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# Conservation Assessment for the American Dipper in the Black Hills National Forest, South Dakota and Wyoming

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**Conservation Assessment**

**for the**

**American Dipper,**

**in the**

**Black Hills National Forest,**

**South Dakota and Wyoming**

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## EXECUTIVE SUMMARY

The Conservation Assessment for the American dipper (Cinclus mexicanus) contains a compilation of information on the biology of this bird and relevant management strategies to the population in the Black Hills National Forest. The American dipper is considered a threatened species in South Dakota. Only a small population is known in the Spearfish Canyon area of the Black Hills.

Dippers are an "aquatic songbird" and are dependent on clean, fast-moving streams with abundant aquatic insect prey. These birds do not migrate, although they do move up and down a particular stream as water freezes and thaws. These birds nest in cliffs, on rocks, or under bridges. In the Black Hills nesting takes place from April to July. Main causes of mortality and nest loss are starvation, winter stress, and spring flooding. These birds defend territories which contain feeding areas and nest sites.

Territorial behavior, availability of nest sites, and availability of food are likely limiting factors. Major risk factors for these birds are pollution and degradation of their streams. Activities such as timber harvesting along streams, overgrazing, mining, pollution, water regulation structures, and severe fires may negatively impact these birds.

More information is needed on the population size and distribution in the Black Hills in order to effectively manage these birds. Water quality on the streams they inhabit should also be carefully monitored, and habitat restoration may be necessary to restore dippers to streams they formerly occupied. Artificial nests are a feasible option for increasing populations because nest sites can be limiting factors.

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# INTRODUCTION

This document represents a compilation of the available information on the American dipper, Cinclus mexicanus. Since the purpose of this document is to provide information for managing dippers in the Black Hills National Forest, information focuses on Black Hills populations where possible. Few studies have been conducted on dippers in the Black Hills, so coverage of many topics draws primarily from information collected elsewhere. Information on the white-throated or European dipper is more plentiful and is used to supplement a few areas where specific information on the habits of the American dipper are lacking. (In these sections, specific notations indicate the information comes from the European dipper.)

The primary assumption of the document is that the biology of the dipper elsewhere accurately reflects the biology of the birds in the Black Hills. Since the population in the Black Hills is relatively small, large-scale dipper studies have not been conducted in this region. Therefore, it is essential that information from elsewhere is included. Where information on the European dipper is offered, it should be viewed as a hypothesis that the American species exhibits similar habits.

This document draws primarily on peer-reviewed scientific studies, often referred to as primary literature. For the purposes of this document, unpublished theses and dissertations are considered primary literature. The primary literature is supplemented with a few sources which would be considered secondary literature, or published documents that summarize other articles but are not necessarily peer-reviewed (including bird field guides, etc.).

The first section of the document explains the management status of the American dipper. Next, separate sections discuss the systematics, distribution, population size, movement patterns, habitat requirements, breeding biology, demography, community ecology, and diseases of this bird. Risk factors and responses to habitat change are discussed next. A summary section follows, which includes an envirogram (after Andrewartha and Birch 1984) depicting the important ecological factors affecting dippers. Management practices and survey and monitoring methods are discussed next. Following that, additional information needed for dipper management in the Black Hills National Forest is discussed. A glossary of definitions and an author biography follow the literature cited section at the end of the report.

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# CURRENT MANAGEMENT SITUATION

## Management Status

In South Dakota, the American Dipper is considered a state threatened species (South Dakota Department of Game Fish and Parks 2000). The Wyoming Bird Conservation Plan includes dippers on their Level II (Monitoring) list (Cerovski and others 2001). No special status is given to this species at the federal level. National Heritage ranks dippers in Utah and Arizona as vulnerable (S3) and in South Dakota and Alberta as imperiled (S2) (Association for Biodiversity Information 2001). Partners In Flight, which uses a combination of vulnerability measures to obtain conservation rankings, includes dippers in the Northern Rockies region (including most of Wyoming, western Montana, and northern Idaho) on its Tier I of high overall priority species with total assessment scores of 23 in the winter and 22 in the breeding season (Rocky Mountain Bird Observatory 2001). In the Badlands and Prairies Region (BCR 17), which includes the Black Hills, have a total assessment score of 20 in the winter and 19 during breeding season, but because of sparse data on population trends, is not given a priority ranking (Rocky Mountain Bird Observatory 2001)

## Existing Management Plans, Assessments, Or Conservation Strategies

The author of this assessment is not aware of any existing management plans, assessments, or conservation strategies that specifically address the American Dipper.

# REVIEW OF TECHNICAL KNOWLEDGE

## Systematics

The dipper is the "only truly aquatic songbird" (Osborn 1999). Five species of dippers are recognized in the family Cinclidae, and these are described here (Tyler and Ormerod 1994). The American dipper is found in western North America from Canada south through Mexico, and Central America. The common names of the other species describe the variation on the plain gray model illustrated by the American dipper. The white-throated dipper or European dipper, *Cinclus cinclus* is found in Europe, Britain, Northern Africa, Russia and China. *C. pallasii*, the brown dipper, lives in Japan and China. *C. leucocephalus*, the white-capped dipper, is found in the Andes Mountains. *C. schulzi*, the rufous-throated dipper, with its reddish throat and whiter wings, is found in a small area of southwestern Bolivia and northwestern Argentina.

