Diversity Monitoring in Montana

2008-2010

Final Report

Lauri Hanauska-Brown, Bryce Maxell, Adam Petersen,

Scott Story

Executive Summary

In Montana, very little information exists on the status and distribution of a diverse assemblage of nonavian vertebrates, including small mammals, amphibians, terrestrial reptiles and bats. The Montana Inventory and Monitoring Project (Diversity Monitoring) was initiated to: (1) simultaneously provide information on a diverse suite of faunal groups; (2) provide baseline information on species' distributions, site occupancy rates, and detection probabilities that can be used to inform current species conservation status ranking and management efforts; (3) evaluate methodologies and preliminary estimates of site occupancy and detection rates in order to refine survey protocols for future monitoring efforts; (4) establish a baseline of information that can eventually be used to assess changes in distribution and status over time related to changes in habitat and/or management efforts; (5) identify immediate or future research needs for individual species, species assemblages, or habitats; and (6) identify gaps in species' ranges across the state and potentially create maps identifying patterns in individual or collective occupancy rates of species across the state.

During the period 2008 - 2010, 3,863 individual surveys were conducted during 213 days at 3,048 unique locations within 282 quarter-quadrangle sampling areas in Montana. A majority of sampling occurred on private property (51%), with additional sampling occurring on US Forest Service (16%), Bureau of Land Management (13%), State (12%), and other lands (9%).

During structured surveys, 5,806 species detections were recorded, and of those detections, 84 unique species were identified. In addition to structured survey observations, 5,912 species observations were recorded incidentally at 2,634 different locations. We detected 21 Species of Concern in Montana during structured surveys, but failed to detect several others identified as Species of Greatest Conservation Need in Montana's 2005 Comprehensive Fish and Wildlife Conservation Strategy. These included, Great Basin Pocket Mouse, Northern Bog Lemming, Meadow Jumping Mouse, Coeur d'Alene Salamander, Milksnake, Smooth Greensnake, and Western Hog-nosed Snake; all of which may require species specific survey efforts in the future.

The data collected through this work expanded the known range for the following seven species: Dusky or Montane Shrew, Pygmy Shrew, Fringed Myotis, Eastern Red Bat, Pallid Bat, Southern Red-backed Vole, and Montane Vole.

The number of detections and number of different species detected for each survey method varied considerably by geographic location. In general, the number of bat species detected was highest along the length of the Missouri River and lowest in the northern quarter of the State. The number of amphibian and aquatic reptile species detected at lentic sites was highest in east-central Montana. For small mammals, the number of species detected at survey sites was highest in eastern Montana and lowest in southwestern Montana. The greatest number of terrestrial reptile species detections was in south-central and southeast Montana, however, detection rates statewide were low overall.

The number of unique species and number of individuals of each species detected for each sample methodology varied considerably by geographic region. For small mammals, both the number of unique species and the total number of individuals detected in each quarter-quad was highest in southwestern

Montana where Great Basin fauna come into the state, the east front of the Rocky Mountains where plains and mountain fauna's meet, and in some areas of higher topographic relief across eastern Montana where major habitat types converge. Conversely, both the number of unique small mammal species and total numbers of small mammal individuals detected was lowest in areas with the least topographic relief and habitat complexity (e.g., plains of eastern Montana). The number of unique bat species detected by acoustic surveys in each quarter-quad was reasonably high (7 to 9 species) across most of the state, but was low (less than 5 species) in eastern Montana north of the Missouri River where tree and rock outcrop roost sites are very limited on the landscape. The number of unique amphibian and aquatic reptile species detected at lentic sites in each quarter-quad was highest (commonly 6-7 species) across most of eastern and northwest Montana, but relatively low (often less than 4 species) across the northwestern Great Plains and in southwest Montana; landscapes that are relatively dry where habitats have been extensively modified for agriculture. The number of unique terrestrial reptile species detected in each quarter-quad with visual encounter surveys was relatively low (almost always less than 4) across the state and visual encounter surveys failed to detect terrestrial reptiles across most of western Montana.

We estimated detection probability at both a statewide extent and within the boundaries of the known range of the species within Montana and found that detection probabilities varied greatly between species and species groups. As a group, reptiles had the lowest detection probabilities. Estimates of detectability from bat acoustic detectors had relatively tight confidence intervals relative to other groups.

Deer Mouse had the highest estimate of occupancy for small mammal trap line surveys. For bat acoustic surveys, several species had occupancy estimates near 80% within their known range at the quarter-quadrangle scale, including Hoary Bat, Little Brown Myotis, Pallid Bat, and Silver-haired Bat. Fringed Myotis and Townsend's Big-eared Bat had the lowest occupancy estimates within their known range. For amphibians, occupancy estimates within the known range of species were highest for Long-toed and Barred Tiger Salamanders and Woodhouse's Toad, although confidence intervals were large for Long-toed Salamander and Woodhouse's Toad. American Bullfrog and Great Plains Toad had the lowest occupancy estimates within their known range. Occupancy estimates were not obtainable for five of the eleven species encountered during terrestrial reptile surveys due to a lack of repeat detections. The occupancy and detection analyses suggest the single-season survey methodology presented herein can serve as an effective monitoring tool for most bats, small mammals, reptiles, and amphibians. We found that the methods used were most appropriate for estimating occupancy of these animals when detection probabilities were greater than ten percent. We estimated detection probabilities of less than one percent for many terrestrial reptile species, Ord's Kangaroo Rat, Preble's Shrew, Merriam's Shrew, Eastern Red Bat, Yuma Myotis, and Spotted Bat. The lack of repeat detections for these species or groups of species suggests that alternative or additional sampling methods may be required. However, considering that we detected 29 of 38 small mammal species that were targeted for survey, 14 of 15 bat species, 12 of 17 reptile species, and 12 of 13 amphibian species during this project, we believe the methodologies presented herein provide an adequate framework for broad-spectrum detection of a majority of target species in Montana.

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Introduction

The Montana Inventory and Monitoring Project (Diversity Monitoring) was proposed in response to a recognized need for baseline information on a variety of non-game species (Montana Comprehensive Fish and Wildlife Conservation Strategy (CFWCS), Montana Fish, Wildlife, and Parks 2005). This recognized need included the need to develop a long-term inventory and monitoring program that would:

- (1) simultaneously provide information on a diverse suite of faunal groups,
- (2) provide baseline information on species' distributions, site occupancy rates, and detection probabilities that can be used to inform current species conservation status ranking and management efforts,
- (3) evaluate methodologies and preliminary estimates of detection and site occupancy rates in order to refine survey protocols for future monitoring efforts,
- (4) establish a baseline of information that can eventually be used to assess changes in distribution and status over time related to changes in habitat and/or management efforts,
- (5) identify immediate or future research needs for individual species, species assemblages, or habitats,
- (6) identify gaps in species' ranges across the state and potentially create maps identifying patterns in individual or collective occupancy rates of species across the state.

Background

Maintaining a diverse assemblage of native species is important for maintaining the ecological relationships and ecological services on which all species depend. Benefits of maintaining biodiversity may include protecting food web dynamics, safeguarding against disease outbreaks, maintaining high quality range and forest land, and providing harvestable plants and animals (Allan and Flecker 1993). Everett et al.(1994), Noss and Cooperrider (1994) suggest that monitoring biodiversity is an important element of ecosystem management and can be incorporated into an adaptive management approach for land management.

In Montana, very little information exists on the status and distribution of a diverse assemblage of vertebrates, including small mammals, amphibians, reptiles and bats (Montana Fish, Wildlife, and Parks 2005). Completing baseline statewide assessments is essential to determining appropriate steps for conserving these species.

The goal of this project was to develop and refine survey, inventory, and monitoring protocols in order to better understand the distribution, status, and habitat requirements of species or groups of species identified as most in need of inventory within Montana (Montana Fish, Wildlife, and Parks 2005). It is our hope that development of effective and standardized methodologies will allow other state, federal,

tribal, and private entities to follow our lead and gather compatible data. In addition, standardized protocols will set the stage for future work.

Methods

Montana encompasses an area of 381,154 square kilometers and is too large to survey systematically in a single year. Thus, surveys were conducted over three years: northeast in 2008, southeast in 2009, and west in 2010 (Figure 1). Six crew members were hired each year to work in teams of two. Table 1 summarizes the materials used by each crew for each survey type.

Sample Site Selection

We used a stratified randomized sampling design to select survey sites across public and private lands statewide in order to make inferences about occupancy and detection rates in various habitats within the known range of individual species. The sample site, or unit of study for this project, was defined as a quarter of a USGS 1:24,000 scale topographic quadrangle; there are 11,265 potential quarter-quadrangles available for sampling across the state (Figure 1). Quarter-quads were divided into primary and oversample groups to give crews flexibility in eliminating those with limited access, inappropriate habitat, or inadequate habitat for surveys. Individual quarter-quads varied slightly in size, but were generally 3 x 4.3 miles in size (Figure 2). Quarter-quads that were entirely contained in water or within Bureau of Indian Affairs or National Parks land were not included as potential sites to be sampled for this study. All quarter-quads that were sampled were surveyed on multiple occasions over a period of several days based on a strict schedule (Figure 3). Specific survey locations within each quarter-quad varied depending on the faunal group that was the focus of each survey type (Figure 4).

Small Mammal Trapline Surveys

Three potential survey sites were placed within each q-quad: one within a riparian cover type, and one within each of the two most dominant cover types. If the two most dominant habitat cover types were extensively modified by humans (e.g., hay field and cropland), only one of the modified habitats was surveyed. Survey locations were prioritized based on: (1) their accessibility, i.e, public land or private land where permission had been granted; and (2) the size of the cover type patch. Large patches were prioritized for sampling to limit influence from adjacent habitat types.

Traplines were oriented in habitat cover type patches so that they were all within relatively uniform habitat structure. Each 90-meter line was composed of 10 stations spaced 10-meters apart. Each station had 1 or 2 Victor mouse traps, 1 museum special trap, 1 pitfall trap, and 1 Sherman trap; station numbers 2 and 9 had a rat trap instead of a second mouse trap (Figures 5 and 6). Traplines were allowed to weave or arc in order to remain within a single habitat cover type. Pitfall traps were dug into the ground and placed flush with soil so that animals were not alerted to their presence; when possible, pitfall traps were placed to take advantage of natural fences in the terrain like logs, rocks and drainages. Snap traps were baited with peanut butter and Sherman traps were baited with sweet feed mix. Snap and Sherman traps were placed in natural runways approximately 1-meter from the central pitfall trap rather than at exact right angles as indicated in the example diagram (Figure 5).

All traps were set in the evening as close to dark as logistically feasible and checked each morning as early as possible to minimize animal stress and mortality. Traps were sprung and left closed each morning in order to prevent incidental mortalities of non-target species during daylight hours. Surveyors wore latex gloves and HEPA masks when handling live and dead animals and checking traps. Hand sanitizers were used after handling traps. To handle live captures in Sherman traps, a plastic bag was placed over the trap opening and the animal was shaken into the bag, sexed, weighed, measured, marked and released. Measured attributes included total length (nose to tail tip), tail length, hind foot length (include claws), and ear length.

The following were kept as museum voucher specimens at each q-quadrant: (1) the first specimen of deer mouse, montane vole, and meadow vole; (2) all snap trap captures of other species regardless of number captured; (3) all shrews; (4) any animal for which species identity was uncertain; (5) one example of each species captured. When necessary, live animals were euthanized by placing a cotton-ball dabbed with a small amount of isoflurane into the opposite corner of the bag until 15 or more minutes after the animal had stopped breathing. Vouchered specimens were placed in an individual zip lock bag with a fully completed museum voucher tag. All specimens from each trap line were placed in a larger bag labeled with the trapline (site) name and number and quarter-quadrant name and number. After the three nights of trapping in a quarter-quadrant, all bags from each trap line were placed in a bag labeled with the quarter-quadrant name and number. Vouchered animals were placed on ice or in a refrigerator. All vouchered species were later sent to the University of Montana, Missoula to be prepared as museum voucher specimens by work study students. Species identification was verified by Paul Hendricks, Montana Natural Heritage Program Zoologist, and Dave Dyer, Curator of the Phil Wright Memorial Zoological Museum.

Variables recorded at each small mammal trap line included both categorical and quantitative descriptions of habitat and conditions during the survey (Appendix I - Small Mammal Trap Line Data Sheet). Digital photographs of each trap line were taken from a vantage point that allowed the trap line flags to be seen in the context of the surrounding habitat.

Bat Acoustic Detector Surveys

Each major habitat cover type within each quarter-quadrant was sampled using a Petterson D240x acoustic detector attached to an Iriver MP3 player/recorder (typically the iFP-899 model, but also the H320 Zoom model). Survey locations were prioritized by the following criteria: (1) representation of all major cover types; (2) readily accessible locations on public land or on private lands where permissions to survey were received; and (3) wetland and native terrestrial cover types; and (4) relatively large habitat patches where the detector could be placed inside the edge of the habitat patch by 100 meters or more. Detectors were spaced a minimum of 400 meters apart in order to ensure independence between surveys.

Variables recorded at each acoustic survey site included both categorical and quantitative descriptions of habitat, quality of the habitat, and potential threats to the habitat (Appendix I - Bat Acoustic Survey Data Sheet).

Acoustic detectors and recording devices were housed inside weatherproof containers that were mounted on conduit attached to a piece of rebar pounded into the ground as an anchor point (Figure 7). Detectors and recorders were turned on shortly before dusk to capture the first emerging bats of the evening and were collected each morning at various times after sunrise. Batteries in the detectors and/or recorders sometimes died during the deployment period, especially on cold nights. However, we feel that the detector/recorder units consistently recorded for the first six hours after deployment. Detectors were collected each morning and .wav files were downloaded to a laptop computer and attributed with q-quad, location, basic habitat descriptions, and other survey information.

At the end of each field season, calls were analyzed using Sonobat 3.0™ (SonoBat 2012), which has automatic species recognition capabilities using a hierarchy of discriminate function analyses based on up to 72 different call characteristics (e.g. duration, upper slope, lower slope, maximum frequency). However, this software package does make regular errors in species identification. Thus, In order to verify the call identification results of this automated program, at least one call sequence per species per site was confirmed by hand by Susan Lenard, Montana Natural Heritage Program Zoologist.

The Petterson D240x detector settings were: normal, time expanded output, high gain, auto trigger, low trigger level, high frequency trigger source, and 1.7 seconds of real-time recording. The H320 Zoom recorder settings were: File Format = MPEG layer 3; Encoder bitrate = 160 kilobytes per second; Frequency = 44.1 kHz; Source = Line In; Channels = Mono; File Split Options = N/A; Prerecord time = 1s; Clear Recording Directory = N/A; Clipping light = N/A, Trigger settings = repeat, stop, 1s, -25db, 0s, -40db, 2 s, 1s; Automatic Gain Control = N/A; AGC Clip Time = N/A.

Amphibian and Aquatic Reptile Surveys

All standing water bodies present within each quad or found incidentally while in the field were surveyed when they were accessible. If no standing water bodies were found on the topographic maps, accessible lands were surveyed for water by driving roads or hiking major trails to examine areas of low topographic relief or backwaters of streams that might provide lentic breeding habitat. If too many suitable water bodies were found within each quarter-quad, those likely to have more suitable habitat were prioritized for survey.

Each water body surveyed within a quarter-quad lentic site was considered an independent survey location. Surveys were considered independent by individual observer as well. Timed visual encounter and dip net surveys were conducted in all portions of the water bodies less than 50 cm in depth. If little emergent vegetation was present, then observers were asked to carefully examine shallow water environments for the presence of eggs, larvae, or post metamorphic animals. Areas with extensive shallows required systematic searches and dip netting while wading through the area on evenly spaced transects (Figure 8). In areas with dense emergent vegetation, observers intensely sampled the area

with a dip net. At sites with steep shorelines, visual searches and dip netting were performed. If multiple waterbodies were surveyed within a 200-meter radius of an existing start point, those waterbodies were considered as part of the original survey. Digital photographs of each site were taken from a vantage point that allowed the entire site to be seen in the context of surrounding habitats.

Variables recorded at each lentic survey site included both categorical and quantitative descriptions of existing habitat, the origin and quality of the habitat, and potential threats to the habitat (Appendix I - Lentic Site Survey Data Sheet).

Voucher specimens of amphibians and reptiles were collected if the record filled a significant data hole or extended the species' known range or if the identity of the species was uncertain, e.g., *Bufo* species tadpoles found in eastern MT. For amphibian and reptile eggs, and newly hatched amphibians, individuals of the same species were placed together in a small jar containing 10% buffered formalin. Amphibian larvae that were collected as vouchers were first placed in a Tricaine (MS-222) solution (1 teaspoon per liter of H₂O) until they failed to respond to a mechanical stimulus. They were then placed in a 10% buffered formalin solution for fixation and storage.

Amphibian adults and juveniles collected as voucher specimens were euthanized by placing a small bead (3/4") of extra strength Orajel (20% Benzocaine active ingredient) on a finger and spreading it out over the thighs, abdomen, and top of the head of the individual(s) collected. The animal was then placed in a Ziploc bag in a darkened area (e.g., a box) for 10-15 minutes until the animal failed to respond to a mechanical stimulus. The brains of the animals were then injected with a 10% neutral buffered formalin solution in order to stop the animal's central nervous system. Animals were then placed in a fixing container containing 10% neutral buffered formalin. Body cavities of large individuals were injected with 10% buffered formalin using a syringe. All specimens remained in 10% buffered formalin until the end of the field season. At the end of the field season specimens were removed and washed in a jar of water (preferably running water) for 48 hours. For long-term storage, individually tagged specimens were placed in a jar containing 70% ethanol.

Reptile Surveys

Survey sites were located by visually assessing each quarter-quad on 1:24,000 scale topographic maps for areas with noticeable topographic relief (Figure 9). Rock outcrops and cliff faces often constitute boundaries between substrate types that differ in erodibility and rock strata. These areas often provide underground chambers or collapsed areas that serve as cover or even hibernacula. Other factors considered in survey site selection included: (1) site accessibility, i.e., public land or private lands where permission was received; (2) size of the rock outcrop (the larger the size, the better); and (3) aspect of the survey location, with higher priority given to south facing sites than north facing sites. When time allowed, field crews attempted to survey four or more rock outcrops per quarter-quad.

Each rock outcrop or coulee rim surveyed was considered an independent survey location. Surveys were considered independent by individual observer as well. If a rock outcrop or coulee rim was large, then multiple survey locations were made using an approximate size of 400 x 100 meters, based on natural breaks such as a drainage or area with reduced amounts of cover objects. If rock outcrops or

coulee rims were not present within a quarter-quad, then transects through a dominant cover type were substituted as survey locations.

Timed visual encounter surveys were conducted in all portions of the rock outcrop by slowly moving through the area. Rocks were visually examined at distances from 0 to 15 meters. Objects providing cover, such as logs or rock slabs were lifted. Potato rakes were used to probe rock crevices while listening and watching for animal movements.

Digital photographs of each site were taken from a vantage point that allowed the entire site to be seen in the context of surrounding habitats. Variables recorded on datasheets at each reptile survey site included categorical descriptions of existing habitat and conditions of the survey that could have influenced the probability of detecting the species (Appendix I - Reptile Survey Data Sheet).

Voucher specimens of reptiles were only collected if the record filled a significant data hole or extended the species' known range or if the identity of the species was uncertain. Protocol for preserving voucher specimens of reptiles followed that of the amphibian preservation protocol. Large snakes and turtles were not euthanized nor were they collected as voucher specimens unless found dead (e.g., road kill).

Incidental Captures and Observations

During surveys for other taxa, crews recorded all non-target animals that could be identified to species. Number of individual and any notable behavior, such as courtship or nesting, was also recorded. (Appendix I - Incidental Data Sheet). Incidental animals encountered that could not be identified to species level were collected as voucher specimens for later identification purposes. No migratory birds were collected.

Millipedes, slugs, and snails were placed directly into vials containing 70% ethanol. No more than two animals of each species were placed in containers. After death (6-24 hours) any mucus exuded was gently brushed off and the animal was placed in 95% ethanol for 24-48 hours. Any remaining mucus was then brushed/washed off again and a dissecting pin was used to perforate the animal along its length so that ethanol would penetrate the body. Animals were then placed in 70% ethanol for long-term storage so they could be used as museum vouchers and as a source of tissue for genetic analyses.

Data Management

Each survey crew used standardized data sheets to record information and describe variables for each type of survey (Appendix I - Data Sheets). At the end of each day, crews used laptop computers to record data into a Microsoft Access database (Figure 10). At the end of the field season, each of the crew databases were checked for errors and missing information. Final data were then appended to a master database.

Once all data were compiled for all years, we used a series of queries in the database to summarize detection and non-detection data in encounter history files that could be used to estimate occupancy and detection probability for each species. Photographs taken of each survey location and

representative photographs of each quad were downloaded onto laptops and labeled with quad name, location name, and date.

For each reptile search area, the area surveyed was delineated in GIS and estimates of total area surveyed were populated back into the database. We also used GIS to populate descriptive statistics for each survey location such as elevation, percent ReGAP habitat cover type within 100 meters of each survey location, and land ownership (public or private).

Data Analysis

We used single-season occupancy models to estimate the proportion of sites occupied (ψ_i) and detection probability (p) for each species detected by the four different survey methodologies. Analyses were simplified to a single-season probability-based model (MacKenzie et al. 2002, 2005, 2006) with ψ_i representing the probability that a site is occupied by the target species and p_j representing the probability of detecting the species at an occupied site during the j th independent survey of a site. Maximum likelihood methods were used to estimate occupancy and detection probability as well as the precision of these metrics (Wintle et al. 2004). Within a given season, no changes in occupancy are assumed at each site (i.e., sites are either always occupied or unoccupied by the species). However, if changes in occupancy occur randomly then this assumption can be relaxed (MacKenzie et al. 2006). Additional assumptions that apply to single-season models include: (1) detections occur independently at sites; (2) occupancy and detection probabilities are similar across sites and time, except when differences can be modeled with covariates; and (3) the target species is identified correctly.

