South Dakota Breeding Bird Atlas II
2009 Field Season Report

January 22, 2010

Rocky Mountain Bird Observatory
Tech. Report # M-SDBBA2-02

ROCKY MOUNTAIN BIRD OBSERVATORY

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

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

***Core Values**:*

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

RMBO accomplishes its mission by:

- ***Partnering** with state and federal natural resource agencies, private landowners, schools, and other nonprofits for conservation.*
- ***Studying** bird responses to habitat conditions, ecological processes, and management actions to provide scientific information that guides bird conservation efforts.*
- ***Monitoring** long-term trends in bird populations for our region.*
- ***Providing** active, experiential, education programs that create an awareness and appreciation for birds.*
- ***Sharing** the latest information in land management and bird conservation practices.*
- ***Developing** voluntary, working partnerships with landowners to engage them in conservation.*
- ***Working** across political and jurisdictional boundaries including, counties, states, regions, and national boundaries. Our conservation work emphasizes the Western United States, including the Great Plains, as well as Latin America.*
- ***Creating** informed publics and building consensus for bird conservation needs.*

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EXECUTIVE SUMMARY

The Breeding Bird Atlas is a relatively simple, repeatable, grid-based survey that aims to monitor and document changes in the distribution of breeding birds on a large scale. Results of the first South Dakota Breeding Bird Atlas, begun 20 years ago, were extremely valuable in describing the status and distribution of South Dakota's breeding birds at the end of the 20th century and established a baseline against which future changes in breeding bird populations will be measured. Since the first Breeding Bird Atlas, South Dakota's landscape has changed, and most likely, these changes are impacting South Dakota's breeding birds. The second South Dakota Breeding Bird Atlas (SDBBA2) is scheduled for 2008 - 2012 and aims to survey 425 3mi x 3mi blocks. The goal of SDBBA2 is to document the current distribution of every bird species that nests in South Dakota and to compare these distributions to those of the first South Dakota Breeding Bird Atlas. These data will support the efforts of land-use planners, decision-makers, researchers, educators, students, and bird enthusiasts to maintain healthy bird populations and conserve avian diversity within the state.

During the first two years of the project, volunteers and paid staff have visited 226 random and special blocks at least once, with a total of 652 visits and 2,535 hours spent on blocks. Observers submitted 10,312 records from 61 counties.

Thus far, 223 species have been detected, including two non-breeding summer residents; 83% of the likely breeding species have been confirmed as breeding within the state. Western Meadowlark has been recorded in the most blocks (205 of 226 blocks), Common Grackle has been confirmed breeding in the most blocks (111), while American Robin and Barn Swallow have been reported from all 61 counties surveyed. Seven breeding species have been observed during SDBBA2 that were not reported during the first South Dakota Atlas: Sandhill Crane, Herring Gull, Black-necked Stilt, Eurasian Collared-Dove, Prothonotary Warbler, Cassin's Sparrow, and Great-tailed Grackle. In addition, Caspian Tern was never confirmed nesting during the first atlas but was confirmed nesting on Lake Oahe in 2008.

In 2009, paid field workers collected data on 43 blocks to estimate species detection probabilities (Dp) using occupancy modeling. Mean Dp for 82 species was 63% and 75% of all species had estimated detection probabilities greater than 50%. Spotted Sandpiper (16%), Sora (22%) and Black Tern (22%) had the lowest detection probabilities. This approach gives us valuable information to evaluate distribution maps and does not appear to impede the ability of observers to collect primary data for the atlas.

ACKNOWLEDGEMENTS

The second South Dakota Breeding Bird Atlas (SDBBA2) is a team effort, both organizationally and financially.

Coordination and organization:

- Eileen Dowd-Stukel, SDGFP, Wildlife Diversity Program
- Nancy Drilling, Rocky Mountain Bird Observatory (RMBO)

Technical Committee:

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- Kristel Bakker, Dakota State University
- Silka Kempema, SDGFP, Wildlife Diversity Program
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- Richard Peterson, coordinator of SDBBA 1, Wewela
- Dave Swanson, University of South Dakota

GIS, database, and web site development:

- Rob Sparks, RMBO
- Chandman Sambuu, RMBO

SDBBA2 Logo design: Michael Retter

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INTRODUCTION

The Breeding Bird Atlas is a relatively simple, repeatable, grid-based survey that aims to monitor and document changes in the distribution of breeding birds on a large scale (Smith 1990). The first South Dakota Breeding Bird Atlas (SDBBA) began 20 years ago (Peterson 1995). During that ambitious project, 71 volunteers collected data over six years of fieldwork and submitted more than 24,000 breeding records, representing 219 bird species. The resulting resource has been extremely valuable in describing the status and distribution of South Dakota's breeding birds, both game and nongame species, at the end of the 20th century. The first atlas database also is a baseline against which future changes in breeding bird populations can be measured.

Since the first Breeding Bird Atlas commenced in 1988, South Dakota's landscape has changed (e.g., Bakker and Higgins, 1998, Higgins *et al*. 2002, Grant *et al*. 2004). In addition, land-use changes in the upcoming few years could be staggering, with increasing CRP conversion, biofuels production, wind farm development, and urbanization, to name a few trends of concern (e.g., Stephens et al. 2006, Stubbs 2007). South Dakota's Wildlife Action Plan (SD GFP 2006) explicitly notes the link between habitat quality/quantity and the health of animal populations. Most likely, these landscape-level changes are impacting South Dakota's breeding birds. Regular monitoring of all breeding species on a large scale allows us to detect impacts of such large-scale landscape changes. Repeating the Breeding Bird Atlas approximately every 20 years not only documents bird response to habitat deterioration and loss, but also can improve our understanding of bird response to management actions designed to improve wildlife habitat quality and quantity. A second Breeding Bird Atlas in South Dakota will not only describe the changes in distribution of all breeding birds over the past 20 years, but will serve as the next baseline to which future changes can be compared.

The goal of the second South Dakota Breeding Bird Atlas is to document the current distribution of every bird species that nests in South Dakota and to compare these distributions to those of the first South Dakota Breeding Bird Atlas (1988-1992). These data will support the efforts of land-use planners, conservation decision-makers, researchers, educators, students, and bird enthusiasts to maintain healthy bird populations and conserve avian diversity within the state. Specific objectives include:

1. Document current distribution of all breeding bird species, including under-surveyed species such as owls and secretive marshbirds.
2. Assess changes in distributions of breeding birds since the first SDBBA (1988-1992).
3. Identify habitat associations and requirements for all breeding species.
4. Produce a report and interactive web site with species distribution maps and analyses.

Scientific questions to be addressed are:

1. What is the current statewide distribution of occurrences and nesting of every breeding bird species?
2. Which species have declined or increased in distribution since 1988-1992?
3. Are non-native bird species increasing as a component of the state's avifauna?
4. What are the habitat associations or requirements of each breeding species?

