 bats representing 8 resident and 2 peripheral species (Table 1) in 40 of the 47 grids during the survey in 2011 (Table 2). On average, we captured 9.1 (±1.5) bats during each survey. The range of bats captured in an evening spanned 0 to 53 individuals (Table 2). The most common species captured were the little brown myotis (*M. lucifugus*; 31.6%), long-legged myotis (*M. volans*; 21.5%), silver-haired bat (*Lasionycteris noctivagans*; 16.9%), and big brown bat (*Eptesicus fuscus*; 10.5%). We captured all other species and undetermined species at rates <10% (Table 2). For all species combined, we captured more males than females (Table 3). The majority of the captured bats were non-reproductive adults (71%), while only 14% were reproductive females that were pregnant, lactating, or post-lactating, 5% were males with descended testes, and 10% were juveniles (Table 3). Means of standard morphometric measurements including forearm length, ear length, and weight, are reported for each species in Table 4.

Bat captures were well-distributed throughout the study area. Activity of bats, as measured by the mean number of captures per net meter hour, was highest in the Black Hills followed by the Sierra Madre Mountains and the Laramie Mountains (Table 5). Conversely, activity of bats was lowest at sites in the Shirley Mountains, followed by the Medicine Bow Mountains, and Green Mountains (Table 5). Generally, the diversity of bats followed a similar pattern to activity of bats, with the highest number of species captured at sites in the Black Hills and the lowest at sites in the Shirley Mountains (Table 5). Activity and diversity of bats in each survey grid is illustrated in Figures 3 and 4, respectively.

Several captures resulted in updates to the Department's Atlas of Birds, Mammals, Amphibians, and Reptiles in Wyoming (Orabona et al. 2012). We recorded new occurrences in latilong degree blocks for eastern red bats (*Lasiurus borealis*), silver-haired bats, long-eared myotis (*M. evotis*), long-legged myotis, and Yuma myotis (*M. yumanensis*; Table 6). We updated reproductive status in latilongs for big brown bats, hoary bats, silver-haired bats, long-eared myotis, little brown myotis, fringed myotis (*M. thysanodes*), long-legged myotis, and

Yuma myotis (Table 6). Maps of individual species' capture distributions are shown in Figures 5-14.

During the course of this project from 2008 to 2011, we surveyed 186 forested locations state-wide representing 170 survey grids for bats (Fig. 15). Accordingly, we captured a total of 1,289 individual bats representing 12 species (Table 6). In forests of Wyoming, little brown myotis were the most common species captured (34.8%), followed by silver-haired bats (21.8%), big brown bats (11.9%), and long-legged myotis (11.9%). The remainder of species we captured during the statewide inventory included spotted bats (*Euderma maculatum*), eastern red bats, hoary bats (*Lasiurus cinereus*), western small-footed myotis (*M. ciliolabrum*), long-eared myotis, northern myotis, fringed myotis, and Yuma myotis. Surveys resulted in novel additions and updates to the Department's Atlas for 11 of the 12 species captured (Johnson and Grenier 2010, Cudworth et al. 2011).

DISCUSSION

All captured species in this study have been previously documented in forested habitats throughout North America (Lacki et al. 2007). We were not successful in capturing 4 of 12 resident species in 2011. Townsend's big-eared bats (*Corynorhinus townsendii*) are adept at avoiding capture in nets (O'Farrell and Gannon 1999). Pallid bats (*Antrozous pallidus*) are more commonly associated with lower elevation habitat (Hester and Grenier 2005). Spotted bats are closely associated with cliffs and rough, semi-arid terrain (Adams 2003). The northern myotis occurs only in extreme northeastern Wyoming (Hester and Grenier 2005). We also captured the eastern red bat and Yuma myotis; two species classified as peripheral in Wyoming.

We captured a different assemblage of species in southeastern Wyoming than reported in northeastern Wyoming in 2010 (Cudworth et al. 2011). Similar to results from 2010, little brown myotis comprised a third of all captured species. However, we captured disproportionately more long-legged myotis than in 2010. Long-legged myotis are thought to be associated with montane, coniferous forests, and individuals within the continental portion of their range are usually found between 2,000 and 3,000 m (Warner and Czaplewski 1984). Netting locations we chose during the survey in 2011 were within the suitable range for long-legged myotis, thus possibly contributing to the greater abundance, whereas netting locations in northeastern Wyoming in 2010 were lower in elevation than the suitable range for this species.

We captured males twice as often as females, consistent with previous reports. Sexual segregation of bats is common during the reproductive season, with females commonly found at lower elevations and males at higher elevations (Speakman and Thomas 2003). Lower elevations are associated with warmer temperatures, which may result in increased production, increased thermoregulatory ability, and decreased energy expenditure for females during energetically costly gestation and lactation stages (Cryan et al. 2000). Males more often utilize torpor as a means of conserving energy during the summer months and would benefit from higher elevations and cooler temperatures (Speakman and Thomas 2003). This sexual segregation by altitude may be responsible for the male-biased captures recorded in this and

previous studies in Wyoming, as our survey grids and netting locations tended towards higher-elevation forests.

When comparing results between years and among sites, we cannot rule out the influence of annual variation in weather patterns and prey availability on activity and reproduction of bats. Variations in weather conditions, intra-seasonal behavior, prey availability, and netting locations may also cause noticeable differences on success of captures for each survey night (Hester and Grenier 2005). We attempted to distribute surveys throughout the study area over the course of the summer. Even so, surveys in some areas of southeastern Wyoming were completed in a short window of time. For example, surveys in the Shirley and Green Mountains were completed early in the season; timing of the survey and temperature may account for the low diversity and activity of bats we observed during those surveys. Conversely, sites in the Black Hills were completed late in the season when temperatures were warmer and young of the year were volant, thus possibly contributing to the higher activity and diversity we observed. This inventory encompassed a large geographic area in a relatively short time period, which should be considered when interpreting results. It is difficult to assess the exact distribution, relative abundance, and diversity of bat species in forests of southeastern Wyoming since replication of surveys was not usually feasible. Nevertheless, since inventories for bats in forests of Wyoming were lacking prior to 2008, this updated information is significant and beneficial to increasing our current understanding of future management and inventory needs.

Current management practices may affect habitat in forested landscapes that bats use for foraging or roosting. Many recent studies have evaluated habitat use throughout different forested regions of North America. Conducting localized studies on bat species of interest within regions is particularly important, as results obtained from these projects are often species- and site-specific. The completion of this project has greatly improved our understanding of distributions for many species of bats and also resulted in novel additions to the Department's Atlas of Birds, Mammals, Reptiles, and Amphibians in Wyoming (Filipi et al. 2009, Johnson and Grenier 2010, Orabona et al. 2012). Additionally, over 1,200 observational records were added to the Department's Wildlife Observation System (WOS). With a better understanding of the distribution, relative abundance, and diversity of bat species associated with forests in Wyoming, we can begin to investigate further how forested bat habitat may change in the presence of logging, fire suppression, mountain pine beetle infestations, and energy production in Wyoming (Hester and Grenier 2005).

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Table 1. Species of bats that are known to occur in Wyoming with number captured during the 2011 survey. Status of residency for bats are represented with the following abbreviations, R = resident (year-round or seasonal); P = peripheral; A = accidental occurrence, as identified by Hester and Grenier (2005). Native Species Status (NSS) of Species of Greatest Conservation Need for bats are 2, 3, 4, or U, as identified in the species accounts of the State Wildlife Action Plan (WGFD 2010).

Scientific Name	Common Name	Resident Status	Native Species Status (NSS)	Captures in 2011
Antrozous pallidus	Pallid bat	R	NSS3	0
Corynorhinus townsendii	Townsend's big-eared bat	R	NSS2	0
Eptesicus fuscus	Big brown bat	R	NSS4	45
Euderma maculatum	Spotted bat	R	NSS3	0
Lasiurus borealis	Eastern red bat	P	NSSU	1
Lasiurus cinereus	Hoary bat	R		18
Lasionycteris noctivagans	Silver-haired bat	R		72
Myotis californicus	California myotis	P		0
Myotis ciliolabrum	Western small-footed myotis	R	NSS4	5
Myotis evotis	Long-eared myotis	R	NSS3	26
Myotis lucifugus	Little brown myotis	R	NSS4	135
Myotis septentrionalis	Northern myotis	R	NSS3	0
Myotis thysanodes	Fringed myotis	R	NSS3	4
Myotis volans	Long-legged myotis	R	NSS3	92
Myotis yumanensis	Yuma myotis	P		4
Nyctinomops macrotis	Big free-tailed bat	A		0
Pipistrellus subflavus	Eastern pipistrelle	A		0
Tadarida brasiliensis	Brazilian free-tailed bat	P		0

Table 2. Demographic parameters for bats captured in southeastern Wyoming, May–September 2011. Data are summarized by species. Unknown species are bats that were not identified because the individual escaped before it could be processed. Undetermined (Und.) age and reproductive status indicate that the individual was released early or escaped the handler before measurements could be taken. Reproductive status is represented by the following abbreviations: N = Non-reproductive; R = Reproductive.

Species	Sex Ratio			Age			Reproductive Status		
	M	F	Und.	Adult	Juv.	Und.	N	R	Und.
Eptesicus fuscus	29	13	3	37	4	4	22	19	4
Lasiurus borealis	0	1		1	0		1	0	
Lasiurus cinereus	12	2	4	11	3	4	12	2	4
Lasionycteris noctivagans	54	18		63	9		64	8	
Myotis ciliolabrum	3	2		5	0		5	0	
Myotis evotis	17	8	1	22	3	1	22	3	1
Myotis lucifugus	103	31	1	126	8	1	120	14	1
Myotis thysanodes	2	2		4	0		2	2	
Myotis volans	43	49		77	12	3	64	26	2
Myotis yumanensis	4	0		3	1		4	0	
Unknown Species			25			25			25
Total	267	126	34	349	40	38	316	74	37

Table 3. Means (±SE) of morphometric measurements of individual bats captured in southeastern Wyoming, May–September 2011. Data are summarized by species.

Species	Weight (g)			Ear Length (mm)			Forearm Length (mm)		
	Mean	±SE	*n*	Mean	±SE	*n*	Mean	±SE	*n*
Eptesicus fuscus	17.9	0.8	41	13.6	0.1	39	43.3	1.6	41
Lasiurus borealis	15.0	n/a	1	10.0	n/a	1	38.4	n/a	1
Lasiurus cinereus	22.8	0.6	14	13.8	0.3	12	46.3	4.5	16
Lasionycteris noctivagans	11.4	0.2	65	12.2	0.1	67	41.0	0.2	71
Myotis ciliolabrum	5.1	0.5	5	12.4	0.2	5	33.2	0.3	5
Myotis evotis	6.5	0.2	25	19.0	0.3	25	36.9	1.5	26
Myotis lucifugus	7.4	0.1	126	12.1	0.1	131	37.8	0.1	131
Myotis thysanodes	5.9	0.1	4	17.5	0.3	4	39.0	0.5	4
Myotis volans	7.8	0.2	82	11.6	0.1	85	37.1	0.8	88
Myotis yumanensis	5.8	0.1	4	14.0	0.7	4	33.6	0.4	4

Table 4. Mean results (±SE) from mist-net surveys within grids in southeastern Wyoming, May–September, 2011, organized by mountain range. Net meter hours is meters of net * hrs of survey per grid. Captures per effort is an index of activity based on the number of captures and the net meter hours per grid. The grids in each mountain range include the Black Hills: grids 33, 36; Green Mountains: grids 67-68; Laramie Mountains: grids 47-66; Shirley Mountains: grids 69-72; Sierra Madres: grids 90-100; Medicine Bow Mountains: grids 74-89.

Capture data	Black Hills (n = 2)		Green Mtns (n = 2)		Laramie Mtns (n = 16)		Shirley Mtns (n = 4)		Sierra Madres (n = 7)		Medicine Bows (n = 16)	
	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE
Total captures	31.5	21.5	5.5	5.5	9.1	2.1	1.8	0.6	10.0	2.7	8.2	2.6
Net meter hours	196.4	97.4	141.0	36.0	138.0	24.9	72.8	13.6	127.7	32.0	145.3	21.6
Captures per effort	14.1	4.0	5.2	5.2	9.9	2.9	2.6	1.1	13.9	4.5	4.9	1.4
Species captured	5.5	1.5	1.5	1.5	2.7	0.5	0.8	0.5	2.7	0.5	2.1	0.3

Table 5. Updates provided to the Atlas of Birds, Mammals, Amphibians, and Reptiles in Wyoming (Orabona et al. 2012) from surveys in southeastern Wyoming, May–September 2011. Updates are presented by latilong, based on individuals captured and summarized by species. B = Breeding, including dependent young, juvenile animals, lactating or post-lactating females, or males in breeding condition observed; O = Observed but due to mobility of the species and lack of factors listed under "B", breeding cannot be assumed; h = Historical record of occurrence before 1965, but no recent data to suggest occurrence; _ = No verified records.

Species	Latilong degree block	Current status	Updated status
Eptesicus fuscus	20, 25, 26	O	B
Lasiurus borealis	26	_	O
Lasiurus cinereus	26	O	B
Lasionycteris noctivagans	20, 21	O	B
	26	_	B
Myotis evotis	7, 19, 20	O	B
	26	_	B
Myotis lucifugus	25	O	B
Myotis thysanodes	7	O	B
Myotis volans	25	_	B
	26	h	B
	27	O	B
Myotis yumanensis	7	_	B

Table 6. Species and numbers of individuals captured during the forest inventory of bats in Wyoming, 2008-2011. Surveys in 2008 were conducted in the southwest portion of the state (Filipi et al. 2009), 2009 were in the northwestern portion (Johnson and Grenier 2010), 2010 were in the northeastern portion (Cudworth et al. 2011), and surveys in 2011 were in southeastern Wyoming (this report). Unknown species are bats that were not identified because the individual escaped before it could be processed.

Species	Number of captures				
	2008	2009	2010	2011	Total
Eptesicus fuscus	3	42	63	45	153
Euderma maculatum	0	0	2	0	2
Lasiurus borealis	0	0	4	1	5
Lasiurus cinereus	2	15	61	18	96
Lasionycteris noctivagans	9	90	110	72	281
Myotis ciliolabrum	0	7	2	5	14
Myotis evotis	8	13	3	26	50
Myotis lucifugus	45	108	161	135	449
Myotis septentrionalis	0	0	27	0	27
Myotis thysanodes	0	1	17	4	22
Myotis volans	8	10	43	92	153
Myotis yumanensis	0	0	1	4	5
Unknown species	1	5	1	25	32
Total	76	291	495	427	1,289

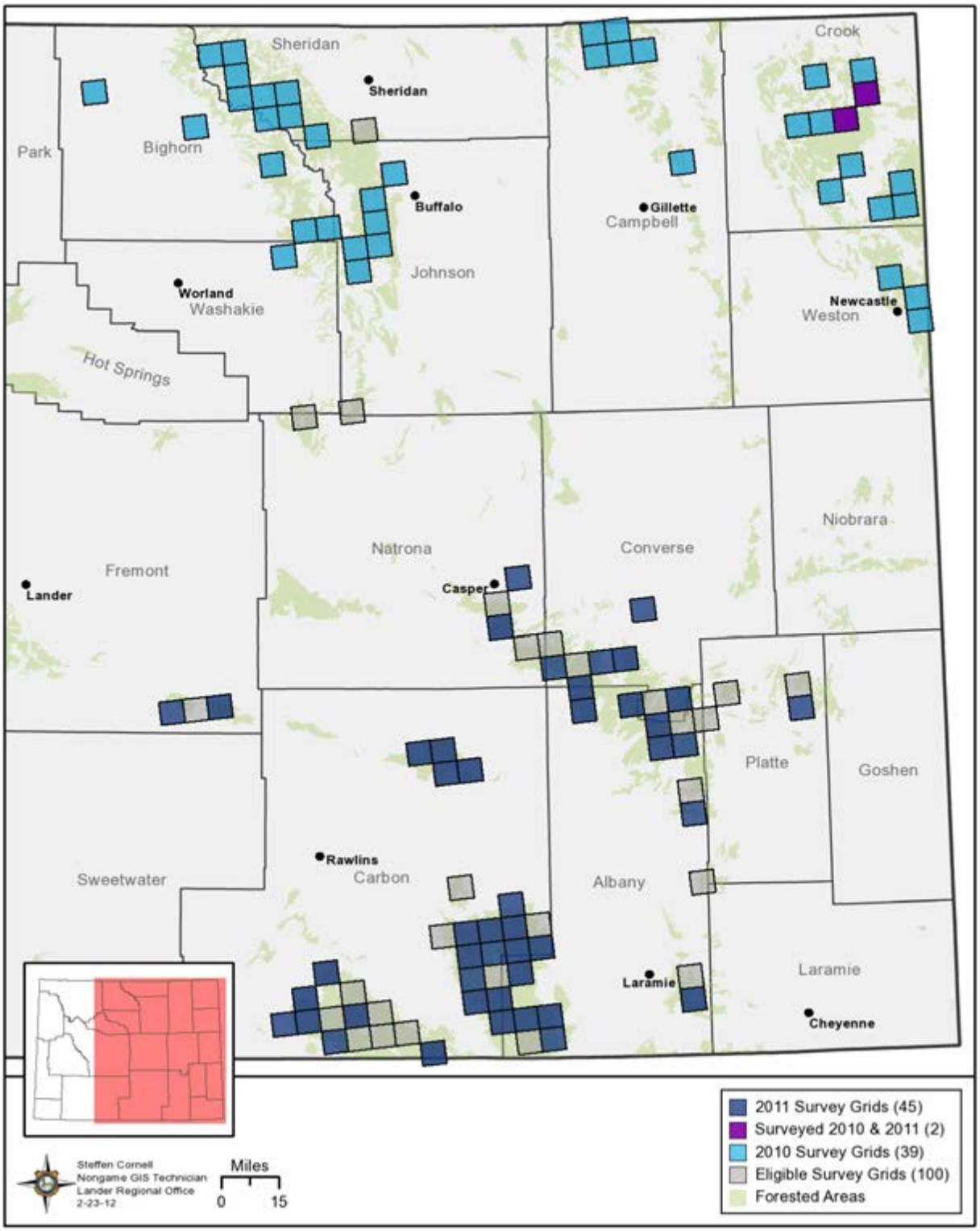

Figure 1. Location of survey grids where we attempted to capture bats in eastern Wyoming. The 2011 inventory focused on survey grids in southeastern Wyoming, while the 2010 inventory focused on northeastern Wyoming. Two survey grids were surveyed both years.

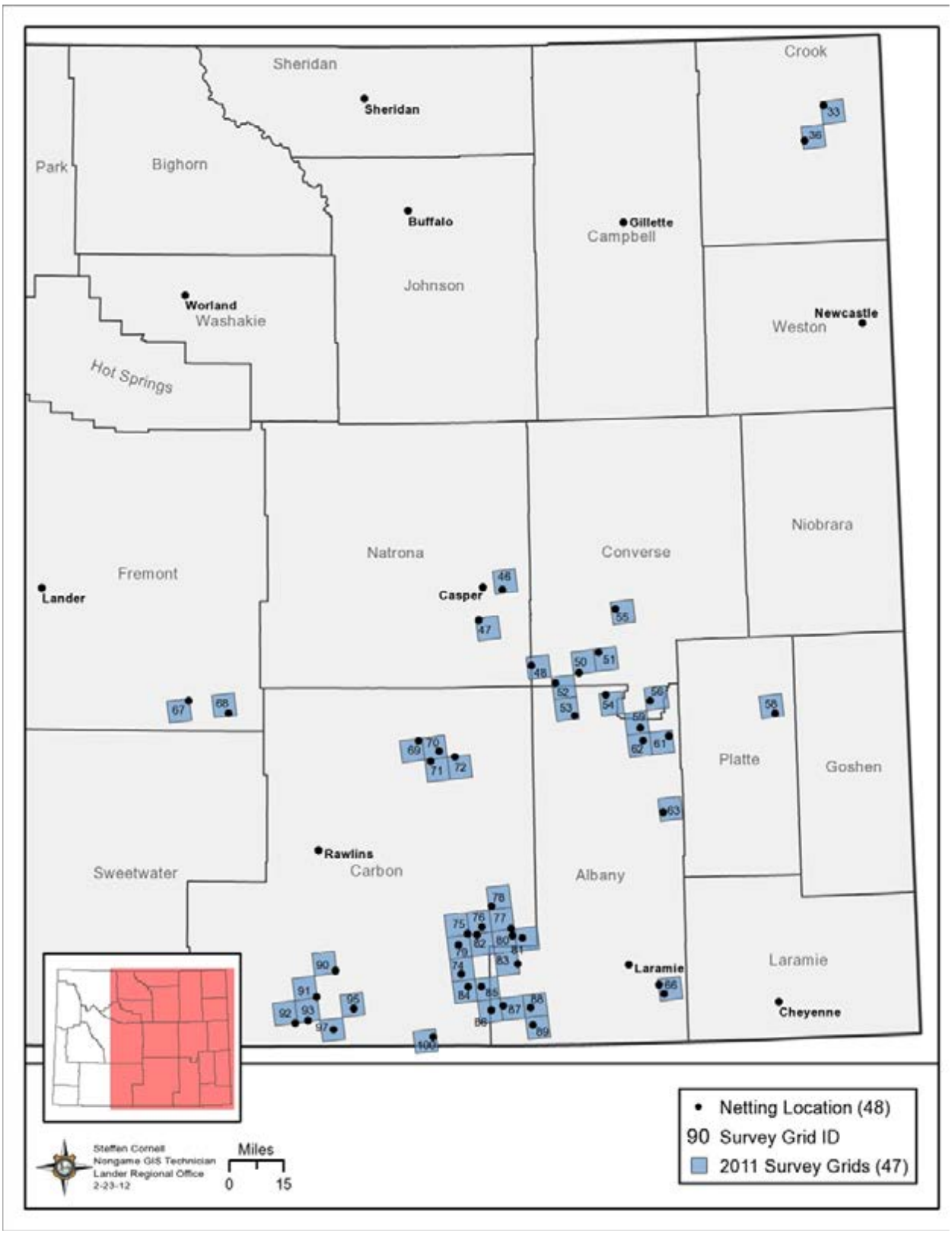

Figure 2. Point locations of surveys within grids where we attempted to capture bats in forests of eastern Wyoming, May–September, 2011. Locations are identified by arbitrarily-assigned grid numbers to facilitate tracking.

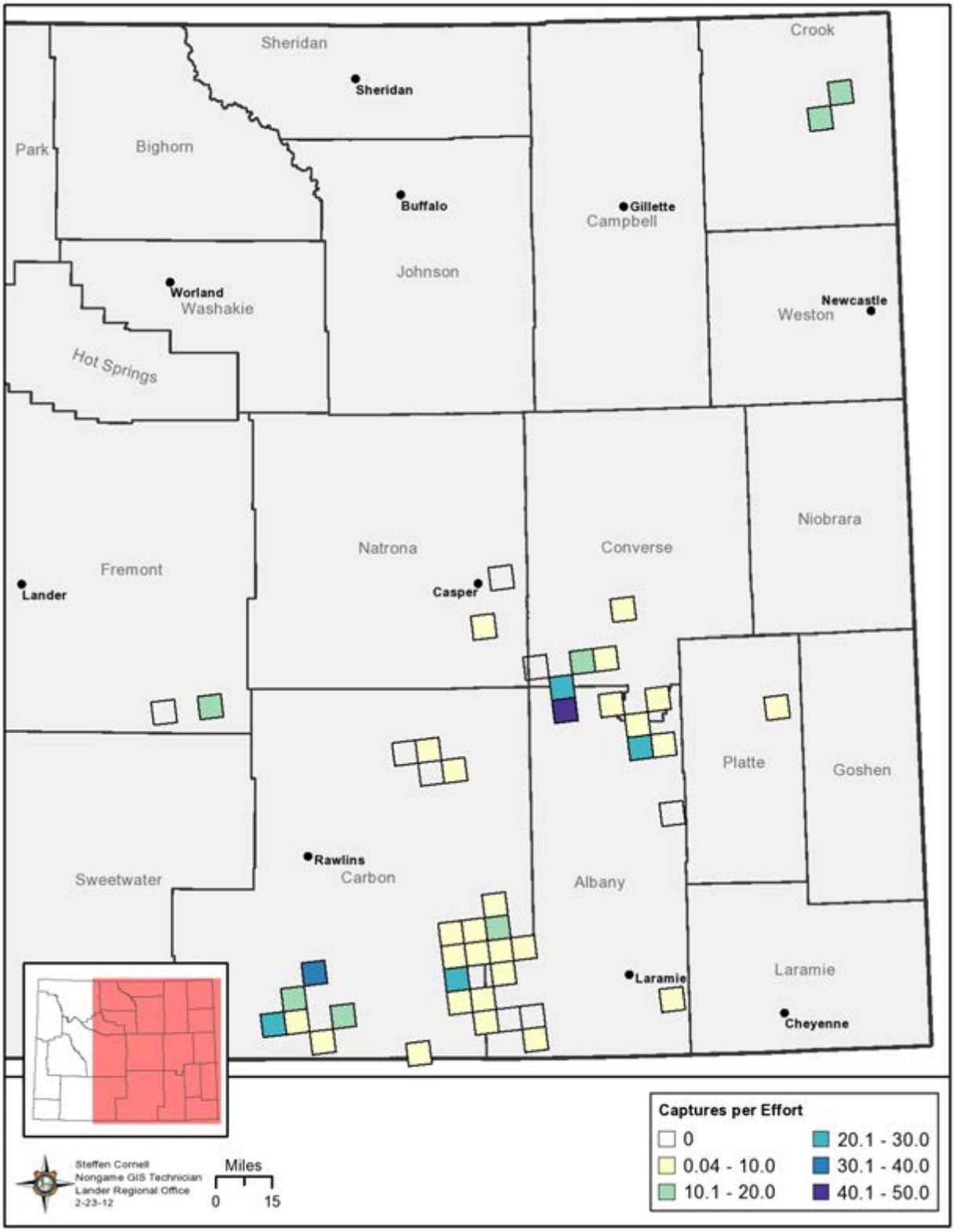

Figure 3. Number of individuals captured per unit effort for each grid surveyed in eastern Wyoming, May–September, 2011. Captures per unit effort is the number of captures per net meter hour.

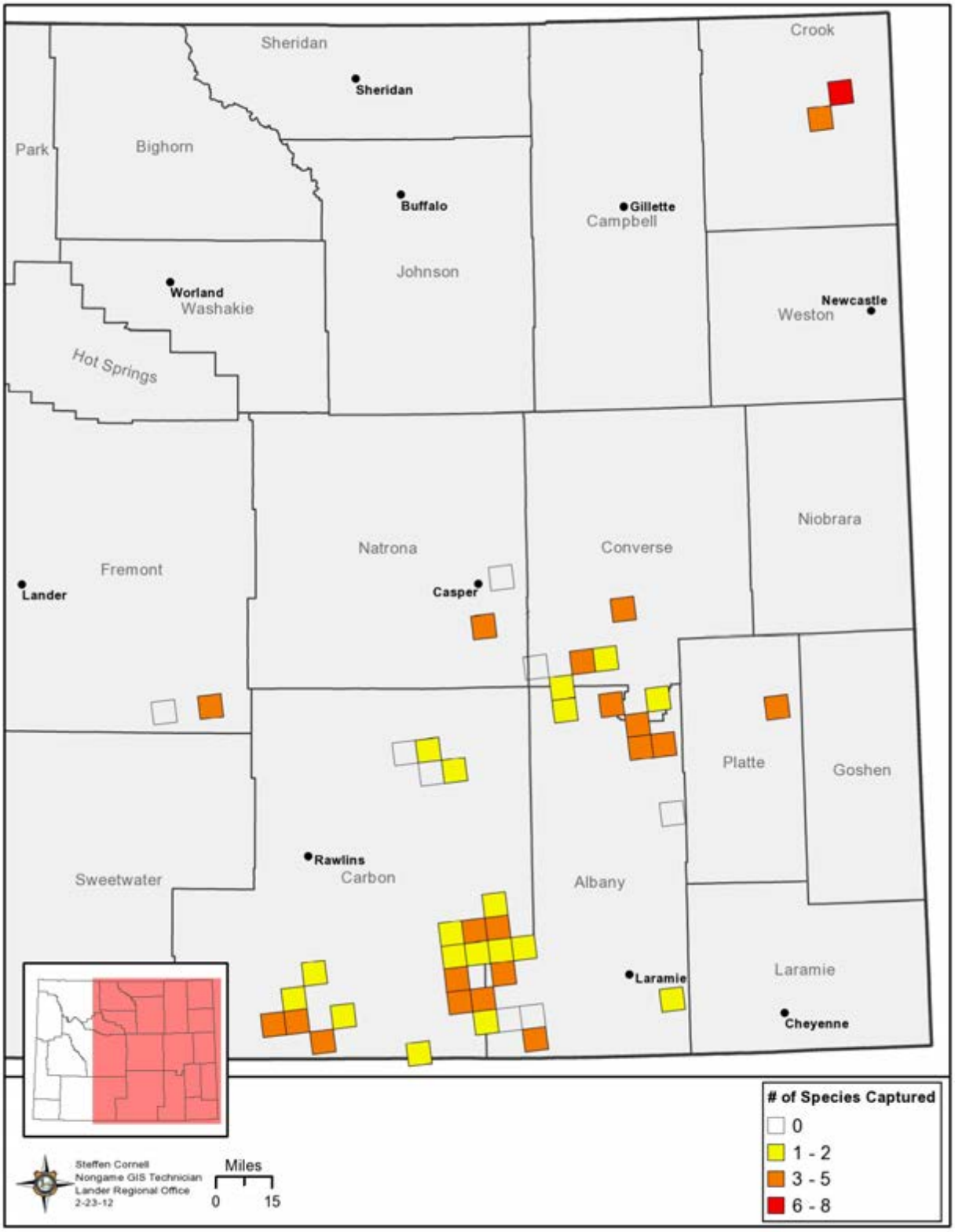

Figure 4. Diversity of species of bats captured within each grid surveyed in eastern Wyoming, May–September, 2011.

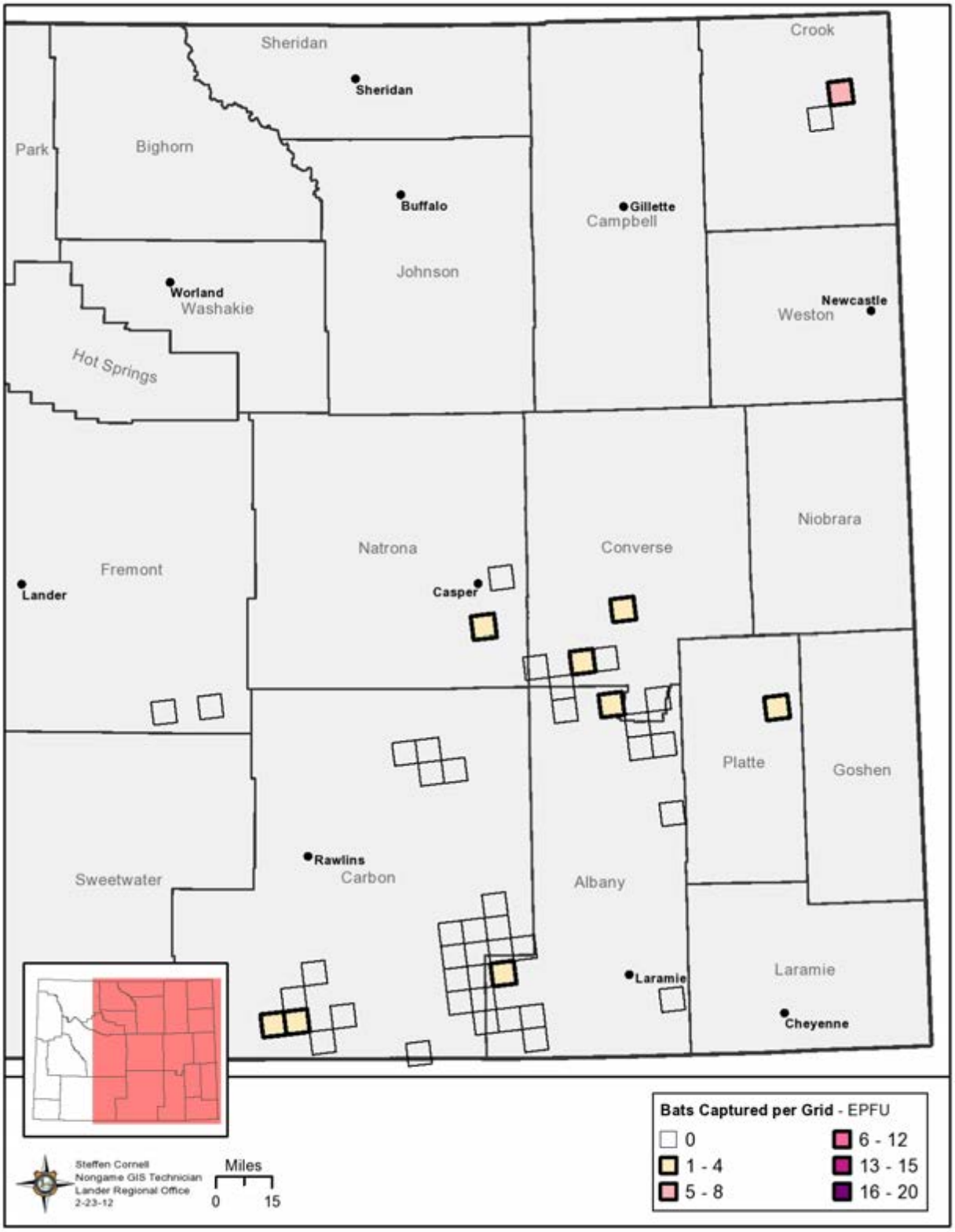

Figure 5. Number of big brown bats (*Eptesicus fuscus*) captured within each survey grid in eastern Wyoming, May–September, 2011.

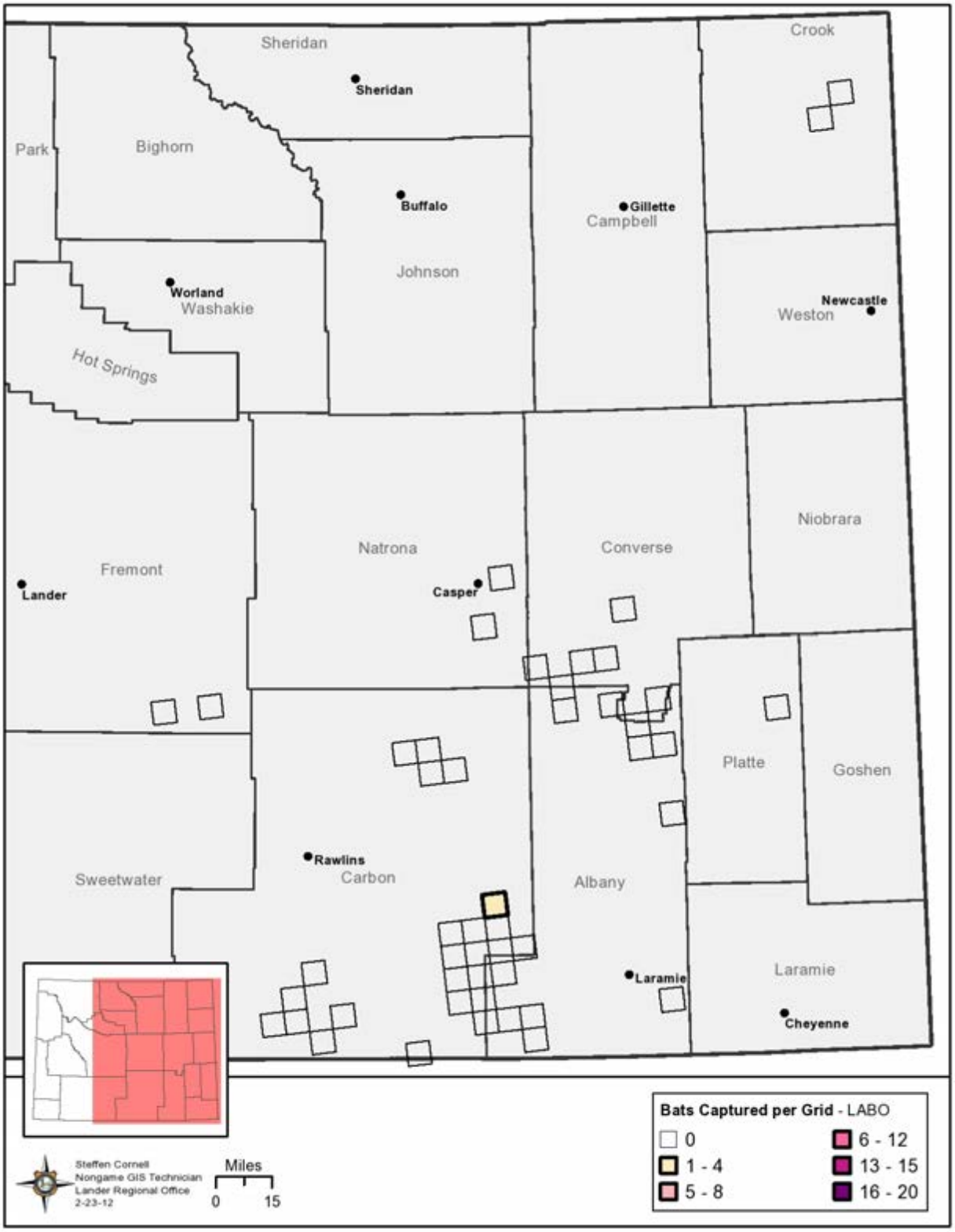

Figure 6. Number of eastern red bats (*Lasiurus borealis*) captured within each survey grid in eastern Wyoming, May–September, 2011.