Occupancy probability can be modeled as a function of site-specific covariates that do not change during the season (e.g., habitat type), whereas detection probability can be modeled as a function of either site-specific or survey-specific covariates (e.g., weather conditions or observer). Occupancy and/or detection probability can be measured as a function of covariates using the logistic equation:

$$\theta_i = \frac{\exp(\mathbf{X}_i\boldsymbol{\beta})}{1 + \exp(\mathbf{X}_i\boldsymbol{\beta})}$$

, where θ_i represents the parameter of interest for site i , $\mathbf{X}_i$ is the row vector of covariate information for site i , and $\boldsymbol{\beta}$ is the column vector of coefficients to be estimated. A number of habitat covariates were collected for future analysis as resources or interest permit (Table 2). The quarter-quad was considered the sampling unit for occupancy and detection estimates at both a statewide scale and within the known existing range of a given species. For each quarter-quad, we summarized species detection and non-detection information on the day of survey. Non-detection may arise if either the target species does not occupy the site or the investigator does not detect the species at an occupied site. After occupancy and detection was estimated at a statewide scale, we then used the known range of a species as a constraint to refine and inform our non-detection data. For example, a species was only considered non-detected when it was not observed at a given site and it was possible to capture the species because the survey occurred in the existing known range of the species. If the quarter-quad being sampled was outside the known range of the species and it was not detected, the corresponding non-detection data was not included in the analysis. An ArcGIS geoprocess that merged

species range maps (Montana Natural Heritage Program and Montana Fish, Wildlife, and Parks 2012) and quarter-quads was used for this constraining process.

Detection data were stored in an MS Access database. A python script was used to access data tables and create encounter history files in a .txt format for each species in a given survey (Appendix II). Encounter history files for each species with detection and non-detection data were formatted such that a '1' was assigned to detections and a '0' was assigned to non-detections for each quad and day sampled for a given survey method. A python script was then used to import encounter history files into an analysis program that estimated occupancy and detection.

We used the R (R Development Core Team 2012) package RMark (Laake and Rexstad 2008) to construct single-season occupancy models for program MARK (White and Burnham 1999). We chose program MARK because it can interface with Program R and allows for single-season occupancy models as well as covariate analysis. Estimates of occupancy and detection probability were made at two different scales, the quarter-quad level (3 x 4.3 miles grid) and location level (defined as a 100-meter buffer around a survey point). By estimating occupancy and detection rates at two different spatial scales, we hoped to see changes in occupancy and detection estimates that might indicate differences in the home ranges of the species being surveyed.

We then refined our occupancy and detection probability estimates by limiting the occupancy and detection estimates to the known range of the species within the state (range-limited estimate). In essence, this estimate of detection and occupancy would indicate the likelihood of detecting a species in areas of the state that may contain suitable habitat in which a species of interest could occur. We later included location level and survey level covariates to explain differences in location-level occupancy and detection probability estimates using a competing-model based approach.

Results

Survey Summary

During the period 2008 - 2010, 3,863 individual surveys were conducted during 213 days at 3,048 unique locations within 282 quarter-quads (Table 3). The number of quarter-quads sampled represents 3% of those available for the entire state. A majority of sampling occurred on private property (51%), with additional sampling occurring on US Forest Service (16%), Bureau of Land Management (13%), state (12%), and other lands (9%).

During structured surveys, 5,806 species detections were recorded, and of those detections, 84 unique species were identified. Species were detected at most small mammal, bat acoustic, and lentic site surveys. However, terrestrial reptile surveys had lower detection rates (Table 4). For small mammal, lentic site, and reptile surveys, most detections were identifiable to a species although a few detections did not result in species identification either because there was not an accompanying or acceptable voucher specimen that could be used to verify the record or the specimen could simply not be identified to the species level. Many bat acoustic call sequences could not be definitively identified to a species

and therefore were identified as ‘probable’ species detections. Only definitively identified bat acoustic call sequences were included as acceptable observation records for analyses (Table 4). In addition to structured survey observations, 5,912 species observations were recorded incidentally at 2,634 different locations. We detected 21 Species of Concern in Montana during structured surveys but failed to detect several others identified as Species of Greatest Conservation Need (CFCWS 2005) including; Great Basin Pocket Mouse, Northern Bog Lemming, Meadow Jumping Mouse, Coeur d’Alene Salamander, Milksnake, Smooth Greensnake, and Western Hog-nosed Snake.

The number of unique species and number of individuals of each species detected for each sample methodology varied considerably by geographic region (Figures 11a - 11d). For small mammals (Figure 11a), both the number of unique species and the total number of individuals detected in each quarter-quad was highest in southwestern Montana where Great Basin fauna come into the state, the east front of the Rocky Mountains where plains and mountain fauna’s meet, and in some areas of higher topographic relief across eastern Montana where major habitat types converge. Conversely, both the number of unique small mammal species and total numbers of small mammal individuals detected was lowest in areas with the least topographic relief and habitat complexity (e.g., plains of eastern Montana). The number of unique bat species detected by acoustic surveys in each quarter-quad (Figure 11b) was reasonably high (7 to 9 species) across most of the state, but was low (less than 5 species) in eastern Montana north of the Missouri River where tree and rock outcrop roost sites are very limited on the landscape. The number of unique amphibian and aquatic reptile species detected at lentic sites in each quarter-quad (Figure 11c) was highest (commonly 6-7 species) across most of eastern and northwest Montana, but relatively low (often less than 4 species) across the northwestern Great Plains and in southwest Montana; landscapes that are relatively dry where habitats have been extensively modified for agriculture. The number of unique terrestrial reptile species detected in each quarter-quad with visual encounter surveys (Figure 11d) was relatively low (almost always less than 4) across the state and visual encounter surveys failed to detect terrestrial reptiles across most of western Montana.

The average amount of time spent surveying varied by survey method (Table 3). Because small mammal trap lines and bat acoustic detector surveys were overnight efforts, those surveys lasted for longer periods of time (851 and 750 minutes, respectively) when compared to lentic site and terrestrial reptile surveys which were discrete events lasting an average of 34 and 45 minutes, respectively (Table 3). Forest and woodland habitats accounted for both the highest number of unique small mammal species detected (30) as well as the highest number of small mammal individuals detected (359) (Table 5). Semi desert, shrubland and grassland, and forest and woodland habitats accounted for both the highest number of unique bat species detected and numbers of bat passes (Table 5). For small mammal trap line surveys, the total number of captures differed by trap type and species (Table 6). Museum Specials accounted for the highest number of captures (619) and had the highest success rate per trap set (6.6%), whereas track plates, which were only used in 2008, were the least productive with four captures and a detection rate of 1.4%.

Occupancy Estimates

We estimated occupancy at the quarter-quad level for each species captured at two different spatial extents, a statewide extent and within the boundaries of the known range of each species in Montana (range-limited estimate) (Tables 7 and 8). We also estimated occupancy at the location level within the boundary of the known range of each species in Montana (Figures 12b – 17b). A lack of repeat detection data prevented the estimation of occupancy at the quarter-quad level for many species (e.g., ground squirrels, weasels, skunks, Bushy-tailed Woodrat, Ord's Kangaroo Rat, Preble's Shrew, Merriam's Shrew, Eastern Red Bat, Yuma Myotis, Spotted Bat, Eastern Racer, Northern Alligator Lizard, Spiny Softshell, and Rocky Mountain Tailed Frog).

Occupancy estimates varied significantly by species and by survey method. For both statewide and range-limited estimates of occupancy (Tables 7-8) at the quarter-quad scale, Deer Mouse had the highest estimate of occupancy for small mammal trap line surveys. The occupancy estimate for Deer Mouse was 93.3% at the quarter-quad scale and 75.6% at the location level. For bat acoustic detector surveys, several species had occupancy estimates near 80% within their known range in Montana at the quarter-quad scale, including Hoary Bat, Little Brown Myotis, Pallid Bat, and Silver-haired Bat; although Pallid Bat had wide confidence intervals. Fringed Myotis and Townsend's Big-eared Bat had the lowest occupancy estimates within their known range in Montana at the quarter-quad scale, at 13.1% and 2.2% respectively.

For lentic site surveys, estimated occupancy rates within the known range of species (Table 8) were highest for Long-toed and Barred Tiger Salamanders and Woodhouse's Toad, although the estimates for Long-toed Salamander and Woodhouse's Toad were imprecise. American Bullfrog, Great Plains Toad had the lowest occupancy estimates within their known range. Occupancy estimates for terrestrial reptile species encountered during reptile area search efforts indicate that Greater Short-horned Lizard had the highest point estimate of occupancy within its known range, although the estimate was very imprecise. Occupancy estimates were not obtainable for five of the eleven species encountered during reptile area search surveys due to a lack of repeat detections.

Detection Estimates

We estimated detection probability at both a statewide extent and within the boundaries of the known range of the species within Montana (Tables 7-8 and Figures 12a – 17a).

We found that detection probabilities varied greatly between species and species groups. For example, most shrews and voles had detection probabilities less than 0.6, whereas Deer Mouse and some bat species had much higher detection probabilities. Species such as Long-tailed Weasel, Northern Flying Squirrel, Ord's Kangaroo Rat, and Striped Skunk that were not the focus of survey efforts had detection probabilities less than 1%. As a group, terrestrial reptiles had the lowest detection rates, with detection probability estimates generally less than 0.2.

Estimates of detectability for bat acoustic detectors had the tightest confidence intervals when compared to other types of surveys. Hoary Bats had the highest probability of detection at 63%, whereas Yuma Myotis and Spotted Bats had detection rates near 1%.

Range Extensions

The data collected through this work expanded the known range for the following seven species: Dusky or Montane Shrew, Pygmy Shrew, Fringed Myotis, Eastern Red Bat, Pallid Bat, Southern Red-backed Vole, and Montane Vole.

Discussion

Results of our occupancy and detection analyses suggest the single-season survey methodology presented herein can serve as an effective monitoring tool for most bats, small mammals, reptiles and amphibians. We found that the methods described were most appropriate for estimating occupancy of these animals when detection probabilities were greater than ten percent. Most of the species for which estimates of detection probability were less than one percent were not the focus of surveys (e.g., most squirrels and rabbits, weasels, skunks, Bushy-tailed Woodrat). However, a number of target species also had detection probability estimates of less than one percent, including many terrestrial reptile species, Ord's Kangaroo Rat, Preble's Shrew, Merriam's Shrew, Eastern Red Bat, Yuma Myotis, and Spotted Bat. Detection probabilities for these species were low because repeat detections rarely occurred at individual sampling locations. The lack of repeat detections for these species or groups of species suggests that alternative or additional sampling methods may be more appropriate for detecting presence. However, considering that we detected 29 of 38 small mammal species that were targeted for survey (i.e. excluding ground squirrels, tree squirrels, lagomorphs, and mustelids), 14 of 15 bat species, 12 of 17 targeted reptile species, and 12 of 13 targeted amphibian species during this project, the methodologies presented herein provide an adequate framework for broad-spectrum detection of a majority of target species in Montana.

Detection probability estimates for many of the bat species were high and precise, indicating that acoustic survey is a good method for monitoring the status of many bat populations.

Reptile occupancy estimates were plagued by a lack of repeat detections at locations by multiple observers. Because detection estimates were generally low for many species encountered during reptile surveys, occupancy estimates were only obtainable for six of the twelve species encountered and were not as precise as those obtained for other taxa. For these taxa, alternative methodologies, such as drift fences and funnel traps, may need to be investigated with future efforts to see if detection rates can be increased in order to provide more precise occupancy estimates.

The ratios of detection-corrected point estimates of occupancy to naïve occupancy rates for species detected in this study (Figures 17a-d), clearly show the value of replicate surveys in estimating true occupancy rates. Although naïve and detection-corrected occupancy estimates were similar for some species (e.g., Deer Mouse and other common small mammal species), estimates of true occupancy were often double naïve estimates for many species and ranged up to 10 times higher than naïve rates for some. Animal behavior, vegetative cover, weather, and observer skill likely contributed to some differences in detection. However, low detection probability estimates for some non-target species was due to the fact that the mouse, Sherman, rat, and pitfall traps used in this effort were inappropriate for detecting some of the larger small mammal species (e.g., lagomorphs, ground squirrels, mustelids).

Detection probability for each species, survey type, and trap type should therefore be a major consideration when estimating site occupancy. Table 7 provides baseline detection and occupancy estimates against which future sampling efforts should be compared.

Preliminary results (not shown in detail in this report) of a competing model based framework for assessing the importance of various covariates on occupancy suggests that the presence of certain species and or species groups may be influenced by a variety of habitat factors. In general, the covariate with highest predictive capability for small mammals was elevation. However, many of the competing models failed to out compete the null model of constant occupancy across the landscape. Bat models similarly appeared to be driven by elevation, although the occupancy of numerous species was sometimes best described by an interaction model that considered dominant habitat type and elevation. Occupancy models for amphibian species seemed to vary somewhat by species, with some being best described by grazing variables, maximum water depth, or elevation. For species that were best described by maximum water depth, the optimal depth was typically a maximum water depth less than one foot. More analyses could be conducted with this data set and the large number of variables measured.

Although an effort was made to sample all habitats with equal proportion, native habitats were sampled more frequently than non-native habitats. Results of both small mammal trap line surveys and bat acoustic detections surveys highlight the importance of forest and grassland habitats for bats and small mammals. Numbers of species and numbers of detections were highest where the dominant cover type was identified as forest and woodland habitats, with shrubland and grassland habitats a close second.

Conclusions

This project developed and refined survey, inventory, and monitoring protocols in order to better understand the distribution, status, and habitat requirements of species and species groups identified as most in need of inventory within Montana (Montana Fish, Wildlife, and Parks 2005). It was our hope that development of effective and standardized methodologies would allow other state, federal, tribal, and private entities to follow our lead and gather compatible data for these species groups. In fact, we have been very pleased that both the Bureau of Land Management and U.S. Forest Service have begun to use these protocols during recent survey efforts. We hope that the use of these protocols will become more widely adopted in the future since use of common protocols allows the distribution and status of species to be more easily assessed over time.

The project simultaneously provided baseline information on species' distributions, site occupancy rates, and detection probabilities that will be used to inform current species' conservation status ranking and management efforts. The information gathered will serve as a statewide baseline to assess changes in the distribution and status of these species over time related to changes in habitat and/or management efforts. The fact that the number of records in the statewide animal observation database was doubled, or in some cases tripled, for many species during the course of this project and that the known ranges of seven species (Dusky or Montane Shrew, Pygmy Shrew, Fringed Myotis, Eastern Red

Bat, Pallid Bat, Southern Red-backed Vole, and Montane Vole) were extended through this work is significant and has important consequences for their current and future management.

We believe the methodologies developed during the course of this project provide an adequate framework for broad-spectrum monitoring of a majority of target species in Montana considering that we detected 29 of 38 small mammal species, 14 of 15 bat species, 12 of 17 reptile species, and 12 of 13 amphibian species that were targeted for survey during this project. The fact that estimates of true occupancy were often double naïve estimates for many species, and ranged up to 10 times higher than naïve rates for some, really emphasizes the importance of the repeated sampling methodologies developed with this effort in order to estimate detection probability and true occupancy rates. The baseline detection and occupancy estimates in Tables 7 and 8 are valuable baselines for planning and executing future sampling efforts and measuring changes in the status and distribution of species over time.

Although we detected 21 Species of Concern using these standard broad spectrum survey methods, we failed to detect several others identified as Species of Greatest Conservation Need (Montana Fish, Wildlife, and Parks 2005) including; Great Basin Pocket Mouse, Northern Bog Lemming, Meadow Jumping Mouse, Coeur d'Alene Salamander, Milksnake, Smooth Greensnake, and Western Hog-nosed Snake. We recommend focal range wide surveys for these species in order to assess their status when and where they are most active and detectable.

Finally, we encourage more complex analyses of the datasets gathered during this effort. Specifically, more in depth analyses of the effect of habitat covariates on species detection and occupancy rates should be conducted to better inform habitat management efforts.

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Figures

Figure 1. Annual sampling frames and quarter-quadrangle sampling plots with primary and oversample plots.

Jordan_NW 0 0.25 0.5 1 Miles

Figure 3. Example of sampling timeline for one quarter-quadrangle.

Figure 4. Sample quarter-quadrangle showing example locations of bat acoustic, lentic amphibian and aquatic reptile, terrestrial reptile, and small mammal trap line sites within a 3 x 4.3 mile quarter-quadrangle area.

Figure 5. Small mammal trap line demonstrating different trap types on each line.

Figure 6. Small mammal trap line in eastern Montana showing the orientation of a pitfall and Sherman live trap.

Figure 7. Bat acoustic detector housed inside a weather protective enclosure.

Figure 8. Lentic site in eastern Montana with significant emergent vegetation that required dip netting and transect surveys for amphibians and aquatic reptiles.

Figure 9. Reptile survey site with high topographic relief in eastern Montana.

Figure 10. Entity relationship diagram of the database tables used to store information collected during structured surveys of the Diversity Monitoring Project. Lookup tables with covariate attributes and options are not shown for the sake of brevity.

tblQquad

QquadID
QQuadName
SamplingPool

tblLocation

LocID
QquadID
LocName
Longitude
Latitude
SPX
SPY
Elevation
Description
Notes
HabitatTypeReGAP
PercentSlope
Aspect
Ownership
DominantSubstrateType
Hibernaculum
GISFeatureID

tblSurveys

SurveyID
LocID
SurveyName
SurveyType
SurveyDate
BeginTime
EndTime
TotalSurveyTime
AreaSearched
WeatherStart
WeatherEnd
WindStart
WindEnd
MoonPhase
WaterTemp
SoilTemp
SoilMoisture

tblCaptures

CaptureID
SurveyID
Elcode
SpCommonName
Males
Females
UnknownSex
Juveniles
Eggs
Nests
EarLength
BodyLength
TailLength
HindFootLength
VoucherNumber

tblObservers

ObserverID
SurveyID
ObserverName

Figure 11a. Locations of small mammal trap line surveys, the number of unique species captured at each quarter-quadrangle, and the total number of each species captured within a quarter-quadrangle for the duration of the sampling period. Example: the large circle in southwest Montana with the number 23 inside it represents a survey where 23 individuals of 12-15 different species were detected. The number '3's in eastern Montana represent survey sites where 3 individuals of 1-2 species were detected.

Figure 11b. Locations of bat acoustic surveys and the number of unique species detected at each quarter-quadrangle and the total number of each species detected within a quarter-quadrangle for the duration of the sampling period. Example: the large circle in northeast Montana with the number 7 inside it represents a survey where at least 7 individuals of 7-9 different species were detected.

Figure 11c. Locations of lentic site surveys and the number of unique amphibian and aquatic reptile species detected at each quarter-quadrangle and the total number of each species detected within a quarter-quadrangle for the duration of the sampling period. Example: the large circle in northeast Montana with the number 8 inside it represents a survey where 8 individuals of 6-7 different species were detected.

Figure 11d. Locations of reptile surveys and the number of unique species detected at each quarter-quadrangle and the total number of each species detected within a quarter-quadrangle for the duration of the sampling period. Example: the large circle in north central Montana with the number 4 inside it represents a survey where 4 individuals of 3 different species were detected.

Detection and occupancy estimates from small mammal capture surveys for Muridae, Heteromyidae and Dipodidae.

Figure 12a. Point estimates and 95% CI of detection probability (p) estimates. Asterisks represent species where too few repeat detections precluded an estimate of detection and/or occupancy.

Figure 12b. Point estimates and 95% CI of occupancy probability (psi) estimates and naïve proportion of quarter-quadrangles where species were detected. Example: Naïve and corrected estimates of occupancy for Deer Mouse are the same while the corrected estimate of occupancy for Heather Vole is higher than the naïve proportion of quarter-quadrangles where the species was detected. The greatest difference between naïve and corrected estimates of occupancy is seen for those species where detection probability was lowest. See Tables 7-8 for additional data.

Detection and occupancy estimates from small mammal capture surveys for Soricidae.

Figure 13a. Point estimates and 95% CI of detection probability (p) estimates. Asterisks represent species where too few repeat detections precluded an appropriate estimate of detection and/or occupancy.

Figure 13b. Point estimates and 95% CI of occupancy probability (psi) estimates and naïve proportion of quarter-quadrangles where species were detected. Example: Naïve and estimated occupancy for Pygmy Shrew are nearly the same while estimated occupancy for Vagrant Shrew is higher than naïve proportion of quarter-quadrangles where the species was detected. The greatest difference between naïve and estimated occupancy is seen for species with the lowest detection probabilities. See Tables 7-8 for additional data.

Detection and occupancy estimates from bat surveys for all bat species detected.

Figure 14a. Point estimates and 95% CI of detection probability (p) estimates. Asterisks represent species where too few repeat detections precluded an appropriate estimate of detection and/or occupancy.

Figure 14b. Point estimates and 95% CI of occupancy probability (ψ) estimates and naïve proportion of quarter-quadrangles where species was detected. Example: Naïve and estimated occupancy for Townsend's Big-eared Bat are the same, while estimated occupancy for Pallid Bat is much higher than the naïve proportion of quarter-quadrangles where the species was detected. The greatest difference between naïve and estimated occupancy is seen for those species with the lowest detection probabilities. See Tables 7-8 for additional data.

Detection and occupancy estimates from lentic site survey efforts for all amphibian and aquatic reptile species.

Figure 15a. Point estimates and 95% CI of detection probability (p) estimates. Asterisks represent species where too few repeat detections precluded an appropriate estimate of detection and/or occupancy.

Figure 15b. Point estimates and 95% CI of occupancy probability (psi) estimates and naïve proportion of quarter-quadrangles where species was detected.

Example: Naïve and estimated occupancy for Great Plains Toad are the same while the estimated occupancy for the Long-toed Salamander is much higher than the naïve proportion of quarter-quadrangles where the species was detected. The greatest difference between naïve and estimated occupancy is seen for those species with the lowest detection probabilities. See Tables 7-8 for additional data.

Detection and occupancy estimates from reptile surveys for all reptiles detected.

Figure 16a. Point estimates and 95% CI of detection probability (p) estimates. Asterisks represent species where too few repeat detections precluded an appropriate estimate of detection and/or occupancy.

Figure 16b. Point estimates and 95% CI of occupancy probability (psi) estimates and naïve proportion of quarter-quadrangles where species was detected. Example: Naïve and estimated occupancy for Common Sagebrush Lizard were relatively close compared to the large difference between the naïve and estimated occupancy for Greater Short-horned Lizard. The greatest difference between naïve and estimated occupancy is seen for those species with the lowest detection probabilities. See Tables 7-8 for additional data.

Figure 17a. Ratio of the proportion of quarter-quadrangles where a detection occurred (naïve detection rate) to the estimated occupancy rate for each species captured during small mammal surveys. A ratio of one indicates that the proportion of quarter-quadrangles where a detection occurred and the estimated occupancy is identical. A ratio less than one indicates that the occupancy estimate is higher than the proportion of quarter-quadrangles where a detection actually occurred. Many of the species with the lowest ratios (e.g., Short-tailed Weasel, Long-tailed Weasel, Bushy-tailed Woodrat, and Striped Skunk) were not targeted with survey methods that are most appropriate for these species (e.g., track plates or Tomahawk traps).

Figure 17b. Ratio of the proportion of quarter-quadrangles where a detection occurred (naïve detection rate) to the estimated occupancy rate for each species captured during bat acoustic surveys. A ratio of one indicates that the proportion of quarter-quadrangles where a detection occurred and the estimated occupancy is identical. A ratio less than one indicates that the occupancy estimate is higher than the proportion of quarter-quadrangles where a detection actually occurred.

