

**FROM TABEAU TO SDOU: A BRIEF HISTORY
OF ORNITHOLOGY IN SOUTH DAKOTA
WITH SPECIAL REFERENCE TO WORKS
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ABSTRACT

The history of ornithology in South Dakota can be divided into several general periods. The initial natural history forays into what was to become South Dakota, including the Lewis and Clark expedition, occurred during the first half of the 1800s and form a period of exploration. During the latter half of the 1800s, sponsored government surveys traversed western North America, including the western Dakotas, while settlement predominated in the east, and ornithological efforts focused on a more complete catalogue of birds within particular regions. Efforts of a number of individual ornithologists during the late 1800s and first half of the 1900s built upon these initial studies to provide more complete catalogues of birds of particular regions within the state. It was also during this period that the first comprehensive treatments of the statewide avifauna appeared. A seminal event in the ornithological history of South Dakota was the founding of the South Dakota Ornithologists' Union in 1949 and this organization still strongly supports bird research in the state. Ornithology content published in the *Proceedings* generally reflects these historical trends. Efforts to more precisely define the status and distribution of birds in the state remain an important focus of ornithology, and such content occurs in the *Proceedings* from its inception until today. More recent years have witnessed the diversification of bird studies in South Dakota and this is also reflected in publication trends in the *Proceedings*. Early ornithology content published in the *Proceedings* focused on history, natural history notes, and poultry science. Major foci of ornithology content in the *Proceedings* from 1960-1989 included contaminant effects, habitat associations and ecology. Habitat associations and ecology remained prominent ornithology topics in the *Proceedings* during the last quarter-century, but conservation and management, climate change and physiology have increased in coverage.

Keywords

Ornithology, history, South Dakota, Audubon, Maximilian of Wied, South Dakota Ornithologists' Union, South Dakota Academy of Science

INTRODUCTION

The study of birds in South Dakota has a long and rich history, which can be conveniently categorized into several distinct periods based on the background knowledge and technology available for studying birds, the funding sources supporting these efforts, and the topics on which ornithological studies focused. Recognizing that other classification schemes are possible, I've divided the history of ornithology in South Dakota into four periods. Early bird study in South Dakota usually was part of larger exploratory excursions into the state which focused on documenting natural history and describing the culture of the resident indigenous peoples. I call this the Period of Exploration and it extended roughly from 1800-1850.

During the latter half of the 1800s was a period of government-sponsored surveys of natural history, geology, and natural resources in the western part of the state and settlement in eastern South Dakota. Ornithological studies during this period focused on refining knowledge of the status and distribution of birds in the state. These topics continued to be a major focus of bird study in the state in the period from 1900-1950, where a number of professional ornithologists and amateur bird enthusiasts greatly refined the knowledge of the status and distribution of birds in the state through more in-depth surveys of the birds within smaller geographic areas (e.g., counties, topographical regions). During this period the first comprehensive avifaunal treatments of the birds of South Dakota also occurred. The founding of the South Dakota Ornithologists' Union (SDOU) toward the end of this period, in 1949, was an important event for promoting ornithological research within the state, a role in which the SDOU is still very active.

More recent advances in technology, as well as increasing availability of government and university funding for research, have expanded the study of birds within the state to a wide diversity of topics. Consequently, I call the period of ornithology in South Dakota since 1950 the Period of Ornithological Diversity. In the remainder of this paper, I'll highlight some of the more noteworthy advances in ornithological study within the state during each of these periods, as well as focus on the role of the South Dakota Academy of Science and its publication, *Proceedings of the South Dakota Academy of Science* (hereafter *Proceedings*), in advancing and disseminating knowledge about birds, both in South Dakota and more broadly.

PERIOD OF EXPLORATION (1800-1850)

Early bird study (prior to 1850) in the geographic region that was to become South Dakota occurred along the Missouri River and its surrounding habitats, as the river formed a conduit for travel and commerce during this period. The earliest exploratory expeditions were by representatives of fur trade companies scouting the area for commercial possibilities, but also included the government-sponsored Lewis and Clark expedition. Following these earliest expeditions, several important privately funded exploratory parties penetrated the Missouri

River region in the Dakotas to describe the natural history as well as the culture of the indigenous people inhabiting the region.

The first written mention of a bird in South Dakota was by Jean-Baptiste Truteau, who traveled up the Missouri River with a scouting party for the Missouri Company in 1794 (Krause 1956). The party wintered at a post they built south of Pickstown, in current Charles Mix County, South Dakota. Truteau's journal mentions that the party shot Wild Turkeys (*Meleagris gallopavo*) for sustenance over the winter. No other birds were specifically mentioned in the journals, but this mention provides a single datum for the historical distribution of turkeys in the region (Krause 1956), and, interestingly, this site is close to the northwestern extent of the historical range of the Eastern subspecies of the Wild Turkey (*M. g. silvestris*) in North America (Speller et al. 2010).

Pierre-Antoine Tabeau accompanied Régis Loisel and a party from the Missouri Company up the Missouri River to a trading post at Cedar Island (current Stanley or Lyman Co., SD) in 1803, serving as narrator for the party and keeping a journal (Abel 1939). The party departed upriver from the mouth of the Missouri on 22 June 1803 and wintered at the Cedar Island post from 1803 to 1804 (Krause 1956). Tabeau apparently continued living among the Arikaras on Cedar Island after Loisel departed in the spring of 1804, finally traveling downriver in April of 1805 with the crew sent downriver by Lewis and Clark from the Mandan villages (Abel 1939). Tabeau was the first to describe a portion of the avifauna of South Dakota for reasons other than table fare, so this narrative really provided the first true ornithological information on bird distribution within the region that was to become South Dakota. Tabeau's bird list includes Black-billed Magpie (*Pica hudsonia*), which were noted as picking at saddle sores on the backs of horses, Golden Eagle (*Aquila chrysaetos*) and Wild Turkey, the latter of which he notes that they seldom occur above the mouth of the Niobrara River (Krause 1956). He also mentions, without noting the precise location along the expedition route, that "the plovers in the autumn and the spring and the pheasants in every season are abundant" and that "The hawk, the merlin, the crow, the owl and others are very common" (Abel 1939, p. 88). These quotations illustrate some of the difficulty in extracting ornithological information from the journal narratives of these early explorers. Bird common names were not codified until later (American Ornithologists' Union 1886), so bird names were often quite variable among different authors. In addition, in this era when good descriptions required shooting the bird and describing it in hand, along with scientific training to recognize what features were important to note, descriptions of birds observed were often incomplete or rudimentary, which makes unambiguous identification difficult or impossible.