The species found in the Black Hills is *C. mexicanus*, the American dipper. This species is larger than *C. leucocephalus*, but generally smaller than the other dipper species (Dunning 1993). American dippers are gray passerines (National Geographic Society 1987; Kingery 1996). Dippers heads are slightly brown (Ridgway 1904; Phillips and others 1964). White feathers on their eyelids create a flash of white when they do their characteristic blinking (Tyler and Ormerod 1994). They also display a characteristic bobbing motion of the entire body (Tyler and Ormerod 1994). The immature birds have a lighter colored breast and underbelly (National Geographic Society 1987). Ridgway (1904) indicates that in winter, some white may appear on the wing feathers. Mature birds of both sexes of the American dipper look the same (Sclater 1912), although the females are slightly smaller (Dunning 1993). The males average 61.0 g (range 57.0-66.0 g), while the females are 54.6 g on average (43.0 to 65.0 g) (Dunning 1993). A study in Alberta found the birds weighed between 48 and 67 g (Ealey 1977). The length is given as 14 to 20 cm long by Kingery (1996), 17.5 to 21.0 cm by Ealey (1977), and 19 cm by National Geographic Society (1987).

Various common names are used for dippers. In Europe, many colorful names exist including:

river pie, water thrush, water blackbird, and splash (Tyler and Ormerod 1994). The American dipper has been called: water ouzel (ousel), water thrush, and teeter-bird (Tyler and Ormerod 1994).

Within the American dipper species are five suggested subspecies: *C. m. unicolor* of western Canada and western United States, *C. m. mexicanus* of northern Mexico, *C. m. anthonyi* of southern Mexico and Guatemala, *C. m. dickermani* of southern Mexico, and *C. m. ardesiacus* of Costa Rica and Panama (Tyler and Ormerod 1994). These subspecies have varying darkness of coloration in adults, and varying amounts of white and mottled plumage on juveniles (Kingery 1996). The geographical boundaries of these subspecies do not always hold. For example, both *C. m. unicolor* and *C. m. mexicanus* have been found in Arizona (Blake 1942; Phillips and others 1964). No suggestions have been made that any subspecies other than *C. m. unicolor* resides in the Black Hills (Pettingill and Whitney 1965), however no efforts have been made to examine the taxonomic status of the dipper in the Black Hills.

Other relatives of dippers are disputed. At various times taxonomists have assumed their closest relatives to be wagtails (Family Motacillidae), wrens (Troglodytidae), thrushes (Turdidae), and accentors (Prunellidae) (Tyler and Ormerod 1994). Recent work with DNA hybridization indicates the dippers are definitely a distinct, monophyletic family, and that their closest relatives may be the mimic thrushes (Family Mimidae) (Sibley and Alquist 1990).

## Distribution And Abundance

### *Distribution Recognized In Primary Literature*

American dippers live on clear, cold, swift streams in the following areas: Alaska south to central California, Mexico south to Panama, and mountain ranges of the west (including the Cascade, Sierra Nevada, and Rocky Mountains) (Kingery 1996). Several patches of populations also exist in areas of southeastern Oregon, Nevada, Utah, Arizona, New Mexico, and South Dakota (Kingery 1996). Their range may be expanding in central Washington (Shook and others 1982).

It would seem logical that the distribution of these birds might be limited by temperature, since they need open water for foraging. However, overall range of American dippers was not correlated with temperature isotherms (Repasky 1991; Root 1998). Dipper physiology allows survival in very cold temperatures, so the cold, per se does not influence the dippers. For example, dippers have a very low critical temperature of 11.5°C (Murrish 1970b), and can keep their normal body temperature even when air temperatures of -30$^{o}$C (Kingery 1996). Cold air temperatures may limit foraging, but are not likely to directly kill individuals. Extreme summertime temperatures may be more of a problem, since temperatures above 36$^{o}$C may be fatal (Kingery 1996).

### *Additional Information From Federal, State, And Other Records*

Dippers were observed on Elk Creek by the Custer Expedition (Ludlow 1875). Pettingill and Whitney (1965) state that in the Black Hills, dippers are "Most numerous along Spearfish Creek in Spearfish Canyon, but a few occur along nearly all permanent, fast-flowing streams in the Black Hills…[and they are] frequently seen in winter at Cleghorn Springs Fish Hatchery." They list Roughlock Falls as a yearly nesting site in the area. Patton (1924) found four successful nests along a one-mile section of French Creek. Current distributions of dippers in the Black Hills is more limited. Recently these birds are only to be found in Spearfish Canyon and Rapid Creek watersheds and the intervening streams (South Dakota Ornithologists' Union 1991; Peterson 1995). Backlund (2001) summarizes rare recent sightings (since 1996) of dippers on Rapid Creek and Bear Butte Creek, but considers Spearfish Creek "the only stream in the Black Hills that is still capable of supporting a self-sustaining population of American dippers".

### *Estimates Of Local Abundance*

Christmas Bird Counts for Spearfish, South Dakota show two birds observed in four of the last five years (counts 97, 99, 100, 101) (Cornell Laboratory of Ornithology and National Audubon Society 2001; Tallman 2001a). Dippers were confirmed to be breeding in the area in April of 2000 (Palmer 2000). From 1949 to 1998, 4% of Christmas Counts in South Dakota contained dippers (Tallman 2001b), which may seem low, but is reasonable since these birds are only found in a small area of the state.