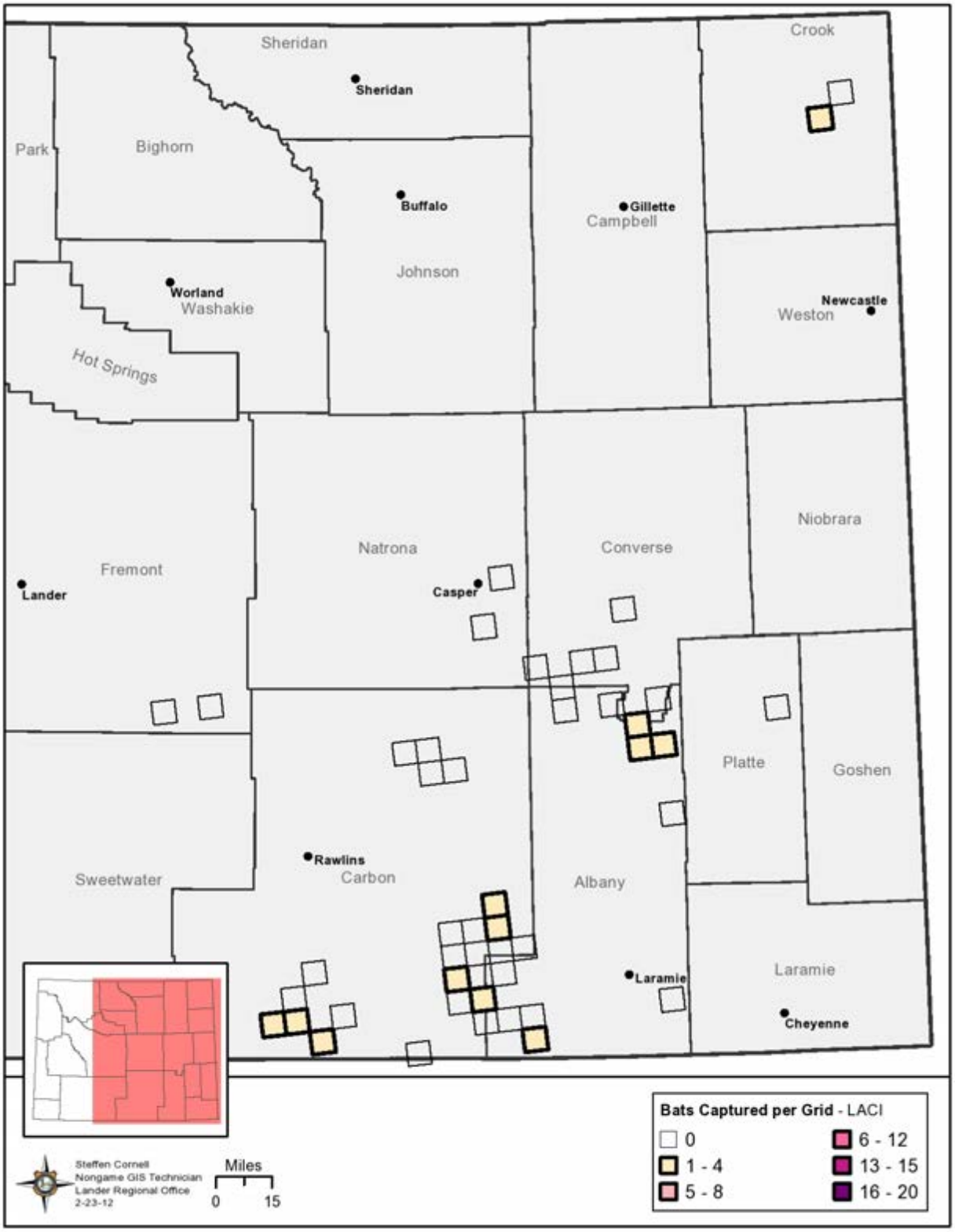

Figure 7. Number of hoary bats (*Lasiurus cinereus*) captured within each survey grid in eastern Wyoming, May–September, 2011.

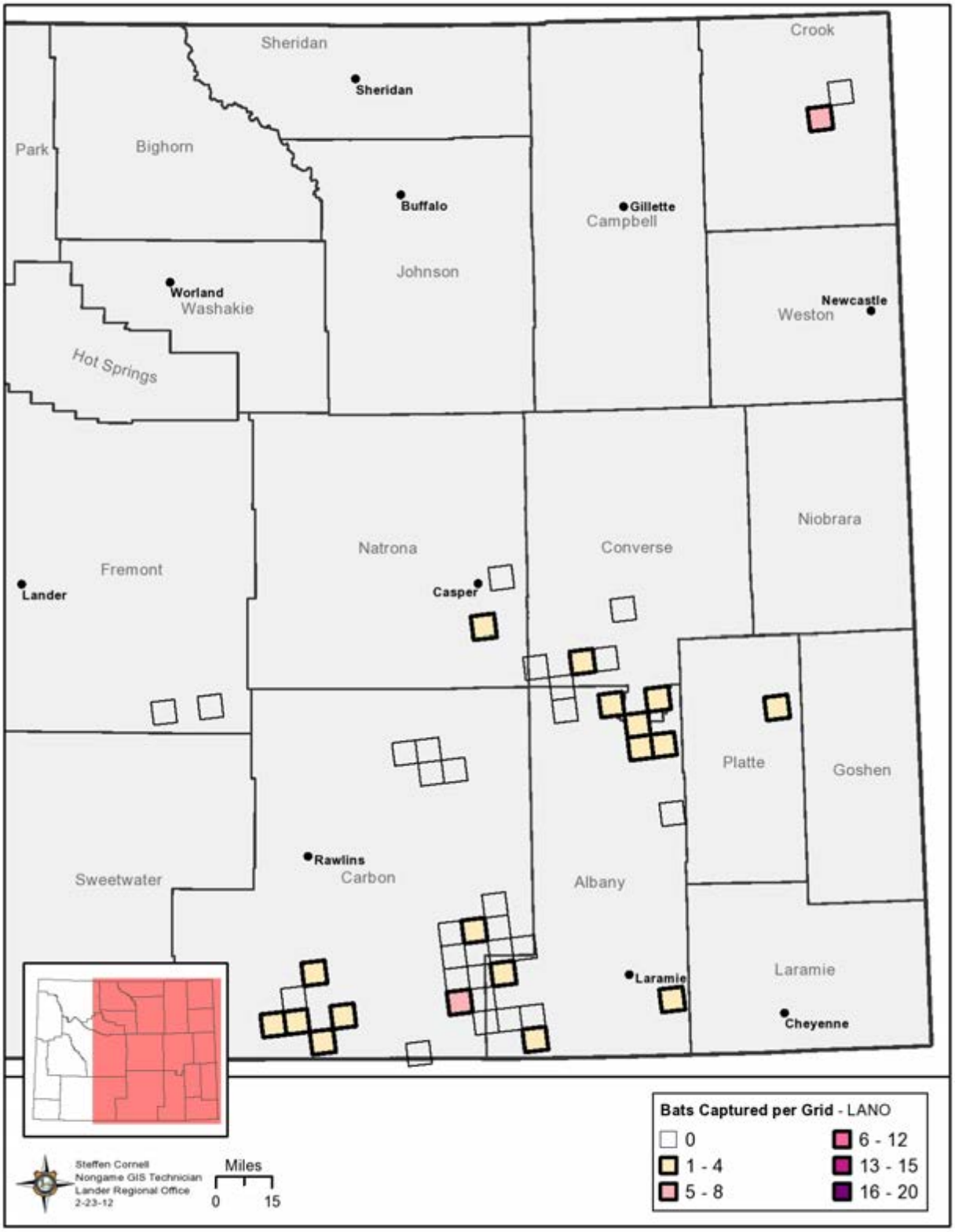

Figure 8. Number of silver-haired bats (*Lasionycteris noctivagans*) captured within each survey grid in eastern Wyoming, May–September, 2011.

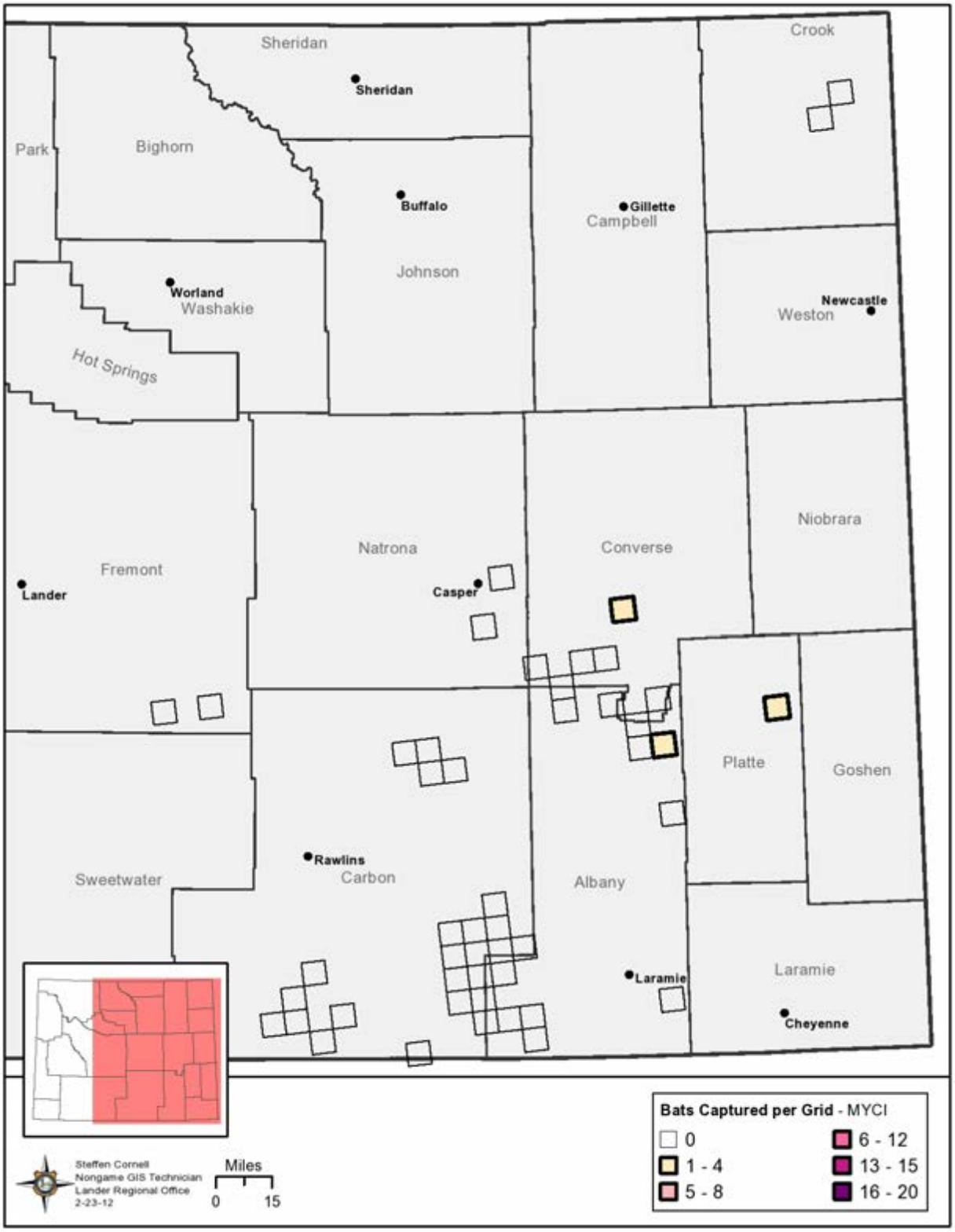

Figure 9. Number of western small-footed myotis (*Myotis ciliolabrum*) captured within each survey grid in eastern Wyoming, May–September, 2011.

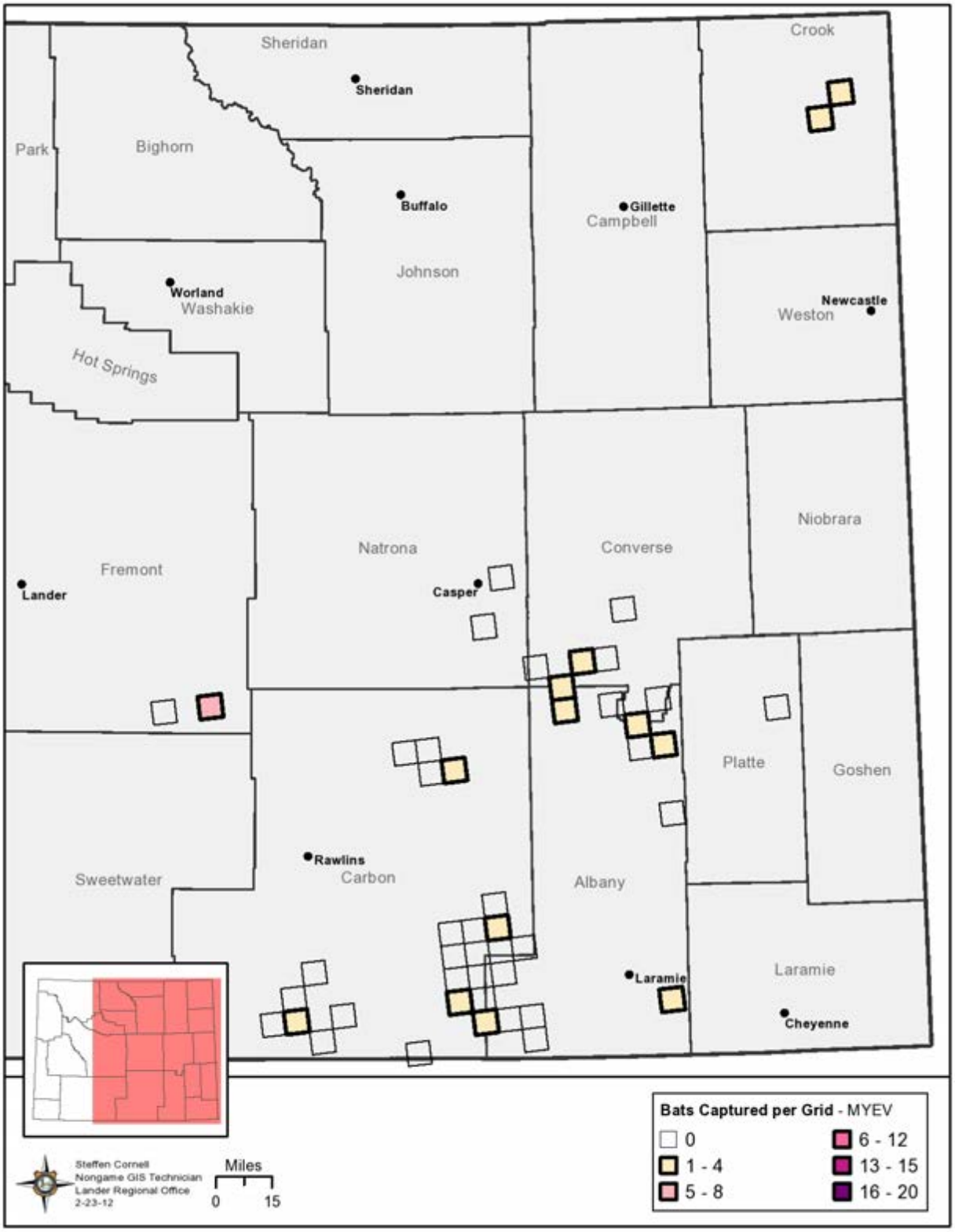

Figure 10. Number of long-eared myotis (*Myotis evotis*) captured within each survey grid in eastern Wyoming, May–September, 2011.

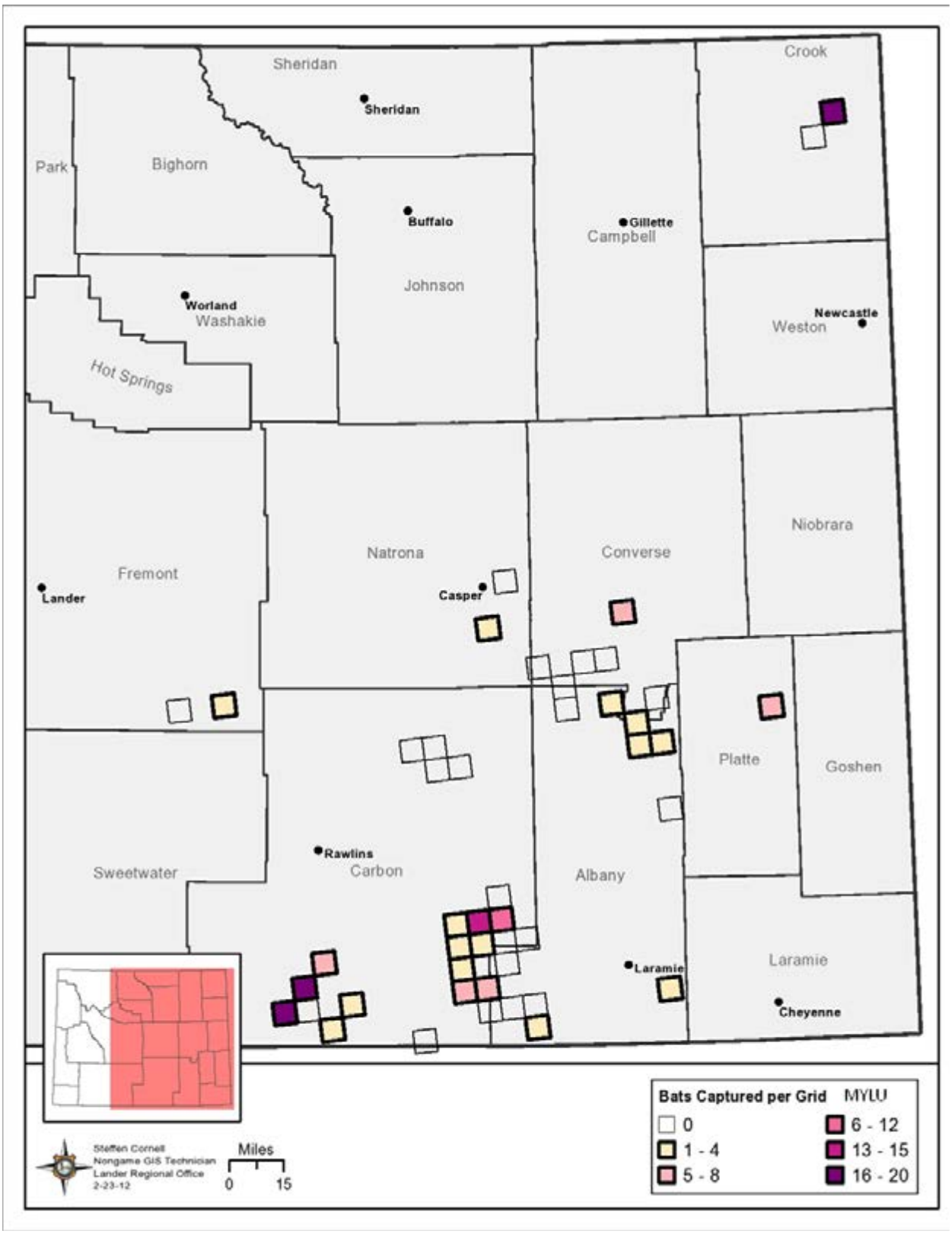

Figure 11. Number of little brown myotis (*Myotis lucifugus*) captured within each survey grid in eastern Wyoming, May–September, 2011.

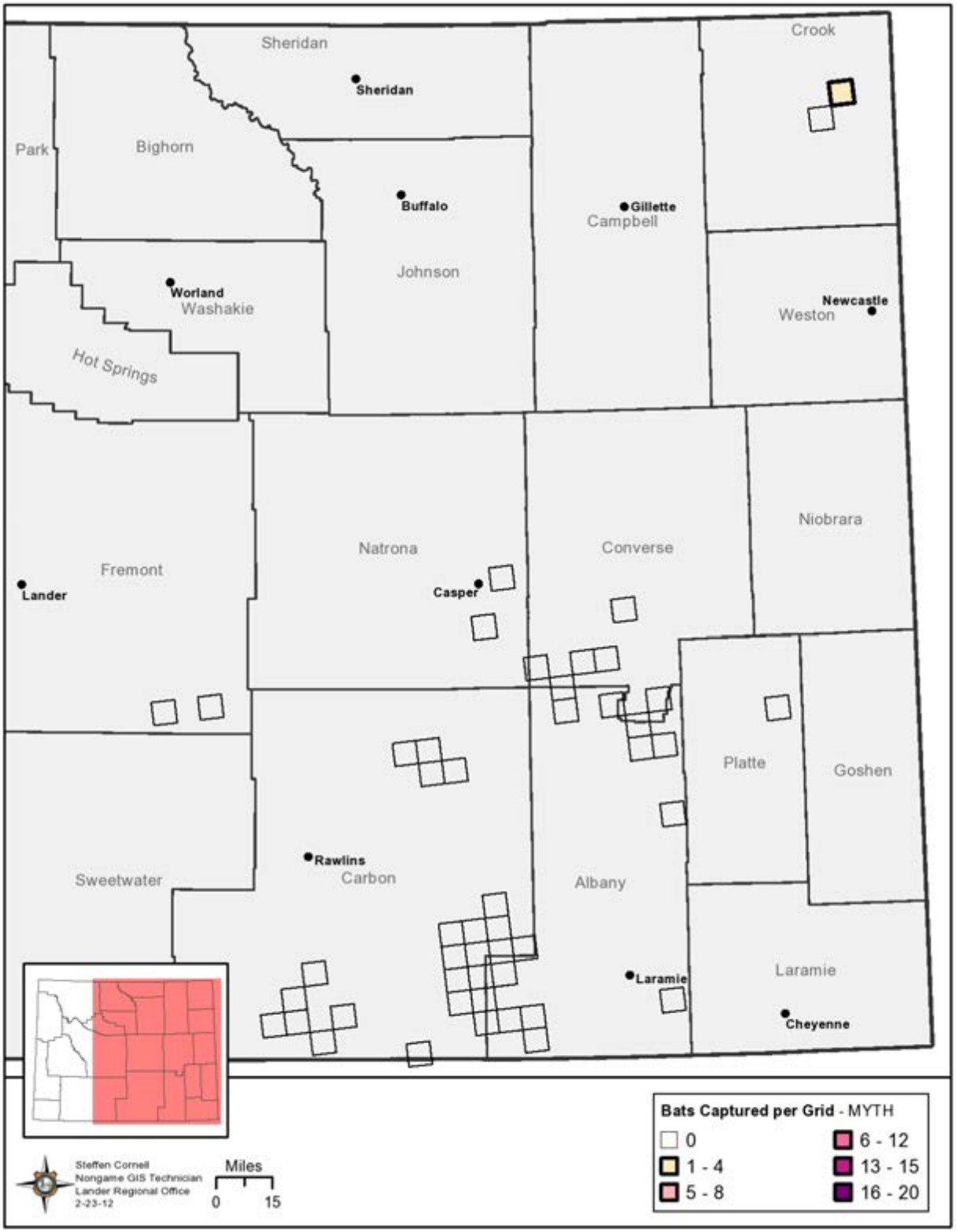

Figure 12. Number of fringed myotis (*Myotis thysanodes*) captured within each survey grid in eastern Wyoming, May–September, 2011.

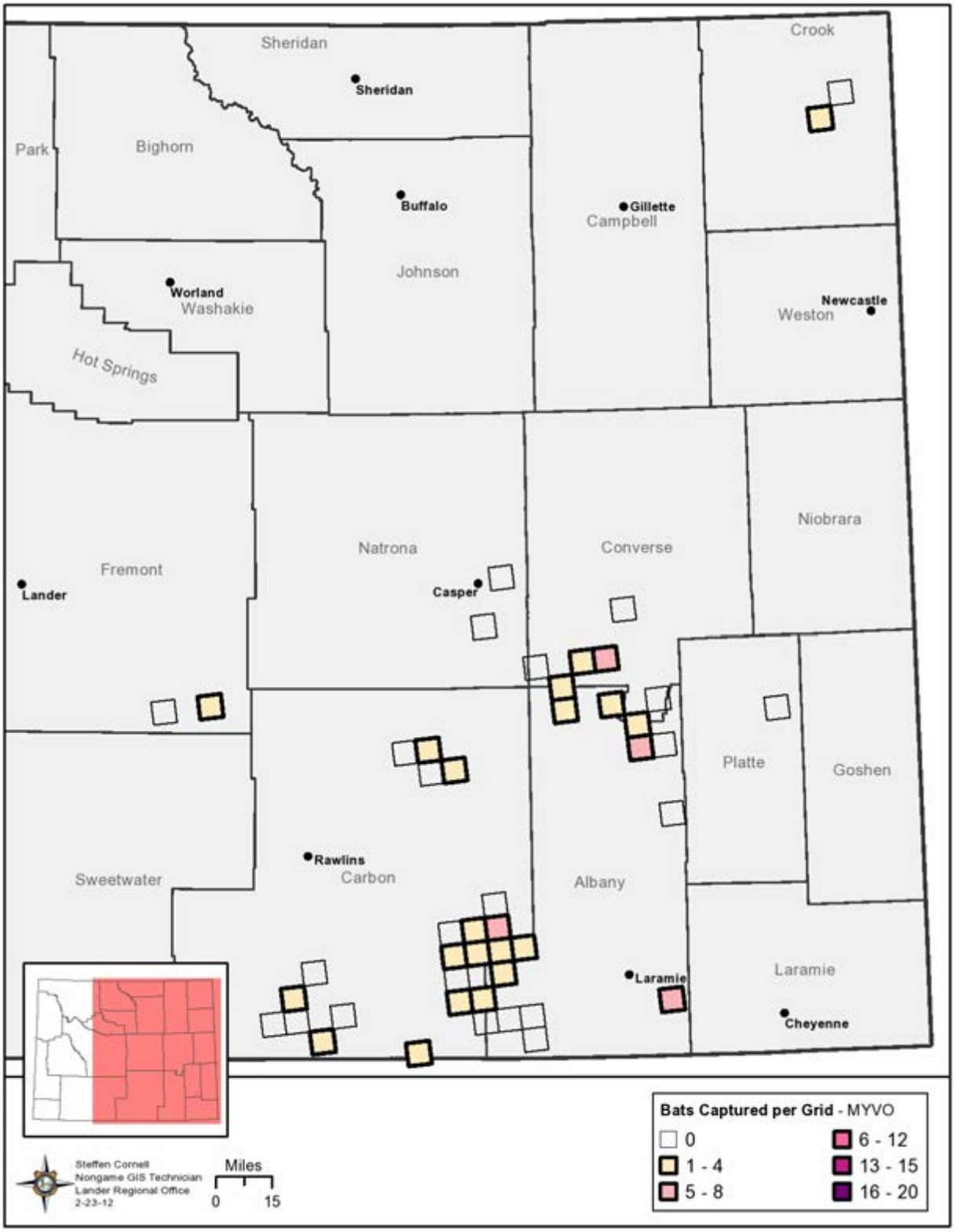

Figure 13. Number of long-legged myotis (*Myotis volans*) captured within each survey grid in eastern Wyoming, May–September, 2011.

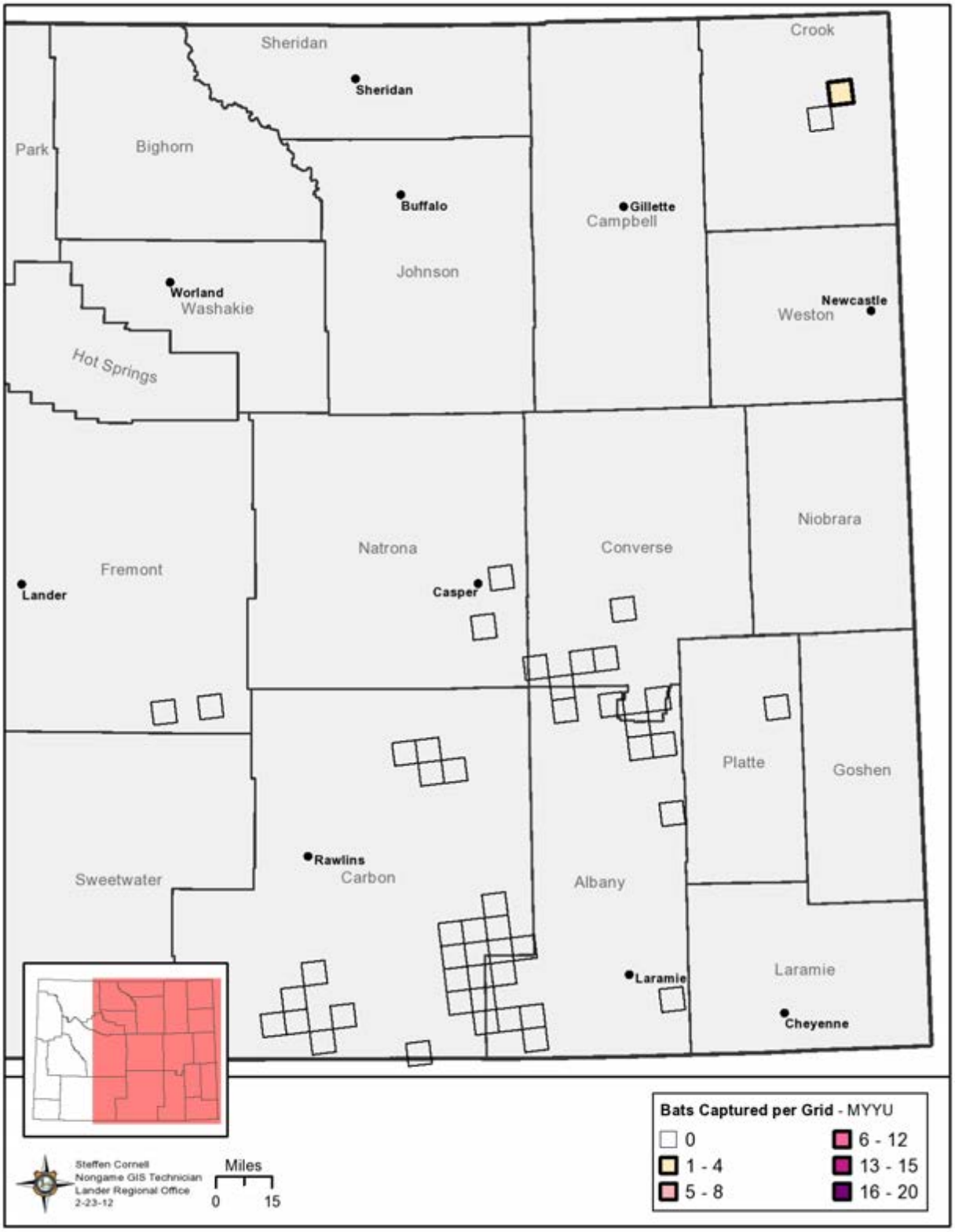

Figure 14. Number of Yuma myotis (*Myotis yumanensis*) captured within each survey grid in eastern Wyoming, May–September, 2011.

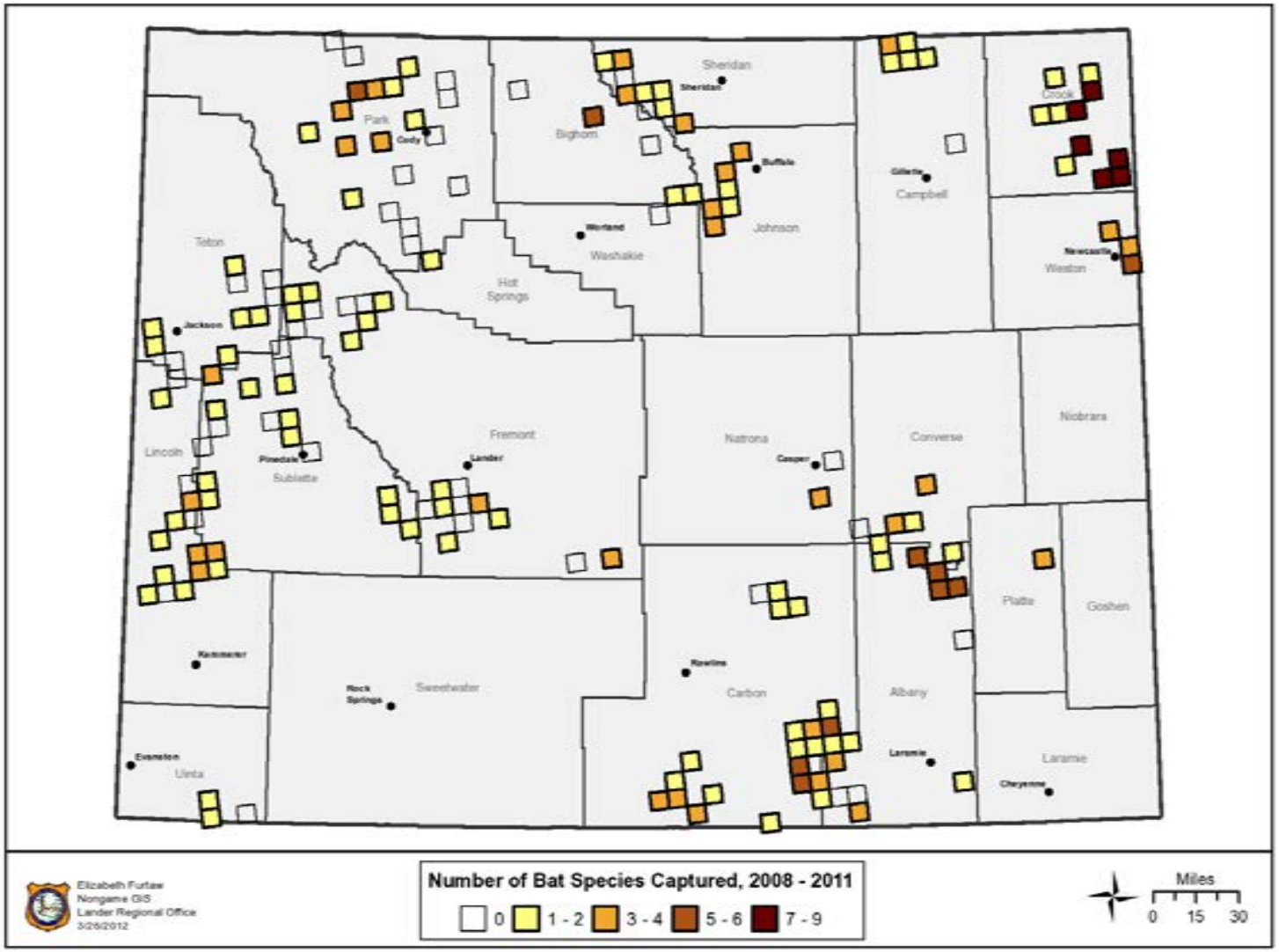

Figure 15. Diversity of species of bats captured and location of grids surveyed in Wyoming, 2008-2011.

INVENTORY OF BATS IN FOREST OF SOUTHEASTERN WYOMING: ACOUSTIC SURVEYS

STATE OF WYOMING

NONGAME MAMMALS: Species of Greatest Conservation Need – Bats

FUNDING SOURCE: United States Fish and Wildlife Service State Wildlife Grants and Wyoming State Legislature General Fund Appropriations

PROJECT DURATION: 1 July 2010 – 30 June 2012

PERIOD COVERED: 15 April 2011 – 14 April 2012

PREPARED BY: Becky Abel, Nongame Biologist
Martin Grenier, Nongame Mammal Biologist

ABSTRACT

Wyoming hosts 12 species of resident bats, 10 of which are recognized as Species of Greatest Conservation Need by the Wyoming Game and Fish Department. Prior to 2008, inventories for bats throughout forests of Wyoming were lacking, limiting our understanding and ability to effectively manage populations of and habitats for bats. Recently, however, the Wyoming Game and Fish Department has invested resources in inventorying forests of Wyoming and has resulted in novel data on several species of bats. In 2011, we completed an inventory of bats that occur in forests of eastern Wyoming. We used acoustic detectors to survey forests of southeastern Wyoming to document distribution, relative abundance, and diversity of bat species. We classified 8,154 call sequences representing 13 species on 54 survey grids. In addition to several resident species, our classifications included three peripheral species, the eastern red bat (*Lasiurus borealis*), Yuma myotis (*Myotis yumanensis*), and California myotis (*M. californicus*). Improving our understanding of distribution and abundance of bats associated with forests in Wyoming is essential for conservation planning, species status review, facilitating management responses to White-nose Syndrome in Wyoming, and minimizing potential impacts to bats from large-scale habitat changes due to logging, fire suppression, bark beetle infestation, and energy development.

INTRODUCTION

Bats (Order: Chiroptera) comprise nearly 20% of mammalian species worldwide. Indeed, there are an estimated 1,232 species of bats occupying a variety of ecological niches (Kunz et al. 2011). There are at least 45 species of bats that occur in North America (O'Shea and Bogan

2003), of which 18 insectivorous species of bats have been documented in Wyoming (Hester and Grenier 2005). Over half of North American bats either exclusively or opportunistically use forests for roosting (Kunz and Lumsden 2003, Barclay and Kurta 2007, Brigham 2007) and foraging (Abel 2011). Survival of bats in forests depends on the availability of suitable roosting sites such as caves, crevices, trees, and foliage and adequate foraging sites such as forest edges, interiors, and clearings (Lacki et al. 2007). Of equal importance are forested bodies of water with abundant insect prey (Grindal and Brigham 1999).

There is growing concern over the status of populations of bats within the United States (Ellison et al. 2003). Insectivorous bats are difficult to study due to their small size and nocturnal, volant behavior, thus making conservation and management of insectivorous bats more challenging (Kunz and Racey 1998). Furthermore, bats are vulnerable to rapid declines in abundance due to low reproductive rates and specialized behaviors (O'Shea and Bogan 2003). Bats and their prey are potentially losing habitat throughout forests of Wyoming due to logging, fire suppression, and bark beetle infestation (Hester and Grenier 2005). Development of wind energy poses an even greater challenge to the conservation of some species of bats (Kunz et al. 2007, Baerwald et al. 2008). Additionally, the most recent threat to the survival of species of North American bats is the fatal white-nose syndrome (WNS), which is causing major declines in abundance of bats that hibernate in caves and abandoned mines in the eastern United States. Species of bats common in forests of Wyoming, such as the little brown bat (*Myotis lucifugus*) and big brown bat (*Eptesicus fuscus*), have been found to be susceptible to WNS (Abel and Grenier 2011). The decline in abundance of bats could have far-reaching consequences, as bats are essential to maintaining functional ecosystems through the suppression of both naturally occurring and human-generated populations of pest insects (Kunz et al. 2011).

Of the 18 species of bats in Wyoming, 12 are considered residents for at least part of the year (Hester and Grenier 2005; Table 1). Ten resident species and one peripheral species have been designated as Species of Greatest Conservation Need by the Department (WGFD 2010; Table 1). Prior to 2008, inventories for bats throughout forests of Wyoming were lacking. This has constrained our ability to manage bats and their habitats effectively in previous years (Hester and Grenier 2005).

Acoustic bat detectors are useful tools for gathering information on activity of bats when physical capture is impractical, unlikely, or unnecessary. Investigators can record, view, and quantify search-phase calls of bats. In many cases, the recorded calls may be identified to species, and data can be used to determine presence and develop an index of activity for each location or survey period (O'Farrell et al. 1999). Acoustic detection can be especially useful for detecting some species in Wyoming that are difficult to capture, for example the Yuma myotis (*Myotis yumanensis*), western small-footed myotis (*M. ciliolabrum*), Townsend's big-eared bat (*Corynorhinus townsendii*), and spotted bat (*Euderma maculatum*; O'Farrell and Gannon 1999). However, some species of bats have similar acoustic signals. These similarities and the presence of background noise can contribute to errors in differentiation of calls to species. Species identification may be further confounded by differences in detectability and call structure in cluttered versus open habitats (Schnitzler and Kalko 1998). Despite these limitations, acoustic surveys provide an efficient method to obtain basic information on presence and activity levels of bats, especially in conjunction with capture surveys.

This is the second year of a two-year project to survey for bats in forests of eastern Wyoming. Our objectives in 2011 were to collect data on distribution, relative abundance, and diversity of species of bats that occur in forests of southeastern Wyoming. This goal included collecting data on population demography and morphometric measurements of individuals and was accomplished by using mist nets concurrently with acoustic detectors (Abel and Grenier 2012). This report summarizes the acoustic portion of the inventory of forest bats in southeastern Wyoming.

METHODS

We used Geographic Information Systems (ArcGIS v9.3, Environmental Systems Research Institute, Redlands, CA, USA) and the Bat Grid system (P. Ormsbee, pers. comm.) to identify potential survey grids in eastern Wyoming. To achieve this, we digitally overlaid 100 km^2 survey grids with ecological system vegetation layers (by NatureServe from existing GAP and ancillary data) and identified all survey grids that contained ≥40% forested habitat. We randomly selected 100 survey grids from all available survey grids in eastern Wyoming. In 2011, we focused our surveys on grids in southeastern Wyoming. While in the field, we identified specific survey locations within each grid based on 1) habitat features that encouraged concentration of bats such as water sources, flyways, and roosting areas, 2) accessibility to site by personnel, and 3) the ability to effectively use detectors to record bats at the site while minimizing the presence of background noise in call files (Hester and Grenier 2005). If accessible and effective survey locations were not available in a pre-selected survey grid, we selected a suitable replacement site in an adjacent grid.