The next exploration of the Missouri River region which provided information on birds of the region was the Lewis and Clark expedition in 1804-1806. Part of the charge of the Lewis and Clark expedition was to record the natural history of the regions through which the expedition passed, including a catalog of the birds observed. Lewis and Clark passed through the middle Missouri River region, defined here as from Omaha north to the North Dakota/South Dakota border, from 27 Jul-14 Oct on the upstream journey, and from 23 Aug-7 Sep 1806 on the downstream journey (Moulton 1986, 1987, 1993). Thus, they observed

birds in the region during the late summer, after the breeding season for most birds in the region, and during fall migration, rather than during the spring and early summer breeding season when birds are typically easier to detect (Tallman et al. 2002). Nevertheless, the Lewis and Clark expedition produced a large leap forward in ornithological knowledge of the American West, and 134 species of birds can be identified with certainty from the journals (Holmgren 1984a,b). Of these, by my count from the journals, 57 species occurred along middle Missouri River region during the dates of passage.

Lewis and Clark are given credit for the first scientific descriptions of 25 bird species or subspecies, including 4 from middle Missouri River region – Sharp-tailed Grouse (*Tympanuchus phasianellus*), Interior Least Tern (*Sternula antillarum athalassos*), Common Poorwill (*Phalaenoptilus nuttallii*), and Black-billed Magpie. The explorers first noted Interior Least Tern near the mouth of the Soldier River in current Washington County, Nebraska. This subspecies is now listed as federally endangered, but still nests regularly on unvegetated sandbars of the Missouri and Cheyenne rivers in South Dakota (Thompson et al. 1997, Tallman et al. 2002). Sharp-tailed Grouse were first noted on 12 September 1804 in current Charles Mix County, South Dakota. One bird was captured and sent back alive to President Thomas Jefferson from the Mandan villages, along with many natural history specimens and other materials, but this individual did not survive the trip (Moulton 1987). Black-billed Magpie was first noted near the mouth of American Crow Creek (current Lyman Co., SD) on 16 Sep 1804. The party eventually captured four magpies and sent them back to Jefferson from Fort Mandan; one survived the trip and was kept by Jefferson as a pet for some time afterward, serving as the model for Alexander Wilson's painting in his American Ornithology (Holmgren 1984c). The final new species new to science was the Common Poorwill, of which Lewis and Clark found a torpid individual near the mouth of the Cannonball River, just north of the South Dakota border in current Sioux County, North Dakota, on 17 October 1804. The circumstances surrounding this observation demonstrate clearly that Lewis was an experimentalist, as his response to finding the dormant bird was to scramble its heart and lungs with his pen-knife and then see what happened. What happened, as noted in the journals, was that the bird "lived upwards of two hours," to which Lewis correctly concluded that "this fanominon [phenomenon] I could not account for unless it proceeded from the want of circulation of the blood" (Moulton 1987, p. 178).

Thus, Lewis was not only the first to describe Common Poorwill, but also the first to discover torpor (a state of dormancy where body temperature drops to save energy) in birds, a phenomenon that would not make its way into the mainstream ornithological literature until the 1940s, when Jaeger (1948, 1949) also found that poorwills use torpor. Interestingly, even though many birds use nocturnal torpor or hypothermia as a strategy for saving energy, usually under conditions of cold or food scarcity, the Common Poorwill is the only bird known to hibernate, that is to remain dormant for periods longer than a single night (Woods et al. 2005).

One other noteworthy record from Lewis and Clark is their mention of the now-extinct Passenger Pigeon (*Ectopistes migratorius*) in Lyman County,

South Dakota on 16 September 1804. This species formerly bred in woodlands throughout eastern North America west to Kansas, northwest to Alberta, and across southern Canada (Blockstein 2002) and occurred as a migrant and uncommon nesting species in South Dakota (Tallman et al. 2002). Lewis and Clark noted it on several occasions, from St. Louis to the Lemhi River, Idaho, including the Lyman County, South Dakota, record where Clark notes that “almost every species of wild game is fond of the acorn ... turkies, ducks, pigeians ...” (Moulton 1987, p. 77).

Following the Lewis and Clark expedition, the fur trade dominated commerce in the region for many years, but the trappers generally added little to our knowledge of birds in South Dakota. During the early 1800s, however, several privately funded expeditions considerably advanced the knowledge of birds in the region. The first of these was by the 26-year old Duke Paul Wilhelm of Württemberg in 1823. Duke Wilhelm was a nephew to King Frederick of Württemberg, and as such was a member of the ruling house of this Prussian Kingdom, presently part of a state in southern Germany. He traveled widely in North America from 1822-1824, including the trip up the Missouri River (Wilhelm 1973). Duke Wilhelm had some scientific training during his schooling, which prepared him well for this expedition, the purpose of which was to document the natural history of the region and the cultures of the indigenous people along the Missouri River. Duke Wilhelm applied scientific names to the observations of species in his journals, which reduced, but did not completely eliminate confusion over species descriptions. As an interesting historical side-note, Baptiste, the son of Sacagawea and Toussaint Charbonneau (interpreter for the Lewis and Clark expedition) who was born at Fort Mandan during the winter of 1805 and later adopted by William Clark, accompanied Duke Wilhelm back to Germany in 1824 and remained there under the Duke's supervision until 1829 (Wilhelm 1973). Duke Wilhelm made another expedition up the Missouri River to its source in 1829 and 1830 (Wilhelm 1973), but to my knowledge, no ornithological material survives from this trip.

Like Lewis and Clark, Duke Paul Wilhelm traveled upriver in 1823 by the relatively slow keelboat, although he often disembarked and traveled overland for long periods as well. Consequently, the party covered the distance from St. Louis to current Chamberlain, South Dakota over a relatively long period, from May through November of 1823 (Wilhelm 1973). The party was in South Dakota from mid-August to early September and had planned to proceed farther up the river than the location of present-day Chamberlain, but they were forced to turn around by rumors of roaming bands of Arikaras that were hostile to intruders. Thus, Duke Paul Wilhelm, like Lewis and Clark, also observed birds in South Dakota during the late summer after the breeding season and during the early fall migration period. He recorded approximately 46 species of birds on the Missouri River expedition (Wilhelm 1973). Prior to entering South Dakota, at the mouth of the Niobrara River, Duke Wilhelm mentions Sharp-tailed Grouse and a “large, pretty grosbeak, brown with yellow underbelly with white spottings, lives either singly or in small flocks in these parts, and seems to frequent the wild cherry trees of the prairie” (Wilhelm 1973, p. 346), perhaps a juvenile or female Black-headed Grosbeak (*Pheucticus melanocephalus*). Specific mention of birds

from South Dakota in Duke Wilhelm's journals are relatively few, but include Cliff Swallow (*Petrochelidon pyrrhonota*), Mississippi Kite (*Ictinia mississippiensis*), swans (perhaps Trumpeter Swan, *Cygnus buccinator*, a former nesting species in eastern South Dakota, now reintroduced in western South Dakota and several areas in the Midwestern and eastern U.S.; Tallman et al. 2002, Mitchell and Eichholz 2010), and American White Pelican (*Pelecanus erythrorhynchos*). The Mississippi Kite record, a specimen collected by Duke Wilhelm on 30 August 1823 from the Bijou Hills, current Brule County, South Dakota, is particularly noteworthy. Only seven records of Mississippi Kite exist for South Dakota, and all other records of the species are of spring migrants from May (Tallman et al. 2002; <http://sdou.org>). The final mention of birds from South Dakota occurred from the mouth of the Big Sioux River on 6 September 1823, where Duke Wilhelm noted that Wild Turkey and the now-extinct Carolina Parakeet (*Conuropsis carolinensis*) "seem rarely to cross this boundary, but appeared in huge flights farther downstream" (Wilhelm 1973, p. 373).

