SOUTH DAKOTA 2012 COLONIAL WATERBIRD SURVEY

Technical Report # SC-ColonySD-06

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ROCKY MOUNTAIN BIRD OBSERVATORY

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EXECUTIVE SUMMARY

Colonial waterbirds prefer to breed in high-density groups in a relatively small number of locations, favoring predator-free habitats such as flooded timber, islands, and marsh reed beds. However, this 'all eggs in one basket' breeding strategy makes these species vulnerable to natural or manmade catastrophic events that could wipe out a large portion of the breeding population. In addition, populations have been reduced because of land-use changes leading to wetland loss, bioaccumulation of toxins, and degradation of wintering habitat. Thus many of these species are the focus of conservation efforts throughout North America (Kushlan *et al.* 2002).

Twenty-six species of colonial waterbirds breed in South Dakota, including herons, night-herons, egrets, grebes, gulls, terns, ibis, American White Pelican and Double-crested Cormorant (Tallman *et al.* 2002). According to South Dakota's Long-term Monitoring Plan for Colonial Waterbirds, the goal of waterbird monitoring in South Dakota is to collect information, on a continuous basis and over a long period of time, which managers and landowners can use to manage and conserve colonial waterbirds and to aid in the prevention of future declines of colonial waterbird species that breed in South Dakota (Drilling 2007). The plan further states that identifying and monitoring breeding colonies are the primary tools for tracking populations. Therefore during 2005-2007, statewide surveys established a baseline inventory of colony site locations and breeding population size (Drilling 2007). These surveys identified 26 wetlands as being key sites for breeding waterbirds, defined as having at least 200 waterbird breeding pairs or more than five breeding species.

The plan also recommends surveys at least every five years, to update colony and population size databases, track populations, and identify potential or actual threats to waterbird colonies and populations in the state. Thus, the 2012 survey project objectives were to:

1) Survey recent and key colonial waterbird breeding colonies to document and enumerate breeding species and their current conservation status.
2) Survey for new sites to update the South Dakota colonial waterbird database.
3) Document factors that could affect surveyed colony sites including current habitat conditions, current land use, and potential or observed threats.
4) Evaluate the 2007 monitoring plan in light of data collected during 2012.

To accomplish these objectives, 311 colonies that were active at some point since 2005 were surveyed during the 2012 breeding season. Of these, surveyors confirmed breeding by colonial waterbirds at 183 sites (59%). Twenty-two sites were identified as being key sites for breeding waterbirds. Of the 26 key sites identified five years earlier, five (19%) had no breeding colonial waterbirds in 2012. Two of these no longer had suitable breeding habitat while three were abandoned for unknown reasons. Another nine of the 26 key sites still had breeding waterbirds in 2012 but too few to meet the 'key site' criteria. Great Blue Heron key colonies showed a higher rate of turnover than did multi-species colonies. Just three of the twelve 2005-2007 key heron colonies

maintained at least 50 breeding heron pairs and another three had no herons in 2012. Overall, surveyors observed few threats to colonies related to human activities. In almost all cases, colony creation, extinction, and location shifts occurred because of natural fluctuations in water levels caused by floods and droughts.

American White Pelicans (~21,560 pairs) and Double-crested Cormorants (~12,630 pairs) were the most abundant nesting colonial waterbirds in the state in 2012. Great Blue Herons were distributed in the greatest number of colonies (93) of any species and were the most common waterbird in West River. Double-crested Cormorants also nested in a large number of colonies (64). There was no evidence that any species' populations decreased in the state since 2007, with the possible exception of Ring-billed Gull. An unexpected result of the 2012 surveys was documentation of breeding by several new and rare colonial waterbird species including Neotropic Cormorant, Yellow-crowned Night-heron, Glossy Ibis, Little Blue Heron, Caspian Tern and Herring Gull.

As a result of the 2012 surveys, South Dakota now has an updated database of colony, population, and species conservation status information, as well as a clearer understanding of the dynamics of colony turnover. Recommendations include:

1) Create a program specifically designed to track colonies between major surveys.
2) Monitor all colonies, not just key colonies.
3) Research factors that impact breeding waterbird colonies in South Dakota.

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INTRODUCTION

South Dakota hosts 26 species of breeding colonial and semi-colonial waterbird species (Tallman *et al*. 2002). Some of these species are locally rare or uncommon in South Dakota and therefore important from a state natural heritage perspective. Others are fairly common within the state but are important from a global perspective as they comprise core portions of the worldwide populations of these species (Beyersbergen *et al.* 2004). These waterbird species nest almost exclusively in predator-free wetland habitats such as flooded timber, islands, and marsh reed beds. Because these habitats are relatively rare and patchily distributed, these species tend to nest in high densities in relatively few locations.

The colonial breeding habits of these species make them especially vulnerable to factors that affect the availability and suitability of nesting and brood-rearing sites, such as severe weather events, disturbance, pollution, and changes in land use (Kushlan *et al*. 2002). In South Dakota, the greatest threats are loss and degradation of wetland habitats caused by large-scale changes in land use (Higgins *et al.* 2002). In addition, wetland number, size and depth can greatly fluctuate on an annual basis because of natural wet-dry climatic cycles (Larson 1995, Johnson *et al.* 2004, van der Valk 2005). As a result of fluctuating water levels, new breeding habitats may become suitable and others unsuitable. With the constant fluctuation of wetland habitat across South Dakota caused by wet-dry cycles and land use conversions, it is crucial that colonial and semi-colonial waterbirds that depend on these habitats are regularly monitored.

During 2005 – 2007, a statewide inventory identified 26 ‘key’ colony sites, mostly in the eastern part of the state (Drilling 2007). These sites harbored large nesting populations of multiple species, and have been found to exhibit higher reproductive success when compared to smaller, isolated colonies (Baker 2010). If habitat conditions remain stable, some of these key nesting areas may have a long history of regular use and provide fairly stable and reliable conditions needed for successful reproduction. Thus, these are critical to the reproductive health, survival, and stability of colonial waterbird populations in South Dakota and need to be monitored. In addition to monitoring known major nesting waterbird colonies, it is also essential to search for new colonies, as some key colonies are likely to relocate in response to changing habitat conditions.

The 2005-2007 statewide inventory established a baseline database of waterbird colonies and developed a long-term monitoring plan for the state (Drilling 2007). As stated in the plan, the goal of waterbird monitoring in South Dakota is to collect information, on a continuous basis and over a long period of time, which managers and landowners can use to manage and conserve colonial waterbirds and to aid in the prevention of future declines of colonial waterbird species that breed in South Dakota.

Specific objectives of statewide colonial waterbird monitoring include:

1) Improve information on conservation status of breeding colonial waterbirds in South Dakota,

2) Identify and track factors that could result in a decline of colonial waterbird species that breed in South Dakota,
3) Determine what and how management actions impact breeding populations,
4) Provide information to aid management of waterbird-fisheries conflicts, and
5) Ensure compatibility with regional and national monitoring efforts.

The plan also recommended an evaluation of plan methods and objectives every five years. Thus the 2012 survey project objectives were to:

1) Survey recent and key colonial waterbird breeding colonies to document and enumerate breeding species and their current conservation status.
2) Survey for new sites to update the South Dakota colonial waterbird database.
3) Document factors that could affect surveyed colony sites including current habitat conditions, current land use, and potential or observed threats.
4) Evaluate the 2007 monitoring plan in light of data collected during 2012.

METHODS

SPECIES

Field crew surveyed for all colonial waterbird species that potentially could breed in South Dakota (Appendix A). These included all heron, night-heron, egret, grebe, ibis, gull, and tern species, American White Pelican and Double-crested Cormorant. Scientific names of all species are listed in Appendix A.

SITE SELECTION FOR SURVEYS

Surveys focused on known colony sites, especially those known to be active between 2005 and 2012. Before the 2012 field season, we compiled a list of known active colony sites of all targeted waterbird species from the 2005-2007 survey baseline colony database (Drilling 2007), South Dakota Breeding Bird Atlas 2 database (Rocky Mountain Bird Observatory, *unpubl. data*), and U.S. Fish and Wildlife Service Waubay Waterfowl Management District database. We also solicited information on new colonies from bird-watchers and federal and state agency staff. We continued to add new colonies to the list during the summer, based on information from the public and from newly-discovered colonies by surveyors in the field. All of these colonies were visited at least once during the summer.