Expected Benefits include:

1. More complete and up-to-date knowledge of breeding bird species status and distribution.
2. More complete understanding of changes in breeding bird populations over last 20 years.
3. More complete knowledge of bird-habitat associations.
4. Identification of species that have declined in distribution over the past 20 years and may be in need of management to keep from becoming a SoGCN.
5. Establishment of a baseline for future surveys and atlases.
6. Contribute to understanding of regional breeding bird status and distribution, in conjunction with simultaneous atlases being conducted in Minnesota, Iowa, and Nebraska.
7. Provide a valuable resource for researchers, land managers, land-use planners, students, agency personnel, educators, and others.
8. Increased interest in birds by the general public and a citizen science opportunity for knowledgeable birders.

One important issue is that not all species are detected, no matter how much effort one puts into the survey (MacKenzie *et al*. 2006). Detectability, 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 more difficult. When detectability is quantified, we can make statements about the 'completeness' of a distribution map or account for this nuisance error during analyses, especially when comparing first and second atlas results. In addition, estimating detectability 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. In 2009, we began to collect data to estimate species detection probabilities on atlas blocks. The objectives were to estimate detection probabilities for as many species as possible, and to evaluate whether collecting this sort of data 1) interferes with or detracts from collecting primary atlas data (species presence and breeding confirmation) and 2) contributes to our understanding of species distributions within the state.

METHODS

GENERAL METHODS

Data collection for the Breeding Bird Atlas involves 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. Each summer, 2-5 paid full-time technicians survey atlas blocks for 4-10 weeks. The target is for paid technicians to survey 200 - 250 blocks during the 4 - 5 year atlas period. The remaining 175 - 225 blocks will be surveyed by volunteers, including agency personnel and both novice and experienced birders. A special emphasis will be to encourage young people to participate.

Surveys during SDBBA2 follow the standardized protocols as recommended by the North American Ornithological Atlas Committee (Smith 1990) with some minor modifications. Atlasers are encouraged to visit their block during the breeding season at least three times plus a nocturnal visit; each visit should be at least 10 days apart. These visits can be spread out over more than one breeding season. Atlasers are asked to keep track of the number of person-hours and to tally at least 20 hours on their block. The entire block does not need to be surveyed; rather, efforts are focused on surveying each habitat type within a block.

Primary focus of surveys is to document all breeding birds in a block. Bird observations are categorized as *Possible* breeding, *Probable* breeding, or *Confirmed* breeding, based on a series of standardized criteria, within that species' breeding season, which is defined by 'safe dates'. To document breeding phenology, emphasis is on recording ALL observations, not just the 'highest' breeding category observed for each species. In addition, the habitat within which each bird is observed is recorded.

Outside of designated blocks, the atlas encourages all interested persons to submit observations of *Confirmed* breeding by any species anywhere within the state. Special forms are available for recording these data.

The SDBBA2 Handbook , available from the author or at the SDBBA2 web site (http://www.rmbo.org/sdbba2), gives detailed protocol information and Code descriptions.

ATLAS BLOCK SELECTION

How many? The second breeding bird atlas will attempt to completely survey 425 random blocks and eight special blocks (Figure 1). Of these blocks, 124 are the same 124 random blocks covered in the first South Dakota Breeding Bird Atlas. The remaining 301 random blocks are newly selected for the second atlas.

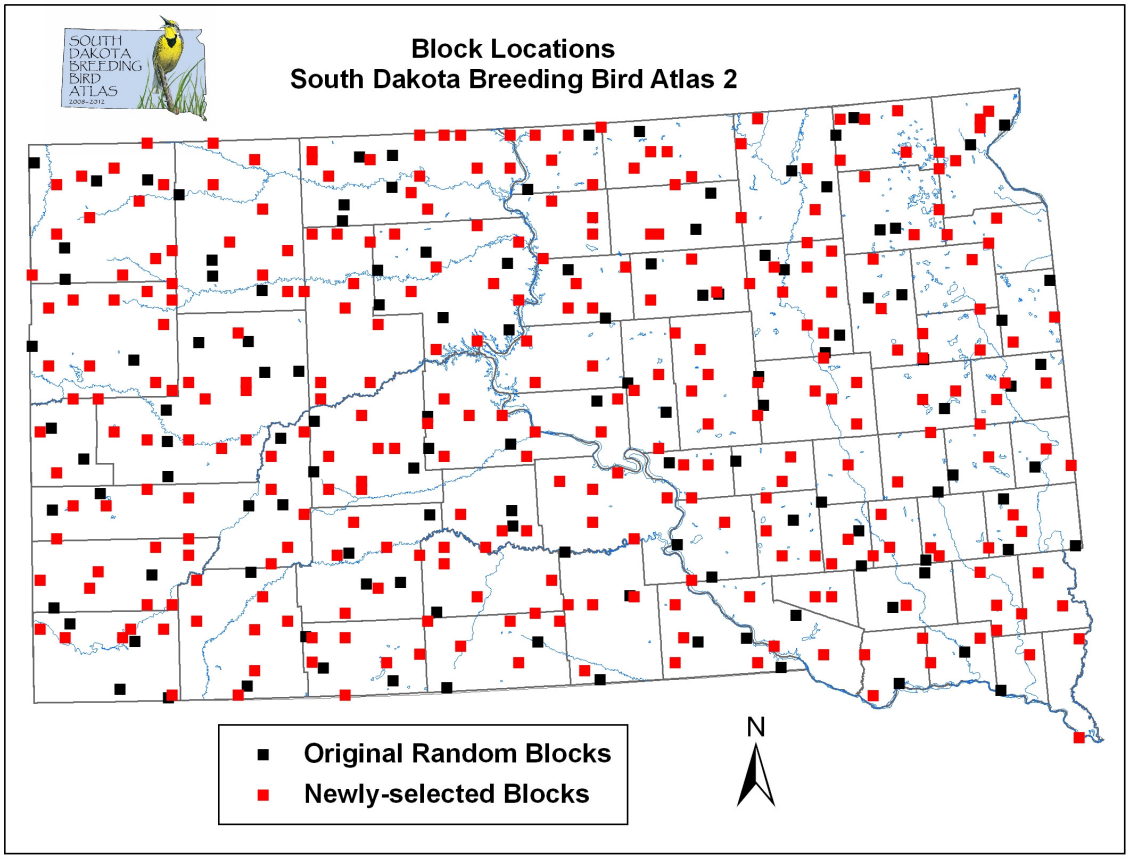

Figure 1. Location of blocks to be surveyed during the second South Dakota Breeding Bird Atlas. Note that block size is enlarged and not to scale.

The eight special blocks were added because they contain rare habitats that are not represented in the randomly-chosen blocks. These blocks include 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 (2 blocks) and coteau forested ravines in Roberts County (1 block).