The next privately funded expedition up the Missouri River was that of the party of Prince Alexander Phillip Maximilian of Wied in 1832-1834. This expedition added considerably to the early ornithological knowledge for South Dakota. Prince Maximilian was the eighth of ten children of Friedrich Karl, Count of Wied-Neuwied, a Prussian principality, now in west-central Germany. He received some training in the sciences from the anthropologist Johann Friedrich Blumenbach at the University of Göttingen and the explorer-naturalist Alexander von Humboldt (Schach 1994, Noll 2011). At the time of the trip up the Missouri River, Maximilian was 50 years old and had considerable previous experience as a naturalist, having conducted an expedition to document the flora, fauna and indigenous peoples of Brazil in 1815-1817 (Noll 2011).

His party traveled by the steamboat *Yellowstone* under the auspices of the American Fur Company and so proceeded at a much faster rate than previous natural history expeditions (Schach 1994). The party made it upriver as far as Ft. Union at the mouth of the Yellowstone River and then retreated downstream to winter at Fort Clark, north of present-day Bismarck, North Dakota, from November 1833 through April 1834 (Witte and Gallagher 2010). Maximilian's personal party consisted of only two people other than himself, the artist Karl Bodmer, now justifiably famous for his iconic historical portraits of the Missouri River region and indigenous peoples, and the hunter-taxidermist, David Dreidoppel, on loan from his brother to support Maximilian's travels in North America (Schach 1994). Maximilian's expedition up the Missouri River, like his previous expedition to South America, focused on documenting the natural history and native cultures of the region (Noll 2011, Witte and Gallagher 2010).

The party passed upriver through South Dakota from 8 May – 13 June 1833, so they were the first of the early natural history expeditions to encounter birds during spring migration and the early part of the breeding season, when birds are in full breeding plumage and are singing and displaying. From my perusal of the journals (Witte and Gallagher 2010), Maximilian made specific mention of 66 bird species for South Dakota. Noteworthy records include Swallow-tailed Kite (*Elanoides forficatus*), a curlew on the prairies near the mouth of the James

River, the now-extinct Passenger Pigeon, and Common Raven (*Corvus corax*). The Swallow-tailed Kite was observed near the mouth of the Big Sioux River on 8 May 1833. Only one record for this species since 1910 exists for South Dakota, although it was apparently more common prior to 1910 (Agersborg 1885, Tallman et al. 2002, <http://sdou.org>). Maximilian mentions that his party observed a curlew of the genus *Numenius* on 11 May and several pairs of curlews on 12 May 1833, both observations occurring on the prairies above the river bluffs between the James and Niobrara rivers. Witte and Gallagher (2010) suggest that these sightings refer to the Long-billed Curlew (*Numenius americanus*), which is reasonable since they nest on mixed grass prairies and arrive on breeding grounds in the Great Plains by mid-April (Tallman et al. 2002), and Audubon also saw them in this area in early May (Audubon 1960). This area is currently east of their range in South Dakota, but they formerly also nested in the southeastern part of the state (Tallman et al. 2002), although they were rare in southeastern South Dakota by the 1880s (Agersborg 1885). Another possibility is the now-extinct Eskimo Curlew (*Numenius borealis*), which was formerly a common spring migrant through eastern South Dakota during the early to mid-May time period when Maximilian observed these birds (Agersborg 1885, Tallman et al. 2002). Common Raven is now a very rare species in South Dakota, averaging fewer than two reports per year, with most records from the fall and winter, but it was formerly more common prior to the disappearance of bison (Tallman et al. 2002, <http://sdou.org>).

The last of these major privately funded expeditions was by the famous ornithologist-naturalist-artist John James Audubon, who traveled up the Missouri River from May through October of 1843 (Audubon 1960, Rhodes 2004). The traveling party of five consisted of the 58-year old Audubon, John Bell as taxidermist, Isaac Sprague as artist, Lewis Squires as assistant, and Edward Harris, who helped fund the journey (Stevens 1943). The Audubon party traveled upstream as passengers on the American Fur Company's steamboat *Omega*, so progress was rapid and it took only 49 days from St. Louis to reach Fort Union at the mouth of the Yellowstone River, which was a record at the time (Stevens 1943). The downstream trip was on a Mackinaw barge, the *Union*. Audubon's focus was on documenting the natural history of the region, principally cataloging the birds and mammals. Audubon described a total of five new bird species on the Missouri River expedition, including Bell's Vireo (*Vireo bellii*), Sprague's Pipit (*Anthus spragueii*), Le Conte's Sparrow (*Ammodramus leconteii*), Baird's Sparrow (*Ammodramus bairdii*), and Common Poorwill, the species observed by Lewis and Clark, but not sufficiently described for scientific purposes.

The party traveled through the region to become South Dakota from 14 May through 3 June on the upstream trip and from 1 September to 1 October on the downstream trip, so Audubon was able to observe South Dakota birds during spring migration, the early breeding season, and fall migration. He listed approximately 72 birds from South Dakota, two of which were new to science and several with ranges that were different at that time than today. The two new species that Audubon collected and described from South Dakota were the Le Conte's Sparrow, from Cedar Island (the same Cedar Island on which Tabeau wintered in 1803) on 22 May 1843, and the Common Poorwill, from some-

where between the mouth of the Moreau River and Fort Pierre on 7 September 1843. Le Conte's Sparrow currently is a rare to uncommon nesting species of moist grasslands in the northeastern and north-central portions of South Dakota (Tallman et al. 2002). Audubon collected the poorwill during fall migration, which he noted in the journals (Audubon 1960), and the date mentioned is within the main fall migratory period for this species in South Dakota (Tallman et al. 2002). Audubon also observed the now-extinct Carolina Parakeet and Passenger Pigeon within South Dakota.