Figure 17c. Ratio of the proportion of quarter-quadrangles where a detection occurred (naïve detection rate) to the estimated occupancy rate for each species captured during amphibian and aquatic reptile lentic site surveys. A ratio of one indicates that the proportion of quarter-quadrangles where a detection occurred and the estimated occupancy is identical. A ratio less than one indicates that the occupancy estimate is higher than the proportion of quarter-quadrangles where a detection actually occurred.

Figure 17d. Ratio of the proportion of quarter-quadrangles where a detection occurred (naïve detection rate) to the estimated occupancy rate for each species captured during reptile surveys. A ratio of one indicates that the proportion of quarter-quadrangles where a detection occurred and the estimated occupancy is identical. A ratio less than one indicates that the occupancy estimate is higher than the proportion of quarter-quadrangles where a detection actually occurred.

Tables

Table 1. List of materials used for each survey type.

General Purpose Gear	Small Mammal Trap Line Surveys	Bat Acoustic Detector Surveys	Amphibian and Aquatic Reptile Lentic Site Surveys	Terrestrial Reptile Surveys
Digital Cameras	Sherman Traps	i-River H320 Zoom digital recorders	Aquarium nets	Potato rakes
Garmin 60 CSX GPS Units	Museum Special Traps	Aluminum bat poles	3 mm mesh dipnets	Retractable snake rakes
Identification kits and Field Guides	1-gallon buckets for Pitfall Traps	PVC housing	Tricaine	Snake grabber
File folders for storing quarter-quadrangle data sheets	Victor brand mouse and rat traps	I-river H320 Zoom wall chargers w/o adaptors	Formalin	Snake hook
Laptop computers	Large Tomahawk traps	I-river H320 Zoom car chargers	Kill jars and cottonballs	Turtle Traps
Data sheets and all-weather paper	Isoflurane, kill jars, and cottonballs	I-river H320 Zoom dock	Oragel (20% Benzocaine)	Formalin
Clipboards, legal pads, pencils, pens	Flagging	Post pounder	pH paper	Kill jars and cottonballs
Miscellaneous hand tools	Sweet feed	Headphones	Thermometer	Head lamps and flashlights
External Hard Drive for data storage	Irwin Chalk	Patch cords		
First aid kits	Ziplock/small plastic bags	Batteries - 9v and AA		
Safety masks and rubber gloves	Weed sprayers for decontaminating gear	Waterproof bat boxes		
BLM topo maps and Laminated quad maps		Petterson D240x bat detector		
Calipers				
Binoculars				
DC to AC power inverter				
Digital scales				
Magnifying glasses				
Rulers / tape measures				

*Only used in 2008.

Table 2. Data types collected for each fauna sampling procedure. *Italics indicates that data was obtained via GIS analysis, whereas bold indicates data was collected in the field for all fauna groups. Variable types are indicated by a letter code, representing Q = quantitative, C = categorical, Y/N = yes or no type variable.*

	LENTIC SURVEYS		MAMMAL TRAP LINE SURVEYS		BAT ACOUSTIC SURVEYS		TERRESTRIAL REPTILE SURVEYS
C	<i>Ecoregion</i>	C	<i>Ecoregion</i>	C	<i>Ecoregion</i>	C	<i>Ecoregion</i>
C	<i>Ownership</i>	C	<i>Ownership</i>	C	<i>Ownership</i>	C	<i>Ownership</i>
Q	<i>Elevation</i>	Q	<i>Elevation</i>	Q	<i>Elevation</i>	Q	<i>Elevation</i>
C	<i>ReGap Habitat Class</i>	C	<i>ReGap Habitat</i>	C	<i>ReGap Habitat</i>	C	<i>ReGap Habitat Class</i>
Q	TotalSurveyTime	Q	TotalSurveyTime	Q	TotalSurveyTime	Q	TotalSurveyTime
C	Observer	C	Observer	C	Observer	C	Observer
Y / N	SiteDry	Q	Trap Effort	C	Moon Phase	C	Percent Slope
C	LenticHabitatType	C	WeatherStart	C	WeatherStart	C	Dom Substrate
C	SiteOrigin	C	WeatherEnd	C	WeatherEnd	Y/N	PotentialHibernaculum
C	WaterColor	Q	TempStart	Q	TempStart	Q	AreaSearched
Q	WaterpH	Q	TempEnd	Q	TempEnd	C	PercentageLocationSurvey
C	WaterTurbidity			C	WindStart	C	SoilMoisture
C	WaterConnectedness			C	WindEnd	Q	SoilTemp
C	WaterPermanence					C	WeatherStart
Q	MaxWaterDepth					C	WeatherEnd
Q	SiteLength					Q	TempStart
Q	SiteWidth					Q	TempEnd
C	% site <50cm deep					C	WindStart
Q	EmergentVegAreaMetersSquared					C	WindEnd
C	PercentSiteWithEmergentVeg					C	Aspect
C	PercentSiteWithLarvalActivity						
Q	RankSedges						
Q	RankGrasses						
Q	RankRushes						
Q	RankWaterLily						
Q	RankShrubs						
Q	RankOther		LENTIC SURVEYS (continued)				
C	PrimaryShallowsSubstrate	Y/N	FishSpawningHabitatPresent				
C	NorthShorelineCharacteristicsShallows	Q	InletWidth				
C	NorthShorelineCharacteristicsEmergen	Q	InletDepth				
Q	DistanceToForestEdgeMeters	C	InletSubstrate				
C	GrazingImpact	Q	OutletWidth				
Y/N	WaterDammedDiverted	Q	OutletDepth				
Y/N	TimberHarvestInArea	C	OutletSubstrate				
Y/N	MiningActivity	Q	Inclination				

Table 3. Summary of the types of surveys and the effort expended for each survey type during the period 2008 - 2010.

Survey Type	Total Number of Days Surveyed	Total Number of Unique Surveys	Total Number of Locations Surveyed	Total Number of Q-Quads surveyed	Average Survey Time (Minutes) with Standard Deviation	Average Area Searched (Square Meters) with Standard Deviation
Small Mammal Trap Line Surveys	161	1,182	423	137	851 +/- 115	NA
Bat Acoustic Surveys	181	1,465	1,418	271	751 +/- 161	NA
Amphibian and Aquatic Reptile Lentic Site Surveys	133	712	706	180	34 +/- 31	3,937 +/- 93,925
Terrestrial Reptile Surveys	146	504	501	168	45 +/- 46	21,419 +/- 85,170
Total	213	3,863	3,048	282		

Table 4. Summary of the number of observations identifiable and unidentifiable to species made for each type of survey during the period 2008 - 2010. Only bat calls with definitive call sequences were included as identifiable captures. Bat acoustic surveys containing probable call sequences with no corresponding definitive call sequence were counted as unidentifiable detections.

Survey Type	Total Number of Identifiable Detections	Total Number of Surveys With Identifiable Detections	Proportion of Surveys With Identifiable Detections	Total Number of Unidentifiable Detections	Total Number of Unique Species Detected
Small Mammal Trap Line Surveys	2,470	832	0.70	24	39
Bat Acoustic Detector Surveys	1,769	783	0.53	628	15
Lentic Site Surveys	1,372	436	0.61	27	20
Reptile Area Search Surveys	195	129	0.26	24	11
All Structured Surveys	5,806	2,180	0.56	703	84
Incidental Observations	5,912	2,634	NA	133	301
Total	11,718	4,814	NA	836	341

Table 5. Summary of sampling efforts and detections made by dominant surrounding habitat type during small mammal trap line surveys and bat acoustic detection surveys, 2008 - 2010.

Dominant Habitat Type	No. Small mammal locations surveyed	No. Small mammal species detected	No. Individual small mammals detected	No. Bat detector locations surveyed	No. Bat species detected	No. Individual bat passes detected
Forest and woodland	121	30	359	397	12	503
Polar and high montane	9	8	21	15	4	8
Semi desert	81	21	205	242	13	310
Shrubland and grassland	107	22	288	349	13	452
Sparse rock vegetation	22	10	52	66	7	98
Transitional Vegetation	12	12	43	42	7	31
Water	3	2	8	39	9	65
Woody Wetland	1	6	3	6	1	1
Developed	8	5	26	59	10	73
Agriculture	36	16	121	150	8	155
Introduced vegetation	18	11	53	59	7	66

Table 6. Summary of trapping effort and detections made by trap type during small mammal trap line surveys, 2008 - 2010.

Trap Type	Total number of traps set	Total number of captures	Percentage successful trap sets
Mouse Trap	10,249	444	4.3 %
Museum Special	9,417	619	6.6 %
Rat Trap	2,104	39	1.9 %
Pitfall	11,416	275	2.4 %
Sherman	10,473	428	4.1 %
Tomahawk (2008 only)	491	17	3.5 %
Track plate (2008 only)	282	4	1.4 %

Table 7. Statewide summary of survey and quarter-quadrangle naïve detections, detection probability (p) estimates, and occupancy probability (psi) estimates for all species captured during structured surveys for bats, amphibians, reptiles, and small mammals. Species with an asterisk represent those where the number of repeat detections was too low to estimate occupancy.

Survey type	Species	No. survey detections	Proportion of surveys where detected	No. quarter-quadrangles with detections	Proportion of quarter-quadrangles where detected	p	psi	p (se)	p lower 95% CI	p upper 95% CI	psi (se)	psi lower 95% CI	psi upper 95% CI
Bat Acoustic	Big Brown Bat	113	0.08	87	0.32	0.36	0.64	0.05	0.27	0.46	0.09	0.46	0.79
Bat Acoustic	California Myotis	36	0.02	28	0.13	0.35	0.22	0.09	0.23	0.53	0.06	0.13	0.35
Bat Acoustic	Eastern Red Bat	6	0.00	6	0.02	0.01	1.00	0.01	0.01	0.03	0.01	0.00	1.00
Bat Acoustic	Fringed Myotis	20	0.01	19	0.07	0.43	0.12	0.17	0.16	0.75	0.04	0.06	0.23
Bat Acoustic	Hoary Bat	235	0.16	168	0.62	0.63	0.80	0.03	0.56	0.69	0.04	0.71	0.87
Bat Acoustic	Little Brown Myotis	224	0.15	161	0.59	0.60	0.80	0.04	0.52	0.66	0.05	0.69	0.87
Bat Acoustic	Long-eared Myotis	148	0.10	105	0.39	0.44	0.68	0.04	0.36	0.53	0.07	0.53	0.80
Bat Acoustic	Long-legged Myotis	34	0.02	32	0.12	0.28	0.28	0.12	0.11	0.56	0.11	0.12	0.53
Bat Acoustic	Pallid Bat	7	0.00	6	0.02	0.12	0.12	0.11	0.02	0.50	0.11	0.02	0.52
Bat Acoustic	Silver-haired Bat	258	0.18	179	0.66	0.60	0.90	0.03	0.54	0.66	0.04	0.78	0.96
Bat Acoustic	Spotted Bat *	2	0.00	2	0.01	0.01	1.00	0.01	0.00	0.02	0.00	1.00	1.00
Bat Acoustic	Townsend's Big-eared Bat	2	0.00	2	0.01	0.20	0.02	0.76	0.00	1.00	0.08	0.00	0.96
Bat Acoustic	Western Small-footed Myotis	109	0.07	90	0.33	0.34	0.68	0.05	0.25	0.45	0.10	0.47	0.83
Bat Acoustic	Yuma Myotis *	2	0.01	2	0.01	0.01	1.00	0.00	0.00	0.02	0.28	0.00	1.00
Lentic Surveys	American Bullfrog	2	0.00	1	0.01	0.41	0.01	0.28	0.07	0.88	0.01	0.00	0.04
Lentic Surveys	Boreal Chorus Frog	96	0.13	62	0.34	0.29	0.43	0.04	0.22	0.37	0.06	0.32	0.55

Survey type	Species	No. survey detections	Proportion of surveys where detected	No. quarter-quadrangles with detections	Proportion of quarter-quadrangles where detected	p	psi	p (se)	p lower 95% CI	p upper 95% CI	psi (se)	psi lower 95% CI	psi upper 95% CI
Lentic Surveys	Columbia Spotted Frog	53	0.07	40	0.22	0.21	0.35	0.05	0.13	0.31	0.08	0.22	0.52
Lentic Surveys	Common Gartersnake	17	0.02	13	0.07	0.15	0.15	0.06	0.06	0.32	0.07	0.06	0.33
Lentic Surveys	Eastern Racer *	6	0.01	6	0.03	0.01	1.00	0.00	0.00	0.00	0.00	0.00	1.00
Lentic Surveys	Gophersnake	6	0.01	4	0.02	0.26	0.03	0.14	0.07	0.60	0.02	0.01	0.10
Lentic Surveys	Great Plains Toad	8	0.01	5	0.03	0.35	0.03	0.14	0.14	0.65	0.02	0.01	0.08
Lentic Surveys	Long-toed Salamander	28	0.04	22	0.12	0.19	0.21	0.06	0.09	0.33	0.07	0.11	0.39
Lentic Surveys	Northern Leopard Frog	67	0.09	50	0.28	0.29	0.34	0.05	0.20	0.39	0.06	0.24	0.46
Lentic Surveys	Pacific Treefrog	6	0.01	4	0.02	0.23	0.03	0.13	0.06	0.57	0.02	0.01	0.11
Lentic Surveys	Painted Turtle	45	0.06	34	0.05	0.18	0.32	0.05	0.11	0.29	0.08	0.19	0.51
Lentic Surveys	Plains Gartersnake	62	0.09	45	0.06	0.24	0.35	0.05	0.17	0.35	0.07	0.23	0.49
Lentic Surveys	Plains Spadefoot	20	0.03	14	0.08	0.18	0.14	0.06	0.08	0.33	0.05	0.06	0.28
Lentic Surveys	Prairie Rattlesnake *	7	0.00	7	0.01	0.01	1.00	0.00	0.00	0.02	0.00	0.00	1.00
Lentic Surveys	Rocky Mountain Tailed Frog *	1	0.00	1	0.01	0.01	1.00	0.01	0.00	0.01	0.07	0.00	1.00
Lentic Surveys	Spiny Softshell Turtle *	1	0.00	1	0.01	0.00	1.00	0.00	0.01	0.03	0.07	0.00	1.00
Lentic Surveys	Terrestrial Gartersnake	27	0.04	27	0.15	0.05	1.00	0.01	0.03	0.07	0.00	0.00	1.00
Lentic Surveys	Tiger Salamander	92	0.13	65	0.36	0.23	0.53	0.04	0.17	0.31	0.08	0.37	0.68
Lentic Surveys	Western Toad	26	0.04	19	0.11	0.18	0.19	0.06	0.09	0.32	0.06	0.09	0.34

Survey type	Species	No. survey detections	Proportion of surveys where detected	No. quarter-quadrangles with detections	Proportion of quarter-quadrangles where detected	p	psi	p (se)	p lower 95% CI	p upper 95% CI	psi (se)	psi lower 95% CI	psi upper 95% CI
Lentic Surveys	Woodhouse's Toad	29	0.04	25	0.14	0.12	0.35	0.05	0.05	0.26	0.15	0.13	0.65
Reptile Area Search	Common Gartersnake	3	0.01	3	0.01	0.01	1.00	0.00	0.00	0.01	0.01	1.00	1.00
Reptile Area Search	Common Sagebrush Lizard	9	0.02	7	0.04	0.19	0.07	0.11	0.05	0.49	0.04	0.02	0.19
Reptile Area Search	Eastern Racer	37	0.07	29	0.06	0.13	0.39	0.04	0.07	0.23	0.13	0.19	0.64
Reptile Area Search	Gophersnake	13	0.03	13	0.03	0.02	1.00	0.01	0.01	0.03	0.00	1.00	1.00
Reptile Area Search	Greater Short-horned Lizard	16	0.03	15	0.09	0.04	0.50	0.04	0.01	0.25	0.47	0.03	0.98
Reptile Area Search	Northern Alligator Lizard *	1	0.00	1	0.01	0.01	1.00	0.01	0.00	0.01	0.07	1.00	1.00
Reptile Area Search	Painted Turtle *	3	0.01	3	0.02	0.00	1.00	0.00	0.00	0.01	0.01	0.00	1.00
Reptile Area Search	Plains Gartersnake	6	0.01	5	0.03	0.13	0.11	0.11	0.02	0.51	0.10	0.02	0.47
Reptile Area Search	Prairie Rattlesnake	28	0.06	24	0.14	0.13	0.07	0.11	0.02	0.51	0.06	0.01	0.30
Reptile Area Search	Rubber Boa *	1	0.00	1	0.01	0.00	1.00	0.00	0.00	0.01	0.03	0.00	1.00
Reptile Area Search	Terrestrial Gartersnake	13	0.03	11	0.02	0.10	0.17	0.07	0.03	0.32	0.11	0.04	0.48
Small Mammal	Bushy-tailed Woodrat *	5	0.00	5	0.04	0.01	1.00	0.01	0.01	0.03	0.00	0.00	1.00
Small Mammal	Deer Mouse	343	0.29	124	0.91	0.88	0.93	0.02	0.85	0.91	0.02	0.87	0.97
Small Mammal	Dusky or Montane Shrew	36	0.03	27	0.20	0.24	0.36	0.06	0.14	0.39	0.09	0.20	0.55

Survey type	Species	No. survey detections	Proportion of surveys where detected	No. quarter-quadrangles with detections	Proportion of quarter-quadrangles where detected	p	psi	p (se)	p lower 95% CI	p upper 95% CI	psi (se)	psi lower 95% CI	psi upper 95% CI
Small Mammal	Golden-mantled Ground Squirrel	2	0.00	1	0.01	0.63	0.01	0.32	0.11	0.96	0.01	0.00	0.06
Small Mammal	Hayden's Shrew	7	0.01	6	0.04	0.10	0.16	0.09	0.02	0.45	0.15	0.02	0.62
Small Mammal	Heather Vole	6	0.01	5	.04	0.12	0.11	0.11	0.02	0.52	0.10	0.02	0.48
Small Mammal	House Mouse	11	0.01	7	0.05	0.26	0.09	0.11	0.11	0.51	0.04	0.03	0.21
Small Mammal	Least Chipmunk	6	0.01	4	0.03	0.29	0.06	0.16	0.08	0.64	0.03	0.02	0.17
Small Mammal	Long-tailed Vole	25	0.02	15	0.11	0.42	0.14	0.09	0.26	0.60	0.04	0.08	0.23
Small Mammal	Long-tailed Weasel *	1	0.00	1	0.01	0.00	1.00	0.00	0.00	0.02	0.00	1.00	1.00
Small Mammal	Masked Shrew	35	0.03	27	0.20	0.23	0.36	0.07	0.13	0.39	0.10	0.20	0.56
Small Mammal	Meadow Vole	92	0.08	53	0.39	0.45	0.48	0.05	0.36	0.54	0.06	0.37	0.59
Small Mammal	Merriam's Shrew *	3	0.00	3	0.02	0.01	1.00	0.01	0.00	0.04	0.00	0.00	1.00
Small Mammal	Montane Vole	38	0.03	29	0.21	0.23	0.40	0.06	0.13	0.37	0.10	0.22	0.61
Small Mammal	Mountain Cottontail	2	0.00	2	0.02	0.45	0.02	0.18	0.16	0.77	0.01	0.00	0.07
Small Mammal	Northern Flying Squirrel *	1	0.00	1	0.01	0.01	1.00	0.01	0.00	0.02	0.00	1.00	1.00
Small Mammal	Northern Grasshopper Mouse	14	0.01	7	0.05	0.56	0.07	0.12	0.33	0.77	0.02	0.03	0.12
Small Mammal	Northern Pocket Gopher	6	0.01	5	0.04	0.16	0.09	0.14	0.02	0.59	0.07	0.02	0.37
Small Mammal	Olive-backed Pocket Mouse	16	0.01	11	0.08	0.25	0.14	0.09	0.12	0.47	0.06	0.06	0.28
Small Mammal	Ord's Kangaroo Rat *	1	0.00	1	0.01	0.01	1.00	0.01	0.00	0.02	0.06	0.00	1.00

Survey type	Species	No. survey detections	Proportion of surveys where detected	No. quarter-quadrangles with detections	Proportion of quarter-quadrangles where detected	p	psi	p (se)	p lower 95% CI	p upper 95% CI	psi (se)	psi lower 95% CI	psi upper 95% CI
Small Mammal	Prairie Vole	12	0.01	7	0.05	0.34	0.07	0.11	0.16	0.58	0.03	0.03	0.16
Small Mammal	Preble's Shrew	4	0.00	4	0.03	0.01	1.00	0.01	0.00	0.03	0.00	0.00	1.00
Small Mammal	Pygmy Shrew	4	0.00	3	0.03	0.28	0.04	0.21	0.05	0.76	0.03	0.01	0.15
Small Mammal	Red Squirrel *	3	0.00	3	0.02	0.01	1.00	0.01	0.00	0.03	0.00	0.00	1.00
Small Mammal	Red-tailed Chipmunk	11	0.01	8	0.06	0.29	0.09	0.13	0.11	0.57	0.04	0.04	0.21
Small Mammal	Richardson's Ground Squirrel	14	0.01	6	0.01	0.72	0.05	0.11	0.47	0.88	0.02	0.02	0.10
Small Mammal	Sagebrush Vole	5	0.00	4	0.03	0.19	0.06	0.16	0.03	0.64	0.05	0.01	0.28
Small Mammal	Short-tailed Weasel	3	0.00	3	0.02	0.01	1.00	0.01	0.00	0.02	0.01	1.00	1.00
Small Mammal	Southern Red-backed Vole	47	0.04	27	0.20	0.48	0.24	0.07	0.35	0.61	0.04	0.16	0.33
Small Mammal	Striped Skunk *	3	0.00	3	0.02	0.01	1.00	0.00	0.00	0.02	0.01	0.00	1.00
Small Mammal	Thirteen-lined Ground Squirrel	6	0.01	3	0.02	0.48	0.03	0.18	0.19	0.79	0.02	0.01	0.08
Small Mammal	Vagrant Shrew	20	0.02	17	0.12	0.16	0.30	0.08	0.06	0.38	0.14	0.11	0.61
Small Mammal	Water Shrew	6	0.01	5	0.02	0.16	0.09	0.14	0.03	0.59	0.08	0.02	0.37
Small Mammal	Water Vole	4	0.00	2	0.02	0.63	0.02	0.22	0.21	0.92	0.01	0.00	0.06
Small Mammal	Western Harvest Mouse	5	0.02	4	0.03	0.12	0.09	0.11	0.02	0.52	0.08	0.01	0.42
Small Mammal	Western Jumping Mouse	36	0.09	22	0.16	0.40	0.21	0.07	0.27	0.55	0.05	0.13	0.31
Small Mammal	White-footed Mouse	10	0.04	9	0.07	0.07	0.33	0.07	0.01	0.36	0.30	0.03	0.88

Survey type	Species	No. survey detections	Proportion of surveys where detected	No. quarter-quadrangles with detections	Proportion of quarter-quadrangles where detected	p	psi	p (se)	p lower 95% CI	p upper 95% CI	psi (se)	psi lower 95% CI	psi upper 95% CI
Small Mammal	Wyoming Ground Squirrel	6	0.12	3	0.02	0.63	0.02	0.18	0.28	0.89	0.01	0.01	0.07
Small Mammal	Yellow-pine Chipmunk	14	0.07	9	0.07	0.40	0.09	0.12	0.20	0.64	0.03	0.04	0.17

Table 8. Range-limited summary of survey and quarter-quadrangle naïve detections, detection probability (p) estimates, and occupancy probability (psi) estimates for all species captured during structured surveys for bats, amphibians, reptiles, and small mammals. Species with an asterisk represent those where the number of repeat detections was too low to estimate occupancy.