Several difficulties exist in trying to obtain an accurate population estimate. Breeding Bird Surveys are not the most informative method because the protocol includes only short listening periods, making it difficult to pick up dipper calls, and the routes usually do not follow streams closely enough to provide enough samples (Kingery 1996). Christmas Bird Counts rarely include very much dipper habitat (Kingery 1996). Winter counts can also be affected by variations in when and what portions of streams freeze (Kingery 1996).

In addition, the population size in a particular section of the creek varies with the season (Price 1975; Price and Bock 1983). These birds seem to be most dense in the fall movement period, at least in Colorado (Price 1975; Price and Bock 1983). For winter estimates, surveys should include feeding and roosting sites in order to determine distribution (Price 1975; Price and Bock 1983).

After informal observations found several dippers nesting in Spearfish Canyon in 1989 (Backlund 1989), a formal survey of the Spearfish Canyon area was designed. The formal spring survey, conducted in 1993, found dippers on Spearfish Creek, Iron Creek, Little Spearfish Creek, East Spearfish Creek, and Whitewood Creek (Backlund 1994). French Creek was surveyed, but no dippers were present. Seventeen individual birds were found in this survey and 10 active nest sites. The dipper monitoring effort along Spearfish Creek continues each year (Backlund 2001). Twenty-eight stops are made along Spearfish Creek where birds and nests are counted in April or May. In the 2001 survey, 28 adult dippers and 15 active nests were observed.

Panjabi (2001) was not able to obtain population or density estimates in the first year of his study monitoring the birds of the Black Hills, but he agreed with Backlund (2001) that the dipper in the Black Hills is "in need of immediate conservation measures".

## Population Trend

Breeding Bird Surveys show a significant decline from 1966 to 2000 in dippers in the Southern Rockies, but otherwise no significant trends (Sauer and others 2001). Christmas Bird Counts show significant increasing trends from 1959 to 1988 in Washington and Montana, but no significant trends are seen in British Columbia, California, Colorado, Oregon, Wyoming, or survey-wide due to the difficulties in finding these birds on these survey routes as explained above (Sauer and others 1996). Not enough data are available from Black Hills routes to determine trends (again because of difficulties discussed above). Breeding Bird Surveys and Christmas Bird Counts are not likely to reliably monitor population trends in dippers (Kingery 1996) for reasons explained above. However, the Rapid City CBC is located in an area that was traditionally dipper habitat. Small numbers of dippers (1 or 2) were recorded in 14 of the surveys between 1955 and 1985 (Sauer and others 1996). That count circle has not recorded any dippers since 1985 (Sauer and others 1996), which supports Backlund's claim (2001) that Rapid Creek is no longer home to dippers.

The Spearfish Canyon dipper monitoring route established by the South Dakota Department of Game, Fish and Parks showed that the population of dippers declined in 1996 and 1997 probably due to severe winters followed by spring flooding (Backlund 2001). After nest boxes were placed in the area, the birds increased in number and 2001 showed an all-time high (Backlund 2001).

## Broad Scale Movement Patterns

In general, American dippers are non-migratory residents. However, some seasonal movement follows freezing-up or thawing of waterways and often follows elevational gradients (Kingery 1996). In one study, the birds moved to non-frozen waters in the winter from November to March, and then moved upstream for breeding (Skinner 1922). In Montana, birds moved upstream in March when pairing began and moved downstream again in October (Bakus 1959a). In British Columbia, dippers were forced into areas that did not freeze (King and others 1973). In a Colorado study, the birds moved upstream after the chicks fledged, and then began to move down in elevation in August and September (Price 1975; Price and Bock 1983). Some wandering occurred in November and December to areas with open water (Price 1975; Price and Bock 1983).

Seasonal movement does not occur with all dippers, however. Individual birds with breeding territories that did not freeze were significantly more likely to remain on their territory in the winter (Price 1975; Price and Bock 1983). Adults in Montana only moved off territory due to molting, freeze-up, high-water levels (flooding), and mate replacement (Sullivan 1973).

Most adults (62 of 76) in a Colorado study disappeared (i.e. left the study area or were in seclusion) around June or July for about a month (Price 1975; Price and Bock 1983). They could also be moving for molting or due to a decrease in food; a significantly lower amount (measured as biomass) of aquatic insects was found in July samples than at other times of the year (Price and Bock 1983). In addition there was an elevational time lag in this movement with birds at lower elevations moving earlier than those at higher elevations. Adults and fledglings in Montana also left nesting areas within two weeks of fledging (Bakus 1959a). In Alberta, birds did not leave their territories to molt (Ealey 1977).

The literature is inconclusive about longer dipper movements. Many investigators state that dippers only move over water (Steiger 1940). However, Skinner (1922) observed one bird flying over land 0.25 miles between creeks. Other, much shorter, overland flights were observed by Bakus (1959b). Some birds move among nearby drainages. In a Colorado study, 10.4% were seen on multiple drainages (Price 1975; Price and Bock 1983). These birds showed much more movement than in other studies, perhaps because the Colorado habitat ices up more and it becomes a very patchy habitat which forces the birds to move (Price 1975; Price and Bock

1983). Price and Bock (1983) suggest that the birds may be flying higher than normal when they fly overland, so they may not always be noticed.