Block size and grid system. All blocks are 3 miles x 3 miles in size. However, blocks selected in the two different atlases are based on different grid systems. The original blocks are comprised of nine Public Land Survey System (PLSS) sections. The new blocks are not based on the PLSS but rather on a uniform 3x3 mile grid placed on the entire state.

Selection of original random blocks. The original 124 blocks were selected in 1988 and surveyed during 1988 - 1992 (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 *et al*. 2004, Theobald *et al*. 2007). This type of sampling design is random, but accounts for the fact that sites closer together are probably more similar and results in a sample distribution that is less clumped. In ArcGIS v.9.0, a uniform grid of 8,819 3-mile x 3-mile blocks was placed over the entire state. Eight hundred 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 constitute the 301 new blocks to be surveyed during the second atlas. The center points of seven selected blocks were outside the state border. These samples were discarded and the next seven samples in the 800 sample list became their replacements. One important assumption 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, block # 276 only can be surveyed if blocks 1-275 are also surveyed.

SPECIES DETECTION PROBABILITIES

Beginning in 2009, paid staff collected data to estimate species detection probabilities using occupancy modeling (MacKenzie *et al*. 2006). Of the 433 atlas blocks, 110 have been randomly chosen to receive special surveys that will allow us to calculate species detectability and occupancy.

Each block targeted for the special surveys is visited three times within a four-week period. They can be done on three consecutive days, three consecutive weeks, or at irregular intervals. Each survey lasts four hours and must be finished by 10:00 AM CDT or 9:00 AM MDT. Each survey is conducted along the exact same route and visits the exact same spots as the first of the three surveys. Observers do not need to survey the entire block or visit every habitat during the four-hour survey. If some portions of the block or certain habitats are missed during the four hours, they are to be surveyed at another time; these data are used as general atlas data but not used in estimating detection probabilities. During the survey, observers record the exact same data as they collect during a regular Atlas survey (species, breeding status, habitat code, and location). Observers also estimated the percentage of the block surveyed during the four hours. These data are recorded on separate forms and entered in a separate database for analyses but they also are included in the general atlas database of species occurrence and breeding status.

We use program PRESENCE v. 2.4 (Hines 2006) to estimate the probability of detecting a species given its presence on a block (D_p) and the proportion of atlas blocks occupied by a species (P_{si}) (Mackenzie *et al*. 2002). The occupancy model uses a detection probability to adjust the proportion of blocks occupied to account for species that were present but undetected. For the breeding bird atlas analyses, we used a single season, one group, constant P model. We evaluated the fit of

each species' occupancy model using Pearson χ^2 goodness of fit test with 1,000 bootstrap iterations (MacKenzie and Bailey 2004). When probability of the χ^2 statistic was less than 0.20, we multiplied the D_p standard errors by the square root of c-hat (test statistic/average test statistic) (MacKenzie and Bailey 2004). Because the estimator is unstable when a species is too rare or too common (Mackenzie *et al*. 2006), only species which were detected on more than 15% of blocks and less than 91% of blocks are included in the analyses.

PROJECT ORGANIZATION

The second South Dakota Breeding Bird Atlas is administered by two committees - a Steering Committee and a Technical Committee. The Steering Committee is responsible for overall guidance of project planning and implementation, as well as publicity and fund-raising. Members of the Steering Committee include a project director, project coordinator, representatives of federal, state, and tribal agencies, representatives of scientific and ornithological organizations and universities, and at-large and youth representatives. The Project Coordinator is in charge of actual planning, implementation, and coordination of all aspects of the Atlas. The Technical Committee is 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 include the project coordinator, SD GFP Wildlife Diversity scientists, and three University scientists. If necessary, two - four regional coordinator positions will be created who will be responsible for data collection by volunteers within their geographic region, including training, assisting with block selection and other issues, and ensuring adequate data quality.

RESULTS

PERSONNEL

Thus far, 37 volunteers have signed up for 91 blocks (Figure 2). In summer 2009, 28 of these volunteers spent 554 hours conducting surveys on blocks during 164 visits. Five paid staff spent 962 hours on blocks during 288 visits. Atlasers submitted 6060 records from blocks and an additional 436 Extra Observations.

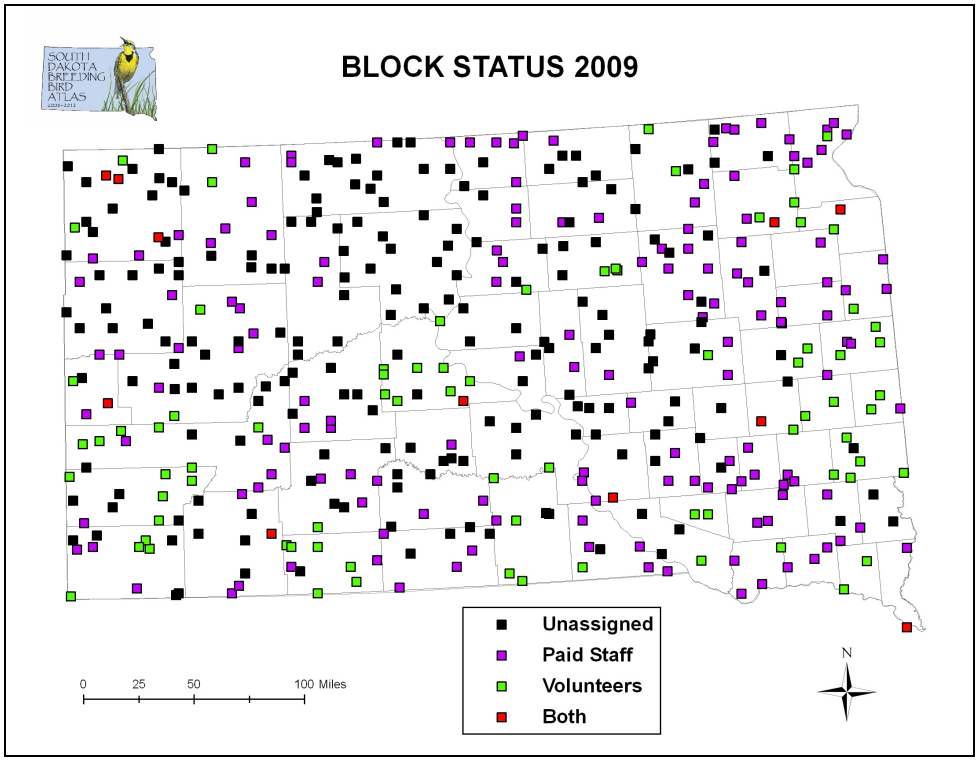

Figure 2. Survey status of breeding bird atlas blocks in 2008-2009. Violet blocks were surveyed by paid staff, green blocks were claimed (and some surveyed) by volunteers, red blocks were surveyed by both volunteers and paid staff, and black blocks were not yet assigned to anyone. Note that block size is not to scale.