Survey type	Species	No. survey detections	Proportion of surveys where detected	No. quarter-quadrangles with detections	Proportion of quarter-quadrangles where detected	p	psi	p (se)	p lower 95% CI	p upper 95% CI	psi (se)	psi lower 95% CI	psi upper 95% CI
Bat Acoustic	Big Brown Bat	113	0.24	87	0.32	0.36	0.64	0.05	0.27	0.46	0.09	0.46	0.79
Bat Acoustic	California Myotis	36	0.17	28	0.27	0.39	0.47	0.09	0.23	0.57	0.10	0.28	0.66
Bat Acoustic	Eastern Red Bat	6	0.04	6	0.05	0.04	1.00	0.01	0.02	0.08	0.00	0.00	1.00
Bat Acoustic	Fringed Myotis	20	0.05	19	0.08	0.46	0.13	0.17	0.18	0.76	0.04	0.07	0.24
Bat Acoustic	Hoary Bat	235	0.49	168	0.62	0.63	0.80	0.03	0.56	0.69	0.04	0.71	0.87
Bat Acoustic	Little Brown Myotis	224	0.47	161	0.59	0.60	0.80	0.04	0.52	0.66	0.05	0.69	0.87
Bat Acoustic	Long-eared Myotis	148	0.31	105	0.39	0.44	0.68	0.04	0.36	0.53	0.07	0.53	0.80
Bat Acoustic	Long-legged Myotis	34	0.07	32	0.12	0.28	0.28	0.12	0.11	0.56	0.11	0.12	0.53
Bat Acoustic	Pallid Bat	7	0.11	6	0.21	0.12	0.93	0.11	0.02	0.51	0.83	0.00	1.00
Bat Acoustic	Silver-haired Bat	258	0.54	179	0.66	0.60	0.90	0.03	0.54	0.66	0.04	0.78	0.96
Bat Acoustic	Spotted Bat *	2	0.01	2	0.03	0.01	1.00	0.01	0.00	0.04	0.00	1.00	1.00
Bat Acoustic	Townsend's Big-eared Bat	2	0.00	2	0.01	0.24	0.02	0.72	0.00	1.00	0.06	0.00	0.94
Bat Acoustic	Western Small-footed Myotis	109	0.23	90	0.33	0.34	0.68	0.05	0.25	0.45	0.10	0.47	0.83
Bat Acoustic	Yuma Myotis *	2	0.01	2	0.01	0.01	1.00	0.00	0.00	0.03	0.03	0.00	1.00
Lentic Surveys	American Bullfrog	2	0.00	1	0.00	0.41	0.01	0.28	0.07	0.88	0.01	0.00	0.04
Lentic Surveys	Boreal Chorus Frog	96	0.18	62	0.29	0.29	0.59	0.04	0.22	0.37	0.08	0.43	0.73
Lentic Surveys	Columbia Spotted Frog	53	0.15	40	0.29	0.21	0.69	0.05	0.13	0.32	0.14	0.38	0.89
Lentic Surveys	Common Gartersnake	17	0.03	13	0.06	0.15	0.18	0.06	0.06	0.32	0.08	0.07	0.40
Lentic Surveys	Eastern Racer *	6	0.01	6	0.02	0.01	1.00	0.00	0.00	0.02	0.00	0.00	1.00
Lentic Surveys	Gophersnake	6	0.01	4	0.01	0.26	0.03	0.14	0.07	0.60	0.02	0.01	0.10
Lentic Surveys	Great Plains Toad	8	0.02	5	0.03	0.35	0.05	0.14	0.13	0.65	0.03	0.02	0.14
Lentic Surveys	Long-toed Salamander	28	0.17	22	0.34	0.19	0.92	0.06	0.09	0.33	0.26	0.01	1.00

Survey type	Species	No. survey detections	Proportion of surveys where detected	No. quarter-quadrangles with detections	Proportion of quarter-quadrangles where detected	p	psi	p (se)	p lower 95% CI	p upper 95% CI	psi (se)	psi lower 95% CI	psi upper 95% CI
Lentic Surveys	Northern Leopard Frog	67	0.12	50	0.24	0.29	0.44	0.05	0.20	0.40	0.07	0.31	0.58
Lentic Surveys	Pacific Treefrog	6	0.07	4	0.11	0.22	0.28	0.13	0.06	0.56	0.18	0.06	0.69
Lentic Surveys	Painted Turtle	45	0.07	34	0.13	0.18	0.35	0.05	0.11	0.29	0.09	0.20	0.54
Lentic Surveys	Plains Gartersnake	62	0.15	45	0.28	0.24	0.62	0.05	0.16	0.34	0.11	0.39	0.81
Lentic Surveys	Plains Spadefoot	20	0.04	14	0.07	0.18	0.19	0.06	0.08	0.33	0.07	0.08	0.36
Lentic Surveys	Prairie Rattlesnake *	7	0.01	7	0.03	0.01	1.00	0.00	0.00	0.02	0.00	1.00	1.00
Lentic Surveys	Rocky Mountain Tailed Frog *	1	0.01	1	0.02	0.01	1.00	0.01	0.00	0.05	0.00	1.00	1.00
Lentic Surveys	Spiny Softshell Turtle *	1	0.00	1	0.01	0.00	1.00	0.00	0.00	0.03	0.00	1.00	1.00
Lentic Surveys	Terrestrial Gartersnake	27	0.05	27	0.12	0.05	1.00	0.01	0.03	0.07	0.00	0.00	1.00
Lentic Surveys	Tiger Salamander	92	0.19	65	0.34	0.23	0.79	0.04	0.17	0.31	0.12	0.49	0.92
Lentic Surveys	Western Toad	26	0.09	19	0.16	0.18	0.45	0.06	0.09	0.32	0.15	0.21	0.72
Lentic Surveys	Woodhouse's Toad	29	0.09	25	0.19	0.12	0.75	0.05	0.05	0.26	0.31	0.11	0.99
Reptile Area Search	Common Gartersnake	3	0.01	3	0.01	0.01	1.00	0.00	0.00	0.02	0.01	0.00	1.00
Reptile Area Search	Common Sagebrush Lizard	9	0.03	7	0.06	0.19	0.14	0.11	0.06	0.49	0.08	0.04	0.38
Reptile Area Search	Eastern Racer	37	0.05	29	0.11	0.13	0.41	0.04	0.07	0.23	0.13	0.19	0.67
Reptile Area Search	Gophersnake	13	0.02	13	0.05	0.02	1.00	0.01	0.01	0.03	0.00	1.00	1.00
Reptile Area Search	Greater Short-horned Lizard	16	0.04	15	0.09	0.04	0.81	0.04	0.01	0.25	0.76	0.00	1.00
Reptile Area Search	Northern Alligator Lizard *	1	0.01	1	0.03	0.01	1.00	0.01	0.00	0.08	0.00	1.00	1.00
Reptile Area Search	Painted Turtle *	3	0.00	3	0.01	0.00	1.00	0.00	0.00	0.01	0.01	0.00	1.00
Reptile Area Search	Plains Gartersnake	6	0.01	5	0.03	0.13	0.11	0.11	0.02	0.51	0.10	0.02	0.47
Reptile Area Search	Prairie Rattlesnake	28	0.04	24	0.09	0.10	0.43	0.04	0.04	0.22	0.19	0.14	0.77

Survey type	Species	No. survey detections	Proportion of surveys where detected	No. quarter-quadrangles with detections	Proportion of quarter-quadrangles where detected	p	psi	p (se)	p lower 95% CI	p upper 95% CI	psi (se)	psi lower 95% CI	psi upper 95% CI
Reptile Area Search	Rubber Boa *	1	0.00	1	0.01	0.00	1.00	0.00	0.00	0.02	0.03	0.00	1.00
Reptile Area Search	Terrestrial Gartersnake	13	0.02	11	0.05	0.10	0.21	0.07	0.03	0.32	0.14	0.05	0.57
Small Mammal	Bushy-tailed Woodrat *	5	0.01	5	0.04	0.01	1.00	0.01	0.01	0.03	0.00	0.00	1.00
Small Mammal	Deer Mouse	343	0.83	124	0.93	0.88	0.93	0.02	0.85	0.91	0.02	0.87	0.97
Small Mammal	Dusky or Montane Shrew	36	0.11	27	0.25	0.25	0.43	0.07	0.14	0.40	0.11	0.24	0.64
Small Mammal	Golden-mantled Ground Squirrel	2	0.01	1	0.01	0.63	0.01	0.32	0.11	0.96	0.02	0.00	0.10
Small Mammal	Hayden's Shrew	7	0.03	6	0.08	0.10	0.27	0.09	0.01	0.45	0.04	0.03	0.81
Small Mammal	Heather Vole	6	0.03	5	0.07	0.12	0.23	0.11	0.02	0.51	0.21	0.03	0.75
Small Mammal	House Mouse	11	0.03	7	0.05	0.26	0.09	0.11	0.11	0.51	0.04	0.03	0.21
Small Mammal	Long-tailed Vole	25	0.06	15	0.12	0.42	0.15	0.09	0.26	0.59	0.04	0.09	0.24
Small Mammal	Long-tailed Weasel *	1	0.00	1	0.01	0.00	1.00	0.00	0.00	0.02	0.00	1.00	1.00
Small Mammal	Masked Shrew	35	0.08	27	0.20	0.23	0.36	0.07	0.13	0.39	0.10	0.20	0.56
Small Mammal	Meadow Vole	92	0.22	53	0.40	0.45	0.48	0.05	0.36	0.54	0.06	0.37	0.59
Small Mammal	Merriam's Shrew *	3	0.01	3	0.04	0.01	1.00	0.01	0.00	0.04	0.00	0.00	1.00
Small Mammal	Montane Vole	38	0.12	29	0.28	0.23	0.51	0.06	0.13	0.37	0.13	0.27	0.74
Small Mammal	Mountain Cottontail	2	0.00	2	0.01	0.45	0.02	0.18	0.16	0.77	0.01	0.00	0.07
Small Mammal	Northern Flying Squirrel *	1	0.01	1	0.02	0.01	1.00	0.01	0.00	0.04	0.00	1.00	1.00
Small Mammal	Northern Grasshopper Mouse	14	0.04	7	0.07	0.56	0.07	0.12	0.33	0.77	0.03	0.04	0.15
Small Mammal	Northern Pocket Gopher	6	0.01	5	0.04	0.16	0.09	0.14	0.02	0.59	0.07	0.02	0.37
Small Mammal	Olive-backed Pocket Mouse	16	0.07	11	0.15	0.25	0.26	0.09	0.12	0.47	0.10	0.11	0.49
Small Mammal	Ord's Kangaroo Rat *	1	0.01	1	0.02	0.01	1.00	0.01	0.00	0.04	0.00	1.00	1.00
Small Mammal	Prairie Vole	12	0.04	7	0.08	0.34	0.11	0.11	0.16	0.58	0.05	0.05	0.24

Survey type	Species	No. survey detections	Proportion of surveys where detected	No. quarter-quadrangles with detections	Proportion of quarter-quadrangles where detected	p	psi	p (se)	p lower 95% CI	p upper 95% CI	psi (se)	psi lower 95% CI	psi upper 95% CI
Small Mammal	Preble's Shrew	4	0.01	4	0.03	0.01	1.00	0.01	0.00	0.03	0.00	0.00	1.00
Small Mammal	Pygmy Shrew	4	0.07	3	0.17	0.36	0.22	0.24	0.07	0.82	0.15	0.05	0.61
Small Mammal	Red Squirrel *	3	0.01	3	0.03	0.01	1.00	0.01	0.00	0.03	0.00	0.00	1.00
Small Mammal	Red-tailed Chipmunk	11	0.11	8	0.24	0.34	0.33	0.14	0.14	0.63	0.13	0.13	0.60
Small Mammal	Richardson's Ground Squirrel	14	0.06	6	0.08	0.72	0.08	0.11	0.47	0.88	0.03	0.04	0.17
Small Mammal	Sagebrush Vole	5	0.01	4	0.04	0.19	0.08	0.16	0.03	0.64	0.06	0.01	0.32
Small Mammal	Short-tailed Weasel	3	0.01	3	0.04	0.01	1.00	0.01	0.00	0.04	0.00	1.00	1.00
Small Mammal	Southern Red-backed Vole	47	0.21	27	0.36	0.48	0.43	0.07	0.35	0.61	0.07	0.30	0.58
Small Mammal	Striped Skunk *	3	0.01	3	0.02	0.01	1.00	0.00	0.00	0.02	0.01	0.00	1.00
Small Mammal	Thirteen-lined Ground Squirrel	6	0.03	3	0.04	0.48	0.05	0.18	0.19	0.79	0.03	0.01	0.14
Small Mammal	Vagrant Shrew	20	0.06	17	0.17	0.18	0.36	0.09	0.07	0.41	0.16	0.13	0.68
Small Mammal	Water Shrew	6	0.03	5	0.06	0.18	0.14	0.15	0.03	0.63	0.12	0.03	0.51
Small Mammal	Water Vole	4	0.02	2	0.04	0.63	0.04	0.22	0.21	0.92	0.03	0.01	0.14
Small Mammal	Western Harvest Mouse	5	0.02	4	0.05	0.12	0.16	0.11	0.02	0.52	0.15	0.02	0.62
Small Mammal	Western Jumping Mouse	36	0.09	22	0.18	0.40	0.23	0.07	0.27	0.55	0.05	0.14	0.33
Small Mammal	White-footed Mouse	10	0.04	9	0.11	0.07	0.56	0.07	0.01	0.36	0.52	0.02	0.99
Small Mammal	Wyoming Ground Squirrel	6	0.12	3	0.19	0.64	0.20	0.18	0.28	0.89	0.10	0.06	0.47
Small Mammal	Yellow-pine Chipmunk	14	0.07	9	0.13	0.39	0.17	0.12	0.19	0.63	0.06	0.08	0.32

Appendix 1

Protocol Overviews and Data Forms

Lentic Site Survey Protocol for Amphibians and Aquatic Reptiles

What is a survey location and what is a survey?

Each lentic site (standing water body) is a survey location and each person surveying the site is considered an independent survey of the site.

Selection of Survey Locations

All standing water bodies present within each QQuad grid cell on 1:24k scale topographic maps or found incidentally while in the field should be surveyed if they are safely accessible and on public land or are on private lands where you have received permission to survey these sites. If no standing water bodies are found on the topographic maps, accessible lands should be ground truthed by driving roads or hiking major trails to examine areas of low topographic relief or backwaters of streams that might provide lentic breeding habitat. If there are too many standing water bodies to survey within the 3 days allocated to each QQuad grid cell, then those likely to have more suitable habitat should be prioritized for survey over springs and wells.

Survey Methodology

Use timed visual encounter and dip net surveys in all portions of the water bodies that are less than 50 cm in depth. If little emergent vegetation is present then careful examination of these shallow water environments for the presence of eggs, larvae, or post metamorphic animals may suffice. However, in areas with dense emergent vegetation, it will be necessary to intensely sample the area with a dip net. At sites where water depths drop off steeply from the shoreline, visual searches and dip netting may be performed from the shoreline. However, areas with extensive shallows will require systematic searches and dip netting while wading through the area on evenly spaced transects. Note that occupancy analysis assumes that surveys are independent and do not influence one another with regard to the detection of various life history stages of species, so be sure to take steps to ensure that surveyors do not influence one another. If ill or dying animals are encountered at a site, place individual animals in individual zip lock bags and keep them on ice so that they can be shipped to a pathologist for analysis. Collect voucher specimens of amphibians and reptiles if the record fills in a significant hole or extends the species' known range or if species identity is uncertain (e.g., toad tadpoles in eastern MT).

Data and Photographs

Data sheets should be filled out thoroughly and care should be taken to ensure that data recorded is consistent with the site drawing and all related data fields (see description sheet for all datasheet fields). Record all detections by individual surveyors on the lower back of the datasheet. However, the front of the datasheet should only include a summary of the greatest numbers of animals observed for an individual life history stage for each species detected. Lentic sites within a 200-meter radius of mapped sites should be lumped under the same data sheet. Digital photographs of each site should be taken from a vantage point that allows the entire site to be seen in the context of surrounding habitats. Ideally only a single photograph will be needed. However, if multiple photographs are necessary, they should be labeled a, b, c, etc. as viewed from left to right. Each lentic site surveyed should be labeled on the QQuad map as A-01, A-02, ...etc..

Washing and Decontamination Procedures

In order to prevent the spread of fungal and viral pathogens, care should be taken to wash mud, aquatic vegetation, and other materials off of dip nets, boots, socks, and other equipment prior to departing from a site. Survey gear should be left to dry in the sun for as long as possible between sites. Dip nets, boots, socks, and other survey equipment should be decontaminated with a mixture of 10% bleach (4 ounces or one half cup) per gallon of water) between all Quarter Quadrangle grid cells, sites where dead, dying, or ill animals are encountered, and sites on different sides of divides separating major drainage basins. This can be accomplished by washing gear in tubs or by simply spraying washed gear down with pressurized sprayer containing 10% bleach and allowing it to dry in the sun. Do not rinse bleached equipment between sites. Instead allow the bleach to remain on the equipment to ensure that pathogens are killed. Most bleach will evaporate between sites so the amount of bleach introduced at the next site should be quickly diluted.

Nocturnal Auditory Amphibian Survey Protocol

When to Perform Surveys

Nocturnal auditory surveys for amphibians are conducted along passable roadways to rapidly add new localities and monitor amphibian species that are cryptic and/or occur less frequently on public lands. The majority of amphibians of interest for calling surveys in eastern Montana will call after and during rains on warmer spring and summer evenings.

Survey Methodology

Call surveys involve slowly driving roads in the evening and nights immediately following or during significant rainfall events while listening for species' breeding calls. Vehicles should be stopped every mile or two in low lying areas suitable for containing pooled water; a GPS unit may be of assistance in locating stream crossings or water bodies most likely to contain suitable habitat. At each stop observers should listen for species' breeding calls for 5 minutes without interference from vehicle noise before moving on. The location of each stop is noted on standard data forms and at each stop where species are detected, the compass bearing and distance to the breeding choruses is documented; likely breeding sites are subsequently identified in the office using digital topographic maps and high resolution aerial photographs. Starting point, ending point, and survey route are recorded in the comments in order for these survey routes to be digitized in the office.

Terrestrial Reptile Survey Protocol

What is a survey location and what is a survey?

Each rock outcrop or coulee rim is a survey location and each person surveying each survey location is considered an independent survey. If a rock outcrop or coulee rim is extremely large then it can be broken into multiple survey locations smaller than 400 x 100 meters based on natural breaks such as a drainage or area with reduced amounts of cover objects. If rock outcrops or coulee rims are not present within a Quarter Quadrangle grid cell then transects through a dominant cover type may be substituted as survey locations.

Selection of Survey Locations

Potential rock outcrops within each Quarter Quadrangle grid cell should be identified on 1:24,000 scale topographic maps by locating areas with greater amounts of topographic relief such as cliff faces. These areas often constitute boundaries between substrate types that differ in their erodibility. Rock strata in these areas may allow access to underground chambers that serve as hibernacula or may have collapsed to provide cover objects. These areas should be targeted for survey based on: (1) their accessibility on public land or are on private lands where you have received permission from the land owners to survey sites; (2) size of the likely rock outcrop (the larger the size, the better); and (3) the aspect of the survey location (south facing sites should be a higher priority for survey than north facing sites). Field crews should attempt to survey 4 or more rock outcrops per Quarter Quadrangle grid cell if time allows.

Survey Methodology

Occupancy analysis assumes that surveys are independent and do not influence one another with regard to the detection of species, so be sure to take steps to ensure that surveyors do not influence one another. Begin by coordinating with other surveyors on which portion of each rock outcrop you intend to survey in order to minimize overlap in area surveyed. Use timed visual encounter surveys in all portions of the rock outcrop by slowly moving through the area. Visually examine rocks at distances of up to 15 meters as well as near your feet. Lift cover-objects taking care to keep the cover object between you and species potentially sheltering under the cover object. Use potato rakes to probe rock crevices while listening and watching for animal movements. Use write-in-rain notebooks to note times at first detection and incidental observations of other animals.

Data and Photographs

Data sheets should be filled out thoroughly and care should be taken to ensure that data recorded is consistent with the site drawing and all related data fields (see description sheet for all datasheet fields). Record all detections by individual surveyors on the lower back of the datasheet. However, the front of the datasheet should only include a summary of the total numbers of animals observed for each species detected; if the same area is surveyed by multiple individuals then the greatest number of animals observed for each species detected should be recorded. Digital photographs of each site should be taken from a vantage point that allows the entire site to be seen in the context of surrounding habitats. Ideally only a single photograph will be needed. However, if multiple photographs are necessary, they should be labeled a, b, c, etc. as viewed from left to right. Finally, the outer boundary of the area surveyed should be drawn on the QQuad topographic maps in order to facilitate digitizing the site boundary in the GIS; each site should be labeled as R-01, R-02, ...etc..

Preventing the Spread of Weeds

In order to prevent the spread of weeds, care should be taken to remove weed seeds from boots, socks, packs, and other field gear between sites. Weed seeds should also be removed from grills, radiators, and under carriages of vehicles whenever possible.

Bat Acoustic Detection Protocol

What is a survey location and what is a survey?

Each location where an individual Petterson Detector and I-River MP3 recorder is set out is a survey location and each night of acoustic recording is a survey.

