Multiple Species Inventory and Monitoring Protocol
Region 3 Study Plan:
Implementation of the Point Count Survey Method

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Patricia N. Manley, Ph.D.
and
Kristian K. McIntyre

Sierra Nevada Research Center
Pacific Southwest Research Station
USDA Forest Service

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Introduction

The purpose of this study plan is to assist National Forests of Region 3 in implementing the Multi-species Inventory and Monitoring protocol (MSIM). This program is intended to 1) fulfill requirements of the National Forest Management Act (NFMA); 2) assess status and trends of species and associated habitat conditions at the Forest scale; 3) examine species/habitat relationships; and 3) evaluate specific population trends and community composition at the ecoregional scale.

The MSIM protocol is intended to provide a consistent approach to meet basic inventory and monitoring objectives specified in the National Forest Management Act (1976). MSIM specifies a sampling design and survey methods for the following taxonomic groups: landbirds, nocturnal birds, small mammals, medium and large carnivores, bats, terrestrial and aquatic amphibians and reptiles, plants, and habitat. As a starting point, National Forests in Region 3 were interested in implementing a portion of MSIM, namely landbird monitoring. We developed this study plan for landbirds, including recommendations for sampling design, survey methods, staffing needs, training procedures, and data management and analysis.

The point count survey method was designed to facilitate the detection of most perching birds (Passeriformes), woodpeckers (Piciformes), doves (Columbiformes), and cuckoos (Cuculiformes) in virtually any habitat type. However, detections are not limited to these 4 main avian orders. Point-count observers should expect to encounter species from other groups such as swallows, swifts, and hummingbirds (Apodiformes), pheasants, grouse, and quail (Galliformes), owls (Strigiformes), and waterfowl (Anseriformes) among others during surveys. Point counts are also effective for detecting vocal mammals and amphibians such as squirrels and frogs, respectively.

Although the MSIM protocol targets presence/absence data across a broad array of taxa, point counts will yield data on species abundance, and enable one to evaluate community composition and co-occurrence patterns, and derive species-habitat and/or community-habitat relationships. This method of data collection will also allow you to formulate specific hypotheses (either *a priori* or *a posteriori*) regarding species and/or community responses to particular land management practices, resource uses, natural or anthropogenic disturbances, vegetative structure, physiognomy, and succession, elevation and climatic gradients, to name a few.

Objectives

Region 3's objectives are to obtain basic status and change data based on species' presence/absence for a large number of the more commonly occurring species on National Forest System lands in Arizona and New Mexico. Abundance estimates are certainly of interest, as are habitat relationships models that can be developed using the monitoring data and then applied to evaluations of the effects of land management activities on populations and habitats of many landbird species.

Study Area

The Southwestern Region of the Forest Service manages over 8.1 million hectares (20 million acres) comprised of 11 National Forests in Arizona and New Mexico (Figure 1). At least 1.09 million ha (2.7 million acres) is comprised of wilderness and less than 0.2% of the area (37900 acres) is comprised of lakes. Many different ecosystem types can be found across these 11 National Forests such as Sonoran desert, high- and semi-desert, chaparral, meadow, riparian and lacustrine, and pine forests. Typical tree species that dominate the forested areas include Ponderosa pine, Douglas fir, piñon pine, Engelmann and blue spruce, aspen, oaks, and juniper. Elevations range from approximately 488 to 3963 meters in the alpine (1600 to 13000 feet). Based on a compendium of state and local bird species occurrence records, 342 species are known to occur during the spring and summer seasons on National Forest System lands in New Mexico and Arizona (Table B-1).

Methods

Sample Design

Sampling Frame

The MSIM protocol is based on the Forest Inventory and Analysis systematic grid of points, and the national protocol specifies that a minimum of 50% of the grid points be monitored. There are 3284 FIA points on National Forest System lands in Region 3, and 50% of these points equates to 1642 sample points. The FIA 100-m offset point serves as the sampling point for MSIM (for more details see Manley et al. 2004a).

For each species, the primary area of inference is the range of the species across all National Forest lands in Region 3. However, however sample size requirements for some species will be low enough relative to the size of their range that estimates will be precise enough to make inferences about population status and change at the scale of an individual National Forest. In addition, for those species with discernable habitat relationships, it will be possible to make inferences about the status and change of habitat conditions for individual species at the scale of an individual National Forest.

Sampling Frequency

The MSIM protocol recommends the use of an augmented serial alternating panel design. In short, this entails sampling 20% of the sites every year, while the remaining sites are sampled over a 5 year period. In Region 3, this equates to sampling 328 points every year, and sampling an additional 263 points once every 5 years, for a total per-year sample effort of 691 points. Two alternatives to this sampling design that represent equivalent effort are 1) sampling 1/3 of the 1642 points each year for three years for a total of 547 points sampled per year and three sample sessions within a 10 year period, or 2) sampling 20% of the full grid (n = 652 points) per year for 5 years and then repeating the sampling, thereby sampling the entire FIA grid.

Jim Baldwin and Rudy King, statisticians from PSW and RMRS, respectively, modeled statistical power for various combinations of sample points, proportion of sites occupied, and probabilities of detection (Appendix A). The objective of the analysis summarized in this paper is to assess the effect of sample size and species detectability on the sensitivity of a test comparing probability of species presence between two years sampled with the Multiple Species Inventory and Monitoring (MSIM) standard protocol. The statistical methods are similar to those described in Azuma et al. (1990), MacKenzie et al. (2002), and MacKenzie et al. (2003). In brief, their results showed that the starting proportion of points occupied appeared to have the greatest effect on statistical power to discern a change between two points in time, followed by sample size and the number of surveys per year. The proportion of points occupied is affected by the definition of the species range and suitable habitat, so there is a limited amount of control over this parameter in the analysis phase. The number of surveys per year is an important variable because it affects the precision of the estimates of probability of detection, which has a significant effect on reliability of estimates of proportion of points occupied. It is recommended that three visits be conducted at least for the first few years of the monitoring effort. The number of sample points will be a function of funding, but it is clear that the sample size should not fall below 50% of the grid.

We evaluated the adequacy of sampling 100% of the grid over a 5 year period and then repeat the sampling so each site is sampled twice over a 10 year period. We found that 65% of the bird species, representing 122 species, were estimated to be adequately detected to discern a 20% relative change in the proportion of points with detections between two points in time with 80% confidence and power. It appeared that up to 100 of the 122 species could be sampled adequately to meet these precision parameters at the Forest scale (assuming an average of 1 million acres and 166 points per National Forest). We found species adequately detected were generally representative of the range of avian orders and families breeding on National Forest System lands in Region 3. As expected, passerine species (songbirds) were adequately detected more frequently (71%) than non-passerine species (57%). The proportion of passerine bird species dropped only slightly with higher standards of precision: 67% of the species (n = 125) were adequately sampled to detect a 10% change with 80% confidence and power; 56% of the species (n = 105) were adequately sampled to detect a 20% change with 90% confidence and power. See Appendix B for a full description of the methods and results of this evaluation.

Based on the results of the sample size analysis, it is recommended that at least 50% of the grid be sampled each sample period, and that the sample periods not span more than 5 years. It is further recommended that the first year's sample consist of 500 to 600 points, so that the data can be evaluated to determine the most advantages design approach (augmented serially alternating panel design or sampling a larger number of sites over a shorter period of time). It is most likely that a larger number of sites sampled over a shorter period of time will be most advantages in terms of a more precise estimate of status and change.

Point Count Survey Method

Point Count Stations

A total of 7 point count stations are established at each sample point. Point count stations are located at the center and each vertex of a 200 m-sided hexagon around the central point (Figure 2). Multiple point count stations within each sample unit enables sampling of various site-scale habitat types and increases the probability of detecting species with large home ranges or infrequent vocalizations. Stations are set 200 m apart because most detections will be within a 100 m radius of the observer; this setting will minimizing overlap in detections, or double counting (Johnson 1995). If a point-count station falls in dangerous, extremely noisy, or otherwise unsuitable terrain (e.g., on cliffs, near loud creeks or rivers, in lakes), the station can be relocated in the nearest suitable location in a direction away from other stations, maintaining a 200 m minimum distance between stations.

Breeding Season

Birds have evolved to adjust the timing of breeding in order to maximize the number of young produced. The primary factor is food availability to feed and raise young and to supply the energy requirements of breeding adults. The breeding season varies little in the temperate zone, generally May through July, but early and late seasons do occur. Seasonal weather patterns and associated food abundance may play a role in either starting or delaying the reproductive process. Birds in warmer lower elevations may initiate nests before those occurring in cooler, perhaps snowy elevations. Timing of nest initiation also varies by latitude. Some resident species may initiate nesting prior to the arrival of migratory species. Therefore, it is advisable to be aware of typical 'safe dates' for species nesting within National Forests in your Region and plan accordingly. Both New Mexico and Arizona have compiled a State Breeding Bird Atlas which may provide information regarding timing of bird breeding. Additionally, it is useful to begin surveys at sample units at warmer lower elevations first, and schedule visitation to higher elevations as weather, vegetation, and food abundance conditions change. During pre-survey training crew-leaders should keep a note of bird nesting behavior; are birds searching for and carrying nest material? Are migratory birds arriving on site? Are males exhibiting courtship behavior? Are males singing more frequently?

Count Specifications

Point counts are generally conducted during the bird breeding season, usually May-July (see Breeding Season section above). Data collection continues as long as territories are maintained and vocalizations are frequent enough to not bias detections per visit (Ralph et al. 1993). All 7 count stations associated with a given point are surveyed on the same day. Each sample unit shall be visited 3 times during the breeding season, with at minimum of 4 days between visits. Multiple visits are prescribed for point counts to improve the precision of estimates. Surveys should not be conducted during periods of high winds (Beauford wind scale 3-4; Table 1), precipitation, or other climatic conditions that might interfere with bird detection. To minimize observer bias, each visit should be carried out by a different observer.

The observer shall begin the survey at the first station approximately 15 minutes after official sunrise and shall complete the entire array of 7 stations no later than four hours after sunrise (Ralph et al. 1993). Each count lasts 10 minutes and data should be recorded in three time intervals: the first 3 minutes, the next 2 minutes, and the final 5 minutes (see sample datasheet, Appendix C). These separate recording intervals allow for the comparison of point-count data with data from other projects using 3, 5, or 10-minute time periods. Additionally, 10-minute counts allow observers more time to identify species and to detect species that vocalize infrequently. Observers will record all bird birds seen or heard (calls and songs) as well as squirrels and amphibians that regularly vocalize. Each detection will be recorded separately within the appropriate distance band where it was first detected. Observers will be cautious to not to double-count birds at each station. All individuals detected at each count station are recorded even if they were detected at another count station during the same morning. Birds seen flying over and not landing or using the habitat within the 100-m radius will be recorded in a separate column. Observers may record the type of observation (auditory or visual) – this can be particularly useful to provide additional documentation for species that are rare or unusual occurrences. Observers are encouraged to carry tape recorders to record calls or songs that can not be identified to species in the field. Additional information to be recorded includes: the date, wind condition (Table 1), sky condition (Table 2), observer name, start time, and end time.

Although the ultimate goal is to accomplish counts at 7 stations per sample unit during 3 visits each season, setbacks such as inclement weather, bad timing, problems regarding access, changes in staffing, or loss of funding may occur which may limit sampling efforts. It is unfortunate, but not detrimental if count stations within a sample unit are missed, however, this situation can not occur in $\geq$ 20% of the sample units per season. If station counts are missing at only a few of the sample units, then the missing stations do not need to be accounted for in the statistical model. If station counts are missing at up to 20% of the sample units then a new statistical model will need to be created to extrapolate between the number of stations counted and 7 stations. If $\geq$ 20% of the sample units are missing station counts, then the probability of detection will need to be calculated for each number of station counted.

Each sample point will be surveyed three times during the breeding season. A minimum of two visits are needed to estimate species richness, probability of detection, and proportion of points occupied per year, but the third visit greatly improves the array of species detected and the precision of all associated estimates. If funding is limited, a subset of sample units may retain just 2 visits, but the selection of sample units with minimized visits must be determined *a priori* to avoid confounding visits with some factor that affects detectability.

Bird Codes

Alpha codes were developed by the USGS Patuxent Wildlife Research Center Bird Banding Laboratory. Alpha codes consist of a 4-letter combination composed from the common name of bird species (e.g., BAEA [Bald Eagle] and RWBL [Red-winged Blackbird]. Code rules exist for those common names that are hyphenated, or names in which the code by the ‘normal rule’ would be identical to another code. Alpha codes for birds can be found at http://www.pwrc.usgs.gov/bbl/manual/aspeclst.htm and a summary of code rules can be found at http://www.nmt.edu/~shipman/z/nom/bblrules.html. These bird codes are widely used and accepted for bird data nationwide. Potential problems with using bird codes include: (1) field biologists who devise individual sets of alpha codes rather than following accepted guidelines or established codes, (2) species that do not have an alpha code (e.g., game species like quail, pheasant, turkey, etc.), and (3) common names that vary between different localities or have recently changed. It is advised that all crew members review alpha codes of bird species that may occur within the region. It is also helpful to create a code-sheet with the alpha code and corresponding common name of each species. Crew members can tape the code-sheet to the back of their clipboard for easy viewing during surveys. Others find it helpful to create a column on the datasheet for observers to record the common name for species in which the code is unknown.

Habitat Survey Method

Habitat monitoring is a primary consideration and complement for avian monitoring and should be conducted simultaneously with bird data collection. Habitat monitoring will 1) strengthen habitat status and trend analyses; 2) facilitate the creation of species/habitat relationships, 3) identify habitat changes associated with changes in species and community composition; 4) improve existing habitat models; and 5) assist in predicting the probability of species occurrences for use in Forest Plan modeling.

Existing FIA phase 2 habitat protocols should be used. Specific habitat measurements not proposed in the FIA protocols can be added to cater to those measurements (such as vegetative structure, complexity, and physiognomy) generally found to be associated with bird species occurrences or to answer specific questions. Habitat monitoring should be conducted at each sample unit annually or up to every 5 years. Four subplots are established at each monitoring point. Subplots are 7.2 m (24 ft) radius circles arranged in an inverted Y shape with the first subplot centered on the point, and the other three subplots placed 36.4 m (120 ft) from the center at 120^{o}, 240^{o}, and 360^{o} azimuths (Figure 3).

A summary of habitat variables derived from field and remotely-sensed data are provided in Table 3. Field protocols are summarized first, followed by a more detailed description below. Data on species composition, vegetation structure, ground cover, and canopy cover are collected at the central monitoring point, while a simplified set of measurements are also taken at a sample of distal sampling locations (e.g., additional point count stations). FIA protocols (http://www.fia.fs.fed.us) serve as the primary habitat measurements at all terrestrial sampling locations. In addition to FIA protocols, canopy cover, ground cover, and vegetation height profiles are measured. Other data sources (i.e., weather stations, satellite imagery) are used to describe a range of environmental characteristics at the monitoring point (e.g., precipitation, aspect, slope, temperature) and at larger scales around the monitoring point (e.g., vegetation types). In this section, field data collection at the center point is described first, followed by the reduced set of measurements prescribed at the distal sampling locations, and then aquatic habitat measurements.

Center Point Methods

As per FIA, three nested, circular plots centered on the point are used to describe habitat conditions: 1 ha (2.54 ac; 56.4 m or 186 ft radius), 0.1 ha (0.25 ac; 17.6 m or 58 ft), and 0.017 ha (0.0625 ac; 7.3 m, 24ft radius) plots. For more detailed descriptions of measurement protocols, refer to the 2002 FIA field instructions manual. The perimeter of each plot is estimated based on a several taped measurements to establish the bounds of the plots.

At the center point, the following information is recorded:

- Vegetation type (Society of American Foresters or The Nature Conservancy classifications) is estimated.

- Slope angle is measured with a clinometer, recording uphill and downhill readings from plot center.

- Slope aspect is determined with compass bearing from plot center.

- Two coarse woody debris (CWD) transects are established, one along the 180º azimuth, and one perpendicular to it, either at 90º or 270º (randomly choose location of second transect). Each transect is 25 m long and runs from the center of the plot outward. It is important to establish the transect in a straight line to avoid biasing the selection of CWD pieces and to allow the remeasurement of transect lines for future change detection. Along each transect, logs touching or crossing the transect that are >3" diameter at the large end are measured: diameter at small end, diameter at large end, length to the nearest 0.5 m, and decay class (Table 11.2). For logs that are broken into portions, each separate portion is considered a single log, provided that the pieces are completely separated.

- Along each CWD transect, the vertical diversity of vegetation is described. Transects serve as point intercept lines, where at every meter, starting at 1 m, the observer records all plant species intersecting the left side of the tape at <u>any</u> height above the tape. For each plant that intersects the vertically projected point, the species and height interval of the intersect is recorded in 1 m intervals up to 10 m, and then in 5 m intervals over 10 m (i.e., each meter from 0 to 10 m, 10.1 to 15 m, 15.1 to 20.0m, 20.1 to 25.0 m, and so on). These data are used to calculate relative frequency of plant species and vertical diversity of vegetation.

- Ground cover measurements along each CWD transect are recorded (as a check for the subplot estimates). Every 5 m along the transect (at 0, 5, 10, 15, and 20 m) and for 1 m length, the percentage of the 1 m length along the left side of the tape occupied by each of 7 ground cover types are estimated: herbaceous plant, grass, shrub, tree, rock, litter, bare soil. All plants are identified to species.

- Three litter depth measurements are taken along both CWD transects at 2.4, 4.8 and 7.3 m (8, 16, and 24 ft, respectively) from plot center. Litter depth is measured by digging a small hole through the litter (can use finger) and down into the mineral soil, with care not to compress the litter around the edge of the hole. The depth of litter at the edge of the hole is measured with a pocket ruler. Litter depth is measured perpendicular to the ground surface.

- Canopy cover estimates are taken with a densiometer, with four readings being taken (one in each of the 4 cardinal directions at a point) in each of the

4 cardinal directions around the perimeter of the 0.017 ha subplots for a total of 16 measurements per plot.

- Disturbance is described within 30 m of the center point.
  - Area of each type of road (m^2) within 30 m: highways, paved roads, primary use dirt roads, secondary dirt roads.
  - Area of trails (m^2) within 30 m.
  - Additional area (m^2) of compacted soil and impermeable surfaces within 30 m.

- The distance to water within 100 m (to the nearest 5 m) and type of water are recorded from the center of the plot.
  - 1 = stream
  - 2 = lake (≥ 0.5 ha in area)
  - 3 = pond (< 0.5 ha in area)
  - 4 = bog
  - 5 = seep or spring

- The distance to nearest road or trail within 100 m (nearest 5 m) of the center of the plot and type of road are recorded.
  - 1 = primary highway (4 lanes, paved)
  - 2 = secondary highway (2 lanes, paved)
  - 3 = paved road
  - 4 = unpaved road
  - 5 = OHV trail
  - 6 = hiking trail

Within each 0.017 ha (0.0625 ac) subplot, the following information is recorded:

- An ocular estimate of percent cover of the following: litter, vegetation (including trees), rock, soil/sand (should add up to 100%).

- For each snag ≥ 12.5 cm (5 in) diameter, the species, diameter at breast height, height estimated to the nearest meter and decay class (Table 5).

- For each tree ≥ 12.5 cm (5 in) diameter, the species, diameter at breast height, and height to the nearest meter, and all decadence features (Table 6).

Within each 0.1 ha (0.25 ac) plot, the following information is recorded:

- For each tree ≥ 28 cm (11 in) in diameter, the species, diameter at breast height, height estimated to the nearest meter, and all decadence features (Table 6).

- For each snag ≥ 12.5 cm (5 in) diameter, the species, diameter at breast height, height estimated to the nearest meter and decay class (Table 5).

Within each 1 ha (2.54 ac) plot, the following information is recorded:

- For each tree ≥ 60 cm (24 in) diameter, the species, diameter at breast height (at 1.4 m or 4.5 ft as measured using a DBH tape or a Biltmore stick), and decadence (Table 6) are recorded. All decadence and damage features observed are recorded and the approximate number of each per tree.

- For each snag ≥ 30.5 cm (12 in) diameter, the species, diameter at breast height, height estimated to the nearest meter, and decay class (Table 5) are recorded. A clinometer is used to measure the height of a subset of snags or trees in each height class, with the remaining heights being estimated. Snag heights are measured as the distance from the ground straight up, parallel to the line of gravity, to the top of the tree such that the height of leaning trees is not recorded as the length of the trunk.

Habitat Measurements at Distal Point Count Stations

Habitat measurements may be taken at each of three point count stations at hexagon vertices (point count station due north (0°), southeast (120º) and southwest (240°). Collecting habitat data at the distal point count stations provides a more robust set of data for building habitat relationship models, but is not essential for monitoring habitat conditions. Habitat protocols at these distal sampling locations are simplified relative to the center point in the following manner: no heights are recorded for live trees (reduces field time significantly), and plant species along transects may be recorded to genus (allows field crew members with lesser botanical skills to collect habitat data). Detailed descriptions of sampling methods at distal locations are as follows.

- Tree heights are not recorded for any live trees, however snag heights are still recorded.

- Along each woody debris transect, the vertical diversity of vegetation is recorded to genus, not species. Thus, for each plant that intersects the vertically projected point, the plant species (if shrub or tree, "graminoid" if grass, "herbaceous" if herbaceous plant) is recorded – the height intervals of intersects are recorded in the same manner as at the center point.

- Ground cover measurements along each CWD transect are recorded (as a check for the subplot estimates) by ground cover type, as opposed to by species. The following seven ground cover types are used: herbaceous plant, grass, shrub, tree, rock, litter, bare soil. All shrubs and trees are identified to species, and other plant types are identified to species when possible.

Plant Codes

Plants codes are generally four-, five-, or six-letter codes that represent the plant species in that record and conform to the current codes for plant species. You may select to use codes already in use by the USDA National Resources and Conservation Services (NRCS) PLANTS database that can be accessed here for your New Mexico and Arizona: http://plants.usda.gov/cgi_bin/topics.cgi?earl=download.html. Or you may elect to use 6-letter acronyms in the field with a tie breaker if needed (7th letter) as is used by the New Mexico Natural Heritage Program (NMNHP). For example, *Populus deltoides ssp.*

wislizeni would be PopDelW. You can then create a relational database (or ask NMNHP for a copy of theirs) that crosswalks the 6-letter codes to codes used in the USDA PLANTS database. Check with Arizona NHP to see which method they use as well.

If for any variety of reasons an individual plant can not be keyed to the species level (e.g. wrong phenological period and plant is not flowering, plant has been grazed, plant is a seedling and too young to identify, etc.), then a hierarchical naming scheme should be employed, becoming increasingly broader in taxonomic order. For instance, if the plant can not be identified to species, then in many cases it could be identified to genus, if not to genus, then at least the family. Finally, the lifeform classification (e.g. tree, shrub, forb, etc.) could be used. Note that in the case of unknown grasses, the lifeform of GRASS need not be used because a narrower classification of Poaceae may be utilized.

If only the genus (or sometimes the family) is known, then the code given is the first five letters of the genus (or family) with only the first letter being capitalized (e.g. Aristida genus = Arist   Fabaceae family = Fabac). Species that remain unknown (and cannot be keyed to even a family) are listed as UNK (all capitals) with an accompanying lifeform (e.g. shrub, forb, etc.).

Point Count Data Analysis

Proportion of Points Occupied

Proportion of points occupied (PPO) and probability of detection (*p*) estimates will be generated using maximum likelihood estimators for all species with adequate detections (MacKenzie et al. 2002, MacKenzie et al. 2003, MacKenzie et al. 2004). All observations obtained by conducting the survey methods for MSIM are considered surveys associated with the point, and therefore are used to determine presence at the point, regardless of where they were conducted in association with the point.

Program PRESENCE developed by USGS Patuxent Wildlife Research Center and available on their website (www.mbr-pwrc.usgs.gov/software.html) can be used to generate estimates of PPO and *p* where data are collected from one sample site over several visits or are collected across several sample sites during one visit, or both. In cases where there are multiple sample sites per point and there is some advantage or importance in tracking data obtained from each site, more complex analysis can be conducted that can be useful for assessing the most efficient sampling effort per point. In such an analysis, the probability of occurrence at multiple sites per points is also estimated.

Population change between sample periods can be determined using parametric or non-parametric statistical tests, such as a paired t-test or MacNemar's test, respectively. Population trend estimates can be determined using regression techniques. Each year that trends are recalculated with an additional year of data, the slope, intercept, and confidence intervals of trend lines for the duration of the monitoring program can be adjusted.

Density Estimates

Estimates of bird density and abundance can be derived from point-count data when a distance from the observer to each detection is recorded. Distances can be recorded in 25 m intervals (0-25, 25-50, 50-75, 75-100, and > 100m). Density and abundance estimates are sensitive response measures and can be used to support detailed habitat models. If this approach is chosen, it is necessary to develop criteria (maximum confidence interval) for evaluating the accuracy of sampling. The software program DISTANCE (Thomas et al. 2002) and the accompanying text (Buckland et al. 2001) are highly recommended analysis tools for deriving density and abundance estimates from survey data.

Community Composition

Avian community composition refers to the integrated group of species inhabiting a given area and their influence on one another's responses. The occurrence or relative abundances of individual species can be assessed to provide information about the species richness, alpha and beta diversity, co-occurrence patterns, and nestedness of the community as a whole. Additionally, the proportions of species that are endemic, exotic, threatened, endangered, parasitic, population limiting, specialist, or generalist may raise questions or may indicate specific ecological conditions. Species can be assigned to guilds based on their nesting substrate/location, foraging substrate/strategy, diet, or migratory tendency to examine guild composition.

Habitat Data Analysis

Field Data

A wide variety of basic habitat variables can be derived from the field data, as listed in Table 3. These variables, along with GIS-based habitat variables, can then be used to evaluate habitat relationships of individual species or species groups using a variety of statistical techniques, such as all possible subsets regression, general additive models, or hyperniche models.