BLOCKS

During summer 2009, 162 blocks were visited at least once: 48 1st atlas random blocks, 107 2nd atlas random blocks, and seven special blocks (Table 1). One-third of visited blocks have been visited once during 2008-2009, while 22% have been visited twice, 21% visited three times, and 24% visited four or more times (Figure

3). At least one visited block occurred in 61 counties; counties not visited yet are Douglas, Sanborn, Dewey, Lincoln, and Buffalo.

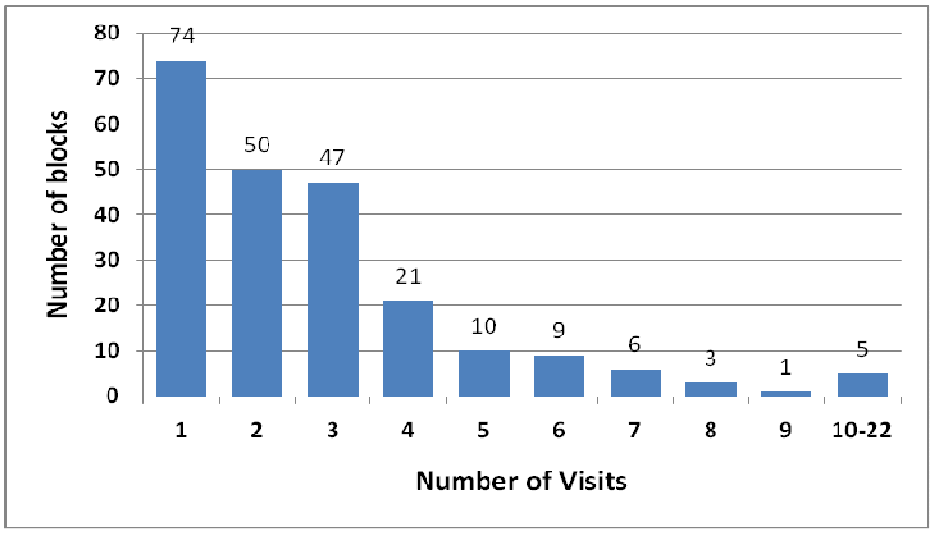

Figure 3. Distribution of number of visits per atlas block during 2008-2009.

Table 1. Summary of annual and total block results of the South Dakota Breeding Bird Atlas II.

	2008	2009	Total
No. blocks visited at least once	101	162	226
Total no. visits to blocks	205	448	652
No. counties visited	32	53	61
Average no. species recorded per block (range)*	39 (5-74)	42** (9-78)	N/A
Average % species confirmed per block (range)*	23 (3-49%)	23 (0-73%)	N/A
No. blocks 'completed'	7	38	45

* Minimum two hours spent on block

** Excludes blocks only visited at night for owl surveys in March-May 2009

Atlasers that spent at least two hours on a block detected an average of 45 species and confirmed breeding by an average of 22% of species detected. For 'finished' blocks, atlasers averaged 55 species per block with 31% confirmed breeding and 19.75 hours spent on the block. Overall, paid staff that spent at least two hours on a block recorded an average of 42 species per block and confirmed breeding by an average of 22% of observed species per block while volunteers

recorded an average of 40 species per block and confirmed breeding by an average of 23% of observed species per block. For any given number of hours spent on a block, volunteers detect fewer species than do paid staff (Figure 4).

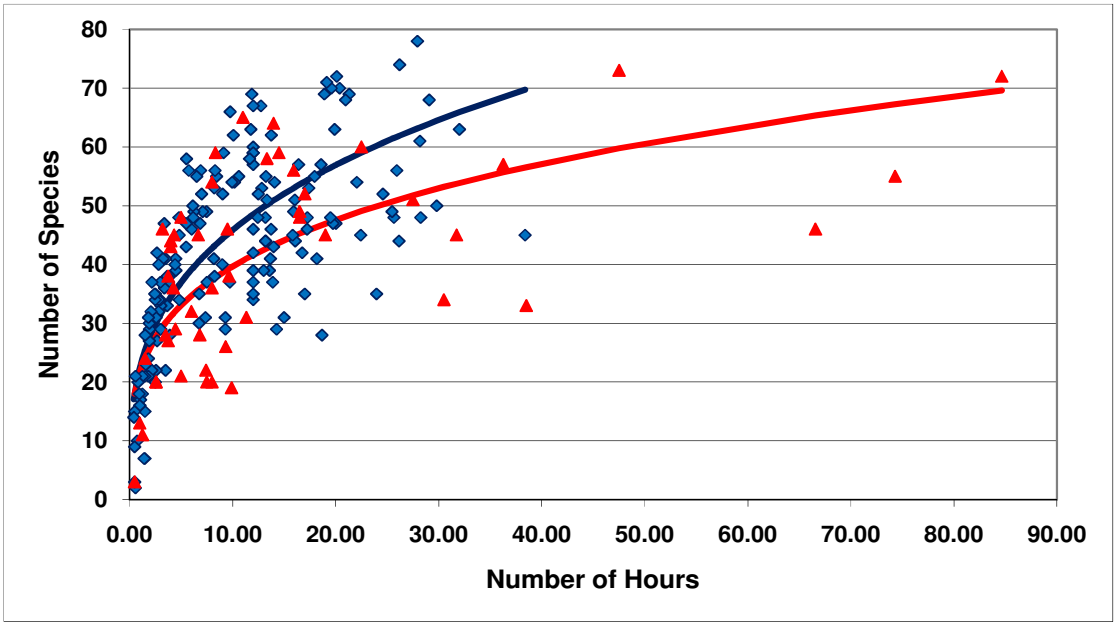

Figure 4. Relationship between number of survey hours on a block and number of species observed during breeding bird atlas surveys in 2008-2009. Blue symbols and predicted-values line represent data of paid field workers while red symbols and line represent volunteers' data.

Atlasers have recorded 70 or more species (excluding observed species) on eight atlas blocks thus far (Table 2). Of this list, Sica Hollow and LaFramboise still require more visits. Another nine blocks have lists of 65-69 recorded species.

Table 2. Breeding Bird Atlas blocks with at least 70 recorded species, excluding observed species.

