Identification and Monitoring of American Dipper Populations and Inhabited Areas in South Dakota

Final Report

March 31, 2019

Bird Conservancy of the Rockies
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Bird Conservancy of the Rockies
Connecting People, Birds and Land

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Connecting people, birds and land

Mission: Conserving birds and their habitats through science, education and land stewardship

Vision: Native bird populations are sustained in healthy ecosystems

Bird Conservancy of the Rockies conserves birds and their habitats through an integrated approach of science, education, and land stewardship. Our work radiates from the Rockies to the Great Plains, Mexico and beyond. Our mission is advanced through sound science, achieved through empowering people, realized through stewardship, and sustained through partnerships. Together, we are improving native bird populations, the land, and the lives of people.

Core Values:

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

Goals:

1. Guide conservation action where it is needed most by conducting scientifically rigorous monitoring and research on birds and their habitats within the context of their full annual cycle.
2. Inspire conservation action in people by developing relationships through community outreach and science-based, experiential education programs.
3. Contribute to bird population viability and help sustain working lands by partnering with landowners and managers to enhance wildlife habitat.
4. Promote conservation and inform land management decisions by disseminating scientific knowledge and developing tools and recommendations.

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Cover Photos: Clockwise from upper left: Upper Devil's Bathtub nest, central Deadwood adult with fledgling, 6-egg clutch at Birchcrest Lane, Cleopatra bridge nest. All photos by Nancy Drilling

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Executive Summary

The American Dipper (*Cinclus mexicanus*) is an aquatic songbird that lives along fast-moving clear cold streams throughout western North America. South Dakota's Black Hills has a small (<100 adults), isolated (>200 km from nearest site) population with relatively low reproductive success. As a result, the dipper is listed as a South Dakota state Threatened Species. In order to be removed from the state list, Black Hills dippers must have a stable or increasing breeding population in at least three watersheds. The aim of this study was to determine the current distribution and breeding success of American Dippers in the Black Hills. Specific objectives were to 1) conduct surveys of potential breeding habitat in watersheds in the northern and eastern Black Hills, 2) monitor nest site occupancy and reproductive success during the 2017 and 2018 breeding seasons, and 3) band dippers for insights into mate fidelity, and movements.

We surveyed over 99 miles of creek in eight watersheds: Spearfish--Little Spearfish--East Spearfish--Iron--Cleopatra (Squaw) creeks, upper and lower Rapid Creek, Whitewood Creek, Elk Creek, Bear Butte Creek, Box Elder Creek, French Creek, and Pine Creek. The distribution of American Dippers in the Black Hills has not changed since previous surveys conducted in the late 1990s and early 2000s. We found 44 active and 15 inactive nest sites in the Spearfish and Whitewood creek systems and one unsuccessful nest on Rapid Creek. Most of these sites have been occupied for at least a decade. Unoccupied creeks had potential nest sites but poor stream quality, with low or no water flow and high levels of sedimentation.

During this study, we documented 35 (2017) to 36 (2018) active nest sites, with a Black Hills breeding population of at least 70 adults. Compared to 57–66 adults counted in 2004–2009, the number of breeding adults appears to be stable. During 2017–2018, the probability that a nest fledged at least one young was 0.62, a lower rate than is found in most other dipper populations. Probability of nest success was lower in 2017 (0.57) compared to 2018 (0.65), lower on small creeks such as Iron or Cleopatra creeks (0.52) than on Spearfish (0.64) and Whitewood (0.61) creeks, and lower in nest box nests (0.48) than in bridge ledge nests (0.79) or natural substrate nests (0.72). In almost 90% of cases, we could not determine the cause of nest failure. Known or suspected causes included cold wet weather, nests falling into the water, and destruction by other dippers. We documented an average of 4.8 eggs (range 4 – 6) in six nests observed during incubation, and counted an average of 1.8 fledglings (range 1-4 fledglings) from 41 successful nests.

We captured and color-banded 37 individuals: 27 adults, 7 fledglings less than one week out of the nest, and 3 juveniles. In 2018, we resighted 79% of individuals banded as adults in 2017, one of the banded fledglings, and two of the juveniles. Almost all banded adults nested on the same territory and with the same mate in both 2017 and 2018. All banded birds that switched sites stayed on the same creek with a maximum distance between nest sites of ~3 miles.

This study shows that the current distribution and population size of breeding American Dippers in the Black Hills is essentially unchanged from those in the mid-2000s. Both Spearfish and Whitewood creeks still have breeding populations and appear to meet the first Recovery Goal as outlined by the state. We did not find evidence of a breeding population in a third watershed and thus this population does not yet meet the second Recovery Goal. Given these results, the American Dipper does not meet criteria for removal from the state's Threatened Species list. As next steps, we recommend studies to understand how threats such as climate change or land-use changes may impact Black Hills dippers, why apparently suitable creeks, such as lower Rapid Creek are not occupied, and causes of low reproductive success and mortality. Despite relatively low nest success in nest boxes, we recommend that efforts to erect, maintain, and replace boxes continue, to provide ample nest sites for the Black Hills population.

Acknowledgements

During pre-field work preparation, Valerie McKean (U.S. Forest Service) and Casey Heimerl (SDGFP) provided the historical dipper records upon which the creek surveys were based. I am extremely grateful to Nikolai O'Hara (SDGFP) for designing the Survey123 Dipper data collection app and for subsequent data management. Paperless data recording was wonderful, especially because field work was always happening in the water. Many thanks to field technicians Dan Horton, Dawn Garcia, and Philip Turner who cheerfully spent long hours traipsing along creeks. Stan Michals, Charlie Miller, Casey Heimerl, Dan Horton, Dawn Garcia, Greg Albrechtsen and Doug Backlund provided excellent dipper chasing skills to help capture and band dippers. Many private landowners graciously provided permission to access their land. Very special thanks goes to Doug Backlund, who not only provided invaluable support and advice during this study, but was the driving force behind listing and recovery efforts of American Dippers in the Black Hills. Suggested edits by Quresh Latif greatly improved an early draft of this report. This study was funded in part by federal funding through State Wildlife Grant T-76 R-1, Study #F16AF01204, administered through the US Fish and Wildlife Service and provided by the South Dakota Department of Game, Fish and Parks. South Dakota Game, Fish and Parks also provided match funding.

Table of Contents

Table of Figures

Table of Tables

Introduction

The American Dipper (*Cinclus mexicanus*) (hereafter dipper) is an aquatic songbird that lives along mountain streams throughout western North America. Dippers are year-round residents of the Black Hills, South Dakota. The Black Hills population is geographically separated from neighboring populations by >240 kilometers and is genetically distinct (Anderson *et al.* 2008). Historically, dippers occupied most permanent streams in the Black Hills (Backlund 2009). The Black Hills' dipper population, however, has declined because of reduced water flows, sedimentation, pollution, and dams. Observers during the first state Breeding Bird Atlas (1988--1992) only found the species in three drainages in the northern Black Hills (lower Rapid Creek, Whitewood Creek, and Spearfish Creek), while dippers were confirmed breeding in only two drainages (Whitewood Creek and Spearfish Creek) during the second state Breeding Bird Atlas (2008--2012) (Peterson 1995, Drilling 2018). More recently, dippers have been confirmed breeding in lower Rapid Creek (Online SBOR 2016). Lovett (2010) counted 57 to 66 breeding adults in the Spearfish and Whitewood creek watersheds between 2004 and 2009. Based on demographic modelling, Palmer and Javed (2014) felt that these birds may not be producing enough young to sustain the population over the long term.

The dipper is a State Threatened species and Species of Greatest Conservation Need in South Dakota because of its isolation, low population size, and continuing threats (e.g., urbanization, climate change, invasive species, toxic waste, land-use) (SDGFP 2014). SDGFP has developed two recovery goals for the South Dakota dipper population (SDGFP 2017). These are: 1) evidence of a self-sustaining population on Whitewood and Spearfish Creeks for at least 5 years in a 6-year timespan, and 2) evidence of a self-sustaining population established on at least one additional river drainage over a similar timeframe. They define a self-sustaining population as one that maintains or increases it numbers over a period of time without significant human intervention (i.e. release of individuals to supplement population numbers).

Concerns over the long-term viability of the Black Hill's dipper population necessitate periodical assessment of species status, including reproductive success and potential limiting factors. The most recent comprehensive surveys of potential habitat occurred in the late 1990s and early 2000s and the latest monitoring of nest success ended in 2009 (Draeger and Johnson 2001, Backlund 2009, Lovett 2010). The aim of this study was to determine the current distribution and breeding success of American Dippers in the Black Hills.

Information gathered from this project provides a better understanding of the current distribution and reproductive success of American Dippers in South Dakota and allow for an evaluation of whether the Black Hills population has met state recovery goals.

Specific objectives of this study were to:

1) Conduct surveys of potential breeding habitat to document new dipper nest locations

2) Monitor nest site occupancy and reproductive success during two breeding seasons

3) Band and monitor marked individuals to evaluate site fidelity, movements, and survival

Methods

Creek Surveys

During 2017 and 2018, we surveyed approximately 99 miles of creeks in the northern and central Black Hills for the presence of dippers and evidence of nesting (Fig. 1). The survey consisted of walking along or in each creek, cataloging any potential nest sites and documenting existing nests and presence of birds. See Table 1 for definitions of site types. For potential, inactive or active sites, we recorded location coordinates, time and date, watershed name, general habitat characteristics (stream type, adjacent habitat type), presence of nest box, potential or actual nesting substrate (e.g., cliff overhang, boulder, bridge, rock crevice, nest box), nest site type (potential site, old nest present, or active nest), and whether birds were present. Photos were taken of many sites, especially old or active nest sites. In 2018 we also identified locations where nest boxes could be erected, included suitable sites for a mid-stream pole with a nest box on top. All site types, including natural and nest box potential sites, are marked on the maps under each individual stream survey description below.

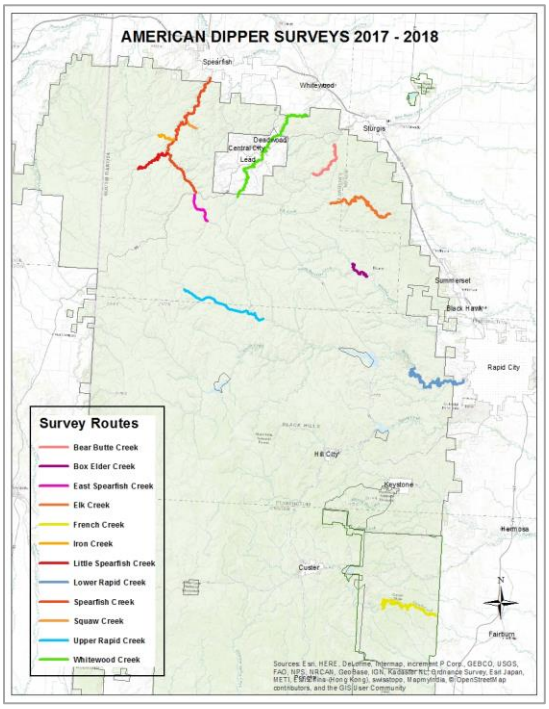

Figure 1. Map of creeks surveyed for American Dippers during 2017-2018

Nest Monitoring

At the beginning of the project, we compiled locations of all known historical and current nest and nest box sites from the South Dakota Dept. of Game, Fish and Parks, the South Dakota Ornithologists' Union online bird database (Online SBOR 2016), the Northern ranger district of the U.S. Forest Service, and members of the public. We checked and monitored all of these sites for nesting activity, as well as those newly discovered during creek surveys. Inactive nest sites (old nest present) were checked once a month. We visited active sites every one to three days to determine nesting outcome. Active sites in three difficult to access areas were visited less frequently and we could not determine their nest outcomes. These areas were Thunderhead Falls, Upper Devil's Bathtub, and the last 2.5 miles of downstream Whitewood Creek. For each site visit, the observer waited up to 20 minutes for dipper activity to determine

whether a nest was active and its nesting stage. For each site visit we recorded date, location coordinates, whether adults were present, nesting stage, and current breeding status code. In addition, we noted any behavior and other observations of interest.

Table 1. Definition of site status and nest fate categories

Category	Definition
Potential nest site	• Natural features with appropriate ledges over water: creekside cliffs and rock outcroppings, instream boulders, waterfalls • Human-made features: bridges with suitable ledges, nest boxes
Potential nest box site	• Bridge without a nest box • Box-on-pole potential location: shady, has suitable fast-running clear water, is away from roads and houses
Inactive nest site	Old dipper nest present but no nesting or bird presence during the 2-year project
Active nest site	Nesting attempted at least once during the 2-year project
Successful nest	Successfully fledged at least one chick
Failed nest	Did not fledge any chicks

We evaluated nest fate following completion of nesting attempts. We considered a nest probably fledged if the nest was empty and nestlings were old enough to fledge, the nest entrance was enlarged, there were large amounts of whitewash nearby, or adults were seen carrying food up or down the creek. A confirmed fledging was one in which at least one fledgling was observed. We could not determine the cause of most nest failures and so the failure was classified according to the nesting stage during which it occurred. We estimated the date the first egg was laid by back-dating from hatch or end date, assuming an incubation period of 13 days, a nestling stage of 24 days, and a clutch size, if not directly observed, of 4 eggs. If not directly observed, we estimated the end date as the mid-point between when the nest was last active and when it was first observed to be inactive. We used methods developed by Mayfield (1975) and Johnson (1979) to estimate daily nest survival (DSR) and probability of nest success ($\hat{S}$).

Capture and Banding

To capture adult and fledgling dippers, we erected a mist net (black polyester threads, 36mm diameter openings, 2m high, 6 to 12m wide depending on creek width) across the targeted bird's favored stretch of creek. Care was taken to choose a location in which the bander was able to safely walk along the entirety of the net to remove a bird. One person monitored the net while a second person flushed the target bird towards the net. The net monitor immediately lifted the net when the bird entered to prevent the dipper from falling into the water while entangled. The bander then removed the bird as quickly as possible.

Figure 2 . Color banded dipper

After capture, the bird was weighed, measured (tail length, natural wing chord, fat score) and banded. We placed four bands on each dipper – one USGS metal numbered band and three plastic color bands (Fig. 2). The color and placement combination of the four bands was unique to each bird so that it could subsequently be identified with a visual observation. We determined age and sex of each bird from criteria delineated in Pyle (1997). We banded dippers under the Bird

Conservancy of the Rockies' federal Master bird-banding permit #22415 and state Scientific Collector Permit #25 (2017) and #13 (2018) to Nancy Drilling.

Bird Sighting and Resighting

We recorded the banding status (banded or not banded) of all birds encountered during surveys and nest checks. Resightings of color-banded birds informed residency status, territoriality, reproductive success of individual birds, movements, and survival. When dippers were sighted, we recorded location coordinates, time and date, number of birds, age and sex of birds (if known), behaviors observed, whether banded, and color-band combinations. We did not record multiple resightings of a bird at a nest after the first sighting but we cross-checked with the original sighting to ensure that the bird 'belonged' to that nest.

Results

Creek Surveys

In all, we surveyed approximately 99.25 miles of creek in eight watersheds (Table 2). Most targeted areas were surveyed, with the exception of dry stretches on Bear Butte and Spearfish creeks and approximately 1.5 miles on lower Rapid Creek where access was denied by private landowners.

Table 2. Summary of 2017-2018 creek surveys for American Dippers in the Black Hills, S.D.

Name	Miles Targeted	Miles Com-pleted	Number Potential Nest Sites	Number Potential Nest Box Sites	Number Inactive Nest Sites	Number Active Nest Sites
Bear Butte Creek	6	4.5[1]	9	0	0	0
Box Elder Creek	3	3	8	3	0	0
Elk Creek	10	10	19	0	0	0
French Creek	12	12	35+[2]	0	0	0
Upper Rapid Creek	10	10.75	0	11	0	0
Lower Rapid Creek	14	12	15	4	1	1
Spearfish Creek	17	15.5[1]	8	13	7	25
Cleopatra (Squaw) Crk	2	4	5	0	0	1
Iron Creek	2	2	1	0	2	4
Little Spearfish Creek	5	5	1	2	0	1
East Spearfish Creek	4	4	4	0	1	4
Whitewood Creek	15	15	8	12	4[3]	9
Pine Creek	N/A	1.5	9	1	0	0
Total	**100**	**99.25**	**122+**	**33**	**16**	**44**

[1] The remaining targeted miles did not have any water

[2] Potential sites in the east half of the survey area were not marked but 'at least' 25 occur there, in addition to the 12 sites catalogued in the western half

[3] Another two sites were classified as 'Unknown' – one because it was not accessible for viewing and the other because it was discovered with an old nest after the breeding season.

Forty-five sites had active nests in at least one year of the study. Most were in the Spearfish Creek watershed, which includes Spearfish, Little Spearfish, East Spearfish, Iron, and Cleopatra (Squaw) creeks. Just 10 sites were elsewhere – nine along Whitewood Creek and one at Thunderhead Falls on Rapid Creek. As detailed in the following creek-specific descriptions, all unoccupied creeks had potential nest sites but water characteristics, such as flow, turbidity, and sedimentation, made them unsuitable for dippers.

The following creek-specific survey accounts summarize the results of the surveys in each reach. The maps show targeted and actual survey routes, potential, inactive, and active nest sites, potential sites to erect nestboxes, historical nest sites, areas of low- or no water, and observations of dippers away from known territories. The accounts include issues relevant to that particular creek.

Bear Butte Creek. The 4.5 mile stretch of Bear Butte Creek between Galena and Camp 5 Road was surveyed on July 25 and 26, 2018 (Figs. 3, 4). The creek goes underground above the Dry X' marker on the map and emerges in the town of Sturgis. The intervening stretch of creek only has water if there is heavy runoff. There are large rocks and boulders with several ATV and road crossings in this stretch (Fig 3, left photo). The creek bed in the1.5 downstream miles of targeted area that we did not survey is an ATV trail.