Aerial surveys provide an efficient means of searching for waterbird colonies (Henny et al. 1972, Rodgers et al. 1995, Kingsford et al. 2008). In the spring before leaf-out, we conducted aerial surveys along major rivers to survey known tree-nesting colonies and to find new colonies (Table 1). These surveys were conducted in a single-engine

Cessna airplane flying 100-200 feet above the canopy at approximately 120 mph. Number of nests per colony was estimated during the flight. These colonies were not visited again on the ground.

Table 1. Dates and routes of colonial waterbird and eagle nest aerial surveys in South Dakota during spring 2012.

Date	Area Surveyed
3/29/2012	Cheyenne River, Belle Fourche River
3/30/2012	Bad River, short section of Missouri River below Pierre
4/3/2012	White River
4/5/2012	Little White River, Keya Paha River
4/9/2012	Missouri River below Pierre to Yankton, James River
4/11/2012	Lk Thompson, Vermillion Riv., Miss. Riv. below Yankton, Big Sioux Riv.
4/16/2012	Grand River, Moreau River, Lake Oahe

SITE SURVEYS

For each visited colony site, we recorded both site-specific and species-specific information. If the entire wetland or wetlands could not be viewed from one location or from roads, observers walked or canoed to survey all appropriate habitat. At the site, we recorded land use within 1/2 mile of the colony, observed or potential threats to the colony, wetland type (natural lake or pond, large impoundment, stock pond, river or creek, or marsh), and colony location (vegetated island, denuded island, peninsula, flooded trees, open water, mainland shoreline or riverbank, or within marsh vegetation). For each colonial waterbird species present, we tried to confirm breeding by noting any of the following behaviors: carrying nesting material, carrying food, adults sitting on or at nests, chicks visible in nests, and for precocial species, precocial chicks accompanying adults. When nests were found, surveyors recorded the nesting substrate(s) - ground, tree, or marsh), and counted number of breeding pairs of each species, as described below.

At the end of the season, we classified each visited site as Active (breeding confirmed for at least one targeted species), Non-active (old nests present but not used by waterbirds in current season), Unknown (species present but breeding not confirmed), or No evidence of breeding.

BREEDING POPULATION COUNTS

If any targeted species was breeding at a site, we counted the breeding population, measuring the parameter appropriate for that species and using the protocol that would cause the least disturbance yet yield a relatively accurate count (Appendix A). When

possible, we counted from outside the colony using binoculars or spotting scopes. If a colony needed to be entered, we limited time in the colony to less than 30 minutes and entered only under favorable weather conditions (not raining, air temperature between 70^{o}–85^{o} F). In addition, colonies were entered only when most nests were in late incubation or early chick stages of breeding. Pelican colonies were not entered because they are extremely sensitive to human presence (Knopf and Evans 2004); nests were counted from aerial photos taken by U.S. Fish and Wildlife staff. At most colonies, two observers counted simultaneously and their counts were averaged. If the two counts differed by more than 10%, both observers recounted. However, at very large multi-species colonies, only one observer counted a particular species or transect to minimize in-colony time and disturbance to nesting birds.

Counting protocols followed those of Steinkamp *et al*. (2003). Choice of the appropriate protocol to use at a particular colony depended on habitat type, colony size, and species composition. Details are as follows.

Total nest count: A total count of all active nests is the most accurate measurement of the number of breeding pairs in a colony (Steinkamp *et al*. 2003). Thus, active nests was the parameter we measured whenever possible. An active nest was any nest with attending adults, eggs, chicks, or fresh fecal matter. If contents of a nest were not visible (e.g., nest high up in tree) and no adult was at the nest, we considered the nest active if it was approximately the same size and condition as other active nests in the colony. Total nests counts were conducted at all colonies with tree-nesting species, i.e., those with any heron, egret, night-heron, or cormorant species, as well as at colonies of open-water nesting Eared Grebes. We also counted all nests of ground-nesting gull and tern species in colonies with <~100 nests. We attempted to count all nests in marsh-nesting grebe and tern colonies, but in the cases of large colony size or dense vegetation, other protocols were used (see below).

For colonies whose nests were in leafless trees, observers positioned themselves so that the entire colony could be counted from one spot to avoid double-counting nests and from outside the perimeter to avoid undue disturbance. Because many Great Blue Heron nests were in live cottonwood (*Populus deltoides*) trees, every effort was made to visit the colony in early spring before leaf-out so that the nests could be counted from outside the perimeter. A small number of colonies with tree nests were too large or too dense to be counted from outside the perimeter. Using flagging tape, these colonies were divided into strip transects 10 - 40 m wide, depending on tree and shrub density. One observer per transect counted all nests in all trees and shrubs with trunks within their transects.

If ground nest colonies needed to be entered, each ground nest was marked with a small dot of spray paint as it was counted to avoid double-counting or missing nests. In marshes, we traveled all open water channels to search for nests and watch for adult behavioral cues to nest locations.

Brood count: Grebe species have precocial young. Marsh nests of these species usually were hard to find or access, and counting broods as they accompany their parents often is a more accurate parameter for assessing the size of the breeding population. Grebe broods were surveyed by systematically searching open water patches and channels. In grebe colonies, we often found both nests and broods during the same visit. The counts of these two parameters were added together to obtain an estimate of the total breeding population.

Adult flush count: Number of adults was the parameter used as measure of breeding population size for *Laridae* species' colonies >~100 nests and marsh colonies of reedbed-nesting herons, night-herons, egrets, or ibis. To estimate the number of adults, colonies were approached until adults flushed off nests. Observers quickly counted the number of adults before birds begin to settle back down or fly away, using a rapid flock size estimation technique (Bibby *et al*. 1992). We assumed that every bird flushed was a breeding adult in that colony and that both parents were present. Thus the total number of flushed adults was divided by two to estimate the number of breeding pairs. These assumptions most likely are never true; limited studies have shown that the divisor is less than two (i.e., both parents of every nest are not present) but the exact number is highly variable, depending on site, species, and nesting stage (Steinkamp *et al.* 2003). Because we lacked this information in surveyed colonies, we used the both-parents-present assumption to produce a more conservative estimate of number of breeding pairs. When flush counts were employed, we attempted to confirm breeding by at least one individual within that colony (i.e., one active nest, one individual carrying nesting material, etc.).

Perimeter counts of large ground-nesting colonies and flush counts of large adult aggregations tend to be less accurate because of large numbers counted in a short period of time (Steinkamp *et al*. 2003). Results from these counts are indicated in this report by the '~' symbol.

DATABASES

Data resulting from the 2012 surveys will be added to the colony and species databases at the South Dakota Natural Heritage Program, South Dakota Dept. of Game, Fish and Parks and with the Fort Collins, CO office of Rocky Mountain Bird Observatory.

RESULTS

Rocky Mountain Bird Observatory staff surveyed waterbird colonies on the ground between March 23 and August 1, 2012. We surveyed a total of 311 different sites for the presence of breeding colonial waterbirds (Figure 1). Of these, we confirmed breeding at 183 sites (58.8%), 16 sites (5.2%) had non-active nests, 94 sites (30.3%) had no

evidence of waterbird breeding, and colonial waterbird breeding was never confirmed (i.e., unknown breeding) at 18 sites (5.8%).