Selection of Survey Locations

Effort should be made to sample each of the major habitat cover types within each Quarter Quadrangle grid cell and ideally each major cover type should be sampled in multiple locations. Prioritize survey locations for acoustic survey in order to: (1) represent all major cover types; (2) survey locations that are readily accessible on public land or are on private lands where you have received permission from the land owners to survey sites; (3) if all cover types have been sampled then add additional survey locations in native cover types over human altered cover types and add additional survey locations in wetland cover types versus terrestrial cover types; and (4) whenever possible please sample cover type patches that are relatively large in size (e.g., place detectors inside the edge of a habitat cover type by 100 meters or more). It may be necessary to sample the same location on multiple nights due access limitations or concerns over hazardous weather conditions that could damage detectors, but this should be kept to a minimum. Detectors should be spaced a minimum of 400 meters apart in order to ensure independence between surveys.

Survey Methodology

Detectors and MP3 recorders should be set out each night in weather proof containers mounted on top of conduit mounted on rebar pounded into the ground as an anchor point. Again, detectors should be spaced a minimum of 400-meters apart in order to ensure independence between surveys. If a major thunderstorm is predicted for the region you are working in you may not want to set out detectors until after the storm passes in order to avoid damaging this expensive equipment. Settings on detectors and MP3 recorders are outlined in detail in a photographic guide that should be followed rigorously each time detectors are set out. Prior to deploying the detectors check the batteries in both the detectors and the MP3 recorders – be sure to recharge the H320 MP3 recorders daily. Make sure that the detector is recording before you leave (test it with finger snaps if there are no bats in the area yet). Detectors should be collected each morning as soon as possible. Guidelines for downloading detectors are outlined in detail in a photographic guide that should be followed rigorously each time detectors are downloaded.

Data and Photographs

Data sheets should be filled out thoroughly with comments on the surrounding habitat for each location a detector is set out. Digital photographs of each site should be taken from a vantage point that allows the detector to be seen in the context of the surrounding habitat. Ideally only a single photograph will be needed. However, if multiple photographs are necessary, they should be labeled a, b, c, etc. as viewed from left to right. Each site where detectors are set out should be labeled on the QQuad map as B-01, B-02, ...etc..

Preventing the Spread of Weeds

In order to prevent the spread of weeds, care should be taken to remove weed seeds from boots, socks, packs, and other field gear between sites. Weed seeds should also be removed from grills, radiators, and under carriages of vehicles whenever possible.

Small Mammal Trap Line Protocol

What is a survey location and what is a survey?

Each trap line is a survey location and each night of trapping on each trap line is a survey.

Selection of Survey Locations

Within each Quarter Quadrangle grid cell target a riparian cover type and the two most dominant habitat cover types within for survey. However, if the two most dominant habitat cover types are both extensively modified by humans (e.g., hay field and cropland), only survey one of these. Additionally, survey locations should be prioritized for survey based on: (1) their accessibility on public land or are on private lands where you have received permission from the land owners to survey; (2) the size of the cover type patch (large patches should be sampled whenever possible to reduce confusion as to which cover type a species is associated with).

Trap Line Orientation and Setting Traps

Trap lines should be oriented in habitat cover type patches so that they are relatively consistent in their habitat structure. Each line is 100-meters long and composed of 10 stations, each spaced 10-meters apart. Each station has 1 Victor mouse trap, 1 Museum Special, 1 pitfall trap, and 1 Sherman trap and station numbers 2 and 9 also have a rat trap (see diagram below). Trap lines do not have to be straight and can be placed in an arc in order to remain in a single habitat cover type. When laying out trap lines, one person can pace out the site, beginning with a flag to facilitate relocation of the trap line, and drop traps and pitfalls at 10-meter intervals. The second person should dig pitfall traps taking care to place them flush with the ground so that animals are not alerted to their presence; when possible, pitfall traps should be placed to take advantage of natural fences in the terrain like logs, rocks and drainages. After the first person has laid out the trap line, they should bait and set the snap and Sherman traps. Snap traps are baited with a peanut butter and sweet feed mix and Sherman traps are baited only with sweet feed mix to keep the trigger devices clean. Snap and Sherman traps should be placed in natural runways approximately 1-meter from the central pitfall trap rather than at an exact right angles as indicated in the example diagram below. Be sure to test and adjust the tension on the Sherman trigger plates each day since the trigger sensitivity changes with temperature and needs to be kept as sensitive as possible in order to capture smaller animals like shrews. Traps should only be set in the evenings.

Checking Traps and Processing Animals

All traps need to be checked daily as early as possible to minimize animal stress and mortality. Traps should all be sprung and left closed each morning in order to prevent incidental mortalities of non-target species during the day. In order to ensure that surveyors do not contract diseases, latex gloves and HEPA masks should be worn at all times when handling live and dead animals and checking traps and hand sanitizer should be used after handling traps. To check Sherman traps with live captures, place a bag over the trap opening and shake the animal into the bag. The animal can then be weighed in the bag and manipulated for measurement. Leather gloves should be used when handling a live specimen for measurement and release. The following measurements should be recorded for the first two specimens of each species: weight in grams (use smallest scale possible), total length (nose to tail tip, excluding hairs extending beyond tail), tail length, hind foot (include claws), ear length, and sex. To allow for identification of possible recaptures, the hairs on the back of live animals should be clipped in an easily identified straight line. If previously marked animals are filling Sherman traps each night, please note this on the datasheet.

Euthanization and Museum Voucher Specimens

The following should be kept as museum voucher specimens within each Quarter Quadrangle grid cell: (1) only the first specimen of deer mouse, montane vole, and meadow vole; (2) all snap trap captures of all other species, regardless of number captured; (3) all shrews (euthanize any live shrews); (4) any animal for which species identity is uncertain (euthanize animals if necessary); (5) one example of each species captured (euthanize live animals if they haven't already been captured in a snap trap). To euthanize live or injured animals place a

cotton-ball dabbed with a small amount of isoflurane into the opposite corner of the bag until 15 or more minutes after the animal has stopped breathing. Vouchered specimens should be placed in an individual zip lock bag with a fully completed museum voucher tags (use the following date format – 25 May 2009). All specimens from each trap line should then be placed in a larger bag labeled with the trap line (site) name and number and Quarter Quadrangle grid cell name and number. After the three nights of trapping in a Quarter Quadrangle grid cell, place all bags from each trap line in a bag labeled with the Quarter Quadrangle grid cell name and number. Immediately after traps are checked, voucher specimens should be placed on ice or in a refrigerator.

Data and Photographs

Data sheets should be filled out thoroughly with comments on the surrounding habitat for each trap line. Digital photographs of each trap line should be taken from a vantage point that allows the trap line flags to be seen in the context of the surrounding habitat. Ideally only a single photograph will be needed. However, if multiple photographs are necessary, they should be labeled a, b, c, etc. as viewed from left to right. Each trap line should be labeled on the QQuad map as M-01, M-02,etc..

Preventing the Spread of Weeds

In order to prevent the spread of weeds, care should be taken to remove weed seeds from boots, socks, packs, and other field gear between sites. Weed seeds should also be removed from grills, radiators, and under carriages of vehicles whenever possible.

Site Data Form for Lentic Breeding Amphibian and Aquatic Reptile Surveys

Locality Information

Date	Observer(s)	Owner	Site Detection: Aerial Photo Topo Map NWI Map Incidental				GPS EPE
DM Region SE MONTANA	QUAD	Site Number	State	County	Map Name		
Locality				T	R	S	Section Description
Map Elevation	FT	Datum	Latitude (DD)	Longitude (DD)	Survey Type 0 1 2 3 4 5 6 7 8		

Habitat Information

Begin Time	End Time	Total Person Minutes of Search	Site Overview Photo Taken ☐ Photo Description(s)									
Site Dry: Y N	Site Origin: Beaver Water Depressional Manmade Other _____				Support Reproduction? Y N		GIS Mapping 0 1 2 3 4 5 6 7					
Habitat Type:	Lake/ Pond	Wetland/ Marsh	Bog/ Fen	Backwater/ Oxbow	Spring/ Seep	Active Beaver Pond	Inactive Beaver Pond	Site Multipooled	Ditch/ Puddle	Reservoir/ Stockpond	Well/ Tank	
Weather: Clear Partly Cloudy Overcast Rain Snow			Wind: Calm Light Strong		Air Temp °C		Water Temp °C		Water pH			
Color: Clear Stained		Turbidity: Clear Cloudy		Water Connectedness: Permanent Temporary Isolated		Water Permanence: Permanent Temporary		Max Depth: < 1 M 1-2 M >2 M		Percent of Site > 2 M 0 1-25 26-50 51-75 76-100		
Site Length:		Site Width:		Percentage of Site Searched: 1-25 26-50 51-75 76-100		Percent of Site at ≤ 50 cm Depth: 0 1-25 26-50 51-75 76-100		~ Emergent Veg Area (M ²)				
Percent of Site with Emergent Veg: 0 1-25 26-50 51-75 76-100			Percent of Site with Larval Activity: 0 1-25 26-50 51-75 76-100			Rank Emergent Vegetation Species in Order of Abundance: Sedges Grasses Cattails Rushes Water Lily Shrubs Other _____						
Primary Substrate of Shallows: Silt/Mud Sand Gravel Cobble Boulder/Bedrock				North Shoreline Characteristics: Shallows Present: Y N Emergent Veg Present: Y N				Distance (M) to Forest Edge:				
Grazing Impact None Light Heavy Structure Heavy Structure and Water Heavy Water					Water Dammed/Diverted Y N		Timber Harvest in Area Y N		Mining Activity Y N			
Other Human Impacts Or Modifications:					Fish Detected? Y N		Time at First Detection:		Fish Species If Identified:			
Fish Spawning Habitat Present? Y N U			Inlet Width:		Inlet Depth:		Inlet Substrate		Outlet Width		Outlet Depth	Outlet Substrate

Species Information

Amphibian Species		Time at first detection	E L M J A	No. Egg Masses		5-20mm larvae	≤10 ≤100 ≤1000 ≤10K >10K	
20-50mm larvae	≤10 ≤100 ≤1000 ≤10K >10K	>50mm larvae	≤10 ≤100 ≤1000 ≤10K >10K	Number Juveniles		Number Adults		
Tissue Number		Voucher Number		Breeding with Fish?	Y N	If breeding with fish is cover present?	Y N	
Amphibian Species		Time at first detection	E L M J A	No. Egg Masses		5-20mm larvae	≤10 ≤100 ≤1000 ≤10K >10K	
20-50mm larvae	≤10 ≤100 ≤1000 ≤10K >10K	>50mm larvae	≤10 ≤100 ≤1000 ≤10K >10K	Number Juveniles		Number Adults		
Tissue Number		Voucher Number		Breeding with Fish?	Y N	If breeding with fish is cover present?	Y N	
Amphibian Species		Time at first detection	E L M J A	No. Egg Masses		5-20mm larvae	≤10 ≤100 ≤1000 ≤10K >10K	
20-50mm larvae	≤10 ≤100 ≤1000 ≤10K >10K	>50mm larvae	≤10 ≤100 ≤1000 ≤10K >10K	Number Juveniles		Number Adults		
Tissue Number		Voucher Number		Breeding with Fish?	Y N	If breeding with fish is cover present?	Y N	
Amphibian Species		Time at first detection	E L M J A	No. Egg Masses		5-20mm larvae	≤10 ≤100 ≤1000 ≤10K >10K	
20-50mm larvae	≤10 ≤100 ≤1000 ≤10K >10K	>50mm larvae	≤10 ≤100 ≤1000 ≤10K >10K	Number Juveniles		Number Adults		
Tissue Number		Voucher Number		Breeding with Fish?	Y N	If breeding with fish is cover present?	Y N	
Reptile Species		Time at first detection	E J A	Number Individuals		SVL in CM	Tissue Number	Voucher Number
Reptile Species		Time at first detection	E J A	Number Individuals		SVL in CM	Tissue Number	Voucher Number
Reptile Species		Time at first detection	E J A	Number Individuals		SVL in CM	Tissue Number	Voucher Number
Reptile Species		Time at first detection	E J A	Number Individuals		SVL in CM	Tissue Number	Voucher Number

Grid Scale:

A blank grid with a compass rose in the top right corner. The compass rose consists of the letter 'N' and an upward-pointing arrow, indicating North. The grid is composed of 15 columns and 15 rows.

Other Notes:

Detection Summary(list surveyors in left column & species detections in others (e.g., 1 @ 5 min) - list adults & breeding separately)

Surveyor	Species	Count	Time	Notes

Compass Bearing	70°	90°	110°	130°	150°	170°	190°	210°
Inclination (degrees)								

Definitions of Variables on Lentic Breeding Amphibian Survey Data Sheet

Locality Information

Date: Use MM-DD-YY format (e.g. 5/12/00 for May 12 of 2000).

Observers: List names or initials of individuals involved with survey of this site and circle the name of the recorder.

Owner: Use abbreviation of the government agency responsible for managing the land you surveyed. (e.g. USFS, BLM). If private land was surveyed list the owner's full name to indicate that you did not trespass.

Site Detection: Was site detected on aerial photo, topographic map, NWI map, or was it observed incidentally while in the field.

GPS EPE: The estimated positional error reported by the GPS receiver in meters.

Strata Number: The sample strata in which the 6th level HUC watershed lies (one of nine defined in western Montana).

HUC Number: The sample number of the 6th level HUC in one of the nine sample strata defined for western Montana.

Site Number: The number pre-assigned to the water body within each 6th level HUC. If the water body was not pre-assigned a number because it was not on topographic maps or aerial photos then assign it a sequential number and draw it on the topo map.

State: Use the two-letter abbreviation.

County: Use the full county name.

Map Name: List the name of the USGS 7.5-minute (1:24,000 scale) topographic quadrangle map.

Locality: Describe the specific geographic location of the site so that the type of site is described and the straight-line air distance from one or more permanent features on a 7.5-minute (1:24,000 scale) topographic map records the position of the site (e.g., Beaver pond, 1.5 miles south of Elephant Peak and 1.3 miles east of Engle Peak).

T: Record the Township number and whether it is north or south.

R: Record the Range number and whether it is east or west.

S: Record the Section number.

Section Description: Describe the location of the site at the ¼ of ¼ section level (e.g., SENE indicates SE corner of NE corner).

Map Elevation: The elevation of the site as indicated by the topographic map in feet (avoid using elevations from a GPS)

UTM Zone: Universal Transverse Mercator zone recorded on the topographic map. Use NAD 27 as the map and GPS datum.

UTM North: Universal Transverse Mercator northing coordinate in meters as recorded on the topographic map or GPS receiver. Be sure to note any major differences between UTM coordinates on the map and those on the GPS receiver.

UTM East: Universal Transverse Mercator easting coordinate in meters as recorded on the topographic map or GPS receiver. Be sure to note any major differences between UTM coordinates on the map and those on the GPS receiver.

Survey Type: Circle the appropriate number defined as follows: 0 = private land so site was not surveyed; 1 = site not surveyed due to logistics; 2 = site is a lotic spring/seep not worth future survey; 3 = lentic site that is worth future survey; 4 = misidentified as a potential lentic site on the aerial photograph or on the topographic map (e.g., a shadow from a tree or a talus slope) and not worth future survey; 5 = inactive beaver dam that now only has lotic habitat and is not worth future survey; 6 = only lotic habitat is present and the site is not worth future survey, but it appears possible that the meadow was an historic beaver dam complex; 7 = a lentic site because it would hold water for at least a short time period during wetter conditions, but it is not worth future survey because it would never hold enough water long enough to support amphibian reproduction; 8 = site is not worth future survey for some reason other than those listed above.

Habitat Information

Begin Time: List the time the survey began in 24-hour format.

End Time: List the time the survey ended in 24-hour format.

Total Person Minutes of Search: Record the total person minutes the site was searched (e.g. if one person surveys for 15 minutes and another surveys for 30 minutes, but takes 5 minutes to measure a specimen the total person minutes is 40 minutes).

Camera and Photo Number(s) / Description (s): Identify the camera and the number of the photo as viewed on the camera's view screen and a description of the contents of the photograph (e.g., 13 = 1 x ASMO larvae and 14 = 1 x habitat). Take photos of all portions of the site and anything else that may be of interest (e.g., areas with fish versus areas with amphibians).

Site Dry: Circle whether the site was dry or not at the time of the survey.

Site Origin: Circle whether the site origin is glacial, beaver, water (i.e., flooding or spring), depressional, manmade, or describe other origin.

Support Reproduction: Is site capable of supporting reproduction so it is worth resurveying (e.g. in wetter years if now dry)?

GIS Mapping: Circle the appropriate number defined as follows: 0 = site not surveyed; 1 = a 4 in the survey type and site is not worth future survey; 2 = a 2, 5, 6, or 8 in survey type and site is not worth future survey; 3 = 7 in survey type and site is not worth future survey; 4 = a 3 in the survey type and site is dry, but is worth future survey; 5 = a 3 in the survey type and site has ephemeral water and is worth future survey (including high elevation sites that freeze solid); 6 = a 3 in the survey type, site is worth future survey, has emergent vegetation, and has permanent water that lasts all summer long and does not freeze solid in the winter so that it is likely to support aquatic overwintering; 7 = a 3 in the survey type, site is worth future survey, does not have functional amounts of emergent vegetation, and has permanent water that lasts all summer long and does not freeze solid in the winter so that it is likely to support aquatic overwintering.

Habitat Type: Circle the appropriate habitat type of the site being surveyed. If site is multi-pooled water information does not need to be gathered for every pool, but you may wish to record this information on the map. If breeding activity is limited to one pool at a multi-pooled site water information should be recorded for this pool and this should be noted in the comments.

Weather: Circle weather condition during survey.

Wind: Circle wind condition during survey (> 20 mph winds should be classified as strong).

Air Temp: Record air temperature at chest height in the shade. Record temperature in Celsius. °C = (°F – 32)/1.8

Water Temp: Record water temperature where larvae or egg masses are observed or at 2 cm depth 1 meter from the margin of the water body. Record temperature in Celsius. °C = (°F – 32)/1.8

Water pH: Record water pH at the same location water temperature was recorded.

Color: Circle whether the water is clear or stained a tea or rust color from organic acids.

Turbidity: Circle whether water is clear or cloudy.

Water Connectedness: Circle if water body has permanent connection to flowing water (Permanent), is connected to flowing water for a temporary period each year (Temporary), or is never connected to flowing waters or other water bodies (Isolated).

Water Permanence: Circle whether the site contains water throughout the entire year (Permanent), or contains water for only a portion of the year (Temporary).

Max Depth: Circle the category corresponding to the maximum depth of the water body.

Percent of Site > 2 M: Circle the percentage of the site with water depth greater than 2 meters deep.

Site Length: The length of the longest dimension of the standing water body.

Site Width: The width of the second longest dimension of the standing water body.

Percentage of Site Searched: Circle the percentage of the site surveyed.

Percentage of the Site at ≤ 50 cm Depth: Circle the appropriate percentage.

Approximate Area with Emergent Veg (M^2): The approximate area of the site that contains emergent vegetation.

Percentage of Site with Emergent Veg: Circle the percentage of the entire site with emergent vegetation.

Percentage of Site with Larval Activity: Circle the percentage of the site where amphibian larvae were observed.

Rank Emergent Veg Species in Order of Abundance: Record the rank order of abundance in front of the 3 most prevalent emergent vegetation species. If the vegetation present is “other” indicate what it is.

Primary Substrate: Circle the substrate that covers the majority of the bottom of the site.

North Shoreline Characteristics: Circle whether shallows and emergent vegetation are present or absent on the north shoreline.

Distance (M) to Forest Edge: Record the closest distance between the water’s edge and the forest margin in meters.

Grazing Impact: Circle the appropriate grazing category defined as follows: no grazing in vicinity of the site; grazing noted in the vicinity of the site, but no major impacts to wetland structure or water quality; heavy structural impacts to site (e.g., vegetation destroyed creating bare ground, hummocks, pugging, or altered hydroregime); heavy structural impacts and water quality impacted due to animal waste; and water quality impacted due to animal waste.

Water Dammed/Diverted: Circle whether or not water has been dammed or diverted at the site (including blow outs or pits).

Timber Harvest: Circle whether or not timber has been harvested within 200 meters of the site.

Mining Activity: Circle whether or not there is evidence of mining activity within 200 meters of the site.

Other Human Impacts or Modifications: Briefly describe if, how, and when the site has been altered by human activities. If the site has not been altered record none for not altered. If multiple anthropogenic impacts exist document all of these using the back of the data sheet if necessary and qualify approximate timing of impact (e.g., recent versus historic).

Fish Detected?: Circle whether or not fish were detected.

Time at First Detection: If fish were detected, indicate the time in total person minutes of survey when they were first detected.

Fish Species if Identified: List the fish species identified.

Fish Spawning Habitat Present?: Are shallow waters with adequate gravels/cobbles present that would allow salmonid fishes to spawn? An active search for fry is also a good idea.

Inlet Width: What is the average width of the inlet stream in meters?

Inlet Depth: What is the average depth of the inlet stream in centimeters?

Inlet Substrate: What is the primary substrate at the inlet stream (Silt/Mud, Sand, Gravel, Cobble, or Boulder/Bedrock)?

Outlet Width: What is the average width of the outlet stream in meters?

Outlet Depth: What is the average depth of the outlet stream in centimeters?

Outlet Substrate: What is the primary substrate at the outlet stream (Silt/Mud, Sand, Gravel, Cobble, or Boulder/Bedrock)?

Species Information

For each species record the first two letters of the scientific genus and species names for all amphibian and reptile species found at the site (e.g., BUBO for *Bufo boreas*). Record the total number of person minutes of survey required before each life history stage of each species was encountered beside the E (egg), L (larvae), M (metamorph), J (juvenile), or A (adult). Record the number or category of number of each of the specified life history and/or size classes. For amphibians indicate whether they have bred in the same water body where fish are present, and if they have, indicate whether there is protective cover (e.g., extensive shallows with emergent vegetation, a log barrier, talus). Record the tissue number or range of tissue numbers for tissue samples collected (see tissue collection protocols). If the animal was swabbed in preparation for testing the animal for chytrid infection indicate the chytrid sample number in the Tissue Number field. Record the preliminary museum voucher specimen number for voucher specimens collected (see voucher specimen collection protocols).

Site Map for Lentic Breeding Amphibian and Aquatic Reptile Surveys

General: Include a rough sketch of the site including the shape of the site and the shape and spatial relations of surrounding biotic and abiotic features. Indicate the area covered with emergent vegetation with cross-hatching. Indicate a 2-meter depth contour for the water body with a dashed line. Indicate the location where the water temperature was taken, the location where the GPS position was taken, the location where clinometer readings for southern exposure were taken, and the location of any photographs with an arrow indicating the direction in which the photo(s) were taken. Make sure that the orientation of the sketch (i.e. the north arrow) corresponds to the orientation of the site.

Grid Scale: Indicate the approximate scale of the grid lines relative to the site sketched in meters.

Other Notes: Include any other notes of interest in this space. Examples: (1) areas of highest larval density; (2) thoughts on why a species may not have been detected at a site; (3) problems associated with the survey of the site (e.g., dangerous boggy conditions); (4) If a site was dry would it support reproduction during wetter years.