Some experts state that these birds are very unlikely to move between geographically separated areas (Tyler and Ormerod 1994). If this is the case, Black Hills dippers are quite isolated from any other populations, with the nearest dippers found in the Bighorn Mountains in Wyoming (Backlund 2001). However, banded individuals were found 55 km and 75 km away from initial locations in Colorado (Price and Bock 1983). Kingery (1996) reports birds in British Columbia and Alberta must migrate off their breeding territories to other drainages because the entire drainages freeze. He also suggests that inter-drainage migration may occur at night, which may explain why there are few reports of it occurring. Movement among areas is essential if the birds are to re-colonize habitats. Information on movement in the Black Hills is unknown.

Juveniles move much more than adults (Price and Bock 1983). However, juvenile movements are not well understood. The three-month post-fledgling period is quite active for this age group (Ealey 1977). Significantly more juveniles moved upstream than downstream in studies in Colorado (Price 1975; Price and Bock 1983) and Alberta (Ealey 1977). Juveniles were found up to a mile away from their nests (but within the same drainage) within a couple of weeks of leaving the nest (Hann 1950). An estimated 80% of juveniles leave their natal areas (Price 1975; Price and Bock 1983). Of the first-year birds, 15% were seen on more than one drainage (Price 1975; Price and Bock 1983). No significant differences were seen between adults and juveniles in between-drainage movements, but this may be biased because of the small number of juveniles seen after fledging (Price 1975; Price and Bock 1983).

Whether or not males and females differ in their overall movements or distances is unknown for this species. Ealey (1977) observed males arrived first at breeding territories.

## Habitat Characteristics

### *Foraging Habitat*

Dippers are usually found along clear, fast-flowing streams in areas with rocks, sand, and rubble bottoms (Kingery 1996). This rubble type of substrate is also associated with the highest levels of aquatic invertebrates (Pennak and van Gerpen 1947), the dippers' main food source.

A study of stomach contents during the breeding season found mainly Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies), with some Chironomidae (midges), Formicidae (ants), Hymenoptera (wasps and bees), and Diptera (flies) (Ealey 1977). Winter feeding includes Trichoptera, Plecoptera, Ephemeroptera, Diptera, and a few Coleoptera (beetles) (Mitchell 1968). Other studies of winter feeding indicate Chironomidae, Acari (mites and ticks), and Gastropoda (snails) also add to the diet (Thut 1970). The dippers show a significant preference for Trichoptera (Mitchell 1968; Ealey 1977). Nestlings are fed a much larger proportion of Ephemeroptera than adults consume in winter (Sullivan 1973). Fish are also consumed (Cordier 1927; Bakus 1959b; Mitchell 1968; Sullivan 1973; Young and Kratt 1981), and even salmon eggs (Bucham 1904; Ehinger 1930; Obermeyer and others 1999). Other rare prey include a spotted frog, *Rana pretiosa*, found in a dipper stomach in Montana (Sullivan 1973), a dragonfly (Odonata) (Kennedy 1950), and oligochaetes (worms) (Bakus 1959b). Presumably dippers along the coasts, such as those reported by Hayward and Thoreson (1980), feed on marine invertebrates in much the same way as the European dippers (Vader 1971).

Dippers utilize larger prey more often (Mitchell 1968) and forage on more abundant prey at a higher rate, which may indicate the birds develop a search image or familiarity with species characteristics (Mitchell 1968). However, this pattern holds only to a point since at very high densities of a particular prey species, fewer are taken (relative to the amount available) which ensures a diverse diet (Mitchell 1968). There appears to be no preference based on prey color or prey habitat (Mitchell 1968).

Dippers may have a substantial impact on some invertebrate prey. Caddisfly larvae (*Dicosmoecus gilvipes*) are significantly higher in areas where dippers are excluded (Harvey and Marti 1993). Effects on other invertebrates depended on depth. How this might translate into effects on fish is unknown. Steiger (1940) states that dippers do not frequent the rearing grounds for fry, so their impact on fish populations is probably limited.

Besides their song and unique dipping motions, dippers are perhaps best known for their foraging methods of catching aquatic invertebrates while swimming or walking underwater. Goodge (1959) describes several other methods dippers use to forage. In shallow water, dippers may stand on rocks with their head underwater. The dippers utilize fly-catching while they are flying over water. They may walk, run, or hop on land. They can also dive into the water directly from the air. Juveniles have some difficulty diving, so they usually stay near shore until their water-repellant plumage develops (apparently after fledging). In winter, dippers may stand on ice overlooking open water and dive into the water when they observe food (Lundwall 1915).

Ealey (1977) lists the foraging methods in decreasing order of frequency: wade-diving, swim-diving, drift-line, terrestrial foraging, plunge-diving, hover-picking, swim-picking, and fly-catching. The frequency of the method varied with the time of day and the individual bird. For example, more terrestrial foraging was done in the evening, presumably due to easier visibility of the insects on rocks at that time of day.