Figure 3. Bear Butte Creek photos.
Photos by Dawn Garcia

As noted by Draeger and Johnson (2001), the lower 1.5 miles of creek, just north/upstream of Galena, is good dipper habitat (Fig. 3, right photo). The creek has a rocky bottom, good clear flow, and cliffs and boulders for nesting. Creekside habitat largely is deciduous riparian habitat with conifer uplands. However, we did not find any sign of dippers or nests. Even if dippers were to nest here again, good habitat only encompasses about one territory (average dipper territory size is 1.6 km in length, Willson and Kingery 2011) and would not support a population of dippers as required by recovery goals.

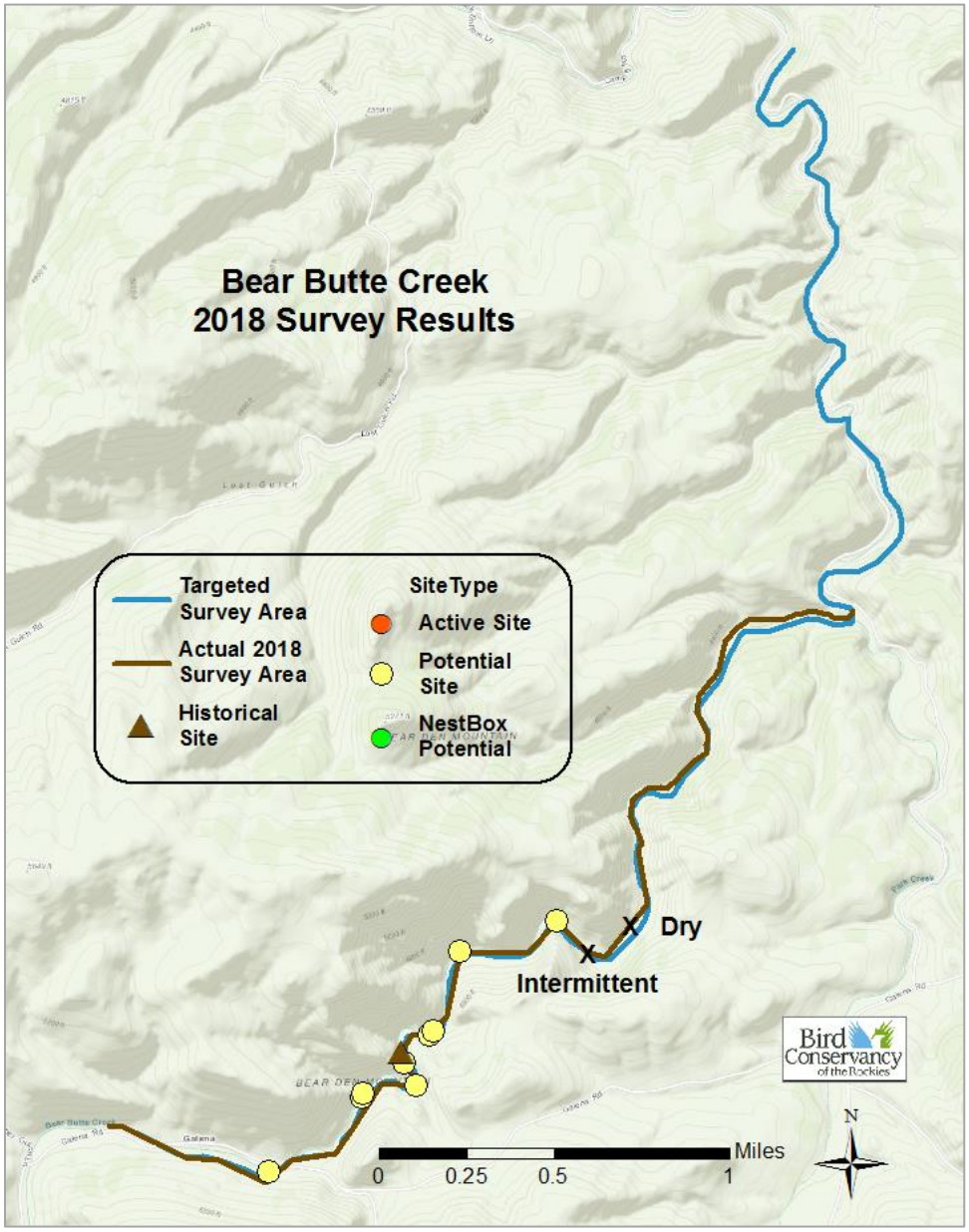

Figure 4. Map of Bear Butte Creek survey area

Box Elder Creek. The 3-mile stretch of Box Elder Creek between Nemo and the US Job Corps campus was surveyed July 24, 2018 (Fig. 5). We documented seven natural (cliff) potential sites and four bridges, one with a nest box. Although the creek has some flow, the water is turbid and has considerable fine sediment on the stream bottom. Habitat along this stretch of creek is a mix of open meadow and conifer forest. No birds or nests were found, including near the historical site.

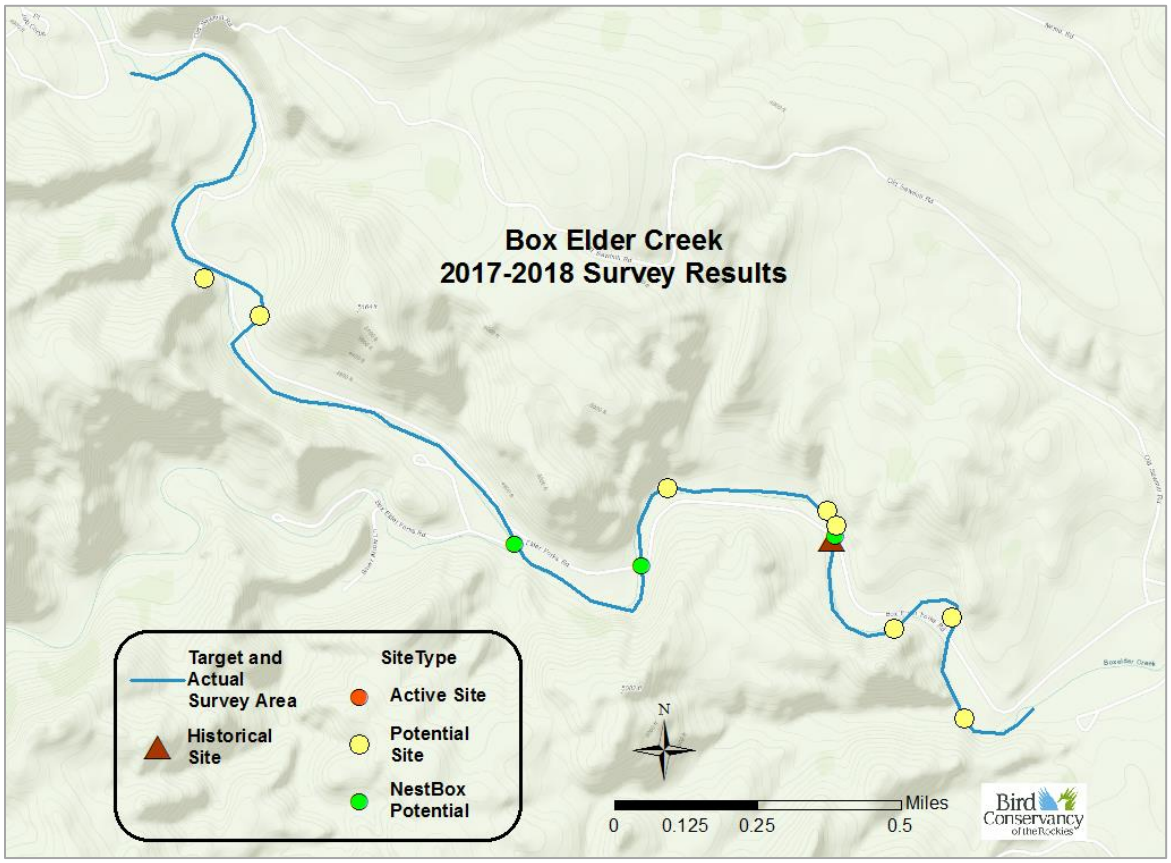

Figure 5. Map of Box Elder Creek survey area

Elk Creek. In late July 2018 we surveyed 10 miles of Elk Creek, between Old Ridge Road on the west end to Bethlehem Road in the east (Figs. 6, 7). No dippers or nests were found. West of Vanocker Canyon Road, the low-gradient creek is primarily bordered by pasture and is severely impacted by grazing – turbid, with deep sediment and thick mats of algae. East of the road downstream to the area with several potential nest sites, the creek again is low gradient with grassy banks and small boulders and cliffs. The middle section of the surveyed area has more riparian tree and shrub vegetation with larger boulders and creek-side cliffs, and a rocky stream bed. The creek goes underground between the Dry 'X' marks. Below this, the section with the historical record and several potential cliffs has good flow, clear clean water, a cobble bed, large granite boulders and slides, and large cliffs and boulders. Otherwise the lower end has intermittent or very low flow, with some large pools containing fish and aquatic invertebrates.

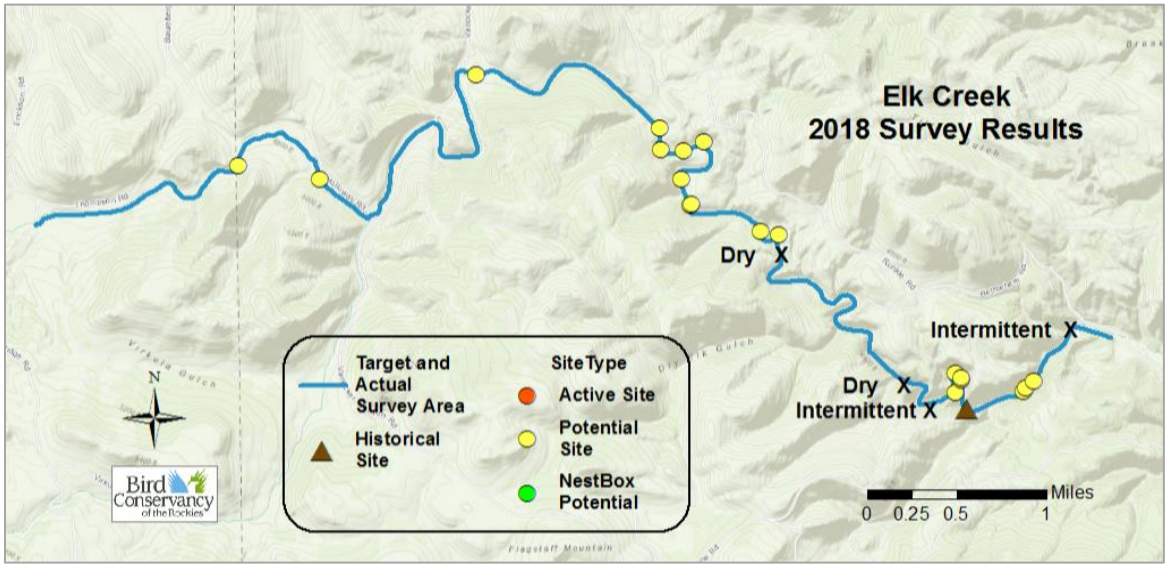

Figure 6. Map of Elk Creek survey area

Figure 7. Photos of Elk Creek
Photos by Dawn Garcia

French Creek. The 12 miles of French Creek running through the French Creek Natural Area in Custer State Park, from Lame Johnny Rd Horse Camp to Wildlife Loop Rd, was surveyed on July 27, 2017 (Figs. 8, 9). We found no evidence of dippers or nests. The creek goes underground at the 'Dry' mark and is dry downstream (east) for the rest of the survey area. We found an abundance of suitable cliffs and boulders for nesting (~25 potential sites on the east end were not marked). Portions of the east half have clear water with good aeration caused by rushing among large boulders. However, the west half traverses fairly level ground and the water is sluggish and turbid, resulting in a considerable amount of sedimentation and stretches of cattail marsh. Given the number of good nest sites and creek stretches with the potential for fast flows it there is enough water, the 1920s historical records of many dippers along this creek is certainly likely. However, Stockade Lake was built upstream in the 1930s and there have been no subsequent dipper records on this creek, suggesting that the lake has altered stream flows and water quality to the detriment of dippers. Water quality in Stockade Lake is poor because of siltation and nutrient loading from highway runoff, grazing, mining, and forestry practices in the watershed (Froiland and Weedon 1990). Until recently, sewage waste from the city of Custer entered the lake.

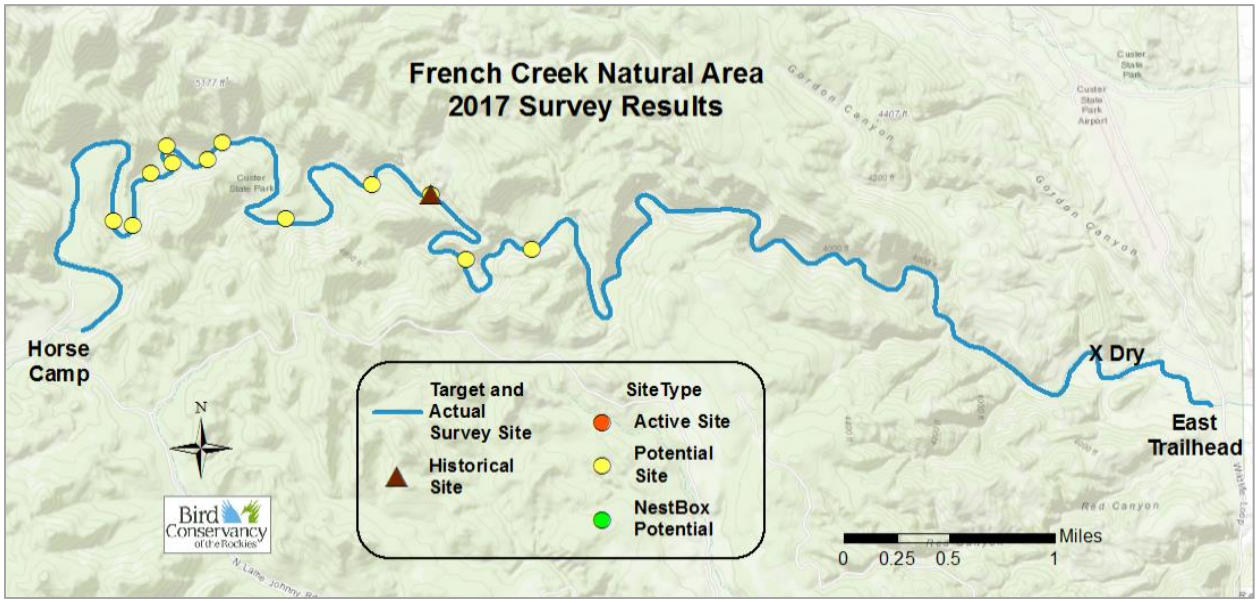

Figure 8. Map of French Creek survey area
Approximately 25 potential nest sites on the east end were not marked.

Figure 9. Photos of French Creek
Historical site (FrC059) on the left, FrC053 on the right. Photos by Nancy Drilling

Upper Rapid Creek. More than half of the 10-mile stretch of the south fork of (upper) Rapid Creek flows through open meadow and is not suitable dipper habitat (between the 'Xs' on Fig. 10). The creek upstream (west) of the pasture to Trebor Draw, as well Rhoad's Fork which flows through Black Fox campground, is forested pastureland, with open mixed spruce-pine forest and bogs. The creek is narrow and, although fed by several springs and seeps, has slow flows because of a low gradient. As a result of the terrain and surrounding land use, the creek bed is covered in sediment, sometimes more than 6" deep. The creek substrate in Black Fox, on Rhoads Fork, is rock and water flows a bit more quickly, perhaps explaining historical and current dipper observations in the campground. One juvenile dipper was photographed by a camper at Black Fox in June 2017 but during the creek surveys, we did not find any sign of dippers or nests. We did not find any natural (cliff, boulder, waterfall) sites on upper Rapid Creek. A handful of spots are shady enough to consider erecting nest boxes on poles, although the water quality is marginal in these areas.

Below the junction of the north fork of Rapid Creek, shown in black on the map, and the south fork, water flows more rapidly and the creek bed is pebbly. No dippers or nests were found but several bridges – road bridges, Mickelson Trail bridges, and private bridges, provide good opportunities for nest boxes.

