Chapter 2. METHODS

GENERAL FIELD METHODS

Data collection for the Breeding Bird Atlas involved visiting pre-selected 3-mile x 3-mile areas (‘blocks’) and surveying all habitats within each block for bird presence and evidence of breeding for all bird species. Surveys during SDBBA2 followed the standardized protocols as recommended by the North American Ornithological Atlas Committee (Smith 1990) and those used during the first South Dakota BBA (Peterson 1995) with some minor modifications. Atlasers were encouraged to visit their block during the breeding season at least three times during the day and once in the evening. Visits usually were at least 10 days apart and often spread out over multiple breeding seasons. Atlasers tabulated the number of person-hours spent surveying their blocks and attempted a minimum effort of at least 15 hours on a block. The entire block did not need to be surveyed; rather, efforts were focused on surveying each habitat type within a block.

The primary focus of surveys was to document all breeding birds within a block. Bird observations were categorized as *Possible* breeding, *Probable* breeding, or *Confirmed* breeding, based upon a series of standardized breeding behavior criteria, within that species’ breeding season (Appendix VII, VIII). To document breeding phenology, emphasis was placed on recording all observations, not just the ‘highest’ breeding category observed for each species. In addition, observers recorded the habitat each bird was observed in (Appendix IX). Outside of designated blocks, the atlas encouraged all interested persons to submit extra observations of *Confirmed* breeding by any species or any observations of rare species anywhere within the state.

ATLAS BLOCK SELECTION

<u>Number of blocks</u>. The SDBBA2 surveys were conducted on 425 random blocks and eight special blocks. At the beginning of field work, 124 of these blocks were the same random blocks covered in the first South Dakota Breeding Bird Atlas while the remaining 301 random blocks were newly selected for the second atlas. However, atlasers were denied access to eleven blocks; two of the original 124 blocks from SDBBA1 and nine of the 301 newly-selected blocks. These were replaced using the spatially-balanced sampling design described below. Figure 1 shows the final result – all blocks that were actually surveyed during the second breeding bird atlas.

Eight special blocks were chosen because they contained rare habitats that were not represented in the original randomly-chosen blocks. These special blocks included forested buttes in Harding County (3 blocks), mountain mahogany shrubland in Custer County (1 block), bluffs of the Missouri River (1 block), southwest sage grassland-sage shrubland in Fall River County (2 blocks) and coteau forested ravines in Roberts County (1 block).

Block size and grid system. All blocks were 3 miles x 3 miles in size. Blocks selected in the two different atlases were based on different grid systems. The original blocks comprised nine Public Land Survey System (PLSS) sections. The SDBBA2 blocks were based on a uniform 3x3 mile grid placed over the entire state rather than on the PLSS sections.