Southern Exposure: From a site on along the northern shoreline that would most likely to be used as an oviposition or larval rearing area (e.g., shallow waters with emergent vegetation in the NW corner of the water body) record the degree inclination from your position to the skyline (e.g., mountain or solid tree line) at each of the eight compass bearings listed. Note that the compass bearings are true north so you will need to adjust your compass according to the map being used to correct for the deviation from magnetic north (15 to 19.5 degrees in western Montana).

Data Form for Reptile Site Surveys

Locality Information

DM Region SE MONTANA	QQUAD	Site No:	Locality:				
State:	County:	Map Name:	T	R	S	Section Description:	
Owner:	Map Elevation: FT	Datum	Latitude (DD)			Longitude (DD)	

Habitat Information

Date:	Observer(s):	Begin Time:	End Time:	Total Person Minutes of Search:	Area (M ²) Searched:	
Percentage of Site Searched: 1-25 26-50 51-75 76-100		Percent Slope:	Aspect: N NE NW S SE SW E W Flat			
Habitat Cover Type As Percent of Site Surveyed:						
Cliff/Outcrop Bluff/Coulee Rim Talus Open Conifer Forest Open Mixed Forest Shrub/Steppe Grassland Other_____						
_____% _____% _____% _____% _____% _____% _____%						
Site Overview Photo Taken ☐				Air Temp: °C		
Photo Description(s)				Soil Temp: °C		
Weather: Clear Partly Cloudy Overcast Rain Snow			Wind: Calm Light Strong		Potential Hibernaculum Y N	
Soil Moisture: Dry Damp Wet Standing Water Snow			Dominant Substrate Type: Bedrock Compressed Soil Sand Detritus Gravel (<4 cm diameter) Cobble (4-30cm diameter) Boulder (>30 cm diameter)			
Habitat Description/Threats:						

Reptile Species Information

Species:	Number and Time at First Detection (e.g., 2 x juveniles, 25 cm TL @ 10 minutes)	Cover Type at Animal's Location:
Tissue Number (e.g., MTHP5533)	Substrate Association of Animal (Circle):	
Voucher Number & Description:	under wood on/under 4-20cm rock fragments on/under >20cm rock fragments in vegetation on leaf litter in rock fracture Other _____	
Species:	Number and Time at First Detection (e.g., 2 x juveniles, 25 cm TL @ 10 minutes)	Cover Type at Animal's Location:
Tissue Number (e.g., MTHP5533)	Substrate Association of Animal (Circle):	
Voucher Number & Description:	under wood on/under 4-20cm rock fragments on/under >20cm rock fragments in vegetation on leaf litter in rock fracture Other _____	
Species:	Number and Time at First Detection (e.g., 2 x juveniles, 25 cm TL @ 10 minutes)	Cover Type at Animal's Location:
Tissue Number (e.g., MTHP5533)	Substrate Association of Animal (Circle):	
Voucher Number & Description:	under wood on/under 4-20cm rock fragments on/under >20cm rock fragments in vegetation on leaf litter in rock fracture Other _____	
Species:	Number and Time at First Detection (e.g., 2 x juveniles, 25 cm TL @ 10 minutes)	Cover Type at Animal's Location:
Tissue Number (e.g., MTHP5533)	Substrate Association of Animal (Circle):	
Voucher Number & Description:	under wood on/under 4-20cm rock fragments on/under >20cm rock fragments in vegetation on leaf litter in rock fracture Other _____	

Grid Scale:

A blank grid with a compass rose in the top right corner. The compass rose consists of a large 'N' and an upward-pointing arrow, indicating North is towards the top of the grid. The grid is composed of 15 columns and 15 rows.

Other Notes:

Surveyor						

Definitions of Variables on Reptile Site Survey Form

Site Information

Strata Number: The sample strata in which the 6th level HUC watershed lies.

HUC Number: The sample number of the 6th level HUC.

Site No: Identify three digit number of the site being surveyed within each sampling block (range 001-999).

Locality: Describe the specific geographic location of the site so that the type of site is described and the straight-line air distance from one or more permanent features on a 7.5-minute (1:24,000 scale) topographic map records the position of the site (e.g., Large talus slope 1.5 miles north of Engle Peak, N side of FS Road 225).

State: Use the two-letter abbreviation.

County: Use the full county name.

Map Name: List the name of the USGS 7.5-minute (1:24,000 scale) topographic quadrangle map.

T: Record the Township number and whether it is north or south.

R: Record the Range number and whether it is east or west.

S: Record the Section number

Section Description: Describe location of the site at the ¼ of ¼ section level (e.g., SENE indicates SE corner of NE corner).

Owner: Use abbreviation of the government agency responsible for managing the land you surveyed. (e.g. USFS, BLM). If private land was surveyed list the owner's full name to indicate that you did not trespass.

Map Elevation: The elevation of the site as indicated by the topographic map in feet (avoid using elevations from a GPS)

Datum: The map datum used (typically NAD 27 if off topographic map or WGS84 if off GPS unit on standard setting).

UTM Zone: Universal Transverse Mercator zone recorded on the topographic map.

UTM East: Universal Transverse Mercator easting coordinate in meters as recorded on the topographic map or GPS receiver. Be sure to note any major differences between UTM coordinates on the map and those on the GPS receiver.

UTM North: Universal Transverse Mercator northing coordinate in meters as recorded on the topographic map or GPS receiver. Be sure to note any major differences between UTM coordinates on the map and those on the GPS receiver.

Survey Information

Date: Use MM-DD-YY format (e.g. 05/12/00 for May 12 of 2000).

Observers: List names or initials of individuals involved with survey of this site and circle the name of the recorder.

Begin Time: List the time the survey began in 24-hour format.

End Time: List the time the survey ended in 24-hour format.

Total Person Minutes of Search: Record the total person minutes the site was searched (e.g. if one person surveys for 15 minutes and another surveys for 30 minutes, but takes 5 minutes to measure a specimen the total person minutes is 40 minutes).

Area (M²) Searched: Area in square meters that was surveyed.

Percent of Site Searched: Circle the appropriate category.

Percent Slope: Percent slope of site. Enter range if variable.

Aspect: Circle primary aspect of the site.

Habitat Cover Type as Percent of Site Surveyed: Identify percent composition of each habitat type within site surveyed.

Photo Frame Number(s) / Descriptions: The number of the photo as viewed on the camera's view screen and a description of the contents of the photograph (e.g., #13 = 1 x Milksnake and #14-18 = 5 x habitat). Take photos of all portions of the site and anything else that may be of interest (e.g., reptile species, potential site threats).

Air Temp: Record air temperature in °C at chest height in the shade. °C = (°F – 32)/1.8

Soil Temp: Record soil temperature in °C at 10 cm depth. °C = (°F – 32)/1.8

Weather: Circle weather condition during survey.

Wind: Circle wind condition during survey (> 20 mph winds should be classified as strong).

Potential Hibernacula: Does the site contain suitable underground refugia (e.g., talus, caves) to support overwintering.

Soil Moisture: Circle the appropriate category.

Dominant Substrate Type: Circle the appropriate category.

Habitat Description/Threats: Note the most prominent characteristics of the site with relation to reptiles (e.g., could the site support overwintering). Also note habitat threats from grazing, logging, mining, flooding, road building, weeds, fire, etc.

Species Information

For each species record the first two letters of the scientific genus and species names for all amphibian and reptile species found at the site (e.g., COCO for *Coluber constrictor*). Record the total number of person minutes of survey required before each life history stage of each species was encountered and the size or size range of the animals encountered. Record the tissue number or range of tissue numbers for tissue samples collected (see tissue collection protocols). Record the preliminary museum voucher specimen number for voucher specimens collected (see voucher specimen collection protocols). Circle the substrate the animal was associated with at time of detection. Record the presence of other species detected at the site (e.g., millipedes), the time at first detection, and the voucher number and description of animals collected (see voucher and tissue collection protocols)

Page ____ of ____						Roadside Amphibian Calling Survey Datasheet													
Observer(s) _____						Start Lat/Long (DD) _____						End Lat/Long (DD) _____							
Summary Comments on Survey Route (record temperatures every half hour or 5 stops)																			
Date		Time		Weather		Latitude (DD)				Detection		Species Number, Bearing, & Distance to Chorus (e.g., 5 x BUWO at 230 degrees and 100 m)							
						Longitude (DD)				Y / N									
Date		Time		Weather		Latitude (DD)				Detection		Species Number, Bearing, & Distance to Chorus (e.g., 5 x BUWO at 230 degrees and 100 m)							
						Longitude (DD)				Y / N									
Date		Time		Weather		Latitude (DD)				Detection		Species Number, Bearing, & Distance to Chorus (e.g., 5 x BUWO at 230 degrees and 100 m)							
						Longitude (DD)				Y / N									
Date		Time		Weather		Latitude (DD)				Detection		Species Number, Bearing, & Distance to Chorus (e.g., 5 x BUWO at 230 degrees and 100 m)							
						Longitude (DD)				Y / N									
Date		Time		Weather		Latitude (DD)				Detection		Species Number, Bearing, & Distance to Chorus (e.g., 5 x BUWO at 230 degrees and 100 m)							
						Longitude (DD)				Y / N									
Date		Time		Weather		Latitude (DD)				Detection		Species Number, Bearing, & Distance to Chorus (e.g., 5 x BUWO at 230 degrees and 100 m)							
						Longitude (DD)				Y / N									
Date		Time		Weather		Latitude (DD)				Detection		Species Number, Bearing, & Distance to Chorus (e.g., 5 x BUWO at 230 degrees and 100 m)							
						Longitude (DD)				Y / N									
Date		Time		Weather		Latitude (DD)				Detection		Species Number, Bearing, & Distance to Chorus (e.g., 5 x BUWO at 230 degrees and 100 m)							
						Longitude (DD)				Y / N									
Date		Time		Weather		Latitude (DD)				Detection		Species Number, Bearing, & Distance to Chorus (e.g., 5 x BUWO at 230 degrees and 100 m)							
						Longitude (DD)				Y / N									
Date		Time		Weather		Latitude (DD)				Detection		Species Number, Bearing, & Distance to Chorus (e.g., 5 x BUWO at 230 degrees and 100 m)							
						Longitude (DD)				Y / N									
Date		Time		Weather		Latitude (DD)				Detection		Species Number, Bearing, & Distance to Chorus (e.g., 5 x BUWO at 230 degrees and 100 m)							
						Longitude (DD)				Y / N									
Date		Time		Weather		Latitude (DD)				Detection		Species Number, Bearing, & Distance to Chorus (e.g., 5 x BUWO at 230 degrees and 100 m)							
						Longitude (DD)				Y / N									
Date		Time		Weather		Latitude (DD)				Detection		Species Number, Bearing, & Distance to Chorus (e.g., 5 x BUWO at 230 degrees and 100 m)							
						Longitude (DD)				Y / N									
Date		Time		Weather		Latitude (DD)				Detection		Species Number, Bearing, & Distance to Chorus (e.g., 5 x BUWO at 230 degrees and 100 m)							
						Longitude (DD)				Y / N									
Date		Time		Weather		Latitude (DD)				Detection		Species Number, Bearing, & Distance to Chorus (e.g., 5 x BUWO at 230 degrees and 100 m)							
						Longitude (DD)				Y / N									
Date		Time		Weather		Latitude (DD)				Detection		Species Number, Bearing, & Distance to Chorus (e.g., 5 x BUWO at 230 degrees and 100 m)							
						Longitude (DD)				Y / N									

Bat Acoustic Survey Form												
QQuad Name/				Observer(s)								
QQUAD Bat Acoustic Survey Comments												
Survey #	Date	Location				Latitude (DD)				Photo Y / N		
						Longitude (DD)				Weather		
Habitat	[Barren Crop/Ag	DecidWoodland	ConifWoodland	Herbaceous	HerbWetland	IntroHerbVeg	MixedUplandWetland	RecentBurnForest	Shrubland	SteppeSavannah	WoodyWetland	]
Recorder ID		Time/Temp Deployed/Collected and other comments:										
Survey #	Date	Location				Latitude (DD)				Photo Y / N		
						Longitude (DD)				Weather		
Habitat	[Barren Crop/Ag	DecidWoodland	ConifWoodland	Herbaceous	HerbWetland	IntroHerbVeg	MixedUplandWetland	RecentBurnForest	Shrubland	SteppeSavannah	WoodyWetland	]
Recorder ID		Time/Temp Deployed/Collected and other comments:										
Survey #	Date	Location				Latitude (DD)				Photo Y / N		
						Longitude (DD)				Weather		
Habitat	[Barren Crop/Ag	DecidWoodland	ConifWoodland	Herbaceous	HerbWetland	IntroHerbVeg	MixedUplandWetland	RecentBurnForest	Shrubland	SteppeSavannah	WoodyWetland	]
Recorder ID		Time/Temp Deployed/Collected and other comments:										
Survey #	Date	Location				Latitude (DD)				Photo Y / N		
						Longitude (DD)				Weather		
Habitat	[Barren Crop/Ag	DecidWoodland	ConifWoodland	Herbaceous	HerbWetland	IntroHerbVeg	MixedUplandWetland	RecentBurnForest	Shrubland	SteppeSavannah	WoodyWetland	]
Recorder ID		Time/Temp Deployed/Collected and other comments:										
Survey #	Date	Location				Latitude (DD)				Photo Y / N		
						Longitude (DD)				Weather		
Habitat	[Barren Crop/Ag	DecidWoodland	ConifWoodland	Herbaceous	HerbWetland	IntroHerbVeg	MixedUplandWetland	RecentBurnForest	Shrubland	SteppeSavannah	WoodyWetland	]
Recorder ID		Time/Temp Deployed/Collected and other comments:										
Survey #	Date	Location				Latitude (DD)				Photo Y / N		
						Longitude (DD)				Weather		
Habitat	[Barren Crop/Ag	DecidWoodland	ConifWoodland	Herbaceous	HerbWetland	IntroHerbVeg	MixedUplandWetland	RecentBurnForest	Shrubland	SteppeSavannah	WoodyWetland	]
Recorder ID		Time/Temp Deployed/Collected and other comments:										
Survey #	Date	Location				Latitude (DD)				Photo Y / N		
						Longitude (DD)				Weather		
Habitat	[Barren Crop/Ag	DecidWoodland	ConifWoodland	Herbaceous	HerbWetland	IntroHerbVeg	MixedUplandWetland	RecentBurnForest	Shrubland	SteppeSavannah	WoodyWetland	]
Recorder ID		Time/Temp Deployed/Collected and other comments:										
Survey #	Date	Location				Latitude (DD)				Photo Y / N		
						Longitude (DD)				Weather		
Habitat	[Barren Crop/Ag	DecidWoodland	ConifWoodland	Herbaceous	HerbWetland	IntroHerbVeg	MixedUplandWetland	RecentBurnForest	Shrubland	SteppeSavannah	WoodyWetland	]
Recorder ID		Time/Temp Deployed/Collected and other comments:										
Survey #	Date	Location				Latitude (DD)				Photo Y / N		
						Longitude (DD)				Weather		
Habitat	[Barren Crop/Ag	DecidWoodland	ConifWoodland	Herbaceous	HerbWetland	IntroHerbVeg	MixedUplandWetland	RecentBurnForest	Shrubland	SteppeSavannah	WoodyWetland	]
Recorder ID		Time/Temp Deployed/Collected and other comments:										

Bat Acoustic Survey Form Page 2					QQUAD				
Survey #	Date	Location			Latitude (DD)			Photo Y / N	
					Longitude (DD)			Weather	
Habitat [Barren Crop/Ag DecidWoodland ConifWoodland Herbaceous HerbWetland IntroHerbVeg MixedUplandWetland RecentBurnForest Shrubland SteppeSavannah WoodyWetland]									
Recorder ID		Time/Temp Deployed/Collected and other comments:							
Survey #	Date	Location			Latitude (DD)			Photo Y / N	
					Longitude (DD)			Weather	
Habitat [Barren Crop/Ag DecidWoodland ConifWoodland Herbaceous HerbWetland IntroHerbVeg MixedUplandWetland RecentBurnForest Shrubland SteppeSavannah WoodyWetland]									
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					Longitude (DD)			Weather	
Habitat [Barren Crop/Ag DecidWoodland ConifWoodland Herbaceous HerbWetland IntroHerbVeg MixedUplandWetland RecentBurnForest Shrubland SteppeSavannah WoodyWetland]									
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					Longitude (DD)			Weather	
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					Longitude (DD)			Weather	
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					Longitude (DD)			Weather	
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					Longitude (DD)			Weather	
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					Longitude (DD)			Weather	
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					Longitude (DD)			Weather	
Habitat [Barren Crop/Ag DecidWoodland ConifWoodland Herbaceous HerbWetland IntroHerbVeg MixedUplandWetland RecentBurnForest Shrubland SteppeSavannah WoodyWetland]									
Recorder ID		Time/Temp Deployed/Collected and other comments:							
Survey #	Date	Location			Latitude (DD)			Photo Y / N	
					Longitude (DD)			Weather	
Habitat [Barren Crop/Ag DecidWoodland ConifWoodland Herbaceous HerbWetland IntroHerbVeg MixedUplandWetland RecentBurnForest Shrubland SteppeSavannah WoodyWetland]									
Recorder ID		Time/Temp Deployed/Collected and other comments:							

Effort Table						Site Overview Photo Taken Y / N Photo Descriptions: Totals					
Date	Mus. Sp.	Vic	Sher	Pitfall	Rat						
Total Effort											
Total Cap.											
Length (mm)											
Date	Capt. ID	Trap-Station	Species	Sex/status	Age	Weight	Ear	Body	Tail	H-Foot	Voucher #
Victor:		Mus. Sp:		Sherman:			Pitfall:		Rat:		
UNAVAILABLE TALLY											

[illegible]

VOUCHER TAGS

Location:				Location:			
Lat/Long (DD):				Lat/Long (DD):			
Date:		Survey #:		Date:		Survey #:	
Collector:		Trap Type-Station #:		Collector:		Trap Type-Station #:	
Voucher #:	10DM-00573	Habitat:		Voucher #:	10DM-00574	Habitat:	
Location:				Location:			
Lat/Long (DD):				Lat/Long (DD):			
Date:		Survey #:		Date:		Survey #:	
Collector:		Trap Type-Station #:		Collector:		Trap Type-Station #:	
Voucher #:	10DM-00575	Habitat:		Voucher #:	10DM-00576	Habitat:	
Location:				Location:			
Lat/Long (DD):				Lat/Long (DD):			
Date:		Survey #:		Date:		Survey #:	
Collector:		Trap Type-Station #:		Collector:		Trap Type-Station #:	
Voucher #:	10DM-00577	Habitat:		Voucher #:	10DM-00578	Habitat:	
Location:				Location:			
Lat/Long (DD):				Lat/Long (DD):			
Date:		Survey #:		Date:		Survey #:	
Collector:		Trap Type-Station #:		Collector:		Trap Type-Station #:	
Voucher #:	10DM-00579	Habitat:		Voucher #:	10DM-00580	Habitat:	
Location:				Location:			
Lat/Long (DD):				Lat/Long (DD):			
Date:		Survey #:		Date:		Survey #:	
Collector:		Trap Type-Station #:		Collector:		Trap Type-Station #:	
Voucher #:	10DM-00581	Habitat:		Voucher #:	10DM-00582	Habitat:	
Location:				Location:			
Lat/Long (DD):				Lat/Long (DD):			
Date:		Survey #:		Date:		Survey #:	
Collector:		Trap Type-Station #:		Collector:		Trap Type-Station #:	
Voucher #:	10DM-00583	Habitat:		Voucher #:	10DM-00584	Habitat:	
Location:				Location:			
Lat/Long (DD):				Lat/Long (DD):			
Date:		Survey #:		Date:		Survey #:	
Collector:		Trap Type-Station #:		Collector:		Trap Type-Station #:	
Voucher #:	10DM-00585	Habitat:		Voucher #:	10DM-00586	Habitat:	
Location:				Location:			
Lat/Long (DD):				Lat/Long (DD):			
Date:		Survey #:		Date:		Survey #:	
Collector:		Trap Type-Station #:		Collector:		Trap Type-Station #:	
Voucher #:	10DM-00587	Habitat:		Voucher #:	10DM-00588	Habitat:	
Location:				Location:			
Lat/Long (DD):				Lat/Long (DD):			
Date:		Survey #:		Date:		Survey #:	
Collector:		Trap Type-Station #:		Collector:		Trap Type-Station #:	
Voucher #:	10DM-00589	Habitat:		Voucher #:	10DM-00590	Habitat:	
Location:				Location:			
Lat/Long (DD):				Lat/Long (DD):			
Date:		Survey #:		Date:		Survey #:	
Collector:		Trap Type-Station #:		Collector:		Trap Type-Station #:	
Voucher #:	10DM-00591	Habitat:		Voucher #:	10DM-00592	Habitat:	
Location:				Location:			
Lat/Long (DD):				Lat/Long (DD):			
Date:		Survey #:		Date:		Survey #:	
Collector:		Trap Type-Station #:		Collector:		Trap Type-Station #:	
Voucher #:	10DM-00593	Habitat:		Voucher #:	10DM-00594	Habitat:	

Montana Native Species List

Common Name	Scientific Name	CODE	DISTRIBUTION_STATUS
Amphibians			
Long-toed Salamander	Ambystoma macrodactylum	AMMA	Resident Year Round
Tiger Salamander	Ambystoma tigrinum	AMTI	Resident Year Round
Coeur d'Alene Salamander	Plethodon idahoensis	PLID	Resident Year Round
Idaho Giant Salamander	Dicamptodon aterrimus	DIAT	Resident Year Round
Rocky Mountain Tailed Frog	Ascaphus montanus	ASMO	Resident Year Round
Western Toad	Bufo boreas	BUBO	Resident Year Round
Great Plains Toad	Bufo cognatus	BUCO	Resident Year Round
Woodhouse's Toad	Bufo woodhousii	BUWO	Resident Year Round
Pacific Treefrog	Pseudacris regilla	PSRE	Resident Year Round
Boreal Chorus Frog	Pseudacris maculata	PSMA	Resident Year Round
Plains Spadefoot	Spea bombifrons	SPBO	Resident Year Round
Northern Leopard Frog	Rana pipiens	RAPI	Resident Year Round
Columbia Spotted Frog	Rana luteiventris	RALU	Resident Year Round
Reptiles			
Snapping Turtle	Chelydra serpentina	CHSE	Resident Year Round
Painted Turtle	Chrysemys picta	CHPI	Resident Year Round
Spiny Softshell	Apalone spinifera	APSP	Resident Year Round
Northern Alligator Lizard	Elgaria coerulea	ELCO	Resident Year Round
Greater Short-horned Lizard	Phrynosoma hernandesi	PHHE	Resident Year Round
Common Sagebrush Lizard	Sceloporus graciosus	SCGR	Resident Year Round
Western Skink	Eumeces skiltonianus	EUSK	Resident Year Round
Rubber Boa	Charina bottae	CHBO	Resident Year Round
Eastern Racer	Coluber constrictor	COCO	Resident Year Round
Western Hog-nosed Snake	Heterodon nasicus	HENA	Resident Year Round
Milksnake	Lampropeltis triangulum	LATR	Resident Year Round
Gophersnake	Pituophis catenifer	PICA	Resident Year Round
Terrestrial Gartersnake	Thamnophis elegans	THEL	Resident Year Round
Plains Gartersnake	Thamnophis radix	THRA	Resident Year Round
Common Gartersnake	Thamnophis sirtalis	THSI	Resident Year Round
Smooth Greensnake	Opheodrys vernalis	OPVE	Resident Year Round
Prairie Rattlesnake	Crotalus viridis	CRVI	Resident Year Round