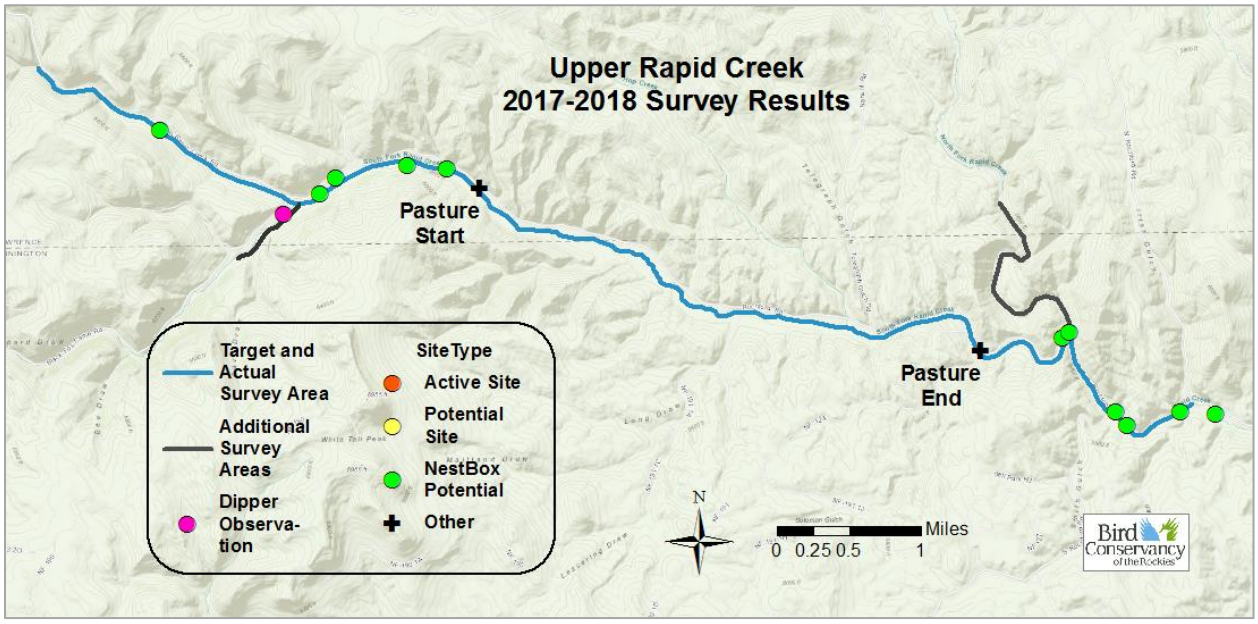

Figure 10. Map of upper Rapid Creek survey area

Lower Rapid Creek. Most of the land bordering the 14-mile stretch of Rapid Creek between Thunderhead Falls Road to Cleghorn Fish Hatchery is privately owned (Fig. 11). We were not able to survey three sections totaling ~2 miles. Magic Canyon just downstream of Dark Canyon, is an urban area with no potential nesting habitat and is unlikely to harbor dippers. The other two non-surveyed sections, upstream and downstream of Hisega, may have more suitable habitat.

Habitat along lower Rapid Creek is Ponderosa Pine upland with riparian shrubs, trees and grass, intermixed with steep canyon walls. In the five communities (Thunderhead Falls, Hisega, Falling Rock, Dark Canyon, and Magic Canyon) along the creek, houses and cabins generally line one bank with steep hills and cliffs on the opposite side. In general, the entire area surveyed

appeared to be good dipper habitat. The creek is wide with a pebbly bottom and relatively little sediment, water flows are strong and the water is clear. We documented nine cliffs and boulders that could be potential nest sites and 10 bridges, six of which already have dipper nest boxes. Yet, we found only one dipper nest on the creek during this survey - at Thunderhead Falls, which is the only known dipper nest site on Rapid Creek for the last several decades. This pair did not appear to get past the nest-building stage during this study (Fig. 12), and oddly, they were never seen by any of the surveyors despite monthly visits to the site.

The reasons for the lack of dippers on lower Rapid Creek are not clear. Rapid Creek below Pactola dam is one of the only areas in the Black Hills with the invasive diatom *Didymosphenia geminata*. This non-native organism creates a biofilm on the bottom substrate and has reduced the density of desired aquatic invertebrates in the creek (James et al. 2010). In addition, since the construction of Pactola Reservoir in the early 1950s, creek flow is controlled by releases from the dam, which usually do not mimic natural flows in either timing or amounts. Aquatic macroinvertebrates decrease in abundance from May to September (and likely later in the year) because of decreasing water flows (Halvorson 2018). This is negatively affecting the trout fishery in lower Rapid Creek (Halvorson 2018). In addition, because of warmer temperatures as one moves downstream, the aquatic invertebrate species composition changes from being dominated by larger species (stoneflies, mayflies) upstream to being dominated by smaller species (midges and black flies) farther downstream. A study of the diet preferences and needs of Black Hills dippers is needed to understand possible explanations for their almost total absence in Rapid Creek.

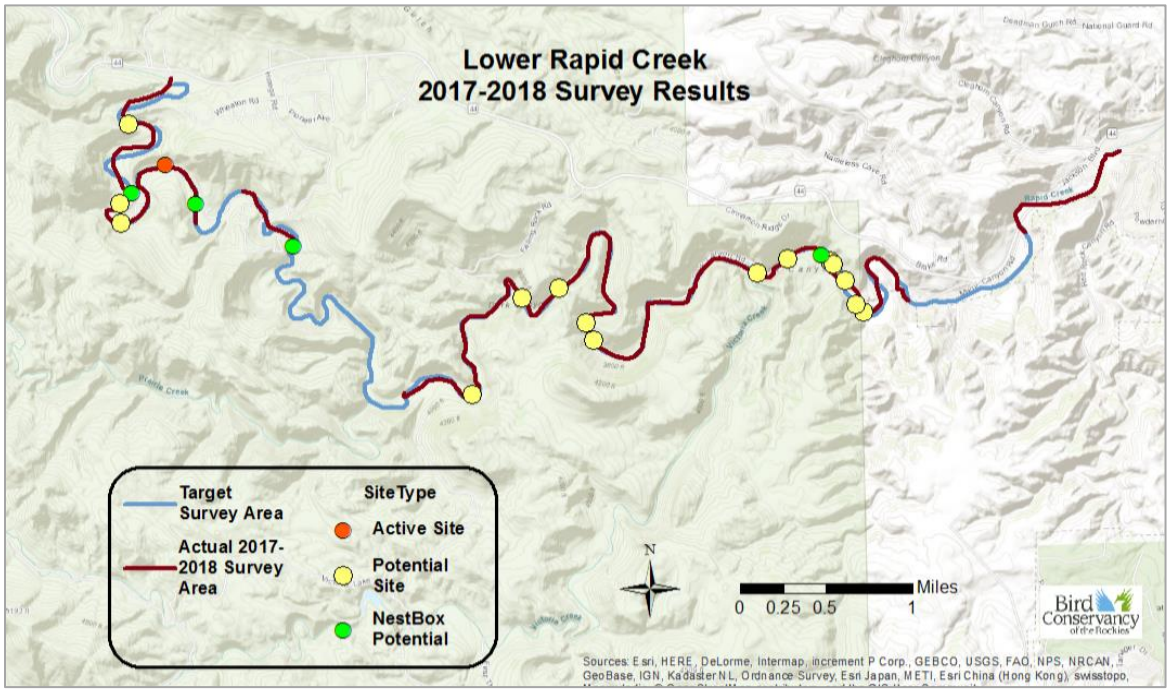

Figure 11. Map of lower Rapid Creek survey area

Figure 12. Photo of Thunderhead Falls incomplete nest
Photo by Nancy Drilling

Spearfish Creek. We surveyed approximately 16 miles of Spearfish Creek, between 1 mi south of Cheyenne Crossing until the water disappeared below Community Caves (Figs. 13, 14). The creek famously drops 3000 ft over its 40-mile course. Although the drop is not evenly distributed along the entire route, this is a classic mountain stream of clear cold fast-flowing water and is perfect dipper habitat. Most dipper breeding in the Black Hills occurs along this creek. Highway 14A runs along the creek at distances of 25 – 150m and there are over 100 creekside cabins and homes along the surveyed section. In addition, about 1 million people visit Spearfish Canyon every year. The creek has a mixed spruce-deciduous riparian zone with upland Ponderosa Pine, and limestone cliffs that tower up to 1000' overhead. Water comes from numerous springs, upwellings and feeder creeks as well as runoff. In the late 1800 and early 1900s several tunnels were built to divert water for mining. Most of these have been closed except for the line between Maurice Intake and Spearfish, which diverts much of the water flowing at that point. About 2 miles below Maurice Intake, the creek meets the Minnelusa outcrop and loses more water, eventually running dry.

Upper Spearfish Creek (between 1mi south of Cheyenne Crossing to Savoy) has no natural nest sites (mid-stream boulders, cliffs) except for Spearfish Falls in the Savoy area (Fig 13). There are two small dams along this stretch. About half of the numerous private bridges have nest boxes, which is where most of the successful nesting along this stretch occurred. Where there was no nest box, dippers attempted to nest on bridge I-beam ledges but only one was successful – at the 'Wide/Gated' bridge. In addition, a mid-stream nestbox-on-pole below the Spillway dam successfully produced fledglings both years. Potential nest box sites (marked as 'Inactive' sites on the map because they had nesting attempts on I-beams) are all private bridges that do not currently have a nest box.

Lower Spearfish Creek (Savoy to Community Caves) in general has a steeper grade and in areas, abundant mid-stream boulders (Fig. 14). Water flow is extremely fast until Maurice Intake. Below the intake, flows are much slower but this reach still is heavily used by dippers. All sites identified were already identified by Lovett (2010) and all of her successful nest sites are still successfully producing young. Active sites are a mix of natural sites (waterfalls, mid-stream boulders, creekside rock outcrops) and nest boxes on bridges. During this study, Botany Bay and Long Valley Picnic Area, identified as potential sites by Lovett, did not have suitable habitat near water. Some sections, especially between Iron Creek and Calamity Gulch bridge, have no natural sites or bridges but good water. These areas are potential locations for the addition of nest boxes-on-poles.

Spearfish Creek has a number of issues that potentially affect dippers. The creek naturally is supersaturated with calcium and magnesium because its water originates from the Madison Limestone formation (Stetler and Sieverding 2001). Warm water temperatures in the summer cause the calcium to precipitate out and form a cement-like layer of calcite on the creek bottom. This likely reduces the surface area for benthic macroinvertebrates to live. In addition, the creek has very high densities of trout, up to 4,000-6,000 fish per mile, possibly affecting fish growth. Although dippers eat small fish, including trout, larger fish are eating the same aquatic invertebrates as dippers and likely are competitors for some of the same food resources.

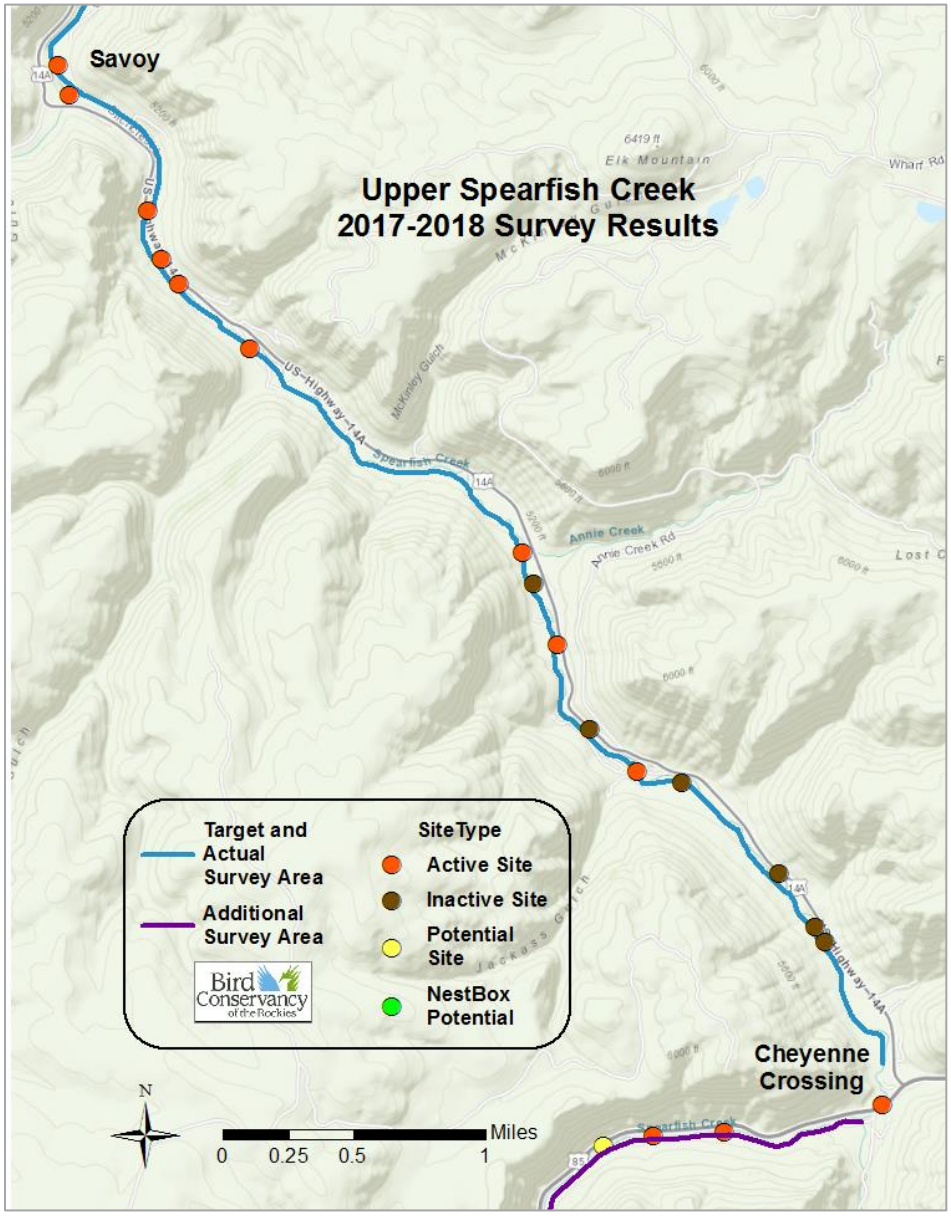

Figure 13. Map of upper Spearfish Creek survey area
Historical sites are not shown on this map.

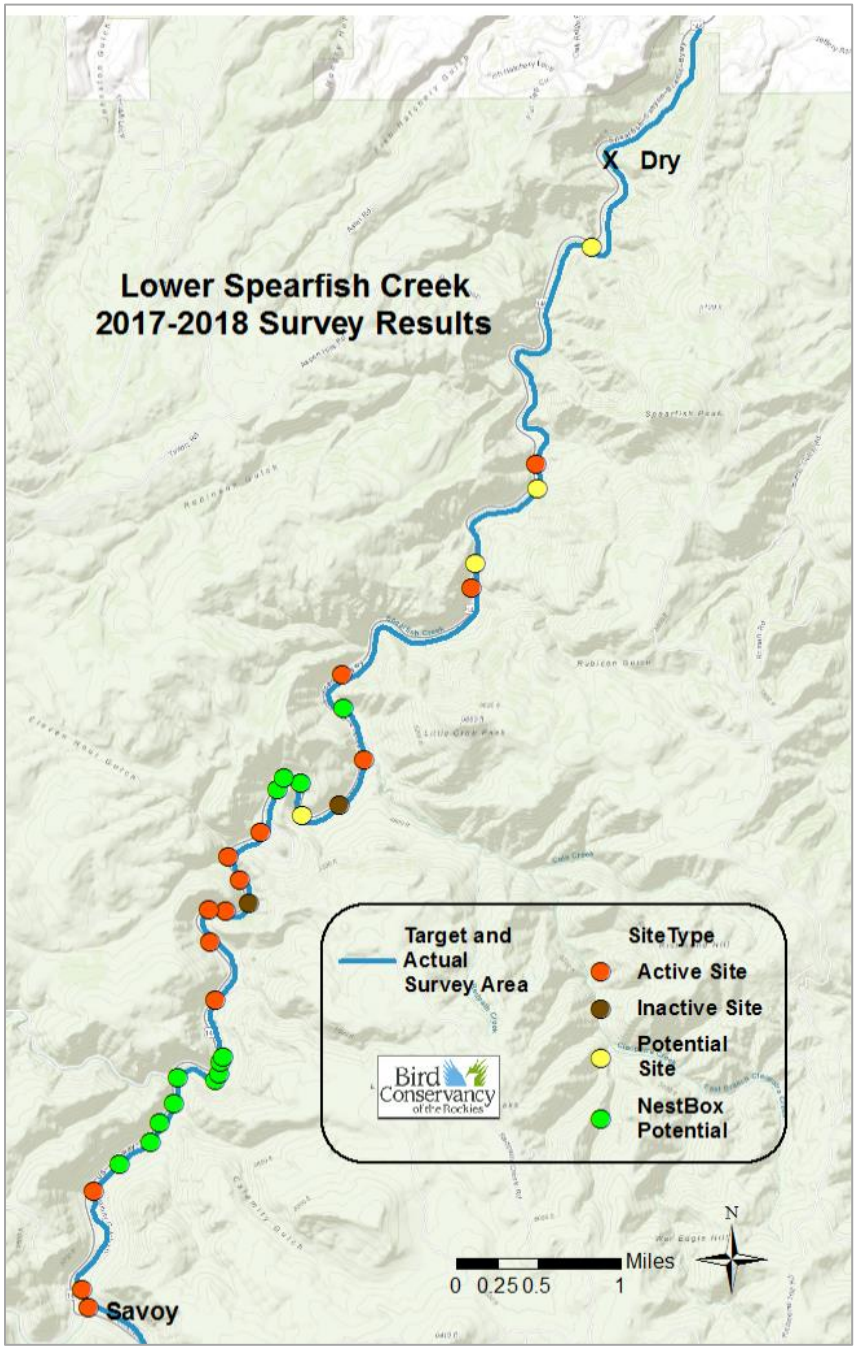

Figure 14. Map of lower Spearfish Creek survey area
Area north of the Dry mark was not surveyed. Historical sites are not shown on this map.

Cleopatra (Squaw) Creek. Because of the ease of access, we began this 4-mile survey, conducted June 17, 2017, at the west end of Labrador Creek Road, about 2 miles above Cole Creek (Fig. 15). Although relatively narrow, the entire length surveyed has a gradient steep enough for a moderate to rapid water flow. The creek is considered a 'gaining' stream and receives its water from springs in the Deadwood formation (Stetler and Sieverding 2001). The substrate mostly is sandstone rocky or pebbly with almost no sedimentation, and the entire length is shady. There are numerous creekside cliffs, most too crumbly to support a dipper nest, and three waterfalls. We documented five potential nest sites and one active site (Upper Devil's Bathtub). In addition to the nesting pair, several fledglings and adults from Spearfish Creek foraged along this creek below Lower Devil's Bathtub.