Several other noteworthy records, either of rare species or species with different ranges than the present day, were also provided by Audubon in the journals (Audubon 1960). A Common Raven, currently only of casual occurrence in the state (Tallman et al. 2002), was observed on 14 May near the mouth of the Big Sioux River. On 16 May, Audubon collected a Henslow's Sparrow (*Ammodramus henslowii*), which is a rare grassland migrant and breeding species in the state that is more common farther southeast in North America (Tallman et al. 2002). Audubon collected several Evening Grosbeaks (*Coccothraustes vespertinus*) on 28 May at Fort George (in current Presho County). Evening Grosbeaks are currently a rare breeding species restricted in the state to the Black Hills (Tallman et al. 2002). Audubon also mentions in the journals that he heard a Pileated Woodpecker (*Dryocopus pileatus*) near the mouth of the Big Sioux River on 1 October. Pileated Woodpecker is currently a rare permanent resident and breeder in northeastern South Dakota, with only a very few records of wandering birds in the southeastern part of the state (Tallman et al. 2002). Audubon also makes mention of a Fork-tailed Hawk on 20 May near the mouth of the James River. The identity of this bird is not certain, but it could be a Swallow-tailed Kite, of which only one has been documented in the state since 1910, but this was a species also noted by Maximilian.

Two papers from the *Proceedings* nicely summarize the ornithological impact of these early explorations. Krause (1956) provides a detailed summary of the ornithological information gleaned from the journals of those expeditions before Audubon, and states that "Before 1794 our knowledge of the avifauna of South Dakota amounted to little or nothing ... By 1834, forty years later, we had considerable information on at least 31 species of birds and some data on their distribution" (p. 201). Over (1922) provides an overview of the Audubon expedition and the birds he recorded and provides a nice commentary describing the single-mindedness of Audubon as a naturalist - "... Audubon had no interest in anything except birds and mammals, of which he saw and recorded many different species" (p. 44). By the end of this Period of Exploration, a solid foundation of knowledge regarding the status and distribution of birds of the region had accumulated, upon which later ornithological studies would capitalize.

PERIOD OF GOVERNMENT SURVEYS
AND SETTLEMENT (1851-1900)

Coues (1874) reviewed bird data collected by several U.S. Army, U.S. Geological Survey and Pacific Railroad expeditions from the 1850s through the early 1870s to western North America, including the entirety of the Missouri River drainage, which is the region of focus of his book. These expeditions include those supervised by G.K. Warren in the mid-1850s to the Upper Missouri, Yellowstone, Platte and Niobrara rivers and the Black Hills and W.F. Reynolds in 1859 to map the area between Fort Pierre and the headwaters of the Yellowstone River. Also included is the analysis of specimens collected by J. Stevenson, H.D. Smith, and C. Hart Merriam (of ecological life zones fame) on 1870 and 1872 expeditions to the region under the supervision of Ferdinand V. Hayden, to whom the introduction to the book is addressed as Geologist in Charge of the U.S. Geological Survey of the Territories. The focus of this handbook is status, distribution and habitats for the species listed, although Coues (1874) also comments on unfamiliar plumages, behavior, nesting details and phenology of the annual cycle for some species. Coues (1874) makes specific mention of 125 species from the region to become South Dakota (Whitney et al. 1978), so the number of species recorded from South Dakota has, for the first time, exceeded the century mark.

Also during this period was the expedition led by George Armstrong Custer to the Black Hills in 1874, where gold was discovered, which led to the penetration and settlement of the Black Hills by Euro-Americans in violation of the 1868 Treaty of Fort Laramie. George Bird Grinnell accompanied the expedition while he was a graduate student at Yale University and served as the naturalist, making most of the bird observations for the expedition report by William Ludlow (1875). The Custer Expedition left Fort Lincoln, near current Bismarck, North Dakota, on 2 July. The party entered South Dakota and explored the Cave Hills in current Harding County on 11 July. On 20 July the expedition entered the Black Hills from the northwest and spent until 16 August in the Black Hills, departing from Bear Butte on that date and returning to Fort Lincoln on 30 August, so they experienced the late breeding season and post-breeding periods for most birds in the Black Hills. A total of 110 species of birds was mentioned in the report (Ludlow 1875). Some of the more interesting or noteworthy records included the White-winged Junco (*Junco hyemalis aikeni*), a subspecies largely endemic to the Black Hills (Pettingill and Whitney 1965, Tallman et al. 2002) which Ludlow (1875, p. 90) calls “the most common bird in the more elevated portions of the Black Hills,” a statement which may still be true to this day. Ludlow (1875) also mentions the Clay-colored Sparrow (*Spizella pallida*) as abundant, but Chipping Sparrow (*Spizella passerina*) as “nowhere abundant” (p. 90). Clay-colored Sparrow is now restricted as a breeding bird to northeastern South Dakota, although it is a statewide migrant, whereas the Black Hills may serve as the epicenter of Chipping Sparrow abundance in North America (Tallman et al. 2002). Whether this difference in population trends for the two species in the Black Hills results from habitat or other changes or identification challenges – late summer and juvenile plumages of Chipping and Clay-colored

sparrows are very similar and plumages of some species in the region over the entire annual cycle were not completely known at that time (Coues 1874) – is not known. The party also saw Common Raven regularly throughout the expedition, and I've already mentioned that this is a very rare species in South Dakota at the present day.

This period was also defined by the settlement of the eastern portion of Dakota Territory, which provided opportunity for people to begin to learn the birds of the areas in which they lived, and the initial descriptions of regional avifaunas began to appear toward the end of this period. An excellent example was that of Gabriel S. Agersborg, a college-trained physician and veterinarian from Vermillion who also served as the first teacher in the Vermillion School District after it was organized in 1867 (Stalheim 1987). Agersborg (1885) described the status and distribution of birds in southeastern South Dakota, covering the area from Yankton County east to Union County and north to Minnehaha County, in an annotated checklist format, listing a total of 215 currently recognized species. Other examples of early regional avifaunas appearing during the late 1800s include those of B. Knickerbocker (Chilson 1968) and C.E. McChesney (1879), both of whom studied the avifaunas of northeastern South Dakota. Publications such as these proliferated during the early to mid-1900s and greatly expanded local and regional knowledge of the status and distribution of birds within the state.