Personnel worked in crews of two to locate suitable acoustic sites and deploy bat detectors. We used Wildlife Acoustics Song Meter SM2BAT detectors (Wildlife Acoustics, Inc., Concord, MA) to record call sequences of bats from late May to early September 2011. We selected sites for acoustic detectors that were near bodies of water or flight corridors that were likely to be used by bats. Within grids that we also surveyed with mist nets, we oriented one detector near the netting site, and 1-2 detectors ≥100 m from the site. Detectors were set approximately 2 m above ground level, and microphones were oriented upward at 45 degrees. We programmed detectors to power on ≤30 min after civil sunset and left them running until 2.5–3 hrs after sunset. If precipitation, lightning, or wind ≥11 kph was present, we closed nets and ended the acoustic survey. We developed the above methods in reference to those outlined by Abel and Grenier (in press).

We recorded additional information at each site regarding the location and conditions present during each nightly survey. We recorded our location and elevation with a GPS unit (GPSMap 76S, Garmin International, Inc., Olathe, KS, USA) in datum NAD 83. We recorded other survey characteristics, including: location of detectors, surrounding vegetation species, habitat description, and weather conditions including temperature, wind speed, and cloud cover at the start and end of each survey.

We used Sonobat 3.02 (J. Sweczak, Arcata, CA, USA) to interpret call sequences of bats. Before classifying call sequences, we ran raw acoustic files through the Sonobat Batch Scrubber 3.vi utility to remove files that did not contain bat call sequences. We then used Sonobat Sonobatch classifier to assist in classifying call sequences to species. Calls of good quality usually resulted in classification from Sonobatch with discriminant probability >0.90. Calls that were classified by Sonobatch but had a discriminant probability <0.90 were secondarily classified by personnel. Because there remained a small percentage of noise files among files with bat calls after using the Sonobat Scrubber, we calculated the number of classified calls (i.e., calls of good quality) per hr as an index of activity instead of using all files recorded per hour.

RESULTS

We successfully surveyed 55 grids in southeastern Wyoming (Fig. 1). We placed 1-3 acoustic detectors within each grid for a total of 92 survey nights. Three additional grids that were surveyed the previous year in northeastern Wyoming (Grids 33, 34, and 36) were surveyed a second time during 2011 to maximize the potential of encountering and gathering data on the northern myotis (*Myotis septentrionalis*), for which the Department lacks records.

We conducted the majority of surveys in montane and subalpine forest, consisting of lodgepole (*Pinus contorta*) and limber pine (*P. flexilis*), Engelmann spruce (*Picea engelmannii*), and subalpine (*Abies lasiocarpa*) and Douglas-fir (*Pseudotsuga menziesii*). Quaking aspen (*Populus tremuloides*) stands were also present in many survey grids. Less frequently, we conducted surveys in xeric and lower montane forests consisting of ponderosa (*Pin. ponderosa*) and limber pine with juniper (*Juniperus* spp.) and sagebrush (*Artemisia* spp.). The survey locations we chose had a mean (±SE) elevation of 2,471 m (±71 m).

We recorded 79,690 files, including bat call sequences and environmental noise, during acoustic surveys in 2011. Of those, we classified 8,154 acoustic files to 10 resident and 3 peripheral species in 54 of 55 grids (Table 1). The most common species we detected were the western small-footed myotis (28.3%), little brown myotis (24.2%), silver-haired bat (*Lasionycteris noctivagans*; 17.3%), and big brown bat (16.4%). We detected all other species at rates <10% (Table 1).

Detections of bats were well-distributed throughout the study area. Activity of bats was highest in the Black Hills and the Sierra Madres followed by the Laramie Mountains (Table 2). Conversely, activity of bats was lowest at sites in the Shirley Mountains followed by the Green Mountains and the Medicine Bows (Table 2). Generally, the diversity of bats followed a similar pattern to activity of bats, with the highest number of species detected at sites in the Black Hills and the lowest at sites in the Green Mountains (Table 2). Activity and diversity of bats in each survey grid is illustrated in Figures 2 and 3, respectively.

Several detections resulted in updates to the Department's Atlas of Birds, Mammals, Amphibians, and Reptiles in Wyoming (Orabona et al. 2012). We recorded new acoustic occurrences in latilong degree blocks for pallid bats (*Antrozous pallidus*), Townsend's big-eared bats, big brown bats, California myotis (*Myotis californicus*), western small-footed myotis, long-

eared myotis (*M. evotis*), fringed myotis (*M. thysanodes*), and Yuma myotis (Table 3). Maps of individual species' acoustic distributions are shown in Figures 4-16.

DISCUSSION

Species detected during this study have been previously documented in forested habitats throughout North America (Lacki et al. 2007). We acoustically detected 10 of 12 resident species of bats in eastern Wyoming in 2011. We were not successful in detecting spotted bats. However, spotted bats are closely associated with cliffs and rough, semi-arid terrain (Adams 2003). We also failed to detect northern myotis even though we attempted to document additional occurrences of this species at 3 sites in northeastern Wyoming. With their extreme northeastern range and unpredictable chance of occurrence, it is not surprising that we did not detect northern myotis given our limited survey effort in northeastern Wyoming (Hester and Grenier 2005). However, we were successful in detecting 3 peripheral species; the eastern red bat, California myotis, and the Yuma myotis.

Results from acoustic surveys were similar to results from mist-netting surveys (Abel and Grenier 2012). However, we detected many more western small-footed myotis and fewer long-legged myotis during acoustic surveys. Western small-footed myotis is a highly maneuverable flier and is adept at avoiding capture in nets (Adams 2003, Hester and Grenier 2005), which may have contributed to the rarity of captures during mist-net surveys. Long-legged myotis are direct fliers and relatively easy to capture in nets, but acoustically detecting this species can be challenging (Adams 2003, WBWG 2007). Consequently, it is clear that using mist-nets concurrently with acoustic detectors maximizes the probability of detecting species of bats that are present at a site. Activity and diversity of bats during acoustic surveys also generally corresponded with results from mist-net surveys (Abel and Grenier 2012).

When comparing results between years and among sites, we cannot rule out the influence of annual variation in weather patterns and prey availability on activity and reproduction of bats. Variations in weather conditions, intra-seasonal behavior, prey availability, and locations of detectors may also cause noticeable differences in the perceived activity of bats for each survey night (Hester and Grenier 2005). We attempted to distribute surveys throughout the study area over the course of the summer. Even so, surveys in some areas of southeastern Wyoming were completed in a short window of time. For example, surveys in the Shirley and Green Mountains were completed early in the season; timing of the survey and low ambient temperature could account for the low diversity and activity of bats we observed during those surveys. Conversely, surveys in the Black Hills were completed late in the season when temperatures were warmer, thus possibly contributing to the comparably higher activity and diversity we detected (Hayes 1997, Ciechanowski et al. 2007). This inventory encompassed a large geographic area in a relatively short time period, which should be considered when interpreting results. It is difficult to assess the exact distribution, relative abundance, and diversity of bat species in forests of southeastern Wyoming since replication of surveys was not usually feasible. Nevertheless, since inventories for bats in forests of Wyoming were lacking prior to 2008, this updated information is significant and beneficial to increasing our current understanding of future management and inventory needs.

Current management practices may affect habitat in forested landscapes that bats use for foraging or roosting. Many recent studies have evaluated habitat use throughout different forested regions of North America. Information obtained from studies is often species- and site-specific, demonstrating the importance of conducting localized studies on bat species of interest within regions of concern. With a better understanding of the distribution, relative abundance, and diversity of bat species inhabiting Wyoming forests, we can further investigate how forested bat habitat may change in the presence of logging, fire suppression, bark beetle infestations, and energy production in Wyoming (Hester and Grenier 2005).

ACKNOWLEDGEMENTS

Funding for this project was provided by the US Fish and Wildlife Service through State Wildlife Grants and the Wyoming State Legislature General Fund Appropriations for which we are extremely grateful. We thank the US Forest Service, Bureau of Land Management, and private landowners for providing access as part of this project. We also extend a special thanks to Wyoming Game and Fish Department personnel L. Beard, C. Atkinson, N. Cudworth, D. Wilckens, and N. Whitford for their assistance in the field and S. Cornell and E. Furtaw for their assistance with GIS, without which this project would not have been possible.

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Table 1. Species of bats that are known to occur in Wyoming with number detected during the 2011 survey. Status of residency for bats are represented with the following abbreviations, R = resident (year-round or seasonal), P = peripheral, A = accidental occurrence, as identified by Hester and Grenier (2005). Native Species Status (NSS) of Species of Greatest Conservation Need for bats are 2, 3, 4, or U, as identified in the species accounts of the State Wildlife Action Plan (WGFD 2010).

Scientific Name	Common Name	Residency Status	Native Species Status (NSS)	Detections in 2011
Antrozous pallidus	Pallid bat	R	NSS3	71
Corynorhinus townsendii	Townsend's big-eared bat	R	NSS2	28
Eptesicus fuscus	Big brown bat	R	NSS4	1,334
Euderma maculatum	Spotted bat	R	NSS3	0
Lasionycteris noctivagans	Silver-haired bat	R	-	1,414
Lasiurus borealis	Eastern red bat	P	NSSU	2
Lasiurus cinereus	Hoary bat	R	-	228
Myotis californicus	California myotis	P	-	19
Myotis ciliolabrum	Western small-footed myotis	R	NSS4	2,311
Myotis evotis	Long-eared myotis	R	NSS3	589
Myotis lucifugus	Little brown myotis	R	NSS4	1,977
Myotis septentrionalis	Northern myotis	R	NSS3	0
Myotis thysanodes	Fringed myotis	R	NSS3	24
Myotis volans	Long-legged myotis	R	NSS3	144
Myotis yumanensis	Yuma myotis	P	-	13
Nyctinomops macrotis	Big free-tailed bat	A	-	0
Pipistrellus subflavus	Eastern pipistrelle	A	-	0
Tadarida brasiliensis	Brazilian free-tailed bat	P	-	0

Table 2. Results from acoustic surveys within grids in southeastern Wyoming, May–September, 2011, organized by mountain range. Total files recorded is the number of files recorded at each survey grid after removing noise files by using the Sonobat Batch Scrubber utility; however a small percentage of noise files remained. Classified files is the number of files with call sequences of good quality that were classified using the Sonobat Sonobatch classification utility. Classified per hour is an index of activity based on good quality calls recorded during surveys. Calls of good quality resulted in classification from Sonobatch with discriminant probability >0.90. Calls that were classified by Sonobatch but had a discriminant probability <0.90 were secondarily classified by personnel. The number of species detected at a site is based upon classifications made by Sonobat and Department personnel. The grids in each mountain range include the Black Hills: grids 33, 34, 36; Green Mountains: grids 67-68; Laramie Mountains: grids 46-66, 102; Shirley Mountains: grids 69-72, 103; Sierra Madres: grids 90-100; Medicine Bow Mountains: grids 75-89.

	Black Hills (n = 3)		Green Mtns (n = 2)		Laramie Mtns (n = 21)		Shirley Mtns (n = 5)		Sierra Madres (n = 11)		Medicine Bows (n = 15)	
	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE	Mean	±SE
Total files recorded	3,727.0	776.8	3,464.5	3,412.5	1,373.3	353.2	1,424.0	657.3	1,602.1	576.9	534.8	119.5
Classified files	426.3	152.9	29.0	29.0	187.8	67.0	35.4	26.2	188.7	65.7	67.6	15.4
Survey hrs	15.2	2.6	11.2	0.2	7.5	0.7	6.2	0.8	7.3	1.4	5.6	0.6
Classified per hr	28.3	9.5	2.6	2.6	20.7	6.5	8.1	6.7	28.3	11.9	13.2	2.7
Species detected	10.0	0.0	3.0	3.0	6.6	0.6	4.2	0.6	6.6	0.9	5.6	0.6

Table 3. Updates to distribution status of bats in the Department's Atlas of Birds, Mammals, Amphibians, and Reptiles in Wyoming by latilong degree block, summarized by detections of species, eastern Wyoming, May–September, 2011. a = Acoustic observation using detectors with classification of bats to species by Department personnel and Sonobat classification software; h = Historical record of occurrence before 1965, but no recent data to suggest occurrence; _ = No verified records.

Species	Latilong degree block	Current status	Updated status
Antrozous pallidus	7, 20, 26	_	a
Corynorhinus townsendii	25, 26	_	a
	7	h	a
Eptesicus fuscus	18	_	a
Myotis californicus	20, 21, 25, 26, 27	_	a
Myotis ciliolabrum	26	_	a
Myotis evotis	27	_	a
Myotis thysanodes	18, 20, 26	_	a
Myotis yumanensis	20, 25, 26	_	a

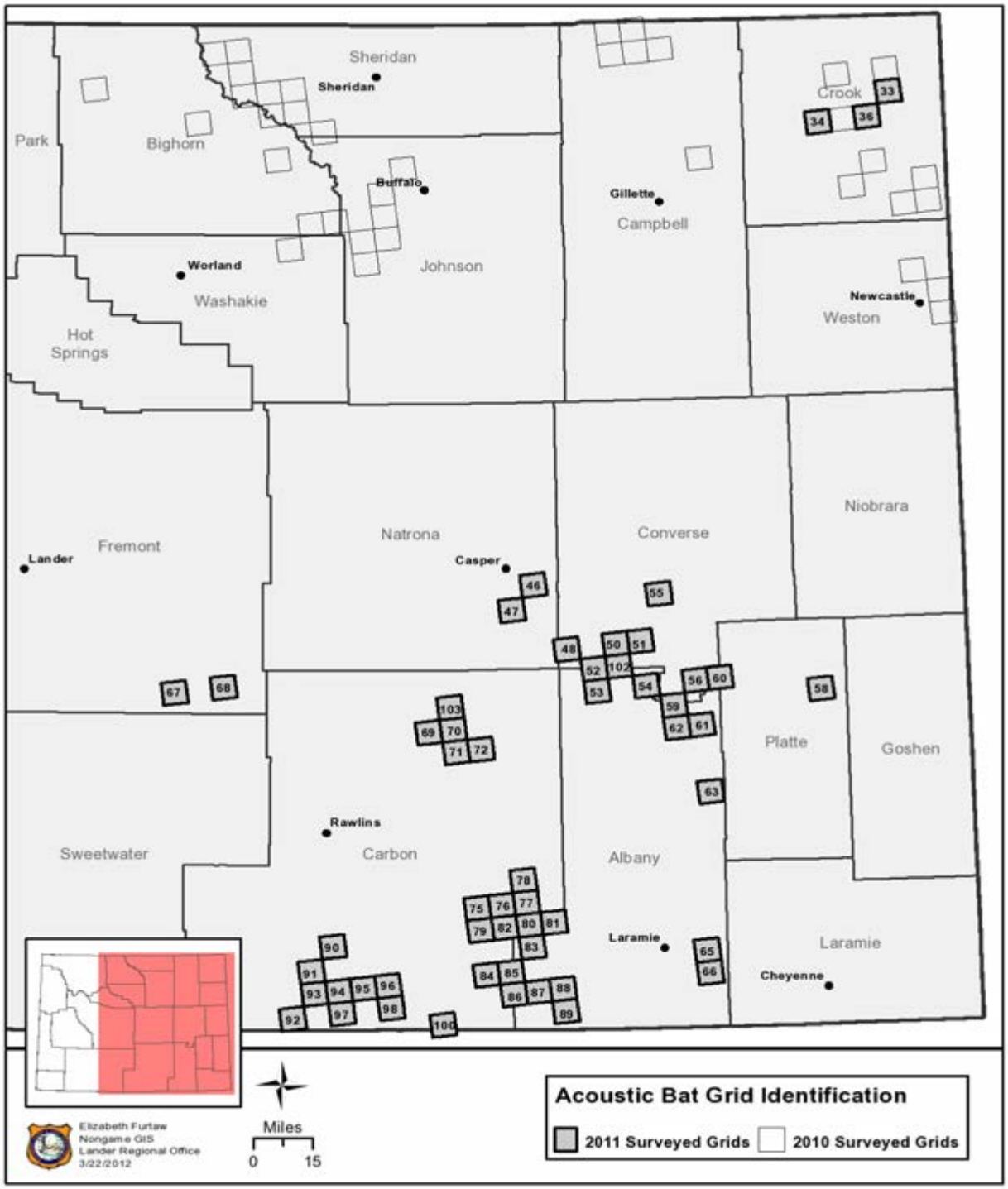

Figure 1. Study area and location of bat survey grids in eastern Wyoming. The 2011 inventory focused on survey grids in southeastern Wyoming, the 2010 inventory on northeastern Wyoming. Grids 33, 34, and 36 were surveyed both years.

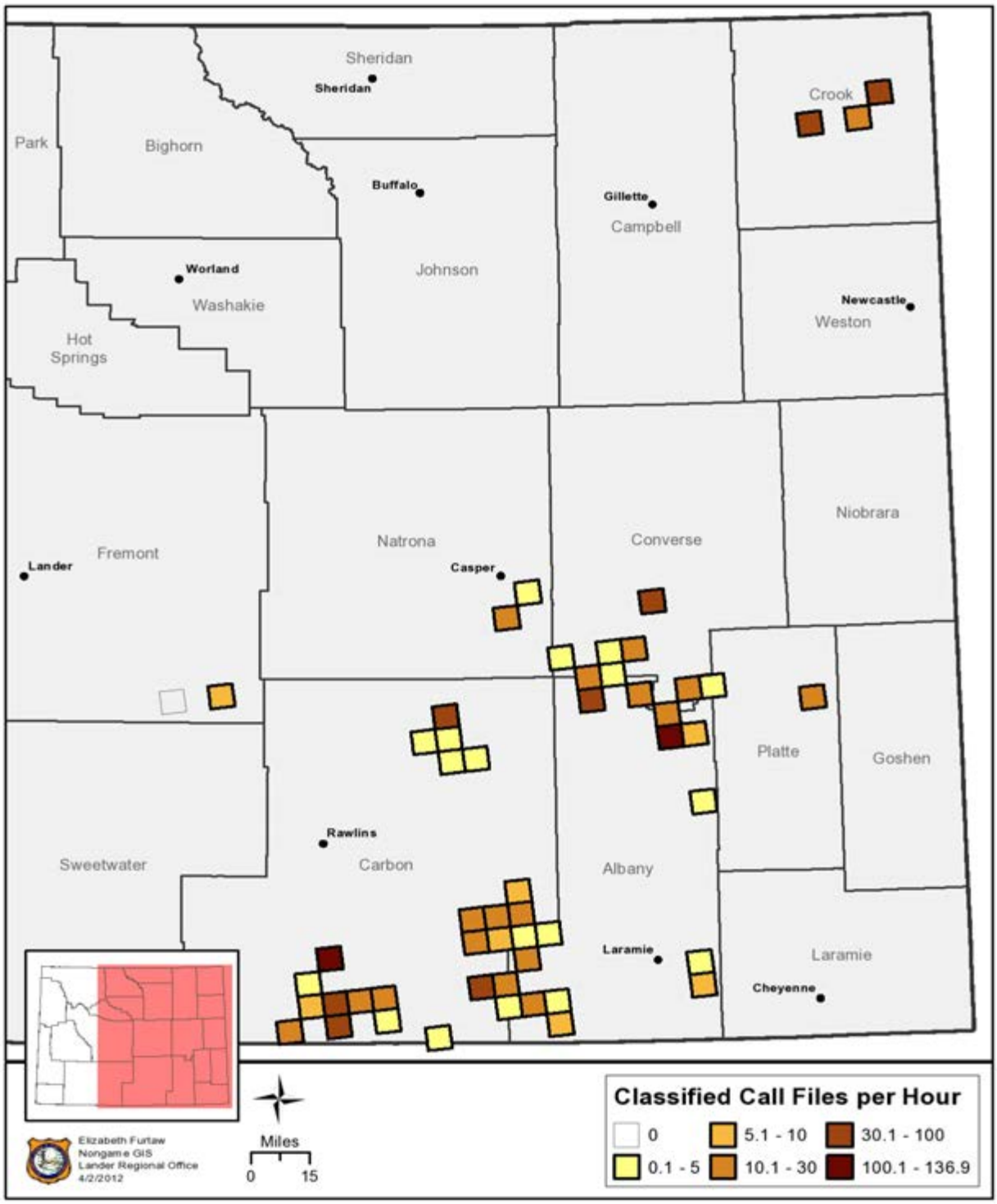

Figure 2. Number of classified call files recorded per survey hour in survey grids in eastern Wyoming, May – September, 2011.

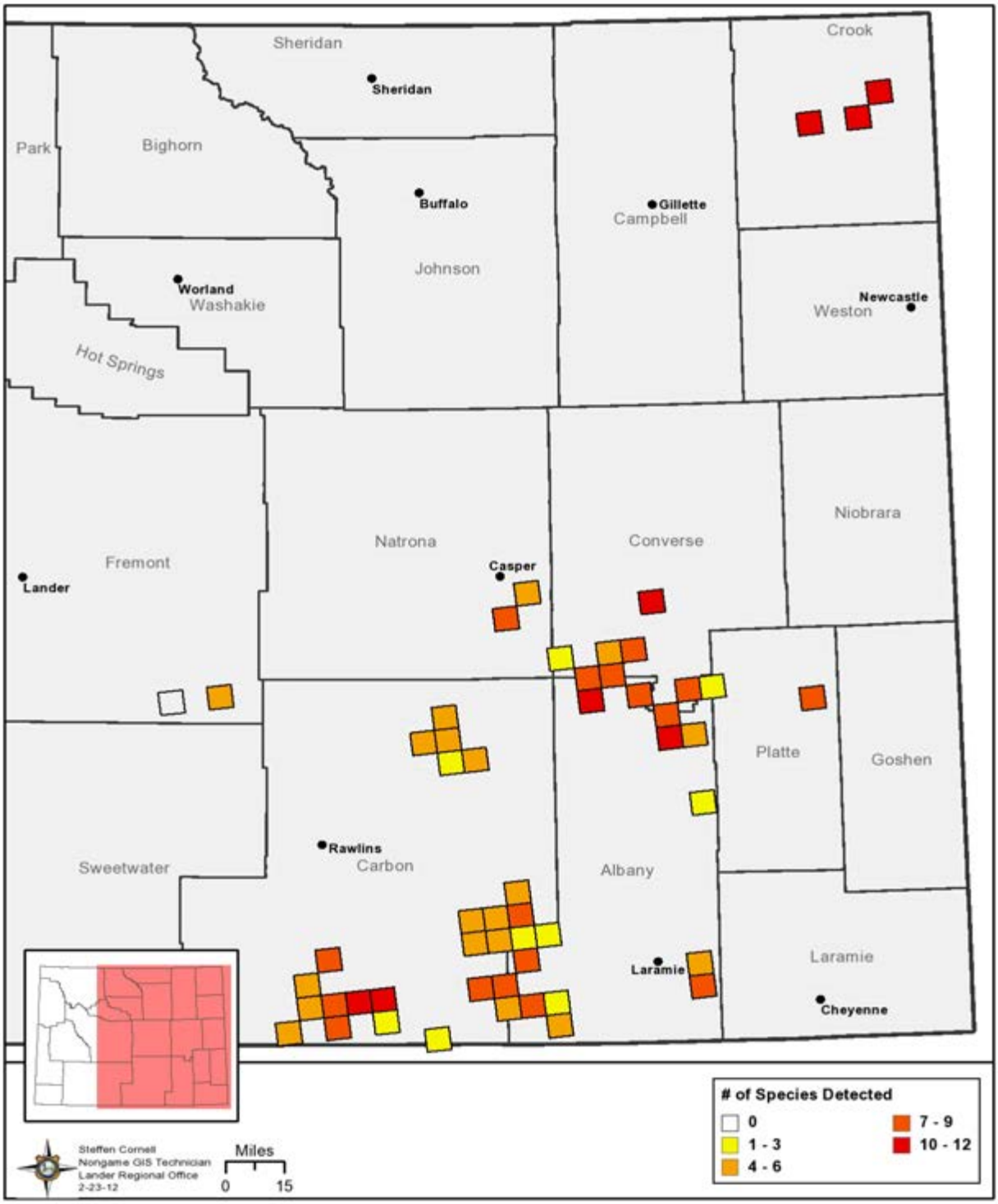

Figure 3. Number of different species detected within survey grids in eastern Wyoming, May–September, 2011.

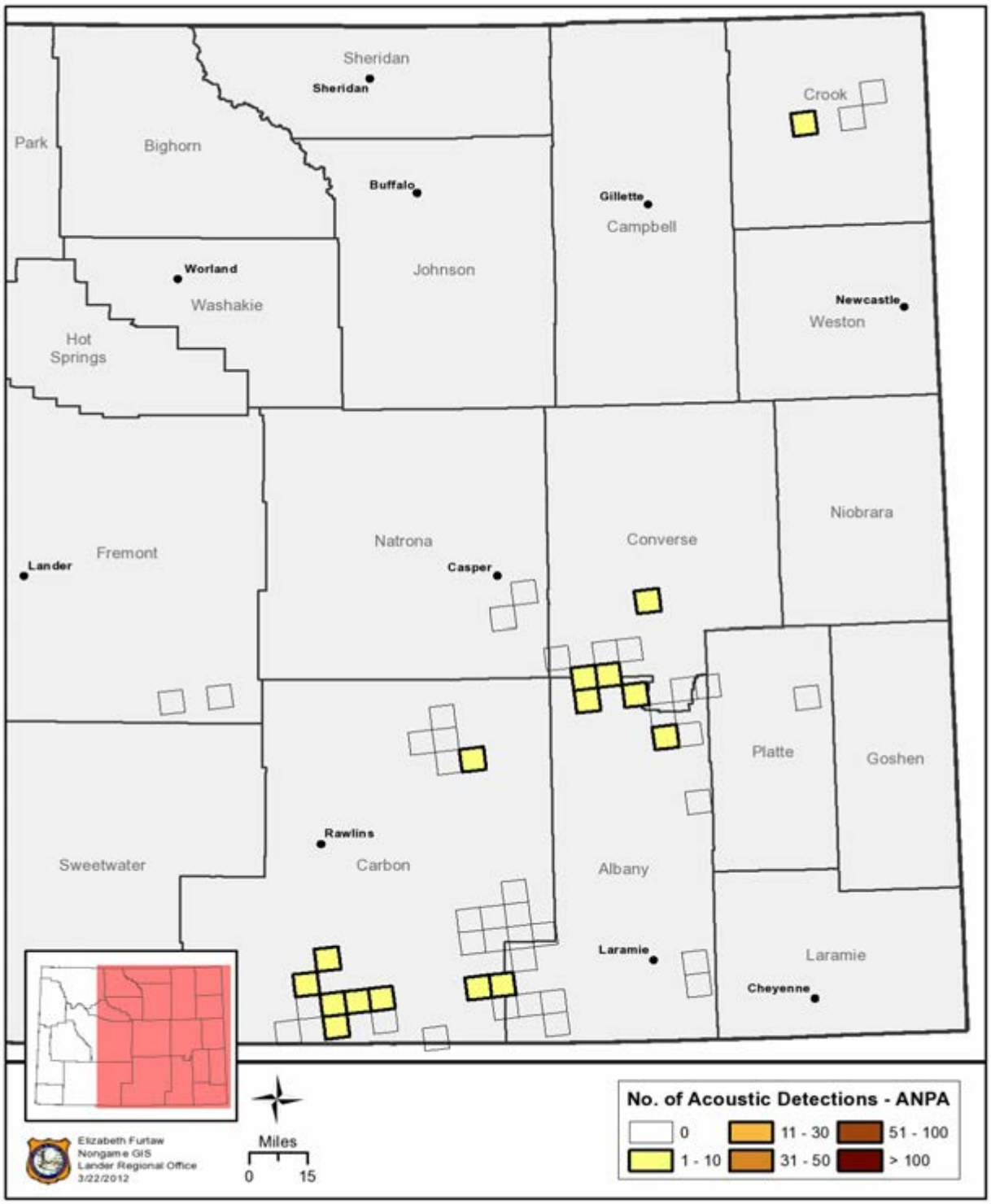

Figure 4. Number and spatial arrangement of detections of pallid bat (*Antrozous pallidus*) in eastern Wyoming, May–September, 2011.

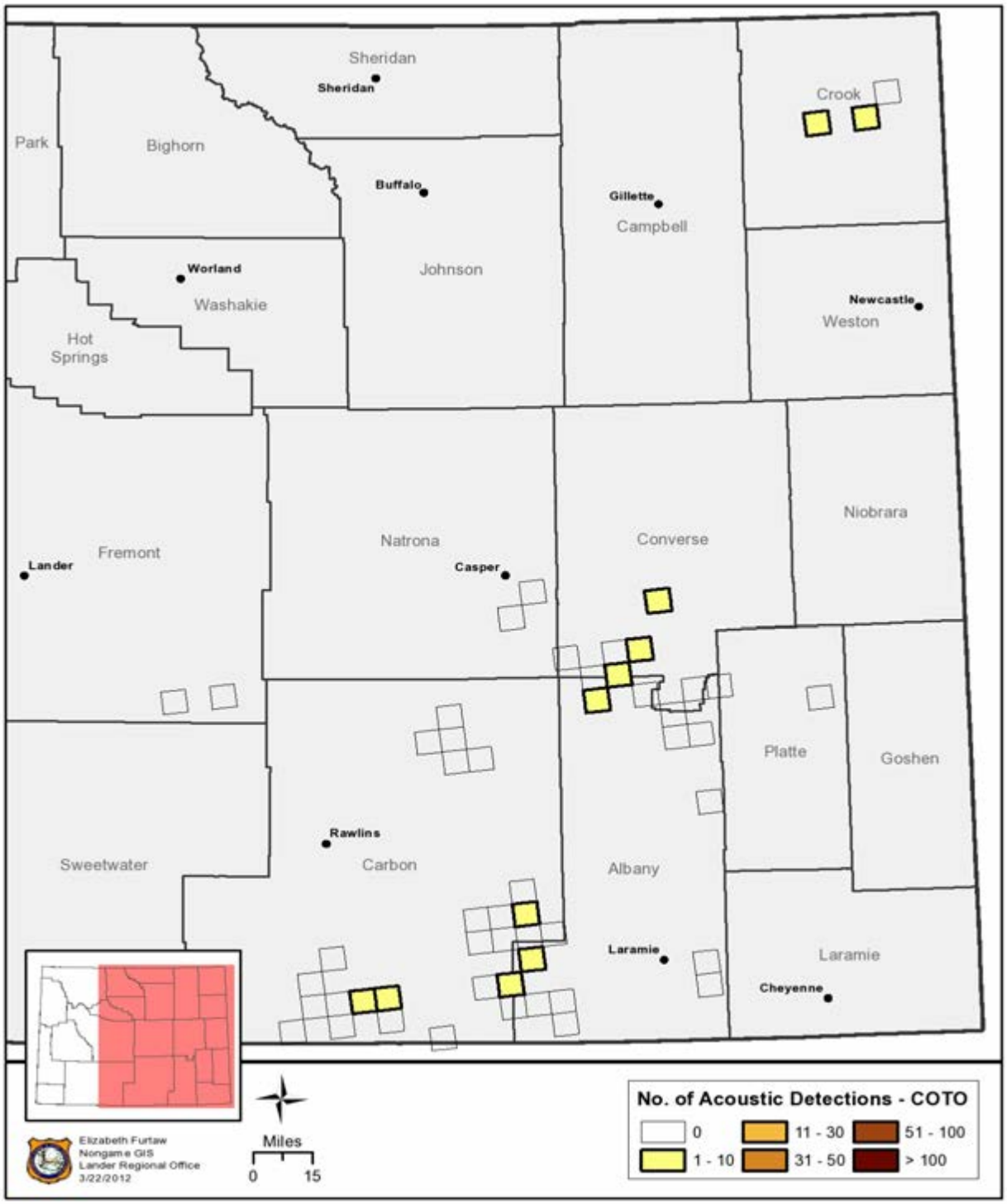

Figure 5. Number and spatial arrangement of detections of Townsend's big-eared bats (*Corynorhinus townsendii*) in eastern Wyoming, May–September, 2011.

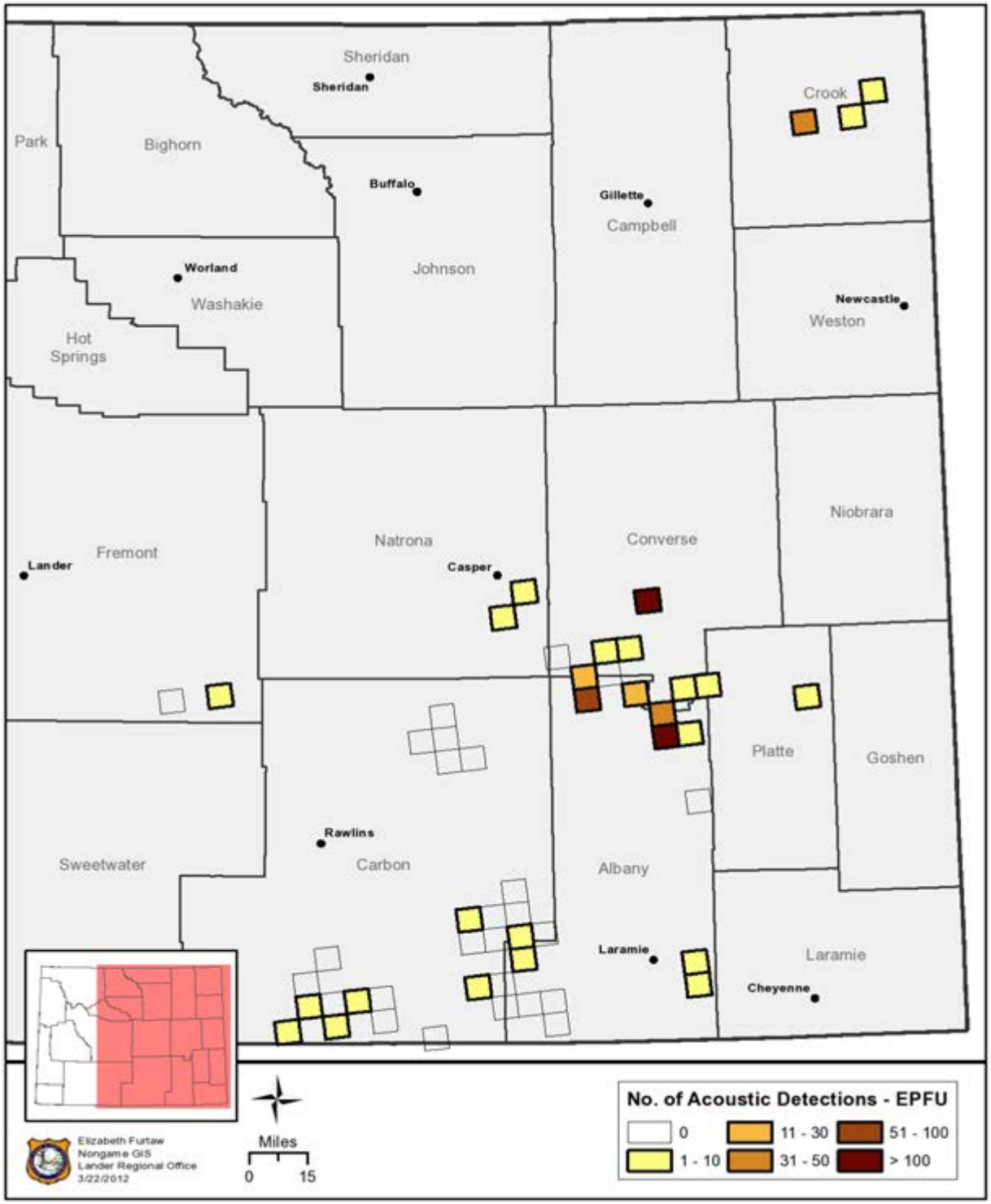

Figure 6. Number and spatial arrangement of detections of big brown bat (*Eptesicus fuscus*) in eastern Wyoming, May–September, 2011.

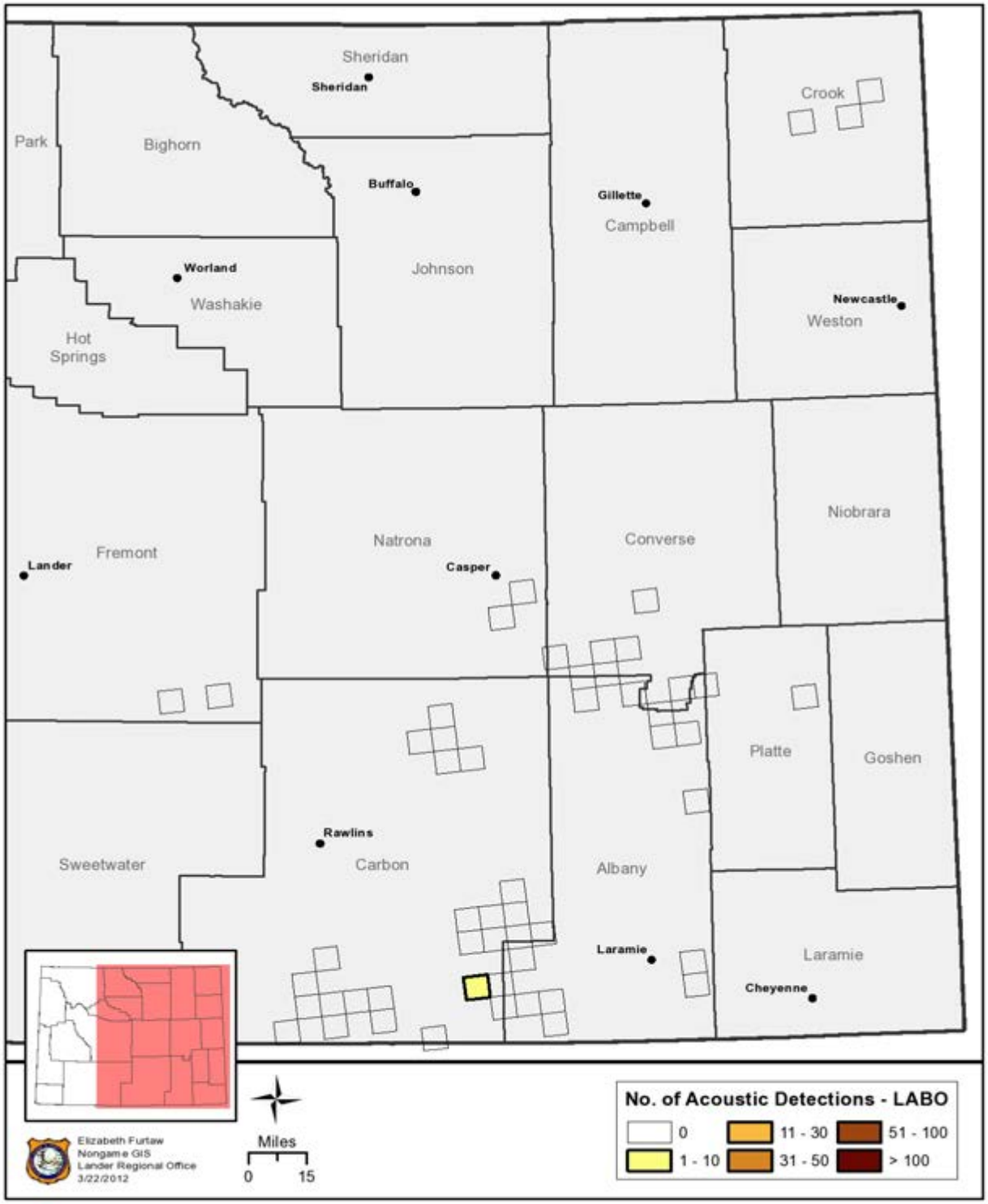

Figure 7. Number and spatial arrangement of detections of eastern red bat (*Lasiurus borealis*) in eastern Wyoming, May–September, 2011.