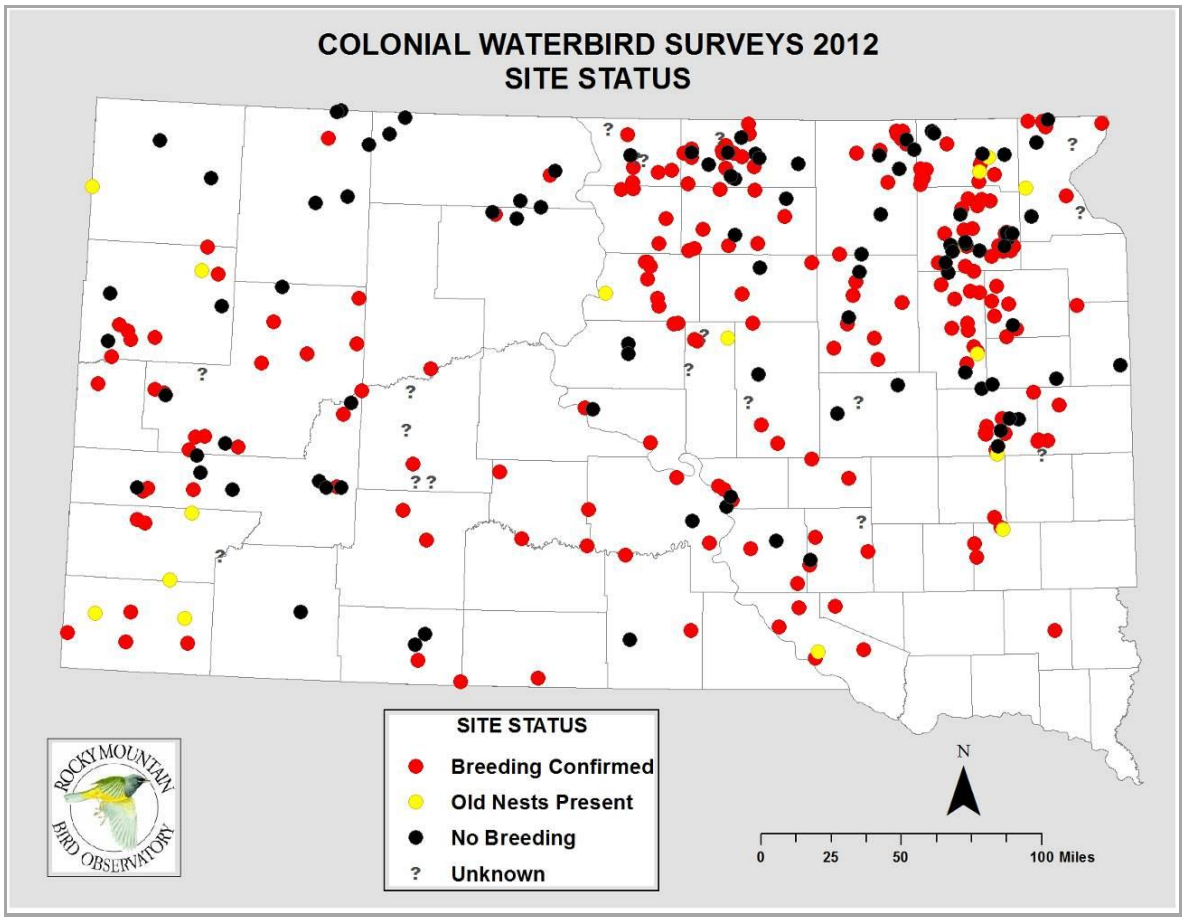

Figure 1. Locations of wetland sites surveyed for presence of breeding waterbirds in 2012 and their status.

Total number of colonial waterbird species confirmed breeding at a site ranged from 1 – 17 species, while total number of confirmed breeding pairs of all species combined at a site ranged from one to almost 22,950 pairs (Table 2). A total of 20 sites had ≥200 pairs, while 9 sites had >5 species breeding (Table 2, Appendix B). Combined, a total of 22 sites were in one category and/or the other (Figure 2). Of the 22 key sites, 10 (45%) were not key sites during 2005–2007, including two (9%) that did not have any breeding colonial waterbirds five years ago. In all, 14 of 26 sites (53%) identified as key colonies during 2005 – 2007 no longer met the key colony criteria in 2012 (Appendix C). Five of these (19% of 26 sites) did not have any breeding colonial waterbirds in 2012.

Table 2. Summary of key colonial waterbird breeding sites in South Dakota documented during the 2005-2007 and 2012 surveys.

	2005	2006	2007	2012
Number sites with >200 confirmed breeding pairs	14	20	17	20
Highest number of waterbird pairs at one site	~11,529	~19,117	~22,488	~22,947
Number sites with >5 breeding waterbird species	6	6	9	9
Highest number of breeding species at one site	13	12	15	17

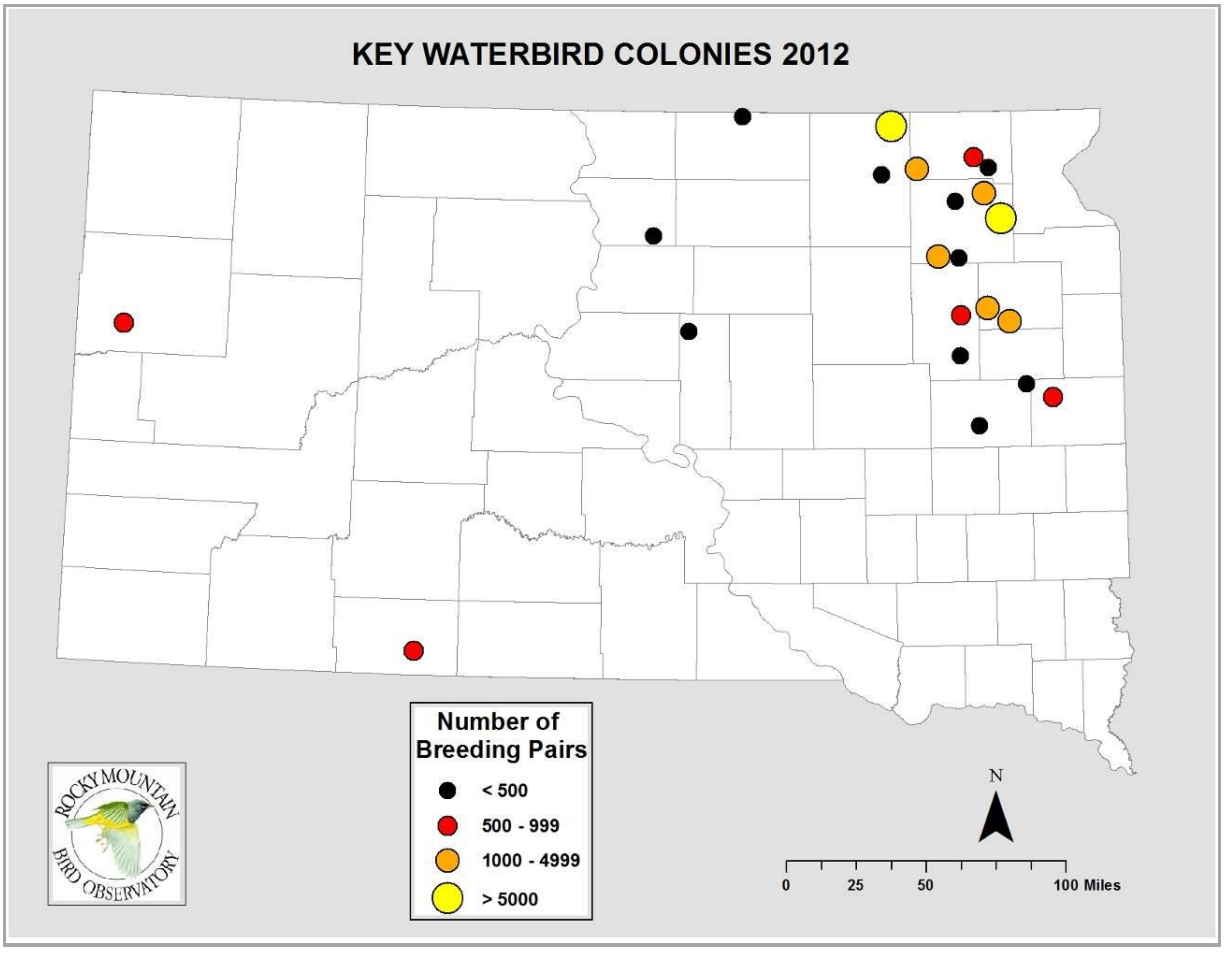

Figure 2. Location of key waterbird colonies in South Dakota in 2012, defined as colonies with ≥ 200 breeding pairs or > five breeding species.

More than 80% of the 2012 multi-species key sites were owned by a federal or state wildlife agency (Figure 3). In contrast, the majority of smaller colony sites were on private land (Figure 3) . Six of nine Great Blue Heron key colonies also were on private land.