REGIONAL SURVEYS AND STATEWIDE AVIFAUNAS (1901-1950)

One of the most prominent ornithologists in the state in the early 1900s was Stephen Sargent Visher, Assistant State Geologist of South Dakota from 1910-1913, who later went on to a distinguished career as a Professor of Geology and Geography at Indiana University (Rose 1971). He completed several regional avifaunal studies during the period he served as Assistant State Geologist, mostly from western South Dakota (Visher 1909, 1912a,b, 1914), but also from Sanborn County in the east-central part of the state, where he grew up (Visher 1913), and Clay County in the southeast (Visher 1915). Numerous other regional avifaunas also appeared during this period and such publications continued into the 1950s and 1960s, prominent examples including Stephens and Felton's (1955) treatment of the birds of Union County and Pettingill and Whitney's (1965) monograph on the birds of the Black Hills.

The first statewide treatments of the avifauna of South Dakota also occurred during this period. The first were by William H. Over, Professor at the University of South Dakota, and Craig Thoms, and were published as monographs by the University of South Dakota Press (Over and Thoms 1921, 1946). The first edition (Over and Thoms 1921) covered 288 species. The count for the second edition (Over and Thoms 1946) had grown to 331 species. The South Dakota Ornithologists' Union undertook the publication of a new treatment of the birds of the state, authored by an appointed checklist committee and published in 1978 (Whitney et al. 1978). The official state list for South Dakota stood at 377 species in this publication. Two more editions of the South Dakota Orni-

thologists' Union-sponsored book have since appeared, one in 1991 (SDOU 1991) covering 395 species, and one in 2002 (Tallman et al. 2002) covering 414 species. The current official South Dakota bird list contains 434 species, seven of which are listed as hypothetical status because of uncertain origins or because they are single observer sight records without additional corroborating evidence (<http://sdou.org>).

THE SOUTH DAKOTA ORNITHOLOGISTS' UNION

Founded in 1949, the South Dakota Ornithologists' Union (SDOU) is an organization whose stated purpose is to "encourage the study of birds in South Dakota, and to promote the study of ornithology by more closely uniting the students of this branch of natural science" (Chapman 1950). The SDOU has been, and continues to be, very active in promoting bird study within the state and producing publications summarizing our knowledge of the status and distribution of South Dakota birds. The quarterly journal of the SDOU, *South Dakota Bird Notes*, has been published continuously since 1949 and published content has greatly advanced our knowledge of the where and when of bird occurrence in the state. The SDOU is still very active in promoting the study of birds within South Dakota and hosts spring and fall meetings each year to encourage networking of professional and amateur ornithologists within the state. Among other activities, the SDOU supports scholarships for students interested in pursuing careers in ecology and ornithology and provides grants supporting bird study within the state.

A detailed summary of the formation and objectives of the SDOU is provided in a paper in the *Proceedings of the South Dakota Academy of Science* by Herman Chapman (Chapman 1950). Chapman includes quotes from several nationally famous ornithologists regarding the formation of the SDOU. The late Roger Tory Peterson, perhaps the most widely known ornithologist in the history of ornithology in the United States, is quoted as saying that SDOU "... should serve an extremely important function in stimulating field work in the state, and particularly in drawing attention to some of the problems of bird distribution that remain to be solved in the state." Chapman (1950) also quotes the late Olin Sewall Pettingill, author of the first widely used textbook for college ornithology courses (and the text I used when I took ornithology as a sophomore in college in 1981), as saying "For a long time I have hoped to see the creation of such an organization in South Dakota because in no other prairie state, except Nebraska, are the resident ornithologists sufficiently well organized to promote the study of birds on a broad regional basis." Thus, the South Dakota Academy of Science and the South Dakota Ornithologists' Union have been collaborating organizations from the beginnings of SDOU.

ORNITHOLOGICAL DIVERSITY (1951-2015) AND
PUBLICATION TRENDS IN THE PROCEEDINGS OF
THE SOUTH DAKOTA ACADEMY OF SCIENCE

Since the 1950s, ornithology, as a field of study, has diversified and moved from a focus on status and distribution of birds within particular geographic areas (although this is still a continuing topic of study) to a diverse set of topics and research questions. Indeed, birds often serve as important models for the study of broader biological themes, such as ecology, evolution, genetics, population biology, behavior, physiology, developmental biology, and neuroscience, among other topics. The number of ornithology publications has exploded worldwide in recent years, and this is also true for bird study in South Dakota. T.C. Stephens, in the earliest ornithology article published in the *Proceedings* (Stephens 1918), focused on the bibliography of ornithology in South Dakota up until that time. He listed a total of 49 publications from 1858-1919, which included government survey publications, regional avifaunas (counties, reservations, etc.), notes on the distribution of various species, and other individual species notes (occurrence, nesting). Most of the focus of these early publications was on the status and distribution of birds within the state. In contrast, a search of Google Scholar on 24 February 2015 using the terms “Birds South Dakota” showed the number of publications increasing by an order of magnitude from relatively stable levels prior to the 1960s to current levels exceeding 2000 publications per year (Figure 1).

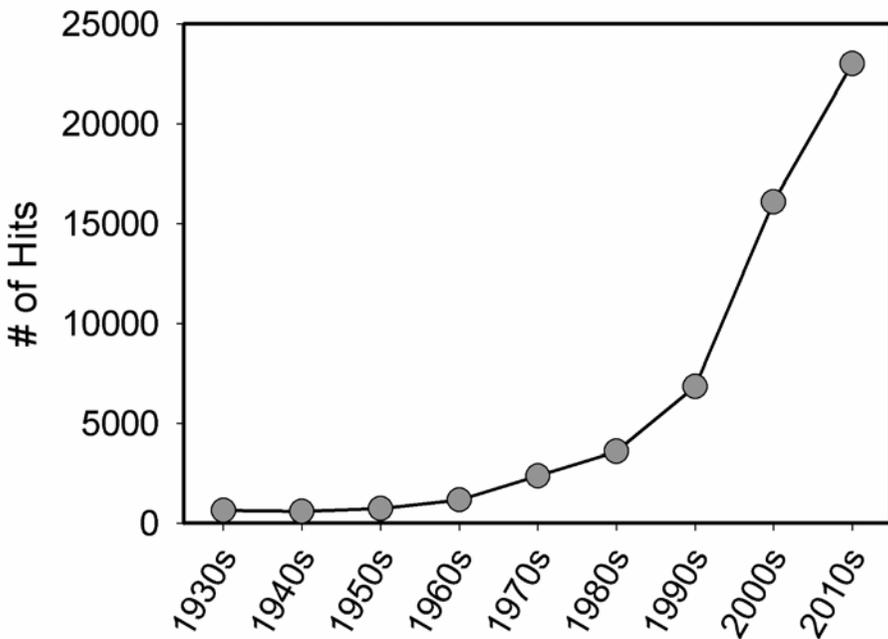


Figure 1. Number of publications (# of Hits) per decade since the 1930s from a Google Scholar search including the terms “Birds South Dakota” on 24 February 2015. The number of hits for the 2010s was calculated by multiplying the number of hits in the 2010-2014 period by 2. Note the exponential increase in the number of publications.