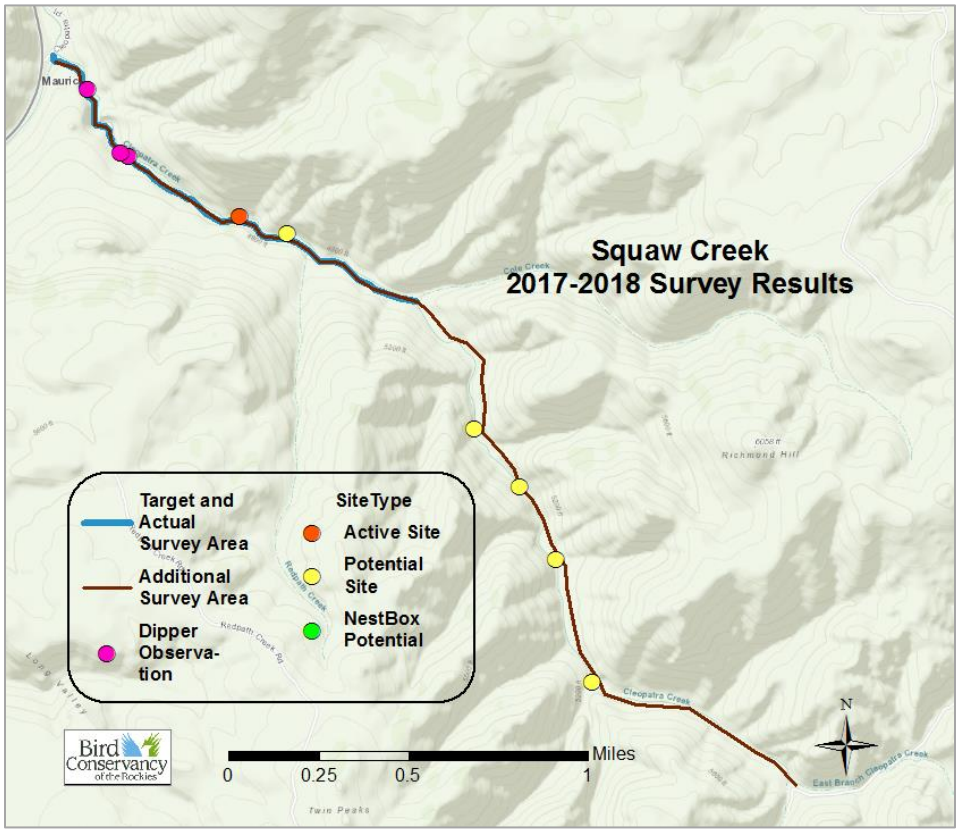

Figure 15. Map of Cleopatra (Squaw) Creek survey area

Apart from Spearfish and Rapid creeks, this creek was the best dipper habitat we encountered during this project, at least in terms of adequate gradient and water flows, low turbidity, shade, rocky substrate, and availability of nest sites. Several mines above and near the headwaters of Cleopatra Creek may be depositing heavy metals in the water. The largest threat is human recreation. With the advent of social media, Devil's Bathtub is no longer a 'secret' swimming hole. An estimated 1000 people per day visit the lower Bathtub during the summer. In addition, the hike is considered 'dog-friendly' and hundreds of dog visit each day. As a result, the creekside area of the lower Bathtub is full of human and dog excrement, trash, and sediment from people clambering up the steep hillsides. An unknown number of people, probably a substantial number, continue upstream to the Upper Bathtub, even though it is on private property. The Upper Bathtub is very popular with groups of young adults who bring food, beverages, and loud music. The 2017 pair tolerated the disturbance and successfully fledged young. The 2018 pair made several unsuccessful attempts; disturbance may have been part of

the problem. In the long term, some of the lower Bathtub issues may be alleviated with plans to build infrastructure. But if people are allowed to continue to trespass upstream, the success of the Upper Bathtub site will continue to rely on the sensitivity of the nesting pair to disturbance.

Iron Creek. We surveyed two miles of Iron Creek, between Spearfish Creek and Sawmill Gulch (Fig. 16). Water in Iron Creek comes from runoff and small seeps that run dry during dry periods. The creek disappears under ground between the 'Dry' marks on the map. The water below the dry section is clear and fast-flowing with pools full of small trout.

As in previous studies, all dipper activity was in the eastern 3/4 mile reach of the creek. We found just one potential site upstream of this area; a crumbling rock outcrop that did not show signs of bird activity. During 2017-2018, a maximum of two dipper pairs had territories on the creek and only one nest successfully fledged young. In contrast, the 2nd Breeding Bird Atlas, documented three breeding pairs and in 2012, all three successfully fledged young (Drilling 2018). The difference may be in climate conditions. During this project, water flows were relatively low because of dry conditions. In addition, a small cave next to a long-time nest site (Tall Smooth Rock, IRC002, SC16b) has become a very popular hiking destination. Hikers cross the creek within a meter of the nest site, likely causing the 2017 nest attempt to fail and discouraging subsequent nest building. Finally, the Iron Creek hiking trail is very popular with dogs and their humans. Most of the dipper nest sites are out of view but dogs frequently traverse the creek rather than the trail, which also could affect dippers.

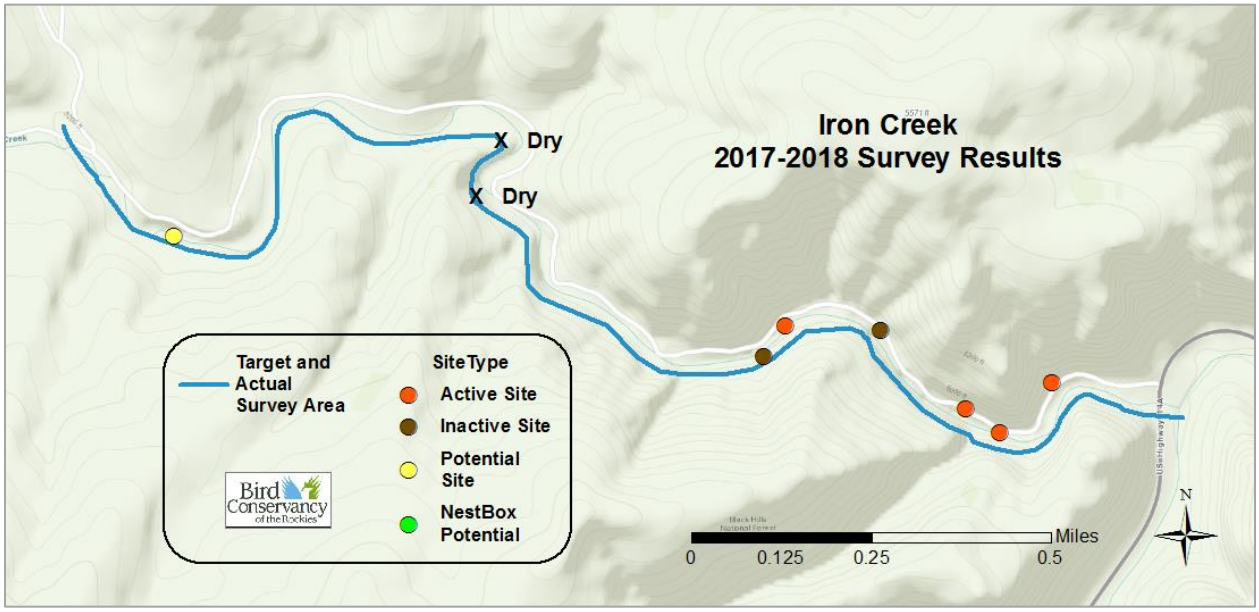

Figure 16. Map of Iron Creek survey area.
Historical nest sites are not marked.

Little Spearfish Creek. We surveyed five miles of Little Spearfish Creek, from Savoy to Timon Campground (Fig. 17). Besides Roughlock Falls and the area near Savoy, this creek is narrow and sluggish because of low gradient and beaver ponds. It has almost no shade, a mud substrate and considerable sedimentation. We only found birds at Roughlock Falls. In 2017 and 2018 dippers attempted to nest in three different cavities in the limestone wall on the north side of the Falls. The previously identified potential natural site 0.5 miles above the Falls does not appear to have a ledge large enough to support a dipper nest. It did have a nesting Cordilleran Flycatcher on the boulder which may have been the source of the previous record of an unfinished dipper nest (Lovett 2010). People have been seen dippers at Timon Campground (J. Baker pers. comm.) and the Savoy fishing pond (pers. observ.) and these two sites are recommended locations to erect nest boxes.

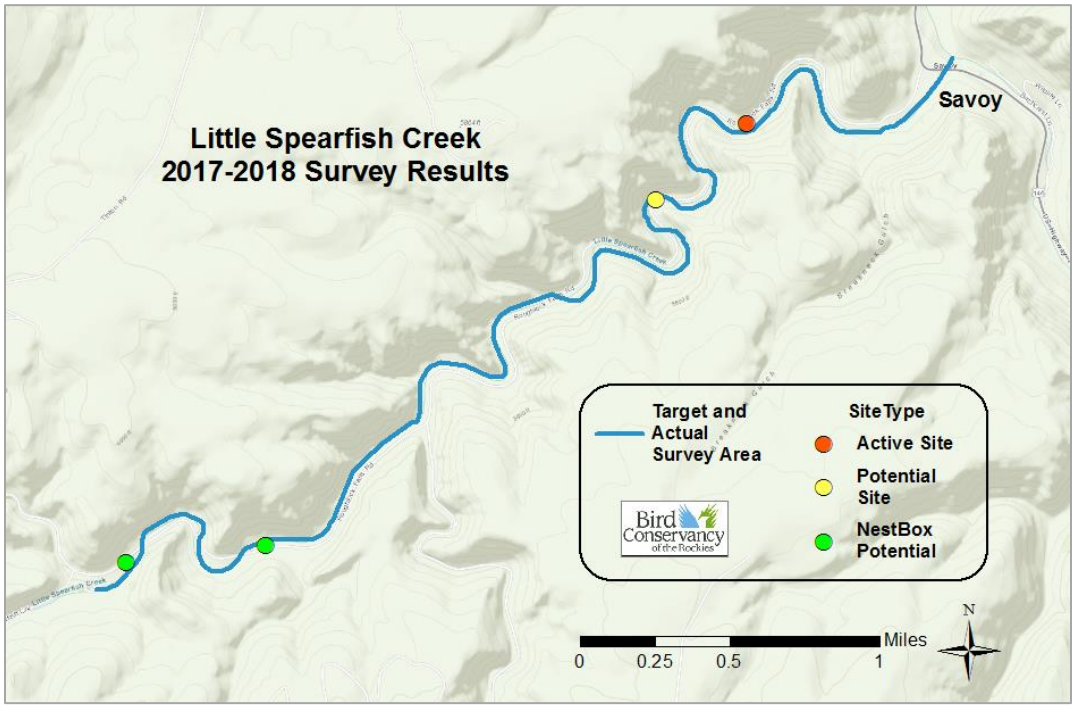

Figure 17. Map of Little Spearfish Creek survey area
Historical sites are not marked

East Spearfish Creek. The entire 4-mile length of East Spearfish (Hanna) Creek from Cheyenne Crossing to Long Draw Road is a popular trout fishery (Fig. 18). The water is clear and fast-flowing, fed by springs, seeps and runoff, with a couple of beaver ponds. It is bordered by a road with multiple bridges leading to homes and cabins. Many of these bridges have nest boxes. Figure 18 indicates sites with nest boxes that were empty as potential sites.

Although the creek is quite narrow, it historically has had one or two active dipper territories (Lovett 2010, Drilling 2018). In 2017 there were two pairs and in 2018, one pair. During this project dippers struggled to successfully fledge young, with each pair making at least two nesting attempts. The Hanna Campground pair was never successful; their first attempt failed just after Memorial Day when the campground opened and the area was flooded with anglers. Apart from this instance, dippers seem accustomed to people and it is not clear why nests on this creek were failing.

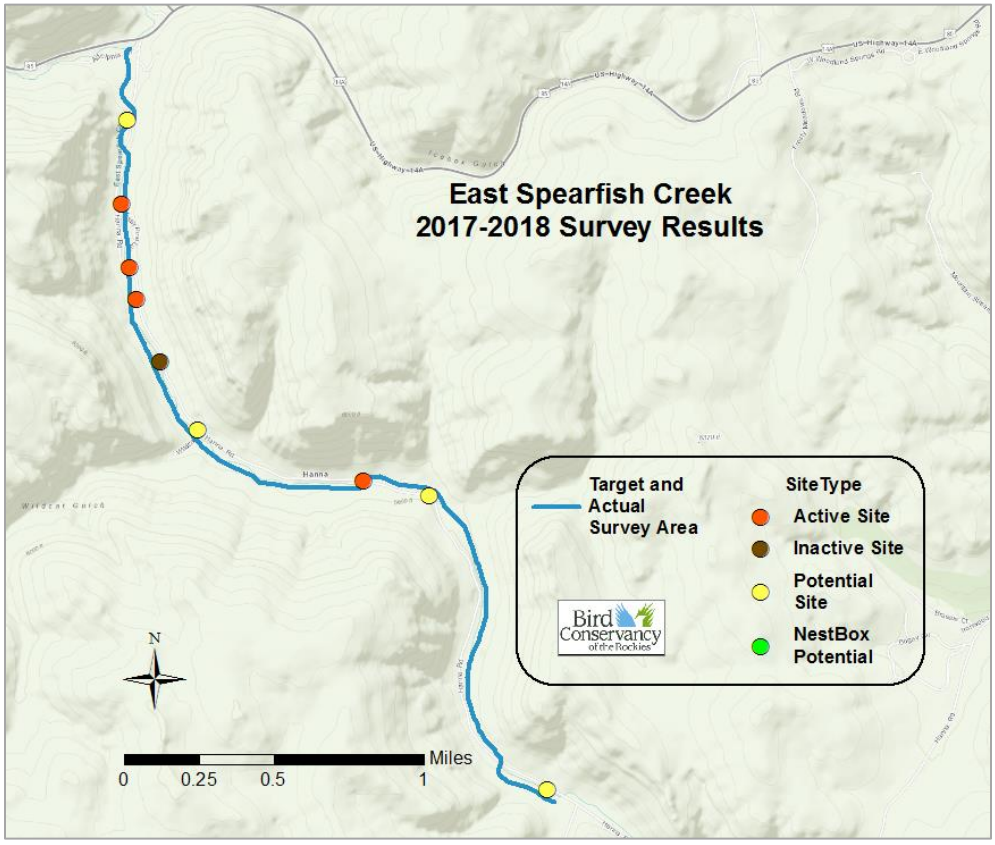

Figure 18. Map of East Spearfish Creek survey area
Historical Sites are not marked.

Whitewood Creek. The 15 miles of Whitewood Creek (Englewood to Sandy Creek) can be split into three different reaches (Figs. 19, 20). The section upstream (south) of Homestake/Lead city limits is typical headwater stream – relatively narrow and shallow with a cobble bottom and decent flow of clear water. Habitat is mixed spruce-pine-deciduous riparian vegetation and upland Ponderosa Pine grasslands; most of this stretch is grazed. There are almost no buildings along this reach and the Mickelson Trail follows the creek. We did not find any sign of dippers or nests during this survey. In 2011, old nests were on railroad pilings at the junction with Yellow Creek Road; this is marked as a potential site on the current map. The Mickelson Trail wooden bridge crossings provide several opportunities for nest boxes.

The urban section runs from Lead to Boulder Canyon Road just north of Deadwood. This section has had considerable restoration efforts since the 1990's when it was a 'dead' creek because of effluents from Homestake mine. Currently it runs fairly quickly over a cobble bed. During dry periods, the water is clear. But during rain events or snow melt, water rushes into the creek from streets and drains, causing dramatic water surges and emitting very turbid, trash-filled water. In several places, the creek has been channelized, or at least corralled, between cement walls. Despite the issues, there is a trout fishery in this reach and two dipper pairs. One natural rock outcropping, at Pluma trailhead, saw successful nesting during this study and in the historical record, but Lovett (2010) did not report nests. The remainder of the nest sites are nest boxes erected under bridges or in bridge drainage pipes. The Unknown site is at the Deadwood Intake, where the water enters a tunnel built under downtown. We heard birds singing from within the tunnel, and this is the likely nest site for the central Deadwood brood, but there is no way to get into or see into the tunnel to be certain. Lovett reported more pairs and nests in this reach than we found during this study because more nest boxes were up in the 2000s. Time, vandalism, and high water have destroyed these boxes and we recommend that new boxes be erected. Despite fewer nests, the nests that did occur were highly successful at producing chicks. Three of the four successful nests fledged four chicks; a number we documented only once on Spearfish Creek.

The downstream section from the Whitewood Creek-Boulder Canyon Rd junction to Sandy Creek is generally clear water with good flow. During extreme runoff events, some of Deadwood's turbidity and much of its trash is evident in this section. Habitat primarily is mixed spruce-deciduous riparian areas with upland Ponderosa Pine. There are two railroad bridges at the south end of this section that dippers use for nesting; all other sites are natural cliffs and rock outcrops. We documented one to two dipper pairs utilizing the first two miles of this reach, as was also the case during Lovett's study.

A one-mile stretch of the final eastern section surveyed on Whitewood Creek is jumbles of huge boulders with several drops, constituting a class V+ whitewater rafting section. As was the case in the early 2000s survey, this rugged area appears to be very important to Whitewood Creek dippers. We found two active nests and two potential sites here. In addition to nest sites, we found from one to seven dippers using the area during late summer visits. The area is inaccessible except when water levels are very low and the creek can be safely waded. It is also private property and requires access permission. We found the easternmost nests near Sandy Creek after the nesting season was over and could not be sure if they were used recently.

The main concern for Whitewood Creek dippers is the continuing legacy of toxins in creek sediments (Hamilton and Buhl 2000), as well as chemicals (salt, engine oil, etc.) and trash in runoff from city streets.