Map-based GIS Data

Physiographic features of each sample unit can be described using a variety of remotely-sensed data, with some variables being redundant of those collected in the field. The redundancy is intended to determine if remotely-sensed sources are reliable for these data, and if so, field measurements can be eliminated. Five features are described using remotely-sensed data or interpolated data: elevation, precipitation, slope, aspect, vegetation, and disturbance (Table 3). Elevation can be obtained from USGS topographic maps, DLGs (digital line graphs), or DEMs (digital elevation models). Precipitation data can be obtained from digital data compiled for your region.
A slope polygon map can be derived by interpreting topographic isoclines. The digital data for these variables represent their values as membership in value classes. Terrestrial vegetation (type and structure) and the occurrence of aquatic habitats surrounding each monitoring point can be described using existing GIS layers (interpreted satellite imagery). Vegetation type amount and distribution can be described at a variety of scales and using a variety of metrics to represent habitat conditions relevant to particular taxa. Care should be taken to ensure that the reliability of vegetation layers is quantified to the extent possible. Because error rates associated with map-based data are not typically available, available vegetation layers are primarily useful for habitat relationship models,

but not for monitoring at these small scales. Low-altitude photography has promise for providing accurate data on vegetation types and disturbance in the vicinity of monitoring points, as well as providing vegetation structure data that could relieve the need to collect some data in the field, such as tree density. Human disturbance can be represented by roads, development, impervious surfaces, land use, recreation, and other anthropogenic features within a variety of distances from the monitoring point.

Project Management

Staffing

Point Counts

There is great interest among young naturalists, ecologists, ornithologists, and wildlife biologists in participating in forest inventory and monitoring programs. Many qualified crew members can be recruited from universities and professional societies. Whether hired in-house or through a contract consultant, crew members must possess a certain level of knowledge, skill, personal stamina, fitness and enthusiasm. Below are recommendations for field crew qualifications and skills to look for when putting together a proficient monitoring team. See Appendix E for a sample position announcement and a list of proven job posting locations that appeal to up and coming biological professionals.

Typical bird crews consist of a mix of tenured (GS-7/9 level) and less experienced (GS 3/4/5 level) field biologists. All field crew members must already know the majority of bird species by sight and sound based on previous experience. It is not possible to teach individuals all bird songs and calls within a reasonable training period prior to data collection. The field crew leader should have at least two years of professional avian survey experience in the Western United States. Crew leaders should have the maturity and responsibility for hiring, training, and supervising all crew members, scheduling surveys, promoting safety, and ensuring data quality and organization, as well as conducting point count surveys. When screening applicants, note all birding experience whether professional, volunteer, or hobby. It is not necessary for crew-member applicants to know all species of birds that occur within the sampling area as seasoned or well-trained birders learn new species quickly. Inexperienced applicants should be able to learn bird songs quickly, work independently without constant supervision, and should exhibit noticeable motivation, enthusiasm, and stamina. All crew members should be physically fit and should be able to hike or backpack long-distances. Each member should have good or corrected vision and must have good hearing for visual and aural bird identification, respectively. If allowable (perhaps applicable for contract-work only), each member should be able to pass a vision and hearing test.

Crew size is dependent on the number of points that will be sampled during the season. The following staffing levels assume Region 3 plans to sample approximately 600 points per year. It will require a field crew of at least 30 members to sample 150 points within a typical work week (1 sample unit per day X 5 workdays X 30 observers). Therefore a maximum of 600 sample units can be sampled within a full month (150 sample units per week X 4 weeks). Because 3 visits are required per sample unit, it will take 3 full months to complete visits at all 600 sites.

The crew size recommendations above should be considered the minimum. With a large field crew, it is expected that one or more members may become ill, be hurt and unable to work outdoors, or may leave the project early. Also, not all surveys will be completed on time because of inclement weather, work holidays, observer illness, navigation problems, and other unforeseen factors. Therefore, it is highly recommended that at least 2 to 3 extra crew members be assigned to the project or on call if needed.

For large field crews (> 10 members) it is advisable to hire multiple crew leaders. Crew leaders should be responsible for no more than 8-10 crew members. Crew leaders should work together to procure all necessary equipment, preside over safety meetings, coordinate training for crew members, and prepare sampling schedules.

Habitat Measurements

Habitat measurements at the center monitoring point are most efficiently collected by persons with 1) a working knowledge of the flora and plant community types of the area; 2) at least two years of experience collecting field botanical data; 3) the ability to identify plant species in the field; and 4) proficiency in using plant identification keys for the area. Ideally, at least one person has expertise in graminoids and grass-like plants to assist in the identification of some of these more difficulty to identify taxa (e.g., species in the genus *Carex*). Lead botanists should qualify for the GS-7/9 level because of their varied responsibilities for effectively training and supervising field crews, setting and enforcing strict data quality and penmanship standards, maintaining equipment in good working order, setting an example of safe/efficient field working habits, and identifying questions/concerns from crew members that need to be addressed by the program supervisor. Field crew leaders are also responsible for quality data collection, field checks and maintaining a reference collection of plants for the area (the area to be determined in Regional Plan and coordinated across all field crews in the area). An ideal field crew leader possesses good communication skills, the ability to perform monotonous tasks, a positive attitude, strict habits for attention to detail, knowledge of specimen collection and preservation techniques, and experience working in remote areas.

Because sampling at distal points is less rigorous in regards to botanical skills needed to complete the tasks, it is possible and perhaps advisable to have the same individuals that conducted bird surveys collect habitat data at these sites. The advantages of this approach are many: 1) these individuals already know the location of the sampling sites; 2) in some cases habitat data collection can be accomplished after point-count surveys are completed, economizing on site visits throughout the field season; 3) and the work period for seasonal employees covers a longer period of time (making the position more attractive to some individuals). Or, you may prefer to hire a separate habitat crew that works with the botany crew during the point count survey period. In either of these two scenarios, a habitat crew of 2 individuals could collect measurements at the three point count stations around three to five monitoring points per week, on average.

Recruitment strategies for knowledgeable botanists and habitat crew members are similar to locating experienced bird surveyors mentioned previously. Appendix E includes a sample position announcement and a list of proven job posting locations that are frequented by coming biological professionals.

Scheduling

A large scheduling board (such as a dry-erase board) is useful for scheduling observers to particular sample units and tracking survey progress and visitation. Begin by scheduling sites that are located at the lowest elevations first then progress to those at higher elevations. Sample units shall be visited by different observers for each of the 3 point count surveys. Habitat data collection should not be collected at the same point and at the same time that bird surveys are being conducted. If scheduled for the same day, habitat surveys may begin once point-counters completed their survey at that site.

Equipment

Point Counts

Each avian crew member must possess their own pair of good-quality binoculars and must use them during every count. A binocular with a moderate to high magnification and large diameter such as an 8x42, 10x42, or 10x50 is recommended. The 10x42 and the 10x50 will have a smaller field-of-view than the 8x42, but greater magnification. The lower the magnification (first number), the less you will be able to identify small species at a distance. The smaller the diameter (second number), the less amount of light is allowed enter the binocular. Full-sized binoculars like those mentioned above, offer great light gathering ability and optical performance. Compact binoculars, although lightweight, allow less light gathering ability and may be difficult to use during the early dawn hours when bird sampling is conducted. Waterproof and/or fog-proof binoculars are ideal. Monoculars are not recommended. Other standard equipment needs: clipboard, field guide to birds, bird recordings, blank recording tapes, tape recorder/player, stopwatch, blank datasheets, pencils (several), notebook, maps, compass, GPS, extra batteries, first-aid kit, radio or cell phone.

Habitat

Standard equipment needs for habitat measurements generally include: clipboard, dichotomous keys, field guides, and species lists to regional flora, retractable measuring tapes (50 m to 100 m), densiometers, DBH (diameter at breast height) tapes, clinometers, blank datasheets, pencils (several), notebook, maps, compass, GPS, extra batteries, first-aid kit, radio or cell phone, large zip-lock plastic bags for collecting unknowns, hand-lenses, plant presses including newspaper and cardboard, access to dissecting microscopes with illuminator and associated tools, and a plant code book with cross-reference to alternative species names and codes.

Bird Identification Training

Observer variability exists in any avian sampling or monitoring program, therefore it is critical to recognize and minimize observer differences prior to data collection. An observer's ability to correctly identify species either aurally or visually can be related to the amount of experience of the individual, and to physical (visual and aural perception) and physiological (motivation, alertness) characteristics as well. Consequently, it is necessary to calibrate and train observers to achieve an adequate degree of comparability.

An intensive 2 to 3 week training period consisting of both indoor and outdoor field exercises is usually sufficient to prepare field crews for avian surveys and data collection. Field training exercises are best conducted from dawn until noon when birds are most active, leaving the afternoons for indoor exercises. Training in the field should be led by an experienced observer who initially points out, identifies, and facilitates discussion on body, flight, and song characteristics and potential identification challenges of various bird species. At first, focus on common species then gradually add more and more species during the training period, while reviewing species already identified. All crew members should have current field guides and a complete list of birds they may encounter within the study area. Keep an eye out for squirrels and frogs in the area and pay attention to their calls. Each crew member should also keep a field notebook in which to jot down bird identification tips, habitat associations, song mnemonics, and sketches. Each crew leader should be aware of and note the arrival time of migrants and bird breeding behaviors such as gathering and carrying nest material, courtship behavior, and increased song frequency.

Once crew members have demonstrated their ability to identify the majority of species (2 to 3 days), a portion of the field training each day should be set aside for practice bird surveys. Small groups of crew members led by an experienced observer should congregate at one point and conduct bird surveys according to the finalized protocol. Members then compare and discuss their list of detections with each other and with the experienced leader. With this approach, observers can realize which species are difficult for them and the crew leader will know where to direct emphasis for training. These trial surveys should continue throughout the training period.

Each observer will need to be trained in distance estimation because the number of individuals of each species is recorded according to their distance from the observer. Distance estimates do not require any additional time during data collection for a trained observer. As a training exercise, measure and flag various radial distances (10, 25, 50, 75, 100, and 125 m, for instance) from practice points and have observers estimate distances of birds during repeated practice point counts. Try this at several different points, especially in areas with different terrain and slope, as one's perspective of distance can be altered by these factors. An accurate range-finder can also be used during distance training.

Afternoons are ideal for observers to review and discuss protocols, learn standard bird codes, and sharpen aural and visual identification skills using recorded bird songs on tapes, CDs, birding software, and/or the internet. Many commercial bird song recordings exist and are readily available. Two of the better known and widely used CD series are the Stokes Field Guide to Bird Songs and the Peterson Field Guide to Bird Songs; both are available for Western and Eastern North America. Birding software is also readily available and proves to be a useful tool for training observers through their use of visual, aural, and narrative format. Some programs, such as Thayer's Birds of North America, allow the user to create a unique list of birds in order to quiz the user to identify those species by their songs or visual cues. Other programs are catered to provide bird songs and other information by state or physiographic province. The internet also has many web pages that provide birding quizzes, bird songs, and other pertinent information. Additionally, many sounds and calls of common squirrels and frogs are available on tape, CD, software, and the internet. Encourage crew members to work together or with an experienced birder.

If a university with a museum bird collection is nearby, schedule a training session with the curator to examine bird skins of species that occur within the region. There, birds that are somewhat similar in appearance can be placed side by side to enable the examination of minute but detectable differences in physical features to aid in identification. Discuss how certain features appear in close proximity compared to when viewed at a distance.

Afternoons are also a productive time for instructing crew members on safety, conduct, and vehicle procedures, first aid, and navigation using maps, compasses and GPS units. Whether staffing occurs in-house or through a work contract, it is of utmost importance to ensure that all crew leaders and members are well-trained and understand the significance of their contribution to this exciting work.

Habitat Measurement Training

Botanists and habitat crew members should be trained in all aspects of the habitat protocol: establishing transects, obtaining measurements, identifying plants, using and maintaining equipment, and recording data. Training can consist of a variety of indoor and field exercises to familiarize the field crew with field methods and plant identification. For instance, you may want to plan one or more visits to examine University or regional herbarium collections to study the variability of defining characteristics of plant species in the area. Schedule field trips with local plant experts to various locations to identify plants in the field (may need to schedule these at a couple of points in the field season as new plant species emerge. Conduct several practice surveys with the entire field crew together and with one-on-one training of crew member by crew leaders. Target geographic areas with representatives of the species occurring on the forest and a variety of aquatic habitat types so crew members gain experience with the variety of conditions and sites encountered in the field. Each crew member should keep a field notebook in which to jot down plant identification tips, habitat associations, protocol notes, and sketches. Whether staffing occurs in-house or through a work contract, it is of utmost importance to ensure that all crew leaders and members are enthusiastic, well-trained, and appreciate the significance of their contribution to this exciting work.

Safety Training

For the most part, bird surveyors work alone so each should carry a reliable radio and/or cell phone, a compass, a GPS unit, and appropriate maps. All crew members must be thoroughly trained and must be able to demonstrate proficiency with each item and must know who to contact should an emergency arise. An experienced crew member or outside expert can provide 2-3 hour afternoon training sessions. The crew-leader is responsible for knowing and tracking the whereabouts of each crew member at all times during each work day. A daily sign-in/sign-out board is highly recommended.

A job-hazard analysis (JHA) should be prepared, thoroughly discussed, and signed by all crew personnel before initiating any field work. All hazards that may be expected to occur in the field should be addressed. Hazards may include and are not limited to snakes, mountain lions, bears, spiders, bees, mosquitoes, and other biting insects, diseases such as Lyme disease, plague, West Nile Virus, hazardous dumped chemicals, unstable slopes, cacti and other spiny vegetation, hypothermia, heat stroke, sunburn, and dehydration. A sample JHA is provided in Appendix F and serves as a template to assess hazards that may occur in your Region.

Most monitoring points are not located on or near roads or trails, so access to a sample unit may require a variable amount of driving and hiking time, occasionally exceeding several hours. Each observer should be trained in navigation techniques using topographic maps, compass, and GPS unit. Each observer should also carry a list of UTM coordinates for each sample unit and should also have these coordinates saved into a GPS unit as waypoints. GPS units may fail or satellites may not be in a workable position, therefore each observer should carry a topographic map of the study area and a good-quality navigation-style compass. Site locations may be penciled in on each topographic map to ease navigation to the site.

Each crew member should be trained in basic first-aid (one afternoon) and should carry basic first-aid supplies when conducting field work. Crew members should also wear or carry appropriate field wear: good quality hiking boots, long pants, long-sleeved shirt, and hat. Other important safety items to include in each pack are sunscreen, insect repellant, extra socks, sunglasses, extra food such as energy bars, and plenty of water.

Management Quality Objectives

Point Count Survey Quality

The potential to bias estimators is inherent in any bird surveying methodology therefore all crew members should learn how to recognize sources of bias and how to minimize it (Bibby et al. 2000). However, some sources of bias are out of our control such as the volume or intensity of species' songs, which affects detection probabilities. Other sources of bias can be controlled for such as ensuring observers are proficient in bird identification, limiting the times surveys are to be conducted, halting surveys during periods of inclement weather, moving away from sources of noise, wearing muted colored clothing. Potential sources of bias should be discussed thoroughly during pre-survey training sessions and throughout the season. Observers should feel comfortable knowing when survey conditions are adequate versus knowing when to suspend the survey should conditions (such as weather) deteriorate. This is why recording weather conditions and sources of noise are important during each survey. Bibby et al. (2002) provides a detailed overview of potential sources of bias in the chapter titled Census Errors.

It is imperative that all observers are trained and tested thoroughly prior to data collection to achieve similar levels of proficiency in bird identification, as described in the training section. Frequent (every 2-3 weeks) trial point count surveys throughout the survey season led by a crew leader or supervisor will ensure that observers are consistent and up to speed. The leader should be aware of the techniques used by crew members to detect birds. For instance, are observers quiet and attentive? Are observers turning their heads and/or bodies to listen for birds in all directions? Are observers utilizing their eyes to scan up and down trees and vegetation, on the ground, and in the sky? Are observers using their binoculars? Can observers determine which direction certain sounds are coming from? Are observers double counting birds? Are observers proficient with distance estimation? Is the data legible? Each crew member should be made aware of each of these simple techniques for conducting surveys and how they perform. Following these trial surveys, discussions should be initiated to address sources of bias of estimators that may occur both by observer and in the field, identification problems, protocol issues and questions, safety, and data collection and management.

Habitat Measurement Quality

Sources of error in detecting plant species include: timing of surveys, vigilance of observer, plant identification skill of observer, accurate location of transects, and site disturbance by field personnel. Observer vigilance and identification skills are a function of training and motivation (see training section), so frequent field checks of observer performance is recommended. This way, field supervisors will be able to identify problems in data collection and can correct them in a timely manner.

Not all plants within the center plot may be readily identifiable in the field to the species level because of growth stage, missing plant parts, and animal and human disturbance. In this case, the most complete specimen available nearby should be collected, including as the roots, stem, leaves, fruit, seeds, or cones and placed into a plastic bag for later identification. Voucher specimens for each species identified in the region should be collected for verification and preserved according to traditional herbarium standards and stored in a climate controlled environment.

Data Management Quality

All bird and habitat data should be collected on approved datasheets and kept in a sturdy closeable metal clipboard. It is not advised to write and accumulate point-count data in a small notebook as a notebook can be lost or destroyed, and thus so is the entire effort recorded within. Small errors in data collection can have a significant impact overall. A good data-quality control plan begins with each observer checking his/her own datasheets first to make sure all bird codes, site names, dates, and times are correct and consistent, and all required information is filled in. The crew leader is then responsible for going over each datasheet, addressing problems or questionable codes to the observer, making sure corrections are made and the data is legible, signing off on the data, and filing the data accordingly. Data should be entered into a relational database as soon as time allows. Data should then be checked for entry errors and multiple back-up copies should be made.

Optional Data Contributions

In addition to basic data handling and storage procedures, point-count data may be contributed to the USGS bird point count database (http://www.mp2-pwrc.usgs.gov/point/Help/Index.cfm 2154). The Patuxent Wildlife Research Center (PWRC) and American Bird Conservancy (ABC) have worked together to build a repository for point-count data. The web-based Bird Point-Count Database can be accessed and used by anyone with point-count data from North America. The goal of the database is to: 1) provide easy data entry and access to everyone over the web; 2) accommodate count data from multiple sources, allowing for small differences in protocols such as counts from different times of year and counts using different time intervals (3 vs. 5 minutes, for example) or radii; 3) store vegetation information associated with points, and 4) enforce data quality control through validation routines and through distributed responsibility.

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Table 1. Beaufort wind scale numbers and descriptions for weather data collection.

Beaufort Code	Wind speed (mph)	Indication
0	<1	Smoke rises vertically
1	1-3	Wind direction shown by smoke drift
2	4-7	Wind felt on face, leaves rustle
3	8-12	Leaves, small twigs in constant motion, light flag extended
4	13-18	Raises dust and loose paper, small branches move
5	19-24	Small trees in leaf sway

Table 2. Sky condition codes for weather data collection.

Sky Condition Codes	Indication
0	Clear sky - few clouds (< 25% cloud cover)
1	Partly cloudy (scattered) or variable sky (25-70%)
2	Cloudy (broken) or overcast (70-100%)
3	Rain
4	Fog or smoke
5	Snow

Table 3. Habitat variables described for sample units (center point and distal point count stations).

Environmental variable	Metric	Source	Center monitoring point	Point count stations (outer)
Abiotic environment:				
Elevation	M	GIS	X	X
Precipitation	Cm	GIS	X	
Slope	Percent	Field	X	X
Aspect	Azimuth	Field	X	X
Distance to water within 100 m	M	Field	X	X
UTM coordinates		Field	X	X
Vegetation:				
Tree density by size class	Stems/ha	Field	X	X
Tree decadence	Frequency by type	Field	X	X
Canopy cover	Percent	Field	X	X
Ground cover by type	Percent per type	Field	X	X
Litter depth	M	Field	X	X
Log density	M/ha	Field	X	X
Snag density	Stems/ha	Field	X	X
Vertical vegetation profile		Field	X	X
Tree diameter	Average dbh and ba	Field	X	X
Plant species composition	Species/genera list	Field	X	
Plant species richness			X	
Proportion of sites occupied by each plant species	%	Field	X	
Cover of each plant species	%	Field	X	X
Occurrence of veg by ht interval	Freq. of occurrence	Field	X	X
Vegetation type (each)	Propotion of area within 100, 300, and 1000 m	GIS	X	X
Human disturbance:				
Distance to nearest road	FLD and GIS		X	X
Road and trail area within 30 m	Proportion of area		X	X
Disturbance index within 100, 500, 1000 m (all sites)	weighted index of roads, trails and development	GIS	X	
Fragmentation index	index of development, patch size, and isolation	GIS	X	

Table 4. Decay classes for and logs.

Decay class	Structural integrity	Texture of rotton portions	Color of wood	Invading roots	Branches and twigs
1	Sound, freshly fallen, intact logs	Intact, no rot; conks of stem decay absent	Original color	Absent	If branches are present, fine twigs are still attached and have tight bark
2	Sound	Mostly intact; sapwood partly soft (starting to decay) but can't be pulled apart by hand	Original color	Absent	If branches are present, many fine twigs are gone and remaining fine twigs have peeling bark
3	Heartwood sound; piece supports its own weight	Hard, large pieces; sapwood can be pulled apart by hand or sapwood absent	Reddish-brown or original color	Sapwood only	Branch stubs will not pull out
4	Heartwood rotten; piece does not support its own weight, but maintains its shape	Soft, small blocky pieces; a metal pin can be pushed into heartwood	Reddish or light brown	Through-out	Branch stubs pull out
5	None, piece no longer maintains its shape, it spreads out on ground	Soft; powdery when dry	Red-brown to dark brown	Through-out	Branch stubs and pitch pockets have usually rotted down

Table 5. Decay classes for and snags.

Decay class	Limbs and branches	Top	% Bark remaining	Sapwood presence and condition	Heartwood condition
1	All present	Pointed	100	Intact; sound, incipient decay, hard, original color	Sound, hard, original color
2	Few limbs, no fine branches	May be broken	Variable	Sloughing; advanced decay, fibrous, firm to soft, light brown	Sound at base, incipient decay in outer edge of upper bole, hard, light to reddish brown
3	Limb stubs only	Broken	Variable	Sloughing; fibrous, soft, light to reddish brown	Incipient decay at base, advanced decay throughout upper bole, fibrous, hard to firm, reddish brown
4	Few or no stubs	Broken	Variable	Sloughing; cubical, soft, reddish to dark brown	Advanced decay at base, sloughing from upper bole, fibrous to cubical, soft, dark reddish brown
5	None	Broken	< 20	Gone	Sloughing, cubical, soft, dark brown, OR fibrous, very soft, dark reddish brown, encased in hardened shell

Table 6. Decadence codes for live trees.

Decadence code	Decadence feature
1	Conks
2	Cavities greater than 6 inches in diameter
3	Broken top
4	Large (> 12 inches in diameter) broken limb
5	Loose bark (sloughing)

Figure 1. Locations of 11 National Forests in Region 3 (Arizona and New Mexico).

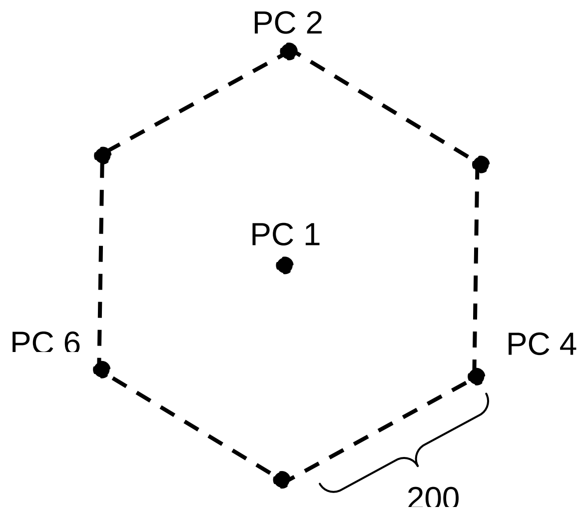

Figure 2. Point count station array for the multiple species monitoring protocol.

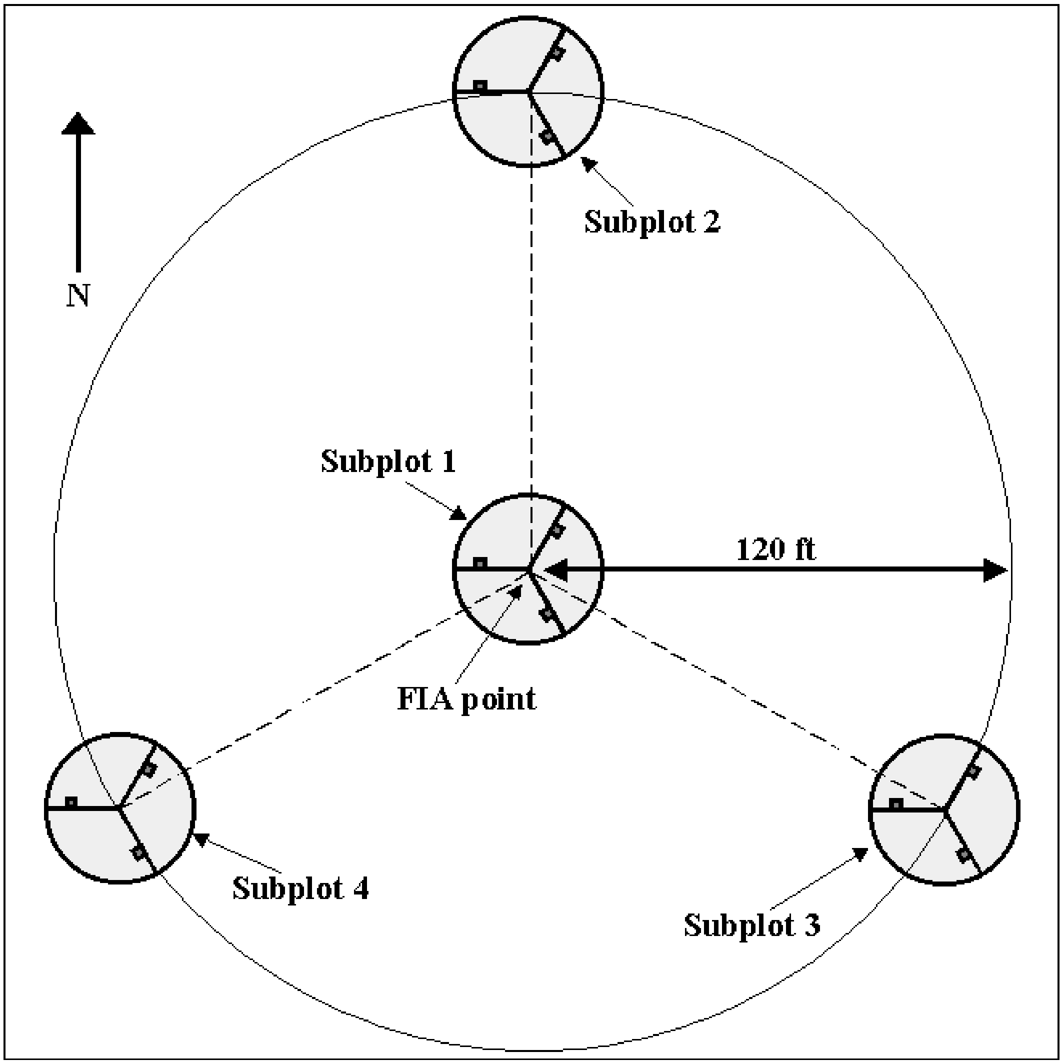

Figure 3. Layout of subplots at a monitoring point (from FIA manual).