Block ID	Block Name	County	No. Species	1st Atlas Total
1R1107	Boyer GPA	Brule	78	49 spp
2S0001	Sica Hollow	Roberts	74	N/A
2R0136	LaFramboise	Stanley	73	N/A
1R0203	Silver City	Pennington	72	58 spp
2R0132	Homer Township	Day	72	N/A
1R1601	Garfield Township	Clark	71	46 spp
1R1605	Johnsons Slough	Hamlin	70	56 spp
2R0227	East of Sturgis	Meade	70	N/A

SPECIES

In 2008 and 2009, 223 species have been recorded at least once (Table 3). Of these, 211 species were recorded at least once on blocks while 12 species were only reported as extra observations (Table 4). At least one confirmed breeding has been recorded for 185 species, 83% of all species recorded (Appendix A). Thirteen species confirmed breeding during the first atlas have not yet been detected during the second atlas: Ruffed Grouse, Sharp-shinned Hawk, Whip-poor-will, American Three-toed Woodpecker, Cassin's Kingbird, Canyon Wren, Winter Wren, Pinyon Jay, Sage Thrasher, LeConte's Sparrow, Nelson's (Sharp-tailed) Sparrow, Cassin's Finch, and Evening Grosbeak.

Table 3. Summary of annual and total species data collected during the South Dakota Breeding Bird Atlas II.

	2008	2009	Total
No. species detected	194	211	223
No. species confirmed breeding	136	160	185
No. records submitted	3757	6497	10,312*
No. species detected on blocks	182	201	211

* Only one record per species per block, plus extra observations

Table 4. Species only recorded as extra observations during 2008-2009.

Species	# Extra Observat.	# Extr Obs confirmed	# County detected	# County confirmed
Trumpeter Swan	4	4	3	3
Black-necked Stilt	3	1	2	1
Barred Owl	2	1	2	1
American Dipper	2	2	1	1
Black-backed Woodpecker	2	2	1	1
Cinnamon Teal	2	0	2	0
Cassin's Sparrow	1	1	1	1
Sandhill Crane	1	1	1	1
Herring Gull	1	1	1	1
Prothonotary Warbler	1	1	1	1
Bufflehead	1	1	1	1
Little Blue Heron	1	0	1	0

Combining 2008-2009 data, Western Meadowlark occurred in the highest number of blocks (205) and an additional 10 species were recorded in at least 70% of blocks (Table 5). Common Grackle was most frequently confirmed as breeding (111 blocks); an additional eight species were confirmed breeding in at least 70

blocks (Table 6). Double-crested Cormorant colonies were the most frequently reported extra observation; observers reported at least 20 extra observations for an additional five species (Table 7). Combining block and extra observation records, observers recorded 16 species in each of at least 90% of all surveyed counties (Table 8) and confirmed breeding by nine species in each of at least 40 counties (Table 9).

Table 5. Species recorded in at least 70% of all blocks surveyed (N=226 blocks), 2008-2009.

Species	# Blocks detected	# Blocks confirmed	# County detected	# County confirmed
Western Meadowlark	205	82	59	43
Mourning Dove	200	74	61	46
Red-winged Blackbird	199	92	60	46
Killdeer	196	72	60	40
Eastern Kingbird	194	70	60	40
Brown-headed Cowbird	191	19	60	18
American Robin	186	109	60	51
Barn Swallow	182	76	61	43
Common Grackle	177	111	60	50
Orchard Oriole	167	42	57	31
Western Kingbird	161	66	57	38

Table 6. Species that have been confirmed breeding in at least 70 blocks during 2008-2009.

Species	# Blocks confirmed	# Blocks detected
Common Grackle	111	177
American Robin	109	186
Red-winged Blackbird	92	199
European Starling	86	147
Western Meadowlark	82	205
Barn Swallow	76	182
Mourning Dove	74	200
Killdeer	72	196
Eastern Kingbird	70	194

Table 7. Species for which at least 20 Extra Observations were submitted by observers, 2008-2009.

Species	# Extra Observat.	# Extr Obs confirmed
Double-crested Cormorant	47	47
Great Blue Heron	40	40
Cliff Swallow	31	31
Long-eared Owl	26	20
Great Horned Owl	25	25
Barn Owl	24	19

Table 8. Species recorded in at least 90% of all counties (N=61) for which data have been submitted, 2008-2009.

Species	# County detected	# County confirmed
Mourning Dove	61	46
Barn Swallow	61	43
American Robin	60	51
Common Grackle	60	50
Red-winged Blackbird	60	46
Killdeer	60	40
Eastern Kingbird	60	40
Brown-headed Cowbird	60	18
Western Meadowlark	59	43
Brown Thrasher	59	30
European Starling	58	44
Horned Lark	57	12
Western Kingbird	57	38
Orchard Oriole	57	31
Mallard	56	34
Grasshopper Sparrow	55	17

Seven species have been detected during SDBBA2 that were not reported during the first South Dakota Breeding Bird Atlas: Sandhill Crane, Herring Gull, Black-necked Stilt, Eurasian Collared-Dove, Prothonotary Warbler, Cassin's Sparrow, and Great-tailed Grackle. In addition, Caspian Tern was never confirmed nesting during the first atlas but was confirmed nesting on Lake Oahe in 2008.

Table 9. Species confirmed breeding in at least 40 counties for which data were submitted during 2008-2009.

Species	# County confirmed	# County detected
American Robin	51	60
Common Grackle	50	60
Mourning Dove	46	61
Red-winged Blackbird	46	60
European Starling	44	58
Cliff Swallow	44	48
Western Meadowlark	43	59
Barn Swallow	43	61
Eastern Kingbird	40	60

SPECIES DETECTION PROBABILITIES

In summer 2009, five paid staff collected detectability data on 43 of 110 randomly-selected atlas blocks (Figure 5). These staff estimated that they surveyed 20-80% of the blocks during the four-hour surveys. At the end of the 12 hours of survey effort per block, observers recorded an average of 51 species (range 29 - 76) and confirmed breeding by an average of 13 species (range 2-27). Subsequent visits to the same blocks added an average of five species not detected during the 12-hour detectability surveys (range 2-15) and confirmed breeding by an additional four species on average (range 0-10).

Of the 163 species detected during detectability surveys, nine species were too common to analyze (detected on $\geq$ 40 blocks) and 72 species were too rare (detected on $\leq$ 6 blocks). Estimated detection probabilities for the remaining 82 species averaged 62.8% (median 63.4%); 75% of all species had estimated detection probabilities greater than 50% (Appendix B, Figure 6). For 21 species, the occupancy model showed a poor fit (χ_2 p<0.20) (Appendix B). The likely explanation is that the data are overdispersed, i.e. the observations are not independent (Anderson *et al*. 1994). This usually is because the species occurs in pairs, clumps, flocks or some other type of aggregate. The result is that standard errors are underestimated; multiplying these by a correction factor (c-hat) resolves the issue.