Some other interesting recent trends in ornithology publication are reflected by changing publication patterns for ornithology content in the *Proceedings*. Prior to 1990, publication by species category was split fairly evenly between poultry/game birds and non-game birds, but since 1990, publications on non-game species have comprised almost three-quarters of all bird studies published in the *Proceedings* (Figure 2). This change is likely explained, at least partially, by increased recent interest in biodiversity conservation, as well as increased focus on basic rather than applied bird study. Publication types have also undergone considerable change in the *Proceedings*, although some of this is likely related to biases in searches through the online version of the *Proceedings* (e.g., papers by graduate students were historically not published in the *Proceedings*, so this creates some bias toward full papers in early years). Nevertheless the trends are strong, so they likely reflect real differences, despite the biases in the search data. Before 1995, all ornithology publications identified by a search of the *Proceedings* data base were full papers. From 1995-2004, full papers made up 60% of all ornithology content and abstracts comprised the remaining 40%. From 2005-2014, full papers made up only 36% of published ornithology content, with abstracts and titles comprising the remaining published content (Figure 3). This trend likely results from increased emphasis in current academic evaluations on broad dissemination (e.g., coverage in multiple search engines and publication indices) and impact factors calculated from numbers of citations. This emphasis functions to encourage publication in broadly disseminated journals with high impact factors, and away from more regional journals with lower distribution and generally lower impact and lower numbers of citations.

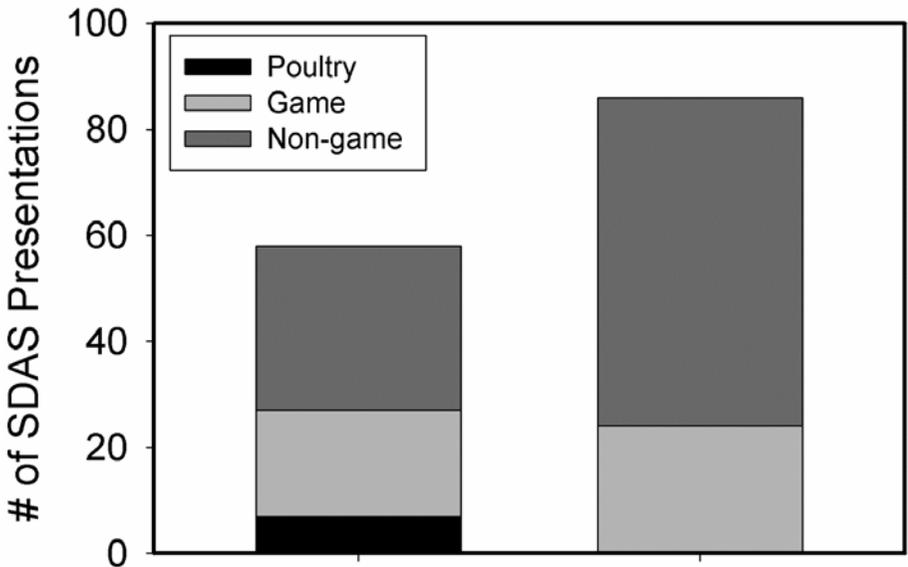


Figure 2. Presentations by bird species category from South Dakota Academy of Science meetings published in the *Proceedings of the South Dakota Academy of Science* (includes full papers, abstracts and titles). Data on numbers of presentations were from a search of ornithological literature published in the *Proceedings* through 2014 provided by Editor Robert Tatina.

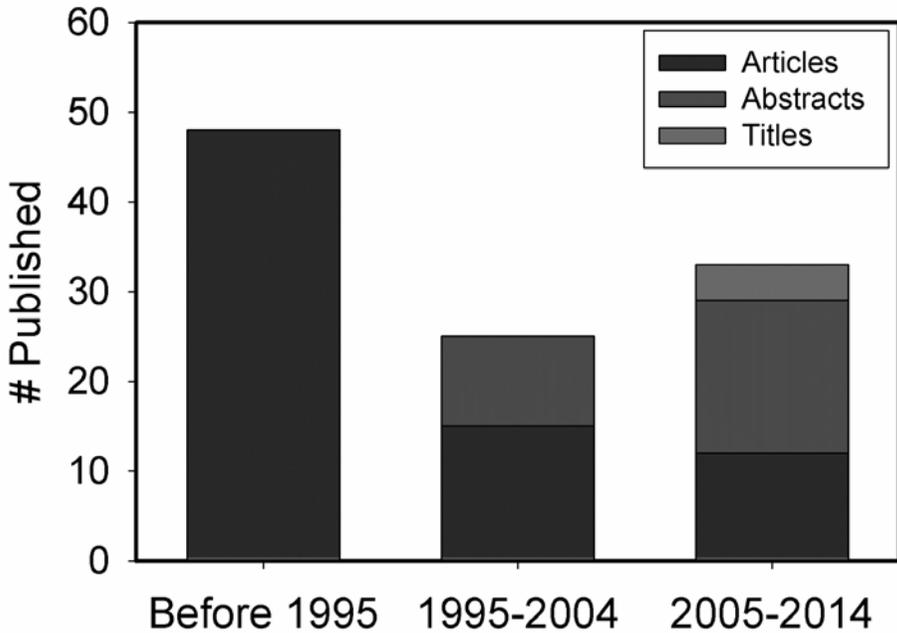


Figure 3. Publication type (articles, abstracts or titles only) for ornithology content published in the Proceedings of the South Dakota Academy of Science. Data were from a search of ornithological literature published in the Proceedings through 2014 provided by Editor Robert Tatina.

Ornithology content published in the *Proceedings* also shows some interesting changes through time (Figure 4) that reflect overall trends in bird research (Bautista and Pantoja 2000, Vihervaara et al. 2010, Altshuler et al. 2013). Status and distribution studies have remained fairly constant over time, comprising between 10 and 20% of all ornithology content published in the *Proceedings* over all periods (Figure 4), suggesting that this topic still is an important topic of research in ornithology, particularly as it relates to changes in abundance and distribution of birds as a function of land-use and climate change impacts on species (e.g., Swanson and Palmer 2009, Bedford et al. 2013, Sohl 2014). Indeed, South Dakota just recently completed its second Breeding Bird Atlas project (2008-2013) to document and track current bird distributions throughout the state for comparisons with the first South Dakota Breeding Bird Atlas completed 20 years ago (Peterson 1996). Studies of bird-habitat associations have become increasingly important in recent years along with the increasing interest in biodiversity conservation (Altshuler et al. 2013), and bird-habitat association studies published in the *Proceedings* have increased from no studies prior to 1960 to almost 30% of all ornithology content since 1990 (Figure 4). Studies on environmental contaminants and their impact on birds increased dramatically in the 1960s and 1970s after the publication of Rachel Carson's *Silent Spring* in 1962, creating a "Silent Spring Effect" in ornithology publication. This trend is also evident in papers published in the *Proceedings*, with studies on contaminants and parasites forming over 20% of all published ornithology content in 1960-1989, but less