Appendix A:

Effect of Sample Size and Detectability on MSIM Change Detection Analysis

by
Jim Baldwin and Rudy King

October 2004

Introduction

The objective of the analysis summarized in this paper is to assess the effect of sample size and species detectability on the sensitivity of a test comparing probability of species presence between two years sampled with the Multiple Species Inventory and Monitoring (MSIM) standard protocol. The statistical methods are similar to those described in Azuma *et al.* (1990), Max *et al.* (1995), MacKenzie *et al.* (2002), and MacKenzie *et al.* (2003).

Description of population

Suppose we have a collection of sites surveyed in one or both of two years with a probability of presence being P_1 in Year 1 and P_2 in Year 2. Further, to make the modeling more realistic suppose that there is some persistence in status at an individual site from one year to the next. We have the probability of a site having presence in Year 2 given that there was presence in Year 1 as M_{11} and the probability of a site having absence in Year 2 given absence in Year 1 as M_{00}. We can therefore set $P_2 = P_1 M_{11} + (1 - P_1)(1 - M_{00})$. (Note that if site status was independent from year to year, then $M_{11} = P_2$ and $M_{00} = 1 - P_2$.)

Description of sampling

Suppose we have *m* randomly selected sites surveyed in Year 1 but not Year 2, another *m* sites surveyed in Year 2 but not Year 1, and *n* sites surveyed in both Year 1 and Year 2. For site *i* suppose there are s_{ij} visits in year *j*. This structure is consistent with a rotating panel design with a fixed panel measured every year.

Because presence is not always observed even when a site has presence, let p_j be the detection probability for observing presence during a single visit to a site with presence (*i.e.,* the detection probability) during Year *j*. (In other words, we allow different detection probabilities in different years.) During a single year we assume a common and constant detection probability.

Description of measurements

For each set of surveys at a single site within a single year, the observed status of each survey presence is recorded: $y_{ijk} = 1$ if presence was observed during visit *k* to site *i* in year *j* and

$y_{ijk} = 0$ otherwise. A handy summary statistic will be the total number of surveys with presence for site *i* in year *j*: $x_{ij} = \sum_{k=1}^{s_{ij}} y_{ijk}$.

Estimating the parameters

Here we give the details for the estimation process. In summary the estimates for the parameters are chosen that maximize the likelihood function (*i.e.*, the method of maximum likelihood, Pawitan, 2001). For a particular site the likelihood of observing x_1 visits with presence in Year 1 and x_2 visits with presence in Year 2 for s_1 and s_2 total visits, respectively, in each year is given by the following:

$$
\begin{aligned}
f(x_1, x_2 \mid s_1, s_2) &= 1 - P_1 + P_1(1-p_1)^{s_1} && \text{if } s_1 > 0, s_2 = 0, x_1 = 0, x_2 = 0 \\
&= 1 - P_2 + P_2(1-p_2)^{s_2} && \text{if } s_1 = 0, s_2 > 0, x_1 = 0, x_2 = 0 \\
&= P_1 \binom{s_1}{x_1} p_1^{x_1}(1-p_1)^{s_1-x_1} && \text{if } s_1 > 0, s_2 = 0, x_1 > 0, x_2 = 0 \\
&= P_2 \binom{s_2}{x_2} p_2^{x_2}(1-p_2)^{s_2-x_2} && \text{if } s_1 = 0, s_2 > 0, x_1 = 0, x_2 > 0 \\
&= P_1 M_{11} \binom{s_1}{x_1} p_1^{x_1}(1-p_1)^{s_1-x_1} \binom{s_2}{x_2} p_2^{x_2}(1-p_2)^{s_2-x_2} && \text{if } s_1 > 0, s_2 > 0, x_1 > 0, x_2 > 0 \\
&= \left((1-P_1)(1-M_{00}) + P_1 M_{11}(1-p_1)^{s_1}\right) \binom{s_2}{x_2} p_2^{x_2}(1-p_2)^{s_2-x_2} && \text{if } s_1 > 0, s_2 > 0, x_1 = 0, x_2 > 0 \\
&= P_1\left(1 - M_{11} + M_{11}(1-p_2)^{s_2}\right) \binom{s_{i1}}{x_{i1}} p_1^{x_1}(1-p_1)^{s_1-x_1} && \text{if } s_1 > 0, s_2 > 0, x_1 > 0, x_2 = 0 \\
&= (1-P_1)\left(M_{00} + (1-M_{00})(1-p_2)^{s_2}\right) + \\
&\quad\; P_1\left(1 - M_{11} + M_{11}(1-p_2)^{s_2}\right)(1-p_1)^{s_1} && \text{if } s_1 > 0, s_2 > 0, x_1 = 0, x_2 = 0
\end{aligned}
$$

The likelihood function for all sites combined is the product

$$L = \prod_i f(x_{i1}, x_{i2} \mid s_{i1}, s_{i2})$$

The estimates of P_1, M_{11}, M_{00}, p_1, and p_2 are found by choosing the values $\hat{P}_1$, $\hat{M}_{11}$, $\hat{M}_{00}$, $\hat{p}_1$, and $\hat{p}_2$ that maximize *L* or, equivalently, $\log L$.

Simulation analysis

Change detection in Year 2 from three values of P_1, P_1 = 0.75, 0.5, and 0.25, was simulated to represent a range of species prevalence. Four combinations of *n* and *m* were simulated. *n* = 328 and m = 263 represents a full 5-year rotating panel design including 50 percent of the R3 FIA points (3284/2 = 1642). Twenty percent of these points (n = 328) are resampled each year, and 20 percent of the remaining points (m = 263) are sampled in one of five years. n = 164 and m = 132 is a 50 percent reduction in the full design and would apply to a species whose range encompassed half the Region. n = 82, m = 66 and n = 41, m = 33 were included to represent species whose ranges encompassed 25 percent and 12.5 percent of the Region, respectively.

The number of visits per site was set to either 2 or 3. Detection probbilities were set to either 0.5, 0.3, or 0.2 to represent different species and/or sampling conditions.

Statistical power is the probability of rejecting the null hypothesis when it is false. In this analysis, the null hypothesis is that $P_1 = P_2$, or that prevalence for a species or community is unchanged between Year 1 and Year 2. The stated goal of the MSIM design is to detect a 20 percent change in P_1 with an 80 percent probability (= $1 - \beta$, or $\beta = 0.2$) with a Type I error or 20 percent ($\alpha = 0.2$). Type I error (α) is the probability of rejecting the null hypothesis when it is true. Type II error (β) is the probability of not rejecting the null hypothesis when it is false. Power = $1 - \beta$, and a typical planning goal is to attain Power = 80 percent or higher.

For each combination of parameter values, 1,000 simulated populations were generated and the maximum likelihood estimates found using the SAS NLMIXED procedure.

Results

Simulated power for P_1 = 0.75 and detectability of $p_1 = p_2 = 0.50$ in both years is displayed in Figure A-1 for different combinations of sample size and number of visits. For three visits in both years, the full design (n = 328, m = 263) and half design (n = 164, m = 132) are capable of detecting a difference of 0.1 with 80 percent power. The quarter design (n = 82, m = 66) is capable of detecting a difference of 0.15 with 80 percent power, and the one-eighth design (n = 41, m = 33) a difference of 0.2. 20 percent of P_1 = 0.75 is 0.15, so all but the smallest design are capable of meeting the MSIM objective when three visits are made to each site. Power decreases somewhat if the number of visits is reduced, especially for smaller sample sizes. The full and half designs could still detect a difference of 0.1 with 80 percent power when visits are reduced to 2 in each year, but the detectable difference increased to 0.2 and 0.3, respectively, for the quarter and one-eighth designs. Both of these detectable differences are larger than the MSIM objective.

An unusual attribute of the power curves in Figure A-1 is the decrease in power apparent for large differences (or, small values of P_2). This anomaly is inherent in the analysis model when $P_i\left(1 - p_i^{s_i}\right)$ becomes small (close to zero) for either year. The problem is minor for the full design but becomes more serious for small sample sizes, which have difficulty producing a reliable estimate of low prevalence.

Simulated power for P_1 = 0.50 and 0.25, and detectability of 0.50 in both years, is displayed in Figures A-2 and A-3, respectively. For P_1 = 0.50, the MISM 20 percent objective is to detect a change of 0.10. The full design falls meets the 80 percent power objective even for only 2 visits in both years. However, the half design attains 80 percent power to detect only 0.15 when the number of visits is 2 for either year. The smaller designs do not attain the MSIM objective even for 3 visits in both years.

For P_1 = 0.25, the MISM 20 percent objective is to detect a change of 0.05. Only the full design attains the 80 percent power objective, requiring 3 visits in both years to do so.

The effect of reduced detectability is displayed in Figures A-4 to A-6 for P_1 = 0.75, 0.5, and 0.25, respectively. The number of visits was held constant at 2 per point. It is apparent that the power of the change detection analysis drops quickly if detectability is reduced, even for the full design.

Discussion

The ability to meet the MSIM objective of detecting a 20 percent change from initial conditions depends strongly on the initial proportion of sites with presence. Characterizing the change of interest as a relative change from the initial proportion of sites with presence is many times used to simplify objectives. It should be noted that selecting a common percent change might not always be the approach to equalize the consequences of a change. For example, consider a 50% decrease from 80% to 40% and a similar 50% decrease from 10% to 5%. The former might have far more serious consequences. The point being made is that both the relative change and the initial starting point are needed for assessment of a monitoring program.

Alternatively, giving the initial starting point and the absolute change in proportion would also give the same complete picture. In our description of the probabilities to meet MSIM objectives we chose to set the initial condition (P_1) and give (along the horizontal axes of the figures) the absolute change in proportion from that initial condition rather than the relative change.

One can observe from the figures that (especially with small sample sizes) as the ending proportion approaches zero (which corresponds to the largest amount of change), sometimes the power decreases. This is due to the inability of the proposed methods to differentiate between low detection probabilities and low proportions of presence when the number of observed sites with presence is low. Obtaining good estimates of detectability *and* proportions of presence is problematic with few observations of presence.

In summary, species with low detection probabilities or low proportions of presence will unlikely meet the MSIM objectives unless detection probabilities are increased or the number of visits is increased. We hope that the figures can be used to get a realistic threshold as to what combinations of presence proportions and detection probabilities can realistically be expected to achieve the desired objectives.

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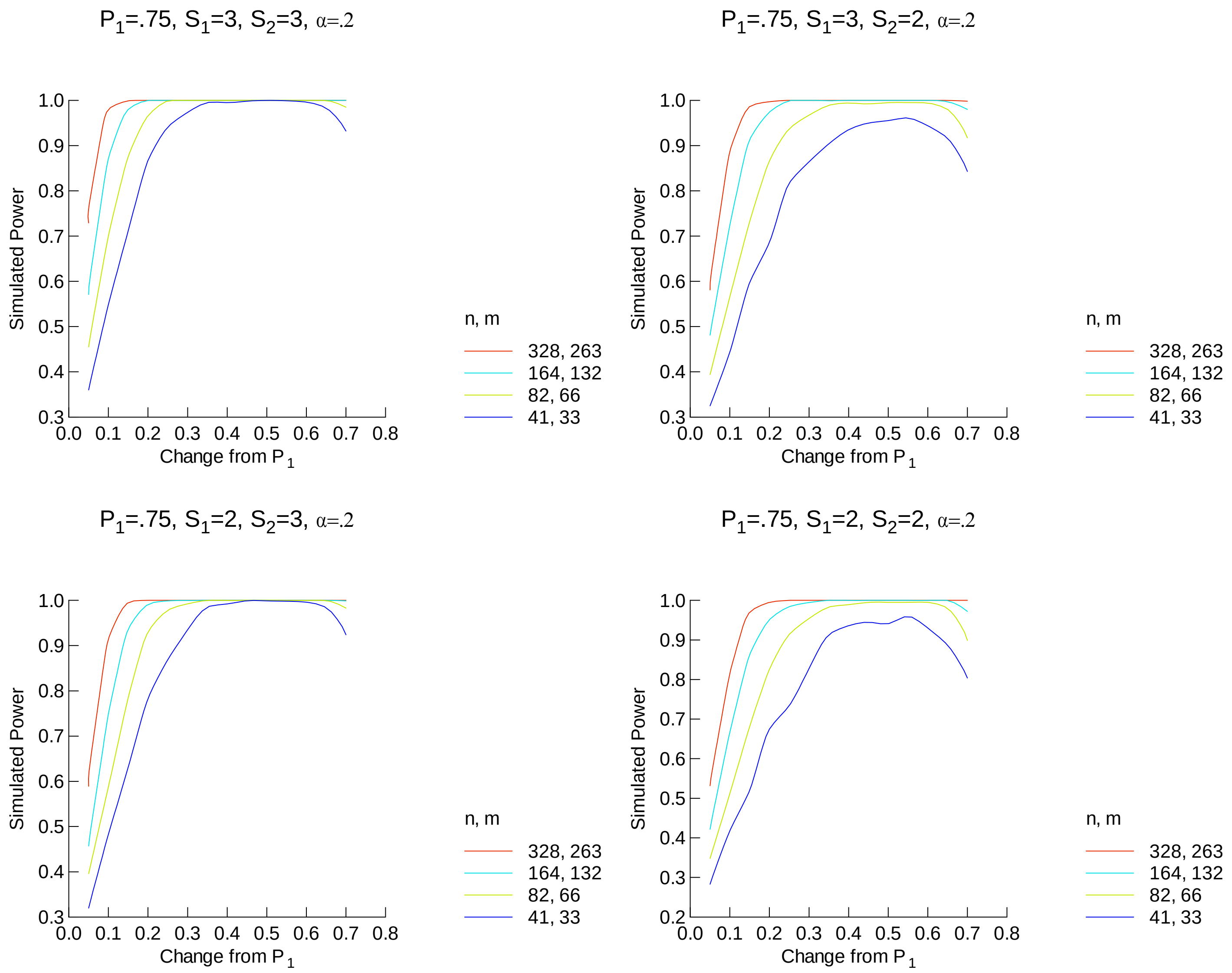

Figure A-1. Simulated power of detecting change from $P_1 = 0.75$. Detection probability is set at $p_1 = p_2 = 0.5$.

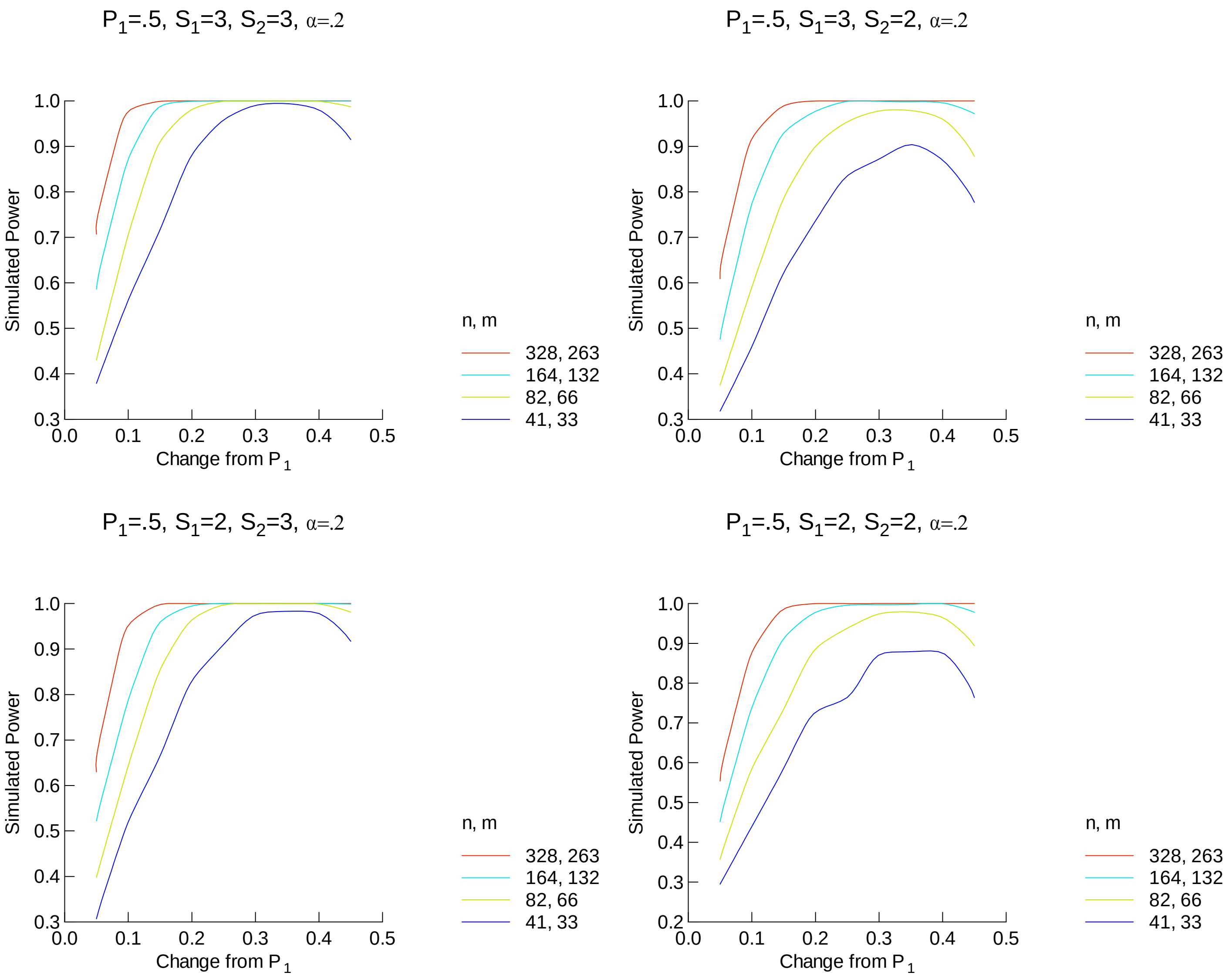

Figure A-2. Simulated power of detecting change from $P_1 = 0.5$. Detection probability is set at $p_1 = p_2 = 0.5$.

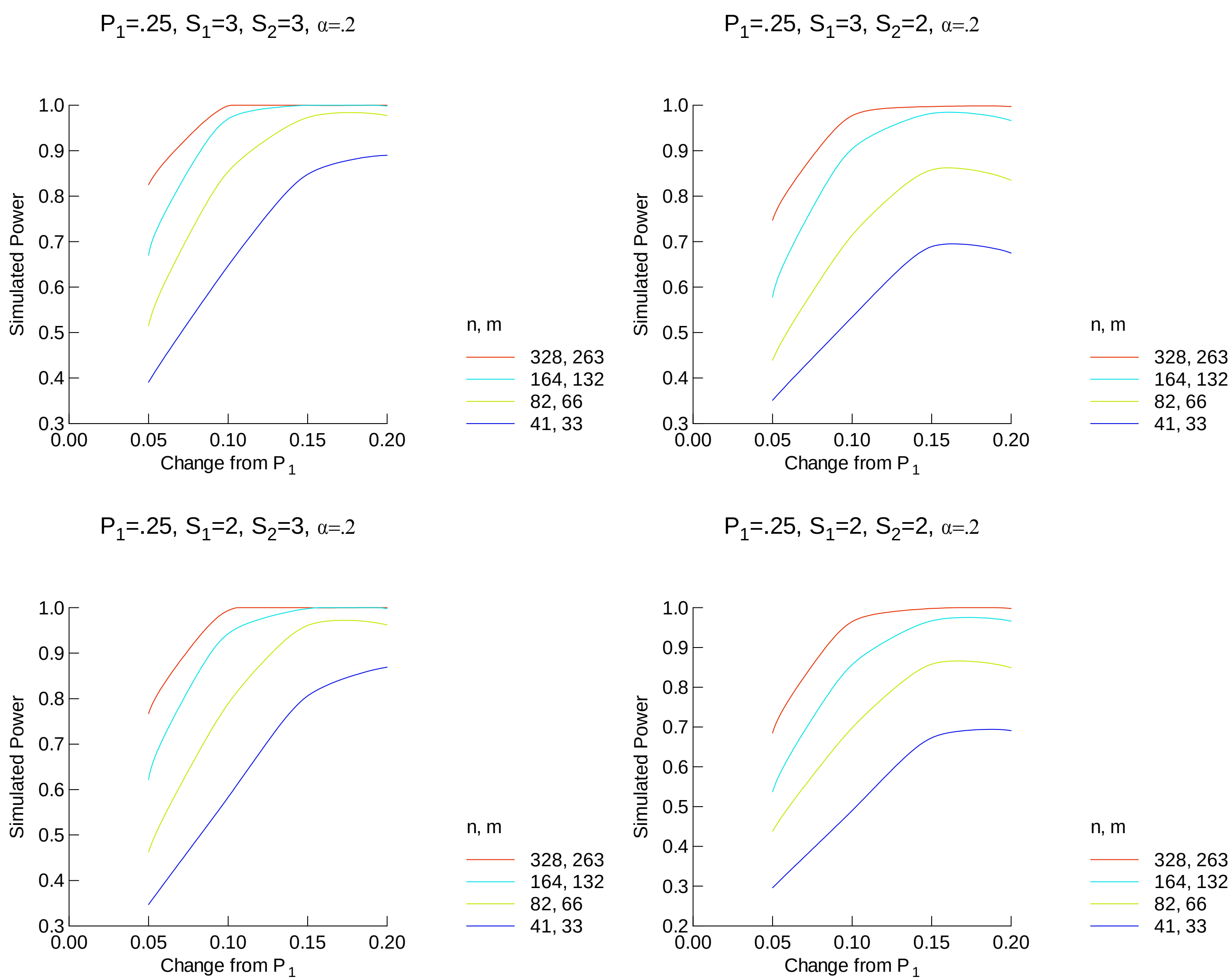

Figure A-3. Simulated power of detecting change from P_1 = 0.25. Detection probability is set at $p_1 = p_2 = 0.5$.

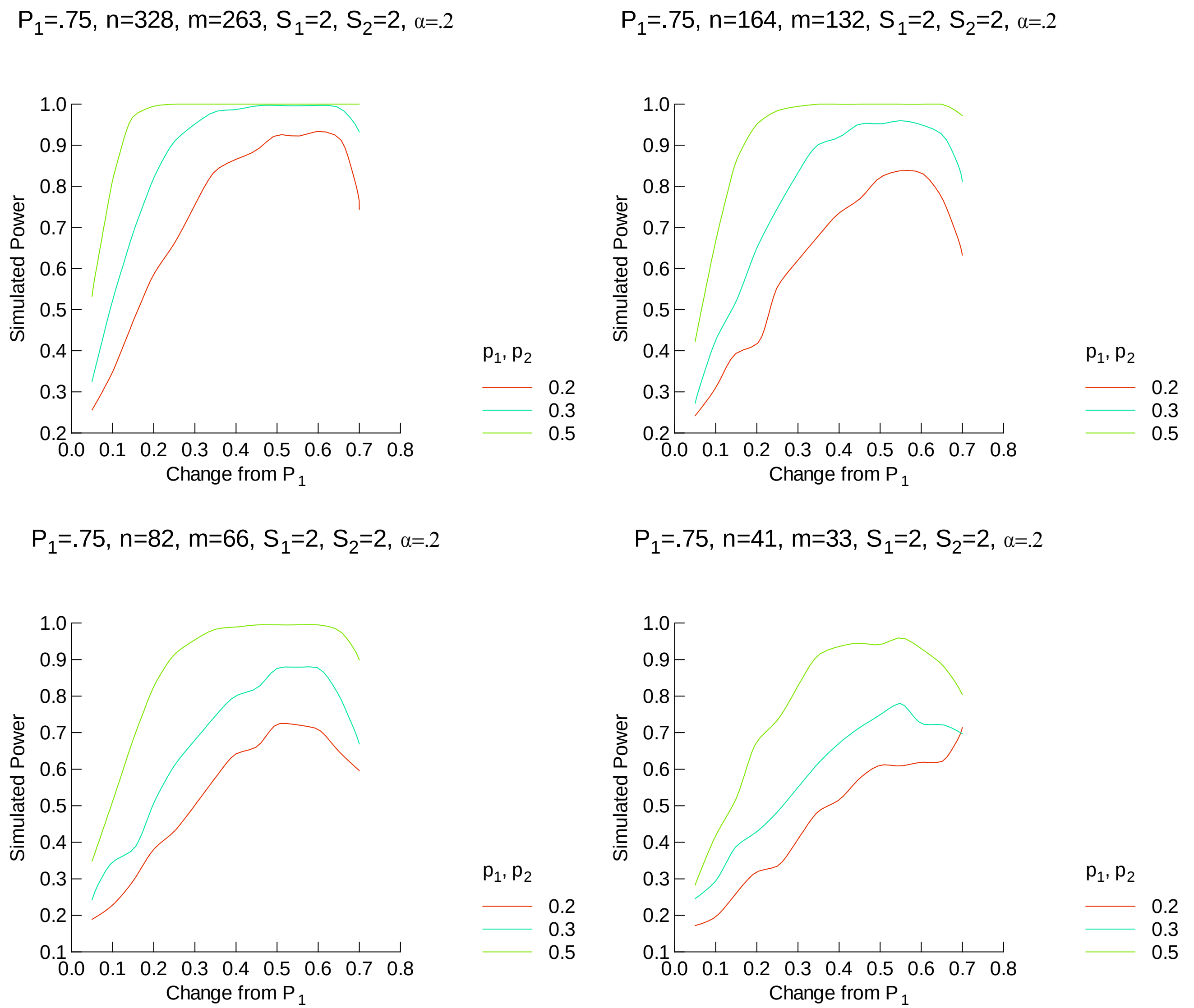

Figure A-4. Simulated power of detecting change from P_1 = 0.75 for two visits per point and a range of detectability.