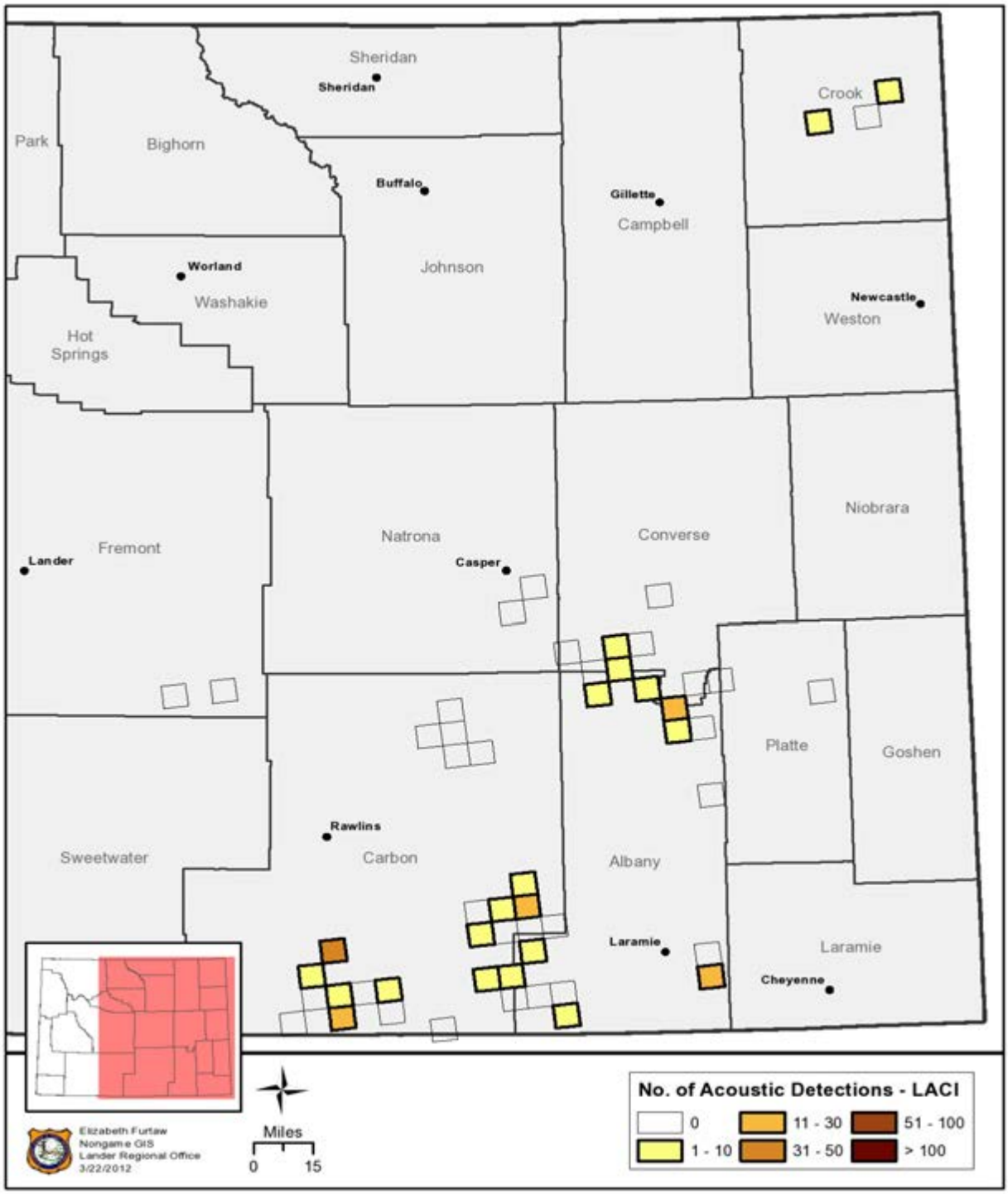

Figure 8. Number and spatial arrangement of detections of hoary bat (*Lasiurus cinereus*) in eastern Wyoming, May–September, 2011.

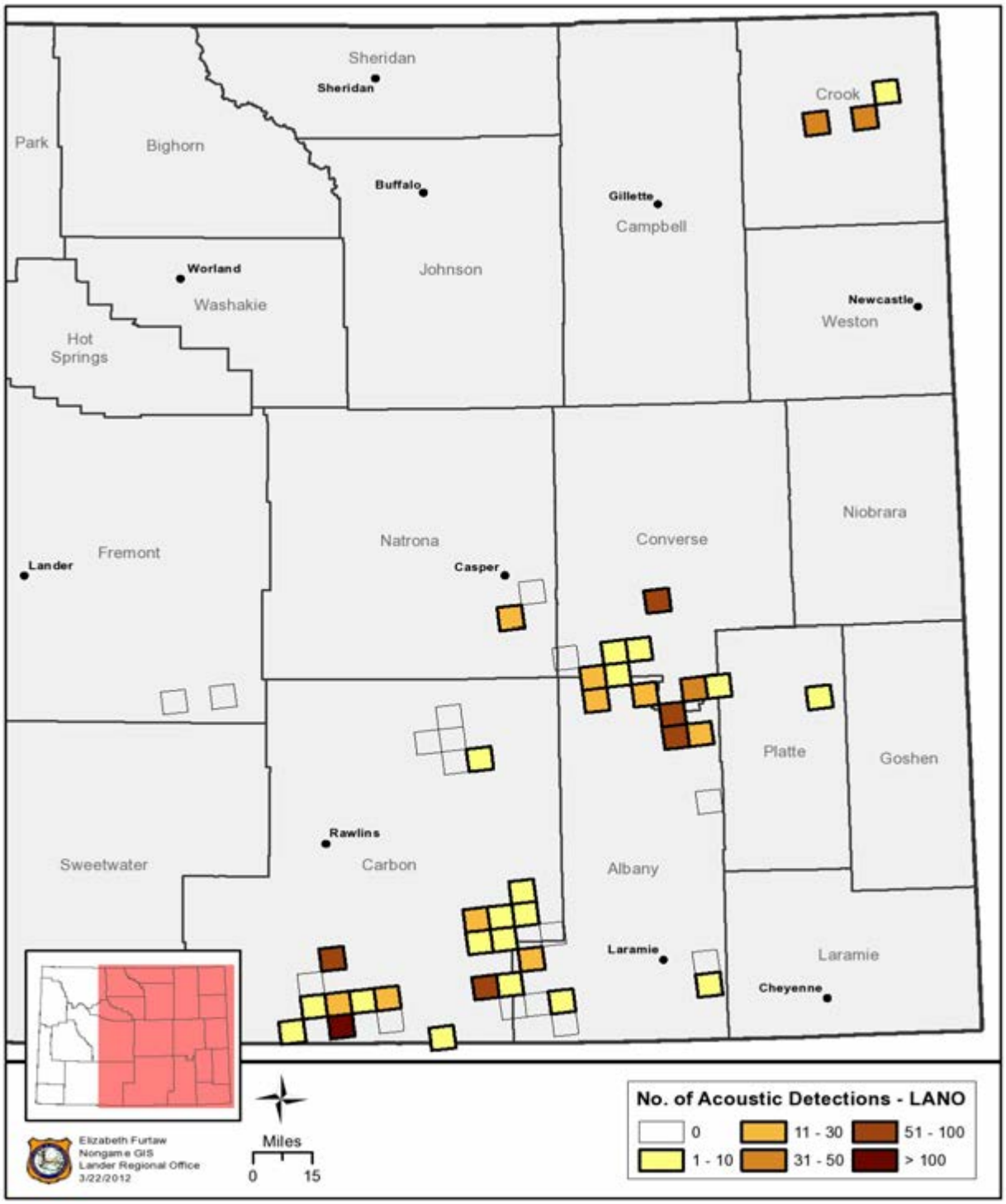

Figure 9. Number and spatial arrangement of detections of silver-haired bat (*Lasionycteris noctivagans*) in eastern Wyoming, May–September, 2011.

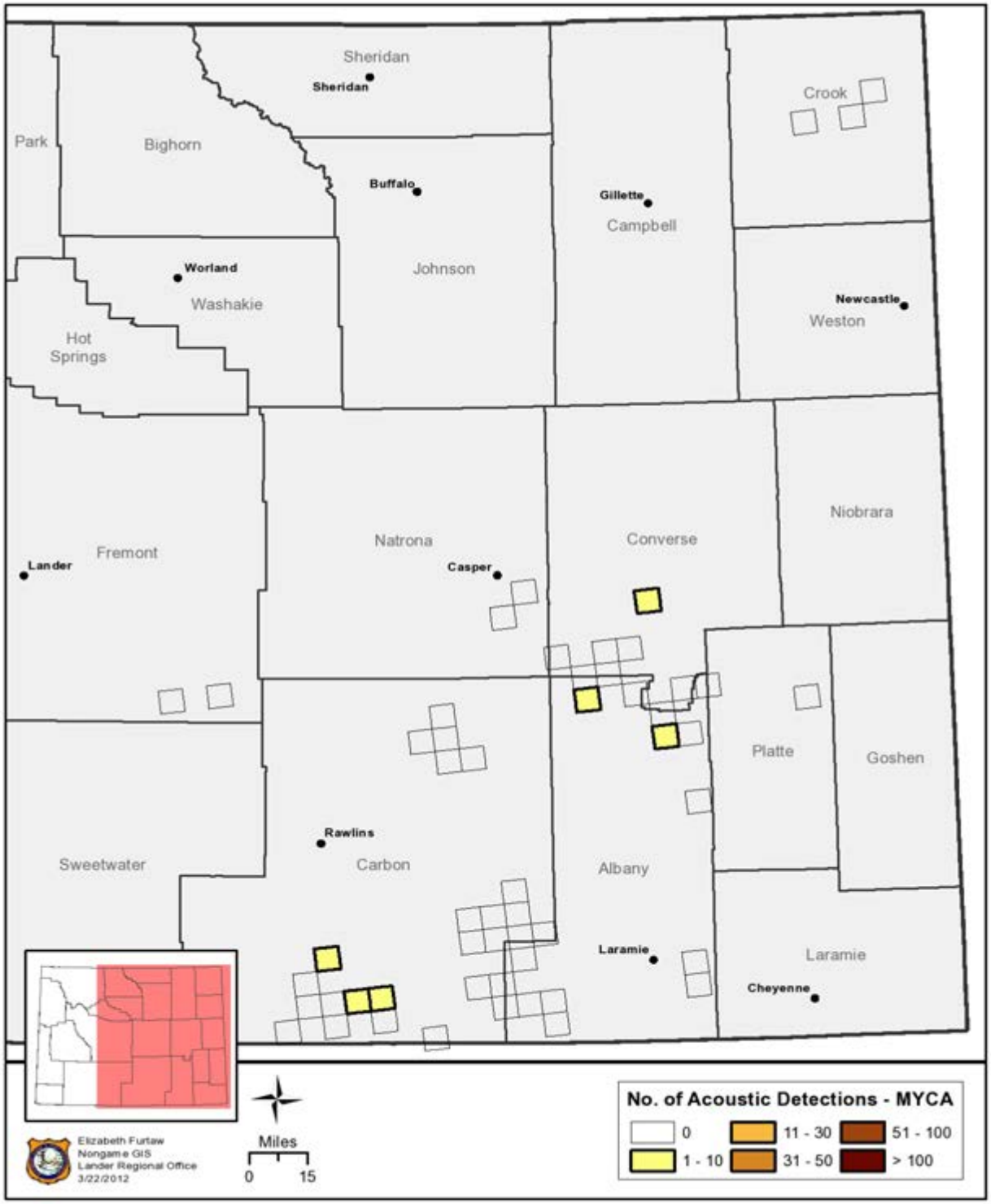

Figure 10. Number and spatial arrangement of detections of California myotis (*Myotis californicus*) in eastern Wyoming, May–September, 2011.

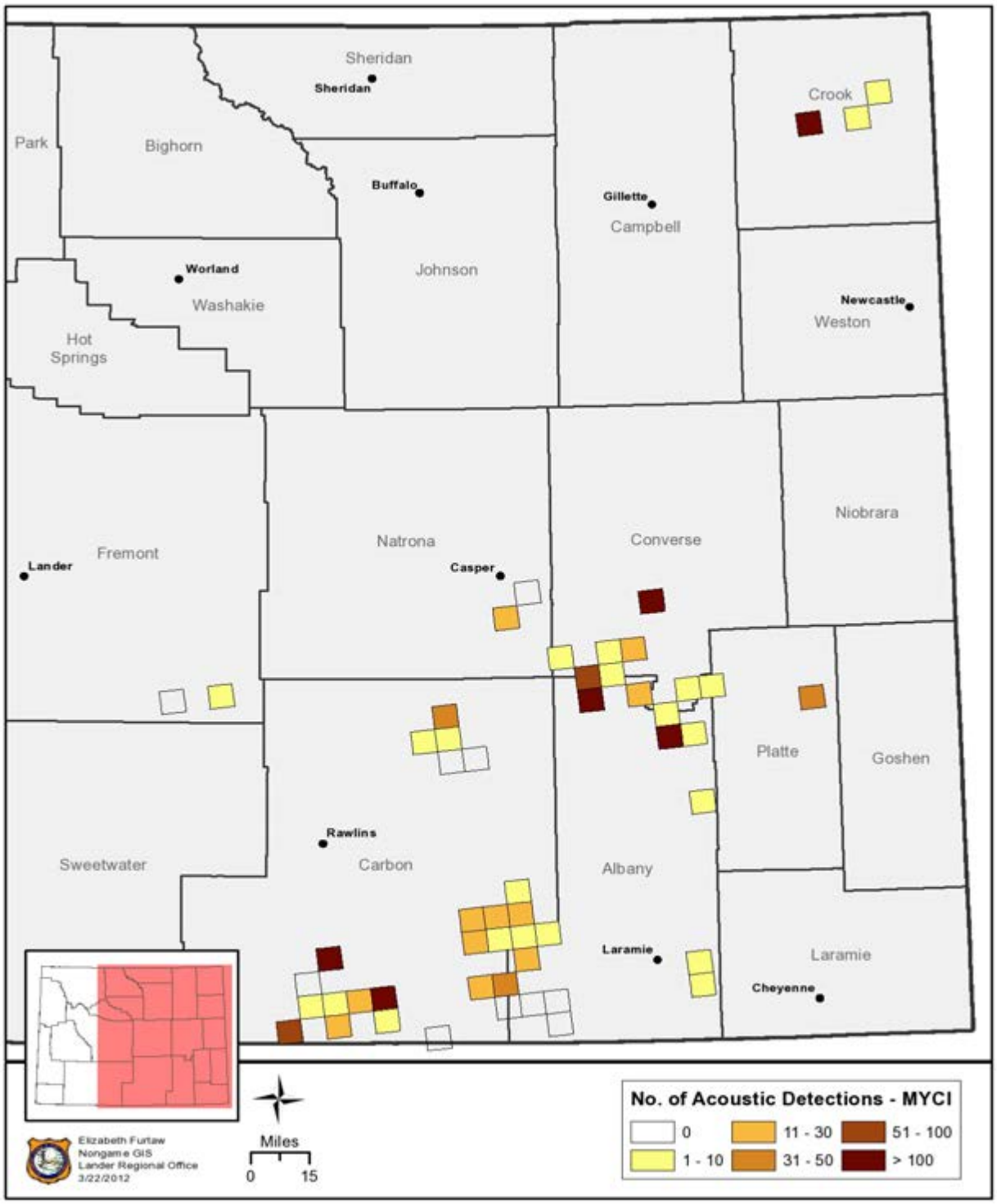

Figure 11. Number and spatial arrangement of detections of western small-footed myotis (*Myotis ciliolabrum*) in eastern Wyoming, May–September, 2011.

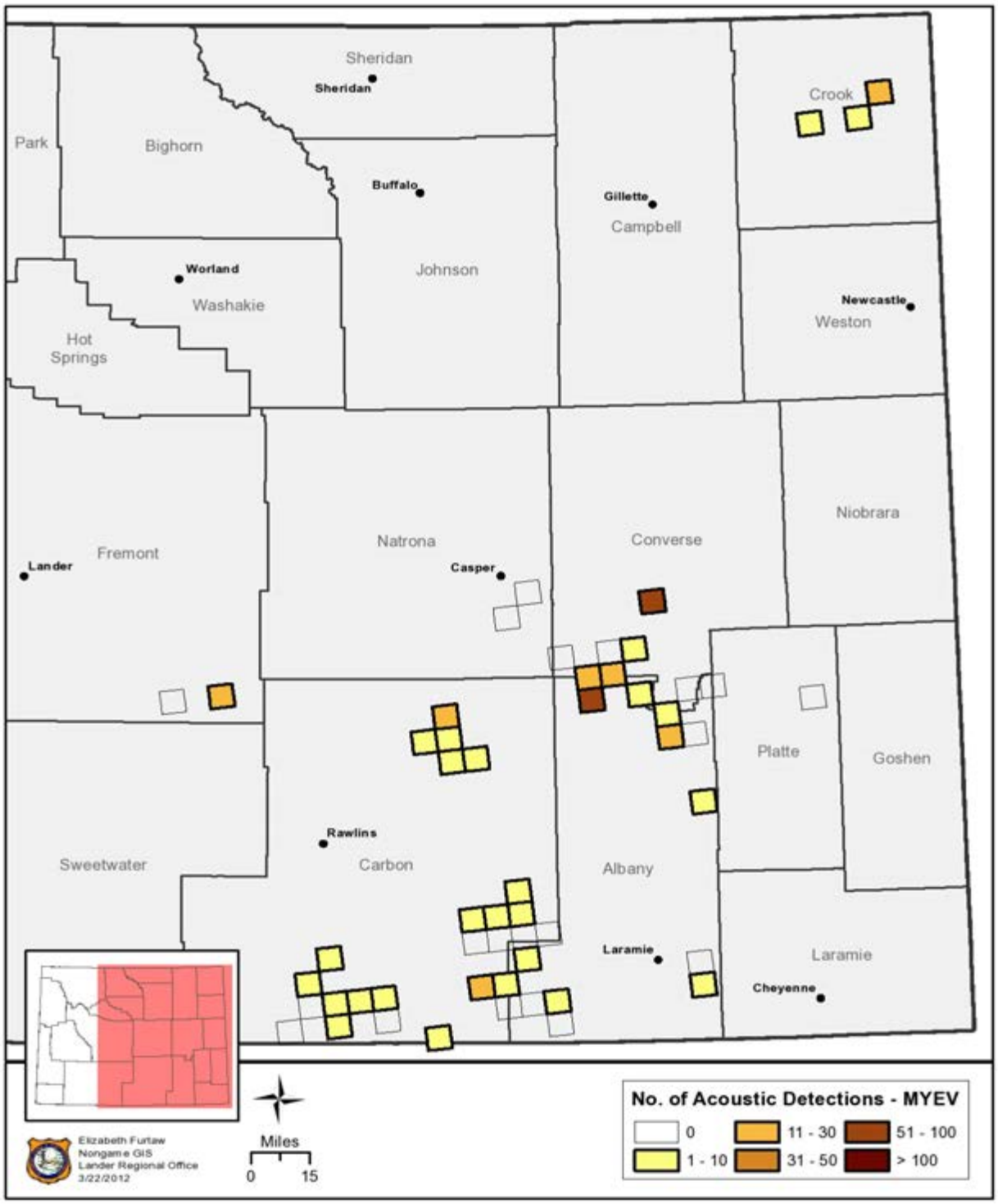

Figure 12. Number and spatial arrangement of detections of long-eared myotis (*Myotis evotis*) in eastern Wyoming, May–September, 2011.

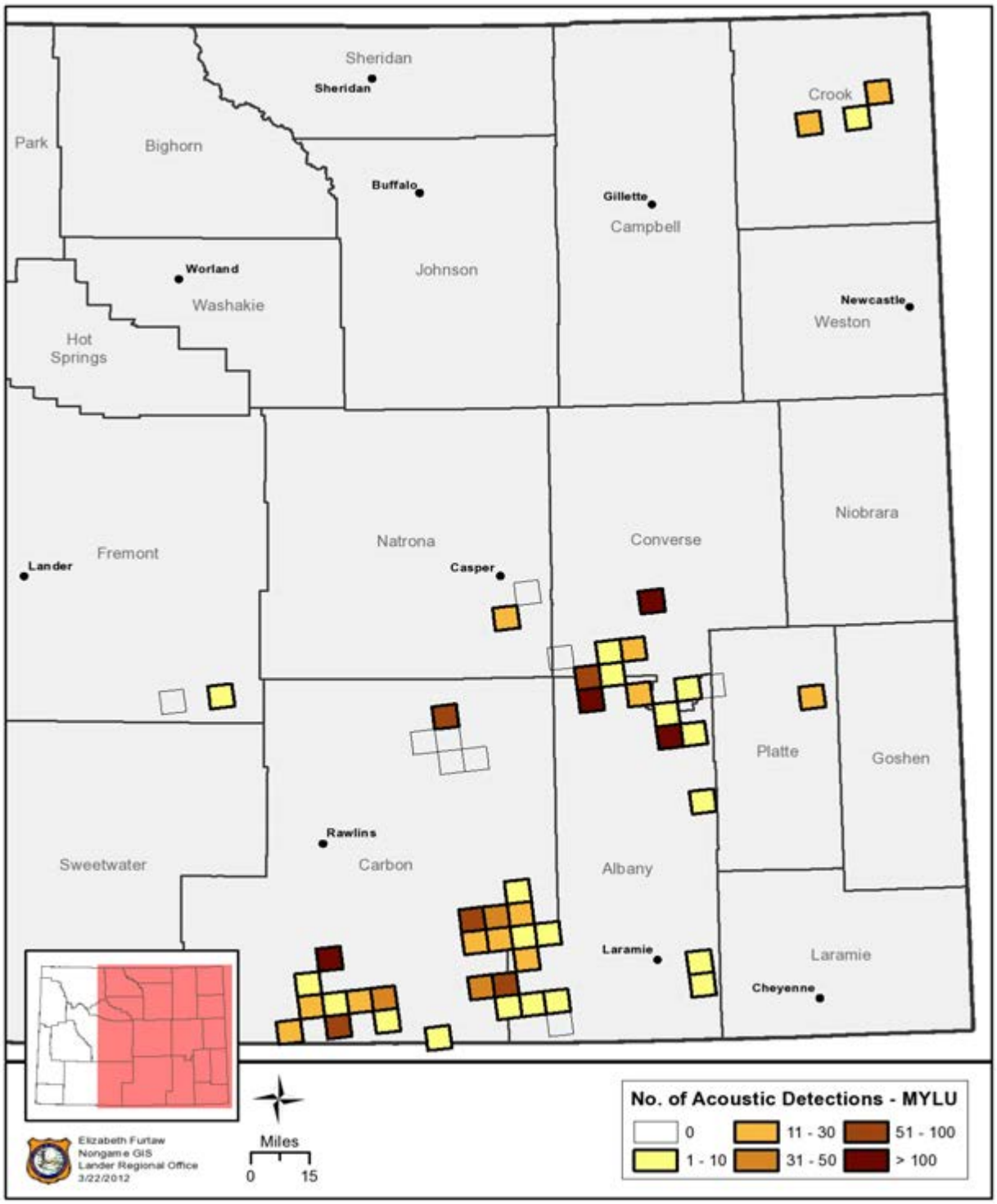

Figure 13. Number and spatial arrangement of detections of little brown myotis (*Myotis lucifugus*) in eastern Wyoming, May–September, 2011.

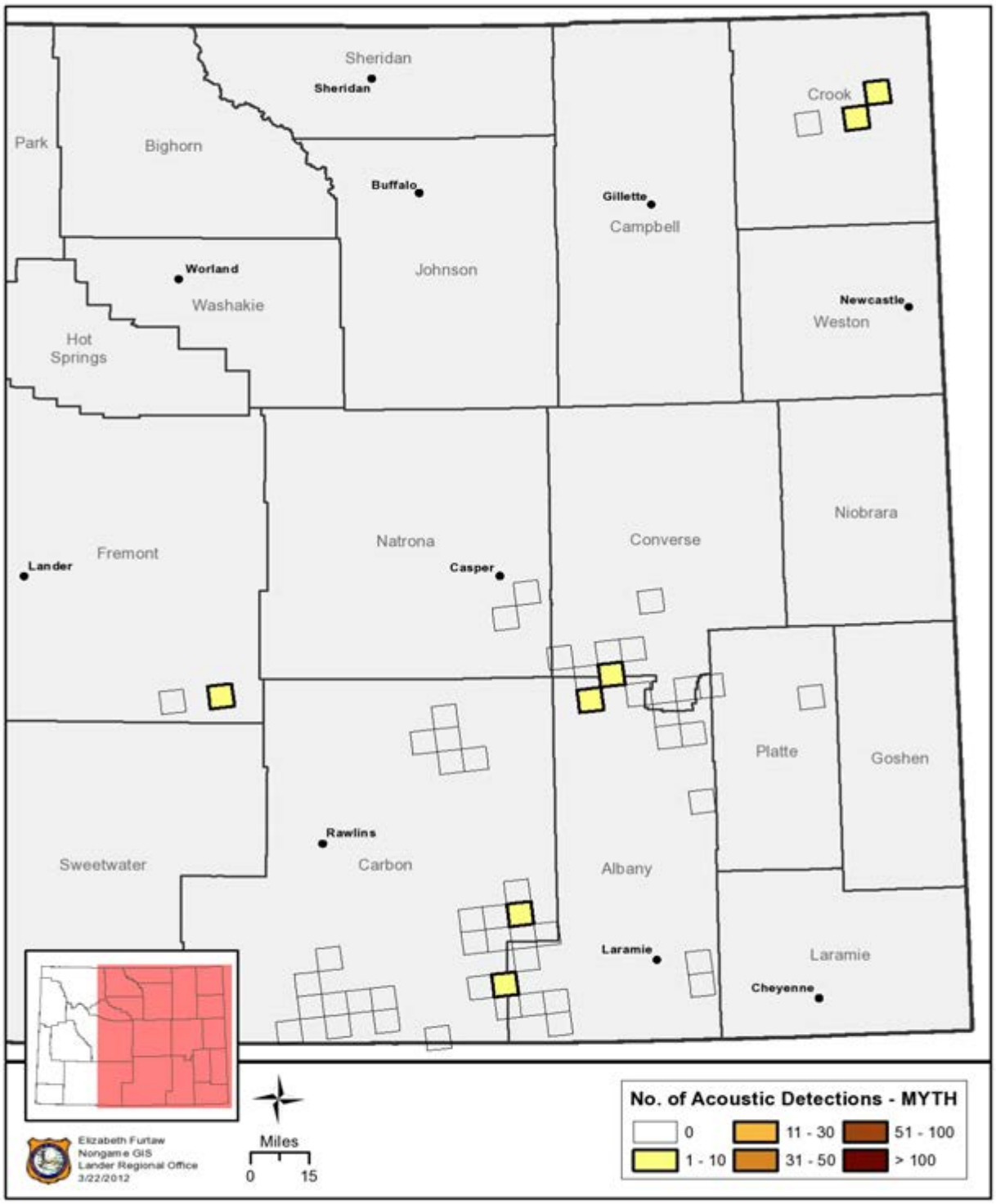

Figure 14. Number and spatial arrangement of detections of fringed myotis (*Myotis thysanodes*) in eastern Wyoming, May–September, 2011.

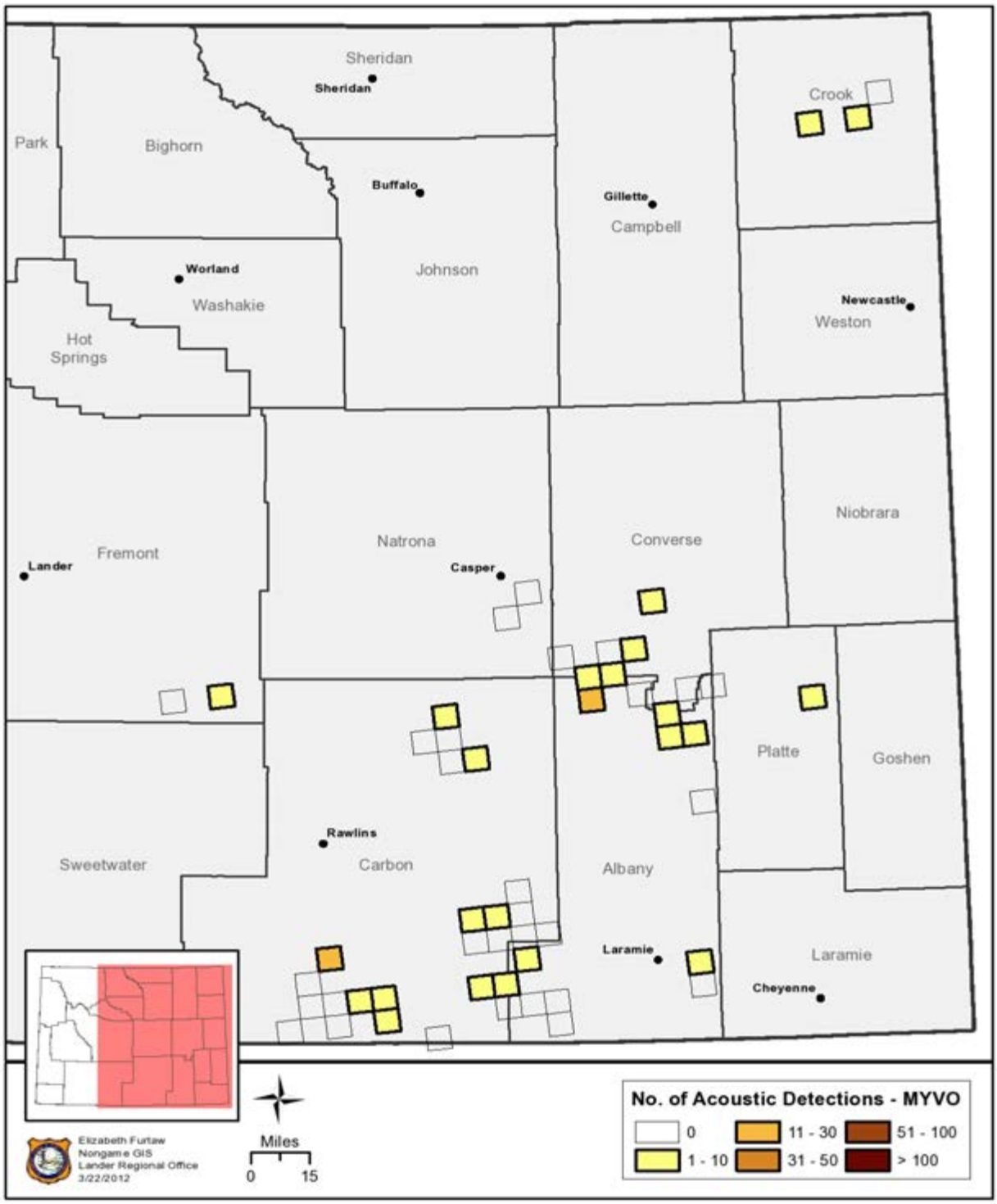

Figure 15. Number and spatial arrangement of detections of long-legged myotis (*Myotis volans*) in eastern Wyoming, May–September, 2011.

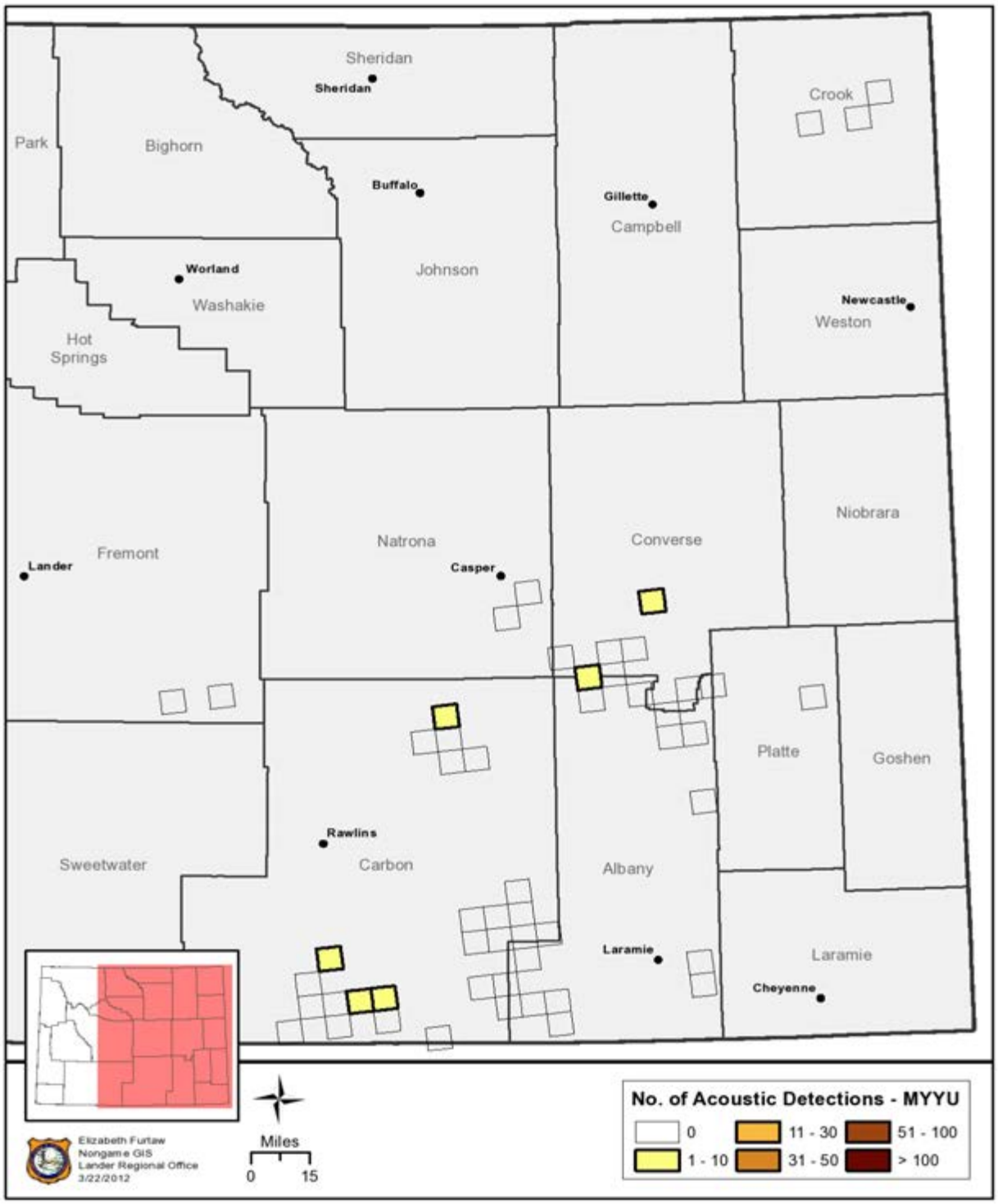

Figure 16. Number and spatial arrangement of detections of Yuma myotis (*Myotis yumanensis*) in eastern Wyoming, May–September, 2011.

EVALUATION OF SURVEY TECHNIQUES FOR THE NORTHERN FLYING SQUIRREL

STATE OF WYOMING

NONGAME MAMMALS: Species of Greatest Conservation Need - Northern Flying Squirrel

FUNDING SOURCE: Wyoming Governor's Big Game License Coalition

PROJECT DURATION: 1 JULY 2011 – 30 JUNE 2012

PERIOD COVERD: 1 July 2011 – 30 June 2012

PREPARED BY: Laurie Van Fleet, Nongame Biologist
Martin Grenier, Nongame Mammal Biologist

ABSTRACT

Few records of the northern Flying Squirrel (*Glaucomys sabrinus*) exist in the Wyoming Game and Fish Department's Wildlife Observation System. The species is classified as a Species of Greatest Conservation Need by the Wyoming Game and Fish Department (WGFD 2010). Population trends are lacking and they may be vulnerable to decreases associated with climate change and increased mortality of mature pine trees due to mountain pine beetles outbreaks. Although live-trapping is effective for quantifying important demography characteristics of a population, and is commonly used to detect northern flying squirrels, it can be labor intensive. This can make it difficult to use this method to estimate population trends across large areas. Remote infra red cameras have been used effectively to detect other nocturnal animals (e.g., swift fox) and may be useful if applied to northern flying squirrels (Knox and Grenier 2010, Cudworth and Grenier 2011). We evaluated our ability to detect flying squirrels and associated costs for three survey methods. Two of the methods used the same survey instrument, infrared cameras. For these, we used a 3 × 3 and a 4 ×4 array of cameras within a 4-ha plot and utilized different baiting techniques. The third method used standard live-trapping approaches (Smith and Nichols 2003). All surveys were conducted between September and October 2011. Mean survey nights was 9 for the 3 × 3, 16 for the 4 ×4 camera arrays, and 60.25 for live-traps. Our mean latency to first detection was highest for the live-traps instrument at 20.2 nights. Our results suggest the 4 × 4 array of infrared cameras offered a feasible, cost effective, and safe alternative to live-trapping. This approach could be used in conjunction with robust mark-recapture approaches such as occupancy modeling to monitor changes in populations of northern flying squirrel throughout Wyoming.

INTRODUCTION

The Wyoming Game and Fish Department (Department) classified the northern flying squirrel (*Glaucomys sabrinus*; flying squirrel) as a Species of Greatest Conservation Need (SGCN) with a Native Species Status of 4 and a Tier 2 species in the State Wildlife Action Plan (WGFD 2010; SWAP). Due to its secretive and nocturnal nature, few data points exist in the WGFD's Wildlife Observation System. In Wyoming, the flying squirrel occurs primarily in Montane and Subalpine Forests of the western mountain ranges, although there are isolated populations in the Xeric and Lower Montane Forests of the Black Hills and Sweetwater County (WGFD 2010). It prefers mature forests, with abundant standing and downed snags. Old growth stands provide the most suitable habitats for the flying squirrel which relies on these stands to facilitate locomotion, for nesting, and to forage for wood-borne fungi and lichens (Carey et al. 1999). The flying squirrel is also an important prey base for owls and small carnivores associated with old growth forests (Martin et al. 1994). In Wyoming, habitat loss is the most limiting factor for populations of flying squirrels (WGFD 2010). They are susceptible to declines as a result of large-scale habitat manipulation projects that destroy or remove suitable habitat (e.g., logging, prescribed fire) with both short- and long-term consequences (Holloway and Smith 2011). The flying squirrel is also vulnerable to habitat loss due to climate change (e.g., mountain pine beetle kill, drought, fire) which may cause their range to contract or fragment.

Currently in Wyoming there are no ongoing efforts to monitor population trends, delineate important habitats, or conduct basic inventories for the flying squirrel. Live-traps are a commonly used technique for surveying for flying squirrels (Smith and Nichols 2003). Although live-trapping is effective for quantifying important demography characteristics of a population it can be labor intensive thereby making it difficult to use to estimate population trends across large areas. Further, the live-traps always represent some risk to individuals (e.g., injury, myopathy, etc.). Remote infrared cameras have been used effectively to detect other nocturnal animals (e.g., swift fox) and may be useful if applied to flying squirrels (Knox and Grenier 2010, Cudworth and Grenier 2011). As such, our objectives for this study were to evaluate cost, efficacy, and feasibility of three survey methods, and to develop recommendations for survey methodology that could be utilized by the Department to conduct future surveys.