than 5% of content in any other period (Figure 4). With the increased interest in biodiversity conservation, the shift in focus away from applied agricultural studies, and the shift toward publication in more specialized higher-impact journals, publications on poultry science in the *Proceedings* have plummeted from 25% of all content before 1960 to no studies since 1990 (Figure 4). Life history, ecology, physiology, conservation and management, and climate change studies have also all increased from no coverage prior to 1960 to form substantial fractions of ornithology content published in the *Proceedings* since 1990 (Figure 4). These publication data offer strong evidence that ornithology content in the *Proceedings* is following the same trend toward increasing diversity of themes that is also present in the ornithological literature at large (Bautista and Pantoja 2000, Altshuler et al. 2013).

I will use the remainder of this paper to review some significant ornithology topics covered in the *Proceedings* and to highlight a few specific studies dealing with this content. I do not intend for this to be a comprehensive review of all ornithology content in the *Proceedings*, but I instead want to highlight some of the

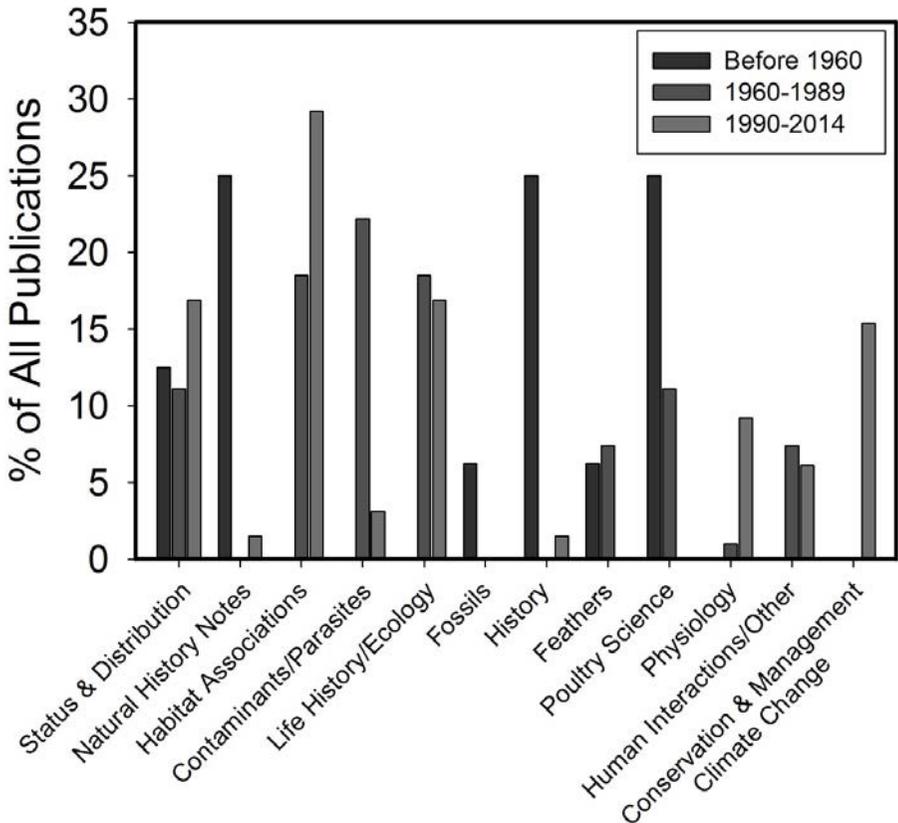


Figure 4. Trends in ornithology content published in the Proceedings of the South Dakota Academy of Science, including articles, abstracts and titles. Data were from a search of ornithological literature published in the Proceedings through 2014 provided by Editor Robert Tatina.

themes and studies that I believe are the most interesting or the most important to South Dakota ornithology. I focus my comments on full papers published in the *Proceedings*, rather than on Abstracts and Titles, which are most often published in full form elsewhere.

Grassland, wetland and woodland habitats are all important for birds in South Dakota (Bakker 2003a), and a number of studies published in the *Proceedings* document important aspects of bird-habitat relationships. Because of its location in the northern Great Plains and substantial remaining grassland habitats, South Dakota is an important region for grassland birds, and this group of birds is showing the most significant recent population declines among all bird groups in North America (Hill et al. 2014). The Conservation Reserve Program, authorized in 1985 (Luttschwager and Higgins 1992), is an important government program facilitating the presence of grasslands on the landscape of South Dakota, and several studies published in the *Proceedings* since 1985 examine impacts of CRP on grassland birds. These studies include Luttschwager and Higgins (1992), who found that a high diversity of birds use both strip and block CRP grassland patches. Leddy et al. (1997) compared bird abundance and species richness on CRP grasslands, pasturelands and croplands and documented higher bird densities and species richness in CRP fields than in other habitat types. Although CRP fields tend to have positive effects on grassland birds, vegetative characteristics may differentially impact different species. For example, Bahm et al. (2011) studied CRP fields in eastern South Dakota and found that Dickcissel (*Spiza americana*) abundance was negatively correlated with dead vegetation and litter depth, but Sedge Wren (*Cistothorus platensis*) abundance was positively correlated with the same variables, whereas Savannah Sparrow (*Passerculus sandwichensis*) abundance was negatively correlated with percent cover of live vegetation.

Among other published studies in the *Proceedings* relating to grassland birds, Bakker (2003b) reviewed research on the impacts of woody vegetation encroaching on grasslands, including site-level to landscape-level studies, finding that such woodlands negatively impact grassland bird occurrence, density and/or nesting success for grasslands birds. Another grassland habitat type that is restricted within the state to the northwest and southwest corners is sagebrush grasslands (Tallman et al. 2002). Lewis and Higgins (2010) used a landscape-level approach to find that Horned Lark (*Eremophila alpestris*) occurrence was negatively correlated with increasing proportions of hayfields on the landscape and that Brewer's Sparrow (*Spizella breweri*), which is restricted in South Dakota to sagebrush habitats as a breeding species (Tallman et al. 2002), showed increasing occurrence with increasing proportions of sagebrush pastures on the landscape. These studies collectively illustrate a recent trend in ornithology and ecology, enabled by the development of Geographic Information Systems (GIS) technology, where bird-habitat association studies now explicitly incorporate larger-scale (i.e., landscape) habitat variables in addition to local-scale characteristics that dominated these types of studies until recently.