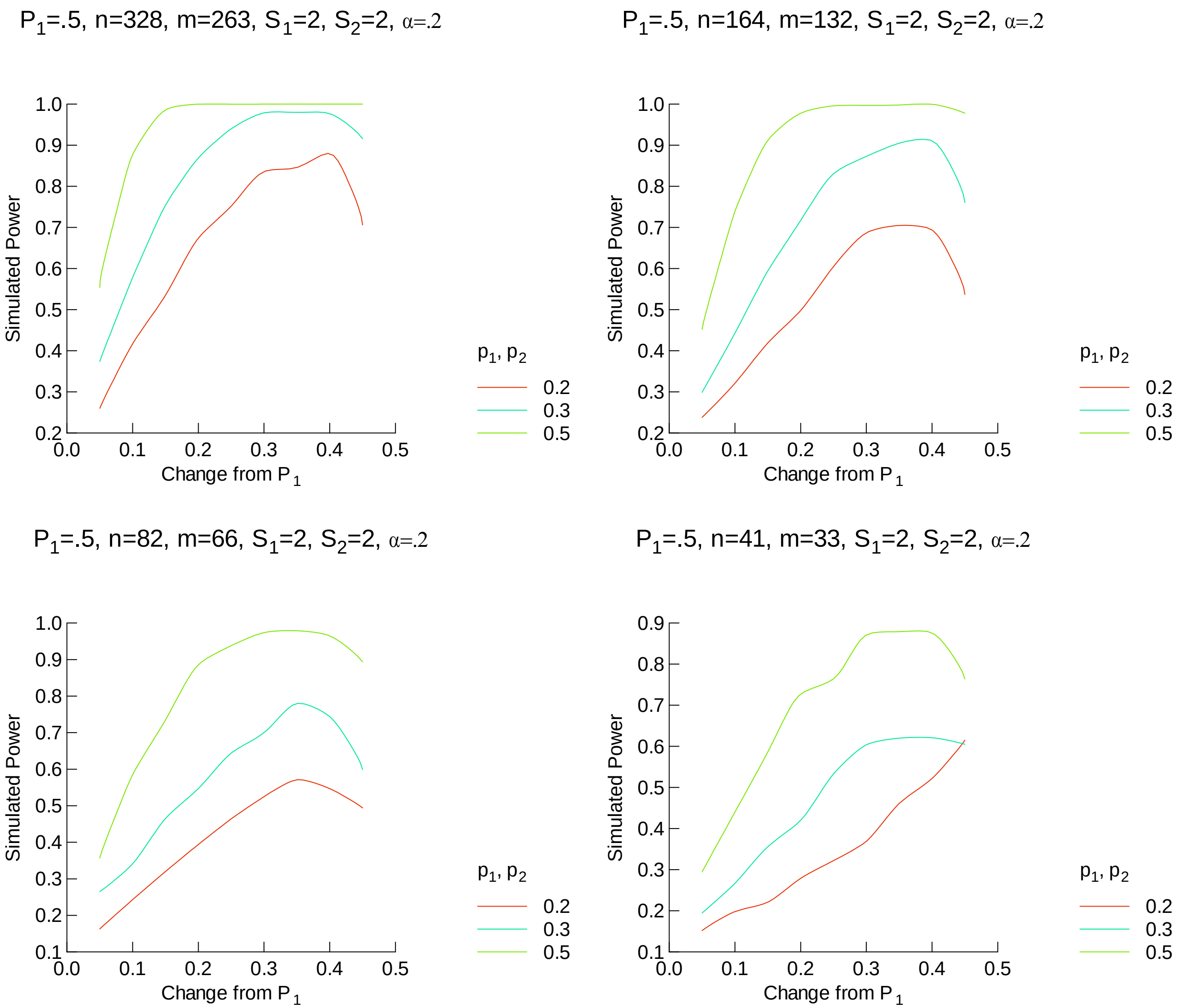

Figure A-5. Simulated power of detecting change from $P_1 = 0.5$ for two visits per point and a range of detectability.

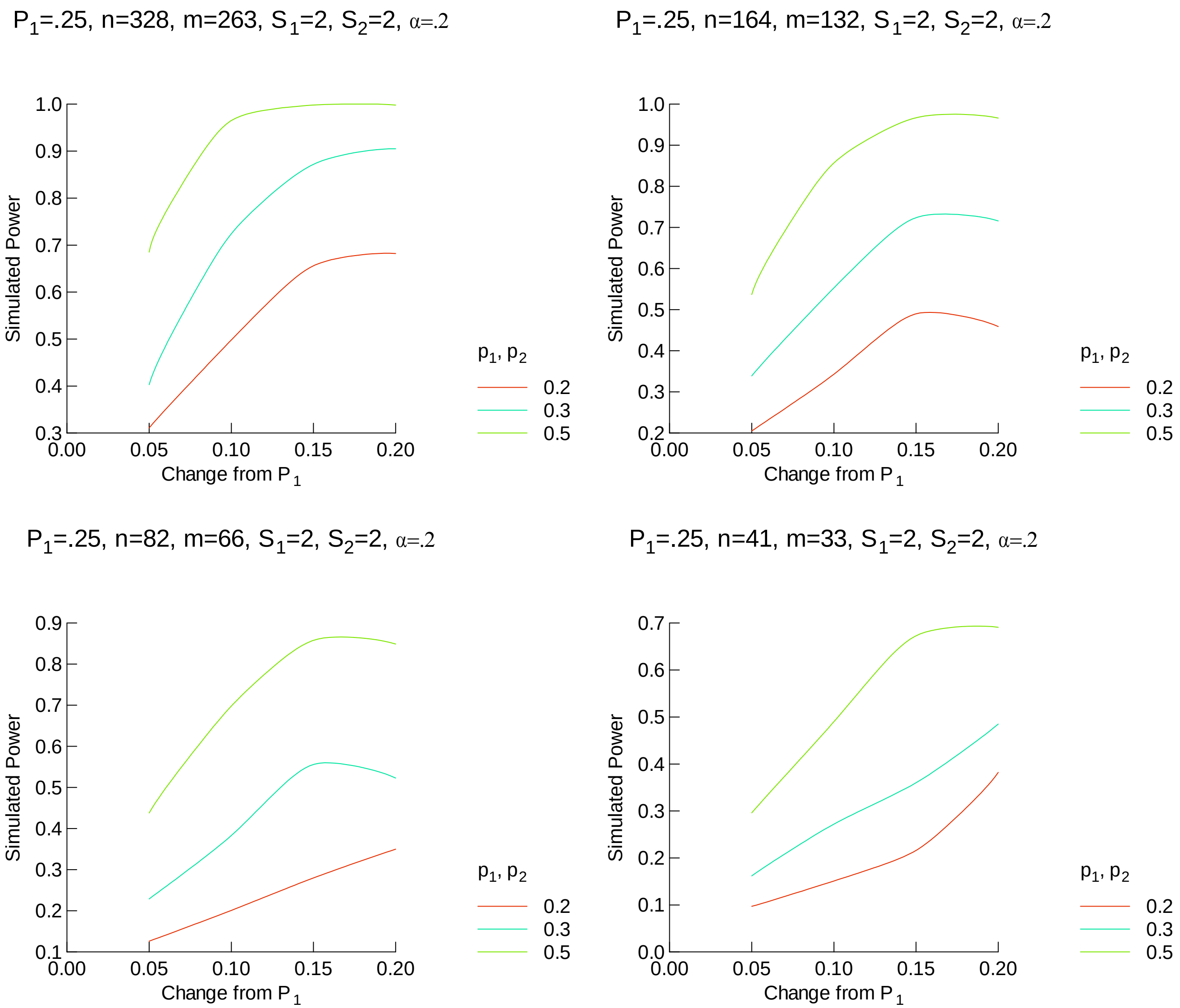

Figure A-6. Simulated power of detecting change from $P_1 = 0.25$ for two visits per point and a range of detectability.

Appendix B:

Evaluation of Proposed MSIM Sampling Design for Adequately Sampling Bird Species in Region 3

Introduction

We hoped to be able to model the relative statistical efficiencies and benefits of various sampling options for monitoring trend, but statistical analysis methods are early in their development and did not allow us to reliably estimate relative performance various sampling options. However, we were able to conduct a simple evaluation of the species adequately detected to discern a relative change of 20% between two sample periods based on the option of sampling 20% of the full grid each year for 5 years and then repeating. This evaluation represents a balance of a high level of effort (full grid, which is twice the nationally recommended sampling effort), but no annual resampling and comparing just two points in time. Therefore, it is our hope that these estimates provide a reasonably reliable general estimate of the number and identity of species that would be adequately detected to detect change over a 10 year period.

Study Area

The Southwestern Region of the Forest Service manages over 8.1 million hectares (20 million acres) comprised of 11 National Forests in Arizona and New Mexico. At least 1.09 million ha (2.7 million acres) is comprised of wilderness and less than 0.2% of the area (37900 acres) is comprised of lakes. Many different ecosystem types can be found across these 11 National Forests such as Sonoran desert, high- and semi-desert, chaparral, meadow, riparian and lacustrine, and pine forests. Typical tree species that dominate the forested areas include Ponderosa pine, Douglas fir, piñon pine, Engelmann and blue spruce, aspen, oaks, and juniper. Elevations range from approximately 488 to 3963 meters in the alpine (1600 to 13000 feet). Based on a compendium of state and local bird species occurrence records, 342 species are known to occur during the spring and summer seasons on National Forest System lands in New Mexico and Arizona (Table B-1).

Methods

A review of breeding birds in Arizona and New Mexico indicated that 284 species are confirmed to nest in the area, 9 of which were considered to be rare or local breeders. Range maps were available for 184 common breeding bird species and 3 rare or local breeders. Of the remaining 134 species for which range maps were not available, 91 species were confirmed breeders, 6 were considered to be rare or local breeders and 37 were verified as non-breeders. We predicted sampling adequacy for 187 breeding bird species with range maps, which represented 15 orders and 45 families (Table B-2).

Sampling adequacy was determined following the same procedures as used by Manley et al. 2004. Manley et al. (2004) evaluated the potential of the MSIM protocol to generate reliable trend data on a breadth and diversity of species at the ecoregional scale. Based on the estimated probability of presence (p_p) of a species throughout its geographic range, the selected primary survey method, and the estimated probability of detection (p_d), they calculated the minimum sample size (i.e., number of points in suitable habitat) required to detect the requisite 20% relative change in points occupied with 80% confidence and power. The proportion of monitoring points with detections for a given sample period (P_t) was the product of the probability of presence (p_p) and probability of detection when present (p_d). As per Manley et al. (2004), all bird species in Region 3 were assigned a probability of detection given implementation of the full survey method (described below) based on published literature and local experts (Table B-1). Species were assigned one of four values of probability of detection (0, 0.1, 0.5, and 0.8). Then, species were assigned one of three values of probability of presence (0.1, 0.5, and 0.8) based on estimates of amount of suitable habitat within the species range on National Forest System lands in Region 3 (Table B-2). A more detailed description of the derivation of p_p and p_d is provided below.

An estimate of probability of detection (p_d) was derived for each of the 342 bird species present during spring or summer on National Forest System lands in Arizona and New Mexico through a considered process of professional opinion. University of New Mexico doctoral student, Hira A. Walker, was commissioned to estimate the probability of detection for each species. The probability of detection is defined as the probability of detecting a bird species if present. We assumed that p_d is not influenced by the observer's ability to identify the species correctly, but rather it is based on such factors as visibility and behavior. After a thorough consideration of influential factors, four primary factors were identified as being particularly influential on detectability: vocalization frequency, vocalization intensity, behavior, and sociality. Vocalization frequency was defined as the regularity or frequency that a species vocalizes in a period in time. Vocalization intensity was defined as the audibility (loudness) of vocalizations within 100 m when given. Behavior was defined as the activity of a species that makes it visually apparent or not (independent of the other three factors). Sociality was defined as the degree to which a species is social and detected with conspecifics (i.e., the likelihood that if one individual of a species is detected another individual of the same species would also be detected). Each of these four factors was rated on a scale from 0 to 3 (Table B-1 and B-2) using the following steps.

- *Vocalization frequency* -- If a species generally never vocalizes and is silent, it was ascribed a value of 0. If a species is generally silent, but occasionally vocalizes, it was ascribed a value of 1. If a species generally vocalizes frequently, it was ascribed a value of 2. If a species generally vocalizes persistently and often, it was ascribed a value of 3.
- *Vocalization intensity* -- The value was averaged over all types of vocalizations (i.e., songs and calls) of a species, but weighted towards songs. If vocalizations are generally not detectable when emitted, the species was ascribed a value of 0. If vocalizations are generally not heard, but may be heard on occasion, the species was ascribed a value of 1. If vocalizations are generally easily heard, but may not always be heard, the species was ascribed a value of 2. If vocalizations are generally always heard, the species was ascribed a value of 3.

- *Behavior* -- Species were ascribed a value of 0 if they 1) are nocturnal and 2) tend to hide, shy way from observers, skulk in dense vegetation, or otherwise remain hidden from view. Species that are often secretive, but can be occasionally observed were ascribed a value of 1. Species that are frequently apparent were ascribed a value of 2. Species that are conspicuous were ascribed a value of 3.
- *Sociality* -- Species that are asocial and almost always alone were ascribed a value of 0. Species that are often detected alone, but can be detected for brief periods with conspecifics, such as its mate, were ascribed a value of 1. Species that are generally detected in pairs or small groups (approx. 3-10 individuals) were ascribed a value of 2. Species that were almost always detected in large groups (approx. >10 individuals) were ascribed a value of 3.

Each species was scored on each criterion in the context of the field survey methodology. The survey methodology includes censusing birds within 100 m during 10 minute fixed-radius point counts conducted from 15 minutes after sunrise to 4 hours after sunrise during spring season. The survey hours excluded many nocturnal species and those species that vocalize most frequently in predawn and evening hours. The survey time period encompassed both spring migration and the breeding season. For those species that primarily only migrate through the region, the scores were based only on characteristics associated with migration. For species that both migrate and breed in the region, the scores were based on aspects of both of these periods. Information used to score species based on the criteria was drawn from field experience and general literature sources (National Geographic Society 1987, Sibley 2000). In addition, several specialized references were used for two bird families: Curson et al. (1994) and Dunn and Garrett (1997) were used for warblers (Parulidae), while Rising et al. (1996) was used for sparrows (Emberizidae). Specific species accounts (Birds of North America 2001) were also consulted. All assumptions made in developing and scoring the criteria are noted in the notes section of the worksheet to aid in any future changes or modifications to the methodology.

Scores from the 4 criteria were summed and used as a guideline for deriving the p_d values (Table B-1). The minimum total score was 0 and the maximum total score was 12. In general, species that scored 0 were ascribed a p_d of 0, species that scored 1 to 4 were ascribed a p_d of 0.25, species that scored 5 to 8 were ascribed a p_d of 0.5, and species that scored 9 to 12 were ascribed a p_d of 0.8. A p_d value of 0.25 indicates that less than 50% of time the observer detects a bird when present, a p_d value of 0.5 indicates that about 50% of time the observer detects a bird when present, and a p_d of 0.75 value indicates that greater than 50% of time the observer detects a bird when present. The total scores based on the criteria were not always used literally to derive p_d values, as some criterion often had greater weight in determining whether a species is detected during surveys. Thus, field experience was always used as the final determinant of the p_d values. In two instances, two species were considered as one and given the same p_d: 1) Strickland's (*Picoides stricklandi*) and Arizona (*Picoides arizonae*) Woodpeckers; and 2) Pacific-slope (*Empidonax difficilis difficilis*) and Cordilleran (*Empidonax occidentalis*) Flycatchers.

As per Manley et al. (2004), the probability of presence (p_p) was based on the proportion of the geographic range occupied by suitable habitat. First, the number of FIA points within each species range NFS lands was calculated for the 187 species with range maps using GIS. A map of the approximate location of FIA points was overlayed onto a map of each species range to determine the number of FIA points within the range. The number of FIA points with species ranges varied 2 to 3284 points, with an average of 1081 points (Table B-2). The Southwestern Wildlife Information System (SWIS), a Region 3 Wildlife GIS/database Model, was used as the basis for identifying suitable habitat types. The subset of FIA points within the species range that occurred in the potential spring and summer habitats was determined for each species. The extent of spring habitat within the species range was used to calculate p_p; the actual proportion of the range occupied by spring habitat was rounded to the nearest of the values used modeling (0.1., 0.5 or 0.8).

Sample size requirements were based on the comparison of two consecutive 5-year sample periods spanning a total of 10 years (see Manley et al. 2004 for details). The absolute number of points needed within a species range for each combination of p_p and p_d was determined based on a two-tailed test of change in the proportion of points with detections. Species for which the number of FIA points in their range exceeded the minimum number of sampling points needed to meet the minimum precision parameters were considered adequately detected by the MSIM protocol. We evaluated the MSIM recommended minimum precision of 20% relative change in points with detections with 80% confidence and power. We also evaluated two scenarios that represented an increase in precision: 10% relative change with 80% confidence and power, and 20% relative change with 90% confidence and power. The results of sampling adequacy calculations were tabulated by taxonomic order and family.

Results

Four species, Northern pygmy owl (*Glaucidium gnoma californicum*), flammulated owl (*Otus flammeolus*), long-eared owl (*Asio otus*), and Mexican spotted owl (*Strix occidentalis lucida*) had a zero probability of detection. These species and their allies are generally are not detected well by point count sampling because they are primarily nocturnal. Over 60% of the species (n = 113) were estimated to have a high probability of detection. Almost 30% of the species (n = 54) were estimated to have a moderate probability of detection, and < 10% were estimated to have a probability of detection of 0.10.

Overall of the 187 breeding birds evaluated, 65% (n = 122 species) were determined to be adequately sampled to detect a 20% relative change in the proportion of points with detections with 80% confidence and power. Of these, most species (n = 100) required less than the average number of FIA points on a single National Forest to be adequately sampled, assuming an average Forest size of 1 million acres, equating to approximately 166 FIA points. Thus, it is likely that sample sizes would be sufficient for up to 100 species to detect a $\geq$ 20% relative change with 80% confidence and power at the Forest scale.

Passerine species faired better than non-passerine species in detection adequacy. The passerine group is the largest group supporting 124 species of breeding birds, most of which are best detected through point-count sampling. The majority (71%) of breeding songbirds within the region were predicted to be adequately detected to identify $\geq$ 20% relative change with 80% confidence and power (Table B-3). Factors limiting the detectability of some passerines species are a combination of small breeding ranges, isolated distributions, highly dispersed or scattered occurrences, and rarity on NFS lands. For instance, the American pipit will most likely not be adequately detected across all 3 change classes because only 12 FIA points are located within its range and only 1 of those points lies within its known breeding range in the region. The predicted inability to adequately detect horned larks across all 3 change categories is based on a combination of a moderate probability of detection (p_d = 0.5) and low probability of presence (p_p = 0.1) within its breeding range.

As a group, the 14 non-passerine orders (n = 63 species) had a lower rate of sampling adequacy compared to passerine species, with only 57% of the species adequately detected. This is not surprising given that point counts are not the preferred method used to detect many non-passerine species such as waterbirds, owls, nightjars, and many raptors, and more appropriate means of detecting these species have been developed. Within this group, 7 non-passerine species (American kestrel, prairie falcon, turkey vulture, greater roadrunner, white-throated swift, black-chinned hummingbird, and broad-tailed hummingbird) belonging to 5 families were predicted to be adequately detected. Conversely, all 12 non-passerine species in 5 of the non-passerine groups (waterfowl, cormorants, herons, plovers and sandpipers, trogons) would not be detected adequately (Table B-3). Waterbirds and water sources are few and scattered throughout Forested lands in Arizona and New Mexico, and aquatic habitat types would need to be targeted for sampling to adequately sample most water-associated species. The breeding range of the elegant trogon within southernmost Arizona and New Mexico encompasses only a small fraction of the forested areas across these states greatly limiting its detectability.

Our evaluation also considered greater precision options (Table B-2). Overall species, increasing confidence and power to 90% resulted in a drop of 13% to 52% of the species adequately detected, and to detect a 10% change with 80% confidence and power we observed a small drop of only 4% to 60% of the species adequately detected. Across all passerines, we observed a drop of 15% to 56% when confidence and power were increased to 90%, and a drop of only 4% to 67% of the species sampled adequately to detect a 10% change with 80% confidence and power. The 7 non-passerine species adequately detected at the minimum standards were all adequately detected in both scenarios representing greater precision.

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Table B-1. Detection probability calculations for all bird species occurring on National Forest System lands in Arizona and New Mexico.

Common Name	Scientific Name	Breed? (Y/N)	Range maps (Y/N)	Vocalization Frequency	Vocalization Intensity	Behavior	Sociality	Total Score	p_d
Black-bellied Whistling-Duck	*Dendrocygna autumnalis fulgens*	Y	N	3	2	2	3	10	0.8
Greater White-fronted Goose	*Anser albifrons frontalis*	N	N	3	3	3	3	12	0.8
Snow Goose*	*Chen caerulescens hyperborea*	N	N	3	3	3	3	12	0.8
Ross's Goose	*Chen rossii*	N	Y	3	3	3	3	12	0.8
Canada Goose	*Branta canadensis*	Y	N	3	3	3	3	12	0.8
Tundra Swan	*Cygnus columbianus columbianus*	N	N	1	2	3	3	9	0.8
Wood Duck	*Aix sponsa*	Y	N	2	2	2	2	8	0.5
Gadwall	*Anas strepera*	Y	N	2	2	2	2	8	0.5
American Wigeon	*Anas americana*	N	N	2	2	2	2	8	0.5
Mallard	*Anas platyrhynchos*	Y	Y	3	3	2	3	11	0.8
Blue-winged Teal	*Anas discors discors*	Y	N	1	2	2	2	7	0.5
Cinnamon Teal	*Anas cyanoptera septentrionalium*	Y	N	1	1	2	2	6	0.5
Northern Shoveler	*Anas clypeata*	Y	Y	2	2	2	2	8	0.5
Northern Pintail	*Anas acuta*	Y	Y	2	3	2	3	10	0.8
Green-winged Teal	*Anas crecca carolinensis*	Y	N	3	3	2	2	10	0.8
Canvasback	*Aythya valisineria*	N	N	1	2	2	3	8	0.5
Redhead	*Aythya americana*	Y	N	2	2	2	2	8	0.5
Ring-necked Duck	*Aythya collaris*	Rare	N	1	2	2	2	7	0.5
Lesser Scaup	*Aythya affinis*	N	Y	2	2	2	2	8	0.5

Table B-1 (cont.)

Common Name	Scientific Name	Breed? (Y/N)	Range maps (Y/N)	Vocalization Frequency	Vocalization Intensity	Behavior	Sociality	Total Score	p_d
Bufflehead	*Bucephala albeola*	N	N	1	2	2	2	7	0.5
Common Goldeneye	*Bucephala clangula americana*	N	N	0	1	2	2	5	0.5
Hooded Merganser	*Lophodytes cucullatus*	N	N	0	0	1	2	3	0.1
Common Merganser	*Mergus merganser americanus*	Y	N	1	1	2	3	7	0.5
Red-breasted Merganser	*Mergus serrator serrator*	N	N	1	1	2	2	6	0.5
Ruddy Duck	*Oxyura jamaicensis rubida*	Y	N	0	1	2	2	5	0.1
Chukar	*Alectoris chukar*	N	N	3	3	0	3	9	0.8
Ring-necked Pheasant	*Phasianus colchicus*	Y	N	2	3	1	2	8	0.5
White-tailed Ptarmigan	*Lagopus leucurus altipetens*	Y	N	2	1	0	2	5	0.1
Blue Grouse	*Dendragapus obscurus obscurus*	Y	Y	2	1	0	2	5	0.1
Wild Turkey	*Meleagris gallopavo*	Y	Y	2	3	0	3	8	0.5
Scaled Quail	*Callipepla squamata pallida*	Y	Y	2	1	0	2	5	0.5
Gambel's Quail	*Callipepla gambelii*	Y	Y	2	2	1	2	7	0.5
Northern Bobwhite	*Colinus virginianus ridgwayi*	Rare	Y	3	2	0	2	7	0.5
Montezuma Quail	*Cyrtonyx montezumae mearnsi*	Y	Y	0	1	0	2	3	0.1
Common Loon	*Gavia immer*	N	N	1	2	2	2	7	0.5
Pied-billed Grebe	*Podilymbus podiceps podiceps*	Y	N	2	3	2	2	9	0.8
Horned Grebe	*Podiceps auritus*	N	N	2	3	2	3	10	0.8
Eared Grebe	*Podiceps nigricollis californicus*	Y	N	2	2	2	3	9	0.8

Table B-1 (cont.)

Common Name	Scientific Name	Breed? (Y/N)	Range maps (Y/N)	Vocalization Frequency	Vocalization Intensity	Behavior	Sociality	Total Score	p_d
Western Grebe	*Aechmophorus occidentalis*	Y	N	2	3	2	2	9	0.8
Clark's Grebe	*Aechmophorus clarkii*	Y	N	2	3	2	2	9	0.8
American White Pelican	*Pelecanus erythrorhynchos*	Rare	N	0	1	2	3	6	0.5
Brown Pelican*	*Pelecanus occidentalis carolinensis*	N	N	0	1	2	3	6	0.5
Neotropic Cormorant	*Phalacrocorax brasilianus*	Y	N	1	1	2	3	7	0.5
Double-crested Cormorant	*Phalacrocorax auritus*	Y	Y	1	1	2	3	7	0.5
American Bittern	*Botaurus lentiginosus*	Y	N	1	3	0	0	4	0.1
Least Bittern	*Ixobrychus exilis*	Y	N	2	3	1	2	8	0.5
Great Blue Heron	*Ardea herodias*	Y	Y	1	3	2	2	8	0.5
Great Egret	*Ardea alba*	Y	N	1	3	2	2	8	0.5
Snowy Egret	*Egretta thula*	Y	N	1	3	2	2	8	0.5
Cattle Egret	*Bubulcus ibis*	Y	N	1	2	2	2	7	0.5
Green Heron	*Butorides virescens*	Y	Y	2	3	2	1	8	0.5
Black-crowned Night-Heron	*Nycticorax nycticorax hoactli*	Y	Y	1	2	1	2	6	0.1
White-faced Ibis	*Plegadis chihi*	Rare	N	1	1	3	3	8	0.8
Black Vulture	*Coragyps atratus*	Y	N	0	0	2	3	5	0.5
Turkey Vulture	*Cathartes aura*	Y	Y	0	0	2	3	5	0.5
California Condor*	*Gymnogyps californianus*	Y	N	0	0	2	2	4	0.1
Osprey	*Pandion haliaetus carolinensis*	Y	N	2	3	2	2	9	0.8

Table B-1 (cont.)