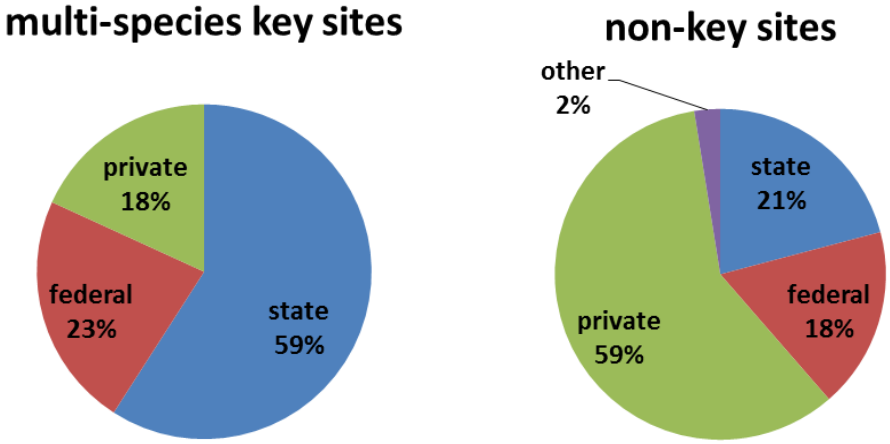

Figure 3. Ownership of multi-species key colony sites (left) and smaller, non-key colony sites (right) surveyed in 2012 in South Dakota. Ownership in the 'other' category included city and tribal ownership.

SPECIES

American White Pelicans and Double-crested Cormorants were the most abundant nesting colonial waterbirds in the state, with total counts of almost 21,600 pelican pairs and more than 12,600 cormorant pairs (Table 3). In addition, known total breeding populations of Ring-billed Gulls, Great Egrets, Great Blue Herons, Black-crowned Night-herons, Eared Grebes, and Franklin's Gulls were each greater than 1,000 pairs. Great Blue Herons were distributed in the greatest number of colonies of any species (92 different colonies), followed by cormorants (64 colonies), and two grebe species - Western Grebes (44 colonies) and Eared Grebes (37 colonies) (Table 3).

For many colonial species, most breeding pairs known in the state were nesting in a small number of colonies (Table 3). Seventeen of 23 colonial species were confirmed to be breeding at less than 10 locations. Most of the more numerous colonial species, except Great Blue Heron and Double-crested Cormorant, had at least one colony that contained at least 25% of the known total 2012 state breeding population (Table 3, last column).

TABLE 3. Total known breeding population size and number of colonies in South Dakota by species during two survey periods. Breeding population size for the 2005-2007 surveys is given as the minimum and maximum yearly count of known pairs over the three year survey period.

Species	Total Num. Known Breeding Pairs		Total Num. Known Colonies		Num '12 Colonies with >25% pop.
	2005-2007 min-max.	2012	2005-2007	2012	
Amer. White Pelican	8760 - 17,137	21,558	2	4	2
Dbl-crested Cormorant	5060 - 9094	12,633	96	64	0
Neotropic Cormorant	0	1	0	1	1
Great Blue Heron	905 - 1691	1,547	115	93	0
Great Egret	1658 - 2241	3,654	18	19	1
Snowy Egret	158 - 510	254	3	9	1
Cattle Egret	783 - 1338	987	10	9	1
Little Blue Heron	0 - 2	3	2	3	0
Black-cr. Night-heron	222 - 281	1,222	12	11	1
Yellow-cr. Night-heron	0	1	0	1	1
White-faced Ibis	53 - 162	876	7	5	2
Glossy Ibis	0	11	0	3	1
Ring-billed Gull	2070 - 4757	1,406	4	7	2
California Gull	70 - 481	421	3	4	1
Herring Gull	0	4	0	2	1
Franklin's Gull	250 - 1350	1,565	4	3	2
Common Tern	41 - 91	73	6	3	1
Caspian Tern	0 - 22	9	2	1	1
Forster's Tern	45 - 105	220	7	9	2
Western Grebe	132 - 382	915	45	44	1
Clark's Grebe	0	9	0	6	0
Eared Grebe	283 - 1581	1,126	32	37	1
Horned Grebe	0	2	0	1	1

On the other end of the spectrum, surveyors documented breeding by eight rare colonial waterbird species in 2012. One or two Little Blue Herons usually nest in the state every year, in large colonies of ibis, night-herons, and 'small' egrets. In 2012, this species nested in three different tree colonies. Caspian Tern also can be found nesting on islands somewhere in the state every year. We did not find the species at Bitter Lake, a traditional nesting spot but Caspian Terns began nesting at Orman Dam around 2010 and nests were present again this year. Herring Gulls began nesting in the state in 2008 on the Missouri River; they have now expanded to both sides of the state, albeit in very small numbers. Horned Grebe is an occasional breeder in the state. Several pairs

were reported to the South Dakota Breeding Bird Atlas between 2009-2011, but we were only able to document one pair in 2012.

In addition to these species which breed in small numbers each year, the 2012 survey documented first state breeding records for three species. Numbers of Glossy Ibis have been increasing within the state over the past five years (*pers. observation*), but 2012 was the first time that anyone has made an effort to determine if this southeast U.S. native is breeding. We documented breeding at three sites in three different counties. Similarly, the Yellow-crowned Night-heron, another southeast native, is regularly seen in South Dakota. This summer we documented one individual carrying nest material.

The most surprising finding was the discovery of a pair of Neotropic Cormorants on a nest in Brown County. In spring 2012, observers found Neotropic Cormorants in two locations in South Dakota – at Torrey Lake, Brule Co. (L. Barber & J. Baker, *pers. comm.*) and just east of Hecla, Brown Co. (B. Unzen, *pers. comm.*). Later in August, observers saw a pair of adult Neotropic Cormorants and at least one possible juvenile near the Torrey Lake colony.

Most breeding pairs of most species were found in the key multi-species colonies (Figure 4). However, many Great Blue Heron, Double-crested Cormants, Eared Grebe and Western Grebe pairs were found breeding in other areas. Detailed results of breeding by Great Blue Heron and Double-crested Cormornats, the most abundant of these species, are given below.

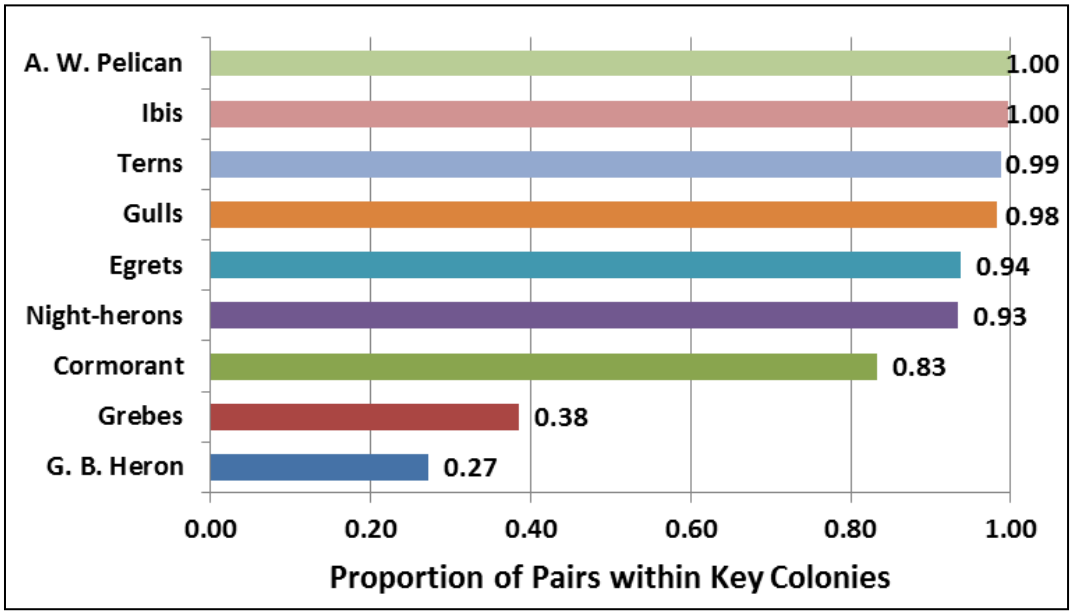

Figure 4. Proportion of breeding pairs per species group found within the 22 key colonies in 2012.