Common Name	Scientific Name	CODE	DISTRIBUTION_STATUS
Mammals			
Masked Shrew	Sorex cinereus	SOCI	Resident Year Round
Preble's Shrew	Sorex preblei	SOPR	Resident Year Round
Vagrant Shrew	Sorex vagrans	SOVA	Resident Year Round
Dusky or Montane Shrew	Sorex monticolus	SOMO	Resident Year Round
Dwarf Shrew	Sorex nanus	SONA	Resident Year Round
Water Shrew	Sorex palustris	SOPA	Resident Year Round
Arctic Shrew	Sorex arcticus	SOAR	Resident Year Round
Merriam's Shrew	Sorex merriami	SOME	Resident Year Round
Pygmy Shrew	Sorex hoyi	SOHO	Resident Year Round
Hayden's Shrew	Sorex haydeni	SOHA	Resident Year Round
Northern Short-tailed Shrew	Blarina brevicauda	BLBR	Resident Year Round
Little Brown Myotis	Myotis lucifugus	MYLU	Resident Year Round
Long-eared Myotis	Myotis evotis	MYEV	Resident Year Round
Fringed Myotis	Myotis thysanodes	MYTH	Resident Year Round
Long-legged Myotis	Myotis volans	MYVO	Resident Year Round
California Myotis	Myotis californicus	MYCA	Resident Year Round
Western Small-footed Myotis	Myotis ciliolabrum	MYCI	Resident Year Round
Northern Myotis	Myotis septentrionalis	MYSE	Resident Year Round
Silver-haired Bat	Lasionycteris noctivagans	LANO	Resident Year Round
Big Brown Bat	Eptesicus fuscus	EPFU	Resident Year Round
Eastern Red Bat	Lasiurus borealis	LABO	Migratory Summer Breeder
Hoary Bat	Lasiurus cinereus	LACI	Migratory Summer Breeder
Spotted Bat	Euderma maculatum	EUMA	Resident Year Round
Townsend's Big-eared Bat	Corynorhinus townsendii	COTO	Resident Year Round
Pallid Bat	Antrozous pallidus	ANPA	Resident Year Round
Pika	Ochotona princeps	OCPR	Resident Year Round
Eastern Cottontail	Sylvilagus floridanus	SYFL	Resident Year Round
Mountain Cottontail	Sylvilagus nuttallii	SYNU	Resident Year Round
Desert Cottontail	Sylvilagus audubonii	SYAU	Resident Year Round
Snowshoe Hare	Lepus americanus	LEAM	Resident Year Round
White-tailed Jack Rabbit	Lepus townsendii	LETO	Resident Year Round
Black-tailed Jack Rabbit	Lepus californicus	LECA	Resident Year Round
Pygmy Rabbit	Brachylagus idahoensis	BRID	Resident Year Round
Least Chipmunk	Tamias minimus	TAMI	Resident Year Round
Yellow-pine Chipmunk	Tamias amoenus	TAAM	Resident Year Round
Red-tailed Chipmunk	Tamias ruficaudus	TARU	Resident Year Round
Uinta Chipmunk	Tamias umbrinus	TAUM	Resident Year Round
Yellow-bellied Marmot	Marmota flaviventris	MAFL	Resident Year Round
Hoary Marmot	Marmota caligata	MACA	Resident Year Round
Richardson's Ground Squirrel	Spermophilus richardsonii	SPRI	Resident Year Round
Uinta Ground Squirrel	Spermophilus armatus	SPAR	Resident Year Round
Columbian Ground Squirrel	Spermophilus columbianus	SPCO	Resident Year Round
Thirteen-lined Ground Squirrel	Spermophilus tridecemlineatus	SPTR	Resident Year Round
Golden-mantled Ground Squirrel	Spermophilus lateralis	SPLA	Resident Year Round
Wyoming Ground Squirrel	Spermophilus elegans	SPEL	Resident Year Round
Black-tailed Prairie Dog	Cynomys ludovicianus	CYLU	Resident Year Round
White-tailed Prairie Dog	Cynomys leucurus	CYLE	Resident Year Round
Eastern Fox Squirrel	Sciurus niger	SCNI	Resident Year Round
Red Squirrel	Tamiasciurus hudsonicus	TAHU	Resident Year Round
Northern Flying Squirrel	Glaucomys sabrinus	GLSA	Resident Year Round
Northern Pocket Gopher	Thomomys talpoides	THTA	Resident Year Round
Idaho Pocket Gopher	Thomomys idahoensis	THID	Resident Year Round
Olive-backed Pocket Mouse	Perognathus fasciatus	PEFA	Resident Year Round
Great Basin Pocket Mouse	Perognathus parvus	PEPA	Resident Year Round

Common Name	Scientific Name	CODE	DISTRIBUTION_STATUS
Mammals			
Ord's Kangaroo Rat	Dipodomys ordii	DIOR	Resident Year Round
Hispid Pocket Mouse	Chaetodipus hispidus	CHHI	Resident Year Round
Beaver	Castor canadensis	CACA	Resident Year Round
Western Harvest Mouse	Reithrodontomys megalotis	REME	Resident Year Round
Deer Mouse	Peromyscus maniculatus	PEMA	Resident Year Round
White-footed Mouse	Peromyscus leucopus	PELE	Resident Year Round
Northern Grasshopper Mouse	Onychomys leucogaster	ONLE	Resident Year Round
Bushy-tailed Woodrat	Neotoma cinerea	NECI	Resident Year Round
Southern Red-backed Vole	Clethrionomys gapperi	CLGA	Resident Year Round
Heather Vole	Phenacomys intermedius	PHIN	Resident Year Round
Meadow Vole	Microtus pennsylvanicus	MIPE	Resident Year Round
Montane Vole	Microtus montanus	MIMO	Resident Year Round
Long-tailed Vole	Microtus longicaudus	MILO	Resident Year Round
Prairie Vole	Microtus ochrogaster	MIOC	Resident Year Round
Water Vole	Microtus richardsoni	MIRI	Resident Year Round
Sagebrush Vole	Lemmiscus curtatus	LECU	Resident Year Round
Muskrat	Ondatra zibethicus	ONZI	Resident Year Round
Northern Bog Lemming	Synaptomys borealis	SYBO	Resident Year Round
Meadow Jumping Mouse	Zapus hudsonius	ZAHU	Resident Year Round
Western Jumping Mouse	Zapus princeps	ZAPR	Resident Year Round
Porcupine	Erethizon dorsatum	ERDO	Resident Year Round
Coyote	Canis latrans	CALA	Resident Year Round
Gray Wolf	Canis lupus	CALU	Resident Year Round
Red Fox	Vulpes vulpes	VUVU	Resident Year Round
Swift Fox	Vulpes velox	VUVE	Resident Year Round
Black Bear	Ursus americanus	URAM	Resident Year Round
Grizzly Bear	Ursus arctos	URAR	Resident Year Round
Raccoon	Procyon lotor	PRLO	Resident Year Round
Marten	Martes americana	MAAM	Resident Year Round
Fisher	Martes pennanti	MAPE	Resident Year Round
Short-tailed Weasel	Mustela erminea	MUER	Resident Year Round
Least Weasel	Mustela nivalis	MUNI	Resident Year Round
Long-tailed Weasel	Mustela frenata	MUFR	Resident Year Round
Black-footed Ferret	Mustela nigripes	MUNI	Extirpated Reintroduction Being Attempted
Mink	Mustela vison	MUVI	Resident Year Round
Wolverine	Gulo gulo	GUGU	Resident Year Round
Badger	Taxidea taxus	TATA	Resident Year Round
Western Spotted Skunk	Spilogale gracilis	SPGR	Resident Year Round
Striped Skunk	Mephitis mephitis	MEME	Resident Year Round
Northern River Otter	Lontra canadensis	LOCA	Resident Year Round
Canada Lynx	Lynx canadensis	LYCA	Resident Year Round
Bobcat	Lynx rufus	LYRU	Resident Year Round
Mountain Lion	Puma concolor	PUCO	Resident Year Round
Elk or Wapiti	Cervus canadensis	CECA	Resident Year Round
Mule Deer	Odocoileus hemionus	ODHE	Resident Year Round
White-tailed Deer	Odocoileus virginianus	ODVI	Resident Year Round
Moose	Alces alces	ALAL	Resident Year Round
Pronghorn	Antilocapra americana	ANAM	Resident Year Round
Bison	Bos bison	BOBI	Resident Year Round
Mountain Goat	Oreamnos americanus	ORAM	Resident Year Round
Bighorn Sheep	Ovis canadensis	OVCA	Resident Year Round

Common Name	Scientific Name	CODE	DISTRIBUTION_STATUS
Birds			
Common Loon	Gavia immer	COLO	Migratory Summer Breeder
Pacific Loon	Gavia pacifica	PALO	Uncommon Migrant
Pied-billed Grebe	Podilymbus podiceps	PBGR	Resident Year Round
Horned Grebe	Podiceps auritus	HOGR	Migratory Summer Breeder
Red-necked Grebe	Podiceps grisegena	RNGR	Migratory Summer Breeder
Eared Grebe	Podiceps nigricollis	EAGR	Migratory Summer Breeder
Western Grebe	Aechmophorus occidentalis	WEGR	Migratory Summer Breeder
Clark's Grebe	Aechmophorus clarkii	CLGR	Migratory Summer Breeder
American White Pelican	Pelecanus erythrorhynchos	AWPE	Migratory Summer Breeder
Double-crested Cormorant	Phalacrocorax auritus	DCCO	Migratory Summer Breeder
American Bittern	Botaurus lentiginosus	AMBI	Migratory Summer Breeder
Great Blue Heron	Ardea herodias	GBHE	Resident Year Round
Great Egret	Ardea alba	GREG	Rare Migrant
Snowy Egret	Egretta thula	SNEG	Migratory Rare Summer Breeder
Cattle Egret	Bubulcus ibis	CAEG	Rare Migrant
Black-crowned Night-Heron	Nycticorax nycticorax	BCNH	Migratory Summer Breeder
White-faced Ibis	Plegadis chihi	WFIB	Migratory Summer Breeder
Tundra Swan	Cygnus columbianus	WHSW	Common Migrant
Trumpeter Swan	Cygnus buccinator	TRUS	Resident Year Round
Greater White-fronted Goose	Anser albifrons	GWFG	Common Migrant
Snow Goose	Chen caerulescens	BLGO	Common Migrant
Ross's Goose	Chen rossii	ROGO	Common Migrant
Canada Goose	Branta canadensis	CAGO	Resident Year Round
Cackling Goose	Branta hutchinsii	CACG	Uncommon Migrant
Wood Duck	Aix sponsa	WODU	Resident Year Round
Green-winged Teal	Anas crecca	AGWT	Resident Year Round
Mallard	Anas platyrhynchos	MALL	Resident Year Round
Northern Pintail	Anas acuta	NOPI	Resident Year Round
Blue-winged Teal	Anas discors	BWTE	Migratory Summer Breeder
Cinnamon Teal	Anas cyanoptera	CITE	Migratory Summer Breeder
Northern Shoveler	Anas clypeata	NSHO	Migratory Summer Breeder
Gadwall	Anas strepera	GADW	Resident Year Round
Eurasian Wigeon	Anas penelope	EUWI	Uncommon Migrant
American Wigeon	Anas americana	AMWI	Resident Year Round
Canvasback	Aythya valisineria	CANV	Migratory Summer Breeder
Redhead	Aythya americana	REDH	Migratory Summer Breeder
Ring-necked Duck	Aythya collaris	RNDU	Resident Year Round
Greater Scaup	Aythya marila	GRSC	Migratory Winter Resident
Lesser Scaup	Aythya affinis	LESC	Resident Year Round
Harlequin Duck	Histrionicus histrionicus	HARD	Migratory Summer Breeder
Long-tailed Duck	Clangula hyemalis	LTDU	Common Migrant
Surf Scoter	Melanitta perspicillata	SUSC	Common Migrant
White-winged Scoter	Melanitta fusca	WWSC	Common Migrant
Common Goldeneye	Bucephala clangula	COGO	Resident Year Round
Barrow's Goldeneye	Bucephala islandica	BAGO	Resident Year Round
Bufflehead	Bucephala albeola	BUFF	Resident Year Round
Hooded Merganser	Lophodytes cucullatus	HOME	Resident Year Round
Common Merganser	Mergus merganser	COME	Resident Year Round
Red-breasted Merganser	Mergus serrator	RBME	Common Migrant
Ruddy Duck	Oxyura jamaicensis	RUDU	Migratory Summer Breeder
Turkey Vulture	Cathartes aura	TUVU	Migratory Summer Breeder
Osprey	Pandion haliaetus	OSPR	Migratory Summer Breeder
Bald Eagle	Haliaeetus leucocephalus	BAEA	Resident Year Round
Northern Harrier	Circus cyaneus	NOHA	Resident Year Round

Common Name	Scientific Name	CODE	DISTRIBUTION STATUS
Sharp-shinned Hawk	Accipiter striatus	SSHA	Resident Year Round
Cooper's Hawk	Accipiter cooperii	COHA	Resident Year Round
Northern Goshawk	Accipiter gentilis	NOGO	Resident Year Round
Broad-winged Hawk	Buteo platypterus	BWHA	Uncommon Migrant
Swainson's Hawk	Buteo swainsoni	SWHA	Migratory Summer Breeder
Red-tailed Hawk	Buteo jamaicensis	RTHA	Resident Year Round
Ferruginous Hawk	Buteo regalis	FEHA	Migratory Summer Breeder
Rough-legged Hawk	Buteo lagopus	RLHA	Migratory Winter Resident
Golden Eagle	Aquila chrysaetos	GOEA	Resident Year Round
American Kestrel	Falco sparverius	AMKE	Resident Year Round
Merlin	Falco columbarius	MERL	Resident Year Round
Peregrine Falcon	Falco peregrinus	PEFA	Resident Year Round
Gyrfalcon	Falco rusticolus	GYRF	Migratory Winter Resident
Prairie Falcon	Falco mexicanus	PRFA	Resident Year Round
Spruce Grouse	Falcipennis canadensis	SPGR	Resident Year Round
Dusky Grouse	Dendragapus obscurus	BGSE	Resident Year Round
White-tailed Ptarmigan	Lagopus leucura	WTPT	Resident Year Round
Ruffed Grouse	Bonasa umbellus	RUGR	Resident Year Round
Greater Sage-Grouse	Centrocercus urophasianus	GRSG	Resident Year Round
Sharp-tailed Grouse	Tympanuchus phasianellus	STGR	Resident Year Round
Sharp-tailed Grouse (Columbian)	Tympanuchus phasianellus columbianus	STGR	Resident Year Round
Sharp-tailed Grouse (Plains)	Tympanuchus phasianellus jamesi	STGR	Resident Year Round
Yellow Rail	Coturnicops noveboracensis	YERA	Migratory Rare Summer Breeder
Virginia Rail	Rallus limicola	VIRA	Migratory Summer Breeder
Sora	Porzana carolina	SORA	Migratory Summer Breeder
American Coot	Fulica americana	AMCO	Resident Year Round
Sandhill Crane	Grus canadensis	SACR	Migratory Summer Breeder
Whooping Crane	Grus americana	WHCR	Rare Migrant
Black-bellied Plover	Pluvialis squatarola	BBPL	Common Migrant
American Golden-Plover	Pluvialis dominica	AMGP	Uncommon Migrant
Semipalmated Plover	Charadrius semipalmatus	SEPL	Common Migrant
Piping Plover	Charadrius melodus	PIPL	Migratory Summer Breeder
Killdeer	Charadrius vociferus	KILL	Resident Year Round
Mountain Plover	Charadrius montanus	MOUP	Migratory Summer Breeder
Black-necked Stilt	Himantopus mexicanus	BNST	Migratory Summer Breeder
American Avocet	Recurvirostra americana	AMAV	Migratory Summer Breeder
Greater Yellowlegs	Tringa melanoleuca	GRYE	Common Migrant
Lesser Yellowlegs	Tringa flavipes	LEYE	Common Migrant
Solitary Sandpiper	Tringa solitaria	SOSA	Common Migrant
Willet	Tringa semipalmata	WILL	Migratory Summer Breeder
Spotted Sandpiper	Actitis macularius	SPSA	Migratory Summer Breeder
Upland Sandpiper	Bartramia longicauda	UPSA	Migratory Summer Breeder
Whimbrel	Numenius phaeopus	WHIM	Uncommon Migrant
Long-billed Curlew	Numenius americanus	LBCU	Migratory Summer Breeder
Hudsonian Godwit	Limosa haemastica	HUGO	Rare Migrant
Marbled Godwit	Limosa fedoa	MAGO	Migratory Summer Breeder
Ruddy Turnstone	Arenaria interpres	RUTU	Rare Migrant
Red Knot	Calidris canutus	REKN	Rare Migrant
Sanderling	Calidris alba	SAND	Common Migrant
Semipalmated Sandpiper	Calidris pusilla	SESA	Common Migrant
Western Sandpiper	Calidris mauri	WESA	Common Migrant
Least Sandpiper	Calidris minutilla	LESA	Common Migrant
White-rumped Sandpiper	Calidris fuscicollis	WRSA	Uncommon Migrant
Baird's Sandpiper	Calidris bairdii	BASA	Common Migrant
Pectoral Sandpiper	Calidris melanotos	PESA	Common Migrant

Common Name	Scientific Name	CODE	DISTRIBUTION_STATUS
Dunlin	<i>Calidris alpina</i>	DUNL	Uncommon Migrant
Stilt Sandpiper	<i>Calidris himantopus</i>	STSA	Common Migrant
Buff-breasted Sandpiper	<i>Tryngites subruficollis</i>	BBSA	Rare Migrant
Short-billed Dowitcher	<i>Limnodromus griseus</i>	SBDO	Rare Migrant
Long-billed Dowitcher	<i>Limnodromus scolopaceus</i>	LBDO	Common Migrant
Wilson's Snipe	<i>Gallinago delicata</i>	COSN	Migratory Summer Breeder
Wilson's Phalarope	<i>Phalaropus tricolor</i>	WIPH	Migratory Summer Breeder
Red-necked Phalarope	<i>Phalaropus lobatus</i>	RNPH	Common Migrant
Franklin's Gull	<i>Leucophaeus pipixcan</i>	FRGU	Migratory Summer Breeder
Bonaparte's Gull	<i>Chroicocephalus philadelphia</i>	BOGU	Common Migrant
Mew Gull	<i>Larus canus</i>	MEGU	Uncommon Migrant
Ring-billed Gull	<i>Larus delawarensis</i>	RBGU	Migratory Summer Breeder
California Gull	<i>Larus californicus</i>	CAGU	Migratory Summer Breeder
Herring Gull	<i>Larus argentatus</i>	HERG	Migratory Winter Resident
Thayer's Gull	<i>Larus thayeri</i>	THGU	Uncommon Migrant
Glaucous Gull	<i>Larus hyperboreus</i>	GLGU	Uncommon Migrant
Sabine's Gull	<i>Xema sabini</i>	SAGU	Rare Migrant
Caspian Tern	<i>Hydroprogne caspia</i>	CATE	Migratory Summer Breeder
Common Tern	<i>Sterna hirundo</i>	COTE	Migratory Summer Breeder
Arctic Tern	<i>Sterna paradisaea</i>	ARTE	Migratory Rare Summer Breeder
Forster's Tern	<i>Sterna forsteri</i>	FOTE	Migratory Summer Breeder
Least Tern	<i>Sterna antillarum</i>	LETE	Migratory Summer Breeder
Black Tern	<i>Chlidonias niger</i>	BLTE	Migratory Summer Breeder
Mourning Dove	<i>Zenaida macroura</i>	MODO	Resident Year Round
Black-billed Cuckoo	<i>Coccyzus erythrophthalmus</i>	BBCU	Migratory Summer Breeder
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>	YBCU	Migratory Rare Summer Breeder
Yellow-billed Cuckoo (Western)	<i>Coccyzus americanus occidentalis</i>	YBCU	Migratory Rare Summer Breeder
Barn Owl	<i>Tyto alba</i>	BNOW	Resident Year Round
Flammulated Owl	<i>Otus flammeolus</i>	FLOW	Migratory Summer Breeder
Eastern Screech-Owl	<i>Megascops asio</i>	EASO	Resident Year Round
Western Screech-Owl	<i>Megascops kennicottii</i>	WESO	Resident Year Round
Great Horned Owl	<i>Bubo virginianus</i>	GHOW	Resident Year Round
Snowy Owl	<i>Bubo scandiacus</i>	SNOW	Migratory Winter Resident
Northern Hawk Owl	<i>Surnia ulula</i>	NHOW	Resident Year Round
Northern Pygmy-Owl	<i>Glaucidium gnoma</i>	NOPO	Resident Year Round
Burrowing Owl	<i>Athene cunicularia</i>	BUOW	Migratory Summer Breeder
Barred Owl	<i>Strix varia</i>	BDOW	Resident Year Round
Great Gray Owl	<i>Strix nebulosa</i>	GGOW	Resident Year Round
Long-eared Owl	<i>Asio otus</i>	LEOW	Resident Year Round
Short-eared Owl	<i>Asio flammeus</i>	SEOW	Resident Year Round
Boreal Owl	<i>Aegolius funereus</i>	BOOW	Resident Year Round
Northern Saw-whet Owl	<i>Aegolius acadicus</i>	NSWO	Resident Year Round
Common Nighthawk	<i>Chordeiles minor</i>	CONI	Migratory Summer Breeder
Common Poorwill	<i>Phalaenoptilus nuttallii</i>	COPO	Migratory Summer Breeder
Black Swift	<i>Cypseloides niger</i>	BLSW	Migratory Summer Breeder
Chimney Swift	<i>Chaetura pelagica</i>	CHSW	Migratory Summer Breeder
Vaux's Swift	<i>Chaetura vauxi</i>	VASW	Migratory Summer Breeder
White-throated Swift	<i>Aeronautes saxatalis</i>	WTSW	Migratory Summer Breeder
Ruby-throated Hummingbird	<i>Archilochus colubris</i>	RTHU	Migratory Rare Summer Breeder
Black-chinned Hummingbird	<i>Archilochus alexandri</i>	BCHU	Migratory Summer Breeder
Calliope Hummingbird	<i>Stellula calliope</i>	CAHU	Migratory Summer Breeder
Broad-tailed Hummingbird	<i>Selasphorus platycercus</i>	BTLH	Migratory Summer Breeder
Rufous Hummingbird	<i>Selasphorus rufus</i>	RUHU	Migratory Summer Breeder