Dippers' habit of obtaining food underwater has led to much speculation of how the physiology of these birds enables them to function in this way. Adaptations for underwater foraging include: nasal flaps over their nostrils, water-proofed feathers (extensive preening coats them with oil), short wings (for manipulation underwater), and strong feet and claws (to function on the rocky water bottoms) (Tyler and Ormerod 1994). Goodge (1960) thoroughly describes adaptations of the dipper's eyes that allow it to see underwater including a nictitating membrane. High oxygen capacity and high hemoglobin levels also benefit these birds when they dive underwater (Murrish 1970a). Some disagreement has occurred in the literature about whether the dippers use their wings to swim underwater (Rishel 1925 among others; Bond 1938; Michael 1938; Steiger 1940; Brownlow 1949; Hann 1950; Jones and King 1952). Current understanding is that underwater movements are some combination of wing and leg movements (i.e. Goodge 1959; Tyler and Ormerod 1994).

Territories follow linearly along the stream and can range from 759 m to 2,070 m during the breeding season (Bakus 1959a; Ealey 1977; Price and Bock 1983). The territories usually do not extend much inland (Bakus 1959a), so it is assumed most feeding takes place within the boundaries of the creekbed. The farthest known nest from water was 7.43 m from a creek in a Montana study (Sullivan 1966,1973). Michael (1926) observed dippers running over snow banks to catch insects 3.7 m inland from the water. Perhaps these territories expand during winter, however feeding on insects in a snow bank is not likely common behavior.

One birder observed dippers washing their food in water before feeding it to the nestlings (Evenden 1943). Whether this is a common behavior is unknown.

Anting behavior has also been observed (Goodge 1959; Osborn 1998). This behavior consists of rubbing ants into its feathers (Osborn 1998), but the purpose of this behavior is not understood.

### *Nesting Habitat*

Dippers utilize unpolluted, fast-flowing streams with rocks in the water column (Tyler and Ormerod 1994). Dippers are also occasionally found in mountain lakes (Bakus 1959b) and may rarely be found along the coast (Hayward and Thoreson 1980). However, these sightings may not be during breeding season (Kingery 1996). They defend territories which include their nesting and foraging areas (Kingery 1996).

Nesting occurs at a variety of elevations ranging from 250 m in California (Hansen 1980) to 3,000 m (Hann 1950) and timberline in Colorado (Johnston 1943). In Yellowstone Park, the birds are found from 1,600 m to over 2,400 m, and even winter at 2,400 m if the water does not freeze (Skinner 1922). These elevations vary considerably among studies and are summarized in Table 1.

Elevation itself is not as important as the gradient of the stream (Tyler and Ormerod 1994). The gradient must be steep enough for the stream flow to form riffles and shallow pools, and these steep gradients usually mean higher elevations (Tyler and Ormerod 1994). Presence of dippers was not significantly related to either elevation or the gradient of the stream in Montana (Osborn 1999). However, dipper productivity at a particular nest site was significantly related to stream gradient, with higher gradients leading to more productivity (Osborn 1999). Confounding these patterns is the fact that nests at lower elevation sites were mainly on bridges and were warmer earlier in the season, so birds that brooded there early had more opportunity to double-brood (Osborn 1999).

**Table 1**. Elevation and Stream Characteristics.

| Elevation, m | Stream Width, m | Location | Citation |
|---|---|---|---|
| 1,550 to 1,630 | ---- | Logan River, Utah | (Fite 1984) |
| 250 to 400 | 2 to 20 (ave. 6) | California | (Hansen 1980) |
| 1,600 to >2,400 | ---- | Yellowstone Park | (Skinner 1922) |
| 305 to 610 | ---- | Cascade Mountains, Washington | (Goodge 1959) |
| Most common at 2,000 m and higher | ---- | New Mexico | (Mitchell 1898) |
| 2,700 to 3,000 | ---- | Colorado | (Hann 1950) |
| 1,600 to timberline | ---- | Colorado | (Johnston 1943) |
| 600 to 1,200 | ---- | Rattlesnake and Lolo Creeks, Montana | (Sullivan 1973) |
| 975 to 2,850 | 2 to >6 | Montana | (Osborn 1999) |
| As low as 610 | ---- | Arizona | (Hargrave 1939) |
| ---- | 3 to 15 | Rattlesnake Creek, Montana | (Bakus 1959a) |
| ---- | 1 to 50 (ave 15) | Alberta | (Ealey 1977) |
| ---- | <1 to >20 | Colorado | (Price 1975; Price and Bock 1983) |

Kingery (1996) states dippers are not usually found on streams wider than 15 m or deeper than 2 m. Overall, the width of the stream does not seem to be important as long as the stream is at least two meters wide (Tyler and Ormerod 1994). Wider and deeper stream areas are more likely to have dippers, but increased width and depth are not correlated with nest success or productivity (Osborn 1999). In general, these birds are not found in creeks less than 2 m wide (Osborn 1999). In Colorado, the dippers were found on streams that narrowed to less than 1 m wide (Price 1975; Price and Bock 1983), but whether the birds were using the narrowest sections of the streams is unclear. The narrowness of streams in the Black Hills may explain why some streams (i.e. see Backlund 2001) have never historically supported dippers.