Wetlands are another extremely important habitat for numerous bird species, but represent another example where available habitats have declined dramatically within the state (Bakker 2003a). Much of the early research on birds and wetlands was driven by concern over waterfowl numbers because of hunting

considerations, but recent research has focused more broadly on wetland bird communities, including non-game species. A number of studies published in the *Proceedings* have dealt with wetland birds. Two examples from the 1970s include McCrow (1974) who studied American White Pelican (*Pelecanus erythrorhynchos*) populations and trends in the state and Flake et al. (1977) who studied site-level habitat relationships of waterfowl on stock ponds in the northwestern part of the state. Thirty years later, May et al. (2008) also studied habitat relationships and productivity of waterfowl on stock ponds in western South Dakota, but this study explicitly included a landscape focus, again demonstrating the recent change from site-level to landscape-level focus of bird-habitat studies. Demonstrating the recent trend toward studies of non-game wetland birds, Swanson and Liknes (2009) documented the first nesting of Great-tailed Grackle (*Quiscalus mexicanus*) in the state from a wetland in Clay County, and examined range expansion trends in this species. As a final illustration of a general trend in ornithological studies, in this case pertaining to wetland birds, Higgins (2010) studied waterfowl population trends from specific wetland sites in the Northern Prairie region by repeating surveys initially completed 20-30 years ago at these same sites (Higgins 2010). Such studies are becoming more common in ornithology as the historical baseline data for these studies are now available and concern over population trends in various bird groups continues to mount.

Woodland habitats are rare in the northern Great Plains, but are disproportionately important for birds, harboring higher species richness and abundance of birds than any other habitat (Peterson 1996, Bakker 2003a). Habitat associations between birds and different types of woodlands have been the focus of a few studies published in the *Proceedings*. One example is the study of Coughlin and Higgins (1993), who documented that riparian habitats along the main channels of rivers offered better habitat than those along their tributaries for Wood Duck (*Aix sponsa*) nesting. Historically, riparian habitats in South Dakota had a variety of successional stages, but with the damming and current flow regulation patterns on many of these rivers that reduce the flooding necessary for generating early successional habitats, this habitat is declining (Dixon et al. 2012). In another *Proceedings* paper, Liknes et al. (1994) found that early and late successional cottonwood forest habitats along the Missouri River produced similar bird densities, but early successional habitats harbored greater species richness, highlighting the importance of early successional habitats to overall bird diversity in these riparian systems.

Disease and contaminant studies of birds were common topics of studies in the *Proceedings* in the 1960s through the 1980s, as part of the previously mentioned Silent Spring effect. One example dealing with disease is Fuller et al. (1968), who described a mass mortality event for water birds at Platte Lake, Aurora Co., possibly due to botulism. Another example, this one dealing with contaminant effects, is Solomon et al. (1973) who experimentally treated Ring-necked Pheasant (*Phasianus colchicus*) hens with 2,4-D or polychlorinated biphenyls (PCB), finding that treatment of hens did not result in increased abnormalities in embryos.

Bird migration has long been a topic of ornithological interest and a number of studies dealing with migration have been published in the *Proceedings*. In an early paper suggesting important bird study needs in South Dakota, Habeger

(1959) mentioned the need for migration (migration paths and weather effects) and breeding bird abundance (population trends) studies as two primary topics needing study in South Dakota. Ornithologists in South Dakota have done yeoman's work in addressing these topics, with efforts examining breeding bird abundance including the two Breeding Bird Atlas projects. Several papers in the *Proceedings* have also studied different aspects of migration. For example, Timken and Anderson (1968) studied age and sex ratios of migrating Blue-winged Teal (*Anas discors*) in eastern South Dakota, finding different sex ratios between northeastern and southeastern South Dakota, with more males in the southeast. Spring raptor migration in Moody County, South Dakota, was studied by Gabbert and Schneider (1998). These authors found that peak abundance of raptors occurred during the first week of April, with a steady decline in numbers continuing until early June, thus establishing a phenology of spring migration for this group of birds.

Winter is a prominent part of life in South Dakota, so naturally the behavior and physiology of birds in winter has been a topic of study in the *Proceedings*, particularly as it relates to the state bird, Ring-necked Pheasant. For example, Sather-Blair and Linder (1980) demonstrated that pheasants preferentially used large wetlands with tall (> 1 m) surrounding vegetation for winter cover. In addition, Purvis et al. (1999) found that pheasants provided with supplemental food plots within their winter home ranges did not have larger fat stores, suggesting that food was widely available in all occupied habitats. These authors did find, however, that winter fat stores were positively related with fat stores in spring, thus demonstrating carry-over effects that might impact reproductive fitness.

Research on climate change and its impacts on flora and fauna has exploded recently and publications on this topic in the *Proceedings* have followed suit. Two recent examples include the papers by DeJong and Higgins (2012) and Bedford et al. (2013). DeJong and Higgins (2012) measured volumes of duck eggs from South Dakota present in museum collections to examine trends in egg size and their association with climate change over the past 150 years. They found that egg volumes changed over time in five of 14 species measured, but these changes were related to drought severity index, rather than directly to temporal changes in temperature, with eggs generally being larger during drought conditions than during moist conditions. Bedford et al. (2013) systematically surveyed Icterids (New World blackbirds and their relatives) during spring migration from 1995-2012 at Oak Lake Field Station, Brookings County, and their data suggest generally earlier spring arrival with recent warming.

One final ornithological study category occurring in the *Proceedings* is the study of the ecology of individual species. One example of such studies is for the Upland Sandpiper (*Bartramia longicauda*), an iconic grassland species. Two publications in the *Proceedings* have focused exclusively on Upland Sandpipers (Kaiser 1979, Gardner et al. 2008) and both highlight the importance of native grasslands and wetland complexes to the breeding ecology of this species. One other noteworthy example of a single-species study is the recent paper by Palmer and Javed (2014) on American Dippers (*Cinclus mexicanus*) in the Black Hills, where they modeled population trends based on annual survival of marked birds. Dippers have a small, restricted population in South Dakota, being limited to a

few fast-flowing clear streams in the northern Black Hills (Tallman et al. 2002). Palmer and Javed's (2014) models predicted high probabilities of population declines for South Dakota dipper populations over the next 25 years, so they recommended that conservation efforts focus on actions to increase reproductive rates, such as increasing provision of artificial nest sites.

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Erratum: The following sentence has been removed from page 34 line 9 of the originally published version: "This specimen [the Mississippi Kite collected by Wilhelm on 30 August 1823 from the Bijou Hills in Brule County, SD] served as the model for Alexander Wilson's painting of this species in American Ornithology." A complete erratum will be published in the 2017 Proceedings of the South Dakota Academy of Science.