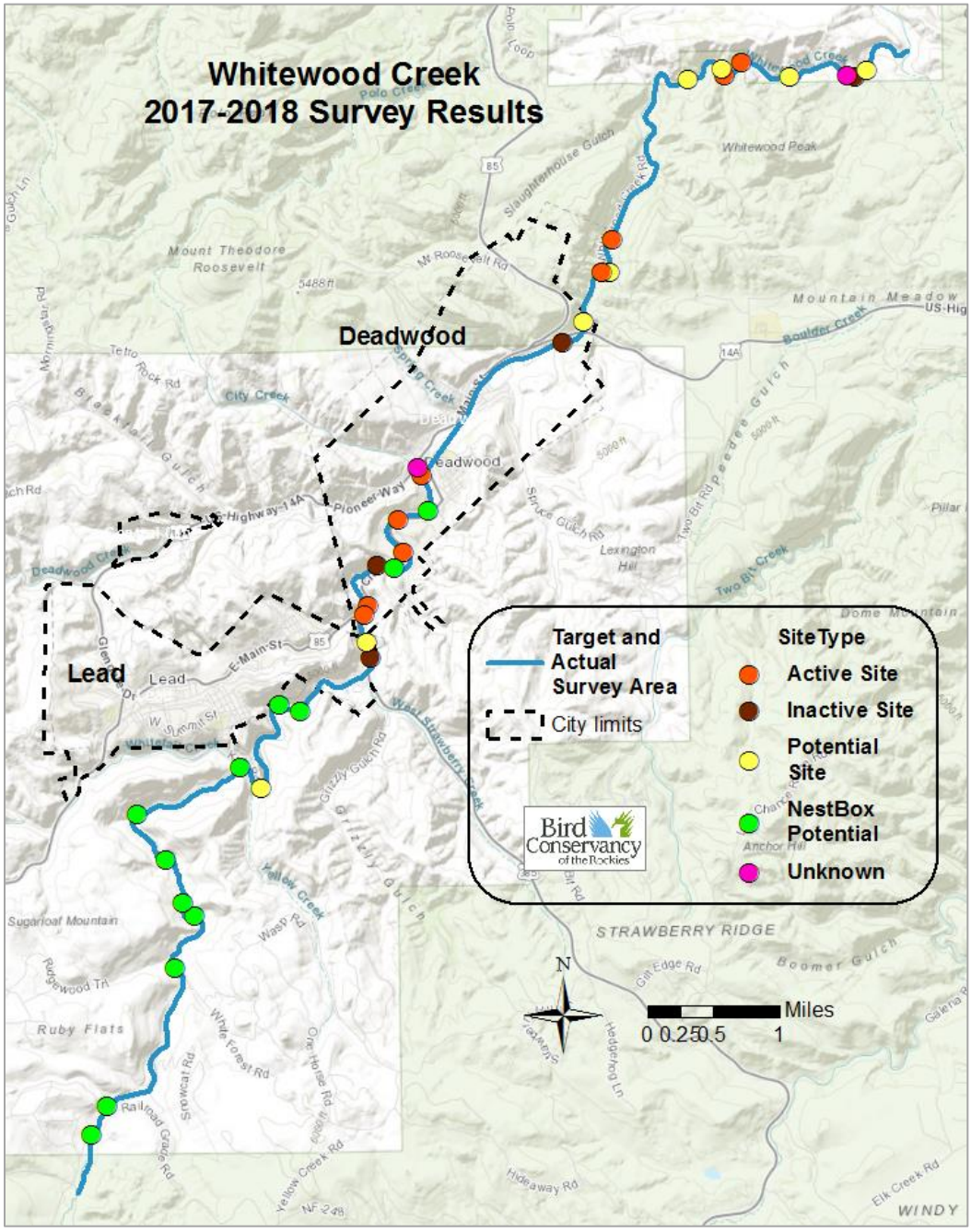

Figure 19. Map of Whitewood Creek survey area

Figure 20. Photos of downstream Whitewood Creek area

Photos by Nancy Drilling

Pine Creek. In July 2018, a report of a dipper sighting west of Keystone at Camp Judson, near the junction of Pine Creek and Battle Creek, appeared on eBird. The observer did not know whether the bird was a juvenile or adult. We surveyed Pine Creek between Horse Thief Lake and Battle Creek in late summer and fall 2018 (Figs. 21, 22). Sections of the creek flow through narrow rock canyons, past tall boulders and cliffs, and through jumbles of large boulders. We did not locate any birds or nests. We identified nine potential natural nest sites and one potential site for erecting 'box-on-pole' type of nest boxes. During periods of moderate to high runoff, such as occurred in summer 2018, water flow is very swift and would be suitable for dippers. However it is less certain whether water flow would be adequate during low water periods, especially with Horse Thief Lake dam upstream.

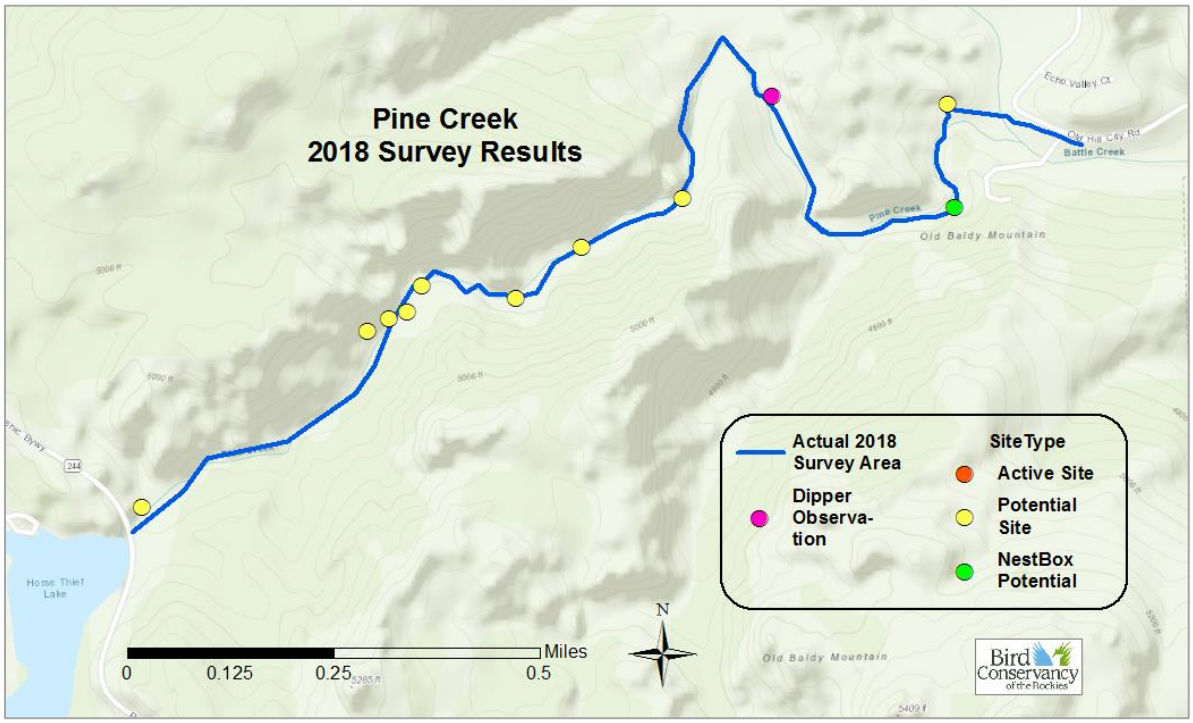

Figure 21. Map of Pine Creek survey area

Figure 22. Photos of Pine Creek
Photos by Nancy Drilling

Nesting

Nest Sites

Overall, 45 sites (see Table 1 for site definitions) had an active nest in at least one year of the study; an additional two sites on the east end of the Whitewood Creek survey area possibly were active during this study (Appendix A, Table 3). We documented 35 active sites in 2017 and 36 active sites in 2018; each active site was occupied by one breeding pair of dippers. Most active sites were along Spearfish Creek (58%) with an additional 20% of the active sites located within the larger Spearfish Creek drainage, including Iron, Cleopatra (Squaw), East Spearfish and Little Spearfish creeks.

Dippers nested behind waterfalls (7% of active sites), on cliff faces and boulders (33%), on infrastructure such as bridge girders, water intake structures and tunnels (20%), and in nest boxes (40%) (Fig. 23). In relation to availability, dippers used 60% of all nest boxes, nesting in almost three-quarters (74%) of Spearfish Creek nest boxes (Fig. 24).

Table 3. Number of active sites and nest attempts of American Dippers in 2017-2018. Multiple nest attempts at a site included renesting after nest failures and second nests.

Creek	Number Active Sites	Total Number Nest Attempts
Spearfish	26	72
Whitewood	9	14
Iron	4	7
East Spearfish	3	6
Little Spearfish	1	3
Cleopatra (Squaw)	1	2
Rapid	1	2
TOTAL	**45**	**106**

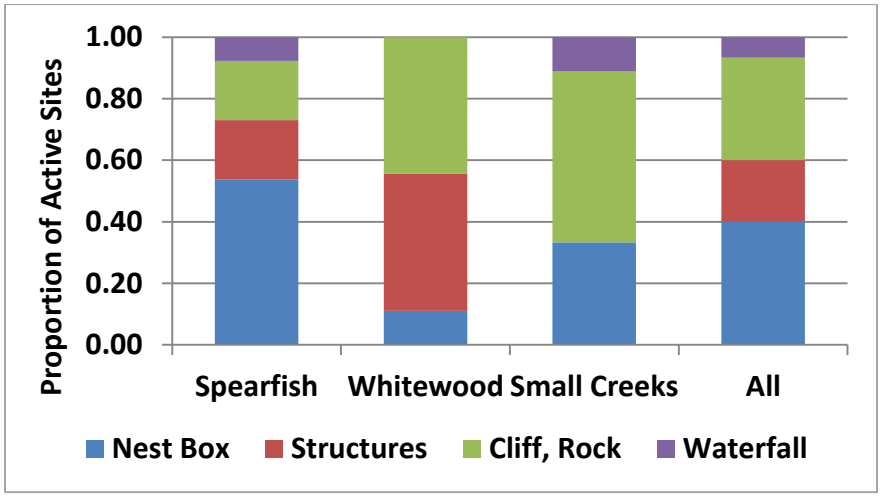

Figure 23. Nest substrates at active sites
Small creeks include East Spearfish, Little Spearfish, Cleopatra, and Iron

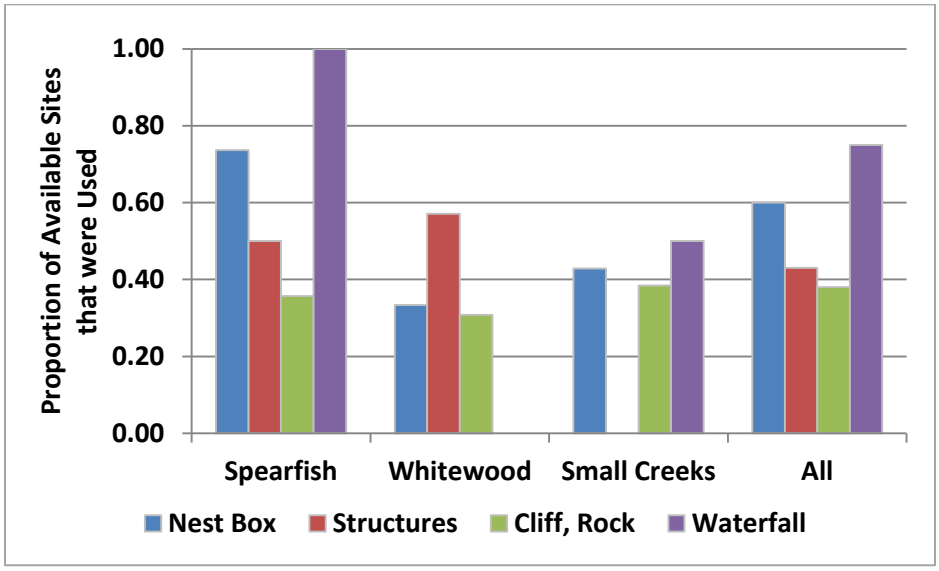

Figure 24. Substrates used for nesting versus availability
Small creeks include East Spearfish, Little Spearfish, Cleopatra, and Iron

Overall, 69% of active sites had at least one successful nest during the two-year study period but this varied among creeks (Fig. 25). Whitewood Creek had the highest proportion of active sites that successfully produced fledglings while collectively, small creeks had the lowest.

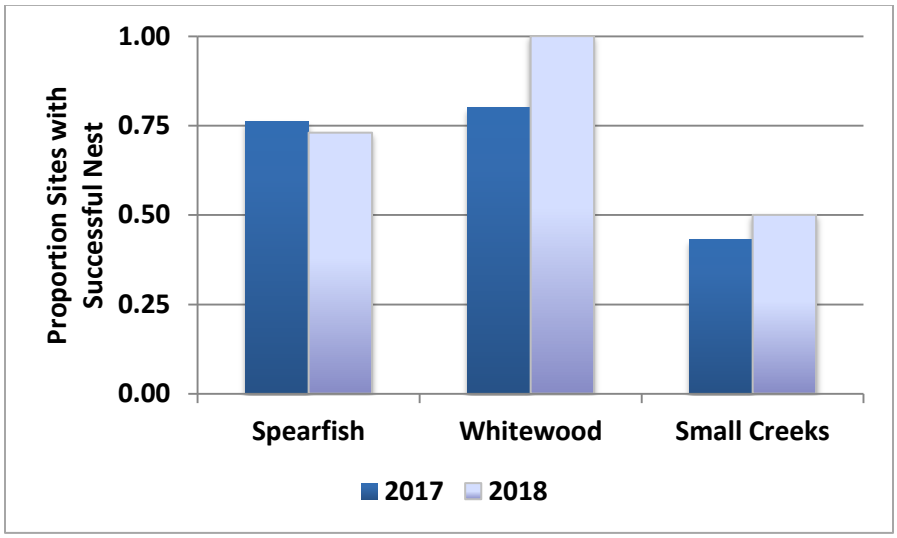

Figure 25. Variation among Black Hills creeks in site nest success
Small creeks include Iron, Cleopatra, East Spearfish and Little Spearfish.

Over the two years of this study, almost one-third of all active sites did not have any successful nests, while less than 5% had four successful nests (Fig. 26). All of the sites with four successful nests occurred downstream (north) of Savoy on Spearfish Creek (Fig. 27).

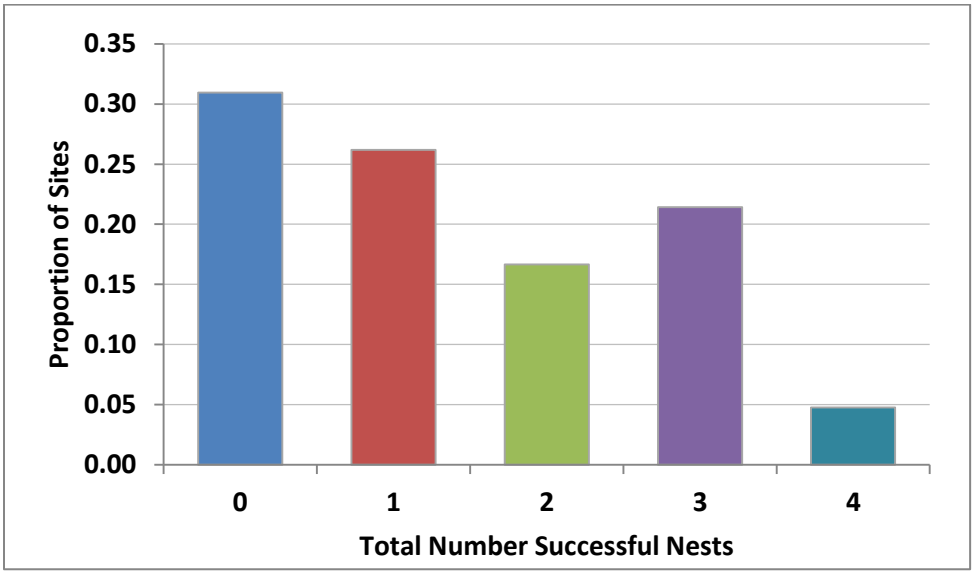

Figure 26. Frequency distribution of total number of successful nests at sites in 2017-2018.