The presence of dippers is related to the stream substrates, especially low levels of silt and gravel and more boulders (Osborn 1999). Dipper territories have more white-water areas than unused areas, but a combination of riffles and glides is important in the overall model of where dippers live (Osborn 1999).

Streamside vegetation varies among studies. Common species mentioned include: cottonwood (*Populus fremontii, P. angustifolia, P. trichocarpa*), alder (*Alnus rhombifola, Alnus crispa, A. tenuifolia*), willow (Salix *sp*.), Ponderosa pine (*Pinus ponderosa*), spruce (*Picea glauca, P. engelmannii*), lodgepole pine (*Pinus contorta*), aspen (*Populus tremuloides*), hawthorn (*Crataegus sp*.), red-osier dogwood (Cornus stolonifera), wild rose (*Rosa sp.*), thimbleberry (*Rubus sp*.), currant (*Ribes sp*.), Douglas-fir (*Pseudotsuga menziesii*), grand fir (*Abies grandis*), subalpine fir (*Abies lasiocarpa*), western larch (*Larix occidentalis*), Pacific yew (*Taxus brevifolia*), Rocky Mountain maple (*Acer glabrum*), and western red cedar (*Thuja plicata*) (Price 1975; Hansen 1980; Price and Bock 1983; Osborn 1999) (Ealey 1977). However, the exact species of vegetation is apparently not important (Kingery 1996).

Amount of vegetation has a mixed affect on dippers, in that it can increase hiding places, but may shade streams and lead to fewer aquatic invertebrates, as suggested by Osborn (1999). In most studies, cover is a measurement of the proportion of the stream bank that the dippers can use as a refuge including vegetation, rocks, etc. (Osborn 1999). The effect of this cover is not clear. In Colorado, cover was significantly related to the distribution of dippers during the summer (Price and Bock 1983). In Montana, cover at streamside was not significantly related to the presence of dippers or to nest success (Osborn 1999). However, productivity was highest in areas of moderate (10 to 50%) cover (Osborn 1999).

The four general requirements for nest sites are that they are : "1) close to water, 2) above high water, 3) inaccessible to terrestrial predators, and 4) on a horizontal ledge or crevice for support" (Sullivan 1973). The farthest known nest from water was 7.43 m from a creek in a Montana study (Sullivan 1966).

Territories with dippers have significantly more potential nest sites (Osborn 1999). This result is somewhat biased by what were considered potential sites and the fact that all used sites have, by definition, at least one nest site. Few (6 of 26 in 1997, 6 of 17 in 1996) unused territories have potential sites (Osborn 1999). This indicates that unused dipper nest sites likely indicate the territory is unoccupied, such as is currently the case on Rapid Creek in the Black Hills (Backlund 2001).

***Roosting Habitat***

Not much literature deals specifically with roosting habitats of the American dipper. Work with the European dipper shows that group roosting is common in the fall and winter, with as many as nine dippers roosting at one site in Wales (Tyler and Ormerod 1994). Many times these roosts are under bridges (Tyler and Ormerod 1994). Roosts are used repeatedly, with 94% of birds returning to the same roost sites in subsequent years (Tyler and Ormerod 1994). The American dipper is assumed to roost mainly on the ground (Ehinger 1930) (or on bridges as mentioned above), but a recent report of a fledgling roosting overnight in a cottonwood speculates that roosting in trees may reduce predation on fledglings (Hendricks 2000). European dippers sometimes roost in trees, especially during breeding season (Hewson 1967). No information is available on roost sites in the Black Hills.

***Landscape Context Review***

No information is available on habitat use on a landscape scale. Some disagreement exists on how mobile the birds are (see earlier section on Broad Scale Movements). Without a better understanding of movement, it is difficult to predict how dippers may perceive the landscape outside their own drainage. Within a drainage, they are not evenly distributed, presumably due to their preference for certain portions of streams with fast water flow as well as their territorial behavior (Ealey 1977).

***Movements.***

These birds are non-migratory in general, but they do move in response to freezing water (Kingery 1996 and see Broad Scale Movement Section above). Virtually no published information is available on movements in Black Hills populations. The birds are year-round residents based on several winter observations (Pettingill and Whitney 1965; Cornell Laboratory of Ornithology and National Audubon Society 2001; Tallman 2001a,b). Pettingill and Whitney (1965) report birds at lower elevations during freeze-up periods. No information is available on molting movements, movements between drainages, juvenile movements, or differences in movements due to age class for the Black Hills.

## Breeding Biology

### *Phenology Of Courtship And Breeding*

In general, the birds leave winter areas to pair and establish breeding territories in the spring. The timing of the breeding cycle varies with geographical location and elevation (Kingery 1996).

In Colorado, courtship and territory establishment occur in February and March and nests are constructed soon afterwards, with the female choosing the site (Price 1975; Price and Bock 1983). Sometime between March and May (usually in April), eggs are laid, one per day (Price 1975), with an average of 4 to five eggs per nest (Kingery 1996). Females incubate for 16 days with males feeding the female (Price 1975). After hatching, both sexes feed chicks (Price 1975). The chicks fledge 24 days later (Price 1975).

In Montana, birds begin pairing in March, although some are unpaired in mid-April, and some remain in wintering areas until early May (Bakus 1959a). In Montana, eggs are laid from March to May (Sullivan 1973). Incubation by the female takes 16 to 17 days. The chicks spend 24 days in the nestling stage.