METHODS

Our study area was located in the southern Wind River Mountains on the Shoshone National Forest where flying squirrels were known to occur (Figure 1). Habitat consisted primarily of mature lodgepole pine (*Pinus contorta*), and Douglas fir (*Pseudotsuga menziezii)* with elevation ranging from approximately 2709 m to 2768 m.

We evaluated three survey methods for detecting flying squirrels between September and October 2011. We used live-trapping and two different arrays (i.e., a 3 × 3 and a 4 × 4 array) of infrared cameras within a 4-ha plot. All plots for camera and live-traps were based loosely from

live-trapping protocols established in Smith and Nichols (2003). Survey stations for camera and live-trap were placed 50 m apart within the plot; this distance ensured at least four cameras or traps were in each flying squirrel's home range and accounted for home range overlap between flying squirrels (Hough and Dieter 2009). We baited all stations with a mixture of peanut butter, rolled oats, and bacon grease (Hough and Dieter 2009). We compared the cost of the materials and number of person•hrs required to implement each method. Cameras and live-traps were already available through the Department's Nongame Program and were not considered in the final cost comparisons. We also contrasted performance of these survey methods using several metrics which included latency to first detection (LTD) and probability of detection (*p*). We calculated LTD by taking the mean number of camera or trap nights until first detection (Forseman et al. 1998) and calculated *p* by dividing the number of flying squirrels detected by the number of camera or trap nights.

For the 3 × 3 array survey we placed nine camera stations within the plot using standard spacing. We also included a 50 m buffer zone between stations and outer perimeter of the square plot. We surveyed three plots using this arrangement. At each survey station we affixed an infrared camera (Reconyx, PM35, Holmen, Wisconsin) approximately 1.5 m above ground on the trunk of a tree. We programmed the cameras to take three photos every 10 sec each time the camera was triggered, between 1800 to 0600 hrs and deployed them for 7 consecutive nights. We stapled hardware cloth (15.25 × 15.25 cm) over the bait on the trunk of another tree <2 m from the camera. All stations were re-baited on the fourth and the seventh day of the survey. At the end of seventh night we retrieved cameras, downloaded pictures to a laptop computer, and erased each memory card. We then calculated associated cost on a per plot basis.

For the live-trapping we placed 16 trapping stations in a 4 × 4 array with 50 m between stations. We surveyed two plots using this arrangement. Two live-traps (Tomahawk Live Trap, Model 201, Tomahawk, Wisconsin) were placed at each station. One trap was hung vertically, approximately 1.5 m above ground on the trunk of a tree with the trap entrance facing up and secured with 16-gauge wire. A second trap was placed on the ground within 1 m of the same tree (Meyer et al 2005, Rosenberg and Anthony 1993). Both traps were covered with black plastic sheeting and a polyethylene stuffing material was provided for thermal insulation. Traps were opened in late afternoon and baited. Traps were checked in the morning and all traps were closed during the day to minimize captures of non-target species. Captured flying squirrels were flushed from the live-trap into a cloth handling cone for processing (Koprowski 2002). Body mass, sex, reproductive condition, and age class were recorded for all captured flying squirrels. Flying squirrels were marked with a numbered metal ear tag (National Band and Tag Co., Monel #1, Newport, KY) on each ear and released after processing. However, due to multiple mortalities of flying squirrel we terminated the survey after two nights.

Finally, for the last survey we set 16 infrared cameras in a 4 × 4 array within the 4-ha plot and surveyed one plot using this arrangement. We deployed cameras in a similar manner as in the 3 × 3 array survey with one modification. We placed the bait in a 10 cm polyvinyl chloride (PVC) pipe enclosure and attached it to a tree <2 m from the camera (Figure 2). We baited the PVC pipe enclosure at each station in the late afternoon for seven consecutive days. At the end

of seventh night we retrieved cameras, downloaded pictures to a laptop computer, and erased each memory card.

RESULTS

We detected 2 flying squirrels during 189 camera nights using the 3 × 3 camera array (Table 1). We failed to detect flying squirrels on two of the three plots we surveyed using this approach. Our combined mean LTD for the 3 × 3 array was 9 nights and $p = 0.03$ (Table 1). Other species observed during our survey included elk (*Cervus canadensis*), least chipmunk (*Neotamias minimus*), mule deer (*Odocoileus hemionus*), red squirrel (*Tamiasciurus hudsonicus*), yellow pine chipmunk (*Neotamias amoenus*), and an unidentified mouse (*Peromyscus sp.*).

Cameras were easily deployed and each plot required about 2 person•hrs to set up and less than 0.75 person•hrs to remove. Re-baiting mid-week required approximately 0.5 person•hrs. Overall, this arrangement required approximately 6 person•hrs per plot to complete the survey. Total cost for surveying one plot with nine cameras was $226.00.

During the live-trapping surveys we captured a total of 7 flying squirrels during 114 trap nights (Table 1). The first night of the survey, we captured two adult males, one adult female, and one sub-adult female and released three of them. We euthanized one adult male due to an injury. On the second check, we had one flying squirrel escape before processing; one adult male was found dead in the trap and a third adult male died after release. One adult male and 1sub-adult female were ear-tagged during the two night survey. Due to the high mortality rate (43%) we discontinued the survey after two nights and removed all live-traps. Notably, all flying squirrels were captured in the vertical traps attached to a tree. Individual capture data is presented in Table 2. Other species trapped during our survey included least chipmunk (*Neotamias minimus*) and yellow-pine chipmunk (*Neotamias amoenus*).

The mean LTD for live-trapping was 20.2 nights and $p = 0.05$ (Table 1). We estimate that live-trapping for a seven night survey would have required approximately 50 person•hrs per plot (Table 1). Each plot required approximately 6 person•hrs to set up and 2 person•hrs to take down. Checking and closing traps in the morning and returning to open and re-bait traps in the afternoon required an additional 14 person•hrs, while the total hours driving to and from the site during the seven night survey would have been approximately 28 person•hrs. Total cost of surveying 1 plot with 16 stations with 2 live-traps per stations (i.e., 32 total traps) was approximately $1,074.00.

For the 4 × 4 array plot we observed flying squirrels 32 times representing 19 detections (Table 1). Flying squirrels were observed at 9 different stations during 112 survey nights and appeared to visit stations repeatedly. We did not observe any flying squirrels that we had previously ear-tagged. Other species detected during our survey included red squirrel

(*Tamiasciurus hudsonicus*), least chipmunk (*Neotamias minimus*), moose (*Alces alces*), mule deer (*Odocoileus hemionus*), domestic cows (*Bos primigenius)*, and one human (*Homo sapien*).

Our mean LTD for this approach was 16 nights and $p = 0.17$ (Table 1). Cameras were easily deployed and each required about 3 person•hrs to set up and less than 1.5 person•hrs to take down (Table 1). Re-baiting each afternoon required approximately 0.75 person•hrs. Total cost of surveying 1 plot with 16 cameras was $565.00.

DISCUSSION

We initially planned to conduct each survey method using three different plots for each survey method, we did using the 3 × 3 array of cameras. However, due to trap mortalities we discontinued the survey using the live-trap. We were also faced with a compressed time frame in which to conduct the surveys due to weather and the threat of losing access to the survey area due to snow, so we were unable to survey all 3 three plots as planned with the 4 × 4 array. We have no reason to believe that results would have been different than to those we reported, had we completed all replicates.

The most efficient survey method for detecting flying squirrel in the southern Wind River Mountains was infrared cameras. This method offers a feasible, cost effective, noninvasive, and safe alternative to live-trapping and can be used any time of the year with minimal effort. Cameras were easily deployed, operated, and removed by one person. Although the cameras we used were available at no cost to us, we point out that there are substantial start up costs (i.e., ≥ $500 per camera) to other users if cameras are not readily available. Among the arrays we tested, we found the 4 × 4 array to be more effective than the 3 × 3 array. Our results indicate that by increasing the number of cameras within the plot we were able to increase detections due to overlapping home ranges of flying squirrels. We believe the addition of the PVC pipe enclosures on the 4 × 4 array of cameras prevented diurnal non-target species (e.g., birds) from consuming the bait, thus increasing opportunities for flying squirrels to visit the camera stations.

The 3 × 3 array of cameras was the least costly method. This method required the shortest time to set up, thus increasing the number of plots that one person could deploy in one day. This arrangement also increased the number of plots that could be maintained in a week. We suspect that the low number of detections of flying squirrel on the 3 × 3 array of cameras may have been a result of how we presented the bait. The hardware cloth made it difficult to consume the bait and because we only baited stations once during the seven night survey the bait dried out rapidly. We hypothesize that if we used the PVC bait tube setup as we did in the 4 × 4 array and re-baited more frequently, p could approach that of the 4 × 4 array.

The cost to implement the survey using live-traps was nearly double the cost of the 4 × 4 array of cameras. This is not surprising as personnel had to visit each station twice daily. Although the operation costs were high, the start up costs of the live-traps was considerably lower (i.e., ≤ $ 50.00 per trap) than for cameras (i.e., ≤$500 per camera). When planning future

surveys we recommend that managers consider start up costs (i.e., cost of survey equipment). If equipment is not readily available, the differences will greatly affect the budget of the project.

Although live-trapping is commonly used for mark-recapture studies and for detecting flying squirrels we were somewhat surprised by the high number of mortalities of flying squirrels during our surveys. Further review revealed that capture myopathy is common among flying squirrels (Rosenberg and Anthony 1993). We believe that extrinsic factors, such as temperature and precipitation were not unreasonable during our survey period and these did not increase risk of mortality during our project. We supplied bedding material in each trap which should have assisted the ability of flying squirrels to stay warm during the night. Notably, no mortalities were reported for non-target species we captured. Although previously reported, it is unclear why such high mortality rates we encountered (Perrin 1975; Gurnell 1982). We hypothesize that possibly conducting surveys using this instrument during the warmer months (i.e., July and August) may prevent the mortalities in the future.

We recommend that the Department utilize the infrared camera method with the 4 × 4 array cameras on the 4-ha plot and the PVC pipe enclosure to deliver the bait in the future. We believe this technique offers a feasible, cost effective, and safe alternative to live-trapping. Further, if robust mark-recapture approaches such as occupancy modeling will be used to monitor changes in populations of northern flying squirrel throughout, it is important to note that $p = 1$ for the plot we surveyed. Although it is a small sample, we detected flying squirrels every night of the survey using this approach. Our results suggest that this method offers the highest potential for application to occupancy modeling.

ACKNOWLEDGEMENTS

Funding for this project was provided by the Wyoming Governor's Big Game License Coalition, for which we are extremely grateful. We also extend a special thanks to Wyoming Game and Fish Department nongame GIS technician S. Cornell and nongame biologist R. Abel for their assistance with field work and data collection, and nongame biologist N. Cudworth who provided expertise in trapping and processing squirrels along with valuable contributions in the field.

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Table 1. Comparison of three survey methods, 3 × 3 and 4 × 4 array of infrared cameras, and live-trapping (Smith and Nichols 2003), using a 4-ha plot for northern flying squirrels (*Glaucomys sabrinus*; GLSA) in the southern Wind River Mountains, Wyoming, September and October 2011. For each survey method we compared several common metrics to evaluate the effectiveness of the method. Total observations represent the total number of individuals observed or captured for the survey. Total detections represent the unique number of observations or captures for the survey. Latency to first detection represents the mean number of trap nights required to first detection. Probability of detection represents the number of northern flying squirrels detected divided by the number of trap nights. Results are presented on a per plot basis.

Survey Method	Total GLSA observations	Total GLSA detections	Total camera or trap nights (days)	Mean camera or trap nights (days)	Latency to first detection	Probability of detection
3 × 3 array	2	2	63	9	9	0.03
4 × 4 array	32	19	112	16	16	0.17
Live-trapping	3.5	3.5	60.25	60.25	20.2	0.05

Table 2. Capture date and demography data for northern flying squirrels (*Glaucomys sabrinus*) we processed during surveys conducted in the southern Wind River Mountains, Wyoming, September and October 2011. SA = sub-adult based on non-reproductive in females or part scrotal in males; AD = adult based on lactating or recent/post lactation in females and scrotal in males.

Capture Date	Capture Order	Ear Tags	Sex	Age	Weight (g)	Comments
9/15/2011	001	Yes	F	SA		
9/15/2011	002	Yes	M	AD	160 g	
9/15/2011	003		M	AD		Euthanized due to injury
9/15/2011	004		F	AD		
9/16/2011	005		M	AD	142 g	Died after release
9/16/2011	006		M	AD		Found dead in trap
9/16/2011						Escaped

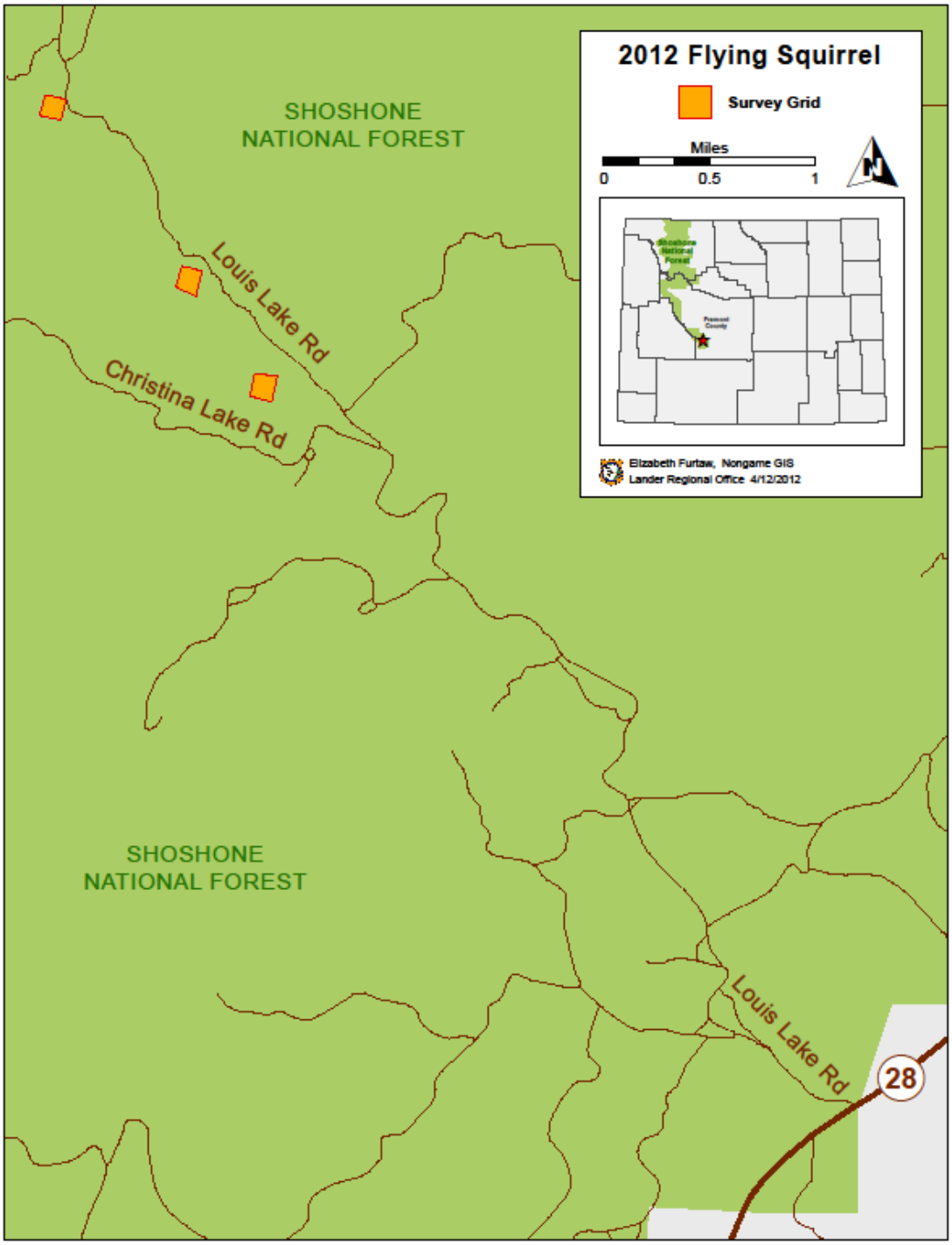

Figure 1. Study area and general locations of survey plots for Northern flying squirrel (*Glaucomys sabrinus*) in the southern Wind River Mountains, Shoshone National Forest, Wyoming, September and October 2011.

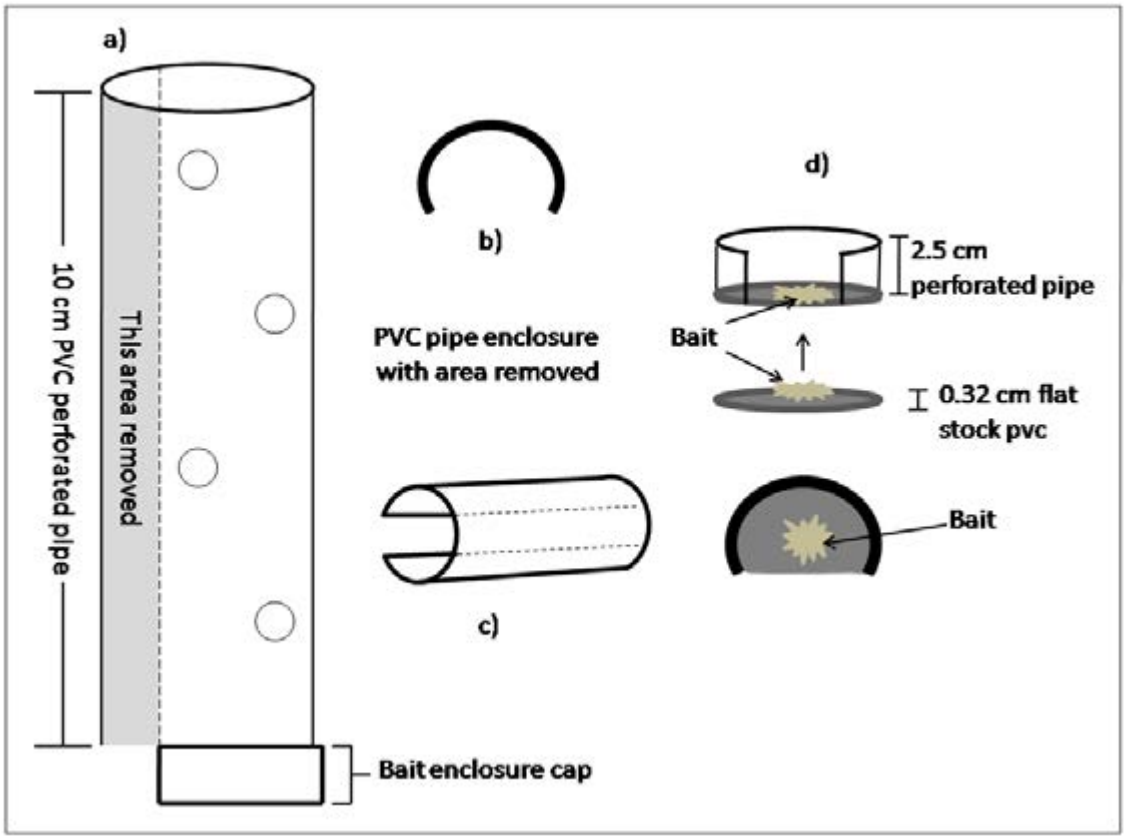

Figure 2. Schematic of polyvinyl chloride (PVC) pipe enclosure used for deploying the bait to northern flying squirrel at survey stations in the southern Wind River Mountains, Wyoming, 2011. a) Side view of 10cm PVC perforated pipe; b) End view with ~7 cm PVC pipe removed; c) Horizontal view with area removed; d) Bait enclosure cap.

INFLUENCE OF ENERGY DEVELOPMENT ON SAGEBRUSH SMALL MAMMALS

STATE OF WYOMING

NONGAME MAMMALS: Species of Greatest Conservation Need / Sagebrush Small Mammals – Sagebrush Vole, Olive-Backed Pocket Mouse, Deer Mouse, Northern Grasshopper Mouse, Dwarf Shrew, Least Chipmunk, Western Harvest Mouse, Northern Pocket Gopher

FUNDING SOURCE: United States Fish and Wildlife Service State Wildlife Grants

PROJECT DURATION: Masters Thesis Research

PERIOD COVERED: 15 April 2011 – 14 April 2012

PREPARED BY: Ian M. Abernethy, Wyoming Cooperative Fish and Wildlife Research Unit
Anna D. Chalfoun, Wyoming Cooperative Fish and Wildlife Research Unit

SUMMARY

This is a Master of Science thesis project through the Wyoming Cooperative Fish and Wildlife Research Unit, and only the summary is presented here. To access the entire thesis, contact the Department of Zoology and Physiology, Biological Science Building Room 419, 1000 East University Avenue, Department 3166, Laramie, WY, 82071, 307-766-5415.

Ecosystems are experiencing anthropogenic disturbances at a global scale, resulting in widespread habitat loss, fragmentation, and alteration. Yet, we know little about how local habitat attributes may interact with landscape-scale human disturbance to influence wildlife communities. Sagebrush habitats range-wide have been highly altered. In the past two decades, energy development has increased in sagebrush habitats in the Intermountain West of North America. While the effects of energy development have been documented in game animals such as the Greater Sage-Grouse (*Centrocercus urophasianus*) and mule deer (*Odocoileus hemionus*), studies documenting responses of nongame mammals are lacking. We examined the effects of habitat characteristics in areas with and without energy development on the abundance and diversity of small mammals in sagebrush steppe. Data were collected in 2009 and 2010 within two natural gas fields and adjacent control areas in the Upper Green River Basin, Wyoming. We used live traps to capture small mammals across a gradient of sagebrush cover and height within energy development and adjacent control areas. When we accounted for important habitat metrics, small mammal abundance varied marginally across gradients of sagebrush cover and height. Specifically, the density of deer mice (*Peromyscus maniculatus*), western harvest mice (*Reithrodontomys megalotis*), and reproductively active individuals increased with increasing sagebrush cover and height. Conversely, northern grasshopper mouse (*Onychomys leucogaster*)

and sagebrush vole (*Lemmiscus curtatus*) density was inversely related to sagebrush cover and height. In addition, the density of deer mice, western harvest mice, northern grasshopper mice, and juvenile individuals as well as species richness increased at sites with energy development. Population estimates of deer mice showed a significant interaction between the sagebrush habitat gradient and energy development.

Our results demonstrated both independent and interactive effects of habitat and disturbance on the small mammal community in a sagebrush-energy development system, suggesting that consideration of local habitat structure may be critical for accurate evaluation of human disturbance effects. Responses were highly species-specific, however, which further suggests that small mammal species (similar to big game species) may need to be evaluated and managed on a species-by-species basis.

Ian Abernethy successfully defended his thesis on 25 April 2011, and his Master's degree was procured from the University of Wyoming in May 2011. The main chapter is in revision for the Journal of Wildlife Management, and the second chapter will be submitted to the Journal of Mammalogy within the next two months.

DEVELOPING PROTOCOLS FOR LONG-TERM MONITORING OF NORTHERN RIVER OTTER IN SOUTHWESTERN WYOMING

STATE OF WYOMING

NONGAME MAMMALS: Species of Greatest Conservation Need – Northern River Otter

FUNDING SOURCE: United States Fish and Wildlife Service State Wildlife Grants

PROJECT DURATION: Masters Thesis Research

PERIOD COVERED: 15 April 2011 – 14 April 2012

PREPARED BY: Merav Ben-David, Zoology and Physiology Department, University of Wyoming

SUMMARY

This is a Master of Science thesis project through the Department of Zoology and Physiology, and only the summary is presented here. To access the entire thesis, contact the Department of Zoology and Physiology, Biological Science Building Room 428, 1000 East University Avenue, Department 3166, Laramie, WY, 82071, 307-766-5415.

Exploration and extraction of natural gas in the Intermountain West has been steadily increasing since the 1980s. In southwestern Wyoming, the Pinedale Anticline and Jonah Field contain some of the largest gas reserves in the Intermountain West and have been in development since the 1990s (BLM 2000). Federal ownership of lands and the current National Energy Policy will likely lead to continued large-scale development of mining operations in this area. The Green River in southwestern Wyoming is the largest tributary for the Colorado River, and the Green River Basin contains many reservoirs and lakes that provide essential water resources for agriculture and urban use within the catchment area as well as down river (Wyoming State Water Plan 2008). Therefore, any disturbance to the flow of the river and any reduction in water quality from natural gas developments (Wang and Yang 2006) may have negative effects on this critical resource.

Northern river otters (*Lontra canadensis*; otters) are semi-aquatic piscivorous mustelids that inhabit freshwater lakes and streams throughout North America. Otters are ubiquitous in nearshore waters along the Atlantic Seaboard and the Pacific Northwest (Lariviere and Walton 1998, Melquist et al. 2003). Otters are particularly sensitive to environmental degradation, pollution (Bowyer et al. 2003), and human disturbance (Gaydos et al. 2007). As such, they serve as an ideal sentinel species to monitor the health of aquatic ecosystems.

Otters are both elusive and difficult to recapture, making a population census via direct observation or mark-recapture approaches impractical. These challenges can be overcome by using indirect sampling of hair and feces for genetic analyses (Hansen et al. 2008, Guertin et al. in press). Otters visit latrine sites with a high degree of fidelity (Crait and Ben-David 2007), sites are easy to identify in a variety of habitats (Bowyer et al. 1995, 2003; Ben-David et al. 2005; DePue and Ben-David in press), sample collection is non-invasive, and otters are not disturbed or displaced by researcher activity at latrine sites (Ben-David and Golden 2007).

Our objectives in this project were to:

1. Estimate the abundance of otters along sections of the Green River and tributaries in Wyoming via hair and fecal DNA analysis and capture re-capture models.
2. Estimate survival of otters along sections of the Green River and tributaries in Wyoming via hair and fecal DNA analysis and capture re-capture models.
3. Assess the optimal sampling design for obtaining an unbiased and precise estimate of otter abundance and survival in the Green River Basin of Wyoming.
4. Develop a monitoring protocol for otter abundance and survival in the Green River Basin of Wyoming.

The first field season was conducted between 15 May and 12 August 2010. We surveyed three river sections in the Green River Basin following the requirements of a robust design, capture-recapture model (Pollock 1982). We surveyed each section 3× during the summer (Table 1). Within each primary occasion, we sampled latrine sites along each river section on 4 consecutive secondary occasions, each lasting 2 days. Thus, we visited each site 12× during the sampling period. We surveyed river sections in: Seedskadee National Wildlife Refuge below the Fontenelle Reservoir (S1), the upper Green River directly above the Fontenelle Reservoir (UGR), and the New Fork River (NF), a large tributary flowing into the Green River above the upper Green River section (Fig. 1). The second field season was conducted between 22 May and 13 August 2011. We surveyed river sections in: S1, the second half of the Seedskadee National Wildlife Refuge (S2), and the UGR. S1 and UGR were surveyed in both field seasons (Fig. 1).

In 2010, for all 3 river sections, we collected a total of 302 scat samples and 18 hair samples (Table 2). We collected the majority of samples from S1 and few from the NF section, despite no observable difference in habitat and vegetation along the bank. In 2011, for the 3 river sections we surveyed, we collected a total of 278 scats and 24 hair samples (Table 2). We collected the majority of samples from the sections S1 and S2. River flows were exceptionally high in summer 2011, and the UGR was close to or in flood stage until August. As such, it is possible that the otters left the river and moved to smaller tributaries. The timing of successful collections on the UGR, which were largely at the end of the season, supports this idea.

We have completed the sieving of scats from both field seasons. We completed extraction of DNA for samples collected in 2010, and amplification is currently underway for these samples. We will commence extraction and amplification of samples collected in 2011 in May 2012.

To evaluate the effects of disturbance on the use of latrines by otters, we quantified the level of disturbance for the river sections surveyed in 2010. We clipped the disturbance rasters developed by The Nature Conservancy for the state of Wyoming to our study area. These rasters incorporated information that included land use, development, power lines, and roads. We conducted analyses for 200 m buffers around each latrine site, as well as for the entire river section surveyed (Fig. 2). Our analyses revealed that disturbance was higher at the NF river section and latrines compared with the UGR and the S1 site, which had the lowest disturbance (Table 3). Further assessment revealed that river otter activity was negatively influenced by the density of actively drilled gas wells in each section (Fig. 3).

Originally it was our plan to survey two new river sections in 2011. The Black's Fork and Ham's Fork were considered for surveys but were deemed unfloatable for the minimum required distance of 30 km because of many shallow areas and obstructions in the river. We surveyed the Big Sandy River above the Big Sandy Reservoir with help from Diana Sweet from the Wyoming Game and Fish Department but detected no sign of resident otters. We therefore decided to resurvey the UGR in hopes of increasing sample sizes from 2010.

In 2011, we used a scent lure made from musk from otter anal glands mixed with Vaseline in conjunction with hair snares in order to attract otters through the snare. This strategy yielded slightly higher success in 2011 (24 samples) than 2010 (18 samples). However, the increase in collections was not as high as expected. It is possible that the efficacy of hair snaring in such an open riparian habitat is low.

The unusually high river flows in summer 2011 posed various safety concerns and led us to rework the survey schedule. The high water levels probably led to the low number of samples collected in the UGR. As such, the importance of obtaining river flow forecasts during survey periods will be emphasized in the final monitoring protocol.

We will be working on a number of new and continuing projects in the upcoming year. Together with Dr. Annika Walters from the Wyoming Cooperative Fish and Wildlife Research Unit, we purchased four conductivity loggers (Onset HOBO U24, Cape Cod MA). We will deploy two of these loggers in the NF river section, one in the UGR, and one in the S1 section in mid-June 2012. We will retrieve these loggers at the end of July. Concurrently, Dr. Walters and her student will deploy three additional loggers in other tributaries of the Green River. We will use data from all seven loggers to assess discharge of heavy metals into stream waters as a result of hydraulic fracturing activities in the Green River Basin.

We will collect 5 water samples from each river section, for a total of 30 water samples throughout our study area (i.e., 5 × 3 in June and 5 × 3 in July) concurrently with deployment and retrieval of data loggers. We will analyze the water samples for heavy metals and organics, which are commonly associated with hydraulic fracturing. During the summer of 2012, we will continue analyses of DNA samples. We will complete the analyses by September 2012. In fall 2012, we will analyze all genetic and conductivity data. Report writing (including developing the monitoring protocol) and thesis defense are scheduled for spring 2013.

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Table 1. Total length (km) and dates of primary occasions for four river sections surveyed for northern river otter (*Lontra canadensis*) latrine sites within the Green River Basin, Wyoming, 2010-2011. River section S1 and S2 represent two sections of the Green River in Seedskadee National Wildlife Refuge; UGR represents the Upper Green River; and NF represents the New Fork River, a tributary of the Green River. Two sections (S1 and UGR) were surveyed in both years. In every primary occasion, each river section was surveyed 4× consecutively (secondary occasions).

Year	River section	Total length (km)	Dates of primary occasions
2010	S1	38.6	May 16-24, June 18-25, July 15-23
	UGR	35.4	May 31-June 8, June 27-July 4, July 25-August 2
	NF	32.2	June 9-16, July 6-13, August 3-12
2011	S1	38.6	May 22 - 29, June 21-28, July 12-19
	S2	38.9	June 1 - 9, June 30 - July 7, July 28 - August 4
	UGR	35.4	June 12 - 19, July 20 - 27, August 6 - 13

Table 2. Number of northern river otter (*Lontra canadensis*) latrines identified and number of scat and hair samples collected along four river sections surveyed in the Green River Basin, Wyoming, 2010-2011. River section S1 and S2 represent two sections of the Green River in Seedskadee National Wildlife Refuge; UGR represents the Upper Green River; and NF represents the New Fork River, a tributary of the Green River.

Year	River section	No. of latrines	No. of scat samples	No. of hair samples
2010	S1	24	234	16
	UGR	17	57	1
	NF	6	11	1
2011	S1	23	133	15
	S2	21	128	9
	UGR	12	17	0
Total		103	580	42

Table 3. River sections surveyed and disturbance values for northern river otter (*Lontra canadensis*) latrines within the Green River Basin, Wyoming, 2010. Disturbance values were derived from raster datasets developed by The Nature Conservancy for the state of Wyoming with help from Dr. Shannon Albeke at the Wyoming Geographic Science Center. River section S1 represents the Green River in Seedskadee National Wildlife Refuge directly below the Fontenelle Reservoir; UGR represents the Upper Green River; and NF represents the New Fork River, a tributary of the Green River.

River section	Mean disturbance values for latrine sites	Mean disturbance values for river sections
S1	11.22	13.45
UGR	28.65	21.38
NF	29.79	32.95

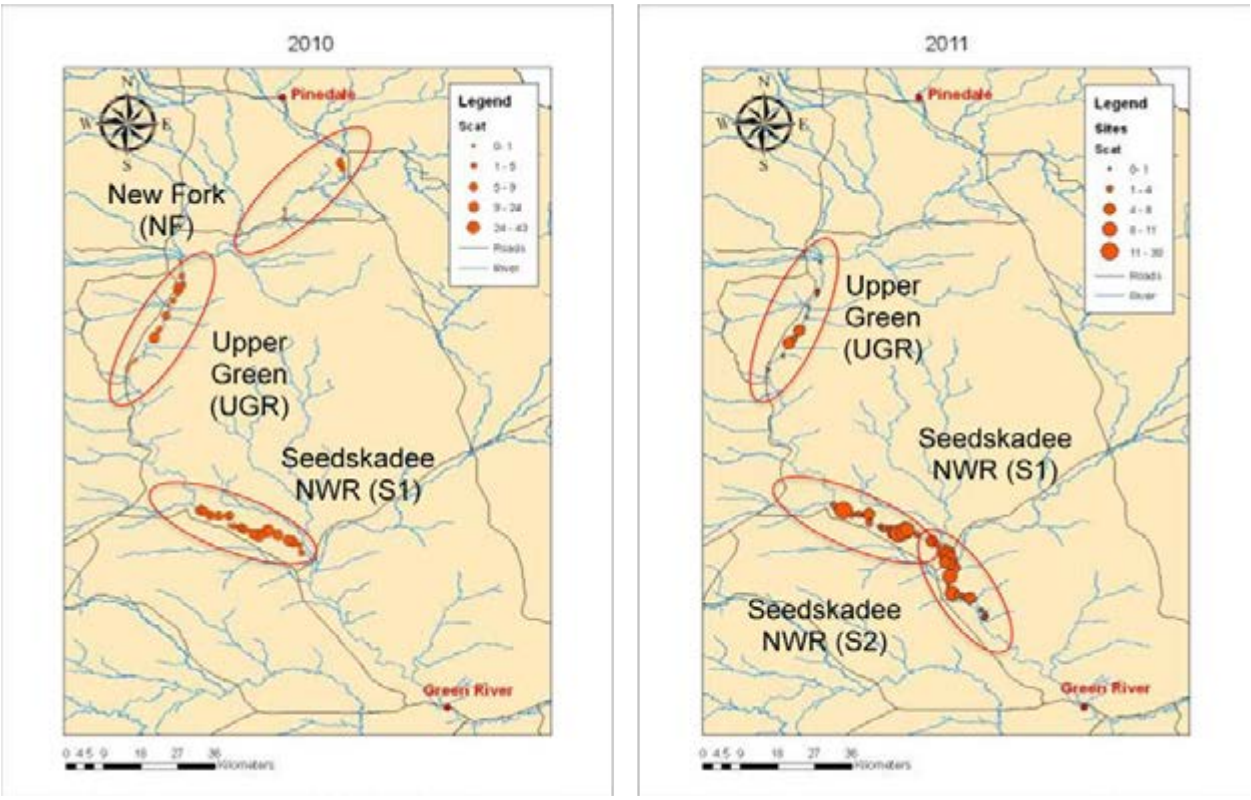

Figure 1. Location of northern river otter (*Lontra canadensis*) latrine sites (colored circles) along the New Fork, Upper Green, and Seedskadee National Wildlife Refuge river sections in the Green River Basin, Wyoming, 2010-2011. Fecal deposition rate (number of scats) is denoted by size of circles.

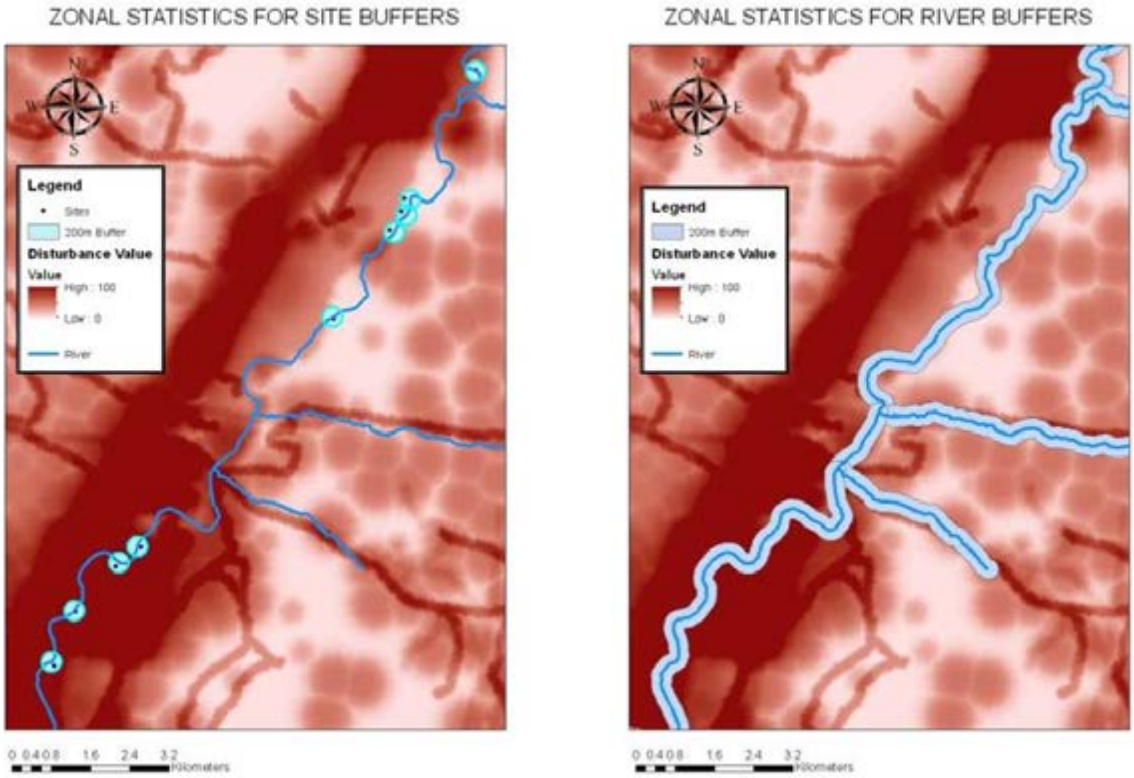

Figure 2. Example of scoring of zonal statistics of disturbance for northern river otter (*Lontra canadensis*) latrine sites (left panel) and river section (right panel) for river sections in the Green River Basin, Wyoming, 2010-2011. Dark red landcover indicates higher disturbance values than light red landcover. Disturbance layers were obtained from The Nature Conservancy with help from the Wyoming Geographic Science Center.