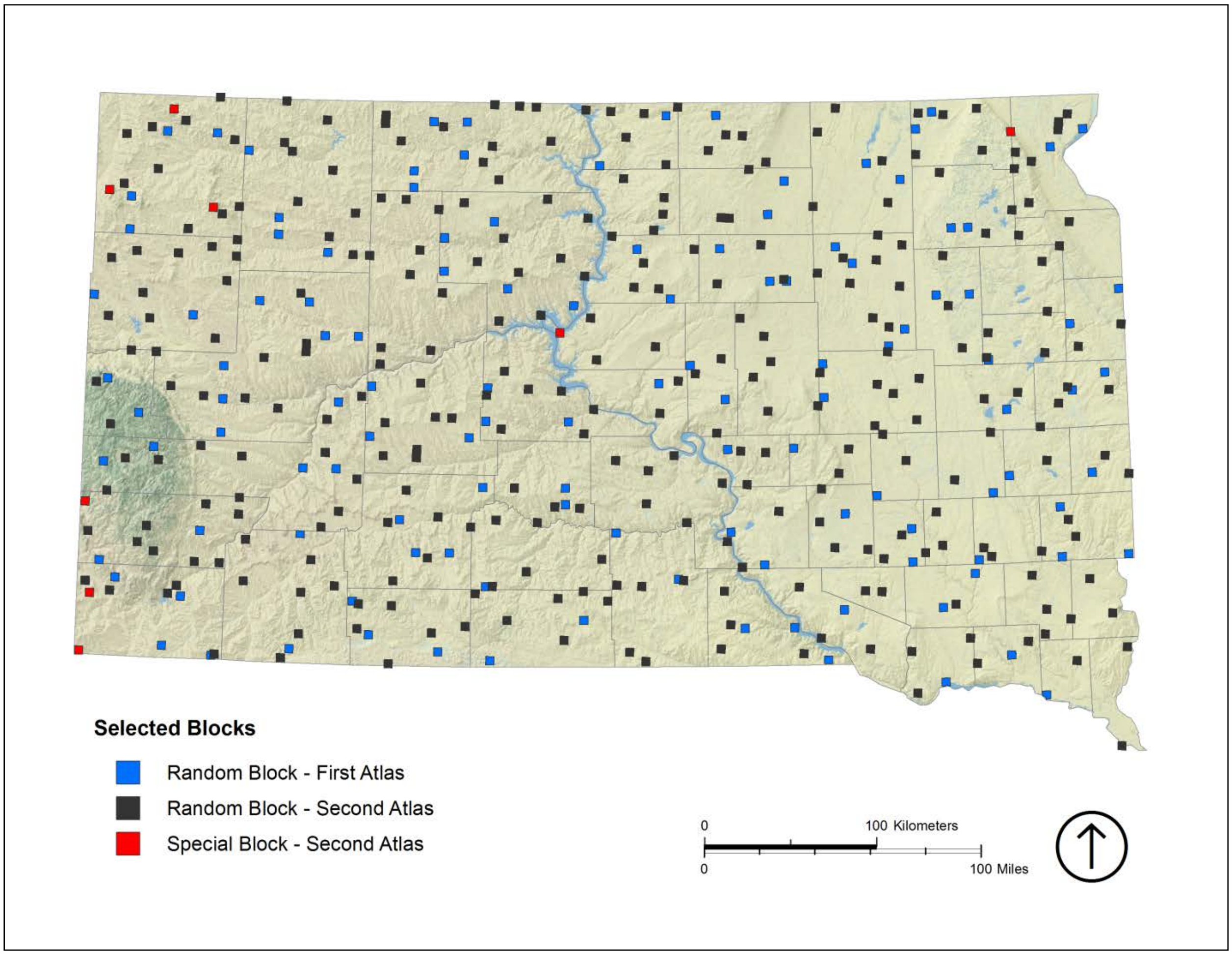

Figure 1. Location of 433 blocks surveyed during SDBBA2.

Selection of original random blocks. The original 124 blocks were selected in 1988 for the first Breeding Bird Atlas (Peterson 1995). The state was divided into 62 equal-sized 'superblocks' and two 3-section x 3-section blocks were randomly selected within each superblock.

Selection of new blocks. The 301 new blocks were selected using a spatially-balanced sampling design (Stevens and Olson 2004, Theobald *et al*. 2007). This probabilistic sampling design incorporates spatial information when selecting samples which results in a more uniform distribution of samples throughout the study area. Another advantage when using a spatially balanced design is that samples that are unavailable for sampling due to unforeseen circumstances (i.e., landowner denies access) can be replaced with backup samples and still retain the spatial balance in the sampling process. In addition, inferences can be made to the whole state when using a probabilistic sampling design.

In ArcGIS v.9.0, a uniform grid of 8,819 3-mile x 3-mile blocks was placed over the entire state. More than 400 blocks were randomly selected using the RRQRR algorithm developed by David Theobald at Colorado State University (Theobald *et al*. 2007). The first 301 samples ‘drawn’ in this procedure represented the new blocks to be surveyed during the second atlas. The center points of seven selected blocks fell outside the state border and were replaced by the next seven samples in the sample list. One important requirement of spatially-balanced sampling is that blocks are surveyed in the order in which they are drawn. If they are not, the resulting design is not spatially balanced nor is it random. Thus, results from block #276 only could be used if blocks 1-275 were also surveyed.

SPECIES OCCUPANCY MODELS

One issue that affects a breeding bird atlas is the fact that not all species are detected, no matter how much effort one puts into the survey. Detection probability, the probability that a species is detected given that it is there, is affected by time of day, season, weather, observer abilities, species, and habitat, among other factors. Failing to record a species that is actually there (false absence) biases the resulting maps and analyses, and makes interpretation of survey results very difficult (MacKenzie *et al*. 2002). We conducted special surveys on a subsample of blocks and then used these data to estimate detection probabilities for each species using occupancy modeling. This allows us to make statements about the ‘completeness’ of a distribution map. In addition, estimating detection probability is the first step to estimating occupancy rates (proportion of an area occupied by a species), which allows us to predict where species may occur in areas that are not surveyed.

During the 2009 – 2012 field seasons, paid staff collected data on 136 randomly chosen blocks (Figure 2) to estimate species detection probabilities and occupancy using occupancy modeling. Each block targeted for the special surveys was visited three times within a four-week period. Each survey lasted four hours and was finished by 10:00 AM CDT. The survey was conducted along the exact same route in each of the three visits. Observers were not required to survey the entire block or visit every habitat during the four-hour survey. If some portions of the block or certain habitats were missed during the four hours, they were to be surveyed at another time; these data were used as general atlas data but not used in the occupancy modeling. During the survey, observers recorded the same data as in a regular Atlas survey (species, breeding status, habitat code, and location). These data were recorded on separate forms and entered in a separate database for analyses but were also included in the general atlas database of species occurrence and breeding status. These data were used both as block data and for estimating species-specific occupancy and detection probabilities.