GREAT BLUE HERON

While Great Blue Herons will nest in multi-species colonies, 63% of the known 2012 colonies consisted of just this one species. In addition, just 27% of all heron pairs nested within one of the 22 key colonies (Figure 5), the lowest of any of the monitored species. In 2012, we found 93 active colonies with a total of 1,547 nests in 39 counties (Figure 5). Number of active nests ranged from 1 – 102 with average count of 17 nests and median of 8 nests. This is similar to results of the 2005-2007 surveys, which found colony sizes of 1 - 151 nests with annual average colony size of 16 – 18 nests and median of 8 nests (Drilling 2007).

In 2012, nine sites (10% of all colonies) had at least 50 nesting pairs of Great Blue Herons. Two were newly discovered this year while two others were established between 2007 and 2012. Six of the nine colonies consisted of just Great Blue Herons while the other three were mixed-species colonies.

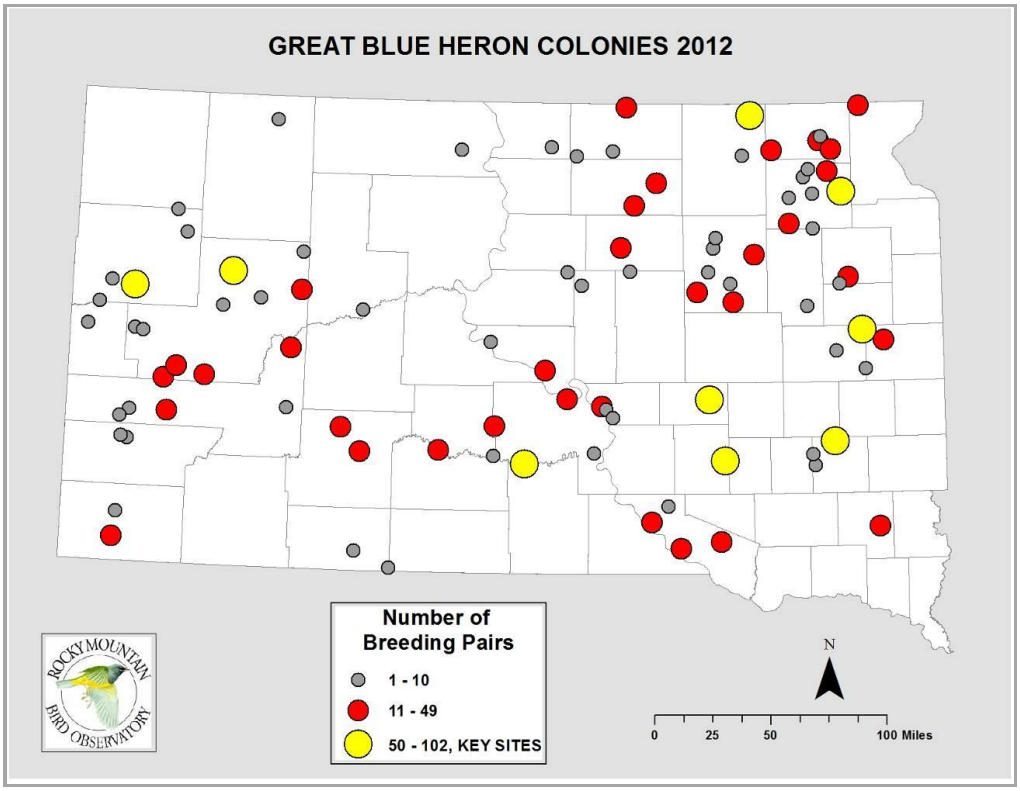

Figure 5. Location of 2012 known Great Blue Heron colonies in South Dakota. Colonies indicated in yellow had ≥ 50 nests - key colonies for the species.

DOUBLE-CRESTED CORMORANT

In 2012, surveyors counted 12,633 Double-crested Cormorant nests in 64 colonies in 23 counties (Figure 6). Another colony that was active in 2011 in Perkins Co., was not visited this year. Colonies ranged in size from 4 – 2107 nests. Colonies surveyed in 2012 averaged larger (186 nests) than did colonies surveyed 2005-2007 (103-125 nests) but the 2012 median colony size (42) is well within the median colony size found in 2005-2007 (39-61 nests). Thirty-eight colonies (59%) with cormorants also had other nesting colonial waterbird species and 92.5% of all cormorants were nesting in one of these mixed-species colonies.

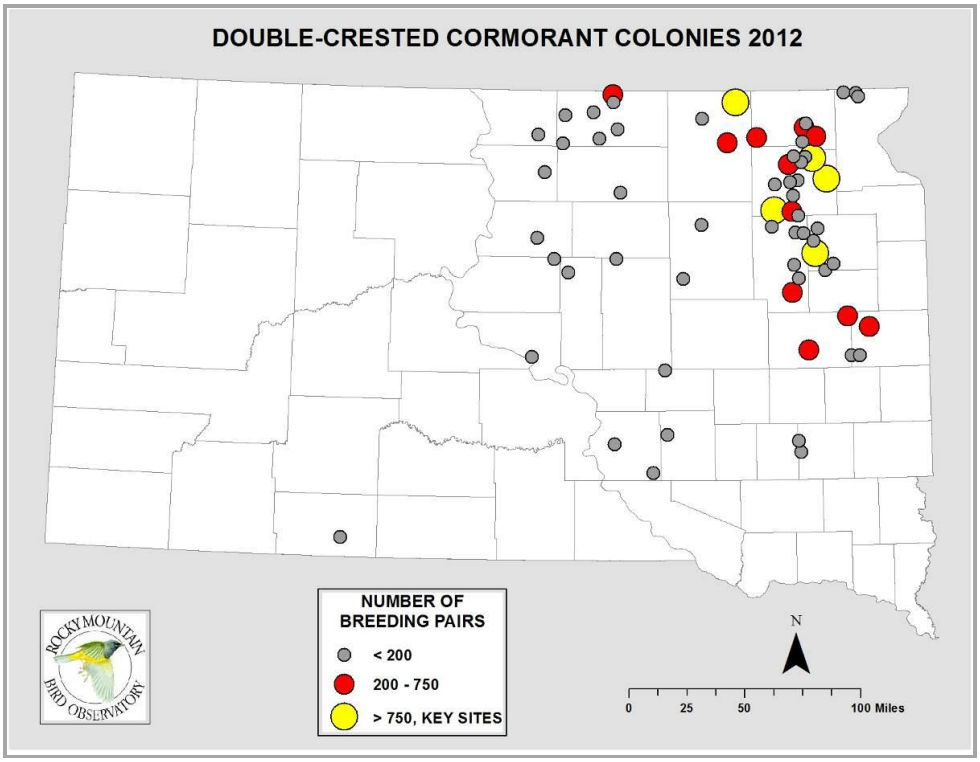

Figure 6. Location of active Double-crested Cormorant colonies documented in 2012 in South Dakota.

Fifteen colonies (23%) in 2012 had more than 200 cormorant nests and five of these had more than 900 pairs. During the 2005-2007 surveys, only Bitter Lake had more than 900 cormorant nests. Of the fifteen key sites, two have become established since 2007. Four of the 2005-2007 key cormorant colonies had no cormorants during the 2012 survey. All of these still had habitat but were abandoned for unknown reasons. All of the current cormorant key sites are also mixed-species key colonies; 83% of all cormorant pairs nested within one of the key colonies.

DISCUSSION

STATUS OF BREEDING COLONIAL WATERBIRDS IN SOUTH DAKOTA

The first objective of the 2007 colonial waterbird monitoring plan, is to "improve information on conservation status of breeding colonial waterbirds" by first, tracking the status of each species. Because of logistical issues discussed at length in the 2007 plan, neither the 2005-2007 survey nor the 2012 survey used a statistical sampling design, which would allow us to estimate population size of each species. Nevertheless, there was no evidence that numbers of any of the targeted waterbird species decreased between the two surveys, except perhaps Ring-billed Gull (Table 3). During the earlier survey, approximately 2250 – 4600 pairs of Ring-billed Gulls nested at Bitter Lake and this colony made up 80-90% of the total known state population. In 2012 there was little suitable island habitat left after the pelicans established their nests on Bitter Lake and only 225 gulls nested there. It is possible that some of the gulls nested on sandbars in the Missouri River, an area we did not survey. I would anticipate that numbers of breeding Ring-billed Gulls will increase when new habitat becomes available.