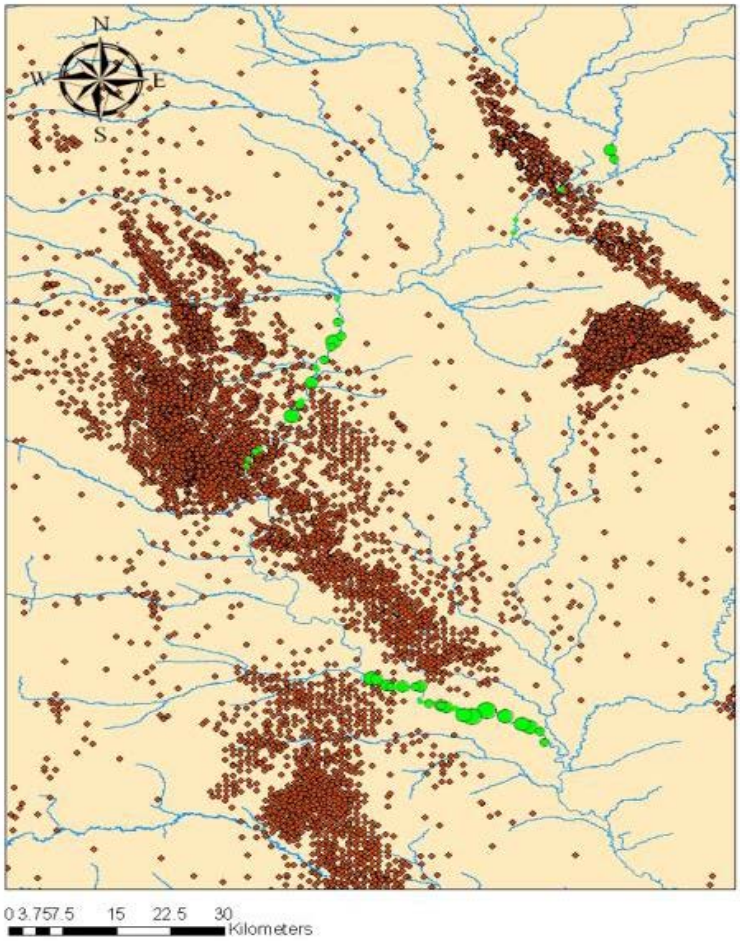

Figure 3. Distribution of gas wells in the vicinity of the Green River Basin, Wyoming, superimposed on northern river otter (*Lontra canadensis*) latrine sites in three river sections surveyed in 2010. Otter activity (as indicated by locations of latrines and fecal deposition, indicated by size of circle) is highest where well density is lowest.

SPECIES OF GREATEST CONSERVATION NEED – BIRDS AND *MAMMALS*

EVALUATION OF IMPACTS OF MOUNTAIN PINE BEETLE EPIDEMIC ON AVIAN AND SMALL MAMMAL SPECIES IN SOUTHEAST WYOMING

STATE OF WYOMING

NONGAME BIRDS AND MAMMALS: Species of Greatest Conservation Need

FUNDING SOURCE: United States Fish and Wildlife Service State Wildlife Grants

PROJECT DURATION: Master's Thesis Research

PERIOD COVERED: 31 March 2011 – 31 March 2012

PREPARED BY: Joslin Heyward, Wyoming Cooperative Fish and Wildlife Research Unit
Anna Chalfoun, Wyoming Cooperative Fish and Wildlife Research Unit

SUMMARY

The following is a summary of a Master of Science thesis project from the Wyoming Cooperative Fish and Wildlife Research Unit. To access the entire thesis, contact the Department of Zoology and Physiology, Biological Science Building Room 419, 1000 East University Avenue, Department 3166, Laramie, WY, 82071, (307)-766-5415.

We completed the second and final season of field research in the Medicine Bow National Forest of Wyoming (June – September, 2011). We sampled songbirds, woodpeckers, and diurnal/nocturnal small mammals across a gradient of patch sizes in two stand types (i.e., young, previously harvested lodgepole and spruce-fir) in order to evaluate the relative value of these alternative stand types as spatiotemporal refugia for lodgepole wildlife and potential critical patch size thresholds prior to mature lodgepole regeneration. We organized and analyzed data and presented results at The Wildlife Society National Conference (Nov 2011), The Wyoming Chapter of The Wildlife Society (Dec 2011), and the Mountain Pine Beetle Symposium (Apr 2012).

We are currently conducting final analyses for data collected during avian point counts and small mammal live-trapping. We plan to complete the thesis and defense by September, 2012.

THE EFFECTIVENESS OF SAGE-GROUSE CORE AREAS AS AN UMBRELLA FOR NONGAME SPECIES OF GREATEST CONSERVATION NEED

STATE OF WYOMING

NONGAME MAMMALS: Species of Greatest Conservation Need

FUNDING SOURCE: United States Fish and Wildlife Service State Wildlife Grants

PROJECT DURATION: PhD Research

PERIOD COVERED: 15 April 2011 – 14 April 2012

PREPARED BY: Jason Carlisle, Wyoming Cooperative Fish and Wildlife Research Unit
Anna D. Chalfoun, Wyoming Cooperative Fish and Wildlife Research Unit

SUMMARY

Wildlife managers, tasked with conserving a growing number of imperiled species and given only limited resources to do so, often focus their efforts on one species in the hopes that management actions focused on benefiting that species will also benefit other co-occurring wildlife. In Wyoming, by protecting areas important to sage-grouse (the umbrella species), managers hope to also conserve viable populations of non-game wildlife species of conservation need which share grouse habitats (including birds, small mammals, and reptiles). Our goal is to determine if Wyoming's sage-grouse core areas really are serving as an umbrella for conserving these non-game wildlife species.

We have compared the boundaries of core areas with predictive maps of nongame wildlife species ranges within Wyoming, providing an initial idea of which species are most likely to fall under the sage-grouse umbrella. We found that 5 of the 10 non-game species examined (i.e., pygmy rabbit, sage sparrow, greater short-horned lizard, sage thrasher, and sagebrush vole) had at least 40% of their predicted statewide range within grouse core areas. Our first field season is underway to collect field data in the Jeffrey City area.

REVIEW OF WILDLIFE OBSERVATION SYSTEM RECORDS FOR SPECIES OF GREATEST CONSERVATION NEED

STATE OF WYOMING

NONGAME BIRDS AND MAMMALS: Species of Greatest Conservation Need

FUNDING SOURCE: Wyoming State Legislature General Fund Appropriations

PROJECT DURATION: 15 April 2011 – 14 April 2012

PERIOD COVERED: 30 December and prior

PREPARED BY: Martin Grenier, Nongame Mammal Biologist

ABSTRACT

The Nongame Program initiated a review of records of Species of Greatest Conservation Need that occur in the Wyoming Game and Fish Department's Wildlife Observation System database in 2012. The objective of the project was to eliminate errors, improve accuracy, and reliability of the data contained in the Wildlife Observation System database. For mammals we reviewed all records prior to 30 December 2010. For birds we reviewed all records entered between 1 January and 30 December 2012. We identified 4,703 mammalian and 1,172 avian records that needed further review. After our review, we determined that 160 mammalian and 4 avian records needed to be removed from the Wildlife Observation System. This review will be performed annually in the future.

INTRODUCTION

The Nongame Program of the Wyoming Game and Fish Department (Department) and the Wyoming Natural Diversity Database anticipate that as awareness of Species of Greatest Conservation Need (SGCN) increases, in part due to the State Wildlife Action Plan (WGFD 2010; SWAP), the number of records submitted to the Wildlife Observation System database (WOS) will also increase. Accordingly, the Nongame Program initiated an annual review of all SGCN data entered into WOS to facilitate future revisions of SWAP, ensure that data contained within the WOS are accurate, and to minimize conflict with data transfers to the Wyoming Natural Diversity Database. This report represents the initial review of both bird and mammal SGCN. In the future, all new records entered into WOS from the previous calendar year will be reviewed and summarized in a similar report.

METHODS

During the spring of 2012, we downloaded all data for mammal SGCNs from WOS. Species classified as Big Game were omitted from the review. The data were constrained to all data points with an observation date of 30 December 2010 or earlier. The data were then imported into ArcGIS (ArcGIS 10.x, ESRI, Redlands, CA, USA). For each species, we reviewed and compared existing data points to their predicted range and distribution maps developed for SWAP. Data points that were identified as being outside of the predicted range and distribution were flagged for comprehensive review. Each flagged data point was carefully reviewed to determine the accuracy of the record. The review included location, date, observation comments, and habitat type. To do the high volume of data points for birds classified as SGCN, we constrained the review to observations that occurred between 1 January and 30 December 2010. Species classified as Game Birds were omitted from the review. The review process was similar to that used for mammal species. We compiled a final list of erroneous records for birds and mammals, which we submitted to the Department's Harvest Survey Coordinator who manages the WOS. Erroneous records were then removed from WOS and stored by the Harvest Survey Coordinator.

RESULTS AND DISCUSSION

For mammalian records, we downloaded 4,703 observations. Our initial review resulted in 197 of these records being flagged for occurring outside of the predicted distribution and range for the species. Further analysis revealed that 160 records were, in fact, erroneous. We suspect that the majority of errors resulted from some sort of coding error (e.g., wrong species code, wrong habitat type, etc.) when the data were entered. Thirty-seven records were reviewed and not removed from WOS.

For avian records, we downloaded 1,172 observations. Our initial review resulted in four records being flagged. Further analysis revealed that all four records were erroneous; however, we were able to correct one of the records and reassign it to a big game species. The other three records were removed from WOS.

Our review of WOS records for mammals classified as SGCN only included species classified as Nongame and Furbearer. Three species, the black-footed ferret (*Mustela nigripes*), wolverine (*Gulo gulo*), and swift fox (*Vulpes velox*) accounted for most of the 37 records that were not erroneous but were outside of the predicted range and distributions. The wolverine and black-footed ferret records represented several historic records where the species is no longer predicted to occur, while the swift fox represented recent records in non-traditional habitats (i.e., Wyoming big sagebrush).

Although the number of records for bird entered in WOS is considerably higher than those for mammals, there appears to be fewer errors made. It is unclear why this difference exists. Although we reviewed a large number of mammalian records during this initial review, we suspect that the number of annual WOS entries for mammals will be quite low in the future. In turn, this review may not need to be done annually in the future. We will continue to carefully

review WOS records annually to determine if these errors are a major concern and if additional actions are needed.

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HARVEST REPORTS

HARVEST OF RAPTORS FOR FALCONRY

STATE OF WYOMING

NONGAME BIRDS: Raptors

FUNDING SOURCE: Wyoming State Legislature General Fund Appropriation and/or Wyoming Governor's Endangered Species Account Fund

PROJECT DURATION: Annual

PERIOD COVERED: 1 January 2011 – 31 December 2011

PREPARED BY: Nichole Cudworth, Nongame Biologist
Mark DeHart, Permitting Officer

SUMMARY

In 2011, the Wyoming Game and Fish Department issued 30 falconry capture licenses. The number of licenses issued represented an increase from 2009 and 2010 (15 and 19 licenses, respectively), but is similar to those issued in 2007 and 2008 (39 and 33 licenses, respectively). Licenses were issued for 16 residents and 14 nonresidents. Similar to 2010, capture success was greater for nonresidents (79%) than residents (25%). Residents filled 4 of 16 licenses; nonresidents filled 11 of 14 licenses. Northern Goshawks (*Accipiter gentilis*) and Golden Eagles (*Aquila chrysaetos*) were the most commonly captured species, with six and five captures each, all of which were taken by nonresidents. Two American Kestrels (*Falco sparverius*), one Red-tailed Hawk (*Buteo jamaicensis*), and one Prairie Falcon (*Falco mexicanus*) were captured by residents (Table 1). Although Ferruginous Hawks (*Buteo regalis*) and Merlins (*Falco columbarius*) were the most commonly captured species in 2010, no individuals of either of these species were captured in 2011. The total number of birds captured in 2011 (15 individuals) was lower than the mean number of captures from 1981-2010 (23.2 ± 1.6 birds). However, capture success for 2011 (50%) was higher than the mean capture success from 1981-2009 (46.8% ± 2.4%; Table 2).

Table 1. Species and number of raptors captured by residents and nonresidents for falconry in Wyoming, 2011.

Species captured	Number of resident captures	Number of nonresident captures	Total captures
American Kestrel	2	0	2
Northern Goshawk	0	6	6
Red-tailed Hawk	1	0	1
Prairie Falcon	1	0	1
Golden Eagle	0	5	5
Total	4	11	15

Table 2. Number of individuals captured and yearly capture success rate (%) for raptors taken for falconry in Wyoming, 1981-2011.

Year	Number of raptors captured	Capture success rate (%)
1981	27	37
1982	40	52
1983	18	18
1984	25	33
1985	39	53
1986	33	35
1987	19	36
1988	28	51
1989	26	55
1990	32	68
1991	29	66
1992	22	53
1993	13	37
1994	21	33
1995	12	30
1996	25	47
1997	19	61
1998	31	63
1999	27	55
2000	24	57
2001	21	45
2002	29	58
2003	21	49
2004	33	48
2005	13	31
2006	14	40
2007	15	45
2008	27	69
2009	8	53
2010	5	26
2011	15	50

OTHER NONGAME

OTHER NONGAME - *BIRDS*

USING THE BREEDING BIRD SURVEY TO MONITOR POPULATION TRENDS OF AVIAN SPECIES IN WYOMING

STATE OF WYOMING

NONGAME BIRDS: Other Nongame

FUNDING SOURCE: Wyoming State Legislature General Fund Appropriation, Wyoming Governor's Endangered Species Account Funds, National Park Service, United States Forest Service, Bureau of Land Management, United States Fish and Wildlife Service, and Bureau of Reclamation Cooperative Agreements

PROJECT DURATION: Annual

PERIOD COVERED: 15 April 2011 – 14 April 2012

PREPARED BY: Nichole Cudworth, Nongame Biologist
Andrea Orabona, Nongame Bird Biologist
US Geological Survey – Biological Resources Division

ABSTRACT

The Breeding Bird Survey has provided long-term monitoring of a variety of avian species in Wyoming since 1968. In 2011, volunteers surveyed 52 Breeding Bird Survey routes across the state. Overall, survey effort and number of detections per survey route have decreased, while the number of species detected per route has increased. Of the 186 species detected in 2011, 57 nongame species have sufficient data to monitor population trends. The majority of these species display stable populations, with only 7 species displaying increasing populations and 10 species displaying decreasing populations. Consistent with nation-wide trends, species in coniferous forests and grasslands are among those with decreasing populations. Recruiting knowledgeable volunteers to conduct Breeding Bird Survey routes is critical to ensuring the success of the Breeding Bird Survey and our ability to continue to monitor breeding bird populations along roadside surveys.

INTRODUCTION

Forty-four nongame avian species are classified as Species of Greatest Conservation Need (SGCN) by the Wyoming Game and Fish Department (Department; WGFD 2010). However, only a small number of these are adequately monitored with species-specific surveys. Consequently, the Department utilizes data from other large-scale, multi-species survey efforts

to monitor trends in avian populations. The Breeding Bird Survey (BBS) is used to monitor trends of breeding birds across North America. The BBS is sponsored jointly by the US Geological Survey – Biological Resources Division (USGS-BRD; formerly the US Fish and Wildlife Service) and the Canadian Wildlife Service. Over 4,100 BBS routes are located across the continental US and Canada, with 108 established routes in Wyoming. The USGS-BRD has reviewed and analyzed data collected from the BBS since the survey's inception in 1966 in the East and 1968 in the West. BBS data provide indices of population abundance and can be used to estimate population trends and relative abundance of individual species at the continental, western region, statewide, and physiographic region scale. Trend estimates for over 420 species of birds and all raw data can be accessed on the BBS web site <http://www.pwrc.usgs.gov/bbs/>. Our objectives in 2011 were to add additional data to the BBS and interpret current trends of nongame breeding birds in Wyoming.

METHODS

Volunteers are instructed to conduct BBS routes during the height of the avian breeding season when birds are most vocal. This is typically during the month of June, although routes in higher elevations can be surveyed through the first week of July. Each route is 39.4 km and consists of 50 stops spaced every 0.8 km. Beginning ½ hr before sunrise, observers record birds seen within a 0.4-km radius and all birds heard at each stop during a 3-min period. Each route is surveyed once annually, and data are submitted to the USGS-BRD for analysis. Species that have sufficient BBS data for trend analyses are defined by the USGS-BRD as those that are detected on ≥14 routes, with a regional abundance of >1.0 bird per route, and the ability to detect a ≥3% change per year (Sauer et al. 2010). For all summary statistics on survey effort, we report averages ±SE. We only include data from those routes that had data submitted to the BBS by the due date. All analyses on abundance and trends of breeding birds in Wyoming were conducted by USGS-BRD.

RESULTS

In 2011, observers surveyed 2,525 of 3,511 (72%) available routes in the US. In Wyoming, observers attempted to survey 76 of the 108 (70%) established routes. We report results for 52 (68%) of the 76 attempted routes that were surveyed. An additional 13 (17%) routes were surveyed but were not included in the analysis because data were not submitted to USGS-BRD by the due date (Table 1). Since 1990, the number of routes surveyed in Wyoming has decreased by 0.92 routes per year ($P < 0.001$; $R^2 = 0.568$; Fig. 1). Consistent with this trend, the number of routes surveyed in 2011 (i.e., 52 routes) was less than the mean number of routes completed from 1990–2010 (66.0 ±1.6 routes).

Observers detected a total of 23,640 individual birds representing 186 species in Wyoming (Table 2). Since 1990, the number of individuals detected has decreased by 4.8 individuals per route per year ($P < 0.001$; $R^2 = 0.517$; Fig. 2), but the number of species detected has increased by 0.2 species per route per year ($P < 0.001$; $R^2 = 0.720$; Fig. 3). Consistent with these trends, the number of individuals detected per route in 2011 (i.e., 454.4

±34.3 individuals) was less than the mean number of individuals detected per route between 1990–2010 (i.e., 540.7 ±8.7 individuals), but the number of species detected per route (i.e., 38.6 ±1.8 species) was similar to the mean number of species detected per route between 1990–2010 (i.e., 38.0 ±0.4 species).

Of the 186 species detected, 57 nongame species have sufficient data for trend analysis from 1968-2010 (Tables 3-5). This includes five SGCN: the Sage Thrasher (*Oreoscoptes montanus*), Brewer's Sparrow (*Spizella breweri*), and Grasshopper Sparrow (*Ammodramus savannarum*) which display stable populations; the Sage Sparrow (*Amphispiza belli*) which displays an increasing population; and the Lark Bunting (*Calamospiza melanocorys*) which displays a decreasing population. Of the 17 species for which the USGS-BRD can determine a directional trend (Tables 4-5), only 6 species differ from nation-wide trends: the Lark Sparrow (*Chondestes grammacus*) and Brown-headed Cowbird (*Molothrus ater*) are increasing in Wyoming but decreasing nation-wide; the Sage Sparrow is increasing in Wyoming but remaining stable nation-wide; the Yellow-rumped Warbler (*Dendroica coronata*) is decreasing in Wyoming but remaining stable nation-wide; and the American Robin (*Turdus migratorius*) and Chipping Sparrow (*Spizella passerina*) are decreasing in Wyoming but increasing nation-wide.

DISCUSSION

A complete history of BBS observers and routes surveyed in Wyoming from 1968 through 2011 is available from the Department's Nongame Bird Biologist in the Lander Regional Office. Because the primary purpose of the BBS is to monitor population trends of avian species nation-wide, it is important each route is conducted annually, preferably by the same observer. However, in Wyoming fewer than 20 of the 108 total routes have been surveyed annually or with minimal interruptions in the annual survey cycle for >10 years. Most routes contain gaps in surveys of ≥2 years or have had ≥2 observers.

Overall, survey effort has decreased in the last 20 years. On average, the number of routes completed decreased by 0.82 routes per year, with 2011 recording the lowest number of routes completed since 1987. Additionally, the number of individual birds detected per route has decreased steadily. However, the number of species detected per route has increased over time. This increase in number of species per route is interesting, and may represent changes in species distributions or increases in identification skills of observers over time.

The UGSG-BRD has sufficient data to develop population trends for 57 nongame species in Wyoming; 40 of these species demonstrate stable trends, including 3 SGCN (i.e., Sage Thrasher, Brewer's Sparrow, and Grasshopper Sparrow). Of the 10 species demonstrating declining populations, over half are associated with coniferous forests (i.e., Yellow-rumped Warbler, Chipping Sparrow, and Pine Siskin [*Carduelis pinus*]) or grasslands (i.e., Horned Lark [*Eremophila alpestris*], Vesper Sparrow [*Pooecetes gramineus*], and Lark Bunting, a SGCN). Both of these habitats are at high risk for degradation, alteration, or loss, with grasslands listed among the most imperiled habitats in the United States (WYPIF 2002, WGFD 2010). Unlike previous years, the Sage Sparrow, a sagebrush-obligate SGCN, displays an increasing

population in Wyoming (Cudworth et al. 2011). Sagebrush habitats are increasingly threatened by habitat modification and are often recognized as the limiting factor for sagebrush-obligate species (WGFD 2010). Consequently, this increase in Sage Sparrows, in addition to stable populations of other sagebrush-obligate SGCN, including Sage Thrashers and Brewer's Sparrows, is promising. However, the majority of the seven species with increasing populations can be classified as habitat generalists (i.e., Red-tailed Hawk [*Buteo gamaicensis*], Common Raven [*Corvus corax*], Lark Sparrow, and Brown-headed Cowbird), suggesting that flexibility in habitat selection may buffer losses of habitat or allow for colonization of more disturbed areas.

Population trends developed from BBS data allow for large-scale, long-term monitoring of a variety of avian species. These trends are not only useful for monitoring individual species across a variety of local, state, and regional scales, but also highlight similar population trends for a suite of species, such as the precipitous decline observed for grassland birds nationwide (WPIF 2002). However, results are only valid for species occurring on ≥14 BBS routes with a regional abundance of >1 individual per route. Notably, the number of routes surveyed has steadily decreased in Wyoming since 1990 as existing observers age and have increasing difficulty detecting vocalizations. Consequently, recruiting knowledgeable and capable volunteers to cover BBS routes across the state is critical to maintaining our ability to monitor breeding birds along roadside surveys.

ACKNOWLEDGEMENTS

We would like to thank the many volunteers and biologists from this and other natural resources management agencies for their valuable contributions to the 2011 Breeding Bird Survey (see names in Table 1). The continued dedication of these individuals to this monitoring effort makes it possible to collect long-term population trend data on numerous avian species in Wyoming.

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Table 1. Observer, number of avian species detected, and number of individuals recorded for each Breeding Bird Survey route in Wyoming, 2011. Data are presented in numerical order by survey route. Late data are not included in analyses and are represented by 'not available.'

Route Number – Name	Latilong	Observer	Species	Individuals
1 – NE Entrance, YNP	1	Leslie Henry	46	473
2 – Cody	2	Grace Nutting	49	499
3 – Otto	3	Observer needed		
4 – Basin	4	N/A – discontinued		
5 – Wyarno	5	John Berry	40	1245
6 – Clarkelen	6	N/A – discontinued		
7 – Sundance	7	Jennifer Adams	54	492
8 – Colter Bay	8	N/A – discontinued		
9 – Dubois	9	Jazmyn McDonald	57	343
10 – Midvale	10	Jim Downham	Not available	Not available
11 – Nowood	11	Donna Walgren	36	328
12 – Natrona	12	N/A – discontinued		
13 – Bill	13	Observer needed		
14 – Redbird	14	N/A – discontinued		
15 – Fontenelle	15	Carol Deno	58	463
16 – Elk Horn	16	Sid Johnson	Not available	Not available
17 – Bear Creek	17	Andrea Orabona	14	287
18 – Ervay	18	Jazmyn McDonald	37	301
19 – Brookhurst	19	Bruce Walgren	67	542
20 – Glenrock	20	N/A – discontinued		
21 – Dwyer	21	Martin Hicks	Not conducted	Not conducted
22 – Cumberland	22	Carol Deno	32	206
23 – McKinnon	23	N/A – discontinued		
24 – Patrick Draw		N/A – discontinued		
25 – Savery	25	Marie Adams	Not conducted	Not conducted
26 – Riverside	26	Steve Loose	44	511
27 – Buford	27	Suzanne Fellows	Not conducted	Not conducted
28 – Yoder	28	Jim Lawrence	46	1006
29 – Canyon		N/A – discontinued		
30 – Mammoth, YNP	1	Leslie Henry	56	416
31 – West Thumb	--	N/A – discontinued		
32 – Hunter Peak	2	Kathryn Hicks	Not conducted	Not conducted
33 – Clark	2	Kathryn Hicks	43	249
34 – no route		N/A – no route		
35 – Frannie	3	Observer needed		
36 – Moose	8	Christine Paige	46	327
37 – Lovell	3	Observer needed		
38 – Meeteetse	3	Jazmyn McDonald	55	398
39 – Ten Sleep	4	C.J. Grimes	53	486
40 – Dayton	4	Tracey Ostheimer	59	664
41 – Bald Mountain	4	Observer needed		

Table 1. Continued.

Route Number – Name	Latilong	Observer	Species	Individuals
42 – Crazy Woman	5	Grace Nutting	32	173
43 – Schoonover	5	Observer needed		
44 – Arvada	5	Donald Brewer	27	508
45 – Recluse	6	Rene Schell	Not available	Not available
46 – Soda Well	6	Rene Schell	Not available	Not available
47 – Piney		N/A – discontinued		
48 – Seely		N/A – discontinued		
49 – Upton	7	Laurie Van Fleet	Not conducted	Not conducted
50 – Moskee		N/A – discontinued		
51 – Alpine	8	Susan Patla	Not conducted	Not conducted
52 – Wilson	8	Observer needed		
53 – Horse Creek	9	Eva Crane	47	264
54 – no route		N/A – no route		
55 – Crowheart	9	James Downham	Not available	Not available
56 – Ethete	10	Jim Downham	Not available	Not available
57 – Anchor	10	Pat Hnilicka	Not conducted	Not conducted
58 – Gebo	10	Jazmyn McDonald	45	409
59 – Arminto	11	Justin Binfet	23	289
60 – Lysite	11	Greg Anderson	24	566
61 – Worland	11	C.J. Grimes	38	380
62 – Teapot Dome	12	Observer needed		
63 – Mayoworth	12	Deane Bjerke	40	466
64 – Sussex	12	Bill Ostheimer	38	514
65 – Harland Flats	13	Observer needed		
66 – Pine Tree	13	Observer needed		
67 – Highlight		N/A – discontinued		
68 – Riverview	14	Observer needed		
69 – Newcastle	14	Laurie Van Fleet	Not conducted	Not conducted
70 – Raven	14	Nichole Cudworth	27	412
71 – Soda Lake	15	Observer needed		
72 – Buckskin Mountain	15	Observer needed		
73 – Daniel		N/A – discontinued		
74 – Boulder	16	Susan Patla	Not conducted	Not conducted
75 – Big Sandy	16	Susan Patla	Not conducted	Not conducted
76 – Farson	16	Sid Johnson	Not available	Not available
77 – Fiddler Lake	17	Eva Crane	41	259
78 – Sand Draw	17	Jazmyn McDonald	30	356
79 – Sweetwater	17	Stan Harter	Not conducted	Not conducted
80 – Gas Hills	18	Observer needed		
81 – Bairoil	18	Greg Hiatt	Not available	Not available
82 – Lamont	18	Greg Hiatt	Not available	Not available
83 – Pathfinder	19	Laurie Schwieger	32	355
84 – Leo	19	Donna Walgren	35	326

Table 1. Continued.

Route Number – Name	Latilong	Observer	Species	Individuals
85 – Shirley	19	Ann Hines	17	234
86 – Warbonnet	20	Jim Lawrence	42	312
87 – Fletcher Peak	20	Gloria Lawrence	50	411
88 – Shawnee	20	Observer needed		
89 – Meadowdale	21	Martin Hicks	Not conducted	Not conducted
90 – Lusk	21	Gloria Lawrence	28	525
91 – Lingle	21	Observer needed		
92 – Diamondville		N/A – discontinued		
93 – Mountain View	22	Observer needed		
94 – no route		N/A – discontinued		
95 – Green River		N/A – discontinued		
96 – Reliance	23	Observer needed		
97 – Rock Springs	23	Fern Linton	26	209
98 – Black Rock		N/A – discontinued		
99 – no route		N/A – no route		
100 – no route		N/A – no route		
101 – Wamsutter	25	Tony Mong	Not available	Not available
102 – Rawlins	25	Observer needed		
103 – Baggs	25	Tony Mong	Not available	Not available
104 – Walcott	26	Frank Blomquist	43	413
105 – Fox Park	26	Observer needed		
106 – Ryan Park	26	Debbie Wagner	25	175
107 – Sybille Canyon	27	Observer needed		
108 – Rock River	27	Observer needed		
109 – Harmony	27	Observer needed		
110 – Cheyenne	28	Alisa Coffin	Not available	Not available
111 – Chugwater	28	Chuck Seniawski	24	427
112 – Pine Bluff	28	Chuck Seniawski	28	543
120 – Welch	20	Chris Michelson	37	417
123 – Flaming Gorge	23	Observer needed		
147 – Rozet	6	Observer needed		
148 – Seely 2	7	Mary Yemington	44	830
150 – Government Valley	7	Jennifer Adams	44	679
167 – Thunder Basin	13	Nichole Cudworth	17	259
173 – Rye Grass	15	Observer needed		
192 – Carter	23	Observer needed		
195 – Seedskadee	23	Observer needed		
198 – Black Rock 2	24	Andrea Orabona	10	254
204 – Basin 2	4	Observer needed		
206 – Caballa Creek	6	Sandra Johnson	28	548
208 – Moran	8	Susan Wolff	44	357
212 – Bucknum	12	Larry Keffer	Not available	Not available
214 – Hampshire	14	Observer needed		

Table 1. Continued.

Route Number – Name	Latilong	Observer	Species	Individuals
224 – Patrick Draw III		N/A – discontinued		
250 – Moskee 2	7	Jennifer Adams	58	643
524 – Patrick Draw VI	24	Laurie Van Fleet	26	365
900 – Hayden Valley		N/A – discontinued		
901 – Yellowstone, YNP	1	Leslie Henry	46	1516
902 – Pryor Flats	1	Observer needed		

Table 2. Number of individuals and relative abundance of each species detected on Breeding Bird Survey routes in Wyoming, 2011. Data are presented in phylogenetic order. The 30 most abundant species detected on BBS routes in 2011 are denoted by an asterisk.

Order	Species	Number Detected	Relative Abundance (%)
Anseriformes	*Canada Goose	1358	5.74
	Trumpeter Swan	18	0.08
	Wood Duck	1	0.00
	Gadwall	27	0.11
	American Wigeon	19	0.08
	Mallard	121	0.51
	Blue-winged Teal	15	0.06
	Cinnamon Teal	16	0.07
	Northern Shoveler	6	0.03
	Northern Pintail	11	0.05
	Green-winged Teal	9	0.04
	Canvasback	4	0.02
	Redhead	2	0.01
	Ring-necked Duck	7	0.03
	Lesser Scaup	46	0.19
	Bufflehead	9	0.04
	Barrow's Goldeneye	26	0.11
	Common Merganser	30	0.13
	Ruddy Duck	2	0.01
Galliformes	Northern Bobwhite	3	0.01
	Chukar	2	0.01
	Gray Partridge	2	0.01
	Ring-necked Pheasant	122	0.52
	Ruffed Grouse	8	0.03
	Greater Sage-Grouse	33	0.14
	Wild Turkey	25	0.11
Podicipediformes	Pied-billed Grebe	1	0.00
	Eared Grebe	8	0.03
	Western Grebe	4	0.02
Pelecaniformes	Double-crested Cormorant	15	0.06
	American White Pelican	66	0.28
Ciconiiformes	Great Blue Heron	26	0.11
	Turkey Vulture	87	0.37
Falconiformes	Osprey	9	0.04
	Bald Eagle	7	0.03
	Sharp-shinned Hawk	2	0.01
	Northern Harrier	19	0.08
	Cooper's Hawk	1	0.00
	Northern Goshawk	2	0.01

Table 2. Continued.

Order	Species	Number Detected	Relative Abundance (%)
Falconiformes	Swainson's Hawk	20	0.08
	Red-tailed Hawk	64	0.27
	Ferruginous Hawk	13	0.05
	Unidentified Buteo	1	0.00
	Golden Eagle	42	0.18
	American Kestrel	70	0.30
	Merlin	4	0.02
	Prairie Falcon	3	0.01
Gruiformes	Sora	7	0.03
	American Coot	4	0.02
	Sandhill Crane	51	0.22
Charadriiformes	*Killdeer	159	0.67
	Mountain Plover	5	0.02
	American Avocet	16	0.07
	Spotted Sandpiper	43	0.18
	Willet	5	0.02
	Upland Sandpiper	41	0.17
	Long-billed Curlew	6	0.03
	Wilson's Snipe	89	0.38
	Wilson's Phalarope	1	0.00
	Ring-billed Gull	2	0.01
	California Gull	36	0.15
Columbiformes	Rock Pigeon	55	0.23
	Eurasian Collared-Dove	46	0.19
	*Mourning Dove	651	2.75
Cuculiformes	Yellow-billed Cuckoo	1	0.00
Strigiformes	Great Horned Owl	1	0.00
	Burrowing Owl	5	0.02
	Short-eared Owl	3	0.01
Caprimulgiformes	Common Nighthawk	89	0.38
	Common Poorwill	3	0.01
Apodiformes	White-throated Swift	61	0.26
	Broad-tailed Hummingbird	6	0.03
	Rufous Hummingbird	1	0.00
Piciformes	Lewis's Woodpecker	1	0.00
	Red-headed Woodpecker	3	0.01
	Williamson's Sapsucker	1	0.00
	Red-naped Sapsucker	17	0.07
	Downy Woodpecker	6	0.03
	Hairy Woodpecker	12	0.05
	American Three-toed Woodpecker	3	0.01

Table 2. Continued.

Order	Species	Number Detected	Relative Abundance (%)
Piciformes	Black-backed Woodpecker	1	0.00
	Northern Flicker	145	0.61
Passeriformes	Olive-sided Flycatcher	2	0.01
	Western Wood-Pewee	103	0.44
	Willow Flycatcher	22	0.09
	Least Flycatcher	9	0.04
	Hammond's Flycatcher	22	0.09
	Dusky Flycatcher	72	0.30
	Cordilleran Flycatcher	14	0.06
	Say's Phoebe	45	0.19
	Western Kingbird	139	0.59
	Eastern Kingbird	77	0.33
	Loggerhead Shrike	32	0.14
	Plumbeous Vireo	8	0.03
	*Warbling Vireo	250	1.06
	Red-eyed Vireo	9	0.04
	Gray Jay	4	0.02
	Pinyon Jay	4	0.02
	Steller's Jay	1	0.00
	Blue Jay	13	0.05
	Clark's Nutcracker	35	0.15
	*Black-billed Magpie	244	1.03
	*American Crow	167	0.71
	*Common Raven	227	0.96
	*Horned Lark	1408	5.96
	Tree Swallow	102	0.43
	Violet-green Swallow	117	0.49
	Northern Rough-winged Swallow	140	0.59
	Bank Swallow	27	0.11
	*Cliff Swallow	803	3.40
	*Barn Swallow	214	0.91
	Black-capped Chickadee	62	0.26
	Mountain Chickadee	107	0.45
	Red-breasted Nuthatch	50	0.21
	White-breasted Nuthatch	6	0.03
	Pygmy Nuthatch	1	0.00
	*Rock Wren	199	0.84
	Canyon Wren	1	0.00
	Bewick's Wren	2	0.01
	*House Wren	169	0.71
	Blue-gray Gnatcatcher	1	0.00

Table 2. Continued.

Order	Species	Number Detected	Relative Abundance (%)
Passeriformes	American Dipper	1	0.00
	*Ruby-crowned Kinglet	230	0.97
	Mountain Bluebird	147	0.62
	Townsend's Solitaire	24	0.10
	Veery	22	0.09
	Swainson's Thrush	15	0.06
	Hermit Thrush	72	0.30
	*American Robin	956	4.04
	Gray Catbird	22	0.09
	Northern Mockingbird	3	0.01
	*Sage Thrasher	462	1.95
	Brown Thrasher	3	0.01
	*European Starling	400	1.69
	American Pipit	5	0.02
	Cedar Waxwing	17	0.07
	Chestnut-collared Longspur	8	0.03
	McCown's Longspur	26	0.11
	Orange-crowned Warbler	6	0.03
	*Yellow Warbler	265	1.12
	Chestnut-sided Warbler	2	0.01
	*Yellow-rumped Warbler	234	0.99
	American Redstart	46	0.19
	Ovenbird	73	0.31
	MacGillivray's Warbler	24	0.10
	Common Yellowthroat	71	0.30
	Wilson's Warbler	10	0.04
	Yellow-breasted Chat	3	0.01
	Green-tailed Towhee	151	0.64
	Spotted Towhee	140	0.59
	Cassin's Sparrow	4	0.02
	*Chipping Sparrow	236	1.00
	Clay-colored Sparrow	15	0.06
	*Brewer's Sparrow	499	2.11
	*Vesper Sparrow	807	3.41
	*Lark Sparrow	294	1.24
	*Sage Sparrow	244	1.03
	*Lark Bunting	1527	6.46
	Savannah Sparrow	147	0.62
	Grasshopper Sparrow	101	0.43
	Fox Sparrow	2	0.01
	Song Sparrow	77	0.33

Table 2. Continued.

Order	Species	Number Detected	Relative Abundance (%)
Passeriformes	Lincoln's Sparrow	65	0.27
	White-crowned Sparrow	98	0.41
	Dark-eyed Junco	155	0.66
	Western Tanager	45	0.19
	Black-headed Grosbeak	41	0.17
	Blue Grosbeak	10	0.04
	Lazuli Bunting	27	0.11
	Dickcissel	15	0.06
	Bobolink	25	0.11
	*Red-winged Blackbird	1227	5.19
	*Western Meadowlark	4037	17.08
	Yellow-headed Blackbird	14	0.06
	*Brewer's Blackbird	735	3.11
	*Common Grackle	177	0.75
	*Brown-headed Cowbird	209	0.88
	Orchard Oriole	3	0.01
	Bullock's Oriole	83	0.35
	Pine Grosbeak	2	0.01
	Cassin's Finch	13	0.05
	House Finch	13	0.05
	Red Crossbill	50	0.21
	Pine Siskin	85	0.36
	American Goldfinch	90	0.38
	*House Sparrow	160	0.68
	Total Individuals	*23,640*	
	Total Species	*186*	

Table 3. Population trends (i.e., % change per year) and relative abundance (i.e., individuals per route) of nongame avian species with stable populations in Wyoming that are adequately monitored (i.e., ≥14 survey routes with detections and relative abundance >1 bird per route) by the Breeding Bird Survey, 1968–2010 (analysis by Sauer et al. 2011). The 95% Lower Confidence Limit (LCL) and Upper Confidence Limit (UCL) are also presented for the reported trend. Total number of survey routes used in the analysis for each species is represented by *n*. Species of Greatest Conservation Need are denoted by superscript §. Results are presented in phylogenetic order.