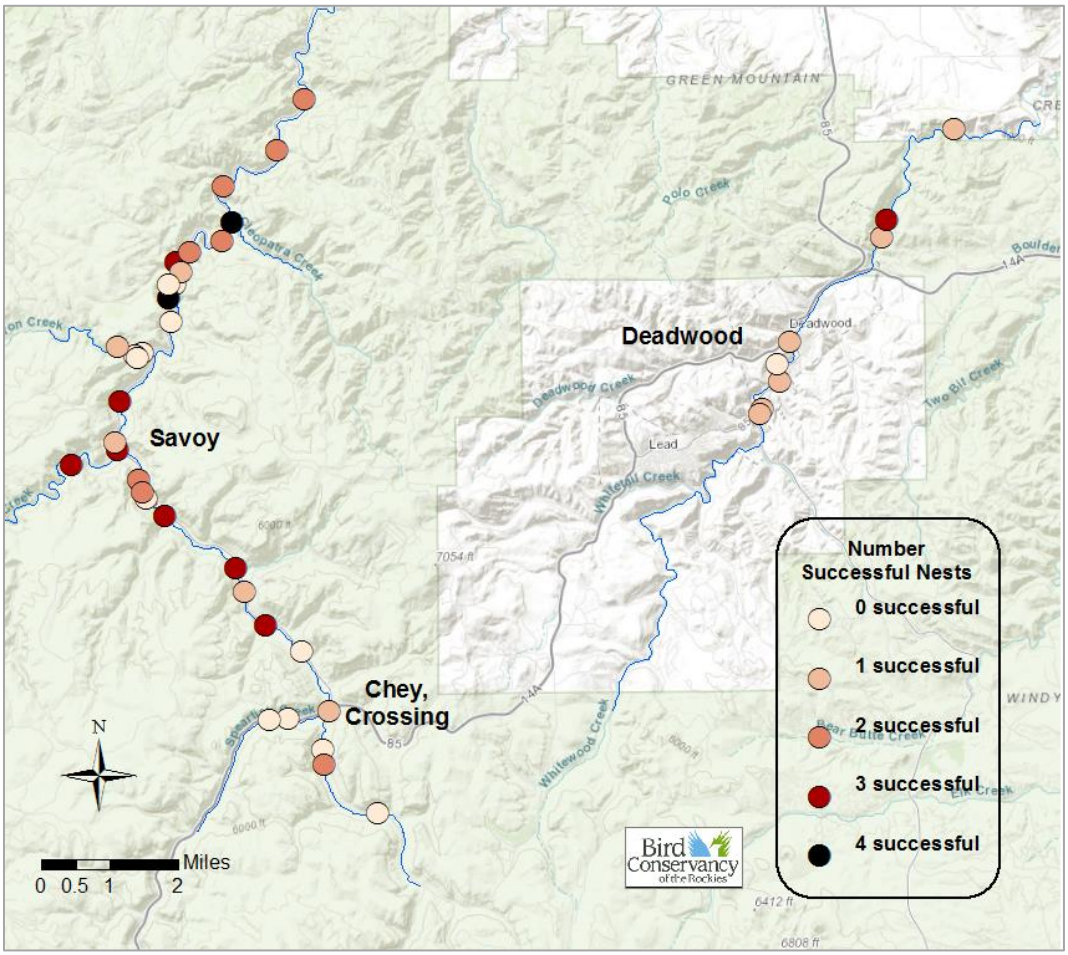

Figure 27. Map of total number of successful nests in 2017-2018 per site

Nest Attempts

During the 2017-2018 breeding seasons, the probability of a nest fledging at least one young was 0.62 (95% CI=0.52-0.73) (Appendices A, B). The probability of a nest surviving through the egg-laying and incubation stage was 0.36 (95% CI=0.25-0.54) while survival probability during the nestling stage was 0.71 (95% CI=0.58-0.86).

Early season nests, those begun before the median nest start date (5/3/2017, 4/25/2018), had a higher probability (0.61) of fledging at least one young compared to late season nests (0.50). Nests on the smaller creeks had lower probability of nest success (0.52) compared to those on the larger creeks (Spearfish 0.64, Whitewood 0.61). Nests in 2017 had a lower probability of nest success (0.57) compared to 2018 (0.65). Nest success probabilities were lower in nest boxes compared to nests on bridge ledges and natural (waterfalls, cliffs, boulder) sites (Fig. 28).

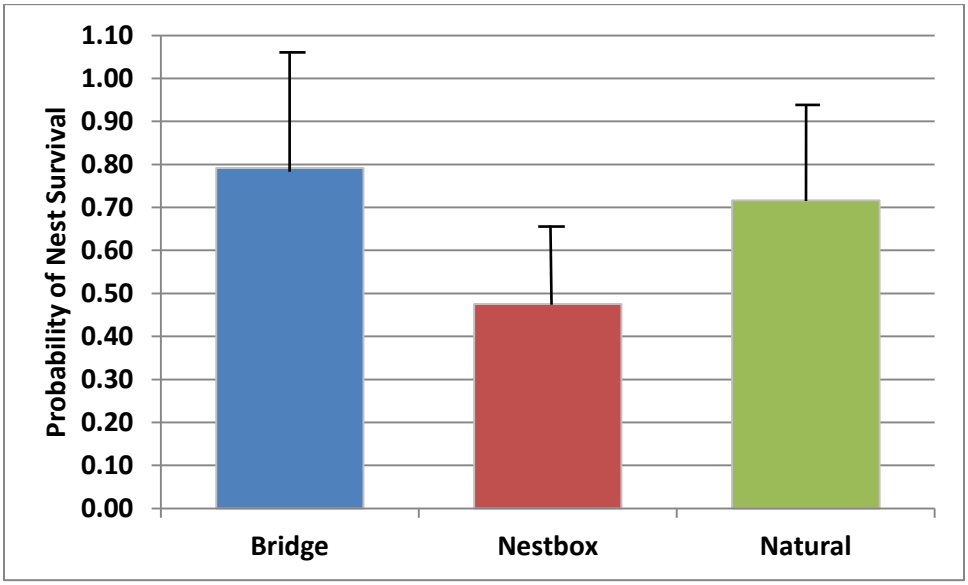

Figure 28. Probability of nest success (Ŝ) by nest substrate.
Error bars show 95% upper confidence intervals

In 2017, the breeding season began earlier than in 2018 (Fig. 29). One quarter of all successful nests in 2017 fledged in early May, giving 18 pairs enough time to attempt a second nest. Nine of these pairs successfully raised a second nest, most of which fledged in late June and early July. An additional three pairs started later and did not have time to attempt a second nest. Ice-out occurred much later in 2018 and thus the first broods fledged two to three weeks later, in mid-May to mid-June. Twelve pairs in 2018 attempted a second nest after a successful first attempt; five successfully raised a second brood. Another seven pairs did not have time to attempt a second nest after raising their first brood.

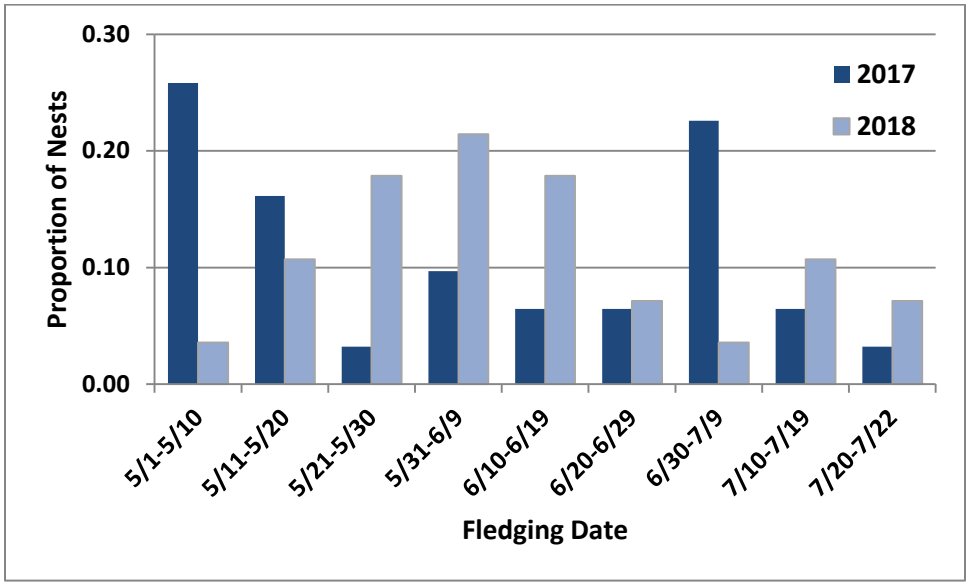

Figure 29. Distribution of fledging dates in successful nests

Most nests were inaccessible and difficult to see into and so we usually were not able to determine number of eggs or nestlings. However we were able to observe contents of six nests with a GoPro camera mounted on a pole. Clutches in these nests had 4, 4, 5, 5, 5, and 6 eggs (average 4.8 eggs).

Number of fledglings also was hard to ascertain. Young dippers leave the nest at different times and the parents split the brood; one parent takes the first fledglings while the second parent takes the rest in the opposite direction. With these caveats in mind, we recorded an average of 1.8 fledglings (range 1-4 fledglings) from 41 successful nests (Appendix A).

In 37 of 42 cases, cause of nest failure could not be identified. Of these, 13 failed during nest-building, 11 failed with eggs in the nest, 11 failed with chicks in the nest, and nest stage was unknown in two failures.

In five cases, we knew the reason for the failure. In a rare case of miscalculation, one pair built a nest on a cliff shelf that received a steady stream of water from above during rains. This caused the nest roof to collapse. The very small nestlings sat on top and were fed by the adults for a few days but died of exposure in the wet cold weather. This was the only weather-related failure that we observed. Unlike Lovett (2010), we did not observe any nests destroyed by floods. In two cases we were able to reach into the nest and discovered clutches that were abandoned although the reasons for the abandonments were unknown. Another failure occurred when the landowners removed the bridge under which a pair were nesting. Finally, one nest built on top of a mid-stream boulder was found ripped to shreds, by either another dipper or a predator.

We also observed four cases where the nest disappeared or was in the water. This may have been caused by the nest weakening and falling, excessive movements by the adults causing the nest to fall, human disturbance, a predator, destruction by a rival dipper, or a combination of these factors.

Banding

We captured 27 adults (22 after-second year, four second year, one unknown age), seven fledglings less than one week out of the nest, and three juveniles older than one week out of the nest (Appendix C). Adult females on average were smaller than adult males but measurements of the two sexes overlapped (Table 4). As expected, young fledglings were smaller than adults. Older juveniles, which probably were 4 – 8 weeks out of the nest, were similar in size to adults.

Table 4. Summary of measurements of American Dippers captured 2017 – 2018 in the Black Hills

	Aver. Weight (g) (range)	**Aver. Tail Length (mm) (range)**	**Aver. Wing Chord (mm) (range)**	***n***
Adult	51.6 (43.8 - 61.4)	46.5[1] (39-54)	88.1[1] (80-97)	27
Female	48.0 (43.8 - 53.5)	43.7 (39-47)	84.1 (80-91)	14
Male	55.8 (45.8 - 61.4)	49.5[1] (39-54)	92.7[1] (82-97)	13
Fledgling < 1 week out of nest	41.0 (32.2-49.7)	38.4 (35-41)	79.9 (77-83)	7
Juvenile > 1 week out of nest	54.9 (49.6 - 60.1)	43.3 (33-52)	86 (82-89)	3

[1] Excludes measurements of one male captured during heavy flight feather molt

Bird Resightings

Of 34 dippers banded in 2017, 21 (18 banded as adults, 2 as juveniles, 1 as a fledgling) were resighted in 2018 (Appendix D). Of the 2017 dippers banded as adults, 13 of 17 females and 9 of 11 males were resighted in 2018. All of these were resighted at a nest. Of the adults, six females and eight males nested at the same nest site in both years (Appendix E). In addition, one juvenile female nested at the same spot she was captured (Bridal Veil Falls).

One male (WHC02617M), captured in late summer below Whitewood Falls, was next resighted in June 2018 when he successfully usurped the male at the Slaty Cliff nest, more than 2 miles away. He destroyed the existing nest but one nestling about 3 weeks old survived and eventually fledged. Other researchers also have seen usurpation attempts and nest destruction by dippers (Lovett 2010, Willson and Kingery 2011).

Three females also switched nest sites between 2017 and 2018. One female (WHC01117F) moved about 100m, from Pluma Trailhead to the Black Hills power station bridge in Deadwood, and likely was still on her same territory. Another female (SQC00617F), banded at the 2017 Upper Devil's Bathtub nest, moved down to the Cleopatra bridge in 2018, about 1 mile away. Her 2017 mate was never resighted in 2018 and a pair of unbanded birds nested at the Bathtub in 2018. The third female to switch sites was the 2017 Central Deadwood female (WHC02117F). In 2018 she nested about three miles downstream under a railroad bridge on Whitewood Creek Road. Her mate was unbanded in both nesting attempts so it is not known if she switched mates.

Of the seven dippers banded as fledglings in 2017, one (WHC00617J2), a female that hatched from the Slaty Cliff nest, was resighted in 2018. She nested successfully at the Super8 bridge in Deadwood, about 3 miles upstream of her natal nest.

Color-banding allowed us to observe one probable case of polygyny. The Pluma Trailhead male on Whitewood Creek was seen with females at two different nests and no other males were ever seen. He likely was the male at both of those nests, even though he was never seen feeding nestlings or fledglings at either nest.

We received three reports of unbanded birds in unusual locations during this study. In June 2017, a juvenile dipper was photographed at Black Fox campground on upper Rapid Creek (Fig. 30). In August of 2017, a juvenile dipper was seen at D.C. Booth Fish Hatchery in central Spearfish. The third dipper, of unknown age, was seen at Camp Judson west of Keystone/Mount Rushmore in July 2018.

Figure 30. Photos of Black Fox juvenile dipper
Photos by Dan Horton

Discussion

Breeding Distribution of American Dippers in the Black Hills

This study shows that the distribution of American Dippers in the Black Hills has not changed since the previous surveys conducted in the late 1990s and early 2000s (Draeger and Johnson 2001, Lovett 2010). Most dippers are in the Spearfish Creek watershed (including side creeks feeding into Spearfish Creek) and along Whitewood Creek. One pair persists in the Thunderhead Falls area of Rapid Creek. This site was not occupied during the earlier surveys but local residents say that the birds have been in the area for several years. As with most of these earlier surveys, we did not find any dippers or nests in French, Box Elder, Bear Butte, or Elk creeks, sites with historical dipper records.

American Dippers require permanent, fast-moving, clear, unpolluted streams with cobble or gravel substrates that provide their main food – aquatic invertebrates. (Willson and Kingery 2011). Aquatic invertebrate abundance is the primary driver of dipper distribution. Although dippers will consume many types of benthic aquatic insects, they prefer the larger more conspicuous types, such as caddisflies and stoneflies, most of which are found in highest abundance in clear, well-oxygenated, unpolluted water (Feck and Hall 2004). Because of local

geology and topography, most streams in the Black Hills do not meet dipper requirements. Black Hills streams originate from a central core and increase in width and flows from ground-water seepage as they flow north and east outwards to the surrounding plains. Many creeks lose most or all of their surface water when they cross the 'Loss Zone', the Madison and Minnelusa sedimentary formations that encircle the central core (Hortness and Driscoll 2004). Thus, substantial sections of Elk, French, Box Elder, Bear Butte, and Spearfish creeks are naturally dry or experience low and intermittent flows. These creeks, with the exception of Spearfish, also have upstream 'losing sections' in which the creek bed is above the water table and not fed by groundwater. Finally, these creeks, again with the exception of Spearfish Creek, have a relatively low gradient so that what water does occur is flowing too slowly to flush out fine sediments. Dippers' preferred prey do not live in these types of conditions.

In addition to natural geological and topographical factors, human activities and land management practices have further altered water flows and water quality. Froiland (1990) notes that one of the most significant changes in water conditions in the past hundred plus years has been the reduction in water flow. The largest single factor causing the reduction is increased forest cover due to curtailment of forest fires and management for timber harvest (Brown and Sieg 1996). A relatively closed canopy cover prevents moisture from reaching the water table. Water tables, and thus stream flows, also have been lowered by the large number of houses and communities that have drilled wells into the aquifers. Stockade Lake and Pactola Reservoir have affected water flows in French and Rapid Creek respectively. Mining activities, stream degradation from livestock grazing, introduction of invasive species, and runoff from roads and urban areas all reduce water quality, and thus invertebrate abundance, in local areas.

All of these changes since the late 1800s likely explain why dippers no longer occur at most historical sites. These negative factors will continue to occur and prevent dippers from recolonizing historical sites as well as possibly affect their future distribution. In addition, climate change is predicted to be an additional stressor on the Black Hills dipper population (Stamm et al. 2015).

Population Size and Reproductive Success

The number and distribution of active nest sites found during this study was very similar to the number studied by Lovett from 2004 to 2009 (Lovett 2010). During this study, we documented 34 active sites in the Spearfish Creek watershed, including Iron, East Spearfish and Little Spearfish creeks; Lovett documented 35 sites. On Whitewood Creek, we had seven active sites in Deadwood and along Whitewood Creek Road; Lovett had nine. In addition, every active site that we found on these creeks and creek sections was also active during Lovett's study. Thus, there appears to be little change in the number or distribution of breeding pairs compared to 10 years ago. In this study, we monitored nests over a larger area than did Lovett, including at Devil's Bathtub, downstream of Whitewood Creek Road on Whitewood Creek, and Thunderhead Falls. As these areas all have historical records of past nesting, they likely do not represent a new expansion of dippers since the mid-2000s.

With a minimum of 35 (2017) to 36 (2018) active nest sites, the Black Hills breeding population currently is at least 70 adults. Lovett counted 57 - 66 breeding adults during her study in the mid-2000s. Palmer and Javed (2014) modeled population demographics and estimated long-term trends for the Black Hills dipper population. Their trend estimates had a large degree of uncertainty, ranging from a best case scenario of a 1% annual population increase to a worst case scenario of a 4% annual decline. The results of this study suggest that the worst case scenario has not occurred over the past 8 years but rather, the number of breeding adults appears to be stable.

Dippers have a limited number of options for suitable nest sites within the Black Hills. Given this, our finding that almost one-third of all active sites did not successfully produce any young during two breeding seasons is concerning. It may be that these sites are poor quality in some way, the dippers at these sites were more inexperienced, or a combination of these factors.

Almost all other studies of dippers in other locations report higher nest success rates, generally ranging from 69 – 92% (Willson and Kingery 2011), than those found in this study. Only a high-elevation population in British Columbia had rates as low as those of the Black Hills (Morrissey 2004). In many populations, flooding is a major cause of nest failure. This did not occur during the present study and only rarely during Lovett's Black Hills study. Predation rarely occurs in dipper nests and was not confirmed to happen in either Lovett's or the current study. Probability of nest success was lower on the smaller side creeks and later in the season, possibly because of low water levels, which in turn may negatively affect food supply. More study is needed to determine the relationships among water levels, food supply and reproductive success.