For the remaining species, 2012 statewide counts were similar to, or greater than the counts from the earlier survey. Numbers of breeding American White Pelicans, a Species of Greatest Conservation Need, were 25% greater in 2012 than in 2006. The colony sites were the same and the number of breeding birds at Lacreek, one of those sites, was the same. The difference was Bitter Lake, where the breeding population increased from approximately 14,800 pairs to almost 21,000 pairs. According to analyses by the Breeding Bird Survey, white pelican populations are increasing in South Dakota (~12% per year) and the Prairie Pothole region (~7% per year) (Sauer *et al*. 2011). However, even though their population appears to be increasing, pelican reproductive success can vary widely among years (Knopf and Evans 2004) and continued monitoring of South Dakota's two permanent colonies is recommended.

In 2012, Double-crested Cormorants, considered a nuisance species by some, still were abundant and widespread in eastern South Dakota. Although more than 40% of known cormorant colonies were single-species colonies, only 7.5% of all cormorants nested in these. More than 90% nested in mixed-species colonies with up to 16 other waterbird species in the colony. The management implication is that any efforts to control nesting cormorant populations in the state will affect other, more desireable or rarer colonial waterbird species.

Baker (2010) found that Great Blue Herons experienced relatively low reproductive success in mixed-species colonies in northeast South Dakota, primarily because of aggression and nest usurpation by cormorants. As a result, herons in these colonies possibly were not fledging enough young to maintain the population. He found that herons experienced higher reproductive success in single-species colonies. The 2012 state-wide surveys show that significant numbers of herons breed outside the northeast region (Figure 5); six of the nine key heron colonies were not in the northeast and all six were single-species colonies. Thus, a possible decline in the northeast may be offset by

better reproduction in the rest of the state. Studies on these other colonies are needed to address this possibility.

An unexpected result of the 2012 surveys was the discovery of breeding by several new and rare colonial waterbird species. The most surprising was a nest of Neotropic Cormorants near Hecla. A pair also stayed all summer at Torrey Lake, Brule County but the cormorant colony there was on private land and we did not attempt to confirm breeding. This species is the most tropical of all New World cormorant species. Until 1974, the species only nested along the coasts of Texas and southwest Louisiana (Telfair and Morrison 2005). Between 1974 and 2005, inland breeding colonies have been established in Texas, New Mexico, Arkansas, Oklahoma, and Arizona. Since 2005, a hybrid Neotropic-Double-crested Cormorant pair bred successfully in Oklahoma (Arterburn and Sheppard 2009), at least one Neotropic pair bred successfully in Kansas (R. Telfair, *pers. comm.*) and in 2012, a Neotropic pair bred successfully in northeastern Iowa (S. Dinsmore, *pers. comm.*). Most likely this species will never be common in South Dakota, but perhaps we can expect a small number to breed in some years. We also documented first state breeding records for Glossy Ibis, a species whose summer numbers have been increasing steadily in the state in the past several years (R. Olson, *pers. comm.*). An East Coast species that "has increased its range enormously" (Davis and Kricher 2000), we confirmed breeding in three locations. It is possible that this species will increase in numbers and become established in the state, although some feel that range expansion westward may be inhibited by its western congener, White-faced Ibis (Davis and Kricher 2000). The sighting of a Yellow-crowned Night-heron carrying nest material was the first breeding record for the species in the state. The presence of young juveniles in Douglas and Hand counties in early August suggests that the species may have bred elsewhere in the state or regions nearby. This southeastern U. S. species regularly breeds near the Mississippi River into Iowa and Minnesota (Watts 2011). At this time, there is no indication that this species will become numerous in the state. Another southeastern species that has followed major river corridors into the Midwest is the Little Blue Heron. First documented nesting in 1980, one to three pairs generally breed in the state every year but this species' population shows no indication of increasing in South Dakota. Herring Gull was first confirmed breeding in the state in 2007 on Lake Oahe but the 2011 floods washed that colony site away. Originally found breeding in northeastern Canada and around the Great Lakes, this species probably will continue to nest in South Dakota in low numbers.

A second action to determine the current conservation status of waterbird species is to track the distribution, species composition and sizes of breeding colonies. With the results from the second round of statewide waterbird colony surveys, we are obtaining a clearer picture of the dynamics of key colony sites. Between the 2005-2007 and 2012 surveys, approximately 50% of key sites switched designation, i.e., decreased in size and ceased to be a key site or increased in size to become a key site (Appendices B, C). A subset of these, 10-20%, went from having no breeding waterbirds to becoming a key site, or vice versa. Reasons why 2005-2007 key colonies had no breeding in 2012 included 1) high water knocked down old dead nesting trees, 2) high water flooded out reed beds used for nesting, or 3) breeding habitat present but no birds. It is instances

when the third situation occurs that are of concern and need more study. Of those former key sites that had some, but fewer breeding waterbirds in 2012, all but one were sites where waterbird populations appear to naturally fluctuate from year to year (Appendix C). The one exception may be the Krause Farm Game Production Area (GPA) colony where the old dead nesting trees and stumps are gradually decaying and falling down. In addition, all of the new 2012 key sites became key sites because fluctuating water levels created more or new breeding habitat. Rising water flooded new timber at four of the new sites, created new islands at three new sites, and new marsh at three sites. Even at many sites that were key during both survey periods, colony locations shifted within the water body as a result of changing water levels. Bitter Lake is an excellent example; all five of the 2007 colony sites had disappeared under water by 2012 and all but one (Deadwood Island) of the 2012 colony sites were dry land in 2007. Thus in almost all cases, colony creation, extinction, and location shifts were caused by fluctuations in water levels.

Great Blue Heron key colonies showed a higher rate of turnover than did multi-species colonies. Just three of the twelve 2005-2007 key heron sites maintained at least 50 breeding pairs and another three had no nesting herons in 2012. Floods along the James River in 2011 knocked down all of the nesting trees in colonies along the river. The Little Vermillion River colony was abandoned for unknown reasons around 2008-2009.

Surveyors observed few threats to colonies related to human activities, recording just five instances. Two colonies had evidence of logging or wood-cutting, one colony had recent cattle grazing and trampling of ground nests, one observation of construction next to a colony, and one case of picnickers on a nesting island. Colonies ultimately failed in each of these cases except those with logging activity; the latter colonies had a reduction in numbers. As each survey generally lasted 15 minutes to perhaps an hour, we might expect to rarely observe problems. Thus it is advisable, in future surveys, to have a second late-season visit to determine if colonies succeed. However if they do not succeed, often it can be difficult to ascertain the cause of abandonment or colony failure (Baker 2010). This requires research specifically targeted for this question. Surveyors recorded potential threats at another 17 sites which involved natural causes, such as predators, drying wetlands, and extremely old decayed nest trees that were falling down.

A key element in the conservation of waterbird colonies is ownership. The majority of smaller colonies and Great Blue Heron colonies were located on private land (Figure 3). Although colonies on private land generally are just as ‘safe’ as those on public land, they can be more difficult to access, generally do not receive visits by biologists for other reasons, and are more vulnerable to land use changes. Thus special monitoring and outreach efforts may be needed for key colonies on private land. In addition, most key multi-species colonies, which are located on land managed by federal or state natural resource agencies (Figure 3), are managed for multiple-use, especially for boaters and anglers. More information needs to be collected on the effects of human

disturbance at these colonies, especially as Baker (2010) felt that disturbance by boaters played a role in nest and colony abandonment.

EVALUATION OF 2007 MONITORING PLAN

The 2007 monitoring plan stipulates that the plan be reevaluated in 2012 in order to 1) reassess goals and objectives, 2) update the plan with new developments and information in statistics, modeling, and research, and 3) evaluate the ability of each aspect of the plan to meet objectives and contribute to the conservation of colonial waterbirds in South Dakota. These three are discussed in separate sections below, ending with a list of recommendations.