Species	Trend	LCL	UCL	Relative abundance	*n*
American Kestrel	-0.9	-1.9	0.2	1.7	112
Wilson's Phalarope	-2.5	-5.6	0.4	1.0	62
Common Nighthawk	-0.2	-1.5	1.1	3.7	111
Western Wood-Pewee	1.2	-0.3	2.6	1.9	76
Say's Phoebe	0.6	-0.8	2.1	1.2	91
Eastern Kingbird	-0.3	-1.7	1.0	1.2	80
Loggerhead Shrike	-1.1	-2.6	0.4	1.2	84
Warbling Vireo	0.9	-0.2	2.0	2.4	58
Clark's Nutcracker	0.3	-2.9	2.6	2.2	45
Black-billed Magpie	0.2	-1.3	1.5	7.4	98
Tree Swallow	-0.3	-2.0	1.4	1.9	69
Violet-green Swallow	1.1	-0.8	3.3	3.2	80
Northern Rough-winged Swallow	1.2	-1.7	4.2	1.0	77
Cliff Swallow	-1.2	-2.7	0.9	184.9	107
Barn Swallow	-1.0	-2.1	0.1	4.4	107
Mountain Chickadee	-0.9	-2.5	0.8	2.5	29
Rock Wren	-0.4	-1.5	0.8	5.2	103
Ruby-crowned Kinglet	0.2	-1.2	1.7	2.8	42
Mountain Bluebird	0.0	-1.3	1.3	5.9	104
Hermit Thrush	-0.2	-2.1	1.7	1.7	24
§Sage Thrasher	1.0	-0.1	2.1	49.9	87
European Starling	0.8	-0.9	2.4	6.5	98
Yellow Warbler	0.1	-0.7	0.9	4.8	90
Western Tanager	-0.2	-2.1	1.6	1.1	53
Green-tailed Towhee	0.0	-1.9	1.3	5.3	73
Spotted Towhee	0.5	-1.0	2.0	1.1	58
§Brewer's Sparrow	0.1	-1.1	1.2	58.2	112
Savannah Sparrow	1.4	-1.0	3.8	2.5	87
§Grasshopper Sparrow	0.5	-2.2	3.3	2.3	63
Song Sparrow	1.1	-0.1	2.2	1.9	89
Lincoln's Sparrow	2.8	-0.1	5.4	1.0	33

Table 3. Continued.

Species	Trend	LCL	UCL	Relative abundance	*n*
White-crowned Sparrow	0.8	-1.1	2.7	3.5	46
Dark-eyed Junco	-1.5	-3.2	0.0	3.5	42
Lazuli Bunting	-1.7	-3.9	0.7	1.1	55
Red-winged Blackbird	-0.1	-0.8	0.6	18.5	109
Western Meadowlark	0.5	-0.1	1.1	172.9	113
Yellow-headed Blackbird	-1.9	-4.2	0.7	7.0	75
Brewer's Blackbird	-0.9	-2.0	0.4	53.0	116
Common Grackle	-0.4	-2.2	1.7	3.4	85
House Sparrow	-0.7	-2.6	1.3	6.5	68

Table 4. Population trends (i.e., % change per year) and relative abundance (i.e., individuals per route) of nongame avian species with increasing populations in Wyoming that are adequately monitored (i.e., ≥14 survey routes with detections and relative abundance >1 bird per route) by the Breeding Bird Survey, 1968–2010 (analysis by Sauer et al. 2011). The 95% Lower Confidence Limit (LCL) and Upper Confidence Limit (UCL) are also presented for the reported trend. Total number of survey routes used in the analysis for each species is represented by *n*. Species of Greatest Conservation Need are denoted by superscript §. Results are presented in phyolgenetic order.

Species	Trend	LCL	UCL	Relative abundance	*n*
Red-tailed Hawk	1.8	1.5	2.8	1.0	115
Western Kingbird	4.8	3.3	6.3	1.9	70
Common Raven	5.7	4.2	7.1	1.8	79
House Wren	2.2	1.0	3.4	1.2	79
Lark Sparrow	1.4	0.1	2.7	3.8	98
§Sage Sparrow	2.7	0.4	5.0	16.5	64
Brown-headed Cowbird	1.7	0.4	3.0	3.2	109

Table 5. Population trends (i.e., % change per year) and relative abundance (i.e., individuals per route) of nongame avian species with decreasing populations in Wyoming that are adequately monitored (i.e., ≥14 survey routes with detections and relative abundance >1 bird per route) by the Breeding Bird Survey, 1968–2010 (analysis by Sauer et al. 2011). The 95% Lower Confidence Limit (LCL) and Upper Confidence Limit (UCL) are also presented for the reported trend. Total number of survey routes used in the analysis for each species is represented by *n*. Species of Greatest Conservation Need are denoted by superscript §. Results are presented in phylogenetic order.

Species	Trend	LCL	UCL	Relative abundance	*n*
Killdeer	-1.7	-2.6	-0.9	7.6	113
Mourning Dove	-1.0	-1.7	-0.2	15.5	116
Northern Flicker	-1.2	-2.2	-0.2	2.6	107
Horned Lark	-1.6	-2.4	-0.8	99.4	106
American Robin	-0.7	-1.2	-0.2	14.5	110
Yellow-rumped Warbler	-1.6	-2.9	-0.1	2.7	43
Chipping Sparrow	-1.3	-2.5	-0.1	2.2	87
Vesper Sparrow	-0.9	-1.8	-0.1	35.5	117
§Lark Bunting	-2.7	-5.5	-0.3	356.4	103
Pine Siskin	-2.8	-5.6	-0.4	6.0	46

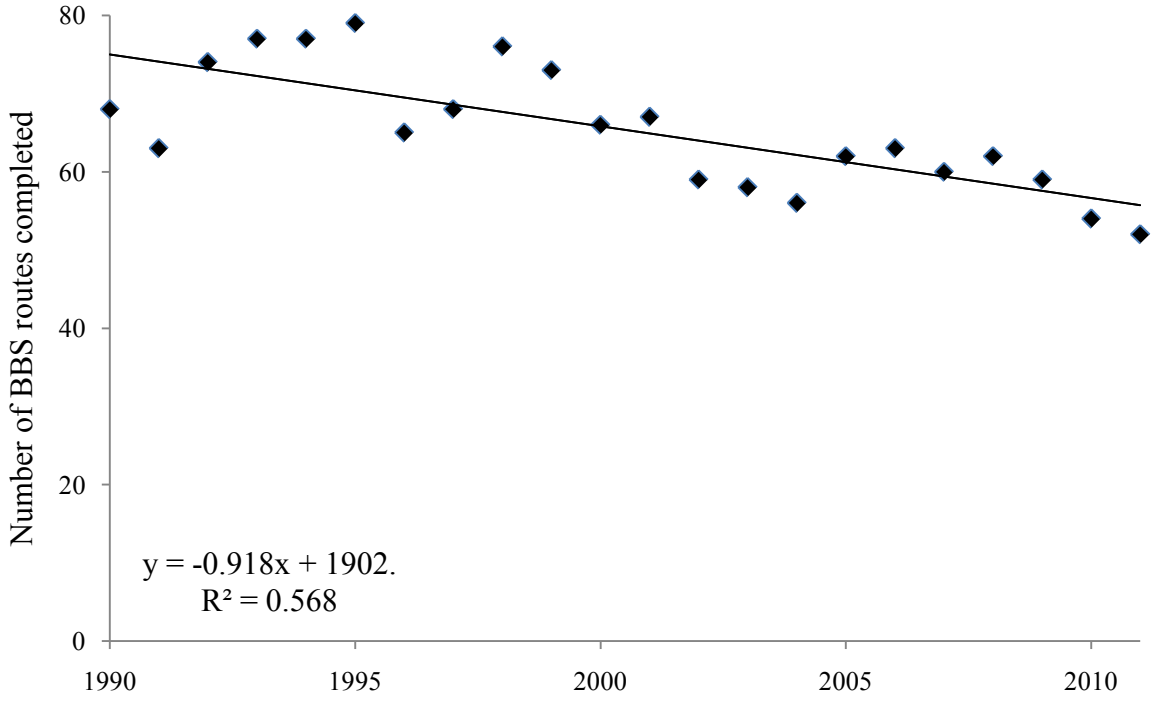

Figure 1. Number of Breeding Bird Survey routes completed in Wyoming, 1990–2011. Only currently active routes with data submitted to the Breeding Bird Survey by the due date are included in the analysis. The trend line is shown for reference.

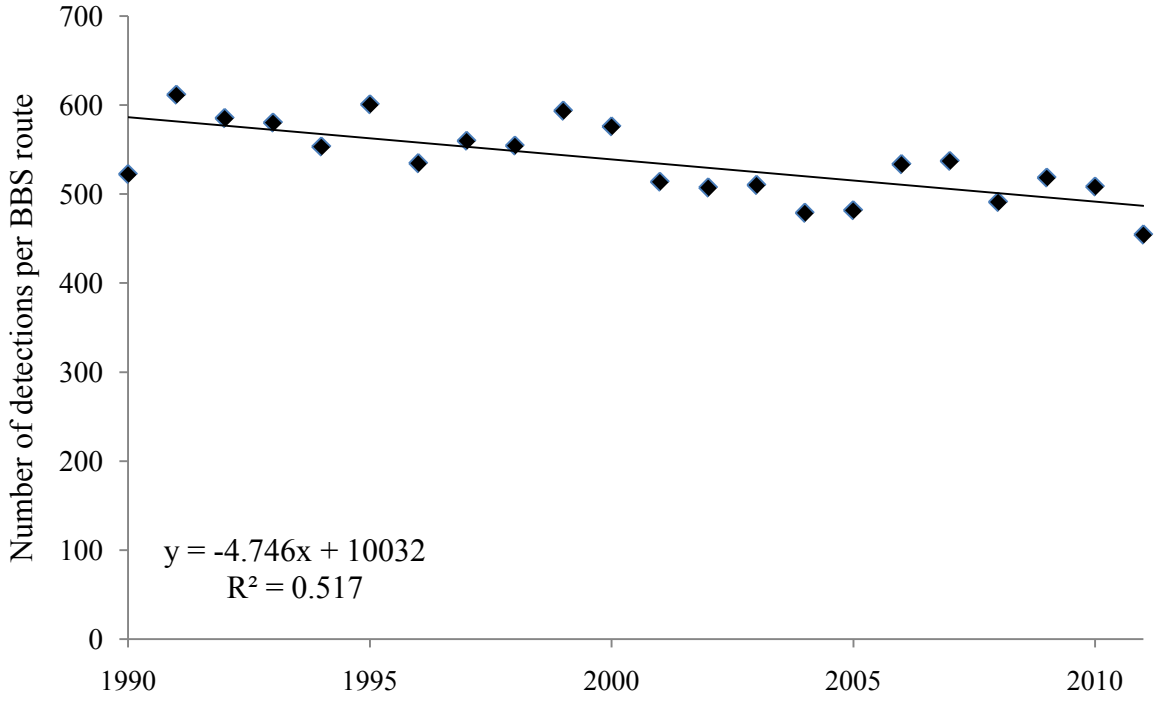

Figure 2. Average number of individual detections of birds per Breeding Bird Survey route in Wyoming, 1990–2011. Only currently active routes with data submitted to the Breeding Bird Survey by the due date are included in the analysis. The trend line is shown for reference.

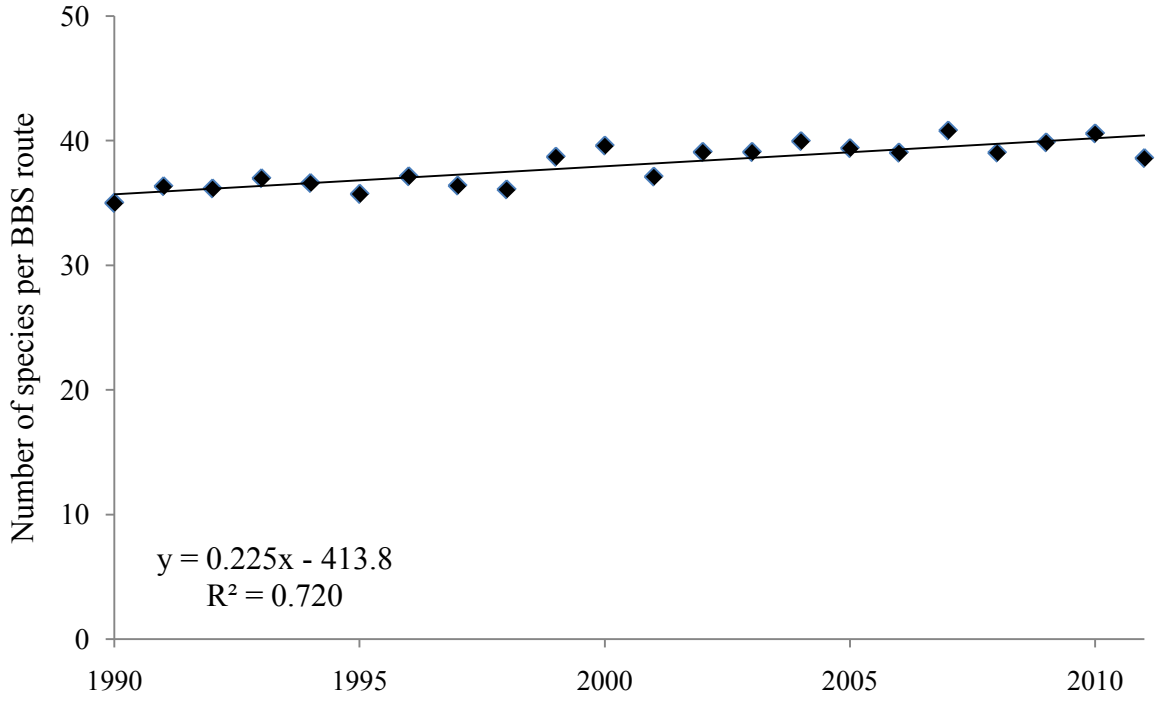

Figure 3. Average number of species detected per Breeding Bird Survey route in Wyoming, 1990–2011. Only currently active routes with data submitted to the Breeding Bird Survey by the due date are included in the analysis. The trend line is shown for reference.

WYOMING PARTNERS IN FLIGHT AND INTEGRATED MONITORING IN BIRD CONSERVATION REGIONS

STATE OF WYOMING

NONGAME BIRDS: Species of Greatest Conservation Need

FUNDING SOURCE: Wyoming State Legislature General Fund Appropriations, Wyoming Governor's Endangered Species Account Funds, and Bureau of Land Management Cooperative Agreement #L08AC13184

PROJECT DURATION: Annual

PERIOD COVERED: 15 April 2011 – 14 April 2012

PREPARED BY: Andrea Orabona, Nongame Bird Biologist
Nichole Cudworth, Nongame Biologist
Chris White, Rocky Mountain Bird Observatory
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ABSTRACT

Landbird populations have declined due to a variety of influences, both natural and human-caused. The Partners in Flight program was initiated in 1990 to address these declines through comprehensive bird conservation planning efforts. Wyoming's working group, Wyoming Partners in Flight, produced the Wyoming Bird Conservation Plan, Version 2.0, which presents avian population objectives, habitat objectives, Best Management Practices to benefit birds, and recommendations to ensure the viability of birds and their habitats. Monitoring is a key component of the Wyoming Bird Conservation Plan (Nicholoff 2003). Through cooperative funding via Wyoming Partners in Flight, we have implemented the Integrated Monitoring in Bird Conservation Regions (formerly Monitoring Wyoming's Birds) program, which allows us to estimate density, population size, occupancy, and detection probabilities for numerous avian species, including Species of Greatest Conservation Need. In 2011, we completed 2,252 point counts on 187 of 192 grids within 4 Bird Conservation Regions in Wyoming, and detected 165 species, including 28 Species of Greatest Conservation Need. We determined density estimates for 12 Species of Greatest Conservation Need, 6 of which provided robust density estimates, and 104 additional avian species, 56 of which provided robust density estimates. We determined occupancy for 10 Species of Greatest Conservation Need, 7 of which provided robust occupancy estimates, and 113 additional avian species, 70 of which provided robust occupancy estimates. The Integrated Monitoring in Bird Conservation Regions design allows us to monitor trends of avian Species of Greatest

Conservation Need that may be overlooked or under-represented by other survey techniques, including sagebrush- and grassland-obligate species, permits slight modifications to the design in order to investigate other priority species as needs arise, reduces monitoring costs through coordination and collaboration with monitoring partners, and can be stepped up to evaluate population parameters on a regional scale.

INTRODUCTION

Long-term data analyses indicate that trends for many populations of North American landbirds have declined due to land use changes; habitat loss, fragmentation, and deterioration; pesticide use; and human influences and disturbance (Robbins et al. 1989, Peterjohn et al. 1995, Sauer et al. 1996, Boren et al. 1999, Donovan and Flather 2002). The international Partners in Flight (PIF) program was initiated in 1990 to address and reverse these declines. The PIF mission is to help species at risk and to keep common birds common through voluntary partnerships that benefit birds, habitats, and people. State, regional, national, and international Bird Conservation Plans comprehensively address the issues of avian and habitat conservation on a landscape scale. The North American Bird Conservation Initiative (NABCI) was initiated in 1998 to ensure the long-term health of North America's native bird populations through effective conservation initiatives, enhanced coordination among the initiatives, and increased cooperation among the governments and citizens of Canada, the US, and Mexico (NABCI 2012).

The state PIF working group, Wyoming Partners in Flight (WYPIF), was established in 1991 and is comprised of participants from the Wyoming Game and Fish Department (Department), Bureau of Land Management (BLM), US Forest Service (USFS), US Fish and Wildlife Service, Bureau of Reclamation, National Park Service, Rocky Mountain Bird Observatory (RMBO), Audubon Wyoming and affiliate chapters, Wyoming Natural Diversity Database (WYNDD), University of Wyoming, and The Nature Conservancy. The Department's Nongame Bird Biologist has served as the WYPIF chairperson since its inception. As a group, WYPIF produced the Wyoming Bird Conservation Plan, Version 2.0 (Plan; Nicholoff 2003). The Plan presents objectives for populations of birds and major habitat groups in the state, Best Management Practices to benefit birds, and recommendations to ensure that birds and the habitats they require remain intact and viable into the future through proactive and restorative management techniques.

One of the highest priority objectives throughout the Plan for populations of birds is to implement *Monitoring Wyoming's birds: the plan for count-based monitoring* (Leukering et al. 2001). Monitoring of populations is an essential component of effective wildlife management and conservation (Witmer 2005, Marsh and Trenham 2008). Besides improving distribution data, monitoring allows us to evaluate populations of target species and detect changes over time (Thompson et al. 1998, Sauer and Knutson 2008), identify species that are at risk (Dreitz et al. 2006), and evaluate responses of populations to management actions (Lyons et al. 2008, Alexander et al. 2009) and landscape and climate change (Baron et al. 2008, Lindenmayer and Likens 2009).

For the 11th consecutive year, biologists from the Department, BLM, RMBO, USFS, Audubon Wyoming, and WYNDD have collectively implemented a BLM-cooperative assistance agreement that provides funding for this collaborative effort. The agreement allows us to execute a statewide monitoring program for birds and revise distributions and estimate abundance of numerous avian species, including Species of Greatest Conservation Need (SGCN; WGFD 2010). Funding is also provided to develop educational materials and improve outreach opportunities that focus on birds in Wyoming. The RMBO is responsible for implementing the monitoring program, which originally focused on six habitats in Wyoming (i.e., aspen, grassland, juniper woodland, mid-elevation conifer, montane riparian, and shrub-steppe). This monitoring program, called Integrated Monitoring in Bird Conservation Regions (IMBCR), now incorporates a region-wide approach and uses a stratified, spatially balanced, grid-based design (Hanni et al. 2009). The USFS contributes funding to the program, and WYNDD assists in program monitoring. Audubon Wyoming assists with inventory and monitoring for those species that require techniques other than point-counts (e.g., Monitoring Avian Productivity and Survivorship [MAPS] bird banding stations), producing and distributing educational materials on birds and their habitats, and providing nature-based outreach opportunities for the public. The Department conducts annual monitoring for SGCN that require species-specific survey methods (e.g., Common Loon [*Gavia immer*], American Bittern [*Botaurus lentiginosus*], Long-billed Curlew [*Numenius americanus*], and raptors), prints and distributes PIF educational materials, and provides point data via the Wildlife Observation System database.

METHODS

In Wyoming's portion of the IMBCR, we conducted surveys within four of the five Bird Conservation Regions (BCRs; Fig. 1). The five BCRs that occur in Wyoming, plus an additional two in other states (i.e., BCRs 11 and 34), comprised the IMBCR sampling frame for 2011.

Within these seven BCRs, all monitoring partners collaborated to define strata and super-strata based on smaller-scale areas to which we wanted to make inferences (e.g., National Forests, BLM lands, individual states). Within each stratum, the IMBCR design used a spatially balanced sampling algorithm (i.e., generalized random-tessellation stratification) to select sample units (Stevens and Olsen 2004). We overlaid BCRs with 1-km^2 sample grids. We randomly selected sample grids and used a 4 × 4 array spaced 250 m apart to establish 16 survey points within each sample grid (Hanni et al. 2009)

Prior to surveys, field technicians completed an intensive training program covering protocols, bird identification, and distance estimation. Field technicians used IMBCR sampling protocols established by RMBO to conduct point counts (Buckland et al. 2001, Hanni et al. 2009). These technicians surveyed grids in the morning from ½ hr before sunrise to 1100 hrs. They surveyed each survey point for 6 min to facilitate estimation of site occupancy. For each bird detected, field technicians recorded species, sex, horizontal distance from the observer, minute of detection, and type of detection (e.g., song, call, visual). Other information, such as flyovers, clusters, and the presence of species difficult to detect, was also noted. Technicians

recorded time, ambient temperature, cloud cover, precipitation, and wind speed at the start and end of each grid. They also recorded vegetation data within a 50-m radius of each survey point and included dominant habitat type, structural stage, relative abundance, percent cover and mean height of trees, species of shrubs, grass height, and groundcover. Distance from a road, if within 100 m, was also recorded.

Biometricians from RMBO used Distance 6.0 to estimate detection probabilities (Thomas et al. 2010). They used the SPSURVEY package in Program R to estimate density, population size, and its variance for each bird species (T. Kincaid, unpubl. data). Lastly, they used a removal design to estimate detection probability for each species (MacKenzie et al. 2006).

RESULTS

Between 13 May and 24 July 2011, field technicians completed 2,252 point counts on 187 of 192 grids that were planned for surveys within 4 BCRs in Wyoming (Fig. 1). A total of 165 species were detected, including 28 SGCN. RBMO was able to estimate density for 12 SGCN, 6 of which provided robust estimates (i.e., CV <50%; Table 1). Density was estimated for an additional 104 avian species, 56 of which provided robust density estimates. RMBO estimated occupancy for 10 SGCN, 7 of which provided robust occupancy estimates (i.e., CV <50%; Table 2). Occupancy was determined for an additional 113 avian species, 70 of which provided robust occupancy estimates.

Annual and multi-year reports, species accounts, and density estimate tables and graphs from this monitoring program are available on the RMBO Avian Data Center web site (RMBO 2012).

DISCUSSION

The methods used by RMBO to monitor avian populations for the IMBCR were used to estimate both density and occupancy for each species when sample sizes were large enough. These robust data not only allow for continuous monitoring of species trends, but also provide information on species abundance and distribution, habitat associations, and evaluation of land management activities (White et al. 2011). The IMBCR provides density and occupancy estimates for a number of avian SGCN at risk in Wyoming due to habitat loss or alteration or for which data on population and trends are lacking. Consequently, the IMBCR provides the Department with an opportunity to monitor trends of avian SGCN that may be overlooked or under-represented by other survey techniques.

As in previous years, the 2011 IMBCR provides robust density and occupancy estimates for six avian SGCN in Wyoming, all of which help fill gaps in current monitoring efforts by the Department. Data on these species help address a number of management challenges, including data deficiencies, habitat loss or degradation, and population declines. Specifically, the IMBCR program provides a quantified approach for monitoring the American Three-toed

Woodpecker (*Picoides tridactylus*). This species is found in higher elevation mature and old-growth coniferous forests, and is classified as a Native Species Status Unknown (NSSU) due to unknown population status and trends resulting from existing monitoring efforts that were insufficient to adequately detect this species (WGFD 2010). Three additional species, Brewer's Sparrow (*Spizella breweri*), Sage Sparrow (*Amphispiza belli*), and Sage Thrasher (*Oreoscoptes montanus*), are considered sagebrush obligates, and the Grasshopper Sparrow (*Ammodramus savannarum*) and Lark Bunting (*Calamospiza melanocorys*) are associated with grasslands. Both of these habitats are at high risk for degradation, alteration, or loss, with grasslands listed among the most imperiled habitats in the US and exhibiting dramatic declines in avian populations (WYPIF 2002, WGFD 2010). Consequently, by monitoring SGCN, the IMBCR program can provide an indication of trends for these species, as well as a suite of sagebrush and grassland associated species. However, several SGCN, including the Bobolink (*Dolichonys oryzivorus*), Chestnut-collared Longspur (*Calcarius ornatus*), Dickcissel (*Spiza americana*), and McCown's Longspur (*C. mccownii*), have not been detected in sufficient numbers to estimate occupancy or density. If this trend continues, we will need to implement a more targeted approach for these species to obtain adequate population information.

The IMBCR's spatially balanced sampling design is more efficient than simple random sampling and can increase precision in density, occupancy, and detection probability estimates (Stevens and Olsen 2004, White et al. 2011). Additionally, this sampling design provides the flexibility to generate population estimates at various scales relevant to land and wildlife management agencies. It also allows sampling of all habitats, which enables managers to relate changes in bird populations to changes on the landscape over time. These results support both local and regional conservation efforts in Wyoming. Moreover, the IMBCR design allows us to monitor trends of avian SGCN that may be omitted or inadequately represented by other survey techniques, permits slight modifications to the design in order to investigate other priority species as needs arise, and reduces monitoring costs through coordination and collaboration with monitoring partners.

ACKNOWLEDGEMENTS

We wish to thank BLM biologists M. Gorges and D. Saville for their tireless efforts and invaluable assistance in securing funding for the IMBCR program. We also thank the RMBO for implementing the IMBCR program, particularly J. Birek, J. Blakesley, J. Fogg, M. McLaren, D. Pavlacky, R. Sparks, and the many field technicians that assisted with the surveys. We also greatly appreciate the collaborative efforts of the regional IMBCR team in making this program a success. Finally, we would like to thank all the individuals who contribute to the success of WYPIF through their respective agencies and organizations; WYPIF thrives because of our collective efforts.

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Table 1. Estimated density (individuals per km^2), population size ($\hat{N}$), percent coefficient of variation (% CV), and number of independent detections (n) of avian Species of Greatest Conservation Need on 192 grids surveyed throughout Wyoming in 2011. Density estimates are considered robust if % CV <50%.

Species	Density	$\hat{N}$	% CV	n
American Three-toed Woodpecker	0.28	71,550	29	24
Brewer's Sparrow	30.69	7,707,408	15	824
Grasshopper Sparrow	3.96	994,665	24	185
Lark Bunting	14.14	3,550,626	28	814
Long-billed Curlew	0.16	41,209	86	3
McCown's Longspur	1.65	414,502	68	50
Pygmy Nuthatch	0.08	19,321	77	2
Sage Sparrow	5.79	1,453,124	21	271
Sage Thrasher	2.31	581,212	13	405
Sandhill Crane	0.06	14,455	55	19
Swainson's Hawk	0.02	4,496	71	3
Upland Sandpiper	0.12	30,357	54	22

Table 2. Estimated proportion of sample units occupied (ψ), standard error (SE), percent coefficient of variation (% CV), and number of grids with ≥1 detections (n) of avian Species of Greatest Conservation Need on 192 grids surveyed throughout Wyoming in 2011. Occupancy estimates are considered robust if % CV <50%.

Species	ψ	SE	% CV	n
American Three-toed Woodpecker	0.067	0.009	9	15
Brewer's Sparrow	0.505	0.052	10	77
Grasshopper Sparrow	0.103	0.028	27	26
Lark Bunting	0.144	0.029	20	37
Lewis's Woodpecker	0.003	0.003	90	1
McCown's Longspur	0.022	0.010	47	4
Pygmy Nuthatch	0.008	0.004	58	2
Sage Sparrow	0.160	0.029	18	23
Sage Thrasher	0.238	0.039	16	33
Upland Sandpiper	0.024	0.020	83	6

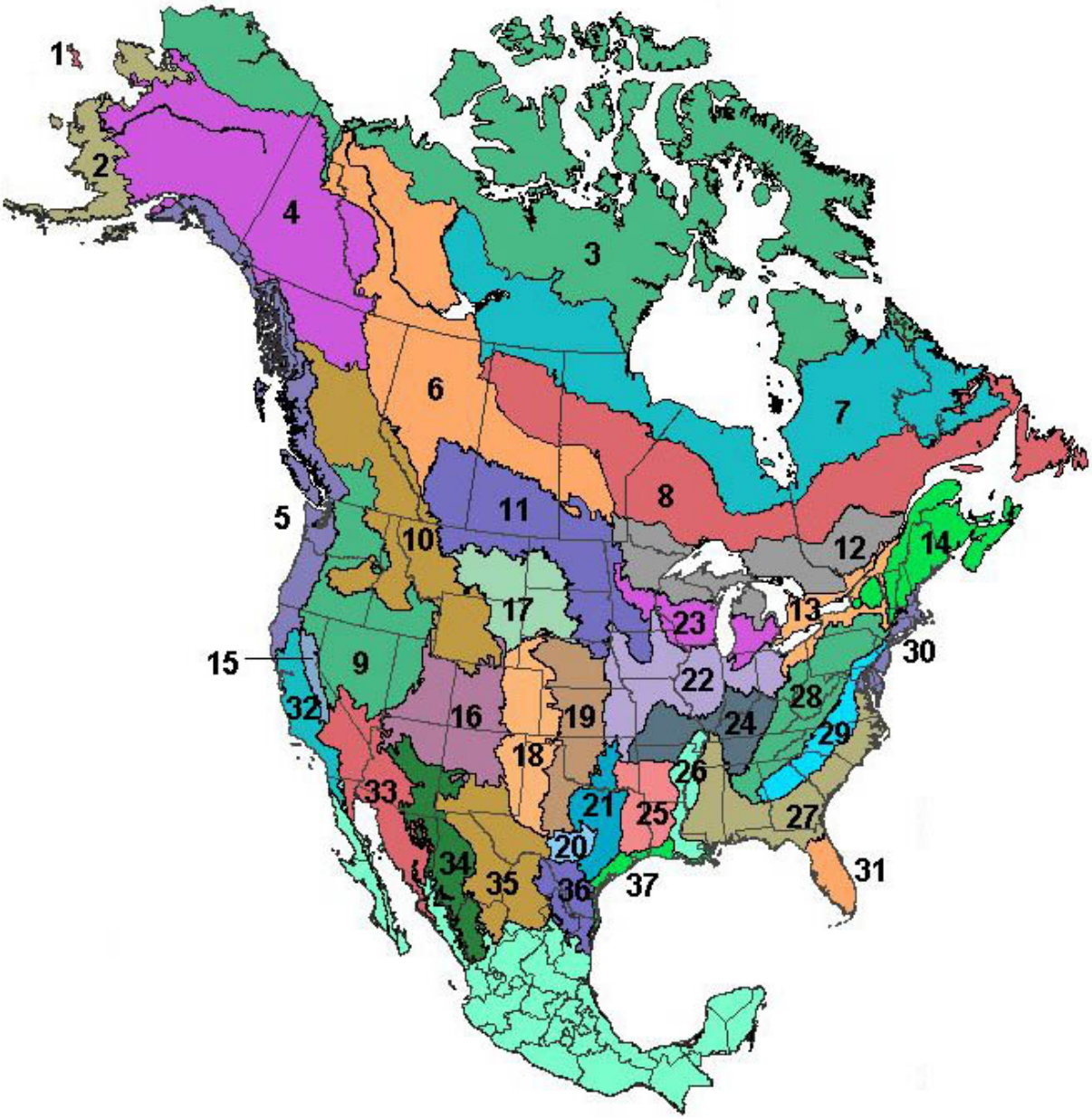

Figure 1. The North American Bird Conservation Region (BCR) map. Portions of BCRs that occur in Wyoming are: 9 – Great Basin, 10 – Northern Rockies, 16 – Southern Rockies/Colorado Plateau, 17 – Badlands and Prairies, and 18 – Shortgrass Prairie. All BCRs except the Great Basin were sampled in Wyoming in 2011.

OTHER NONGAME – *MAMMALS*

EVALUATING AERIAL SURVEY TECHNIQUES TO ESTIMATE ABUNDANCE OF WHITE-TAILED PRAIRIE DOGS IN WYOMING

STATE OF WYOMING

NONGAME MAMMALS: White-tailed prairie dog

FUNDING SOURCE: United States Fish and Wildlife Service Cooperative Agreements

PROJECT DURATION: 1 July 2010 – 30 June 2012

PERIOD COVERED: 15 April 2011 – 14 April 2012

PREPARED BY: Nichole Cudworth, Nongame Biologist
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ABSTRACT

White-tailed prairie dogs (*Cynomys leucurus*), although prevalent throughout the western US, are susceptible to a number of threats that may decrease abundance and distribution, including loss or conversion of habitat and outbreaks of sylvatic plague. Although no longer classified as a Species of Greatest Conservation Need in Wyoming, white-tailed prairie dogs remain a priority species for the Wyoming Game and Fish Department in accordance with a memorandum of understanding signed with the Western Association of Fish and Wildlife Agencies. In 2011, we used aerial survey techniques to assess changes in abundance since the previous survey in 2008. We also incorporated ground-based surveys to evaluate the accuracy of aerial survey techniques and the appropriateness of continuing to use these methods. We documented white-tailed prairie dog colonies on 8.5% of the area we surveyed via aerial techniques, for an estimated 978,465 ha of habitat occupied by white-tailed prairie dog colonies state-wide. Based upon results from ground surveys, however, aerial surveys tended to overestimate the area comprised of active colonies by 272%, suggesting that only 356,852 ha of habitat are occupied by active colonies. Although results from aerial surveys are similar to those from 2008, results from ground surveys suggest that results from both 2008 and 2011 likely overestimate the amount of area actually containing active white-tailed prairie dog colonies. Because both aerial and ground-based surveys that estimate colony area require a number of assumptions that are likely not met, we recommend implementing an occupancy modeling approach for future surveys to monitor white-tailed prairie dogs in Wyoming. Occupancy modeling provides a survey method that is repeatable, provides accurate trend estimations, and is comparable among states.

INTRODUCTION

The white-tailed prairie dog (*Cynomys leucurus*; prairie dog) has historically been persecuted through control programs sponsored by national and local governments in response to perceived competition with livestock for forage (Clark et al. 1971). Although government-subsidized control efforts have ceased and some toxicants have been banned, prairie dogs are still susceptible to a number of threats that cause drastic fluctuations in abundance and distribution, including loss of habitat and outbreaks of sylvatic plague (Seglund et al. 2004). In fact, this exotic disease may be a major cause of mortality for prairie dogs, with mortality as high as 100% for some colonies (Orabona-Cerovski 1991, Antolin et al. 2002, USFWS 2010). Because of historical trends and threats due to habitat loss and disease, the species was petitioned for listing under the Endangered Species Act in 2002 (Seglund et al. 2004). However, the US Fish and Wildlife Service issued a 'not warranted' finding in 2010 (USFWS 2010).

The prairie dog was previously classified as a Species of Greatest Conservation Need in Wyoming, but this classification was removed in the revision of the 2010 Wyoming State Wildlife Action Plan as a result of a revised matrix (WGFD 2010). However, because Wyoming contains approximately 75% of the range of white-tailed prairie dogs (Seglund et al. 2004) and because the Wyoming Game and Fish Department (Department) signed a conservation memorandum of understanding (MOU) with other states in the Western Association of Fish and Wildlife Agencies, the Department still considers the prairie dog a priority species. As per the MOU, the Department continues to monitor trends in abundance and distribution in an effort to avoid potential future listings.

In 2008, the Department assessed a number of techniques to evaluate distribution and trends of white-tailed prairie dogs throughout the state. Based upon these results, the Department implemented an aerial survey of 600 grids to assess the amount of area occupied by white-tailed prairie dog colonies in 2008 (Grenier and Filipi 2009, Grenier et al. 2009). However, the Interstate Prairie Dog Conservation Team raised concerns about an observer's ability to correctly assign status and delineate colonies from aerial surveys. Consequently, we implemented a double-observer technique in 2011 and attempted to return to all grids for which observers had assigned an occupied classification in order to ground-truth the aerial results. However, both aerial and ground-based surveys involve a number of assumptions that may or may not be valid, including imperfect detection, consistent visibility for both observers during double-observer flights, and the ability to orient from the air, correctly assign status and delineate boundaries, and distinguish between burrows created by prairie dogs and those created by other burrowing mammals.

We had three objectives for this project in 2011. First, we used previously defined aerial survey techniques to estimate current abundance of prairie dogs in Wyoming. Second, we compared abundance estimates to previous surveys to determine trends. Finally, in response to concerns raised by the Interstate Prairie Dog Conservation Team, we evaluated the efficacy of aerial survey techniques, assessed the validity of assumptions for both aerial and ground-based methods, and provide recommendations for modification as necessary.

METHODS

We followed guidelines outlined by Grenier and Filipi (2009) to complete aerial surveys. We surveyed the same 600, 25-ha grids as in 2008 in order to directly compare aerial surveys in 2011. To address issues of detection probability, we used a double-observer technique on a subset of grids (n = 137; Cook and Jacobson 1979, Caughley and Grice 1982). When observers were conducting double-observer flights, observer 1 was always in the front of the plane with observer 2 in the seat directly behind observer 1. Observers always flew in the front of the plane during solo flights. For all 600 grids, we recorded whether the grid was occupied by a prairie dog colony, if the colony was active or inactive, and ancillary data including vegetation type, observed human disturbances, and other prairie dog mound-like features in the grid, such as rocks, ants, ground squirrel mounds, and bare ground, as well as if another colony was located near the grid. We completed all aerial surveys between 24 May and 10 June in order to coincide with green-up and maximize detections of mounds (Grenier and Filipi 2009).

We attempted to return to all grids on which we had located a colony to verify that the colony was indeed present, whether the colony was active or inactive, and to delineate boundaries of active colonies or active portions of colonies on the ground. During these ground surveys, we classified grids as active if we observed prairie dogs or recent signs of presence, including scat or active burrows (Cudworth et al. in press). At each grid, we started at one corner and began walking the boundary of the grid. Once we had walked three of the four boundary transects, we walked to the center point of the grid and then returned to the starting location. We used binoculars to scan for prairie dogs and burrows at each corner of the grid and while walking along transects. We delineated the boundaries of all active colonies or active portions of colonies by walking the perimeter of the colony and using a GPS to record waypoints every 10 m. We stopped recording when we returned to our starting location or when we encountered the boundary of the grid (Cudworth et al. in press). We completed all ground surveys in July and August to maximize detections of prairie dogs, since adults disappear below ground by late August (Clark et al. 1971, Orabona-Cerovski 1991).

We used digital photos from the 2009 National Agriculture Imagery Program as a background to develop preflight field maps for each of the 600 survey grids. After completing the aerial portion of the survey, we scanned field maps into digital format and used ArcMap GIS software to georeference all maps. We then used heads-up digitizing to create shapefiles from delineations of colonies outlined by observers during aerial surveys that represented colonies present within grids. We clipped these areas to the boundary of each corresponding grid and calculated the total area of colonies within grids. We used these same digitizing and clipping techniques to calculate total area of active colonies within grids from ground-based surveys.