We used an occupancy modeling framework to estimate 1) occupancy and 2) detection probability (MacKenzie *et al*. 2002). Occupancy models have gained wide use in wildlife studies to describe occupancy status and distribution. Repeat visits are used in occupancy models to account for imperfect observation. The repeat visits provide encounter histories used to estimate detection probability. The occupancy model has two components, 1) the process model which is related to the ecological process describing the occurrence state and 2) the observation model which accounts for imperfect observation. The assumptions of this model are that surveyed sites are occupied by the species of interest throughout the duration of the study, with no sites becoming occupied or unoccupied during the survey period, species are not falsely detected, but can remain undetected if present and species detection at a site is assumed to be independent of species detection at other sites.

To model species distributions using occupancy modeling, we included several covariates that are thought to influence bird species distribution. Within a Geographic Information System (ESRI 2012), we used the LANDFIRE existing vegetation type layer (USGS 2008) to derive continuous covariates for the percent cover of Grassland, Agriculture, Shrubland, Riparian, NonVegetated, Developed, Sparsely Vegetated, Hardwood, Conifer and Conifer Hardwood within each sampled block, the National Hydrology Dataset (USGS 2012) to estimate percent cover of waterbody, and the Latitude and Longitude block center points. We then predicted occupancy throughout the state of South Dakota for each species with at least five detections during the occupancy surveys. We estimated parameters of the occupancy model by maximizing the likelihood function in the program R software (R Development Core Team 2013) using the R package ‘unmarked’ (Fiske, Chandler and Royle 2010), considering detection to be constant. We developed a set of candidate models for each species based on habitat associations during the breeding season. We used the model with the lowest Akaike’s Criterion (AIC) value to predict occupancy throughout the state for that species (Appendix VI).When models had similar AIC values we used the model with the least number of parameters for predicting occupancy. The top occupancy model result for each species was imported into ArcMap (ESRI 2012) to create the predicted occupancy map.

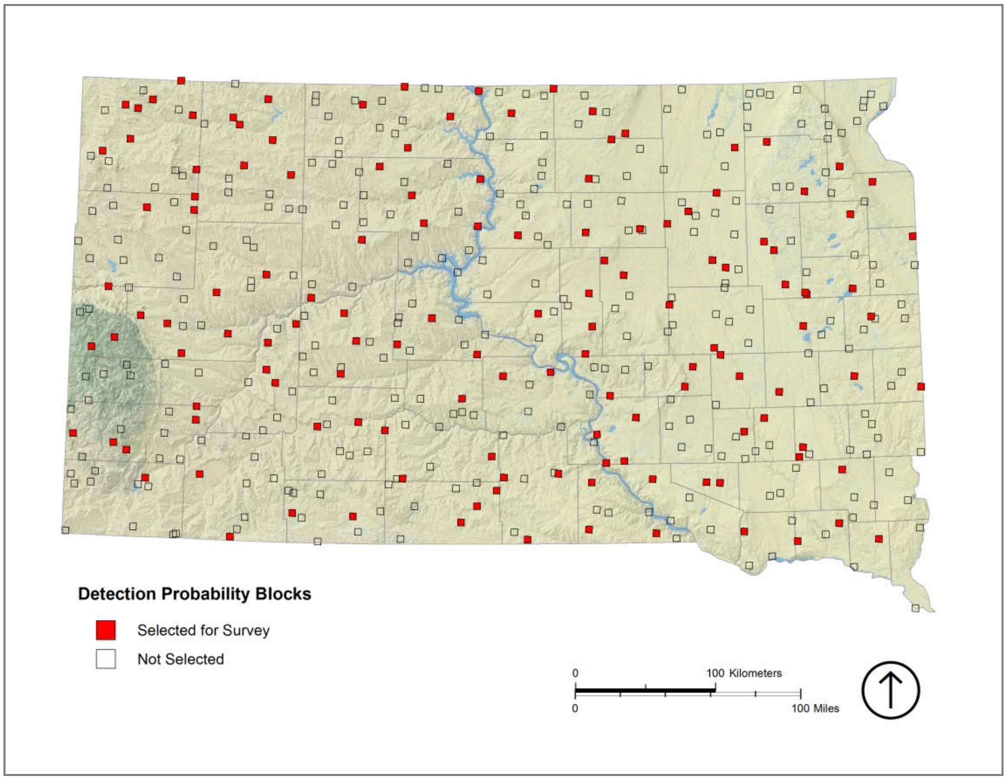

Figure 2. Location of breeding bird atlas blocks randomly selected for collecting species detection data (red squares). Open squares are blocks that were not selected.

PROJECT ORGANIZATION

The second South Dakota Breeding Bird Atlas was administered by two committees - a Steering Committee and a Technical Committee. The Steering Committee was responsible for overall guidance of project planning and implementation, as well as publicity and fund-raising. Members of the Steering Committee included a Project Director and Project Coordinator. The Project Coordinator was in charge of actual planning, implementation, and coordination of all aspects of the Atlas. The Technical Committee was responsible for providing guidance on all scientific issues, such as appropriate methods of block selection and data collection, and data analyses and presentation. Members of the Technical Committee included the Project Coordinator, SD GFP Wildlife Diversity scientists, and three University scientists.