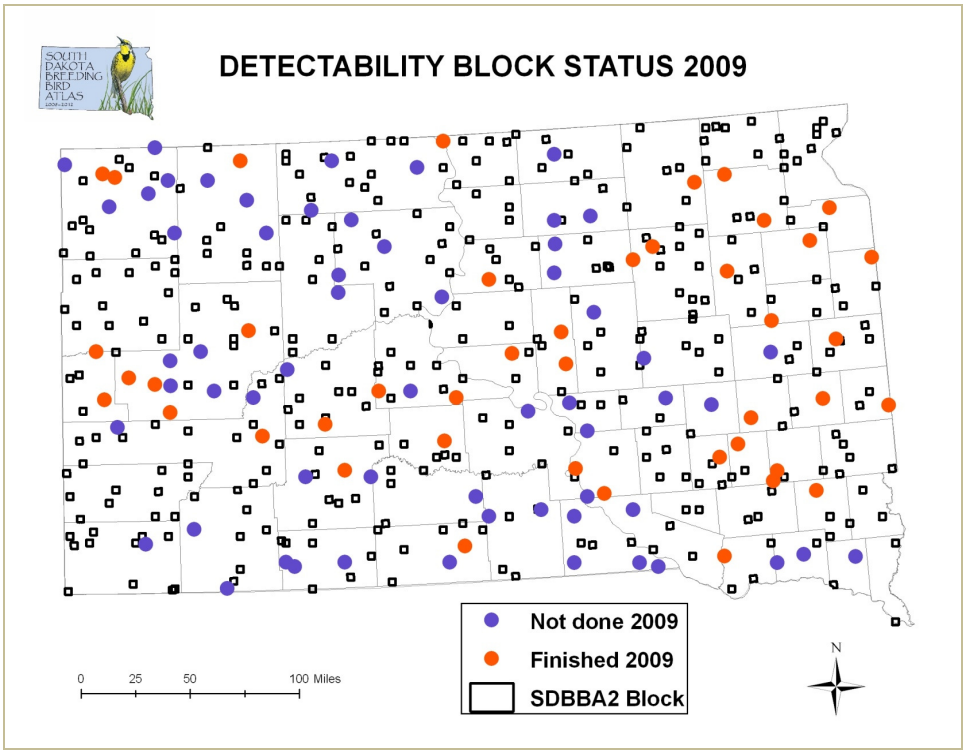

Figure 5. Location of breeding bird atlas blocks randomly selected for collecting species detectability data. Dots are blocks selected for detectability data collection, squares are blocks not selected. Orange dots indicate locations of blocks where detectability surveys were completed in 2009, blue dots indicate locations of blocks not done yet.

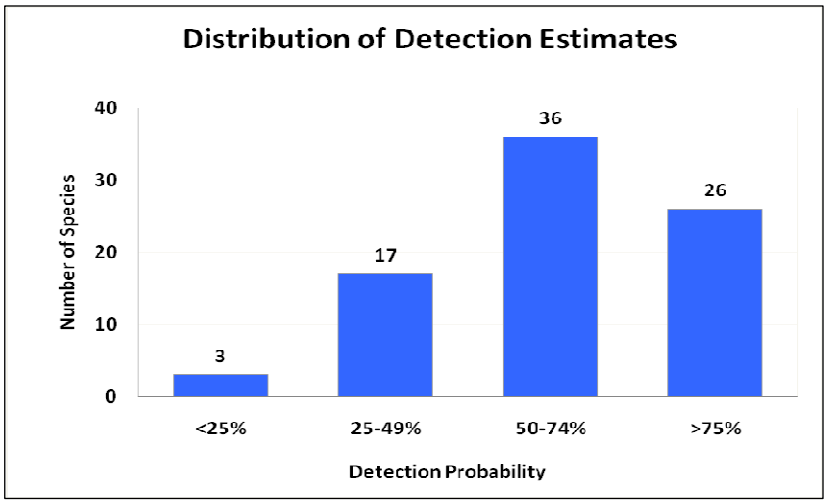

Figure 6. Distribution of estimated detection probabilities for 82 species recorded during four-hour special breeding bird atlas surveys in 2009.

DISCUSSION

With a total of 226 blocks receiving at least one visit in the first two years of data collection, the SDBBA2 is on track to collect data on all 425 blocks within five years. However, only 11% of blocks have received enough coverage to be considered 'finished'. The number of finished blocks accelerated from 7 blocks in 2008 to 38 blocks in 2009. As atlasers continue to visit partially-finished blocks and as volunteers increase their efforts, the number of finished blocks should accelerate in each of the upcoming years. Nevertheless, it will take a concerted effort to finish all blocks within five years. In 2009, paid staff began a strategy of making quick first visits (usually less than three hours) to as many blocks as possible. Besides recording atlas data, the purposes of the quick visit were to identify the best birding areas in the block, determine if these areas require landowner contacts, and identify above-average blocks that should receive extra attention. This should allow us to prioritize our efforts and be more efficient as the end of the atlas project nears.

During the first atlas, an average of 49 species were recorded per random block (Peterson 1996) while in this atlas, an average of 55 species have been recorded on finished blocks. In addition, SDBBA2 already has three blocks with more than 72 species, the maximum number of species recorded on first atlas random blocks. In part, higher species totals are because of the use of paid staff for the second atlas, who tend to survey with greater efficiency than volunteers (Figure 4) and on average, detect more species per block. However some volunteers equal or possibly exceed the birding and atlasing skills of paid staff. The challenge is to identify less skilled volunteers and increase species reporting on their blocks. This can be accomplished by a combination of training, encouraging these observers to spend more time atlasing, and if necessary, sending more skilled observers to these blocks to supplement the data.

With two years of data collection, SDBBA2 already has approximately the same number of breeding species as recorded 20 years ago during the first atlas. The current list includes two probable non-breeding species (Snow Goose, Peregrine Falcon) and two 'new' species which have been split from Rufous-sided Towhee and Northern Oriole since the first atlas. Although the first and second atlas lists are the same length, they are not identical. Seven breeding species are new to the second atlas. All of the 13 first atlas species that thus far have been 'missed' in SDBBA2 are rarer species, especially those with limited and local distribution within the state such as Ruffed Grouse and Canyon Wren. Mostly likely most of these species will be located before the end of the second atlas. Both Virginia's Warbler and Lesser Goldfinch are known to occur in the state but neither has been recorded during either atlas. For common species, first and second atlas results are similar. The following were most frequently reported species on first atlas random blocks (in decreasing order of frequency): Mourning Dove, Western Meadowlark, Brown-headed Cowbird, Killdeer, Red-winged Blackbird, Eastern

Kingbird, Barn Swallow, Common Grackle, American Robin, and Mallard (Peterson 1995). This list is almost identical to the SDBBA2 data (Table 5).

The highlight of 2009 was the discovery of three Blue-gray Gnatcatcher nests in three corners of the state (Custer Co., Harding Co., and Union Co.). Only two nests were reported during the first atlas, both in the Sioux Falls/Newton Hills area. The first Great-tailed Grackle sightings were reported in 2009 on two atlas blocks in Minnehaha and one in Lake County. This species, like the Eurasian Collared-Dove, is a fairly recent arrival to the state that was not present during the first atlas. Northern Cardinal continues to expand to the north and west. The species now is quite common East River and along the Missouri River north to Pierre and is now recorded as far west as the eastern edge of the Badlands.