Palmer and Javed's (2014) calculations, based on Lovett's research, suggested that the Black Hills dipper population has a lower reproductive rate, in terms of number of young produced per female, than do other dipper populations. We found that in the small proportion of nests that we were able to access, clutch sizes (average 4.8 eggs) were well within the typical clutch size of four to five eggs. If these nests were representative of all nests, then number of eggs laid is not driving the low reproductive rate in the Black Hills population. In the current study, the average observed fledgling to clutch size ratio (1.8 fledglings:4.8 eggs or 37.5%) is lower than that found in other populations (47-69%, Willson and Kingery 2011). This suggests that brood reduction, which usually reflects food limitation, occurs in this population.

In some dipper populations, lack of suitable nest sites is a major limiting factor (Willson and Kingery 2011). The irony in the Black Hills is that surveyed creeks without dippers, including Elk, Bear Butte, Box Elder, and French Creeks, have more natural nest sites than do creeks with nesting dippers. The problem on these creeks is water quality and low flows, not nest site availability. Spearfish and Whitewood Creeks have relatively few natural nest sites and nest boxes have helped maintain their populations. Nesting dipper numbers exploded on Spearfish Creek after nest boxes were erected in the late 1990s (Backlund 2009). Nest boxes in Deadwood also have increased the number of nesting birds (Lovett 2010). However, dippers have never used any of the 10 – 15 nest boxes on lower Rapid Creek and a handful of boxes on French and Bear Butte Creek. Nest boxes are a needed conservation tool for the Black Hills population because of the lack of suitable nest sites on occupied creeks, but only on those waterways that provide all of the other habitat features required by dippers. In addition, managers must be aware that nest boxes are not a panacea for the Black Hills population because the probability of nest success is lower in nest boxes.

Summary and Recommendations

This study shows that the current distribution and population size of breeding American Dippers in the Black Hills is essentially unchanged from those in the mid-2000s. Both Spearfish and Whitewood creeks still have breeding populations and appear to meet the first Recovery Goal as outlined by the state. However we did not find evidence of a breeding population in a third watershed, and thus this population does not yet meet the second Recovery Goal. As a result, the American Dipper should not be considered for removal from the state's Endangered and Threatened Species list.

The topography and geology of Black Hills creeks will not change in the short term so there will always be limited suitable area for dippers. On potentially suitable stretches, various threats (urbanization, climate change, invasive species, toxic waste, land-use, dams, and wells) will further reduce the amount of suitable habitat. We need a better understanding of the mechanisms of how each of these threats impact dippers. Lower Rapid Creek appears to be the most promising candidate for dipper expansion but for unknown reasons, dippers have not permanently established themselves there. Study is needed to understand why this is the case.

Besides limited suitable habitat, the Black Hills dipper population has relatively low reproductive success, restricting its ability to increase. Understanding the causes of nest failure and low reproductive success is critical to ensure the long-term presence of the species in the state. Some evidence suggests that low food availability may be a contributing cause but this needs study. Winter mortality is a major factor in most dipper populations (Willson and Kennedy 2011). High winter mortality has been inferred in the Black Hills (Backlund 2009) but further study on this and other mortality rates, such as among fledglings, is needed.

We encourage continued annual monitoring of site use and nest success to track population trends. In addition, a cohort of 34 dippers was banded in 2017. Resightings of these birds will provide vital information for survival analyses, documentation of movements, and longevity. A centralized location for storing resighting data would help future analyses.

Despite low nest success in nest boxes, a robust nest box program is vital to the Black Hills dipper population because of the lack natural nest sites on occupied creeks. This project catalogued all existing nest boxes and identified new sites that may be suitable nest box sites. In 2019, the South Dakota Ornithologists' Union initiated a nest box program with the goal of erecting 60 boxes on Spearfish, Whitewood, and Rapid creeks. A commitment needs to be made to maintain and replace nest boxes over the long-term to ensure continued success of the program.

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Appendix A. Nest Records

Creek	Site Name	Year	Season	Nest Num	Num Eggs	Max # Chicks Seen	Num Fledgling seen	Estim. End Date	Outcome
ESC	Beginning Hanna CG	2017	early	1	U	---	---	5/28/17	Failed with chicks
ESC	Beginning Hanna CG	2017	late	2	5	---	---	7/9/17	Failed with eggs-abandoned
EsC	Lower Mossy Pine Lp	2018	early	1	5	---	---	4/27/18	Failed with eggs-abandoned
ESC	Upper Mossy Pine Lp	2017	late	1	U	4	2	7/3/17	Definitely Fledged
EsC	Upper Mossy Pine Lp	2018	late	1	U	---	---	5/26/18	Failed with eggs
EsC	Upper Mossy Pine Lp	2018	late	2	U	4	0	7/15/18	Probably Fledged
IrC	2nd (short) cliff	2017	early	1	---	---	---	5/15/17	Failed during nest-building
IrC	First Cliff	2017	early	1	U	---	---	5/2/17	Failed with eggs
IrC	First Cliff	2017	late	2	---	---	---	5/17/17	Failed during nest-building
IrC	First Cliff	2018	early	1	U	---	---	5/23/18	Failed with chicks
IrC	First Cliff	2018	late	2	---	---	---	6/19/21	Failed during nest-building
IrC	Long cliff	2018	late	1	U	3	2	6/27/18	Definitely Fledged
IrC	Tall smooth rock	2017	early	1	---	---	---	5/21/17	Failed during nest-building
LSC	Roughlock Falls	2017	early	1	U	---	0	5/9/17	Probably Fledged
LSC	Roughlock Falls	2017	late	2	U	3	1	7/12/17	Definitely Fledged
LsC	Roughlock Falls	2018	late	1	U	---	0	6/13/18	Probably Fledged
RaC	Thunderhead Falls	2017	early	1	---	---	---	U	Failed during nest-building
RaC	Thunderhead Falls	2018		1	U	---	---	U	Unknown outcome
SpC	#21213	2017	early	1	U	3	0	5/2/17	Probably Fledged
SpC	#21213	2017	late	2	U	---	---	6/21/17	Failed with chicks
SpC	#21213	2018	early	1	U	4	3	5/15/18	Definitely Fledged
SpC	#21213	2018	late	2	4	3	1	7/12/18	Definitely Fledged
SpC	#21420 Hwy 85S	2017	early	1	U	---	---	4/29/17	Failed with eggs
SpC	#21432/36 Hwy 85S	2017	early	1	---	---	---	5/14/17	Failed during nest-building
SpC	Big Rock	2017	early	1	U	3	1	5/11/17	Definitely Fledged
SpC	Big Rock	2017	late	2	U	2	1	7/3/17	Definitely Fledged
SpC	Big Rock	2018	early	1	U	3	1	6/2/18	Definitely Fledged
SpC	Big Rock	2018	late	2	U	3	1	7/22/18	Definitely Fledged
SpC	Birchcrest Lane	2017	early	1	U	3	2	5/14/17	Definitely Fledged
SpC	Birchcrest Lane	2017	late	2	U	2	---	6/20/17	Failed with chicks

Creek	Site Name	Year	Season	Nest Num	Num Eggs	Max # Chicks Seen	Num Fledgling seen	Estim. End Date	Outcome
SpC	Birchcrest Lane	2018	early	1	6	2	1	5/29/18	Definitely Fledged
SpC	Birchcrest Lane	2018	late	2	U	---	---	6/23/18	Failed with eggs
SpC	Box on pole	2017	early	1	U	>1	0	5/1/17	Probably Fledged
SpC	Box on pole	2018	early	1	U	---	0	5/23/18	Probably Fledged
SpC	Bridal Veil Falls	2017	early	1	U	3	1	6/6/17	Definitely Fledged
SpC	Bridal Veil Falls	2017	late	2	---	---	---	6/23/17	Failed during nest-building
SpC	Bridal Veil Falls	2018	late	1	U	4	4	6/10/18	Definitely Fledged
SpC	Bridal Veil Falls	2018	late	2	---	---	---	6/19/18	Failed during nest-building
SpC	Calamity Gulch Ln	2017	early	1	U	4	0	5/6/17	Probably Fledged
SpC	Calamity Gulch Ln	2017	late	2	U	4	3	7/6/17	Definitely Fledged
SpC	Calamity Gulch Ln	2018	early	1	U	---	---	4/17/18	Failed with chicks-human cause (bridge taken down)
SpC	Calamity Gulch Ln	2018	late	2	U	3	1	6/16/18	Definitely Fledged
SpC	Chey. Crossing	2017	early	1	U	3	1	5/11/17	Definitely Fledged
SpC	Chey. Crossing	2017	late	2	U	---	---	U	Failed, unknown nest stage
SpC	Chey. Crossing	2018	early	1	U	---	---	U	Failed with eggs
SpC	Chey. Crossing	2018	early	2	U	---	---	5/18/18	Failed with eggs
SpC	Chey. Crossing	2018	late	3	U	---	---	5/26/18	Failed, unknown nest stage
SpC	Cleopatra Place	2017	early	1	U	4	0	5/1/17	Probably Fledged
SpC	Cleopatra Place	2017	late	2	U	3	2	6/29/17	Definitely Fledged
SpC	Cleopatra Place	2018	early	1	U	4	3	6/2/18	Definitely Fledged
SpC	Cleopatra Place	2018	late	2	U	3	0	7/20/18	Probably Fledged
SpC	Coyote Lane	2017	early	1	U	2	1	5/13/17	Definitely Fledged
SpC	Coyote Lane	2017	late	2	U	---	0	7/3/17	Probably Fledged
SpC	Coyote Lane	2018	early	1	4	---	2	6/8/18	Definitely Fledged
SpC	Dwnstrm Spearfish Falls	2018	early	1	U	5	0	5/29/18	Probably Fledged
SpC	Dwnstrm Spearfish Falls	2018	late	2	U	---	---	6/23/18	Failed with eggs
SpC	Elmore	2017	early	1	U	---	3	5/7/17	Definitely Fledged
SpC	Elmore	2017	late	2	U	2	2	7/7/17	Definitely Fledged
SpC	Elmore	2018	early	1	U	4	0	5/18/18	Probably Fledged
SpC	Fire #69 (21341)	2018	early	1	---	---	---	4/25/18	Failed during nest-building
SpC	Hydro Electric #2	2018	early	1	U	1	1	5/13/18	Definitely Fledged
SpC	Hydro Electric #2	2018	late	2	U	3	0	6/30/18	Probably Fledged

Creek	Site Name	Year	Season	Nest Num	Num Eggs	Max # Chicks Seen	Num Fledgling seen	Estim. End Date	Outcome
SpC	Large rock	2017	late	1	U	3	0	6/17/17	Probably Fledged
SpC	Large rock	2018	early	1	U	---	---	4/27/18	Failed with eggs
SpC	Long Valley Ln	2018	late	1	---	---	---	5/24/18	Failed during nest-building
SpC	Maurice Intake	2018	early	1	U	---	1	6/2/18	Definitely Fledged
SpC	Maurice Intake	2018	late	2	U	---	0	7/16/18	Probably Fledged
SpC	Midstream boulder	2017	early	1	U	---	---	5/9/17	Failed with eggs-nest destroyed
SpC	Rimrock Pl	2017	early	1	U	3	2	5/7/17	Definitely Fledged
SpC	Rimrock Pl	2017	late	2	U	2	---	6/21/17	Failed with chicks
SpC	Rimrock Pl	2017	late	3	---	---	---	7/9/17	Failed during nest-building
SpC	Rimrock Pl	2018	early	1	U	4	2	5/9/18	Definitely Fledged
SpC	Rimrock Pl	2018	late	2	5	3	---	6/27/18	Probably Fledged
SpC	small rectangular	2017	late	1	U	---	---	5/31/17	Failed during nest-building
SpC	Spearfish Falls	2017	early	1	U	---	2	5/12/17	Definitely Fledged
SpC	Spearfish Falls	2017	late	2	U	---	3	7/5/17	Definitely Fledged
SpC	Spearfish Falls	2018	early	1	U	3	2	5/29/18	Definitely Fledged
SpC	Spillway bridge	2017	late	1	U	---	---	5/29/17	Failed with eggs
SpC	Spillway bridge	2017	late	2	U	2	---	7/1/17	Failed with chicks
SpC	Spillway bridge	2018	late	1	U	---	---	6/23/18	Failed with chicks
SpC	Twin Rock	2017	early	1	U	2	0	5/2/17	Probably Fledged
SpC	Twin Rock	2017	late	2	U	---	1	6/25/17	Definitely Fledged
SpC	Twin Rock	2018	late	1	U	---	0	6/19/18	Probably Fledged
SpC	Victoria Ln	2017	early	1	U	---	2	6/1/17	Definitely Fledged
SpC	Victoria Ln	2017	late	2	---	---	---	6/19/17	Failed during nest-building
SpC	Victoria Ln	2018	early	1	U	---	1	5/21/18	Definitely Fledged
SpC	Victoria Ln	2018	late	2	U	---	---	6/19/18	Failed with chicks
SpC	Wide/gated bridge	2017	late	1	U	1	1	7/1/17	Definitely Fledged
SpC	Wide/gated bridge	2018	early	1	U	---	---	5/12/18	Failed with chicks
SpC	Wide/gated bridge	2018	late	2	U	---	---	6/23/18	Failed with eggs, nest disappears
SqC	Upper Devil's Bathtub	2017	late	1	U	3	0	7/20/17	Probably Fledged
SqC	Upper Devil's Bathtub	2018	late	1	U	---	---	U	Unknown outcome
WhC	2nd RR bridge	2018	early	1	U	5	1	5/31/18	Definitely Fledged
WhC	BH Power Stn bridge	2018	early	1	U	4	4	6/8/18	Definitely Fledged

Creek	Site Name	Year	Season	Nest Num	Num Eggs	Max # Chicks Seen	Num Fledgling seen	Estim. End Date	Outcome
WhC	Claim Jumper's bridge	2017	early	1	U	---	---	4/23/17	Failed with chicks
WhC	East low bank	2017		1	U	---	---	0	Probably Fledged
WhC	East low bank	2018		1	U	---	---	U	Unknown outcome
WhC	Limestone Cutbank	2017		1	U	---	---	U	Unknown outcome
WhC	Limestone Cutbank	2018		1	U	---	---	U	Unknown outcome
WhC	Long limestone bank	2018		1	U	---	---	U	Unknown outcome
WhC	Parking Garage wall	2017	late	1	U	---	1	6/15/17	Definitely Fledged
WhC	Pluma TH	2017	early	1	U	4	4	5/19/17	Definitely Fledged
WhC	Pluma TH	2017	late	2	U	---	---	5/25/17	Failed with eggs, nest disappears
WhC	Pluma TH	2017	late	3	U	2	---	6/27/17	Failed with chicks
WhC	Slaty Cliff	2017	early	1	U	3	2	6/7/17	Definitely Fledged
WhC	Slaty Cliff	2017	late	2	U	---	3	7/16/17	Definitely Fledged
WhC	Slaty Cliff	2018	early	1	U	2	---	5/3/18	Failed with chicks-weather
WhC	Slaty Cliff	2018	late	2	U	3	1	6/22/18	Definitely Fledged
WhC	Super8 bridge	2018	late	1	U	2	1	6/17/18	Definitely Fledged

Appendix B. Mayfield Estimates of Nest Success

Daily nest survival rates (DSR) and probabilities of fledgling at least one young (Ŝ) for American Dippers during the 2017-2018 breeding seasons in the Black Hills. Analyses do not include nests that failed during nest-building. Egg-laying and incubation stages were combined for the Nest Stage analysis. For the Nest Substrate analyses, bridge nests were on bridge ledges, while natural substrates included waterfalls, cliffs, rock outcroppings, and mid-stream boulders.