Common Name	Scientific Name	Breed? (Y/N)	Range maps (Y/N)	Vocalization Frequency	Vocalization Intensity	Behavior	Sociality	Total Score	p_d
White-tailed Kite	*Elanus leucurus*	Rare	N	2	3	2	2	9	0.8
Mississippi Kite	*Ictinia mississippiensis*	Y	Y	1	3	2	2	8	0.5
Bald Eagle	*Haliaeetus leucocephalus*	Y	Y	3	3	2	2	10	0.8
Northern Harrier*	*Circus cyaneus hudsonius*	Y	N	2	3	2	1	8	0.5
Sharp-shinned Hawk	*Accipiter striatus velox*	Y	Y	1	3	1	1	6	0.5
Cooper's Hawk	*Accipiter cooperii*	Y	Y	3	3	2	2	10	0.8
Northern Goshawk	*Accipiter gentilis*	Y	Y	1	3	1	1	6	0.1
Gray Hawk	*Asturina nitida maximus*	Y	N	3	3	2	2	10	0.8
Common Black-Hawk	*Buteogallus anthracinus anthracinus*	Y	N	3	3	2	2	10	0.8
Harris's Hawk	*Parabuteo unicinctus harrisi*	Y	Y	2	3	2	2	9	0.8
Swainson's Hawk	*Buteo swainsoni*	Y	Y	2	3	2	3	10	0.8
Zone-tailed Hawk	*Buteo albonotatus*	Y	Y	2	3	2	1	8	0.5
Red-tailed Hawk	*Buteo jamaicensis*	Y	Y	1	3	2	2	8	0.5
Ferruginous Hawk	*Buteo regalis*	Y	Y	1	3	2	1	7	0.5
Golden Eagle	*Aquila chrysaetos canadensis*	Y	Y	1	1	2	1	5	0.1
American Kestrel	*Falco sparverius sparverius*	Y	Y	2	3	2	2	9	0.8
Merlin*	*Falco columbarius*	N	N	0	2	2	1	5	0.1
Aplomado Falcon	*Falco femoralis septentrionalis*	Y	N	2	2	2	2	8	0.5
Peregrine Falcon	*Falco peregrinus anatum*	Y	N	1	3	2	2	8	0.5

Table B-1 (cont.)

Common Name	Scientific Name	Breed? (Y/N)	Range maps (Y/N)	Vocalization Frequency	Vocalization Intensity	Behavior	Sociality	Total Score	p_d
Prairie Falcon	*Falco mexicanus*	Y	Y	3	3	1	2	9	0.5
Clapper Rail	*Rallus longirostris*	Y	N	3	3	0	2	8	0.5
Virginia Rail	*Rallus limicola limicola*	Y	N	2	3	0	1	6	0.1
Sora	*Porzana carolina*	Y	N	2	3	1	2	8	0.5
Common Moorhen	*Gallinula chloropus cachinnans*	Y	N	2	3	2	2	9	0.8
American Coot	*Fulica americana americana*	Y	N	2	3	2	2	9	0.8
Sandhill Crane	*Grus canadensis*	N	Y	3	3	3	3	12	0.8
Black-bellied Plover	*Pluvialis squatarola*	N	N	1	2	2	1	6	0.5
Snowy Plover	*Charadrius alexandrinus nivosus*	Y	N	2	2	2	2	8	0.5
Semipalmated Plover	*Charadrius semipalmatus*	N	Y	1	1	2	1	5	0.1
Killdeer	*Charadrius vociferus vociferus*	Y	Y	3	3	3	2	11	0.8
Mountain Plover	*Charadrius montanus*	Y	Y	0	2	1	2	5	0.1
Black-necked Stilt	*Himantopus mexicanus*	Y	N	2	2	2	2	8	0.5
American Avocet	*Recurvirostra americana*	Y	N	2	2	2	3	9	0.8
Greater Yellowlegs	*Tringa melanoleuca*	N	N	2	3	2	1	8	0.5
Lesser Yellowlegs	*Tringa flavipes*	N	Y	2	3	2	2	9	0.5
Solitary Sandpiper	*Tringa solitaria*	N	N	2	2	2	1	7	0.5
Willet	*Catoptrophorus semipalmatus inornatu*	N	N	0	2	2	2	6	0.5
Spotted Sandpiper	*Actitis macularia*	Y	Y	3	3	2	2	10	0.8

Table B-1 (cont.)

Common Name	Scientific Name	Breed? (Y/N)	Range maps (Y/N)	Vocalization Frequency	Vocalization Intensity	Behavior	Sociality	Total Score	p_d
Upland Sandpiper	*Bartramia longicauda*	Y	N	3	3	2	2	10	0.8
Long-billed Curlew	*Numenius americanus*	Y	N	2	2	2	2	8	0.5
Marbled Godwit	*Limosa fedoa*	N	Y	2	2	2	3	9	0.5
Western Sandpiper	*Calidris mauri*	N	N	1	2	2	3	8	0.5
Least Sandpiper	*Calidris minutilla*	N	Y	1	2	2	3	8	0.5
Baird's Sandpiper	*Calidris bairdii*	N	N	1	2	2	2	7	0.5
Stilt Sandpiper	*Calidris himantopus*	N	N	1	2	2	3	8	0.5
Long-billed Dowitcher	*Limnodromus scolopaceus*	N	Y	2	2	2	3	9	0.5
Common Snipe	*Gallinago gallinago delicata*	Rare	Y	1	2	1	1	5	0.1
Wilson's Phalarope	*Phalaropus tricolor*	Y	N	1	1	2	2	6	0.5
Red-necked Phalarope	*Phalaropus lobatus*	N	N	1	1	2	3	7	0.5
Franklin's Gull	*Larus pipixcan*	N	N	1	1	2	3	7	0.5
Bonaparte's Gull	*Larus philadelphia*	N	N	2	2	2	3	9	0.5
Ring-billed Gull	*Larus delawarensis*	N	N	1	1	2	3	7	0.5
California Gull*	*Larus californicus*	N	N	1	2	2	3	8	0.5
Herring Gull	*Larus argentatus smithsonianus*	N	N	1	2	2	3	8	0.5
Caspian Tern*	*Sterna caspia*	N	N	2	3	2	2	9	0.8
Forster's Tern	*Sterna forsteri*	N	N	2	2	2	3	9	0.8
Black Tern	*Chlidonias niger surinamensis*	N	N	2	2	2	3	9	0.8

Table B-1 (cont.)

Common Name	Scientific Name	Breed? (Y/N)	Range maps (Y/N)	Vocalization Frequency	Vocalization Intensity	Behavior	Sociality	Total Score	p_d
Rock Pigeon	*Columba livia*	Y	Y	2	1	3	3	9	0.8
Band-tailed Pigeon	*Patagioenas fasciata fasciata*	Y	N	3	3	2	3	11	0.8
White-winged Dove	*Zenaida asiatica*	Y	Y	3	3	2	3	11	0.8
Mourning Dove	*Zenaida macroura*	Y	Y	2	1	2	2	7	0.5
Inca Dove	*Columbina inca*	Y	Y	3	2	2	2	9	0.8
Common Ground-Dove	*Columbina passerina pallescens*	Y	Y	3	2	2	2	9	0.8
Yellow-billed Cuckoo	*Coccyzus americanus*	Y	N	1	3	1	1	6	0.5
Greater Roadrunner	*Geococcyx californianus*	Y	Y	2	1	2	1	6	0.5
Barn Owl*	*Tyto alba*	Y	N	2	1	0	1	4	0
Flammulated Owl	*Otus flammeolus*	Y	Y	1	3	0	2	6	0
Western Screech-Owl	*Megascops kennicottii*	Y	N	2	3	1	2	8	0.1
Whiskered Screech-Owl	*Megascops trichopsis*	Y	N	2	3	1	2	8	0.1
Great Horned Owl	*Bubo virginianus*	Y	Y	2	3	1	1	7	0.1
Northern Pygmy-Owl	*Glaucidium gnoma californicum*	Y	Y	2	3	0	2	7	0
Ferruginous Pygmy-Owl	*Glaucidium brasilianum cactorum*	Y	N	2	3	1	2	8	0.1
Elf Owl	*Micrathene whitneyi whitneyi*	Y	Y	2	3	1	2	8	0.1
Burrowing Owl	*Athene cunicularia hypugaea*	Y	Y	2	2	2	2	8	0.5
Mexican Spotted Owl	*Strix occidentalis lucida*	Y	Y	2	3	0	1	6	0
Long-eared Owl	*Asio otus*	Y	Y	1	3	0	2	6	0

Table B-1 (cont.)

Common Name	Scientific Name	Breed? (Y/N)	Range maps (Y/N)	Vocalization Frequency	Vocalization Intensity	Behavior	Sociality	Total Score	p_d
Northern Saw-whet Owl	*Aegolius acadicus acadicus*	Y	Y	2	3	1	1	7	0.1
Lesser Nighthawk	*Chordeiles acutipennis texensis*	Y	Y	1	2	2	2	7	0.5
Common Nighthawk	*Chordeiles minor*	Y	Y	3	3	2	2	10	0.8
Common Poorwill	*Phalaenoptilus nuttalli nuttalli*	Y	Y	3	3	1	1	8	0.1
Buff-collared Nightjar	*Caprimulgus ridgwayi ridgwayi*	Y	N	2	2	1	1	6	0.1
Whip-poor-will	*Caprimulgus vociferus arizonae*	Y	Y	3	3	1	1	8	0.1
White-throated Swift	*Aeronautes saxatalis saxatalis*	Y	Y	2	3	2	2	9	0.8
Broad-billed Hummingbird	*Cynanthus latirostris*	Y	N	2	1	1	0	4	0.1
Blue-throated Hummingbird	*Lampornis clemenciae bessophilus*	Y	N	2	1	1	0	4	0.1
Magnificent Hummingbird	*Eugenes fulgens aureoviridis*	Y	N	1	1	1	0	3	0.1
Black-chinned Hummingbird	*Archilochus alexandri*	Y	Y	2	2	2	0	6	0.5
Anna's Hummingbird	*Calypte anna*	Y	N	3	2	2	0	7	0.5
Costa's Hummingbird	*Calypte costae*	Y	N	2	1	2	0	5	0.1
Calliope Hummingbird	*Stellula calliope*	N	Y	1	1	1	0	3	0.1
Broad-tailed Hummingbird	*Selasphorus platycercus platycercus*	Y	Y	2	2	2	0	6	0.5
Rufous Hummingbird	*Selasphorus rufus*	N	N	2	1	2	1	6	0.5
Elegant Trogon	*Trogon elegans canescens*	Y	Y	2	2	1	2	7	0.5
Belted Kingfisher	*Ceryle alcyon*	Y	Y	3	3	2	1	9	0.8
Lewis's Woodpecker	*Melanerpes lewis*	Y	Y	2	2	2	2	8	0.8

Table B-1 (cont.)

Common Name	Scientific Name	Breed? (Y/N)	Range maps (Y/N)	Vocalization Frequency	Vocalization Intensity	Behavior	Sociality	Total Score	p_d
Red-headed Woodpecker	*Melanerpes erythrocephalus caurinus*	Rare	Y	3	3	3	2	11	0.8
Acorn Woodpecker	*Melanerpes formicivorus formicivorus*	Y	N	3	3	3	3	12	0.8
Gila Woodpecker	*Melanerpes uropygialis uropygialis*	Y	Y	3	3	2	2	10	0.8
Williamson's Sapsucker	*Sphyrapicus thyroideus nataliae*	Y	Y	2	2	1	2	7	0.5
Red-naped Sapsucker	*Sphyrapicus nuchalis*	Y	Y	2	2	1	2	7	0.5
Ladder-backed Woodpecker	*Picoides scalaris*	Y	Y	2	3	2	1	8	0.8
Downy Woodpecker	*Picoides pubescens leucurus*	Y	Y	2	3	2	2	9	0.8
Hairy Woodpecker	*Picoides villosus*	Y	Y	2	3	2	1	8	0.8
Arizona Woodpecker	*Picoides arizonae*	Y	N	2	3	1	1	7	0.5
Strickland's Woodpecker	*Picoides stricklandi*	Y	N	2	3	1	1	7	0.5
American Three-toed Woodpecker	*Picoides dorsalis*	Y	N	0	3	2	2	7	0.1
Northern Flicker	*Colaptes auratus*	Y	Y	3	3	2	2	10	0.8
Northern Beardless-Tyrannulet	*Camptostoma imberbe ridgwayi*	Y	N	3	3	1	1	8	0.5
Olive-sided Flycatcher	*Contopus cooperi*	Y	Y	2	3	2	1	8	0.5
Greater Pewee	*Contopus pertinax pallidiventris*	Y	Y	2	2	1	1	6	0.5
Western Wood-Pewee	*Contopus sordidulus*	Y	N	3	3	1	1	8	0.8
Willow Flycatcher	*Empidonax traillii*	Y	Y	3	3	1	2	9	0.8
Least Flycatcher	*Empidonax minimus*	N	N	1	1	1	0	3	0.1
Hammond's Flycatcher	*Empidonax hammondii*	Y	Y	2	2	1	1	6	0.5

Table B-1 (cont.)

Common Name	Scientific Name	Breed? (Y/N)	Range maps (Y/N)	Vocalization Frequency	Vocalization Intensity	Behavior	Sociality	Total Score	p_d
Gray Flycatcher	*Empidonax wrightii*	Y	Y	2	2	1	1	6	0.5
Dusky Flycatcher	*Empidonax oberholseri*	Y	Y	2	2	1	1	6	0.5
Pacific-slope Flycatcher	*Empidonax difficilis difficilis*	Y	N	2	2	1	1	6	0.5
Cordilleran Flycatcher	*Empidonax occidentalis*	Y	Y	2	2	1	1	6	0.5
Buff-breasted Flycatcher	*Empidonax fulvifrons pygmaeus*	Y	N	2	3	1	2	8	0.5
Black Phoebe	*Sayornis nigricans semiatra*	Y	Y	1	2	1	1	5	0.5
Eastern Phoebe*	*Sayornis phoebe*	N	N	1	2	1	0	4	0.1
Say's Phoebe	*Sayornis saya*	Y	Y	2	2	2	1	7	0.5
Vermilion Flycatcher	*Pyrocephalus rubinus*	Y	Y	3	3	2	1	9	0.8
Dusky-capped Flycatcher	*Myiarchus tuberculifer olivaceus*	Y	Y	2	3	1	1	7	0.5
Ash-throated Flycatcher	*Myiarchus cinerascens cinerascens*	Y	Y	3	3	2	1	9	0.8
Brown-crested Flycatcher	*Myiarchus tyrannulus magister*	Y	Y	3	3	1	2	9	0.8
Sulphur-bellied Flycatcher	*Myiodynastes luteiventris swarthi*	Y	N	2	3	1	1	7	0.5
Tropical Kingbird	*Tyrannus melancholicus*	Y	N	3	3	3	2	11	0.8
Cassin's Kingbird	*Tyrannus vociferans vociferans*	Y	Y	3	3	3	2	11	0.8
Thick-billed Kingbird	*Tyrannus crassirostris*	Y	Y	3	3	3	2	11	0.8
Western Kingbird	*Tyrannus verticalis*	Y	Y	3	3	3	2	11	0.8
Eastern Kingbird	*Tyrannus tyrannus*	Y	Y	2	3	2	2	9	0.8
Scissor-tailed Flycatcher	*Tyrannus forficatus*	Y	N	2	3	3	2	10	0.8

Table B-1 (cont.)

Common Name	Scientific Name	Breed? (Y/N)	Range maps (Y/N)	Vocalization Frequency	Vocalization Intensity	Behavior	Sociality	Total Score	p_d
Loggerhead Shrike	*Lanius ludovicianus*	Y	Y	1	2	2	1	6	0.5
Bell's Vireo	*Vireo bellii*	Y	Y	3	3	2	2	10	0.8
Gray Vireo	*Vireo vicinior*	Y	Y	3	3	2	2	10	0.8
Plumbeous Vireo	*Vireo plumbeus*	Y	N	3	3	1	1	8	0.5
Cassin's Vireo	*Vireo cassinii*	Y	N	3	3	1	1	8	0.5
Hutton's Vireo	*Vireo huttoni stephenii*	Y	Y	3	3	1	2	9	0.8
Warbling Vireo*	*Vireo gilvus swainsonii*	Y	N	3	3	1	2	9	0.8
Gray Jay	*Perisoreus canadensis capitalis*	Y	Y	1	2	2	2	7	0.5
Steller's Jay	*Cyanocitta stelleri macrolopha*	Y	Y	3	3	3	2	11	0.8
Blue Jay	*Cyanocitta cristata*	N	N	3	3	3	2	11	0.8
Western Scrub-Jay	*Aphelocoma californica*	Y	N	3	3	3	2	11	0.8
Mexican Jay	*Aphelocoma ultramarina arizonae*	Y	Y	3	3	3	2	11	0.8
Pinyon Jay	*Gymnorhinus cyanocephalus*	Y	Y	3	3	3	3	12	0.8
Clark's Nutcracker	*Nucifraga columbiana*	Y	Y	3	3	2	2	10	0.8
Black-billed Magpie	*Pica hudsonia*	Y	N	3	3	2	2	10	0.8
American Crow	*Corvus brachyrhynchos*	Y	Y	2	3	2	2	9	0.8
Chihuahuan Raven	*Corvus cryptoleucus*	Y	Y	2	3	2	3	10	0.8
Common Raven*	*Corvus corax sinuatus*	Y	N	2	3	2	1	8	0.8
Horned Lark	*Eremophila alpestris*	Y	Y	2	2	1	2	7	0.5

Table B-1 (cont.)

Common Name	Scientific Name	Breed? (Y/N)	Range maps (Y/N)	Vocalization Frequency	Vocalization Intensity	Behavior	Sociality	Total Score	p_d
Purple Martin	*Progne subis*	Y	Y	2	2	2	2	8	0.5
Tree Swallow	*Tachycineta bicolor*	Y	Y	2	2	2	3	9	0.8
Violet-green Swallow	*Tachycineta thalassina lepida*	Y	Y	2	2	2	3	9	0.8
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	Y	Y	2	2	2	3	9	0.8
Bank Swallow	*Riparia riparia riparia*	Y	Y	2	2	2	3	9	0.8
Cliff Swallow	*Petrochelidon pyrrhonota*	Y	Y	2	2	2	3	9	0.8
Cave Swallow	*Petrochelidon fulva pallida*	Y	N	2	2	2	3	9	0.8
Barn Swallow	*Hirundo rustica erythrogaster*	Y	Y	2	2	2	3	9	0.8
Black-capped Chickadee	*Poecile atricapillus*	Y	Y	2	2	2	2	8	0.8
Mountain Chickadee*	*Poecile gambeli gambeli*	Y	N	2	2	2	2	8	0.8
Mexican Chickadee	*Poecile sclateri*	Y	N	3	2	2	2	9	0.8
Bridled Titmouse	*Baeolophus wollweberi phillipsi*	Y	Y	3	3	2	2	10	0.8
Juniper Titmouse	*Baeolophus ridgwayi*	Y	Y	3	3	1	2	9	0.8
Verdin	*Auriparus flaviceps ornatus*	Y	Y	3	3	2	1	9	0.8
Bushtit	*Psaltriparus minimus*	Y	Y	3	1	2	3	9	0.8
Red-breasted Nuthatch	*Sitta canadensis*	Y	Y	3	2	2	1	8	0.5
White-breasted Nuthatch	*Sitta carolinensis nelsoni*	Y	Y	1	2	2	2	7	0.5
Pygmy Nuthatch	*Sitta pygmaea melanotis*	Y	Y	3	3	3	3	12	0.8
Brown Creeper	*Certhia americana*	Y	Y	2	1	1	1	5	0.1

Table B-1 (cont.)

Common Name	Scientific Name	Breed? (Y/N)	Range maps (Y/N)	Vocalization Frequency	Vocalization Intensity	Behavior	Sociality	Total Score	p_d
Cactus Wren	*Campylorhynchus brunneicapillus coue*	Y	N	3	3	2	2	10	0.8
Rock Wren	*Salpinctes obsoletus obsoletus*	Y	Y	3	3	1	2	9	0.8
Canyon Wren	*Catherpes mexicanus conspersus*	Y	Y	3	3	1	2	9	0.8
Bewick's Wren	*Thryomanes bewickii*	Y	Y	3	3	2	2	10	0.8
House Wren	*Troglodytes aedon parkmannii*	Y	Y	3	3	1	2	9	0.8
Marsh Wren	*Cistothorus palustris*	Y	Y	3	3	1	2	9	0.8
American Dipper*	*Cinclus mexicanus unicolor*	Y	N	2	3	1	1	7	0.5
Golden-crowned Kinglet	*Regulus satrapa*	Y	Y	3	2	2	2	9	0.8
Ruby-crowned Kinglet	*Regulus calendula calendula*	Y	Y	3	3	2	2	10	0.8
Blue-gray Gnatcatcher	*Polioptila caerulea amoenissima*	Y	Y	2	1	2	2	7	0.5
Black-tailed Gnatcatcher	*Polioptila melanura melanura*	Y	Y	3	1	2	2	8	0.5
Eastern Bluebird	*Sialia sialis*	Y	Y	3	2	2	2	9	0.8
Western Bluebird	*Sialia mexicana bairdi*	Y	Y	3	2	2	2	9	0.8
Mountain Bluebird	*Sialia currucoides*	Y	Y	3	2	2	2	9	0.8
Townsend's Solitaire	*Myadestes townsendi townsendi*	Y	Y	3	3	2	2	10	0.8
Swainson's Thrush	*Catharus ustulatus*	Y	Y	3	3	1	2	9	0.1
Hermit Thrush	*Catharus guttatus*	Y	Y	3	3	1	1	8	0.1
American Robin	*Turdus migratorius*	Y	Y	3	3	2	3	11	0.8
Gray Catbird	*Dumetella carolinensis*	Y	N	3	3	0	2	8	0.5

Table B-1 (cont.)

Common Name	Scientific Name	Breed? (Y/N)	Range maps (Y/N)	Vocalization Frequency	Vocalization Intensity	Behavior	Sociality	Total Score	p_d
Northern Mockingbird	*Mimus polyglottos leucopterus*	Y	Y	3	3	3	2	11	0.8
Sage Thrasher	*Oreoscoptes montanus*	Y	Y	3	3	1	1	8	0.5
Brown Thrasher*	*Toxostoma rufum longicauda*	Y	N	3	3	1	2	9	0.5
Bendire's Thrasher	*Toxostoma bendirei*	Y	Y	2	2	1	2	7	0.5
Curve-billed Thrasher	*Toxostoma curvirostre celsum*	Y	Y	2	3	1	2	8	0.5
Crissal Thrasher	*Toxostoma crissale*	Y	N	2	3	1	2	8	0.5
European Starling	*Sturnus vulgaris*	Y	Y	3	1	2	3	9	0.8
American Pipit	*Anthus rubescens*	Y	Y	2	2	2	2	8	0.8
Cedar Waxwing	*Bombycilla cedrorum*	N	Y	3	1	2	3	9	0.8
Phainopepla	*Phainopepla nitens lepida*	Y	Y	2	2	3	2	9	0.8
Olive Warbler	*Peucedramus taeniatus arizonae*	Y	Y	2	3	1	2	8	0.5
Orange-crowned Warbler	*Vermivora celata*	Y	Y	3	3	2	2	10	0.8
Nashville Warbler	*Vermivora ruficapilla ridgwayi*	N	Y	2	2	3	1	8	0.5
Virginia's Warbler	*Vermivora virginiae*	Y	Y	3	3	1	2	9	0.8
Lucy's Warbler	*Vermivora luciae*	Y	Y	2	3	2	2	9	0.8
Yellow Warbler	*Dendroica petechia*	Y	Y	3	3	2	2	10	0.8
Yellow-rumped Warbler	*Dendroica coronata*	Y	Y	3	3	2	2	10	0.8
Black-throated Gray Warbler	*Dendroica nigrescens*	Y	Y	2	3	2	2	9	0.8
Townsend's Warbler	*Dendroica townsendi*	N	Y	2	2	1	1	6	0.5

Table B-1 (cont.)

Common Name	Scientific Name	Breed? (Y/N)	Range maps (Y/N)	Vocalization Frequency	Vocalization Intensity	Behavior	Sociality	Total Score	p_d
Grace's Warbler	*Dendroica graciae graciae*	Y	Y	3	3	1	2	9	0.8
Black-and-white Warbler*	*Mniotilta varia*	N	N	1	2	1	1	5	0.5
American Redstart	*Setophaga ruticilla tricolora*	Y	N	3	3	3	2	11	0.8
Northern Waterthrush	*Seiurus noveboracensis*	N	Y	2	3	1	2	8	0.8
MacGillivray's Warbler	*Oporornis tolmiei*	Y	Y	2	3	2	2	9	0.8
Common Yellowthroat	*Geothlypis trichas*	Y	Y	3	3	2	2	10	0.8
Wilson's Warbler	*Wilsonia pusilla*	Y	Y	3	3	2	2	10	0.8
Red-faced Warbler	*Cardellina rubrifrons*	Y	Y	3	3	3	2	11	0.8
Painted Redstart	*Myioborus pictus pictus*	Y	Y	3	3	3	2	11	0.8
Yellow-breasted Chat*	*Icteria virens auricollis*	Y	N	3	3	1	2	9	0.8
Hepatic Tanager	*Piranga flava*	Y	Y	1	2	1	2	6	0.1
Summer Tanager	*Piranga rubra*	Y	Y	3	3	1	1	8	0.5
Western Tanager	*Piranga ludoviciana*	Y	Y	3	3	1	2	9	0.8
Green-tailed Towhee	*Pipilo chlorurus*	Y	Y	2	2	1	2	7	0.5
Spotted Towhee	*Pipilo maculatus*	Y	Y	3	3	1	2	9	0.8
Canyon Towhee	*Pipilo fuscus*	Y	Y	3	3	1	2	9	0.8
Abert's Towhee	*Pipilo aberti aberti*	Y	N	3	3	1	2	9	0.8
Rufous-winged Sparrow	*Aimophila carpalis*	Y	N	2	2	2	2	8	0.5
Cassin's Sparrow	*Aimophila cassinii*	Y	Y	2	2	2	2	8	0.5

Table B-1 (cont.)