ASSESSMENT OF 2007 PLAN GOALS AND OBJECTIVES

The goals and objectives described in the long-term monitoring plan are still relevant and needed. Below in italics are the five objectives and action items to meet each objective. Comments and suggested changes follow each objective.

1. *Improve information on conservation status of breeding colonial waterbirds in South Dakota.*
    a. *Establish and track status of each species within the state*
    b. *Track distribution, species composition, and sizes of breeding colonies*
    c. *Maintain up-to-date database of historic and current colony sites*
    d. *Long-term: determine each species' state-level conservation status in relation to its regional status*

This is the primary objective that is met with periodic colony surveys. There have not been any updates to regional status since Beyersbergen et al. (2004) and Niemuth (2005) published their regional waterbird plans. However it would be a useful exercise to do action item D to create a baseline 'relative' status of South Dakota's colonial waterbirds that can be updated when regional status assignments are updated.

2. *Identify and track factors that could result in a decline of colonial waterbird species that breed in South Dakota.*
    a. *Track habitat quality at colony site*
    b. *Identify actual or potential threats to colonies*
    c. *Identify why colonies fail or disappear (within and between years)*
    d. *Long-term:*
        i. *Set population size objectives and track population trends*
        ii. *Determine landscape-level land use impacts*
        iii. *Identify limiting factors to breeding waterbirds*

Although some information concerning factors impacting colonies can be gained from quick-visit surveys, surveyors spend too little time at a colony to witness threats or colony abandonment as it happens. Even Baker (2010), who spent much longer periods of time and made repeated visits to colonies, did not directly witness threats and was not able to determine reasons for colony abandonment. These only can be learned from research projects specifically targeting these issues. Over the long term, we may be able to document population declines with surveys. But conservationists will not be able to prevent or reverse declines without targeted research explaining why declines are happening.

Concerning population size objectives, many espouse the general goal of 'no net loss' for non-nuisance species or species of conservation need (e.g., Beyersbergen *et al*. 2004, Niemuth 2005). This may be a worthwhile goal for South Dakota waterbird populations in the short time until species-specific targets can be set. Note that item 2.d.i. (set population size objectives) should be moved up to objective 1 as another long-term action item.

3. *Determine what and how management actions impact breeding populations, positively or negatively*
    a. *Determine land use and management practices at time of visit at 3 scales (colony site, wetland, within 0.5 mile)*
    b. *Identify ownership category (federal, state, tribal, or private)*
    c. *Promote compatible management actions among land managers*

Data on land use, management, and ownership provide information at the time of the survey visit. However these data do not inform how or whether observed management practices are impacting the colony and thus do not help delineate what constitutes 'compatible management actions'. Conservationists cannot promote best management practices if we do not know what they are. Another action item is needed to connect actions A and B with action item C. This action item could read:

c. Conduct research on how different management practices affect breeding waterbirds.

This action item then logically leads to promoting compatible management practices.

4. *Provide information to aid management of waterbird-fisheries conflicts*
    a. *Track location and sizes of cormorant, pelican, egret, and heron colonies*

Every effort needs to be made to ensure that fisheries managers receive results of every survey and research project.

5. *Ensure compatibility with regional and national monitoring efforts*
    a. *Coordinate data-sharing with regional and national databases*
    b. *Participate in regional monitoring planning*

At the moment, there does not seem to be a regional or national database exclusively for waterbird colonies. There are databases for all bird species, such as the Avian Knowledge Network (www.avianknowledge.net), which may be an appropriate venue for South Dakota colony data.

NEW RESEARCH AND METHODOLOGY DEVELOPMENTS

As far as the author knows, there have been no new developments over the past five years in statistical design, monitoring techniques, or field methods that could be applied to colonial waterbirds surveys in South Dakota. Most developments have concerned monitoring secretive marshbirds (Johnson *et al.* 2009, Conway 2011). These sampling designs and protocols do not solve the logistical issues of monitoring colonial waterbirds in the Great Plains such as the relative rarity of colonies compared to available habitat, the ephemeral nature of breeding habitat and thus of some colonies, the enormous number of wetlands in South Dakota, and wet-dry climatic cycles which cause dramatic changes in the composition and number of wetlands across the landscape (Beyersbergen *et al.* 2004, Drilling 2007).

EVALUATION OF 2007 RECOMMENDED MONITORING PROTOCOL

The 2007 monitoring plan recommended two components to tracking populations: monitoring known colonies and searching for new or previously-unknown colonies. For known colonies, the plan recommends that all key colonies be visited every 2-3 years. Between 2007 and 2012, this happened for most active colonies, including key colonies, but only because other bird survey projects were collecting data during that time frame and happened to visit the colonies. Surveyors for the South Dakota Breeding Bird Atlas (2008-2012) visited most known colonies to determine if they were active and identify breeding species. Birds were not counted during these visits and no land use, management, or threat information were recorded. In 2010, the U.S. Fish and Wildlife's Waubay Wetland Management District began monitoring colonies within their seven-county district, which encompasses the extreme northeast part of South Dakota. Thus at the beginning of 2012, we already knew about many colonies that had disappeared and didn't need to be visited as well as several new colonies, which made 2012 survey more efficient and successful. The Atlas project is now finished and future colony monitoring will not be able to draw from sightings made during several thousand hours of bird survey field work throughout the state. Waubay's colony monitoring project probably will not last forever. We recommend that specific efforts be made to monitor colony status (active or not) and species composition at least once between the major five-year surveys so that colonial waterbird conservation in the state does not suffer from lack of surveys.

For the 2012 surveys, we chose to visit all known active colonies, not just the key colonies called for in the 2007 plan. We made this decision because we noted that numbers of breeding pairs and species composition fluctuate widely among years in

some colonies (Appendices B, C). This decision was vindicated by the fact that almost 50% of key colonies either increased in numbers to become a key site or decreased in numbers to fall below the key site threshold between the two survey periods. If we had only surveyed the original 26 key colonies, we would have counted 5,300 fewer waterbird nests and missed 10 of the 22 key colonies of 2012. Thus we recommend that the protocol be modified to state that all known active sites, rather than just key sites, should be monitored. This would allow for tracking fluctuations as well as increase our understanding of the incidence of and reasons for fluctuations in species composition and numbers at South Dakota colonies. This also is the approach taken by the Western Colonial Waterbird Survey (WCWS *in press*) and makes South Dakota's monitoring approach compatible with regional approaches.

Another way to evaluate the most efficient way to track populations is to examine the proportion of all known breeding pairs of a species that were found in key colonies (Figure 4). For 17 of 23 species for which we have data, at least 90% of all known breeding pairs were counted in key colonies. For these species, just visiting key colonies (both previously-known and new) would be sufficient to track their populations. For Double-crested Cormorant, 83% of all known pairs were in key colonies. For this species, monitoring location and sizes of the smaller colonies in addition to key colonies, is desirable because of their sheer numbers and conflicts with fisheries. All grebe species were underrepresented in key colonies with just 46% of Eared Grebe pairs, 29% of Western Grebe pairs, and no Horned Grebe pairs found in the 22 key colonies. In addition, relatively few Great Blue Heron pairs (27%) were found in key colonies. Thus, for grebes and Great Blue Heron, significant effort needs to be exerted to find most of their colonies, including major colonies.

The 2007 monitoring plan recommends aerial surveys as a more efficient method to discover new colonies than ground surveys. In 2012, the only aerial surveys conducted were searches for Great Blue Heron colonies in early spring before leaf-out along all major river systems in the state. This was successful in discovering several new colonies, confirming the presence of many known colonies, and revealing that 2011 floods wiped out almost all colonies on the James River. However, if only aerial river surveys and key colony ground visits were employed, most Great Blue Heron colonies would be missed. For this species there needs to be extensive ground surveys, along with soliciting information from field biologists and bird-watchers, and being lucky to stumble across previously-unknown colonies.

In 2012, we did not do any aerial flights flown in a transect pattern over the northeastern Coteau region, as recommended in the 2007 monitoring plan. This was because we had so much up-to-date information from the South Dakota Breeding Bird Atlas and Waubay colonial waterbird monitoring, especially in the Coteau region, that we felt that little would be discovered during such aerial flights. In the the future, when such secondary information does not exist, transect aerial flights should be attempted.