		Number of Nests			Daily Survival Rate (DSR)				Nest Survival Rate (Ŝ)		
		Failed	Successful	Exposure Days	DSR	Variance	95% LCI	95% UCI	Ŝ	95% LCI	95% UCI
All Nests		29	59	2539	0.989	4.45E-06	0.984	0.993	0.62	0.518	0.735
Nest Stage	Egg-laying & Incubation	25	43	1054	0.976	2.2E-05	0.967	0.985	0.36	0.245	0.541
	Nestling	12	59	1448	0.992	5.68E-06	0.987	0.996	0.71	0.578	0.859
Year	2017	14	30	1048	0.987	1.26E-05	0.980	0.994	0.57	0.442	0.763
	2018	15	29	1491	0.990	6.68E-06	0.985	0.995	0.65	0.527	0.810
Season	Early	18	41	1563	0.988	7.28E-06	0.983	0.994	0.61	0.491	0.769
	Late	16	18	976	0.984	1.65E-05	0.976	0.992	0.50	0.355	0.701
Creek	Spearfish	19	45	1813	0.990	5.72E-06	0.985	0.994	0.64	0.526	0.784
	Whitewood	4	7	337	0.988	3.48E-05	0.977	1.000	0.61	0.369	0.987
	Small creeks	6	7	389	0.985	3.9E-05	0.972	0.997	0.52	0.308	0.875
Nest Substrate	Bridge	3	14	541	0.994	1.02E-05	0.988	1.001	0.79	0.607	1.030
	Nestbox	19	23	1083	0.982	1.59E-05	0.975	0.990	0.48	0.340	0.663
	Natural	7	22	885	0.992	8.87E-06	0.986	0.998	0.72	0.559	0.917

Appendix C. Banding Data

Banding data for American Dippers captured in the Black Hills during 2017-2018. Creek codes: ESC=East Spearfish Creek; IRC=Iron Creek; SPC=Spearfish Creek; SQC=Cleopatra (Squaw) Creek; WHC=Whitewood Creek. Sex codes: F=female; M=male; U=unknown. Colorband Combinations show colors of Right leg: upper/lower bands and Left leg: upper/lower bands. Colors: B=black; L=lime green; O=orange; R=red; W=white; Y=yellow; X=metal USGS band

Creek	Capture Site	Capture Date	Bird ID	Age	Sex	Weight (g)	Wing (mm)	Tail (mm)	Colorband Combo	Notes
ESC	Beginning Hanna CG	7/9/2017	ESC00317F	Adult	F	45.8	83	43	R: O/W L: B/X	
ESC	Up. Mossy Pine Lp	6/13/2017	ESC00217M	Adult	M	61.4	93	50	R: Y/L L: B/X	
ESC	Up. Mossy Pine Lp	7/9/2017	ESC00217F	Adult	F	44.1	80	43	R: B/X L: O/L	
ESC	Up. Mossy Pine Lp	7/9/2017	ESC00217J	Fledgling	U	49.7	81	36	R: R/X L: O/W	Fledgling of Upper Mossy Ln nest
IRC	Long Cliff	5/25/2018	IRC00318M	Adult	M	58.1	92	52	R: X/Y L: L/L	
IRC	Long Cliff	5/25/2018	IRC00318F	Adult	F	53.5	81	45	R: W/O L: O/X	
SPC	Big Rock	6/9/2017	SPC02317M	Adult	M	54.6	92	51	R: O/X L: R/W	
SPC	Big Rock	6/28/2017	SPC02317F	Adult	F	46.4	85	47	R: L/L L: X/Y	
SPC	Birchcrest Lane	6/6/2017	SPC00117F	Adult	F	46.7	86	40	R: Y/W L: X/W	
SPC	Bridal Veil Falls	7/10/2017	SPC00317M	Adult	M	55.2	91	52	R: Y/O L: R/X	
SPC	Bridal Veil Falls	7/10/2017	SPC00317J2	Juvenile	F	49.6	89	45	R: L/L L: B/X	
SPC	Cleopatra Place	6/9/2017	SPC00417F	Adult	F	46.3	82	44	R: X/O L: O/B	
SPC	Cleopatra Place	6/9/2017	SPC00417M	Adult	M	53.6	96	49	R: R/X L: L/Y	
SPC	Coyote Lane	6/9/2017	SPC01617M	Adult	M	57.9	95	54	R: W/X L: B/B	
SPC	Coyote Lane	6/9/2017	SPC01617F	Adult	F	48.7	84	46	R: X/L L: O/R	
SPC	Elmore	6/9/2017	SPC01117M	Adult	M	56.9	91	50	R: X/R L: O/O	
SPC	Elmore	6/9/2017	SPC01117F	Adult	F	52.3	81	44	R: W/W L: Y/X	
SPC	Maurice Intake	5/25/2018	SPC03218M	Adult	M	45.8	82	42	R: X/R L: O/R	
SPC	Rimrock Place	6/6/2017	SPC00217M	Adult	M		94	39	R: X/R L: W/B	
SPC	Rimrock Place	6/6/2017	SPC00217F	Adult	F	48.3	91	39	R: R/L L: X/B	
SPC	Wide/gated bridge	6/30/2017	SPC01217F	Adult	F	52.0	89	44	R: B/W L: X/B	
SQC	Up. Devil's BT	6/29/2017	SQC00617M	Adult	M	58.7	97	53	R: Y/X L: L/W	
SQC	Up. Devil's BT	7/9/2017	SQC00617F	Adult	F	47.1	84	43	R: X/B L: R/W	
WHC	Below Whitewd Falls	8/24/2017	WHC50517J1	Juvenile	U	60.1	87	52	R: B/L L: O/X	
WHC	Below Whitewd Falls	8/24/2017	WHC50517J2	Juvenile	U	55.1	82	33	R: R/X L: B/Y	

Creek	Capture Site	Capture Date	Bird ID	Age	Sex	Weight (g)	Wing (mm)	Tail (mm)	Colorband Combo	Notes
WHC	HardwHank/Deadwd TH bridge	6/22/2017	WHC01417F	Adult	F	43.8	82		R: W/W L: X/O	With 2 fledglings
WHC	HardwHank/Deadwd TH bridge	6/22/2017	WHC01417J1	Fledgling	U	43.3	83	39	R: X/L L: O/W	Fledgling of mid-Deadwood nest
WHC	HardwHank/Deadwd TH bridge	6/22/2017	WHC01417J2	Fledgling	U	41.9	77	35	R: Y/R L: X/Y	Fledgling of mid-Deadwood nest
WHC	Limestone Cutbank	8/24/2017	WHC02617M	Adult	M	57.4	77	35	R: W/Y L: X/L	
WHC	Pluma TH	6/13/2017	WHC01117M	Adult	M	58.7	94	52	R: R/B L: O/X	
WHC	Pluma TH	6/22/2017	WHC01117F	Adult	F	50.0	86	44	R: W/L L: X/O	
WHC	Slaty Cliff	6/8/2017	WHC00617M	Adult	M	50.8	95	50	R: X/B L: Y/R	
WHC	Slaty Cliff	6/8/2017	WHC00617J1	Fledgling	U	42.6	79	41	R: R/O L: L/X	Fledgling of 1st Slaty Cliff nest
WHC	Slaty Cliff	6/8/2017	WHC00617J2	Fledgling	F	35.7	77	37	R: X/O L: L/Y	Fledgling of 1st Slaty Cliff nest
WHC	Slaty Cliff	7/11/2017	WHC00617F	Adult	F	46.8	84	46	R: B/R L: O/X	
WHC	Slaty Cliff	7/20/2017	WHC00617J3	Fledgling	U	41.9	80	40	R: R/X L: Y/L	Fledgling of 2nd Slaty Cliff nest
WHC	Slaty Cliff	7/20/2017	WHC00617J4	Fledgling	U	32.2	82	41	R: W/X L: W/B	Fledgling of 2nd Slaty Cliff nest

Appendix D. Resightings of Banded Birds

Locations and dates of first capture and subsequent resightings of banded American Dippers in the Black Hills during 2017-2018. Birds seen repeatedly at a nest were not recorded; only the first sighting at its nest is listed in this table. Colorband Combinations show colors of Right leg: upper/lower bands and Left leg: upper/lower bands. Colors: B=black; L=lime green; O=orange; R=red; W=white; Y=yellow; X=metal USGS band

Bird ID	Colorband Combo	Date	Observation Site	Observation Type	Notes
ESC00217F	R: B/X L: O/L	7/9/2017	Upper Mossy Pine Lp	1st Capture	Never resighted
ESC00217J	R: R/X L: O/W	7/9/2017	Upper Mossy Pine Lp	1st Capture	Never resighted
ESC00217M	R: Y/L L: B/X	6/13/2017	Upper Mossy Pine Lp	1st Capture	Never resighted
ESC00317F	R: O/W L: B/X	7/9/2017	Beginning Hanna CG	1st Capture	Never resighted
IRC00318F	R: W/O L: O/X	5/25/2018	Long Cliff nest	1st Capture	
		8/16/2018	Iron Creek	Visual	
IRC00318M	R: X/Y L: L/L	5/25/2018	Long Cliff nest	1st Capture	
		6/29/2018	Tall smooth rock	Visual	Forage, with 1 fledgling
		12/8/2018	Iron Creek	Visual	
SPC00117F	R: Y/W L: X/W	6/6/2017	Birchcrest Ln nest	1st Capture	
		4/12/2018	Birchcrest Ln nest	Visual	Building nest
SPC00217F	R: R/L L: X/B	6/6/2017	Rimrock Pl nest	1st Capture	
		1/19/2018	Just upstrm of Rimrock	Visual	Forage
		3/14/2018	Rimrock Pl nest	Visual	Forage, Gather nest material
SPC00217M	R: X/R L: W/B	6/6/2017	Rimrock Pl nest	1st Capture	
		6/25/2017	Rimrock Pl nest	Visual	Roosting by nestbox
		7/10/2017	Bridal Veil Falls	Recapture	
		1/19/2018	Downstrm botany bay	Visual	Forage
		3/14/2018	Rimrock Pl nest	Visual	Forage,Rest
SPC00317M	R: Y/O L: R/X	7/10/2017	Bridal Veil Falls	1st Capture	
		1/19/2018	Downstream Bridal Veil Falls	Visual	Sing,Forage
		3/30/2018	Downstream Bridal Veil Falls	Visual	Social
		1/13/2019	Bridal Veil Falls nest	Visual	Forage, with female
SPC00317J2	R: L/L L: B/X	7/10/2017	Bridal Veil Falls	1st Capture	
		1/19/2018	Downstream Bridal Veil Falls	Visual	Forage, with male
		3/30/2018	Downstream Bridal Veil Falls	Visual	Social

Bird ID	Colorband Combo	Date	Observation Site	Observation Type	Notes
		4/10/2018	Downstream Bridal Veil Falls	Visual	Roosting
		1/13/2019	Bridal Veil Falls nest	Visual	Forage, with male
SPC00417F	R: X/O L: O/B	6/9/2017	Cleopatra Place nest	1st Capture	Never resighted after season
SPC00417M	R: R/X L: L/Y	6/9/2017	Cleopatra Place nest	1st Capture	
		3/14/2018	Cleopatra Place	Visual	Rest
		3/30/2018	Cleopatra Place nest	Visual	Nest-building,Sing, with female
		1/10/2019	Cleopatra Place	Visual	
SPC01117F	R: W/W L: Y/X	6/9/2017	Elmore nest	1st Capture	
		4/29/2018	Elmore nest	Visual	At Nest,Feeding Chicks
SPC01117M	R: X/R L: O/O	6/9/2017	Elmore nest	1st Capture	
		11/20/2017	Wide/gated bridge	Visual	Forage
		4/4/2018	Elmore nest	Visual	Roosting under bridge
		4/18/2018	Elmore nest	Visual	Roosting under bridge
SPC01217F	R: B/W L: X/B	6/30/2017	Wide/gated bridge	1st Capture	Never resighted
SPC01617F	R: X/L L: O/R	6/9/2017	Coyote Lane nest	1st Capture	
		5/5/2018	Coyote Lane nest	Visual	Forage
SPC01617M	R: W/X L: B/B	6/9/2017	Coyote Lane nest	1st Capture	
		5/14/2018	Coyote Lane nest	Visual	Feeding nestlings
SPC02317F	R: L/L L: X/Y	6/28/2017	Big Rock nest	1st Capture	
		7/7/2017	Boulder by bend SC13	Visual	Rest
		3/14/2018	Big Rock nest	Visual	At_Nest, Roosting
		3/30/2018	Big Rock nest	Visual	Mating
		7/23/2018	Big Rock nest	Visual	Sing,Social,Enters nest
SPC02317M	R: O/X L: R/W	6/9/2017	Big Rock nest	1st Capture	
		3/30/2018	Big Rock nest	Visual	Mating,Rest
SPC03218M	R: X/R L: O/R	5/25/2018	Maurice Intake	1st Capture	Never resighted after season
SQC00617F	R: X/B L: R/W	7/9/2017	Upper Devil's Bathtub nest	1st Capture	
		3/30/2018	Cleopatra Place nest	Visual	Nest building, with male
		6/7/2018	upstream Cleopatra bridge	Visual	Feeding fledgling
SQC00617M	R: Y/X L: L/W	6/29/2017	Upper Devil's Bathtub nest	1st Capture	
		7/13/2017	downstream U. Devils BT	Visual	Forage
WHC00617F	R: B/R L: O/X	7/11/2017	Slaty cliff nest	1st Capture	
		7/26/2017	Slaty cliff	Visual	Forage, Feeding fledgling
		4/12/2018	Slaty cliff nest	Visual	Forage, with male

Bird ID	Colorband Combo	Date	Observation Site	Observation Type	Notes
WHC00617J1	R: R/O L: L/X	6/8/2017	Slaty cliff	1st Capture	Never resighted
WHC00617J2	R: X/O L: L/Y	6/8/2017	Slaty cliff nest	1st Capture	Fledgling
		3/14/2018	Pluma TH	Visual	Forage,Rest
		4/30/2018	HardwHank/Deadwd TH bridge	Visual	Forage
		6/4/2018	Super8 bridge nest	Visual	Feeding nestlings
		6/19/2018	Behind Super8	Visual	Forage, Feeding fledgling
WHC00617J3	R: R/X L: Y/L	7/20/2017	Slaty cliff nest	1st Capture	Fledgling
		8/24/2017	East low bank	Visual	Fly by
WHC00617J4	R: W/X L: W/B	7/20/2017	Slaty cliff nest	1st Capture	Fledgling
		7/26/2017	Slaty cliff	Visual	Forage, Fed by female
WHC00617M	R: X/B L: Y/R	6/8/2017	Slaty cliff nest	1st Capture	
		7/11/2017	Slaty cliff nest	Recapture	
		4/12/2018	Slaty cliff nest	Visual	Forage
WHC01117F	R: W/L L: X/O	6/22/2017	Pluma TH nest	1st Capture	
		7/8/2017	BH Power Stn bridge	Visual	Rest
		1/24/2018	Pluma TH	Visual	Interacting with male at nest
		3/20/2018	Pluma TH	Visual	Forage,Rest
		4/12/2018	BH Power Stn bridge nest	Visual	Sing
WHC01117M	R: R/B L: O/X	6/13/2017	Pluma TH	1st Capture	
		1/24/2018	Pluma TH	Visual	Interacting with female at nest
		4/30/2018	Claim Jumper metal bridge	Visual	Forage, with unbanded bird
		5/2/2018	BH Power Stn bridge nest	Visual	Sleeping under bridge in evening
WHC01417F	R: W/W L: X/O	6/22/2017	HardwHank/Deadwd TH bridge	1st Capture	
		1/24/2018	Timm Ln	Visual	Flush
		4/12/2018	2nd RR bridge nest	Visual	Rest,Forage
WHC01417J1	R: X/L L: O/W	6/22/2017	HardwHank/Deadwd TH bridge	1st Capture	Fledgling. Never resighted
WHC01417J2	R: Y/R L: X/Y	6/22/2017	HardwHank/Deadwd TH bridge	1st Capture	Fledgling. Never resighted
WHC02617M	R: W/Y L: X/L	8/24/2017	Limestone Cutbank	1st Capture	
		6/20/2018	Slaty cliff nest	Visual	Feeding nestling
		7/30/2018	Slaty cliff	Visual	Forage
WHC50517J1	R: B/L L: O/X	8/24/2017	Below Whitewood Falls	1st Capture	
		7/30/2018	Below Whitewood Falls	Visual	Forage,Rest
WHC50517J2	R: R/X L: B/Y	8/24/2017	Below Whitewood Falls	1st Capture	Never resighted

Appendix E. Banded Dipper Nesting Records

Nest records for each banded American Dipper during the 2017-2018 breeding seasons. Note that 2017 birds were not banded until mid-season and most likely had already nested, which is not reflected in this table. Creek codes: ESC=East Spearfish Creek; IRC=Iron Creek; SPC=Spearfish Creek; SQC=Cleopatra (Squaw) Creek; WHC=Whitewood Creek.

Creek	Bird ID	Sex	2017 Nest 1	2017 Nest 2	2018 Nest 1	2018 Nest 2
ESC	ESC00317F	F	Beg. Hanna CG nest2			
ESC	ESC00217M	M	U. Mossy Pine nest 2			
ESC	ESC00217F	F	U. Mossy Pine nest 2			
IRC	IRC00318M	M			Long Cliff	
IRC	IRC00318F	F			Long Cliff	
SPC	SPC02317M	M	Big Rock nest2		Big Rock nest1	Big Rock nest2
SPC	SPC02317F	F	Big Rock nest2		Big Rock nest1	Big Rock nest2
SPC	SPC00117F	F	Birchcrest Ln nest2		Birchcrest nest1	Birchcrest nest2
SPC	SPC00317M	M			Bridal Veil nest1	Bridal Veil nest2
SPC	SPC00317J2	F			Bridal Veil nest1	Bridal Veil nest2
SPC	SPC00417F	F	Cleopatra nest2			
SPC	SPC00417M	M	Cleopatra nest2		Cleopatra nest1	Cleopatra nest2
SPC	SPC01617M	M	Coyote Ln nest2		Coyote Ln	
SPC	SPC01617F	F	Coyote Ln nest2		Coyote Ln	
SPC	SPC01117M	M	Elmore nest2		Elmore	
SPC	SPC01117F	F	Elmore nest2		Elmore	
SPC	SPC03218M	M			Maurice nest1	Maurice nest2
SPC	SPC00217M	M	Rimrock nest2	Rimrock nest3	Rimrock nest1	Rimrock nest2
SPC	SPC00217F	F	Rimrock nest2	Rimrock nest3	Rimrock nest1	Rimrock nest2
SPC	SPC01217F	F	Wide/gated			
SQC	SQC00617M	M	U. Devils Bathtub			
SQC	SQC00617F	F	U. Devils Bathtub		Cleopatra nest1	Cleopatra nest2
WHC	WHC01417F	F	C. Deadwood			
WHC	WHC01117M	M	Pluma nest2		BH Power stn[1] Super8 bridge[1]	
WHC	WHC01117F	F	Pluma nest2		BH Power stn	
WHC	WHC00617J2	F			Super8 bridge	

Creek	Bird ID	Sex	2017 Nest 1	2017 Nest 2	2018 Nest 1	2018 Nest 2
WHC	WHC00617M	M	Slaty Cliff nest1	Slaty Cliff nest2	Slaty Cliff nest1	Slaty Cliff nest2
WHC	WHC00617F	F	Slaty Cliff nest1	Slaty Cliff nest2	Slaty Cliff nest1	Slaty Cliff nest2
WHC	WHC02617M	M				Slaty Cliff nest2[2]

[1] Male was seen with females at two different nests and so is assumed to be the male at both of those nests. However he never was seen feeding nestlings or fledglings at either nest.

[2] This male usurped male WHC00617M and destroyed the active Slaty Cliff nest 2. However, one nestling survived and was occasionally fed by this usurping male until it fledged.