Common Name	Scientific Name	Breed? (Y/N)	Range maps (Y/N)	Vocalization Frequency	Vocalization Intensity	Behavior	Sociality	Total Score	p_d
Botteri's Sparrow	*Aimophila botterii arizonae*	Y	N	2	3	1	2	8	0.5
Rufous-crowned Sparrow	*Aimophila ruficeps*	Y	Y	2	2	1	2	7	0.5
Five-striped Sparrow	*Aimophila quinquestriata*	N	N	3	2	2	2	9	0.8
American Tree Sparrow	*Spizella arborea ochracea*	N	Y	2	1	2	3	8	0.8
Chipping Sparrow	*Spizella passerina arizonae*	Y	Y	3	3	2	2	10	0.8
Brewer's Sparrow	*Spizella breweri*	Y	Y	3	2	1	2	8	0.5
Clay-colored Sparrow	*Spizella pallida*	N	Y	2	1	1	3	7	0.5
Black-chinned Sparrow	*Spizella atrogularis evura*	Y	Y	3	2	2	2	9	0.8
Vesper Sparrow	*Pooecetes gramineus*	Y	Y	3	2	2	2	9	0.8
Lark Sparrow	*Chondestes grammacus strigatus*	Y	Y	3	3	2	2	10	0.8
Black-throated Sparrow	*Amphispiza bilineata*	Y	Y	2	2	2	2	8	0.5
Sage Sparrow	*Amphispiza belli*	Y	N	3	2	1	2	8	0.5
Lark Bunting	*Calamospiza melanocorys*	Y	Y	3	3	3	2	11	0.8
Savannah Sparrow	*Passerculus sandwichensis*	Y	Y	3	2	2	2	9	0.8
Grasshopper Sparrow*	*Ammodramus savannarum perpallidus*	Y	N	2	2	1	2	7	0.5
Fox Sparrow	*Passerella iliaca*	N	Y	2	1	1	2	6	0.5
Song Sparrow	*Melospiza melodia*	Y	Y	3	2	2	2	9	0.8
Lincoln's Sparrow	*Melospiza lincolnii*	Y	Y	3	2	1	2	8	0.5
Swamp Sparrow	*Melospiza georgiana ericrypta*	N	Y	1	1	1	1	4	0.1

Table B-1 (cont.)

Common Name	Scientific Name	Breed? (Y/N)	Range maps (Y/N)	Vocalization Frequency	Vocalization Intensity	Behavior	Sociality	Total Score	p_d
White-throated Sparrow	*Zonotrichia albicollis*	N	Y	2	1	2	3	8	0.5
White-crowned Sparrow	*Zonotrichia leucophrys*	Y	N	3	3	2	2	10	0.8
Dark-eyed Junco	*Junco hyemalis*	Y	Y	3	3	3	2	11	0.8
Yellow-eyed Junco	*Junco phaeonotus palliatus*	Y	Y	3	3	2	2	10	0.8
McCown's Longspur	*Calcarius mccownii*	N	Y	0	1	1	3	5	0.1
Chestnut-collared Longspur	*Calcarius ornatus*	N	Y	0	1	1	3	5	0.1
Northern Cardinal	*Cardinalis cardinalis*	Y	Y	3	3	2	2	10	0.8
Pyrrhuloxia	*Cardinalis sinuatus sinuatus*	Y	Y	3	3	2	2	10	0.8
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	N	Y	1	2	1	2	6	0.5
Black-headed Grosbeak	*Pheucticus melanocephalus*	Y	Y	3	3	2	2	10	0.8
Blue Grosbeak	*Passerina caerulea interfusa*	Y	N	3	3	2	2	10	0.8
Lazuli Bunting	*Passerina amoena*	Y	Y	3	3	2	2	10	0.8
Indigo Bunting	*Passerina cyanea*	Y	Y	3	3	2	2	10	0.8
Varied Bunting	*Passerina versicolor*	Y	Y	2	3	3	2	10	0.8
Painted Bunting	*Passerina ciris*	N	N	3	3	2	2	10	0.8
Dickcissel	*Spiza americana*	Rare	N	3	3	2	3	11	0.8
Red-winged Blackbird	*Agelaius phoeniceus*	Y	Y	3	3	3	3	12	0.8
Eastern Meadowlark	*Sturnella magna lilianae*	Y	Y	3	3	2	3	11	0.8
Western Meadowlark	*Sturnella neglecta*	Y	Y	3	3	2	3	11	0.8

Table B-1 (cont.)

Common Name	Scientific Name	Breed? (Y/N)	Range maps (Y/N)	Vocalization Frequency	Vocalization Intensity	Behavior	Sociality	Total Score	p_d
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	Y	N	3	3	3	3	12	0.8
Brewer's Blackbird	*Euphagus cyanocephalus*	Y	Y	2	2	2	3	9	0.8
Common Grackle	*Quiscalus quiscula versicolor*	Y	N	3	3	3	3	12	0.8
Great-tailed Grackle	*Quiscalus mexicanus*	Y	Y	3	3	3	3	12	0.8
Bronzed Cowbird	*Molothrus aeneus loyei*	Y	Y	2	3	2	3	10	0.8
Brown-headed Cowbird	*Molothrus ater*	Y	Y	2	3	2	3	10	0.8
Orchard Oriole	*Icterus spurius*	Rare	N	2	3	2	2	9	0.8
Hooded Oriole	*Icterus cucullatus*	Y	Y	1	2	2	2	7	0.5
Bullock's Oriole*	*Icterus bullockii*	Y	N	2	3	2	2	9	0.8
Scott's Oriole	*Icterus parisorum*	Y	Y	3	3	2	2	10	0.8
Pine Grosbeak	*Pinicola enucleator montana*	Y	Y	3	3	2	2	10	0.8
Cassin's Finch	*Carpodacus cassinii*	Y	Y	3	3	2	3	11	0.8
House Finch	*Carpodacus mexicanus frontalis*	Y	Y	3	3	2	3	11	0.8
Red Crossbill	*Loxia curvirostra*	Y	Y	3	3	2	3	11	0.8
Pine Siskin	*Carduelis pinus pinus*	Y	Y	3	3	3	3	12	0.8
Lesser Goldfinch	*Carduelis psaltria*	Y	Y	3	3	3	2	11	0.8
American Goldfinch	*Carduelis tristis pallidus*	Y	Y	3	3	3	3	12	0.8
Evening Grosbeak	*Coccothraustes vespertinus*	Y	Y	1	2	1	2	6	0.5
House Sparrow	*Passer domesticus*	Y	N	3	2	2	3	10	0.8

Table B-2. Sampling adequacy calculations for breeding bird species on National Forest System lands in Arizona and New Mexico with range maps available. Three precision scenrios were evaluated: 20% relative change with 80% confidence and power (20/.2/.2), 20% relative change with 90% confidence and power (20/.1/.1) and 10% relative change with 80% confidence and power (10/.2/.2).

					20/.2/.2			20/.1/.1			10/.2/.2		
Common Name	FIA pts range-wide	FIA pts breeding habitat	Pp value	Pd value	FIA pts needed range-wide	Have - Needed	Ade-quate	FIA pts needed range-wide	Have - Needed	Ade-quate	FIA pts needed range-wide	Have - Needed	Ade-quate
Mallard	35	167	0.1	0.8	574	-539	N	2008	-1973	N	1059	-1024	N
Northern Shoveler	6	43	0.1	0.5	948	-942	N	3320	-3314	N	1752	-1746	N
Northern Pintail	15	98	0.1	0.8	574	-559	N	2008	-1993	N	1059	-1044	N
Blue Grouse	645	471	0.8	0.1	574	71	Y	2008	-1363	N	1059	-414	N
Wild Turkey	2462	1973	0.8	0.5	76	2386	Y	258	2204	Y	136	2326	Y
Scaled Quail	300	23	0.1	0.5	948	-648	N	3320	-3020	N	1752	-1452	N
Gambel's Quail	400	340	0.8	0.5	76	324	Y	258	142	Y	136	264	Y
Northern Bobwhite	21	113	0.8	0.5	76	-55	N	258	-237	N	136	-115	N
Montezuma Quail	467	420	0.8	0.1	574	-107	N	2008	-1541	N	1059	-592	N
Double-crested Cormorant	3	1	0.5	0.5	151	-148	N	520	-517	N	275	-272	N
Great Blue Heron	106	10	0.1	0.5	948	-842	N	3320	-3214	N	1752	-1646	N
Green Heron	27	3	0.1	0.5	948	-921	N	3320	-3293	N	1752	-1725	N
Black-crowned Night-Heron	8	1	0.1	0.1	4934	-4926	N	17323	-17315	N	9136	-9128	N
Turkey Vulture	3259	3166	0.8	0.5	76	3183	Y	258	3001	Y	136	3123	Y
Mississippi Kite	11	115	0.1	0.5	948	-937	N	3320	-3309	N	1752	-1741	N
Bald Eagle	383	63	0.1	0.8	574	-191	N	2008	-1625	N	1059	-676	N
Sharp-shinned Hawk	2166	2166	0.8	0.5	76	2090	Y	258	1908	Y	136	2030	Y
Cooper's Hawk	2503	2437	0.8	0.8	21	2482	Y	98	2405	Y	52	2451	Y
Northern Goshawk	3245	1611	0.5	0.1	948	2297	Y	3320	-75	N	1752	1493	Y
Harris's Hawk	137	41	0.1	0.8	574	-437	N	2008	-1871	N	1059	-922	N
Swainson's Hawk	672	285	0.5	0.8	76	596	Y	258	414	Y	136	536	Y
Zone-tailed Hawk	1209	1142	0.8	0.5	76	1133	Y	258	951	Y	136	1073	Y

Table B-2 (cont.)

Common Name	FIA pts range-wide	FIA pts breeding habitat	Pp value	Pd value	20/.2/.2 FIA pts needed range-wide	20/.2/.2 Have - Needed	20/.2/.2 Ade-quate	20/.1/.1 FIA pts needed range-wide	20/.1/.1 Have - Needed	20/.1/.1 Ade-quate	10/.2/.2 FIA pts needed range-wide	10/.2/.2 Have - Needed	10/.2/.2 Ade-quate
Red-tailed Hawk	3258	3165	0.8	0.5	76	3182	Y	258	3000	Y	136	3122	Y
Ferruginous Hawk	1121	513	0.5	0.5	151	970	Y	520	601	Y	275	846	Y
Golden Eagle	3134	2892	0.8	0.1	574	2560	Y	2008	1126	Y	1059	2075	Y
American Kestrel	3082	2993	0.8	0.8	21	3061	Y	98	2984	Y	52	3030	Y
Prairie Falcon	1749	947	0.5	0.5	151	1598	Y	520	1229	Y	275	1474	Y
Killdeer	175	17	0.1	0.8	574	-399	N	2008	-1833	N	1059	-884	N
Mountain Plover	120	52	0.5	0.1	948	-828	N	3320	-3200	N	1752	-1632	N
Spotted Sandpiper	94	12	0.1	0.8	574	-480	N	2008	-1914	N	1059	-965	N
Common Snipe	23	2	0.1	0.1	4934	-4911	N	17323	-17300	N	9136	-9113	N
Rock Pigeon	8	1	0.1	0.8	574	-566	N	2008	-2000	N	1059	-1051	N
White-winged Dove	296	129	0.5	0.8	76	220	Y	258	38	Y	136	160	Y
Mourning Dove	3153	1778	0.5	0.5	151	3002	Y	520	2633	Y	275	2878	Y
Inca Dove	10	1	0.1	0.8	574	-564	N	2008	-1998	N	1059	-1049	N
Common Ground-Dove	14	4	0.1	0.8	574	-560	N	2008	-1994	N	1059	-1045	N
Greater Roadrunner	720	271	0.5	0.5	151	569	Y	520	200	Y	275	445	Y
Flammulated Owl	1867	1567	0.8	0	9999	-8132	N	99999	-98132	N	99999	-98132	N
Great Horned Owl	3257	3164	0.8	0.1	574	2683	Y	2008	1249	Y	1059	2198	Y
Northern Pygmy-Owl	1929	1023	0.5	0	99999	-98070	N	99999	-98070	N	99999	-98070	N
Elf Owl	396	140	0.5	0.1	948	-552	N	3320	-2924	N	1752	-1356	N
Burrowing Owl	1429	518	0.5	0.5	151	1278	Y	520	909	Y	275	1154	Y
Mexican Spotted Owl	1395	1168	0.8	0	9999	-8604	N	99999	-98604	N	99999	-98604	N
Long-eared Owl	3153	1593	0.5	0	99999	-96846	N	99999	-96846	N	99999	-96846	N

Northern Saw-whet Owl	1710	1545	0.8	0.1	574	1136	Y	2008	-298	N	1059	651	Y

Table B-2 (cont.)

					20/.2/.2			20/.1/.1			10/.2/.2		
Common Name	FIA pts range-wide	FIA pts breeding habitat	Pp value	Pd value	FIA pts needed range-wide	Have - Needed	Ade-quate	FIA pts needed range-wide	Have - Needed	Ade-quate	FIA pts needed range-wide	Have - Needed	Ade-quate
Lesser Nighthawk	285	168	0.5	0.5	151	134	Y	520	-235	N	275	10	Y
Common Nighthawk	2220	1803	0.8	0.8	21	2199	Y	98	2122	Y	52	2168	Y
Common Poorwill	1706	894	0.5	0.1	948	758	Y	3320	-1614	N	1752	-46	N
Whip-poor-will	942	490	0.5	0.1	948	-6	N	3320	-2378	N	1752	-810	N
White-throated Swift	2078	1521	0.8	0.8	21	2057	Y	98	1980	Y	52	2026	Y
Black-chinned Hummingbird	1617	672	0.5	0.5	151	1466	Y	520	1097	Y	275	1342	Y
Broad-tailed Hummingbird	1985	1717	0.8	0.5	76	1909	Y	258	1727	Y	136	1849	Y
Elegant Trogon	81	4	0.1	0.5	948	-867	N	3320	-3239	N	1752	-1671	N
Belted Kingfisher	758	29	0.1	0.8	574	184	Y	2008	-1250	N	1059	-301	N
Lewis's Woodpecker	1361	1558	0.8	0.8	21	1340	Y	98	1263	Y	52	1309	Y
Red-headed Woodpecker	29	1	0.1	0.8	574	-545	N	2008	-1979	N	1059	-1030	N
Gila Woodpecker	172	16	0.1	0.8	574	-402	N	2008	-1836	N	1059	-887	N
Williamson's Sapsucker	1615	1365	0.8	0.5	76	1539	Y	258	1357	Y	136	1479	Y
Red-naped Sapsucker	1382	932	0.8	0.5	76	1306	Y	258	1124	Y	136	1246	Y
Ladder-backed Woodpecker	1043	523	0.5	0.8	76	967	Y	258	785	Y	136	907	Y
Downy Woodpecker	1274	1133	0.8	0.8	21	1253	Y	98	1176	Y	52	1222	Y
Hairy Woodpecker	2312	1853	0.8	0.8	21	2291	Y	98	2214	Y	52	2260	Y
Northern Flicker	2860	1608	0.5	0.8	76	2784	Y	258	2602	Y	136	2724	Y
Olive-sided Flycatcher	1321	1233	0.8	0.5	76	1245	Y	258	1063	Y	136	1185	Y
Greater Pewee	354	32	0.1	0.5	948	-594	N	3320	-2966	N	1752	-1398	N

Willow Flycatcher	3284	151	0.1	0.8	574	2710	Y	2008	1276	Y	1059	2225	Y

Table B-2 (cont.)

					20/.2/.2			20/.1/.1			10/.2/.2		
Common Name	FIA pts range-wide	FIA pts breeding habitat	Pp value	Pd value	FIA pts needed range-wide	Have - Needed	Ade-quate	FIA pts needed range-wide	Have - Needed	Ade-quate	FIA pts needed range-wide	Have - Needed	Ade-quate
Hammond's Flycatcher	1281	1210	0.8	0.5	76	1205	Y	258	1023	Y	136	1145	Y
Gray Flycatcher	750	280	0.5	0.5	151	599	Y	520	230	Y	275	475	Y
Dusky Flycatcher	998	807	0.8	0.5	76	922	Y	258	740	Y	136	862	Y
Cordilleran Flycatcher	1239	852	0.8	0.5	76	1163	Y	258	981	Y	136	1103	Y
Black Phoebe	66	12	0.1	0.5	948	-882	N	3320	-3254	N	1752	-1686	N
Say's Phoebe	1769	1490	0.8	0.5	76	1693	Y	258	1511	Y	136	1633	Y
Vermilion Flycatcher	12	1	0.1	0.8	574	-562	N	2008	-1996	N	1059	-1047	N
Dusky-capped Flycatcher	158	107	0.8	0.5	76	82	Y	258	-100	N	136	22	Y
Ash-throated Flycatcher	2293	1841	0.8	0.8	21	2272	Y	98	2195	Y	52	2241	Y
Brown-crested Flycatcher	318	6	0.1	0.8	574	-256	N	2008	-1690	N	1059	-741	N
Cassin's Kingbird	2092	1185	0.5	0.8	76	2016	Y	258	1834	Y	136	1956	Y
Thick-billed Kingbird	6	1	0.1	0.8	574	-568	N	2008	-2002	N	1059	-1053	N
Western Kingbird	1877	1093	0.5	0.8	76	1801	Y	258	1619	Y	136	1741	Y
Eastern Kingbird	3	1	0.5	0.8	76	-73	N	258	-255	N	136	-133	N
Loggerhead Shrike	1621	1025	0.5	0.5	151	1470	Y	520	1101	Y	275	1346	Y
Bell's Vireo	233	14	0.1	0.8	574	-341	N	2008	-1775	N	1059	-826	N
Gray Vireo	999	232	0.1	0.8	574	425	Y	2008	-1009	N	1059	-60	N
Hutton's Vireo	394	196	0.5	0.8	76	318	Y	258	136	Y	136	258	Y
Gray Jay	156	141	0.8	0.5	76	80	Y	258	-102	N	136	20	Y
Steller's Jay	1720	1594	0.8	0.8	21	1699	Y	98	1622	Y	52	1668	Y

Common Name	FIA pts range-wide	FIA pts breeding habitat	Pp value	Pd value	FIA pts needed range-wide	Have - Needed	Ade-quate	FIA pts needed range-wide	Have - Needed	Ade-quate	FIA pts needed range-wide	Have - Needed	Ade-quate
Mexican Jay	296	232	0.8	0.8	21	275	Y	98	198	Y	52	244	Y

Table B-2 (cont.)

					20/.2/.2			20/.1/.1			10/.2/.2		
Common Name	FIA pts range-wide	FIA pts breeding habitat	Pp value	Pd value	FIA pts needed range-wide	Have - Needed	Ade-quate	FIA pts needed range-wide	Have - Needed	Ade-quate	FIA pts needed range-wide	Have - Needed	Ade-quate
Pinyon Jay	1476	774	0.5	0.8	76	1400	Y	258	1218	Y	136	1340	Y
Clark's Nutcracker	1228	1060	0.8	0.8	21	1207	Y	98	1130	Y	52	1176	Y
American Crow	1634	1445	0.8	0.8	21	1613	Y	98	1536	Y	52	1582	Y
Chihuahuan Raven	297	49	0.1	0.8	574	-277	N	2008	-1711	N	1059	-762	N
Horned Lark	780	161	0.1	0.5	948	-168	N	3320	-2540	N	1752	-972	N
Purple Martin	525	389	0.8	0.5	76	449	Y	258	267	Y	136	389	Y
Tree Swallow	1682	1427	0.8	0.8	21	1661	Y	98	1584	Y	52	1630	Y
Violet-green Swallow	2323	1881	0.8	0.8	21	2302	Y	98	2225	Y	52	2271	Y
Northern Rough-winged Swallow	1397	687	0.5	0.8	76	1321	Y	258	1139	Y	136	1261	Y
Bank Swallow	2	1	0.5	0.8	76	-74	N	258	-256	N	136	-134	N
Cliff Swallow	1498	53	0.1	0.8	574	924	Y	2008	-510	N	1059	439	Y
Barn Swallow	809	19	0.1	0.8	574	235	Y	2008	-1199	N	1059	-250	N
Black-capped Chickadee	485	288	0.5	0.8	76	409	Y	258	227	Y	136	349	Y
Bridled Titmouse	595	277	0.5	0.8	76	519	Y	258	337	Y	136	459	Y
Juniper Titmouse	2328	381	0.1	0.8	574	1754	Y	574	1754	Y	1059	1269	Y
Verdin	222	101	0.5	0.8	76	146	Y	258	-36	N	136	86	Y
Bushtit	1728	1665	0.8	0.8	21	1707	Y	98	1630	Y	52	1676	Y
Red-breasted Nuthatch	1480	1468	0.8	0.5	76	1404	Y	258	1222	Y	136	1344	Y
White-breasted Nuthatch	2450	1964	0.8	0.5	76	2374	Y	258	2192	Y	136	2314	Y
Pygmy Nuthatch	897	805	0.8	0.8	21	876	Y	98	799	Y	52	845	Y

Brown Creeper	1364	1146	0.8	0.1	574	790	Y	2008	-644	N	1059	305	Y

Table B-2 (cont.)

					20/.2/.2			20/.1/.1			10/.2/.2		
Common Name	FIA pts range-wide	FIA pts breeding habitat	Pp value	Pd value	FIA pts needed range-wide	Have - Needed	Ade-quate	FIA pts needed range-wide	Have - Needed	Ade-quate	FIA pts needed range-wide	Have - Needed	Ade-quate
Rock Wren	2079	370	0.1	0.8	574	1505	Y	574	1505	Y	1059	1020	Y
Canyon Wren	1381	703	0.5	0.8	76	1305	Y	258	1123	Y	136	1245	Y
Bewick's Wren	1277	1238	0.8	0.8	21	1256	Y	98	1179	Y	52	1225	Y
House Wren	1858	1542	0.8	0.8	21	1837	Y	98	1760	Y	52	1806	Y
Marsh Wren	23	476	0.1	0.8	574	-551	N	2008	-1985	N	1059	-1036	N
Golden-crowned Kinglet	506	477	0.8	0.8	21	485	Y	98	408	Y	52	454	Y
Ruby-crowned Kinglet	245	145	0.5	0.8	76	169	Y	258	-13	N	136	109	Y
Blue-gray Gnatcatcher	1327	976	0.8	0.5	76	1251	Y	258	1069	Y	136	1191	Y
Black-tailed Gnatcatcher	147	58	0.5	0.5	151	-4	N	520	-373	N	275	-128	N
Eastern Bluebird	57	3	0.1	0.8	574	-517	N	2008	-1951	N	1059	-1002	N
Western Bluebird	1939	1753	0.8	0.8	21	1918	Y	98	1841	Y	52	1887	Y
Mountain Bluebird	2278	1694	0.8	0.8	21	2257	Y	98	2180	Y	52	2226	Y
Townsend's Solitaire	1768	1508	0.8	0.8	21	1747	Y	98	1670	Y	52	1716	Y
Swainson's Thrush	1219	644	0.5	0.1	948	271	Y	3320	-2101	N	1752	-533	N
Hermit Thrush	1664	1375	0.8	0.1	574	1090	Y	2008	-344	N	1059	605	Y
American Robin	2018	1710	0.8	0.8	21	1997	Y	98	1920	Y	52	1966	Y
Northern Mockingbird	799	415	0.5	0.8	76	723	Y	258	541	Y	136	663	Y
Sage Thrasher	882	860	0.8	0.5	76	806	Y	258	624	Y	136	746	Y
Bendire's Thrasher	540	166	0.5	0.5	151	389	Y	520	20	Y	275	265	Y
Curve-billed Thrasher	493	212	0.5	0.5	151	342	Y	520	-27	N	275	218	Y
European Starling	173	107	0.5	0.8	76	97	Y	258	-85	N	136	37	Y

American Pipit	12	1	0.1	0.8	574	-562	N	2008	-1996	N	1059	-1047	N

Table B-2 (cont.)

					20/.2/.2			20/.1/.1			10/.2/.2		
Common Name	FIA pts range-wide	FIA pts breeding habitat	Pp value	Pd value	FIA pts needed range-wide	Have - Needed	Ade-quate	FIA pts needed range-wide	Have - Needed	Ade-quate	FIA pts needed range-wide	Have - Needed	Ade-quate
Phainopepla	1579	133	0.1	0.8	574	1005	Y	2008	-429	N	1059	520	Y
Olive Warbler	495	262	0.5	0.5	151	344	Y	520	-25	N	275	220	Y
Orange-crowned Warbler	1364	1194	0.8	0.8	21	1343	Y	98	1266	Y	52	1312	Y
Virginia's Warbler	1961	1534	0.8	0.8	21	1940	Y	98	1863	Y	52	1909	Y
Lucy's Warbler	278	494	0.5	0.8	76	202	Y	258	20	Y	136	142	Y
Yellow Warbler	1082	28	0.1	0.8	574	508	Y	2008	-926	N	1059	23	Y
Yellow-rumped Warbler	1778	1549	0.8	0.8	21	1757	Y	98	1680	Y	52	1726	Y
Black-throated Gray Warbler	3282	773	0.1	0.8	574	2708	Y	2008	1274	Y	1059	2223	Y
Grace's Warbler	764	610	0.8	0.8	21	743	Y	98	666	Y	52	712	Y
MacGillivray's Warbler	1277	490	0.5	0.8	76	1201	Y	258	1019	Y	136	1141	Y
Common Yellowthroat	9	2	0.1	0.8	574	-565	N	2008	-1999	N	1059	-1050	N
Wilson's Warbler	1312	1093	0.8	0.8	21	1291	Y	98	1214	Y	52	1260	Y
Red-faced Warbler	783	657	0.8	0.8	21	762	Y	98	685	Y	52	731	Y
Painted Redstart	426	280	0.8	0.8	21	405	Y	98	328	Y	52	374	Y
Hepatic Tanager	2175	945	0.5	0.1	948	1227	Y	3320	-1145	N	1752	423	Y
Summer Tanager	14	2	0.1	0.5	948	-934	N	3320	-3306	N	1752	-1738	N
Western Tanager	1743	1512	0.8	0.8	21	1722	Y	98	1645	Y	52	1691	Y
Green-tailed Towhee	1635	1222	0.8	0.5	76	1559	Y	258	1377	Y	136	1499	Y
Spotted Towhee	1276	452	0.5	0.8	76	1200	Y	258	1018	Y	136	1140	Y
Canyon Towhee	1194	514	0.5	0.8	76	1118	Y	258	936	Y	136	1058	Y

Cassin's Sparrow	268	9	0.1	0.5	948	-680	N	3320	-3052	N	1752	-1484	N

Table B-2 (cont.)