In California, the pair bond forms in March when the male tolerates the female nearby (Hansen 1980). In Utah, nest-building begins in late March, eggs are laid in April, and the birds fledge in May (Fite 1984). In Alberta, birds had arrived in their breeding areas by mid May (Ealey 1977). Goodge (1959) reported that birds at 305 m elevation (the lower elevations in his study) in Washington nested early and eggs hatched by late April.

In the Black Hills, nest building has been known as early as March 23, although nesting typically occurs from late April through July (South Dakota Ornithologists' Union 1991).

Breeding may be affected by weather. At least in the European dipper, harsh weather in January and February delays breeding (Tyler and Ormerod 1994). The timing of breeding at sites in Alberta appears closely tied to when the water is free of ice (Ealey 1977).

After nestlings leave the nest they are not fully independent for another 14 to 15 days (Sullivan 1973). During these days they rapidly attain the needed skills to survive. Fledgling dippers remain with their siblings for about 7 days, before they begin to move independently within their parents' territory. They become independent and are no longer fed by their parents about 38 to 39 days post-hatching, and eventually they are forced out of their parents' territory. Young birds are quite mobile even immediately after they leave the nest (Bryant and Bryant 1915).

The long nestling stage may allow for more advanced development needed for swimming and diving (Sullivan 1973). In the difficult conditions where the dipper resides, several other adaptations are useful, including: the short molt, utilization of a range of feeding behaviors, and a solitary nature that increases the feeding efficiency near the nest (Sullivan 1973).

Second broods occur in some areas. Sometimes second nests are even started before the first brood has fledged (Sullivan 1973). In Colorado, second broods occurred in 40% of the pairs, all of which were below 1,830 m in elevation (Price 1975; Price and Bock 1983). This phenomenon is likely due to lower elevation birds beginning nesting earlier in the year. In Utah, 45% of pairs brooded twice (Everett and Marti 1979). Second nests of a season are not necessarily at the same site as the first (Osborn 2000). Birds that produce two clutches are usually more experienced (two and three years old) (Sullivan 1973). Shaw (1978) suggests that, at least for European dippers in Britain, second broods may be in response to an abundance of food at a particular site.

Adults undergo a complete molt phase during which they cannot fly for about 5 days (Sullivan 1965,1973). This molting period is during late summer (July through September) when weather is warm and food is available so energy can be saved for later in the year (Sullivan 1973).

### *Courtship Characteristics*

Four main phases of courtship as defined by Sullivan (1973) are described here. The Proximity Tolerance phase begins in December where potential mates allow feeding within the same winter territory. The Courtship Feeding phase involves females begging and males feeding them. The third phase is the Singing phase. Lastly, the Flight-Chase phase involves joint-flights with maneuvers over the water.

Hansen's (1980) observations of courtship displays include stretching vertically with the head up, singing, and circular flights around the nest area. Other observations of courtship include feeding of the mate, frequent dipping motions, and male singing (Goodge 1959).

The dipper's song has long been fascinating people, as in Muir's (1894) account describing, "The more striking strains are perfect arabesques of melody, composed of a few full, round, mellow notes, embroidered with delicate trills which fade and melt in long slender cadences. In a general way his music is that of the streams refined and spiritualized. The deep booming notes of the falls are in it, the thrills of rapids, the gurgling of margin eddies, the low whispering of level reaches, and the sweet tinkle of separate drops oozing from the ends of mosses and falling into tranquil pools." Both sexes sing the dipper song, which is a quite variable series of notes and repetitions (Fite 1984). Fite proposes an explanation for both sexes singing in that the loudness of the environment would make it difficult for only one singing sex to define the territory. The males may sing more often, however, since some indicate they found mostly males singing (Sullivan 1973). Singing frequency is highest in April, but singing does not occur during the incubation period (Kingery 1996).

American dippers utilize a variety of vocalizations. Interestingly, the dippers have evolved calls at frequencies that differ from that of the stream noise in their habitat. Stream noise is most intense at <3.0 to 3.5 kHz while most dipper call notes are at 4 kHz or more (3 to 6 kHz) (Fite 1984). Four types of calls categorized and described by Fite (1984) are described here. The *jih* call is a short call which may be repeated various number of times with short pauses between each syllable. The *jih* call is used during flight, when approaching a mate, when feeding nestlings, during territorial confrontations, and when a predator is present when young are nearby. The *grawk* call has a lower frequency than the *jih* call and is used during nest building and feeding. The *weep* call is only made by adult females when a male is present while they are brooding. The fourth type of call is the distress call. In addition, Skinner (1922) describes a hissing noise used to scare off other birds.

Nestlings and fledglings also have several variations of begging calls while they are feeding (Fite

1984). In addition, adults display the unusual behavior of singing after feeding nestlings, which usually results in quieting the fledglings (Fite 1984). Fite proposes this behavior may enhance vocal learning.

In Alberta, three pairs bred again in the same territories in subsequent years, and there was no evidence of mate switching (Ealey 1977). Skinner (1922) believed the birds "mate for life" since they pair early, but this is not always supported by others. Sullivan (1973) found 85% of birds re-nested in the same area in the following year, and all of those surviving used the same nests in two subsequent years. Some individuals return to the same nest site, but not necessarily with the same mate (Bakus 1959a; Osborn 1999). Males in a Montana study stayed with their nest site even if their mate was lost (Sullivan 1973).