RECOMMENDATIONS

1) *Create a program specifically designed to track colonies between the major 5-year surveys*. Waterbird colonies in South Dakota dramatically change size, location, and species composition over five years. A program that specifically tracks colonies at shorter intervals would provide better tracking and better understanding of waterbird population changes, as well as alert managers to immediate dangers to a colony. In addition, major surveys are more efficient and effective when they are based on more up-to-date information. Without such a program, managers and surveyors must rely on ad hoc information that often will be inadequate.

   At their simplest, these 'mini' surveys could track whether each colony is active, although other data also could be collected. Such information can be gathered by volunteers and agency staff doing their normal field work. Many states operate a volunteer-based 'Colony Watch' program, complete with online data entry. A pilot project in South Dakota demonstrated that such a program would be feasible in the state (Drilling 2007). Once the program is set up, annual operating costs are minimal (~$5,000) (D. Hanni, *pers. comm.*). Thus we recommend that South Dakota initiate such a volunteer program.

2) *Monitor all colonies, not just key colonies.* One reason to monitor all colonies is because some species, specifically grebes and Great Blue Herons, primarily nest in smaller or single-species colonies. Secondly, key colonies shift, disappear, shrink, expand, and reappear in response to fluctuating water level impacts on nesting habitat. Although monitoring all colonies involves more travel, and thus more time and expense, the additional costs are less than one would expect because visits to most colonies are very quick and do not require a boat, and most colonies are clustered in the northeastern and north-central part of the state.

3) *Research factors that impact breeding waterbird colonies in South Dakota.* Colony surveys track species population trends but do not explain why those trends are occurring. Land and fisheries managers need to know how their decisions will impact waterbird colonies. Specific problems that need examining include the impacts of boater disturbance as it relates to the nesting cycle, colony size and species composition, effects of different land management practices on breeding waterbirds, and effects of landscape-level changes in wetland quantity and quality. All of these issues, as well as others, can not be answered through surveys but rather through specific research projects that preferably would include an experimental component.

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APPENDIX A.

Target species for the 2012 Colonial Waterbird surveys in South Dakota with their associated count technique. Species in bold are those of special conservation concern listed by Bakker (2005): those in capital letters are those listed by SD Game, Fish, and Parks (2006).

Common Name	Scientific Name	Count Protocol(s)
GREAT BLUE HERON	*Ardea herodias*	total nest count
LITTLE BLUE HERON	*Egretta caerulea*	adult flush count
TRICOLORED HERON	*Egretta tricolor*	adult flush count
BLACK-CROWNED NIGHT-HERON	*Nycticorax nycticorax*	adult flush count, total nest count
YELLOW-CROWNED NIGHT-HERON	*Nyctanassa violacea*	adult flush count, total nest count
GREAT EGRET	*Ardea alba*	total nest count
SNOWY EGRET	*Egretta thula*	adult flush count, total nest count
Cattle Egret	*Bubulcus ibis*	adult flush count, total nest count
WHITE-FACED IBIS	*Plegadis chihi*	adult flush count
Glossy Ibis	*Plegadis falcinellus*	adult flush count
AMERICAN WHITE PELICAN	*Pelecanus erythrorhynchos*	nest counts from aerial photos
Double-crested Cormorant	*Phalacrocorax auritus*	total nest count
Neotropic Cormorant	*Phalacrocorax brasilianus*	total nest count
Ring-billed Gull	*Larus delawarensis*	adult flush count, total nest count
CALIFORNIA GULL	*Larus californicus*	adult flush count, total nest count
Herring Gull	*Larus argentatus*	total nest count
Franklin's Gull	*Leucophaeus pipixcan*	adult flush count
Forster’s Tern	*Sterna forsteri*	adult flush count, total nest count
COMMON TERN	*Sterna hirundo*	total nest count
CASPIAN TERN	*Hydroprogne caspia*	total nest count
Western Grebe	*Aechmophorus occidentalis*	total brood, nest counts
CLARK’S GREBE	*Aechmophorus clarkii*	total brood, nest counts
Eared Grebe	*Podiceps nigricollis*	total brood, nest counts
HORNED GREBE	*Podiceps auritus*	total brood, nest counts

APPENDIX B.

Sites with ≥ 200 breeding pairs of colonial waterbirds or > 5 colonial waterbird species confirmed breeding in South Dakota in 2012. Sites with dashed line were not visited in that year.

Colony Site	County	Total No. Breeding Pairs				Total No. Species				Previous Key Colony?
		2005	2006	2007	2012	2005	2006	2007	2012	
Bitter Lake & GPA	Day	11,529	19,117	22,488	22,947	13	12	15	15	yes
East Hecla (& Zabrasha) GPAs	Brown	272	986	602	6,556	3	3	6	17	yes
Blythe Slough GPA	Clark	1,273	681	704	2,068	6	6	5	8	yes
Amherst Drainage	Marshall	---	90	43	1,826	---	3	3	12	no
Lily Lake / Jesse Sl. / Troy Twp	Day/Clark	367	691	440	1,726	3	3	3	6	yes
Goose Lake & GPA	Codington	731	545	18	1,351	8	6	1	7	yes
Hazelden Springs GPA	Day	186	117	397	1,146	3	1	3	3	no
Lacreek Nat. Wildlife Refuge	Bennett	845	2,437	650	818	7	5	5	4	yes
Oakwood Lakes State Park	Brookings	186	225	215	698	2	3	4	3	yes
Casey's Slough GPA	Clark	---	---	60	624	---	---	2	3	no
Four mile Clubhouse Slough	Marshall	515	1,113	691	589	3	3	4	3	yes
Belle Fourceh Res. & Owl Creek	Butte	390	487	375	574	4	3	4	7	yes
Rath/Opp Ehley WPAs	McPherson	111	181	107	470	1	1	1	4	no
Mydland Pass GPA	Day	148	179	81	386	2	1	1	3	no
Lake Thompson	Kingsbury	64	178	93	369	2	1	2	5	no
East Stink Lake	Marshall	0	0	0	338	0	0	0	3	no
Long Lake	Day	---	18	39	311	---	1	1	2	no
Dry Lake No. 2 & GPA	Clark	294	533	231	303	5	3	3	3	yes
Lake Albert Island GPA	Kingsbury	1,466	1,943	919	286	6	6	6	3	yes
Putney Slough & GPAs	Brown	4	686	262	229	3	14	9	2	yes
Spring Lake & Medicine Creek	Hyde	---	present	present	138	---	5	5	11	no
Swan Lake	Walworth	0	---	0	43	0	---	0	6	no

APPENDIX C.

2005-2007 Key Waterbird Colonies (≥ 200 breeding pairs of colonial waterbirds or >5 colonial waterbird species confirmed breeding) which did not meet criteria as a Key Site in 2012. Sites with dashed line were not visited in that year.

Colony Site	County	Total No. Breeding Pairs				Total No. Species			
		2005	2006	2007	2012	2005	2006	2007	2012
Pond 101 St at 453 Av	Roberts	--	--	151	137	--	--	6	3
Lehrman Slough	McCook	265	202	37	106	3	3	3	2
Sand Lake NWR	Brown	276	72	1,126	62	5	7	12	2
Red Lake	Brule	11	0	375	61	2	0	8	2
Herman-Jutzy WPA	Edmunds	80	295	13	53	1	3	1	2
Krause Farm GPA	Day	329	324	352	40	2	2	2	1
408 Av-108 St marsh	Brown	--	--	177	36	--	--	6	1
Simon/Schmidt WPA, Alkali Lk	Edmunds	0	296	1	30	0	1	1	1
Morlock GPA	McPherson	--	230	2	11	--	1	1	1
Renziehausen GPA	Brown	32	657	698	0	4	11	7	0
Drywood Lake	Roberts	--	4	387	0	--	3	5	0
Kettle Lake	Marshall	118	168	312	0	1	1	3	0
Opitz Lake	Day	438	381	232	0	2	2	2	0
James River at Hwy 12	Brown	1	247	172	0	1	3	3	0