To our knowledge the SDBBA2 is the first breeding bird atlas to estimate species detectability. Because we felt that conducting point counts (one common way to derive detection probabilities) would distract from and reduce our ability to adequately survey all blocks for bird presence, we decided to use occupancy modeling, which can use atlas presence data. We successfully estimated probabilities for about half of the species found on the 'detectability' blocks. Of the species with too few detections to estimate probabilities, some, such as Cooper's Hawk or Northern Mockingbird are quite rare. Others, such as Mountain Bluebird are relatively common but only occur in a portion of the state. Hopefully we will be able to calculate detection probabilities for many of these species, especially the locally common species, after another year or two when we have a larger sample size.

One objective was to evaluate the efficacy of doing this type of analysis. Did this method of data collection interfere or detract from the primary goal of determining species presence and confirming breeding? For paid staff, the answer is no. Requiring the paid field worker to spend a certain amount of time on a block per day and to repeat visits over a short period of time resulted in more efficient data collection. Paid staff were able to concentrate their efforts in a relatively small geographic area over a several-day period, which most said helped them in scheduling and travel time. Theoretically, volunteers could also collect these data - the methods are the same as their usual atlasing. However, some volunteers may be unwilling or unable to visit a block three times within a fairly short time frame.

Collecting detectability data also did not seem to reduce the total number of species recorded for a block. Paid staff averaged 51 species detected during the 12 hours of detection surveys with an average of 13 species added in subsequent visits. This compares favorably with species totals in other blocks. Overall, it appears that collecting atlas data in a way that allows us to estimate detectability does not detract from the primary purpose of the breeding bird atlas.

The detectability data will be most useful for interpreting distribution maps of species that seem to be rarer than expected. Spotted Sandpiper (SPSA) and Pied-

billed Grebe (PBGR) are two good examples. Both species were reported ‘less frequently than expected’ during the first atlas (Peterson 1995). We now know that SPSA has a low detectability when present. Thus, although the species is reported on about 26% of blocks (naive occupancy), the estimated true occupancy is closer to 62%. Most likely the unexpectedly low number of reports was because of not detecting sandpipers that were there. In contrast, PBGR has a relatively high detectability (56%) and both ‘naive’ (28%) and estimated true (31%) occupancies are similar. Thus, the perceived rareness probably is a real phenomenon that has conservation and management implications.

In the upcoming year, we will be conducting the following activities to improve the scope, efficiency, and usefulness of SDBBA2:

1. Finish owl surveys in the Black Hills and begin surveys in Pine Ridge and Rosebud areas
2. Continue collecting species detection data to increase sample sizes for rarer species.
3. Give presentations at bird club and other scientific meetings
4. Publish newspaper and newsletter articles
5. Increase volunteer recruitment and training

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APPENDIX A. UNCONFIRMED SPECIES

Observed species not yet confirmed breeding during the second SDBBA

Species	# Blocks detected	# Extra Observat.	# County detected
American White Pelican	24	0	19
Clark's Grebe	2	0	2
Least Bittern	4	1	5
Little Blue Heron	0	1	1
Cinnamon Teal	0	2	2
Ring-necked Duck	8	0	7
Lesser Scaup	7	0	6
Bufflehead	0	1	1
Hooded Merganser	1	1	2
Greater Sage Grouse	1	0	1
Northern Bobwhite	9	0	7
American Woodcock	1	0	1
Broad-winged Hawk	4	0	3
Peregrine Falcon	1	0	1
Olive-sided Flycatcher	1	0	1
Eastern Wood-pewee	21	1	15
Chimney Swift	18	0	15
White-throated Swift	2	0	2
Common Poorwill	5	0	2
Broad-tailed Hummingbird	1	0	1
Black-billed Cuckoo	17	0	16
Northern Mockingbird	10	1	8
Pygmy Nuthatch	1	0	1
Brown Creeper	3	0	2
Golden-crowned Kinglet	2	0	2
Sprague's Pipit	2	0	2
Scarlet Tanager	2	1	3
Wood Thrush	1	1	2
Veery	2	0	1
Black-and-White Warbler	1	0	1
Eastern Towhee	4	0	3
Baird's Sparrow	3	0	3
Lazuli Bunting	9	0	5
Great-tailed Grackle	3	0	2
Eastern Meadowlark	2	1	2
White-winged Crossbill	1	0	1
Red Crossbill	8	0	4

APPENDIX B. SPECIES DETECTION PROBABILITIES

Estimated Detection Probabilities (D_p) Naive Occupancy Rate (# Blocks Detected/Total # Blocks), Adjusted Estimated Occupancy Probability (Psi), standard errors (SE), χ^2 test statistic, and p values for 82 species detected during special detectability field surveys on atlas blocks in 2009. The list is ordered by species with highest D_p to species with lowest D_p.

Species	# Blk Detect	Dp	SE_Dp	Naive Occup	Psi	SE_Psi	χ^2	P
American Robin	39	0.95	0.021	0.91	0.91	0.044	2.08	0.25
Common Yellowthroat	37	0.89	0.054	0.86	0.86	0.053	3.83	0.01**
Wild Turkey	9	0.89	0.062	0.21	0.21	0.062	2.48	0.23
Ring-necked Pheasant	32	0.88	0.033	0.74	0.75	0.067	1.10	0.44
Mallard	35	0.87	0.066	0.81	0.82	0.060	4.62	0.00**
Horned Lark	31	0.85	0.055	0.72	0.72	0.069	2.39	0.06**
Song Sparrow	31	0.83	0.061	0.72	0.72	0.069	2.59	0.03**
Western Kingbird	37	0.82	0.038	0.86	0.87	0.053	1.12	0.37
House Wren	33	0.82	0.052	0.77	0.77	0.065	1.84	0.11**
Blue-winged Teal	31	0.82	0.072	0.72	0.72	0.069	3.25	0.01**
Dickcissel	23	0.82	0.048	0.53	0.54	0.076	0.28	0.98
Brown Thrasher	37	0.82	0.037	0.88	0.89	0.049	0.77	0.59
Vesper Sparrow	28	0.82	0.056	0.65	0.66	0.073	1.79	0.13**
European Starling	39	0.82	0.037	0.91	0.92	0.045	0.64	0.73
Marsh Wren	16	0.81	0.060	0.37	0.37	0.074	0.64	0.75
House Sparrow	33	0.80	0.042	0.77	0.77	0.065	1.26	0.27
Yellow-headed Blackbird	29	0.79	0.057	0.67	0.68	0.072	1.61	0.17**
Gadwall	29	0.79	0.046	0.67	0.68	0.072	1.02	0.40
American Goldfinch	36	0.78	0.043	0.81	0.82	0.060	1.06	0.38
Northern Flicker	34	0.78	0.044	0.79	0.80	0.063	0.92	0.44
Bobolink	32	0.77	0.045	0.74	0.75	0.068	0.63	0.71
Chestnut-collared Longspur	9	0.77	0.120	0.21	0.21	0.063	2.72	0.09**
Lark Bunting	15	0.77	0.067	0.35	0.35	0.074	0.42	0.92
Cliff Swallow	25	0.76	0.074	0.58	0.59	0.076	2.10	0.06**
Upland Sandpiper	36	0.76	0.061	0.84	0.85	0.058	1.86	0.06**
Spotted Towhee	10	0.76	0.084	0.23	0.24	0.066	1.59	0.28
Grasshopper Sparrow	38	0.74	0.076	0.88	0.90	0.050	2.74	0.01**
Yellow Warbler	35	0.74	0.062	0.81	0.83	0.061	1.72	0.09**
N. Rough-winged Swallow	8	0.74	0.097	0.19	0.19	0.061	1.03	0.59
Field Sparrow	9	0.73	0.093	0.21	0.21	0.064	1.77	0.22
Lark Sparrow	13	0.70	0.081	0.30	0.31	0.072	1.14	0.40
Red-headed Woodpecker	27	0.70	0.056	0.63	0.65	0.077	1.00	0.37