					20/.2/.2			20/.1/.1			10/.2/.2		
Common Name	FIA pts range-wide	FIA pts breeding habitat	Pp value	Pd value	FIA pts needed range-wide	Have - Needed	Ade-quate	FIA pts needed range-wide	Have - Needed	Ade-quate	FIA pts needed range-wide	Have - Needed	Ade-quate
Rufous-crowned Sparrow	1448	220	0.1	0.5	948	500	Y	3320	-1872	N	1752	-304	N
Chipping Sparrow	2494	2127	0.8	0.8	21	2473	Y	98	2396	Y	52	2442	Y
Brewer's Sparrow	331	32	0.1	0.5	948	-617	N	3320	-2989	N	1752	-1421	N
Black-chinned Sparrow	688	275	0.5	0.8	76	612	Y	258	430	Y	136	552	Y
Vesper Sparrow	386	55	0.1	0.8	574	-188	N	2008	-1622	N	1059	-673	N
Lark Sparrow	1074	414	0.5	0.8	76	998	Y	258	816	Y	136	938	Y
Black-throated Sparrow	371	107	0.1	0.5	948	-577	N	3320	-2949	N	1752	-1381	N
Lark Bunting	275	12	0.1	0.8	574	-299	N	2008	-1733	N	1059	-784	N
Savannah Sparrow	121	11	0.1	0.8	574	-453	N	2008	-1887	N	1059	-938	N
Song Sparrow	128	34	0.1	0.8	574	-446	N	2008	-1880	N	1059	-931	N
Lincoln's Sparrow	40	882	0.1	0.5	948	-908	N	3320	-3280	N	1752	-1712	N
Dark-eyed Junco	1798	1446	0.8	0.8	21	1777	Y	98	1700	Y	52	1746	Y
Yellow-eyed Junco	25	16	0.5	0.8	76	-51	N	258	-233	N	136	-111	N
Northern Cardinal	318	789	0.5	0.8	76	242	Y	258	60	Y	136	182	Y
Pyrrhuloxia	135	17	0.1	0.8	574	-439	N	2008	-1873	N	1059	-924	N
Black-headed Grosbeak	1380	1322	0.8	0.8	21	1359	Y	98	1282	Y	52	1328	Y
Lazuli Bunting	58	8	0.1	0.8	574	-516	N	2008	-1950	N	1059	-1001	N
Indigo Bunting	451	15	0.1	0.8	574	-123	N	2008	-1557	N	1059	-608	N
Varied Bunting	248	20	0.1	0.8	574	-326	N	2008	-1760	N	1059	-811	N
Red-winged Blackbird	45	3	0.1	0.8	574	-529	N	2008	-1963	N	1059	-1014	N

Eastern Meadowlark	156	16	0.1	0.8	574	-418	N	2008	-1852	N	1059	-903	N

Table B-2 (cont.)

					20/.2/.2			20/.1/.1			10/.2/.2		
Common Name	FIA pts range-wide	FIA pts breeding habitat	Pp value	Pd value	FIA pts needed range-wide	Have - Needed	Ade-quate	FIA pts needed range-wide	Have - Needed	Ade-quate	FIA pts needed range-wide	Have - Needed	Ade-quate
Western Meadowlark	516	50	0.1	0.8	574	-58	N	2008	-1492	N	1059	-543	N
Brewer's Blackbird	100	19	0.1	0.8	574	-474	N	2008	-1908	N	1059	-959	N
Great-tailed Grackle	27	3	0.1	0.8	574	-547	N	2008	-1981	N	1059	-1032	N
Bronzed Cowbird	74	10	0.1	0.8	574	-500	N	2008	-1934	N	1059	-985	N
Brown-headed Cowbird	2598	2417	0.8	0.8	21	2577	Y	98	2500	Y	52	2546	Y
Hooded Oriole	32	5	0.1	0.5	948	-916	N	3320	-3288	N	1752	-1720	N
Scott's Oriole	1492	932	0.5	0.8	76	1416	Y	258	1234	Y	136	1356	Y
Pine Grosbeak	323	289	0.8	0.8	21	302	Y	98	225	Y	52	271	Y
Cassin's Finch	1698	1407	0.8	0.8	21	1677	Y	98	1600	Y	52	1646	Y
House Finch	2907	2767	0.8	0.8	21	2886	Y	98	2809	Y	52	2855	Y
Red Crossbill	3245	1993	0.5	0.8	76	3169	Y	258	2987	Y	136	3109	Y
Pine Siskin	1842	1591	0.8	0.8	21	1821	Y	98	1744	Y	52	1790	Y
Lesser Goldfinch	2893	1612	0.5	0.8	76	2817	Y	258	2635	Y	136	2757	Y
American Goldfinch	941	267	0.1	0.8	574	367	Y	2008	-1067	N	1059	-118	N
Evening Grosbeak	1771	1529	0.8	0.5	76	1695	Y	258	1513	Y	136	1635	Y

Table B-3 . Predicted adequacy of avian point-count sampling for breeding birds (by taxonomic groups) expected to occur in National Forest lands in Region 3 (Arizona and New Mexico).

Order	Family	Number of species	≥ 20% relative change with 80% confidence and power: Number adequately detected	≥ 20% relative change with 80% confidence and power: Percent adequately detected	≥ 20% relative change with 90% confidence and power: Number adequately detected	≥ 20% relative change with 90% confidence and power: Percent adequately detected	≥ 10% relative change with 80% confidence and power: Number adequately detected	≥ 10% relative change with 80% confidence and power: Percent adequately detected
Anseriformes		3	0	0	0	0	0	0
	Anatidae (Swans, geese, ducks)	3	0	0	0	0	0	0
Galliformes		6	3	50	2	33	2	33
	Phasianidae (Grouse)	2	2	100	1	50	1	50
	Odontophoridae (Quail)	4	1	25	1	25	1	25
Pelecaniformes		1	0	0	0	0	0	0
	Phalacrocoracidae (Cormorants)	1	0	0	0	0	0	0
Ciconiiformes		3	0	0	0	0	0	0
	Ardeidae (Herons)	3	0	0	0	0	0	0
Falconiformes		14	11	79	10	71	11	79
	Cathartidae (New world vultures)	1	1	100	1	100	1	100
	Accipitridae (Eagles, kites, hawks)	11	8	73	7	64	8	73
	Falconidae (Falcons)	2	2	100	2	100	2	100
Charadriiformes		4	0	0	0	0	0	0
	Charadriidae (Plovers)	2	0	0	0	0	0	0
	Scolopacidae (Sandpipers)	2	0	0	0	0	0	0

(Table B-3 cont.)

Order	Family	Number of species	≥ 20% relative change with 80% confidence and power		≥ 20% relative change with 90% confidence and power		≥ 10% relative change with 80% confidence and power	
			Number adequately detected	Percent adequately detected	Number adequately detected	Percent adequately detected	Number adequately detected	Percent adequately detected
Columbiformes		5	2	40	2	40	2	40
	Columbidae (Doves)	5	2	40	2	40	2	40
Cuculiformes		1	1	100	1	100	1	100
	Culucidae (Cuckoos, roadrunners)	1	1	100	1	100	1	100
Strigiformes		8	3	38	2	25	3	38
	Strigidae (Owls)	8	3	38	2	25	3	38
Caprimulgiformes		4	3	75	1	25	2	50
	Caprimulgidae (Nightjars)	4	3	75	1	25	2	50
Apodiformes		3	3	100	3	100	3	100
	Apodidae (Swifts)	1	1	100	1	100	1	100
	Trochilidae (Hummingbirds)	2	2	100	2	100	2	100
Trogoniformes		1	0	0	0	0	0	0
	Trogonidae (Trogons)	1	0	0	0	0	0	0
Coraciiformes		1	1	100	0	0	0	0
	Alcedinidae (Kingfishers)	1	1	100	0	0	0	0
Piciformes		9	7	78	7	78	7	78
	Picidae (Woodpeckers)	9	7	78	7	78	7	78

(Table B-3 cont.)

Order	Family	Number of species	≥ 20% relative change with 80% confidence and power: Number adequately detected	≥ 20% relative change with 80% confidence and power: Percent adequately detected	≥ 20% relative change with 90% confidence and power: Number adequately detected	≥ 20% relative change with 90% confidence and power: Percent adequately detected	≥ 10% relative change with 80% confidence and power: Number adequately detected	≥ 10% relative change with 80% confidence and power: Percent adequately detected
Passeriformes		124	88	71	70	56	83	67
	Tyrannidae (Flycatchers)	17	11	65	10	59	11	65
	Laniidae (Shrikes)	1	1	100	1	100	1	100
	Vireonidae (Vireos)	3	2	67	1	33	1	33
	Corvidae (Jays and crows)	7	6	86	5	71	6	86
	Alaudidae (Larks)	1	0	0	0	0	0	0
	Hirundinidae (Swallows)	7	6	86	4	57	5	71
	Paridae (Chickadees and titmice)	3	3	100	3	100	3	100
	Remizidae (Verdin)	1	1	100	0	0	1	100
	Aegithalidae (Bushtit)	1	1	100	1	100	1	100
	Sittidae (Nuthatches)	3	3	100	3	100	3	100
	Certhidae (Creepers)	1	1	100	0	0	1	100
	Troglodytidae (Wrens)	5	4	80	4	80	4	80
	Regulidae (Kinglets)	2	2	100	1	50	2	100

(Table B-3 cont.)

Order	Family	Number of species	≥ 20% relative change with 80% confidence and power		≥ 20% relative change with 90% confidence and power		≥ 10% relative change with 80% confidence and power	
			Number adequately detected	Percent adequately detected	Number adequately detected	Percent adequately detected	Number adequately detected	Percent adequately detected
	Sylviidae (Gnatcatchers)	2	1	50	1	50	1	50
	Turdidae (Thrushes)	7	6	86	4	57	5	71
	Mimidae (Mockingbirds and thrashers)	4	4	100	3	75	4	100
	Sturnidae (Starlings)	1	1	100	0	0	1	100
	Motacillidae (Pipits)	1	0	0	0	0	0	0
	Ptilogonatidae (Phainopepla)	1	1	100	0	0	1	100
	Peucedramidae (Olive warbler)	1	1	100	0	0	1	100
	Parulidae (Warblers)	12	11	92	10	83	11	92
	Thraupidae (Tanagers)	3	2	67	1	33	2	67
	Emerizidae (Towhees and sparrows)	17	8	47	7	41	7	41
	Cardinalidae (Grosbeaks and buntings)	6	2	33	2	33	2	33
	Iceridae (Blackbirds and orioles)	9	2	22	2	22	2	22
	Fringillidae (Finches)	8	8	100	7	88	7	88

Appendix C:

Sample datasheets for point counts and habitat data collection

Observer____________________ **POINT COUNT DATA** Date________________________

Sample Unit_________________ Visit #______________________

			0-3 min						3-5 min						5-10 min					
Station	**Time**	**Spcode**	**0-25**	**25-50**	**50-75**	**75-100**	**>100**	**FO**	**0-25**	**25-50**	**50-75**	**75-100**	**>100**	**FO**	**0-25**	**25-50**	**50-75**	**75-100**	**>100**	**FO**

Noise ____ **Weather** **Incidentals** ______________________

Other Disturbance ______________________________ **Temp** _______ **Wind** _______ ______________________

Comments ______________________________________ **Sky** _______ ______________________

POINT COUNT AND BAT SITE
DATA SHEET FOR HABITAT-VEGETATION

OBS:_________________________ DATE:______________ PAGE:_____of _____

SURVEY POINT:_________________ PC:__________ VISIT:_________

** perhaps edit to have both transects listed in line across page and have page landscape, then leave room for many plant species names to be added in lines below cover types after cover percentages determined at each 1 m section, then list all species detected in each 1 m section

Line intercept ground cover

Transect	GROUND COVER TYPE/ PLANT SP.	Percent of 1 meter length					Transect	Percent of 1 meter length				
		0 - 1 m	5 - 6 m	10 - 11 m	15 - 16 m	20 - 21 m		0 - 1 m	5 - 6 m	10 - 11 m	15 - 16 m	20 - 21 m
180 azi	Rock						90 or 270					
	Litter						(circle)					
	Bare Soil											
	Woody debris (>3in diam)											
	Grasslike (sedge, grass rush)											
	Herb											
	Shrub											
	Tree											

* put check marks in each line transect for presence of each plant species identified
** estimate % cover for each cover class. Total cover must = 100%
*** cover is anything below 0.5m in height

POINT COUNT rev. 7/1/04
DATA SHEET FOR HABITAT-VEGETATION

General Plot Information

OBS:______________________ DATE:____________ PAGE:_____of _____

SURVEY POINT:______________ PC:________ VISIT:_________

Vegetation type (CWHR Type):____________________ Aspect:___________ (Ikonos)

% Slope uphill:___________ (Ikonos) downhill:__________ (Ikonos) average:__________ (Ikonos)

Disturbance (compacted soil and impermeable surfaces) within 30 m:

	Area (m2)
Hwy	________________
Paved rd	________________
Primary use dirt rd	________________
Secondary use dird rd	________________
Trail (only human use)	________________
Other ________________ (compacted soil due to human activity)	________________

presence of invasive weeds (Y/N; list species_____ ____________________

Distance to nearest road or trail w/in 100m: Type _______________ (Ikonos) Distance (m) ___________ (Ikonos)

Distance to water w/in 100 m: Type ____________________ (Ikonos) Distance (m) _______________ (Ikonos)

16th ACRE (24 ft or 7.3 m radius) SUBPLOT

% Cover

Litter:______ (including course woody debris) Rock:_______ Live Vegetation:_______ (including basal area of trees) Bare Soil/Sand:________

Canopy Cover @ edge of 1/4 ac plot (number of open dots)

	Dots						
North	N	South	N	East	N	West	N
	E		E		E		E
	S		S		S		S
	W		W		W		W

POINT COUNT
DATA SHEET FOR HABITAT-VEGETATION
16th ACRE (24 ft or 7.3 m radius) SUBPLOT

*Note: Do not repeat trees across three plots.

** For all plots, liner trees need to be ≥ 1/2 in plot to be measured and recorded.

OBS:____________________________ DATE:_______________ PAGE:_____of _____

SURVEY POINT:__________________ PC:_________ VISIT:__________

TREE SP ≥ 12.5 cm	DBH cm	HEIGHT m	DECAD. code

SNAG SP ≥ 12.5 cm	DBH cm	HEIGHT m	DECAY (1-5)

1/4 ACRE (58 ft or 17.6 m radius) PLOT

TREE SP ≥28 cm	DBH cm	HEIGHT meters	DECAD.

TREE SP.	DBH	Height	DECAD.

SNAG SP ≥ 12.5 cm	DBH (cm)	HEIGHT (m)	DECAY (1-5)

Note: Across all 3 plot sizes; only measure height of first 3 live trees per spp in each site class.
Measure height of all snags. [12.5cm - 28cm, 28cm - 61cm, 61cm - 76.2cm, >76.2cm]

POINT COUNT
DATA SHEET FOR HABITAT-VEGETATION
1 HECTARE (186 ft or 56.4 m radius) PLOT

OBS:___________________________ DATE:_________ PAGE:_____ of _____

SURVEY POINT:_________________ PC:_________ VISIT:_________

TREE SP ≥ 61 cm	DBH cm	HEIGHT (m)	DECAD. code

SNAG SP ≥ 28 cm	DBH cm	HEIGHT (m)	DECAY class

POINT COUNT
DATA SHEET FOR HABITAT-VEGETATION
EXTRA TREE SHEET

OBS:____________________________ DATE:__________ PAGE:_____ of _____

SURVEY POINT:__________________ PC:__________ VISIT:__________

PLOT	TREE OR SNAGS	SPECIES	DBH cm	HEIGHT meters	DECAD/ DECAY

* Plot = 24 ft
1/4 AC
1ha

Note: Decadence codes only recorded for live trees. (live tree is any tree with at least some green stems on it)

POINT COUNT
DATA SHEET FOR HABITAT-VEGETATION
1/4 ACRE (58 ft or 17.6 m radius) PLOT

OBS:__________________________ DATE:______________ PAGE:_____of _____

SURVEY POINT:_________________ PC:__________ VISIT:_________

VEGETATION TRANSECT POINT INTERCEPT

180 degree Azimuth			
Point Intercept	Litter Depth(mm)	Plant Species	Height Interval
1m			
3m			
5m			
7m			
9m			
11m			
13m			
15m			
17m			
19m			
21m			
23m			
25m			

Coarse Woody Debris Transect
180 degree Azimuth

SPECIES	DIA.SM END (cm)	DIA.LG END (cm)	LENGTH to 0.5 m	DECAY CLASS

* write "None" if no logs intersect transect.

** if species of tree can not be determined, record whether it is conifer (C) or hardwood (H)

POINT COUNT
DATA SHEET FOR HABITAT-VEGETATION
1/4 ACRE (58 ft or 17.6 m radius) PLOT

OBS:___________________________ DATE:_______________ PAGE:_____of _____

SURVEY POINT:__________________ PC:___________ VISIT:__________

LINE TRANSECT POINT INTERCEPT

90 0r 270 degree Azimuth			
Point Intercept	Litter Depth(mm)	Plant Species	Height Increment
1m			
3m			
5m			
7m			
9m			
11m			
13m			
15m			
17m			
19m			
21m			
23m			
25m			

** Height intervals:

.5 = 0-.5	4 = 3-4	8 = 7-8	20 = 15-20
1 = .5-1	5 = 4-5	9 = 8-9	25 = 20-25
2 = 1-2	6 = 5-6	10 = 9-10	30 = 25-30
3 = 2-3	7 = 6-7	15=10-15	35 = 30-35

Note: Use clinometer for height interval when needed

Coarse Woody Debris Transect

90 or 270 degree Azimuth

SPECIES	DIA.SM END(cm)	DIA.LG END(cm)	LENGTH to 0.5 m	DECAY CLASS

* write "None" if no logs intersect transect.
** if species of tree can not be determined, record whether it is conifer (C) or hardwood (H)

Appendix D:

Contracting recommendations

The following table may provide assistance in planning and implementing a work contract for completing MSIM projects. The information provided is only a timeline tool and reference guide found useful in establishing contracts in Region 5, and may not be completely accurate for contracting procedures in Region 3. We recommend that you contact a contract specialist in your Region prior to planning contracts.

Item #	Planning objective/product produced	# days work	Timeframe for initiation	Deadline for completion	Comments
1	Add project to Advanced Acquisition Plan (AAP)	0.25	ASAP (121 days prior to start date of work)	121 days before start date	Immediately after you hear about funding for your project. This assigns a Contracting Officer (CO) to your project
2	Complete all supporting documents for a contracting "Request for proposal"	5 to 10	ASAP (start 120 days prior to work start date)	110 days before start date	Be as detailed/clear as possible on this document. If you can, start this prior to Item #1
	a). Solicitation Package checklist				Work with a contract specialist, or find contract information webpage for your Region.
	b). Request for contract action				
	c). Funds Availability Certification Worksheet				
	d). Computation of contract Time				
	e). Contract Specs or Statement of Work (This takes the most time to develop)				

	f). Indicate a requested COR for your project				
	g). Other items as specified by the Contracting Officer				
3	Correspondance with CO to finalize supporting documents	3	117 days prior to work start date	114 days before start date	
	a). Complete "Contractor Representative Designation" Form				This formally assigns a COR to the project. Someone with the required training you can lean on for advice in the contracting process
	b). Complete "Designation of Inspectors" Form				
4	Submit all completed documents to CO (via email and originals in mail)	0.25	116 days prior to work start date	113 days before start date	
5	Develop proposal evaluation criterion to objectively rate proposals	1	115-27 days prior to work start date	112 days before start date	Proposals >$100K require development of formal evaluation criterion. Criterion are developed based on importance of performance and/or contractor cost
6	Receive proposals from contractors	0	26 days prior to work start date	26 days before start date	RPF (request for proposal) must be on website for 90 days (if contract is less than $1 million)
7	Read/Evaluate proposals, and develop criterion to evaluate upcoming interviews	5	Start 26 days prior to work start date	21 days before start date	
8	Schedule/Conduct interviews of top 2-5 contractors	2	Start 21 days prior to work start date	19 days before start date	

9	Evaluate interviews and schedule start up meetings	2	Start 19 days prior to work start date	17 dyas before start date	
10	Prepare for Start up meeting	1	Start 17 days prior to work start date	variable	Depends on how soon contractor can meet for start up meeting.
11	Startup meeting	1	Meet 10 days prior to work start date	9 days before start date	
12	Respond to questions/concerns, additional info requests from Start up meeting	2	Start 9 days prior to work start date	7 days before start date	
13	Secondary Startup meeting (if necessary)	0.5	Start 7 days prior to work start date	6 days before start date	
14	Project Initiation	1	Day of protocol start date	day of protocol start date	Be available on site for questions that arise in the field on first day of project initiation
15	Week 1 Project weekly inspection and write up (daily/weekly journal entries)	2		7 days after start date	Be sure to update contractor with a brief performance evaluation
16	Week 2 Project weekly inspection and write up (daily/weekly journal entries)	2		14 days after start date	Be sure to update contractor with a brief performance evaluation
17	Week 3 Project weekly inspection and write up (daily/weekly journal entries)	2		21 days after start date	Be sure to update contractor with a brief performance evaluation
18	Continue weekly inspections/writeup/journal througout contract period	2 days X ? Weeks		Last day of contract deliverables	

19	Final contract evaluation (write up)	1	Start 1 week after all deliverables received		Basically a summary of weekly inspection reports and overal performance evaluation of the contractor
20	Contract completion meeting	0.5	Start 1-2 weeks after contract completion	1-2 weeks after contract completion	Meet with contractor to discuss their performance evaluation, and for feedback for improving future contracting efforts

* Potential work associated with contract:
1). If contractor not meeting specifications of the statement of work (contract): may require a few days time to meet with COR and discuss options/inform contractor

2). If contractor requests a contract modification (price or otherwise). May need 2-3 days to review request, discuss with COR and CO and produce modification documents: SF-30, + justification, + other documents requested by CO
** NOTE: If contract is for greater than $1 million, than you must add 30 days to the timeline (as the RFP must be on the RFP website for 120 days, not 90 days)

** NOTE2: If you are hiring a contractor that is not already familiar with the type of work being conducted, add approximately 1-2 weeks of time prior to the start date necessary for surveys in order for contractor to conduct in the field training with 50% to 100% availability of the project manager to aid in the training process.

Appendix E:

Sample position announcement and job listing locations

BIOLOGICAL FIELD TECHNICIANS (30-40) needed for a multi-species inventory and monitoring project with the USDA Forest Service at the ___________National Forest in beautiful new Mexico and Arizona starting early-mid May through Aug/Sept. Positions are GS-404- 07 ($16.46/hr) level positions primarily, but may also be GS-404-05 ($13.29/hr). Duties include conducting early morning point count surveys for terrestrial and aquatic birds throughout the New Mexico and/or Arizona. These positions will require that individuals have at least 2 full seasons prior experience conducting point counts surveys and at least 1 full season within the past 3-4 years surveying for birds in the southwest. Must have excellent bird identification skills and are able to identify western birds by sight and sound. Applicants may be required to pass a hearing test. All positions will require self-motivated individuals with the ability to work well alone and with others, work long field days, navigate effectively across terrain with map/compass and GPS unit, hike off trails and off roads to remote survey locations, have an excellent driving record, drive 4x4 vehicles on dirt roads, be organized and accountable for all data collected, and be willing to help out when needed with other aspects of the projects. Positions may additionally involve site set-up and flagging, and site habitat measures. Government housing is NOT guaranteed, but assistance in finding affordable housing in the local area will be provided. Please contact ______________ (Email: ____________ , Phone: ______________) for information on how to apply.

Ecology-based internet listservs and university job boards are excellent resources for posting position announcement:

BIRDJOBS-L	http://www.nmnh.si.edu/birdnet/elists/BIRDJOBSL.html
ORNITH-L	http://www.nmnh.si.edu/BIRDNET/elists/ORNITHL.html
Ornithological Newsletter	http://birds.cornell.edu/OSNA/ornnewsl.htm
TWS-WEST	http://www.tws-west.org/jobs.html
TWS-L	http://www.wildlife.org/professional/index.cfm?tname=listserv
STUDENT-TWS	http://www.wildlife.org/professional/index.cfm?tname=listserv
ECOLOG-L	http://www.nmnh.si.edu/BIRDNET/elists/ECOLOGL.html
CONSBIO	http://www.aldea.com/guides/ag/a712.html

ENVJOBS http://environment.harvard.edu/activities/email/envjobsl.php?&pw=780#II

TX A&M Wildlife Job Board http://www.wfsc.tamu.edu/jobs/job_view.cfm

Appendix F:
Job Hazard Analyses

This analysis is to be used as a guide only, as field hazards may differ in your region.

FS-6700-7 (11/99)

U.S. Department of Agriculture Forest Service	1. WORK PROJECT/ACTIVITY MSIM Projects General office work, vehicle operation, general field work	2. LOCATION	3. UNIT Wildlife & Ecology
JOB HAZARD ANALYSIS (JHA) References-FSH 6709.11 and -12 (Instructions on Reverse)	4. NAME OF ANALYST	5. JOB TITLE Wildlife Biologist	6. DATE PREPARED 05/22/2003

7. TASKS/PROCEDURES	8. HAZARDS	9. ABATEMENT ACTIONS Engineering Controls * Substitution * Administrative Controls * PPE
Office Work	Personal Injury	
Ergonomics	Hands, Wrists, Back and Eye Injury	Maintain paperwork station setup and alignment with adequate illumination. Use an adjustable chair (wrists/foot rests if necessary). Take frequent breaks. Practice stretching exercises and relaxing techniques.
Walking Surfaces	Slips, Trips, Falls	Keep individual work areas and storage rooms clean, orderly, and free of tripping/ slipping hazards. Ensure that the appropriate means of ingress/egress are available and sufficiently lighted at all times. Use hand rails when going up or down stairways.
Lifting	Back Injury	Ask for help if load is heavy. Do not try to lift or otherwise move material beyond ability; reduce weight of object by packing smaller parcels instead of

		one large one. Use mechanical devices to help lift and move materials, or request contract moving services.
Material Storage	Falling Objects	Remove materials from top of file cabinets, bookcases, any location above shoulder height. Use suitable step stool or ladder to avoid lifting above shoulder height.
Chemical Storage	Fire, Burns	Incidental storage of flammables/combustibles must be in an NFPA approved storage cabinet and labeled "Flammable - keep Fire Away". Never store flammable/combustible liquids in office areas except those required for maintenance and operation of building and equipment. Such storage must be in closed metal containers in a storage cabinet or in safety containers.
Heaters/appliance use in office and barracks	Burns, smoke inhalation	All portable heaters and electrical appliances must have authorization from Property. Staff directors are responsible for checking approvals. Approved heaters and appliances shall be connected to a ground fault interrupter.
Appliance use	Electrical Shock	Do not use extension cords in place of permanent wiring circuits. Locate cords away from heat sources and protected from abrasion, crushing, and kinking. Disconnect cords only by pulling on the plug. Never knot a cord. Inspect and replace damaged or frayed electrical cords. Do not overload circuits. Shut off power before working on any machines. Never touch appliances, tools, or machines with wet hands while grounded or touching plumbing pipes or faucets.
Building Evacuation	Fire, Bomb Threat	Refer to Occupant Emergency Plan.
FIREARMS		Firearms are <u>prohibited</u> in the field and at government provided housing.
DRUGS and ALCOHOL		The use of drugs or alcohol is <u>prohibited</u> while on duty. Notify the supervisor if an employee’s work is affected by the apparent use of drugs or alcohol.