Common Name	Scientific Name	CODE	DISTRIBUTION_STATUS
Belted Kingfisher	Megaceryle alcyon	BEKI	Resident Year Round
Lewis's Woodpecker	Melanerpes lewis	LEWO	Resident Year Round
Red-headed Woodpecker	Melanerpes erythrocephalus	RHWO	Migratory Summer Breeder
Yellow-bellied Sapsucker	Sphyrapicus varius	YBSA	Rare Migrant
Williamson's Sapsucker	Sphyrapicus thyroideus	WISA	Migratory Summer Breeder
Red-naped Sapsucker	Sphyrapicus nuchalis	RNSA	Migratory Summer Breeder
Downy Woodpecker	Picoides pubescens	DOWO	Resident Year Round
Hairy Woodpecker	Picoides villosus	HAWO	Resident Year Round
Black-backed Woodpecker	Picoides arcticus	BBWO	Resident Year Round
American Three-toed Woodpecker	Picoides dorsalis	TTWO	Resident Year Round
Northern Flicker	Colaptes auratus	NOFL	Resident Year Round
Northern Flicker (Yellow-shafted)	Colaptes auratus auratus	YSFL	Resident Year Round
Northern Flicker (Red-shafted)	Colaptes auratus cafer	RSFL	Resident Year Round
Pileated Woodpecker	Dryocopus pileatus	PIWO	Resident Year Round
Olive-sided Flycatcher	Contopus cooperi	OSFL	Migratory Summer Breeder
Western Wood-Pewee	Contopus sordidulus	WEWP	Migratory Summer Breeder
Yellow-bellied Flycatcher	Empidonax flaviventris	YBFL	Rare Migrant
Alder Flycatcher	Empidonax alnorum	ALFL	Migratory Summer Breeder
Willow Flycatcher	Empidonax traillii	WIFL	Migratory Summer Breeder
Least Flycatcher	Empidonax minimus	LEFL	Migratory Summer Breeder
Hammond's Flycatcher	Empidonax hammondii	HAFL	Migratory Summer Breeder
Dusky Flycatcher	Empidonax oberholseri	DUFL	Migratory Summer Breeder
Gray Flycatcher	Empidonax wrightii	GRFL	Migratory Summer Breeder
Cordilleran Flycatcher	Empidonax occidentalis	COFL	Migratory Summer Breeder
Eastern Phoebe	Sayornis phoebe	EAPH	Rare Migrant
Say's Phoebe	Sayornis saya	SAPH	Migratory Summer Breeder
Great Crested Flycatcher	Myiarchus crinitus	GCFL	Rare Migrant
Cassin's Kingbird	Tyrannus vociferans	CAKI	Migratory Summer Breeder
Western Kingbird	Tyrannus verticalis	WEKI	Migratory Summer Breeder
Eastern Kingbird	Tyrannus tyrannus	EAKI	Migratory Summer Breeder
Horned Lark	Eremophila alpestris	HOLA	Resident Year Round
Purple Martin	Progne subis	PUMA	Migratory Rare Summer Breeder
Tree Swallow	Tachycineta bicolor	TRES	Migratory Summer Breeder
Violet-green Swallow	Tachycineta thalassina	VGSW	Migratory Summer Breeder
Northern Rough-winged Swallow	Stelgidopteryx serripennis	NRWS	Migratory Summer Breeder
Bank Swallow	Riparia riparia	BANS	Migratory Summer Breeder
Cliff Swallow	Petrochelidon pyrrhonota	CLSW	Migratory Summer Breeder
Barn Swallow	Hirundo rustica	BARS	Migratory Summer Breeder
Gray Jay	Perisoreus canadensis	GRAJ	Resident Year Round
Steller's Jay	Cyanocitta stelleri	STJA	Resident Year Round
Blue Jay	Cyanocitta cristata	BLJA	Resident Year Round
Pinyon Jay	Gymnorhinus cyanocephalus	PIJA	Resident Year Round
Clark's Nutcracker	Nucifraga columbiana	CLNU	Resident Year Round
Black-billed Magpie	Pica hudsonia	BBMA	Resident Year Round
American Crow	Corvus brachyrhynchos	AMCR	Resident Year Round
Common Raven	Corvus corax	CORA	Resident Year Round
Black-capped Chickadee	Poecile atricapillus	BCCH	Resident Year Round
Mountain Chickadee	Poecile gambeli	MOCH	Resident Year Round
Boreal Chickadee	Poecile hudsonica	BOCH	Resident Year Round
Chestnut-backed Chickadee	Poecile rufescens	CBCH	Resident Year Round
Red-breasted Nuthatch	Sitta canadensis	RBNU	Resident Year Round
White-breasted Nuthatch	Sitta carolinensis	WBNU	Resident Year Round
Pygmy Nuthatch	Sitta pygmaea	PYNU	Resident Year Round

Common Name	Scientific Name	CODE	DISTRIBUTION STATUS
Brown Creeper	<i>Certhia americana</i>	BRCR	Resident Year Round
Rock Wren	<i>Salpinctes obsoletus</i>	ROWR	Migratory Summer Breeder
Canyon Wren	<i>Catherpes mexicanus</i>	CANW	Resident Year Round
House Wren	<i>Troglodytes aedon</i>	HOWR	Migratory Summer Breeder
Winter Wren	<i>Troglodytes troglodytes</i>	WIWR	Resident Year Round
Sedge Wren	<i>Cistothorus platensis</i>	SEWR	Migratory Rare Summer Breeder
Marsh Wren	<i>Cistothorus palustris</i>	MAWR	Migratory Summer Breeder
American Dipper	<i>Cinclus mexicanus</i>	AMDI	Resident Year Round
Golden-crowned Kinglet	<i>Regulus satrapa</i>	GCKI	Resident Year Round
Ruby-crowned Kinglet	<i>Regulus calendula</i>	RCKI	Migratory Summer Breeder
Blue-gray Gnatcatcher	<i>Polioptila caerulea</i>	BGGN	Migratory Summer Breeder
Eastern Bluebird	<i>Sialia sialis</i>	EABL	Migratory Summer Breeder
Western Bluebird	<i>Sialia mexicana</i>	WEBL	Migratory Summer Breeder
Mountain Bluebird	<i>Sialia currucoides</i>	MOBL	Migratory Summer Breeder
Townsend's Solitaire	<i>Myadestes townsendi</i>	TOSO	Resident Year Round
Veery	<i>Catharus fuscescens</i>	VEER	Migratory Summer Breeder
Gray-cheeked Thrush	<i>Catharus minimus</i>	GCTH	Rare Migrant
Swainson's Thrush	<i>Catharus ustulatus</i>	SWTH	Migratory Summer Breeder
Hermit Thrush	<i>Catharus guttatus</i>	HETH	Migratory Summer Breeder
American Robin	<i>Turdus migratorius</i>	AMRO	Resident Year Round
Varied Thrush	<i>Ixoreus naevius</i>	VATH	Migratory Summer Breeder
Gray Catbird	<i>Dumetella carolinensis</i>	GRCA	Migratory Summer Breeder
Northern Mockingbird	<i>Mimus polyglottos</i>	NOMO	Migratory Rare Summer Breeder
Sage Thrasher	<i>Oreoscoptes montanus</i>	SATH	Migratory Summer Breeder
Brown Thrasher	<i>Toxostoma rufum</i>	BRTH	Migratory Summer Breeder
American Pipit	<i>Anthus rubescens</i>	AMPI	Migratory Summer Breeder
Sprague's Pipit	<i>Anthus spragueii</i>	SPPI	Migratory Summer Breeder
Bohemian Waxwing	<i>Bombycilla garrulus</i>	BOWA	Migratory Winter Resident
Cedar Waxwing	<i>Bombycilla cedrorum</i>	CEDW	Resident Year Round
Northern Shrike	<i>Lanius excubitor</i>	NSHR	Migratory Winter Resident
Loggerhead Shrike	<i>Lanius ludovicianus</i>	LOSH	Migratory Summer Breeder
Blue-headed Vireo	<i>Vireo solitarius</i>	BHVI	Rare Migrant
Warbling Vireo	<i>Vireo gilvus</i>	WAVI	Migratory Summer Breeder
Philadelphia Vireo	<i>Vireo philadelphicus</i>	PHVI	Rare Migrant
Red-eyed Vireo	<i>Vireo olivaceus</i>	REVI	Migratory Summer Breeder
Plumbeous Vireo	<i>Vireo plumbeus</i>	PLVI	Migratory Summer Breeder
Cassin's Vireo	<i>Vireo cassinii</i>	CAVI	Migratory Summer Breeder
Tennessee Warbler	<i>Vermivora peregrina</i>	TEWA	Migratory Summer Breeder
Orange-crowned Warbler	<i>Vermivora celata</i>	OCWA	Migratory Summer Breeder
Nashville Warbler	<i>Vermivora ruficapilla</i>	NAWA	Migratory Summer Breeder
Yellow Warbler	<i>Dendroica petechia</i>	YWAR	Migratory Summer Breeder
Chestnut-sided Warbler	<i>Dendroica pensylvanica</i>	CSWA	Uncommon Migrant
Magnolia Warbler	<i>Dendroica magnolia</i>	MAWA	Uncommon Migrant
Cape May Warbler	<i>Dendroica tigrina</i>	CMWA	Uncommon Migrant
Yellow-rumped Warbler	<i>Dendroica coronata</i>	UYRW	Migratory Summer Breeder
Black-throated Gray Warbler	<i>Dendroica nigrescens</i>	BTYW	Migratory Rare Summer Breeder
Townsend's Warbler	<i>Dendroica townsendi</i>	TOWA	Migratory Summer Breeder
Black-throated Green Warbler	<i>Dendroica virens</i>	BTNW	Rare Migrant
Palm Warbler	<i>Dendroica palmarum</i>	WPWA	Uncommon Migrant
Bay-breasted Warbler	<i>Dendroica castanea</i>	BBWA	Rare Migrant
Blackpoll Warbler	<i>Dendroica striata</i>	BLPW	Common Migrant
Black-and-white Warbler	<i>Mniotilta varia</i>	BAWW	Migratory Rare Summer Breeder
American Redstart	<i>Setophaga ruticilla</i>	AMRE	Migratory Summer Breeder

Common Name	Scientific Name	CODE	DISTRIBUTION_STATUS
Ovenbird	Seiurus aurocapilla	OVEN	Migratory Summer Breeder
Northern Waterthrush	Seiurus noveboracensis	NOWA	Migratory Summer Breeder
Connecticut Warbler	Oporornis agilis	CONW	Rare Migrant
Mourning Warbler	Oporornis philadelphia	MOWA	Rare Migrant
MacGillivray's Warbler	Oporornis tolmiei	MGWA	Migratory Summer Breeder
Common Yellowthroat	Geothlypis trichas	COYE	Migratory Summer Breeder
Wilson's Warbler	Wilsonia pusilla	WIWA	Migratory Summer Breeder
Canada Warbler	Wilsonia canadensis	CAWA	Uncommon Migrant
Yellow-breasted Chat	Icteria virens	YBCH	Migratory Summer Breeder
Scarlet Tanager	Piranga olivacea	SCTA	Rare Migrant
Western Tanager	Piranga ludoviciana	WETA	Migratory Summer Breeder
Rose-breasted Grosbeak	Pheucticus ludovicianus	RBGR	Common Migrant
Black-headed Grosbeak	Pheucticus melanocephalus	BHGR	Migratory Summer Breeder
Blue Grosbeak	Passerina caerulea	BLGR	Migratory Rare Summer Breeder
Lazuli Bunting	Passerina amoena	LAZB	Migratory Summer Breeder
Indigo Bunting	Passerina cyanea	INBU	Rare Migrant
Dickcissel	Spiza americana	DICK	Migratory Rare Summer Breeder
Green-tailed Towhee	Pipilo chlorurus	GTTO	Migratory Summer Breeder
Spotted Towhee	Pipilo maculatus	SPTO	Migratory Summer Breeder
American Tree Sparrow	Spizella arborea	ATSP	Migratory Winter Resident
Chipping Sparrow	Spizella passerina	CHSP	Migratory Summer Breeder
Clay-colored Sparrow	Spizella pallida	CCSP	Migratory Summer Breeder
Brewer's Sparrow	Spizella breweri	BRSP	Migratory Summer Breeder
Field Sparrow	Spizella pusilla	FISP	Migratory Summer Breeder
Vesper Sparrow	Pooecetes gramineus	VESP	Migratory Summer Breeder
Lark Sparrow	Chondestes grammacus	LASP	Migratory Summer Breeder
Sage Sparrow	Amphispiza belli	SAGS	Migratory Rare Summer Breeder
Lark Bunting	Calamospiza melanocorys	LARB	Migratory Summer Breeder
Savannah Sparrow	Passerculus sandwichensis	SAVS	Migratory Summer Breeder
Baird's Sparrow	Ammodramus bairdii	BAIS	Migratory Summer Breeder
Grasshopper Sparrow	Ammodramus savannarum	GRSP	Migratory Summer Breeder
Le Conte's Sparrow	Ammodramus leconteii	LCSP	Migratory Summer Breeder
Nelson's Sharp-tailed Sparrow	Ammodramus nelsoni	NSTS	Migratory Summer Breeder
Fox Sparrow	Passerella iliaca	FOSP	Migratory Summer Breeder
Song Sparrow	Melospiza melodia	SOSP	Resident Year Round
Lincoln's Sparrow	Melospiza lincolni	LISP	Migratory Summer Breeder
Swamp Sparrow	Melospiza georgiana	SWSP	Rare Migrant
White-throated Sparrow	Zonotrichia albicollis	WTSP	Common Migrant
White-crowned Sparrow	Zonotrichia leucophrys	WCSP	Migratory Summer Breeder
Harris's Sparrow	Zonotrichia querula	HASP	Common Migrant
Dark-eyed Junco	Junco hyemalis	UDEJ	Resident Year Round
Dark-eyed Junco (White-winged)	Junco hyemalis aikenii	WWJU	Resident Year Round
Dark-eyed Junco (Slate-colored)	Junco hyemalis hyemalis	SCJU	Migratory Winter Resident
Dark-eyed Junco (Oregon)	Junco hyemalis oregonus	ORJU	Resident Year Round
Dark-eyed Junco (Pink-sided)	Junco hyemalis mearnsi	ORJU	Migratory Summer Breeder
McCown's Longspur	Calcarius mccownii	MCLO	Migratory Summer Breeder
Lapland Longspur	Calcarius lapponicus	LALO	Migratory Winter Resident
Smith's Longspur	Calcarius pictus	SMLO	Rare Migrant
Chestnut-collared Longspur	Calcarius ornatus	CCLO	Migratory Summer Breeder
Snow Bunting	Plectrophenax nivalis	SNBU	Migratory Winter Resident
Bobolink	Dolichonyx oryzivorus	BOBO	Migratory Summer Breeder
Red-winged Blackbird	Agelaius phoeniceus	RWBL	Resident Year Round
Western Meadowlark	Sturnella neglecta	WEME	Migratory Summer Breeder

Common Name	Scientific Name	CODE	DISTRIBUTION_STATUS
Yellow-headed Blackbird	Xanthocephalus xanthocephalus	YHBL	Migratory Summer Breeder
Rusty Blackbird	Euphagus carolinus	RUBL	Uncommon Migrant
Brewer's Blackbird	Euphagus cyanocephalus	BRBL	Resident Year Round
Common Grackle	Quiscalus quiscula	COGR	Migratory Summer Breeder
Brown-headed Cowbird	Molothrus ater	BHCO	Migratory Summer Breeder
Orchard Oriole	Icterus spurius	OROR	Migratory Summer Breeder
Baltimore Oriole	Icterus galbula	BAOR	Migratory Summer Breeder
Bullock's Oriole	Icterus bullockii	BUOR	Migratory Summer Breeder
Black Rosy-Finch	Leucosticte atrata	BLRF	Resident Year Round
Gray-crowned Rosy-Finch	Leucosticte tephrocotis	GCRF	Resident Year Round
Gray-crowned Rosy-Finch (Cassin's)	Leucosticte tephrocotis tephrocotis		Resident Year Round
Gray-crowned Rosy-Finch (Hepburn's)	Leucosticte tephrocotis littoralis		Migratory Winter Resident
Pine Grosbeak	Pinicola enucleator	PIGR	Resident Year Round
Purple Finch	Carpodacus purpureus	PUFI	Uncommon Migrant
Cassin's Finch	Carpodacus cassinii	CAFI	Resident Year Round
House Finch	Carpodacus mexicanus	HOFI	Resident Year Round
Red Crossbill	Loxia curvirostra	RECR	Resident Year Round
White-winged Crossbill	Loxia leucoptera	WWCR	Resident Year Round
Common Redpoll	Carduelis flammea	CORE	Migratory Winter Resident
Hoary Redpoll	Carduelis hornemanni	HORE	Migratory Winter Resident
Pine Siskin	Carduelis pinus	PISI	Resident Year Round
Lesser Goldfinch	Carduelis psaltria	LEGO	Migratory Rare Summer Breeder
American Goldfinch	Carduelis tristis	AMGO	Migratory Summer Breeder
Evening Grosbeak	Coccothraustes vespertinus	EVGR	Resident Year Round

Common Name	Scientific Name	CODE	DISTRIBUTION_STATUS
Fish			
Mottled Sculpin	Cottus bairdi	MOSC	Resident Year Round
Slimy Sculpin	Cottus cognatus	SLSC	Resident Year Round
Torrent Sculpin	Cottus rhotheus	TOSC	Resident Year Round
Spoonhead Sculpin	Cottus ricei	SPSC	Resident Year Round
Deepwater Sculpin	Myoxocephalus thompsonii	DESC	Resident Year Round
White Sturgeon	Acipenser transmontanus	WHST	Resident Year Round
Pallid Sturgeon	Scaphirhynchus albus	PAST	Resident Year Round
Shovelnose Sturgeon	Scaphirhynchus platyrhynchus	SHST	Resident Year Round
Paddlefish	Polyodon spathula	PADD	Resident Year Round
Shortnose Gar	Lepisosteus platostomus	SHGA	Resident Year Round
Goldeye	Hiodon alosoides	GOLD	Resident Year Round
Lake Whitefish	Coregonus clupeaformis	LAWH	Resident Year Round
Yellowstone Cutthroat Trout	Oncorhynchus clarkii bouvieri	YSCT	Resident Year Round
Westslope Cutthroat Trout	Oncorhynchus clarkii lewisi	WSCT	Resident Year Round
Rainbow Trout	Oncorhynchus mykiss	RATR	Resident Year Round
Columbia River Redband Trout	Oncorhynchus mykiss gairdneri	RERT	Resident Year Round
Pygmy Whitefish	Prosopium coulteri	PYWH	Resident Year Round
Mountain Whitefish	Prosopium williamsoni	MOWH	Resident Year Round
Bull Trout	Salvelinus confluentus	BUTR	Resident Year Round
Lake Trout	Salvelinus namaycush	LATR	Resident Year Round
Arctic Grayling	Thymallus arcticus	ARGR	Resident Year Round
Northern Pike	Esox lucius	NOPI	Resident Year Round
Lake Chub	Couesius plumbeus	LACH	Resident Year Round
Western Silvery Minnow	Hybognathus argyritis	WEMI	Resident Year Round
Brassy Minnow	Hybognathus hankinsoni	BRMI	Resident Year Round
Plains Minnow	Hybognathus placitus	PLMI	Resident Year Round
Peamouth	Mylocheilus caurinus	PEAM	Resident Year Round
Golden Shiner	Notemigonus crysoleucas	GOSH	Resident Year Round
Emerald Shiner	Notropis atherinoides	EMSH	Resident Year Round
Sand Shiner	Notropis stramineus	SASH	Resident Year Round
Northern Redbelly Dace	Phoxinus eos	NRBD	Resident Year Round
Northern Redbelly X Finescale Dace	Phoxinus eos x phoxinus neogaeus	NRDH	Resident Year Round
Fathead Minnow	Pimephales promelas	FAMI	Resident Year Round
Northern Pikeminnow	Ptychocheilus oregonensis	NOPM	Resident Year Round
Longnose Dace	Rhinichthys cataractae	LODA	Resident Year Round
Redside Shiner	Richardsonius balteatus	RESH	Resident Year Round
Creek Chub	Semotilus atromaculatus	CRCH	Resident Year Round
Sturgeon Chub	Macrhybopsis gelida	STCH	Resident Year Round
Sicklefin Chub	Macrhybopsis meeki	SICH	Resident Year Round
Pearl Dace	Margariscus margarita	PEDA	Resident Year Round
Flathead Chub	Platygobio gracilis	FLCH	Resident Year Round
River Carpsucker	Carpionodes carpio	RICA	Resident Year Round
Longnose Sucker	Catostomus catostomus	LOSU	Resident Year Round
White Sucker	Catostomus commersoni	WHSU	Resident Year Round
Largescale Sucker	Catostomus macrocheilus	LASU	Resident Year Round
Mountain Sucker	Catostomus platyrhynchus	MOSU	Resident Year Round
Blue Sucker	Cycleptus elongatus	BLSU	Resident Year Round
Smallmouth Buffalo	Ictiobus bubalus	SMBU	Resident Year Round
Bigmouth Buffalo	Ictiobus cyprinellus	BIBU	Resident Year Round
Shorthead Redhorse	Moxostoma macrolepidotum	SHRE	Resident Year Round
Channel Catfish	Ictalurus punctatus	CHCA	Resident Year Round
Stonecat	Noturus flavus	STON	Resident Year Round
Trout-perch	Percopsis omiscomaycus	TRPE	Resident Year Round
Burbot	Lota lota	BURB	Resident Year Round

Common Name	Scientific Name	CODE	DISTRIBUTION_STATUS
Burbot	Lota lota pop. 1	BURB	Resident Year Round
Brook Stickleback	Culaea inconstans	BRST	Resident Year Round
Iowa Darter	Etheostoma exile	IODA	Resident Year Round
Sauger	Sander canadensis	SAUG	Resident Year Round
Freshwater Drum	Aplodinotus grunniens	FRDR	Resident Year Round