APPENDIX B - Species Detection Probabilities (cont.)

Species	# Blk Detect	Dp	SE_Dp	Naive Occup	Psi	SE_Psi	χ^2	P
Eurasian Collared-dove	7	0.69	0.111	0.16	0.17	0.058	1.43	0.36
Say's Phoebe	7	0.69	0.111	0.16	0.17	0.058	0.48	0.94
Savannah Sparrow	15	0.69	0.090	0.35	0.36	0.075	1.55	0.19**
American Coot	16	0.69	0.074	0.37	0.38	0.077	1.08	0.42
Tree Swallow	31	0.67	0.054	0.72	0.75	0.072	1.19	0.26
Least Flycatcher	17	0.63	0.097	0.40	0.42	0.080	1.60	0.14**
Warbling Vireo	25	0.63	0.095	0.58	0.61	0.081	2.13	0.04**
Blue Jay	19	0.63	0.073	0.44	0.46	0.081	0.84	0.54
Clay-colored Sparrow	11	0.63	0.096	0.26	0.27	0.071	0.52	0.85
Chipping Sparrow	28	0.63	0.060	0.65	0.68	0.078	0.34	0.92
Great-crested Flycatcher	8	0.63	0.112	0.19	0.20	0.063	1.29	0.38
Willow Flycatcher	17	0.63	0.077	0.40	0.42	0.080	0.77	0.60
Wood Duck	11	0.63	0.096	0.26	0.27	0.071	0.05	1.00
Baltimore Oriole	23	0.61	0.069	0.51	0.54	0.083	0.83	0.53
Northern Harrier	20	0.61	0.073	0.47	0.49	0.083	0.68	0.66
Gray Catbird	17	0.61	0.079	0.40	0.42	0.081	0.53	0.78
Loggerhead Shrike	15	0.60	0.085	0.35	0.37	0.079	0.81	0.54
Ruddy Duck	14	0.60	0.088	0.33	0.35	0.078	0.83	0.57
Red-tailed Hawk	36	0.60	0.055	0.84	0.90	0.066	1.05	0.31
Wilson's Phalarope	10	0.59	0.160	0.23	0.25	0.071	2.77	0.04**
Canada Goose	18	0.58	0.079	0.42	0.45	0.083	0.52	0.75
American Wigeon	7	0.57	0.177	0.16	0.18	0.063	2.71	0.09**
Black-capped Chickadee	7	0.57	0.128	0.16	0.18	0.063	1.17	0.47
Red-eyed Vireo	7	0.57	0.128	0.16	0.18	0.063	0.66	0.81
Rock Pigeon	28	0.57	0.064	0.65	0.71	0.084	0.57	0.73
Pied-billed Grebe	12	0.56	0.099	0.28	0.31	0.077	1.24	0.32
American Crow	16	0.55	0.136	0.37	0.41	0.085	2.43	0.03**
Hairy Woodpecker	13	0.53	0.097	0.30	0.34	0.082	0.32	0.93
American Kestrel	24	0.52	0.072	0.56	0.63	0.092	1.19	0.21
Sharp-tailed Grouse	8	0.52	0.125	0.19	0.21	0.070	0.35	0.94
Marbled Godwit	10	0.49	0.114	0.23	0.27	0.079	1.35	0.31
Common Nighthawk	16	0.49	0.090	0.37	0.43	0.092	0.19	0.98
Redhead	16	0.49	0.090	0.37	0.43	0.092	0.85	0.51
Northern Shoveler	24	0.48	0.115	0.56	0.65	0.100	2.28	0.03**
Blue Grosbeak	11	0.46	0.110	0.26	0.30	0.086	0.29	0.96
White-breasted Nuthatch	8	0.45	0.130	0.19	0.22	0.077	0.73	0.76
Great Blue Heron	25	0.44	0.074	0.58	-0.71	0.109	0.46	0.84
Cedar Waxwing	19	0.43	0.085	0.44	0.54	0.109	0.82	0.49

APPENDIX B - Species Detection Probabilities (cont.)

Species	# Blk Detect	Dp	SE_Dp	Naive Occup	Psi	SE_Psi	χ^2	P
Swainson's Hawk	19	0.43	0.085	0.44	0.54	0.109	0.73	0.58
Rose-breasted Grosbeak	7	0.42	0.140	0.16	0.20	0.078	1.11	0.51
Belted Kingfisher	11	0.41	0.112	0.26	0.32	0.097	0.75	0.64
Turkey Vulture	11	0.41	0.112	0.26	0.32	0.097	0.79	0.63
Northern Pintail	18	0.38	0.088	0.42	0.55	0.122	0.81	0.54
Downy Woodpecker	13	0.36	0.104	0.30	0.41	0.119	0.19	0.99
Green-winged Teal	9	0.35	0.125	0.21	0.29	0.107	0.76	0.69
Great Horned Owl	17	0.29	0.090	0.40	0.62	0.176	0.99	0.44
Eastern Phoebe	9	0.28	0.124	0.21	0.34	0.146	0.65	0.81
Black Tern	8	0.22	0.155	0.19	0.36	0.198	2.21	0.16**
Sora	8	0.22	0.126	0.19	0.36	0.198	1.64	0.29
Spotted Sandpiper	11	0.16	0.100	0.26	0.62	0.354	1.06	0.51

** $p < 0.20$, SE_Dp is adjusted standard error (see methods for formula)