7. TASKS/PROCEDURES	8. HAZARDS	9. ABATEMENT ACTIONS Engineering Controls * Substitution * Administrative Controls * PPE
General Field Work	Personal Injury	
Walking Surfaces	Slips, Trips, Falls, Other injuries	Use caution while stepping on logs, log decks, and jack-strawed logs. Be aware of animal holes, eroding stream banks, rocks and debris. When hiking, use appropriate footwear designed for hiking. Six inch hiking boots are preferred over 8 or 10 inch boots because hiking boots are (1) designed to support the foot under a load, and (2) taller boots may cause shin splints while hiking with a heavy load up steep inclines. Plan ahead. Select safe routes and watch your footing. Use caution on steep slopes. If you feel yourself slipping, pick a landing spot. Know how to fall. Try to land in the least obstructed spot. Protect your head and back. Roll with the fall. Do not stick your arms out to break a fall. While hiking on trails that are free of brush, shorts may be worn as they are less binding, allow for unencumbered body movement, and allow for evaporation of perspiration.
	Slips, Trips, Falls, Other injuries (continued)	If you need to push branches out of your way, push branches down rather than away from you. Be aware of people behind you when moving branches to avoid branches from swinging and hitting them. Never run. When contouring steep slopes, do not lean into the hill. This tends to loosen footing. Erect posture or slightly leaning out gives more secure footing. Safe walking and working distance in mountainous terrain is 10’ minimum between people.

		Do not walk below people or hazards that parallel your path. In other words, avoid rolling rocks or falling bodies. Up...when moving uphill or in sandy soils, lean slightly forward, turn feet outward, shorten stride and use as much of the inside foot as possible. Down...on slippery or loose ground, or going downhill, keep most of your weight on your heels. Shorten your stride, keep knees bent, and lean slightly backward. Slow down and exaggerate steps in area of exposed roots or downed wood to keep from catching your toes. Never run blindly if a rolling rock or tree is heard. Try to determine the direction of fall, then move out of its path.
	Water crossings	Choose stream crossing routes by scouting the area first. Avoid crossing when water levels are higher than knee height. Avoid crossing on logs whenever possible. To secure footing, use a stick or pole, placing it on the upstream side at a slight angle. Work the pole ahead to test for deep holes, then wade up to the pole. Stay out of areas with swift current, especially after heavy snowfall, rain, or spring melt. Use appropriate footwear with non-slip soles while waking in streams. Do not wear tevas or sandals in streams. While working in water, avoid wearing jeans because once wet and heavy they may impede body movements. Avoid hypothermia by wearing waders or by wearing clothing that will dry quickly. Caution must be taken as to not allow water to enter waders. Quick drying pants are preferred over jeans. When possible, step on streambed proper instead of the tops of boulders that may be slippery.
Backpacking/Camping	Slips, Trips, Falls, and	See “Walking Surfaces” above regarding footwear and clothing.

	Sprains, Burns	First-aid and CPR is required by at least one crew member. Backpacks should be loaded with the weight distributed closest to the back and toward the middle of the pack. Limit the amount of equipment attached to the exterior of the pack. Use proper lifting techniques while getting the pack on your back. Have someone help lift pack or prop pack on rock or tailgate. Cooking and waste disposal in accordance with proper backcountry ethics (Leave NO Trace). Dispose wastewater 500 ft from water. Use approved fuel containers. Follow fire restrictions. Carry a first-aid kit. Wear a hard hat in forested areas during high winds.
	Falling logs/snags	Avoid traveling or camping under a snag or rock slide in windy weather. Choose sites free of unsound trees or limbs, danger from rolling rocks, and danger of flooding. Set up camp before dark. Follow all Forest Service rules and regulations for camping. Carry campfire permits if necessary.
	Campfire	Be fire safe. You are responsible for your own fires. Never leave fire unattended. Follow all rules, regulations and restrictions. Make sure fires are completely out. Drown any smolders with water before vacating the area. Do not leave trash in firepits. Do not throw batteries, glass in firepit.
	Bees, wasps, yellowjackets, mosquitos	Do not provoke wasps and bees by swinging or swatting at them. Remain calm and move away from the area. Fill out a CA-1 if stung. Stay alert for sights and sounds of bees - on the ground as well as above. Walk around any nests you encounter. Inform coworkersof bee hazard areas- flag nearby if possible. Know about past allergic reactions in your coworkers. If you are allergic, or are unsure, carry a doctor prescribed bee sting kit (epinephrine) with you at all times and check to see that the kit's expiration date has not expired. Inform your coworkers as to the location of the kit so it can be administered if stung. Wear long sleeve shirts and trousers and tuck in

		shirt. Bright colors, perfumes, and metal objects may attract bees. If stung, cold compresses may bring relief. If a stinger is left behind, scrape it off the skin. Do not use tweezers as this squeezes the venom sack, worsening the injury. If the victim develops hives, asthmatic breathing, tissue swelling, or a drop in blood pressure, seek medical help immediately. Give victim antihistime, (Benadryl, chlo-amine tabs) or administer doctor prescribed epinephrine. Prevent bug/mosquito bites by using an approved bug repellent. Spray on clothing and avoid prolonged exposure to skin. Wear long sleeves and long pants. Be aware of insect transmitted diseases (West Nile virus, Plague, Lyme disease).
	Ticks	Ticks carry Lyme disease, Rocky Mtn. spotted fever and other serious diseases. Use insect repellant and wear clothing that fits tightly at wrist, ankles and waist. Check yourself several times a day from head to foot and inside clothing, since ticks seldom attach within the first few hours. If any ticks are attached, remove immediately using fingers or tweezers – never try to burn the tick or cover it with oil. Save the tick in an empty container with a date label. Fill out a CA-1 for every tick bite. If you can not remove the tick, or the head detaches, seek prompt medical help. Watch for warning signs of illness: a large red spot on the bite area; fever, chills, headache, joint and muscle ache, significant fatigue, and facial paralysis are reactions that may appear within two weeks of the attack. Symptoms specific to Lyme disease include: confusion, short-term memory loss, and disorientation.
	Spiders, scorpions and solpugids	Spiders and scorpions in our area may give painful butt not poisonous bites and stings. Wear work gloves and never leave them on the ground. If camping check boots, pants, shirts before putting them on. Inspect materials (logs, wood, rocks, equipment) before handling. Inspect outdoor toilets before using them. If any bitten area shows rapid inflammation and pain or if chills, fever, joint pains, or nausea and vomiting develop, see a doctor immediately.

	Snakes	Be aware of poisonous snakes in your study area. Most snakes in our area are non-poisonous, however rattlesnakes do occur. Keep your eyes and especially ears open. Avoid snakes whenever possible - if a snake is encountered, retrace your steps without making any sudden movements.
	Giardia and Cryptosporosis	Never assume water is safe. Do not drink from streams or lakes without filtering (using an approved water filter) or treating water with iodine or chlorine tablets.
	Poison Oak	Learn to recognize poison oak with and without leaves, and in its many forms (shrub, vine, ground cover). Poison Oak is not likely to be found in the Tahoe Basin, but does occur at lower elevations in the Eldorado National Forest. Find an alternate route around densely covered areas. If you come into contact with poison oak, wash the area with cold water as soon as possible. Use an after-exposure lotion such as Technu. Do not wear contaminated clothing.
	Hanta virus, spread by saliva, urine, feces of rodents. Bubonic plague, carried by fleas from rodents.	While camping, keep food and water covered and stored in rodent-proof metal or thick plastic containers with tight-fitting lids. Wash dishes and cooking utensils immediately after use and remove all spilled food at your campsite. Dispose of trash and clutter. Avoid coming into contact with rodents and rodent burrows or disturbing dens (such as pack rat nests). Do not use cabins or other enclosed shelters that are rodent in-fested until they have been appropriately cleaned and disinfected. Do not pitch tents or place sleeping bags in areas in proximity to rodent feces or burrows or near possible rodent shelters (e.g., garbage dumps or wood piles) If possible, do not sleep on the bare ground. Use a cot with the sleeping surface at least 12 inches above the ground. Use tents with floors. Use filtration, boiling, chlorination, or iodination methods to treat water prior to drinking, cooking, washing dishes, and brushing teeth.

	Rabies	Be aware of animals acting strangely. If bitten by a wild or domestic animal, get medical attention and report to local health authorities or animal control officer. Locate animal if possible. Follow accident procedures for animal bite.
	Bears	Be aware that black bears may be in the area. When in bear country, hang food. Avoid where possible. Never approach any bear, regardless of its size. Be wary of cubs. Do not get between a bear and her cubs. If you see a bear at a distance, and it is unaware of your presence, remain quiet and alter your travel path to avoid the animal, remaining down-wind of it. If you encounter a bear at close quarters, and it appears to be non-aggressive, face the bear and make yourself look big. Back away SLOWLY. Leave an escape route for the animal. If the bear appears to be aggressive and comes toward you, make yourself look big, shout, and throw objects at it. Do not run from a bear. Drop a backpack or other object that the bear may become interested in and stop its advance. Use pepper spray if the bear comes to within 15-20 feet of you. If a black bear makes physical contact, defend yourself aggressively.
	Mountain lions	To avoid mountain lion confrontation while working: Try to work in a group. If a lion is close by do not bend over, squat, or sit down. Carry a noisemaker and something to throw at or strike a lion if needed. Be alert to your surroundings and check behind you frequently. Whenever possible avoid brushy, thickly wooded areas. Let someone know your exact location and time you plan to return. Carry a Forest Service radio. If you encounter a lion: If not being chased, turn immediately and face the animal. Do NOT lose eye contact. Remain standing. Do NOT run away or bend over. Face the animal and stand your ground. Raise your arms, look big. Talk loudly and firmly. Prepare to use the noisemaker or shout if necessary. If the lion starts to crouch or advance, make noise and throw whatever you can without losing eye contact or bending over. Wait for the lion to withdraw before moving. Although unusual, be alert for a second lion. If the lion comes within 15-20 feet of you and you have pepper spray use it (see JHA for pepper spray). If you are attacked, FIGHT BACK. (This information is from "Trail runner safety in lion country" by the Western States

		Training Camp. May 28, 1994.) Use all safety precautions discussed in detail in bear and mountain lion safety handouts provided. Keep alert.
	Hypothermia	Hypothermia is a condition of subnormal body temperature caused by exposure to cold and aggravated by numerous factors. Do not go out if winds exceed 30 mph during cold temperatures or if blizzard conditions exist. Use common sense. Be aware of weather forecasts and road conditions. Carry survival kit, and proper clothing. Always bring extra layers when heading into the field as weather conditions can change rapidly. Drink plenty of liquids , cold water, ice, snow. Set up camp early, be prepared for cold nights. Provide yourself with adequate shelter, firewood. Have high energy foods available.
	Heat exhaustion	Know the signs and symptoms of heat exhaustion, heat cramps and heat stroke. Heat stroke is a medical emergency requiring immediate response. Drink plenty of water, use sunscreen, wear a hat to avoid direct sunlight. During hot periods, at least 2 gallons of water should be consumed daily when field work is being conducted. Drink metabolite drinks when possible.
	Lightning, thunderstorms	Seek lower ground. Stay out of dry creek beds. Stay away from lone trees and rock overhangs. Do not use your radio. If you are in open country, crouch down and hug your knees. Avoid grouping together. Get away from ponds, streams and lakes. Take shelter in buildings or vehicles if possible. Do not use radio. Put down all tools. If you feel an electrical charge or your hair is standing on end, lightning may be about to strike you. Drop to the ground immediately. Persons struck by lightning may be burned. They carry no electrical charge and can be touched safely. A person struck by lightning can often be revived by prompt mouth-to-mouth resuscitation or cardiac massage and prolonged artificail respiration.
		Fatigue can cause poor judgment. Don’t go out or continue with your work

	Fatigue Wildfire If lost Radio use	if you are too tired to think clearly. Don't panic. Be alert, keep calm. Think clearly and act decisively. Get out of the area immediately. Maintain communication with other crewmembers and with dispatch. Follow local district policies regarding reporting fire. Always know 2 escape routes via trail or cross country in the event of fire. Stay calm and stay put. Try to orient yourself on a map. Radio yyour crewmwmbers and explain conditions. If possible mark your location with flagging or other brightly colored items. Always carry a compass or GPS unit, maps and survival gear (flashlight with spare batteries and bulb, matches, extra food water, space blanket).
Personal Security Check-out/Check-in		Line officer or competent person must approve and document the assignment of employees to work alone. If it is determined that there is significant potential hazard to a lone worker, additional personnel shall be assigned. Before leaving for the field every day, Leave an itinerary on crew board. Include destination, departure/return times, and a point of contact, such as a phone number, where your family and your supervisor can reach you in case of an emergency. If employees fail to call in or return on schedule, the supervisor shall take appropriate follow-up actions.
Radio Communication	No communication due to dead spots from terrain and/or weather. No communication due to malfunction of radio. Nobody in office to	Make sure radio is working before you leave the office or field station. Assure that batteries are charged. Carry a second rechargable battery or a "clam shell" with fresh batteries for a back-up. Check in with your supervisor if you are going to be in the field later than scheduled. If you are working alone, sign out in the office with destination and return times. Check in during the day. Schedule someone to receive check-in on the weekends. Make sure they know

	receive check-ins on weekends, early and late in season, or after work hours in the evening. Accidents: major and minor Dead spots, radio failure, no communication, Accidents	your itinerary. In the field, make sure you know where "dead spots" are and find locations where radio can transmit. Relay messages through lookouts if/when required. If you are working alone, and there is no one available to monitor the radio, go "in service" with dispatch. Remember to sign off or go "out of service" at the end of your work day. ALWAYS make sure at least one person (supervisor), knows your intended itinerary before you leave as a backup safeguard in case the radio fails you. Follow crew specific safety/check-in/check-out procedures. Know which radio frequencies to use and which to monitor. Know who to call in the case of an emergency. Know how to reach repeaters. Be prepared to relay messages in an emergency. Keep messages short, < 30 seconds per transmission. Do not assume that your batteries are charged. Always carry a spare. Do not leave the scanner on. Turn radio off overnight while camping. Save your batteries. Your life may depend on it. Keep calm and determine seriousness of situation/injury. Make radio contact with dispatch. Let dispatch know that you are a FS employee, and indicate whether or not the injured person is a FS employee. Provide all the information that dispatch requests. You will need to provide a location in Lat/Long, UTM, or Township and Range, down to 1/4 section. During the emergency, keep the radio on and with you at all times. For dead spots: move around and find a place to transmit. You may need to walk/drive up out of a valley, or simply walk down the road a way. If there is a failure to communicate, try changing batteries or using a different tone. Set up a procedure with your supervisor in case an accident prevents you from calling in (for example, if no check-in is received by a certain hour, a search will be initiated). If you are close to a phone, call in.
Illegal activities occurring on public land	Marijuana farms, Methamphetamine labs	Be aware of the possibility of methamphetamine labs, marijuana farms, and other illegal drug production occurring on Forest Service ands. If you encounter such an activity, immediately leave the area and return to your vehicle. Promptly drive away from the area. Once in a safe area, record a brief description of what you observed (chemical dump, active water lines, marijuana plants, etc). and the location where this was observed.

		Immediately report this information to your supervisor. Your supervisor will contact appropriate Forest Service authorities. NEVER ATTEMPT TO GAIN ADDITIONAL INFORMATION about these sites if you encounter them; leave immediately.
	Hostility/Threats	Be aware of what is going on around you. If you feel threatened or in danger, leave the area immediately. Report any threatening situations to local authorities and your supervisor. Do not deal with threatening people yourself.
	Illegal/unattended campfires	If you encounter illegal campfires (based on current fire restrictions for the area) report the incident to your supervisor. If you encounter an unattended campfire that poses an immediate safety risk or threat of spreading, call the Forest Service office or local law enforcement.
Personal Hygiene & Safety	Insect & Tick Bites, Poison Oak	Wear long sleeves when in brushy areas and areas where poison oak is present. If exposed, use Technu. (See technical advise above) Check for ticks daily. If any ticks are attached, remove immediately using fingers or tweezers (Never try to burn the tick with a match or cover it with oil). Wash area with water or sanitizer.
	Blisters & Rashes	To prevent blisters, if working in water for extended periods of time, “dry out.” While in camp or travel status, consider wearing Tevas. Rubbing alcohol will hasten drying “wrinkled” feet. Wear clean socks. To prevent blisters when not working in water, tape (athletic tape or moleskin) over vulnerable areas (heels, toes) before hiking.
	Personal Injury	In open terrain with no overhead hazard, consider wearing wide-brim hats as opposed baseball caps or hardhats to prevent sunburn. Use sunblock as needed to prevent sunburn. Wear sunglasses that block UV rays. Always carry some form of communication device (radio preferred). Make

		clear plans with crewmembers if splitting up when and where to meet. Never leave the field without knowing the whereabouts and safety of your crewmembers unless specific arrangements are made. When not otherwise identified in this JHA, appropriate PPE for field work projects and activities include: hardhat, gloves, long sleeve shirt, 8" leather lace up boots with nonskid soles. Personal communications device.
	Heat stress	Keep skin, pores, and hair clean. Dirty clogged skin and matted hair slow down heat dissipation. Take frequent rest periods and relax in cool, shady locations.

7. TASKS/PROCEDURES	8. HAZARDS	9. ABATEMENT ACTIONS Engineering Controls * Substitution * Administrative Controls * PPE
Vehicle Operation	Personal Injury	
Travel	Stress/Fatigue	Follow established work/rest guidelines, a 12- hour work day should be the maximum of which only 10 hours may be spent driving. When driving, stop for a break at least every 2 hours.
Certification, Training, and General Use		A valid State driver's license and a Forest Service issued ID card are required. Both must be in your possession whenever driving government owned or leased vehicles. • Defensive driving training is required for all Forest Service employees who drive Government or Private vehicles while on official duty. • Employees shall not operate a motor vehicle while under the influence of alcohol and/or drugs, nor while sick or suffering from excessive fatigue or emotional distress. • Drivers must observe all State and local traffic regulations. • Government drivers are prohibited from picking up hitch-hikers. • All State and local traffic laws must be followed. • All use of cellular phones of any type is prohibited while driving government owned or leased vehicles. This prohibition includes hands-free phones. If you must use a cellular phone, park your vehicle safely and then make your call. • Use of government-owned or leased vehicles for personal gain is strictly forbidden, and appropriate punishment may be administered to any employee violating this policy.
Maintenance	Mechanical breakdowns	Perform daily safety checks (lights, oil, coolant, power steering and brake fluid, wiper fluid, etc.) Make sure vehicle is equipped with the following safety gear and that you are familiar with the location and operation of these

		items: • Safety belts for all passengers • Triangular warning reflectors or safety flares. • First-aid kit • Chock blocks • Fire extinguisher • Spare-tire, lug nut wrench, and jack • Shovel and axe • Motor vehicle accident report kit (Form AD-65) Conduct monthly preventative maintenance (PM) checks and report any problems to your supervisor immediately.
Driving	Motor vehicle accidents/safety	Select appropriate vehicle for work needs and location to be traveled. Familiarize yourself with the vehicle and know where the controls are, especially when using rental vehicles. Review maps and plan route of travel prior to beginning trip. Drive defensively. A driver refresher training course is required every 3 years. All motor vehicles on official business (government, leased or privately owned) involved in an accident must be reported regardless of the dollar amount. Privately owned vehicles are not to be used for government business unless authorized by a supervisor.
	Unequipped vehicle	Factory installed safety devices and equipment shall not be nullified, altered, or removed. Ensure that all vehicles are equipped with: Safety belts for ALL passengers, warning markers or reflectors, flashlight, first aid kit, chock blocks, tire chains, window scraper, fire extinguisher.
	Vehicle malfunction, safety hazards	Before driving determine the conditions in the area to be traveled and choose the appropriate vehicle and route. Walk completely around vehicle checking for hazards and obstructions. Make sure all windows, mirrors and lights are clean. Check headlights, turn signals, and tires. Secure all objects inside the

		cab and cargo areas. Monitor vehicle performance when driving. Inspect a vehicle after use. Correct or report problems before a vehicle is used again.
	Vehicle accident	Everyone must wear seatbelts anytime the vehicle is in motion. Passengers must ride in the cab only – NO passengers in the truck bed. Practice defensive driving. Be aware of weather and road conditions and adjust your driving accordingly. When driving the following are prohibited: engaging in distracting conversations or activities; eating or drinking; using a two-way radio; using a hand-held cellular phone; using radio/stereo headphones; taking prescription drugs that may cause dizziness or lack of concentration or reduce response time; reading maps, instructions, or other material; transporting pets. Pull off the road for a break or to change drivers if you experience any of these warning signs: vehicle begins to feel too warm; drowsiness; eye strain; inattention or daydreaming; hallucinations; impatience, irritability not normally experienced; stress that results in anxiety, anger, or lack of concentration; muscular tension, restlessness, or inability to get comfortable. Take a break after every 2 hours of driving time. On forest roads be aware of special hazards such as: narrow road surface; steep grades; rough and/or slippery road surface; blind curves; tourists, heavy equipment operators, logging trucks, mountain bicyclists, motorcyclists; watch out for wildlife and domestic stock on the road.
	Emergency stopping	When it is safe to do so, move the vehicle to the shoulder of the road, away from traffic. Set the emergency brake. Activate four-way flashers. Keep alert to passing trafic. Exit the vehicle when traffic volume/flow presents undue hazards. Raise the hood. Display emergency reflectors, triangles, or other suitable warning devices.
	Parking on a grade,	Use a chock block every time you park –NO EXCEPTIONS. Turn wheels into a bank or curb to avoid rolling. Shut off engine while your foot is on the service brake and then set the emergency brake. Put the

	roll-aways	transmission in the lowest gear that is in the direction the vehicle would roll, or into park for an automatic transmission.
	Backing accident	Never back up or make a U-turn on blind corners. It is better to park a vehicle (when possible) so the operator can drive forward and eliminate backing altogether. Before backing: select a wide spot that provides adequate sight distance in each direction; always use a person to serve as a guide for backing, when available; walk around the vehicle to check for hazards and obstructions; back the rear of the vehicle toward a cutbank; use caution when backing on fill-sloped edges of roadways; always face the danger.
	Visual glare and obstruction	Carry sunglasses for bright driving conditions. Keep windshield clean – inside and outside. Keep wiper fluid level full. Replace old wiper blades.
Travel	Inclement weather	Sudden changes in climatic conditions require adjusting to different driving situations. Do not drive in adverse weather conditions if trip can be delayed. Avoid being rushed, you will need more time to prepare the vehicle and get to your destination. In fall and winter, remove all frost, ice, and snow before driving. Make sure vents are clear of snow to provide adequate airflow for defrosting. Always carry PPE for changing weather conditions. Listen to weather forecasts and plan field work projects and activities accordingly.
	Off-highway driving accidents	Prior to driving on mountain roads, check with local unit or district regarding logging traffic and other concerns (construction, washouts, fires, blow downs, closures, etc. Drive defensively and courteously. Be alert for oncoming traffic. Yield to oncoming vehicles even if you think you have the right-of-way (find a safe place to pull over). Proceed slowly around blind corners and hug the right shoulder. Be able to stop within 1/2 your viewing distance. Move rocks out of the way instead of driving over them. Use a spotter when necessary on narrow roads and bridges. Do not ford streams if water is more

		than 12" deep. Check with local unit or district regarding logging traffic and other concerns.
	Insect, Animals, Poisonous Plants	Be alert to hazards associated with insects, animals, and poisonous plants (see previous section). First aid/body fluids barrier kits shall be readily accessible.
	Other	Use adequate UV protection, such as sunglasses and sunscreen.

JHA Instructions (References-FSH 6709.11 and .12)

The JHA shall identify the location of the work project or activity, the name of employee(s) involved in the process, the date(s) of acknowledgment, and the name of the appropriate line officer approving the JHA. The line officer acknowledges that employees have read and understand the contents, have received the required training, and are qualified to perform the work project or activity.

Blocks 1, 2, 3, 4, 5, and 6: Self-explanatory.

Block 7: Identify all tasks and procedures associated with the work project or activity that have potential to cause injury or illness to personnel and damage to property or material. Include emergency evacuation procedures (EEP).

Block 8: Identify all known or suspect hazards associated with each respective task/procedure listed in block 7. For example:

a. Research past accidents/incidents.
b. Research the Health and Safety Code, FSH 6709.11 or other appropriate literature.
c. Discuss the work project/activity with participants.
d. Observe the work project/activity.
e. A combination of the above.

Block 9: Identify appropriate actions to reduce or eliminate the hazards

Emergency Evacuation Instructions (Reference FSH 6709.11)

Work supervisors and crew members are responsible for developing and discussing field emergency evacuation procedures (EEP) and alternatives in the event a person(s) becomes seriously ill or injured at the worksite.

Be prepared to provide the following information:

a. Nature of the accident or injury (avoid using victim's name).
b. Type of assistance needed, if any (ground, air, or water evacuation).
c. Location of accident or injury, best access route into the worksite (road name/number), identifiable ground/air landmarks.
d. Radio frequencies.
e. Contact person.
f. Local hazards to ground vehicles or aviation.
g. Weather conditions (wind speed & direction, visibility, temperature).
h. Topography.
i. Number of individuals to be transported.
j. Estimated weight of individuals for air/water evacuation.

The items listed above serve only as guidelines for the development of emergency evacuation procedures.

JHA and Emergency Evacuation Procedures Acknowledgment

We, the undersigned work leader and crew members, acknowledge participation in identified in block 8. Abatement measures listed below are in the order of the preferred abatement method:

a. Engineering Controls (the most desirable method of abatement). For example, ergonomically designed tools, equipment, and furniture.

b. Substitution. For example, switching to high flash point, non-toxic solvents.

c. Administrative Controls. For example, limiting exposure by reducing the work schedule; establishing appropriate procedures and practices.

d. PPE (least desirable method of abatement). For example, using hearing protection when working with or close to portable machines (chain saws, rock drills, and portable water pumps).

e. A combination of the above.

Block 10: The JHA must be reviewed and approved by a line officer. Attach a copy of the JHA as justification for purchase orders when procuring PPE.

Blocks 11 and 12: Self-explanatory.

the development of this JHA (as applicable) and accompanying emergency evacuation procedures. We have thoroughly discussed and understand the provisions of each of these documents:

SIGNATURE	DATE	SIGNATURE	DATE