In order to determine the total area occupied by prairie dogs in Wyoming, we summed the area classified as occupied from each grid and divided by the total area surveyed (15,000 ha), which yielded the proportion of land occupied for our survey grids. We multiplied this value by the total amount of available prairie dog habitat in Wyoming (11,511,356 ha; Seglund et al. 2004) to estimate the total area occupied by prairie dogs. To evaluate the accuracy of aerial survey techniques, we report the average of the difference between the amount of area designated as occupied from aerial surveys and the amount of area designated as active from

ground surveys. We adjusted the total area occupied for each grid based upon these results, and followed an identical procedure to estimate the total area occupied by active prairie dog colonies. We report summary statistics for the number of grids surveyed, activity status, omission and commission error rates, and amount of occupied area. For analyses of occupied area, we report means ±SE.

RESULTS

Of the 600 grids surveyed from the air, 137 were surveyed by two observers simultaneously. Observers were in agreement 79.6% of the time, with 90 grids classified as unoccupied, 2 grids classified as inactive, and 17 grids classified as active by both observers. An additional 5.8% of grids were classified as occupied by both observers, but were classified as active by one observer and inactive by another. The remaining 14.6% of grids were classified as unoccupied by one observer and either active (n = 18) or inactive (n = 2) by the other observer.

Of the 47 grids that were classified as occupied by ≥1 observer in the double-observer flights, we were able to return to 21 grids to conduct ground surveys. The observer in the front of the plane (observer 1) recorded omission errors on one grid: observer 1 misclassified the grid as unoccupied when it was active. The observer in the back of the plane (observer 2) was three times more likely to have errors of commission (i.e., classifying a grid as occupied when it was unoccupied) than when he was in the front of the plane during solo flights (52.6% vs. 17.4%, respectively). Because of the difficulty in correctly identifying occupancy from the back of the plane, we only use data from observers when they were in the front of the plane for all further analyses.

Based upon aerial surveys of 600 grids, 19.7% were classified as active, an additional 2.2% were classified as inactive, and 78.2% were classified as unoccupied, since we observed neither prairie dogs nor mounds. Although we attempted to conduct ground surveys on all 131 grids classified as occupied, a number of these fell on private land for which we could not contact landowners or were denied permission to trespass. Consequently, we were only able to return to 61 grids before 1 September 2011.

We pooled data from both observers for all analyses because errors in classification of status and commission were similar between observers overall (Table 1). Observers correctly classified a grid as occupied on 83.6% of grids (n = 51). Of these correctly classified grids, 60.8% were assigned the appropriate activity status. Observers misclassified status on 39.2% of grids and were more likely to incorrectly classify a grid as active (85%) than inactive (15%). Observers incorrectly classified 10 grids as occupied. Of these, 80% contained burrows of other species, such as ground squirrels (*Urocitellus* spp.), badgers (*Taxidea taxus*), and rabbits (*Sylvilagus* spp.). The remaining 20% of grids did not contain burrows (Tables 2 and 3).

We digitized a total of 1,282.2 ha of prairie dog colonies from 131 grids that we classified as occupied during aerial surveys, for an average of 9.8 ha (±0.8 ha) of prairie dog colonies per occupied grid. Out of 600 grids surveyed, 8.5% of the land area contained prairie dog colonies. Based upon estimates from 2008 of potential habitat throughout Wyoming (11,511,356 ha), we

estimate total occupied area throughout the state at 978,465 ha (±80,425 ha) from aerial surveys. Although generally lower than 2008 estimates (95% CI 960,157 to 1,381,751), total area occupied in 2011 is not different from previous surveys. However, based upon ground surveys, we tended to over-estimate the amount of area occupied by active prairie dog colonies by 6.2 ha (±1.1 ha) per occupied grid. Taking this into account, we estimate total area occupied by active colonies throughout available habitat in Wyoming as 356,852 ha (±78,063 ha) from ground surveys.

DISCUSSION

The total area estimated to contain prairie dogs in Wyoming (978,465 ha) is similar to previous surveys in 2008 (1,170,954 ha; Grenier and Filipi 2009), suggesting that the amount of area occupied by prairie dogs has likely not changed in the past 3 years. However, based upon results from ground surveys, it is likely we overestimated the area occupied by active white-tailed prairie dog colonies in aerial surveys for both years. This is not surprising as we made no distinction between active and inactive portions of colonies during aerial surveys. However, area comparisons between aerial and ground-based techniques may be problematic because of differing goals and techniques. Colony delineations from the air included the entire colony within the grid, whereas delineations from the ground only included colonies or portions of colonies that contained active prairie dog burrows. Additionally, both aerial and ground surveys incorporated a number of assumptions that may or may not be valid.

Aerial surveys assume observers are able to orient themselves to the grid based upon aerial photographs and correctly assign activity status and delineate colony boundaries from the air. To address these assumptions, we used a double-observer technique on a subset of grids to assess detection probability (Cook and Jacobson 1979, Caughley and Grice 1982). However, the large commission error rates suggest the observer in the back of the plane had a distinct disadvantage when conducting surveys. Consequently, the feasibility and usefulness of a double-observer for aerial surveys of prairie dogs is likely inadequate. Based upon comparisons of aerial surveys to results from ground surveys, the ability to correctly assign status from the air is also problematic for this species. Burrows can persist on the landscape for many years after die-offs (Seglund et al. 2004), and are likely to be included in estimates of colony size from the air. Despite these difficulties, however, observers still had a high accuracy of detecting colonies of prairie dogs. Observers made errors of commission on 16% of ground-truthed grids, although the majority of these grids contained burrows of other species, suggesting the ability to distinguish among burrows of prairie dogs, ground squirrels, badgers, and other mammals may be difficult from the air in areas where these burrowing mammals overlap.

In comparison, ground-based surveys may suffer from the same errors of incomplete detection as aerial surveys, although errors of commission are likely minimal. Activity of prairie dogs varies with weather, temperature, and time of day (Clark et al. 1971). Consequently, prairie dogs may not have been active or calling during all ground surveys even if they were present in the grid. Although we systematically searched each grid from the ground for burrows, our ability to locate burrows and assign status may have been impacted by prairie dog activity and vegetation. In fact, we recorded instances where prairie dog burrows were not initially detected

along transects because of vegetation and were only observed after detecting vocalizations. Because we did not attempt to account for imperfect detection during ground surveys (Nichols et al. 2000), and because we made no effort to correct for the 4.8% omission error from aerial surveys, our estimates of area occupied by active prairie dog colonies in Wyoming are likely biased low.

Identifying a survey method for white-tailed prairie dogs that is repeatable, accurate, and feasible on a range-wide scale has always been difficult. Surveys that use either aerial or ground-based surveys that focus on burrows have a number of drawbacks (Seglund et al. 2004). To address these concerns, we recommend implementing an occupancy modeling approach as outlined by Andelt et al. (2009) and McDonald et al. (2011). These surveys follow a similar grid-based system described by Grenier and Filipi (2009), but observers record presence of prairie dogs instead of area of colonies within a grid, thus eliminating a significant source of error associated with correctly delineating colony boundaries. Because visual or aural observation is required to document occupancy, correctly assigning activity status is no longer an issue. Additionally, this method accounts for detection probability by requiring multiple surveys of the same grid (MacKenzie et al. 2006). Surveys can be conducted from either the air or the ground, although ground-based surveys are likely more effective at detecting prairie dogs. During aerial surveys, observers detected individual prairie dogs on only 19 of 118 grids classified as active (16%). Conversely, observers detected individual prairie dogs on 25 of 30 grids classified as active during ground surveys (83%); the remaining 5 grids were classified as active based upon burrow condition and observation of fresh scat. Although ground-based surveys are considerably more costly and can be difficult in Wyoming because of the large amount of prairie dog habitat that falls on private land (Grenier et al. 2009), they are likely more effective in detecting prairie dogs than aerial surveys. However, detection probabilities for aerial and ground surveys can be modeled separately, thus providing an alternative when access or permission to trespass cannot be obtained (Andelt et al. 2009). Because occupancy modeling provides a survey method that is repeatable, provides accurate trend estimates, and is comparable among states, we recommend incorporating this approach in future monitoring efforts for white-tailed prairie dogs in Wyoming.

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Table 1. Error rates (% of grids) from aerial surveys for colonies of white-tailed prairie dogs (*Cynomys leucurus*) throughout Wyoming in May-August 2011. Error rates were determined based upon status designations from subsequent ground surveys. 'Status error' represents a misclassification as active or inactive. 'Commission error' represents a classification of occupied when the grid in fact contained no prairie dogs or their burrows. 'Other burrows present' indicates that burrows of other species (e.g., ground squirrels [*Urocitellus* spp.] or badgers [*Taxidea taxus*]) were present on the grid, but no prairie dog burrows were located. Only grids that were surveyed from both the air and the ground are included.

Aerial observer	*n*	Correct status	Status error	Commission error: other burrows present	Commission error: no burrows present
Observer 1	38	55.3	28.9	15.8	0.0
Observer 2	23	43.5	39.1	8.7	8.7
Combined	61	50.8	32.8	13.1	3.3

Table 2. Activity status designations (% of grids) for colonies of white-tailed prairie dog (*Cynomys leucurus*) throughout Wyoming in May-August 2011. All grids were initially classified as active during aerial surveys; status designations are based upon subsequent ground surveys. 'Other burrows present' indicates that burrows of other species (e.g., ground squirrels [*Urocitellus* spp.] or badgers [*Taxidea taxus*]) were present on the grid, but no prairie dog burrows were located. Only grids that were surveyed from both the air and the ground are included.

Aerial observer	*n*	Active	Inactive	Other burrows present	No burrows present
Observer 1	33	63.6	24.2	12.1	0.0
Observer 2	19	31.6	47.4	10.5	10.5
Combined	52	51.9	32.7	11.5	3.8

Table 3. Activity status designations (% of grids) for colonies of white-tailed prairie dog (*Cynomys leucurus*) throughout Wyoming in May-August 2011. All grids were initially classified as inactive during aerial surveys; status designations are based upon subsequent ground surveys. 'Other burrows present' indicates that burrows of other species (e.g., ground squirrels [*Urocitellus* spp.] or badgers [*Taxidea taxus*]) were present on the grid, but no prairie dog burrows were located. Only grids that were surveyed from both the air and the ground are included.

Aerial observer	*n*	Active	Inactive	Other burrows present	No burrows present
Observer 1	5	60.0	0.0	40.0	0.0
Observer 2	4	0.0	100.0	0.0	0.0
Combined	9	33.3	44.4	22.2	0.0

TECHNICAL COMMITTEES AND WORKING GROUPS

A 5-YEAR REVIEW OF THE CENTRAL AND PACIFIC FLYWAY NONGAME MIGRATORY BIRD TECHNICAL COMMITTEES

STATE OF WYOMING

NONGAME BIRDS: Nongame Migratory Birds

FUNDING SOURCE: Wyoming State Legislature General Fund Appropriation and/or Wyoming Governor's Endangered Species Account Fund

PROJECT DURATION: Annual

PERIOD COVERED: 15 April 2011 – 14 April 2012

PREPARED BY: Andrea Orabona, Nongame Bird Biologist
Joe Bohne, Staff Biologist

SUMMARY

The Central Flyway Council (CFC) was established in 1951 and Pacific Flyway Council in 1948, to represent states that occur within each flyway. The CFC includes representative from 10 states (i.e., Montana, Wyoming, Colorado, New Mexico, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas) and three Canadian provinces (i.e., Saskatchewan, Alberta, and the Northwest Territories). The PFC includes representatives from Washington, Oregon, California, Arizona, New Mexico, Colorado, Wyoming, Idaho, Montana, Alaska, Nevada, and Utah. The Canadian Wildlife Service and British Columbia are also active participants in the Pacific Flyway. The function of the Central and Pacific Flyway Councils is to work with the US Fish and Wildlife Service (USFWS), in conjunction with the councils of the Atlantic and Mississippi flyways, in the cooperative management of North American migratory game birds. Specific responsibilities include season setting of migratory bird hunting regulations. The CFC and PFC, via their technical committees, also conduct and contribute to a wide variety of migratory bird research and management programs throughout the United States, Canada, and Mexico.

Considerable technical information is required for the flyway councils to accomplish their objectives. Various Technical Committees (TC) have been established to fulfill this role. The Central Flyway Waterfowl TC and the Pacific Flyway Study Committee were established in 1953 and 1948 respectively. The Central Management Unit TC was formed in 1966 to provide technical input on Mourning Dove management and research issues. In 1967, the scope of this TC was broadened to include species other that doves, and the name was changed to the Central Migratory Shore and Upland Game Bird TC. In 1999, the name was changed to the Central Flyway Webless Game Bird TC, and in 2001, the name was again changed to the Central Flyway

Webless Migratory Game Bird TC. The Central Management Unit Mourning Dove TC was established in 2003, and its name was changed to the Central Management Unit Dove TC in 2007 to recognize responsibility for all dove species with regulated hunting seasons. In 2006, the Central and Pacific Flyway Councils established the Central and Pacific Flyway Nongame Migratory Bird TC to address a growing number of regulatory issues for migratory birds that were not currently addressed by the other TCs, and to broaden the Flyway Councils' focus beyond traditional game birds.

It is the intent of the CFC, PFC, and TCs that the division of responsibilities for avian species follows the definition for game birds as defined in the migratory bird conventions with Canada and Mexico. The Central Flyway Waterfowl TC is responsible for the families Anatidae (i.e., ducks, geese, and swans) and Rallidae (i.e., American Coots). The Central Flyway Webless Migratory Bird TC is responsible for the families Rallidae (i.e., rails, gallinules, and other coots), Gruidae (i.e., cranes), Charadriidae (i.e., plovers and lapwings), Haematopodidae (i.e., oystercatchers), Recurvirostridae (i.e., stilts and avocets), Scolopacidae (i.e., sandpipers, phalaropes, and allies), Corvidae (i.e., jays, crows, and their allies), and Columbidae (i.e., pigeons). The Central Management Unit Mourning Dove TC is responsible for the Columbidae family (i.e., doves only). The Central Flyway Nongame Migratory Bird TC is responsible for all migratory birds, as per the Migratory Bird Treaty Act, not included in the above division of responsibilities. Technical Committee members do recognize, however, that they may need to collaborate on some issues. For example, the webless TCs should coordinate with the nongame TC on issues related to shorebirds, rails, and federally threatened or endangered species that are not hunted.

The state, provincial, and territorial representatives to the TCs are usually biologists with considerable training and experience in the field of waterfowl, migratory shore and upland game bird, dove, or migratory nongame bird management and research, respectively. The function of the TCs is to serve the CFC and PFC, with primary responsibility for the technical information needs of the Flyway Councils related to management of migratory game birds, wetland resources and nongame migratory birds. The TCs may also recommend research projects, surveys, and management programs to the Flyway Councils for their collective consideration or implementation. The Wyoming Game and Fish Department's Nongame Bird Biologist, Andrea Orabona, and Nongame Biologist, Susan Patla, serve as the state's representatives on the Central and Pacific Nongame Migratory Bird TCs, respectively.

Since the TC inception, the Central Flyway Nongame Migratory Bird TC has submitted 8 recommendations to the CFC for signing and submission, and 24 letters of correspondence to a variety of recipients on a diversity of nongame issues, both regulatory and non-regulatory. A summary of the recommendations and letters is presented below (Tables 1 and 2). A summary of the Pacific Flyway Nongame Migratory Bird TC's activities and recommendations is presented in Table 3.

Table 1. Summary of recommendations submitted by the Central Flyway Nongame Migratory Bird Technical Committee, 2007-2012. US Fish and Wildlife Service (USFWS); Central Flyway Committee (CFC); Atlantic Flyway (AF); Mississippi Flyway (MF); Central Flyway (CF); Technical Committee (TC)

Date	Recommendation #	Pertaining to	Recommendation
March 20, 2007	10	Selection of shorebird species for Avian Influenza surveillance.	The CFC recommends that the USFWS prohibit lethal collection of certain shorebird species during avian influenza surveillance activities. Samples from highly imperiled species should be taken by nonlethal means.
March 20, 2007	11	Comment period during proposed rule stage.	The CFC recommends that the USFWS allows for comment periods for all nongame migratory bird regulations to be 90 days, but no less than 60 days, and considers the option of establishing nongame migratory bird regulatory cycles similar to that which exists for the Waterfowl, Webless, and Central Management Unit-Dove TC.
March 20, 2007	12	Finalization of MOU for the Cooperative Exchange, Interpretation, and Evaluation of Data and Information Used for Developing Migratory Bird Regulations.	The CFC recommends that the MOU listed above be finalized and signed by the Director of the USFWS and the Chairperson of the CFC.
March 17, 2009	14	Allocation of passage Peregrine Falcon take for falconry purposes in the United States east of 100° W longitude.	The CFC recommends an equitable distribution of 36 first-year migrant peregrine falcon take permits among the CF, MF, AF, for the 20 September to 20 October 2009 trapping season; 12 permits each for the CF, MF, and AF. Of the Central Flyway's allocation, the CFC recommends 10 first-year migrant peregrine falcons for Texas and 2 first-year migrant peregrine falcons for Oklahoma for the 20 September to 20 October 2009 trapping season only.

Table 1. Continued.

Date	Recommendation #	Pertaining to	Recommendation
March 17, 2009	15	Allocation of nestling/post-fledgling first-year Peregrine Falcon take for falconry purposes in the United States west of 100° W longitude.	The CFC recommends allocating 5 nestling per post-fledgling first-year Peregrine Falcons to Montana, 5 to Wyoming, 4 to Colorado, and 2 to New Mexico for take during the nesting period through 31 August 2009 only.
March 23, 2010	14	Allocation of the take of passage immature Peregrine Falcons for falconry purposes in the United States east of 100° W longitude.	The CFC recommends that 12 of the 36 first-year migrant Peregrine Falcon take permits be allocated to the CF for the fall of 2010 trapping season, with 11 of the 12 permits designated for Texas and 1 of the 12 permits designated for Oklahoma for the fall 2010 trapping season only.
March 15, 2011	14	Participation in the USFWS Eagle Technical Assessment Group.	The CFC recommends that a Central Flyway Nongame Migratory Bird TC representative is included on the USFWS's Eagle Technical Assessment Group.
March 15, 2011	15	Peregrine Falcon allocation for falconry purposes.	The CFC recommends adoption of Alternative A (allocation of 12-12-12) for allocation of permits for the take of passage immature Peregrine Falcons for falconry, and that states consider the use of a quota system to provide additional opportunity where the probability of take is expected to be less than 1 permit:1 falcon captured.

Table 2. Summary of correspondence submitted by the Central Flyway Nongame Migratory Bird Technical Committee, 2006-2012. Technical Committee (TC); Central Flyway Committee (CFC); Central Flyway (CF);

Date	Recipient	Issue(s)	CF Key Remark(s)
June 9, 2006 -and- June 12, 2006	Michelle Morgan, Chief, Branch of Recovery and Delisting, USFWS, -and- Brian Millsap, Chief, Division of Migratory Bird Management, USFWS	• Proposed Rule to delist the Bald Eagle	• Support the delisting, but "recommend the post-delisting monitoring plan be finalized to coincide with the final delisting".
		• Definition of "disturb"	• Definition too narrowly focused on nest sites; "recommend that the term "nest abandonment" be replaced with "nest site or communal roost abandonment".
		• Review of Draft National Bald Eagle Management Guidelines	• "Recommend that voluntary habitat protection and management activities be maintained and enhanced in the Guidelines, and that a positive, voluntary, non-regulatory tone be maintained"; represent the most liberal estimates of acceptable disturbance; and "recommend the guidelines be reviewed after 5 years for efficiency and accuracy."
November 3, 2006	Paul Schmidt, USFWS, -and- Dr. Bea Van Horne, USFS	• Review of "Opportunities for Improving North American Avian Monitoring"	• Support the four goals proposed, but believe the report needs to provide more recognition of the realities of personnel, budgets, and time restraints to reach these goals.
November 15, 2006	Robert Blohm, Acting Chief, Division of Migratory Bird Management, USFWS	• Draft EA on Take of Raptors from the Wild under the Falconry Regulations and the Raptor Propagation Regulations	• "Substantially more detail is required regarding the population model, reporting and data management, oversight and communication, and enforcement." • "Concerned that other proposed changes to the regulations governing falconry have not been adequately addressed to date."

Table 2. Continued.

Date	Recipient	Issue(s)	CF Key Remark(s)
January 11, 2007	Robert Blohm, Acting Chief, Division of Migratory Bird Management, USFWS	• Reopening of comment period: Protection of Bald Eagles; Definition of ''Disturb''	• Reinforced our June 9th and 12th 2006 comments. • Suggested this definition, with our additions in italics: "Disturb means to agitate or bother a bald or golden eagle to the degree that causes *or is likely or predicted to cause* (i) *repeated displacement*, injury, or death to an eagle (including chicks and eggs) due to interference with breeding, feeding, or sheltering behavior, or (ii) nest *site or communal roost* abandonment or *likely or predictable abandonment of nest site or communal roost*."
March 6, 2007	Central Flyway Council	• Participation of Canadian provinces in Central Flyway NMBTC activities	• "Our Committee suggests that an invitation be extended to Northwest Territories, Alberta, and Saskatchewan to nominate an individual to serve on the Central Flyway Nongame Migratory Bird TC for input on issues that affect bird species or populations that are common to provinces and states within the CF."
March 6, 2007	Dr. Thomas DeLiberto, USDA APHIS-Wildlife Services, -and- Dr. Thomas J. Roffe, USFWS	• Avian influenza surveillance in 2007	• Samples from Buff-breasted Sandpiper and other highly imperiled species should be taken by nonlethal methods.

Table 2. Continued.

Date	Recipient	Issue(s)	CF Key Remark(s)
August 31, 2007	Jody Millar, Bald Eagle Monitoring Coordinator, USFWS	• Draft Post-delisting Monitoring Plan for Bald Eagles	• The plan is generally well developed, but "we are disappointed that the sampling plan was not completed, approved, and ready for implementation prior to delisting of the Bald Eagle." • "Troubled at the apparent lack of dedicated funding to support the monitoring effort." • Unclear as to what exactly is expected of the states.
August 31, 2007	Division of Migratory Bird Management, USFWS	• Proposed Rule: Authorizations Under the Bald and Golden Eagle Protection Act for Take of Eagles	• Recommend the Service "include state agency expertise in defining regions that may be used to assess the impact of take..." • "It has been our understanding that take permits will not be issued and take resulting from disturbance of Bald Eagles will not be prosecuted as long as the national guidelines have been followed." • "Take" should be based on state guidelines when they differ from federal guidelines." • Lacks specific information relating to Golden Eagles. Recommend a document similar to Bald Eagles Management Guidelines be developed for Golden Eagles. • Recommend the Service consider development of monitoring strategy for Golden Eagles. Lacking "defensible information on the status and trends of Golden Eagle populations."

Table 2. Continued.

Date	Recipient	Issue(s)	CF Key Remark(s)
January 21, 2008	Robert Blohm, Chief, Division of Migratory Bird Management, USFWS	• Draft Environmental Assessment and Management Plan for the take of migrant Peregrine Falcons in the US for use in falconry	• The DEA asserts that Canadian provinces will be involved in the allocation through the Flyways; however, the Canadian Provinces have not accepted our offer to provide representation on the Central Flyway Nongame Migratory Bird TC.
August 14, 2008	H. Dale Hall, Director USFWS	• Eagle Take Permit comment period	• Extend comment period from 30 to 60 days.
September 15, 2008	Diana Whittington, Division of Policy and Directives Management, USFWS	• Draft Environmental Assessment for the Proposal to Permit Take Provided Under the Bald and Golden Eagle Protection Act	• "Based on this review the CFC does not support any of the proposed alternatives in the Draft Environmental Assessment." • We request that Golden Eagles be removed from consideration for take permits until such time that sufficient supporting information can be collected and presented. We also recommend that the Service develop an Alternative 4 in the Draft Environmental Assessment to address a proposed take permitting system that includes Bald Eagles only." • "We continue to be concerned at the very short public comment periods provided by the Service for significant issues."
October 1, 2008	Alan Peoples (OK)	• Participation of Oklahoma in Central Flyway NMBTC activities	• Request they identify a representative ASAP, or contact the current Council chair if and when they decide to do so.

Table 2. Continued.

Date	Recipient	Issue(s)	CF Key Remark(s)
March 6, 2009	George Allen Division of Policy and Directives Management	• Proposed Rule for Removal of Rusty Blackbird and Tamaulipas (Mexican) Crow From the Depredation Order and other changes	• We do not believe rusty blackbird is a nuisance species warranting depredation measures. Agree to remove it from the depredation order. • Agree to remove the Tamaulipas Crow from the order.
March 9, 2009	Central Flyway Council	• Allocation of nestling/post-fledgling first-year Peregrine Falcons between the Central and Pacific Flyways	• Nongame technical committee members of the Central Flyway whose state is split with the Pacific Flyway provided recommendations on the level at which take should be authorized.
March 15, 2010	CFNMBTC	• Developed a flyway-wide list of Species of Greatest Conservation Need	• Illustrated the diversity of the species with which we work and demonstrated the Central Flyway Nongame Migratory Bird TC's interest in all native habitat types.
March 23, 2010	US Senators Feinstein and Alexander, -and- US Representatives Dicks and Simpson	• State Wildlife Grants program appropriation	• Requests funding for the State Wildlife Grants program at a level of $90 million during FY2011 and retention of the 65:35 cost-share ratio, which Congress enacted during FY2010.
March 23, 2010	George Allen, Chief Branch of Permits and Regulations, USFWS	• Bird Banding Lab letter	• The CFC requested that each of the four flyways be allowed a 120-day review period in order to evaluate and prepare a coordinated response among our TC.

Table 2. Continued.

Date	Recipient	Issue(s)	CF Key Remark(s)
March 4, 2011 (original) August 10, 2011 (signed)	USFWS	• Double-crested Cormorant letter	• The CFC had several questions about the USFWS's long-term vision to manage Double-crested Cormorants before we develop a flyway management plan.
March 23, 2011	USFWS	• Eagle Technical Assessment letter	• We requested the USFWS to include the Central Flyway Nongame Migratory Bird TC in inaugural and on-going efforts to address Bald and Golden Eagle issues.
October 3, 2011	USFWS	• Bald and Golden Eagle captive propagation letter	• In general, we do not see the need and, therefore, do not support captive propagation of Bald and Golden Eagles.
October 3, 2011	Senators Reed and Murkowski, and Representatives Simpson and Moran	• State Wildlife Grants support letter	• Support the continuation of State Wildlife Grants funding at $90 million for FY2012 and retention of the 65:35 cost-share ratio.
December 20, 2011	USFWS	• Double-crested Cormorant Management	• Request 60-day comment period extension for Federal Register Notice of Intent regarding Double-crested Cormorant management.
March 13, 2012	USFWS	• Double-crested Cormorant Management	• Comments to Federal Register Notice of Intent regarding Double-crested Cormorant management.

Table 3. Summary of Pacific Flyway Nongame Migratory Bird Technical Committee activities and recommendations, 2006-2012.

Date	Activities and Recommendations
March 2006	• Pacific Flyway Nongame Migratory Bird Technical Committee (PFNMBTC) Bylaws • Comments on proposed rule to delist the Bald Eagle • Comments on proposed Definition of "Disturb" • Comments on National Bald Eagle Management Guidelines
July 2006	• Comments on the Draft Environmental Assessment for Take of Raptors from the Wild under the Falconry Regulations and the Raptor Propagation Regulations • Letter requesting that Council provide travel support for the PFNMBTC's Arizona representative to attend necessary meetings related to songbird harvest in Mexico (Trilateral) • Proposed 2007 changes to subsistence harvest regulations in Alaska • Comments on the proposed rule to revise the list of migratory birds to be protected by the Migratory Bird Treaty Act • Letter to FWS concerning regulatory document releases to better accommodate PFNMBTC meeting schedule
March 2007	• Bald Eagle post-delisting monitoring plan (initial discussion) • Passage take of peregrine falcons (initial discussion) • Federal falconry database (beta testing) • Regulations governing falconry (initial discussion) • Avian Influenza (Joint surveillance plan with Study Committee)
July 2007	• Comments on final rule changing the regulations governing handling of birds trapped in buildings • Request for carry forward funding approved by the PFC in July 2006 to attend songbird harvest workshop in Mexico • Proposed 2008 changes to subsistence harvest regulations in Alaska • Authorizations under the Bald and Golden Eagle Protection Act for take of eagles (discussion) • Peer review of Bald Eagle Post-Delisting Monitoring Strategy • Comments on Draft Bald Eagle Post-Delisting Monitoring Plan

Table 3. Continued.

March 2008	• Comments on Draft Environmental Assessment and Management Plan for the Take of Migrant Peregrine Falcons from the Wild for use in Falconry • Comments on the revisions to Migratory Bird Import and Export Regulations • Alaska Migratory Bird Co-Management Council (discussion) • Eagle take authorizations (initial discussion) • Swamphen and Muscovy Duck MBTA exemptions (joint resolution)
July 2008	• Allocation of Peregrine Falcon take (discussion) • Proposed 2009 changes to subsistence harvest regulations in Alaska • Comments on proposed rules to change regulations governing control of Muscovy Duck and Purple Swamp Hen • Regulations governing falconry (discussion) • Comments on Draft Environmental Assessment Authorizations to Permit Take for Bald and Golden Eagles • Subsistence harvest in Alaska – Yellow-billed Loon incidental take allocation, Aleutian and Arctic Tern eggs, 2009 regulations.
March 2009	• Comments on proposed USGS Bird Banding Laboratory rules (Joint Recommendation with Study Committee) • Allocation of nestling/post-fledgling first-year Peregrine Falcon take for falconry purposes in the United States west of the 100° W longitude • Comments on Final Environmental Assessment and Management Plan on Take of Migrant Peregrine Falcons from the Wild for Use in Falconry, and Reallocation of Nestling/Fledgling Take • Memorandum of Understanding between the FWS and PFC (Joint recommendation with Study Committee)
July 2009	• Comments on Changes in the Regulations Governing Falconry • Avian predation scoping document and policy statement (initial discussion) • Subsistence harvest in Alaska – Yellow-billed Loon incidental take allocation, 2010 regulations

Table 3. Continued.

March 2010	• Letter requesting clarification of the FWS process for developing programmatic take permits for Bald and Golden Eagles as well as an opportunity to be involved in that development process • Avian predation on fish resources draft scoping document (initial outline / framework) • Organizing the Pacific Flyway Migratory Bird Habitat Committee (Joint note with Study Committee) • Eagle take authorizations (continued discussion) • Bylaw revisions (continued discussion with Study Committee)
July 2010	• Comments on FWS Bald Eagle Post-Delisting Monitoring Update and Discussion Points • Letters to all state Directors requesting support for attendance of PFNMBTC members at all Flyway meetings • Budget request for one PFNMBTC representative to attend March meetings of the PFC and summer meetings of the SRC • Comments on regulations for Nongame Migratory Bird Subsistence Hunting in Alaska for the 2011 Season and Incidental Take of Yellow-billed Loon • Avian predation scoping document and policy statement (draft) • Clarification regarding falconry allocation
March 2011	• Letter to FWS supporting request for a review of the role, responsibility, and future vision of the Flyway Nongame Technical Committees at a national level • Letter to FWS requesting PFNMBTC representation on Eagle Technical Assessment Team • Avian predation on fish resources policy statement (final) • Comments on Draft Eagle Conservation Plan Guidance • Comments on Draft Land-Based Wind Energy Guidelines
July 2011	• PFNMBTC internal review • American White Pelican management plan • Double-crested Cormorant management plan • Eagle issues (continued discussion)

Table 3. Continued.

December 2011	• American White Pelican management plan • Double-crested Cormorant management plan
March 2012	• Recommendation: A Framework for the Management of American White Pelican Depredation on Fish Resources in the Pacific Flyway • Recommendation: A Framework for the Management of Double-crested Cormorant Depredation on Fish resources in the Pacific Flyway • Informational Note: Pacific Flyway Habitat Committee Update • Informational Note: Flyway Nongame Technical Committee Update • Eagle issues (continued discussion). Members of the NMBTC participated in several meetings of the Service's Eagle Technical Assessment Team to help complete version 2 of the Eagle Conservation Plan Guidance. Continued to work toward coordination of Golden Eagle monitoring proposals. • Review of the Pacific Flyway webpage to update information and enhance the presence of NMBTC. • Discussed and reviewed the Council's by-laws in conjunction with the Study Committee in anticipation of updating the NMBTC's bylaws later this year. • Coordinated response to questions from Service regarding development of monitoring strategy for secretive marsh birds • Developed responses for FWS review of PFNMBTC

WYOMING BIRD RECORDS COMMITTEE

STATE OF WYOMING

NONGAME BIRDS: Rare and Unusual Birds

FUNDING SOURCE: Wyoming State Legislature General Fund Appropriations

PROJECT DURATION: Annual

PERIOD COVERED: 1 January 2011 – 31 December 2011

PREPARED BY: Andrea Orabona, Nongame Bird Biologist

SUMMARY

The Wyoming Bird Records Committee (WBRC) was established in 1989 to accomplish the following goals.

1) To solicit, organize, and maintain records, documentation, photographs, tape recordings, and any other material relative to the birds of Wyoming.
2) To review records of new or rare species or species difficult to identify and offer an intelligent, unbiased opinion of the validity or thoroughness of these reports. From these reviews, the WBRC will develop and maintain an Official State List of Birds in Wyoming.
3) To disseminate useful and pertinent material concerning the field identification of Wyoming birds in order to assist Wyoming birders in increasing their knowledge and skill.

The WBRC is interested in promoting and maintaining quality and integrity in the reporting of Wyoming bird observations, and it treats all bird records as significant historical documents. The Wyoming Bird Records Committee operates under a set of bylaws approved in 1991 and updated in 1992 and 1998.

As of 31 December 2011, the WBRC has reviewed 1,202 reports of rare and unusual birds in Wyoming. Of those reports, 972 (81%) have been accepted and 230 (19%) have not been accepted. Eleven reports have been submitted thus far in 2012 and are awaiting review.

The Wyoming Bird Records Committee Database is a dynamic document, updated once or twice a year following the WBRC meetings. All WBRC reports for 2010, as well as Rare and Unusual Bird Forms are available from the Nongame Bird Biologist in the Lander regional office.

BLACK-FOOTED FERRET RECOVERY AND IMPLEMENTATION TEAM ANNUAL SUMMARY

STATE OF WYOMING

NONGAME MAMMALS: Species of Greatest Conservation Need, Endangered Species – Black-footed Ferret

FUNDING SOURCE: United States Fish and Wildlife Service Section 6 Funds, Wyoming State Legislature General Fund Appropriations

PROJECT DURATION: Annual

PERIOD COVERED: 15 April 2011 – 14 April 2012

PREPARED BY: Martin Grenier, Nongame Mammal Biologist

SUMMARY

The Black-footed Ferret Recovery and Implementation Team (BFFRIT) was created in 1996 by the US Fish and Wildlife Service (USFWS) to serve as an interstate advisory group to the USFWS on management issues for the black-footed ferret (*Mustela nigripes*; ferret). BFFRIT replaced the advisory group (i.e., Black-footed Ferret Advisory Team) created by the Wyoming Game and Fish Department in 1986.

BFFRIT continues to develop the framework for the landowner incentive program. During the last year BFFRIT expanded to include two additional subcommittees, Sylvatic Plague Vaccine Sub-Committee (SPVS) and Incentive Sub-Committee (IS). These new sub-committees were developed to address the growing needs of the new initiatives launched by BFFRIT. It is anticipated that IS and SPVS will work closely with existing BFFRIT entities.

The IS continued to expand the framework for landowner incentive program to benefit the recovery of the ferret. It is anticipated that the USFWS will release an assurance package for private landowners centered around the Safe Harbor Agreement. Additional details will be released this summer. A fully functioning working draft is expected later this year.

The SPVS is heading up the development of the Sylvatic Plague Vaccine (SPV) for oral consumption by prairie dogs. It is anticipated that the SPV will be available for a complete clinical field trial during the summer of 2013-2016. Wyoming has nominated the Pitchforck Ranch and Devil's Tower as potential project sites.

SWIFT FOX CONSERVATION TEAM ANNUAL SUMMARY

STATE OF WYOMING

NONGAME MAMMALS: Species of Greatest Conservation Need – Swift Fox

FUNDING SOURCE: United States Fish and Wildlife Service State Wildlife Grants, Wyoming State Legislature General Fund Appropriations

PROJECT DURATION: Annual

PERIOD COVERED: 15 April 2011 – 14 April 2012

PREPARED BY: Martin Grenier, Nongame Mammal Biologist

SUMMARY

The Swift Fox Conservation Team (Team) was created in 1995 following the petition to list the swift fox (*Vulpes velox*) as Threatened or Endangered under the Endangered Species Act of 1973 (ESA). State agencies within the historic range of the swift fox created the Team in an effort to coordinate management across the species range. The Team is comprised of representative from various state and federal agencies, and enjoys participation from several non-governmental organizations as well as native American tribes.

Since its inception the Team has worked diligently to remove the swift fox from the ESA and to preclude future relisting of the species. In recent years, in collaboration with Kansas, Colorado, and Wyoming, swift fox have been reintroduced into western and central South Dakota. The Team produces an annual report available from their website maintained by Colorado Division of Wildlife at http://wildlife.state.co.us/WildlifeSpecies/GrasslandSpecies/SwiftFoxAdditionalResources.htm

The team met in Pueblo, Colorado during the spring of 2012. States and recovery partners shared results of recent work completed within their jurisdictions. The distribution of swift fox continues expand through direct efforts of the Team. Accordingly, few threats were identified as rising to the population level. The team discussed disbanding as many of the objectives in the Conservation Assessment have been accomplished. After careful review and debate the team decided to remain intact through 2015, as per the Conservation Assessment. Accordingly the team elected a new chair, Matt Peek, Kansas Department of Wildlife and Parks.

WYOMING BAT WORKING GROUP ANNUAL SUMMARY

STATE OF WYOMING

NONGAME MAMMALS: Species of Greatest Conservation Need – Bats

FUNDING SOURCE: United States Fish and Wildlife Service State Wildlife Grants, Wyoming State Legislature General Fund Appropriations

PROJECT DURATION: Annual

PERIOD COVERED: 15 April 2011 – 14 April 2012

PREPARED BY: Martin Grenier, Nongame Mammal Biologist

SUMMARY

The Wyoming Bat Working Group (WYBWG) is a subgroup of the larger Western Bat Working Group that coordinates management and conservation of bats in the western US. Both group were formed in the mid 1990s to address growing concern over Townsend's big-eared bat (*Corynorhinus townsendii*; COTO). After the development of the COTO Conservation Assessment and Strategy (Pierson et al. 1999), emphasis broadened to include all bat species. The WYBWG is comprised of representatives from Bureau of Land Management, US Fish and Wildlife Service, US Forest Service, Washakie Conservation District, Wyoming Department of Environmental Quality, and Wyoming Game and Fish Department (Department). Bill Munro, US Forest Service, is the current chair for the WYBWG and Diane Probasco, US Forest Service, is the vice-chair.

White Nose Syndrome (WNS) and risk assessment for the Rocky Mountain Region continues to be a concern for the WYBWG. The WYBWG and Department continue to implement strategies in the state WNS strategic plan (Abel and Grenier 2010). Accordingly, partners have collaborated to purchase several i-button data loggers to record internal temperature and humidity data of caves and abandoned mines in Wyoming. The Department is currently deploying the i-buttons across several caves. The loggers will record data every 3 hrs for approximately one year. Results will be summarized in future completion reports.

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