Birds may switch mates within the spring season (Bakus 1959a). Mate-switching has been observed after territories are established (Hansen 1980). Two females were observed to chase and fight with one another when the second female entered a territory where pair bonding had begun between marked birds (Hansen 1980). Eventually one of the females abandoned the territory and relocated downstream. Mate switching by a female was observed between first and second broods in a single season (Osborn 2000). A small percentage of males are polygynous (Tyler and Ormerod 1994). The rates of polygyny can be very low, at 3.4% in a Utah study (Marti and Everett 1978) or moderate, like the 12.8% in a Colorado study (Price and Bock 1973). Hansen (1980) suggests polygyny is possible due to unequal parental care and asynchrony of female cycles.

### *Nest Site Characteristics*

Dipper nests are commonly located on rocky ledges along streams, behind waterfalls, on large rocks in the stream, and under bridges or other man-made structures (Kingery 1996). For further discussion of the habitat in which the nests are found, see nesting habitat section.

Dipper nests are round or dome-shaped with a small opening over a cup-like bottom (Bakus 1959b; Collins 1960; Sullivan 1973). The nests are large, about 20 to 25 cm in diameter (Cordier 1927; Hann 1950). The top or outside is made of moss (Collins 1960), grasses and leaves (Sullivan 1973). The shape is sometimes altered to fit crevices available for nest sites (Everett and Marti 1979). Lining in the nest can consist of twigs, bark, leaves, pine needles, or grass (Towne 1904; Sullivan 1973). The nesting materials are molded and woven in and then the entire form freezes into its permanent shape (Sullivan 1973). Entrance holes usually face downstream (Sullivan 1973). Pairs may reuse an old nest or build a new one (Sullivan 1973). Nests are generally 0.9 to 4.6 m above water (Hann 1950).

Nests in Alberta are in areas less accessible to predators with more noise, more stable substrate, and closer to rapids (Ealey 1977). Early descriptions that nests are in areas always damp with spray (Ridgeway 1904; Sclater 1912) are contradicted by data showing equal numbers of wet and dry sites (Ealey 1977).

Overall productivity was not related to type of substrate the nest was built on (Osborn 1999). Nests in Yellowstone were observed in a crack in a boulder, on a bank between gravel layers, on bridge rafters, on a dead log, and on a rock (Skinner 1922). Other nest sites include cliff ledges, ledges near waterfalls, boulders in the streams, bridge rafters, culverts, dam spillway platforms, sluiceways, and logs (Sullivan 1973; Osborn 1999). Rarely, nests are found in less probable sites such as dirt banks (Ealey 1977; Osborn 1999), below grassy overhangs (Ealey 1977), on/under roofs of buildings (Whittle 1921; Sullivan 1973), behind waterfalls (Hann 1950) or in a pipe in a dam (Hansen 1980).

Nest boxes are sometimes used (Price 1975). Of 10 nest boxes placed out in Colorado, one was used in the course of the three-year study (Price 1975). In California, 12 nest boxes were constructed and three were used to successfully raise dippers over a 5-year period (Hawthorne 1979). One nest site that Ealey (1977) chiseled into rock ledges showed breeding activity, but no broods were actually raised there. A new round of nest boxes in Colorado had better success with 6 of 26 being used each year (Carty 1994). In the Black Hills, the addition of nest boxes along Spearfish Creek is most likely the reason for the increased number of dippers (Backlund 2001).

Abandoned dipper nests have been utilized for nesting by other species such as a mountain bluebird (*Sialia currucoides*) (Calder 1970) and a cliff swallow (*Petrocheliodon albifrons*) (Bakus 1959b).

### *Clutch Initiation And Size*

Eggs are usually laid in April (Kinger 1996). Clutch size, usually 4 or 5 (Kingery 1996), varies slightly among studies and is summarized in Table 3. In Colorado, mean clutch size is 4.32 eggs (Price 1975; Price and Bock 1983). Published notes from New Mexico report clutches of 5 eggs (Mitchell 1898). Slightly smaller average clutches of 4.08 eggs/nest are reported in Montana, but they include the largest reported clutches of 6 eggs (Sullivan 1973).

### *Parental Care*

Both sexes help build the nest (Sullivan 1973). The female does most of the incubating (Goodge 1959). During incubation, the female averages 62 minutes incubating per 16 minutes feeding (Hansen 1980).

Both parents share in feeding the young (Goodge 1959), although many sources indicate females do the majority of the feeding (Cordier 1927; Hann 1950; Bakus 1959b). Females make feeding trips significantly more often than males (Sullivan 1973). This supports Cordier's (1927) statement that females make about ten times more trips than the males. Females also do all the cleaning of the nest (Cordier 1927).

Females can and do occasionally raise chicks on their own. One chick successfully fledged from a single female's nest (Hansen 1980).

After fledging, parents continue to feed young for several days until the fledglings are able to obtain food on their own (Sullivan 1973).

## Demography

### *Life History Characteristics*

The life span of dippers is unknown. Some birds were at least four years old at the end of one study (Sullivan 1973). Age at first reproduction is one year (Kingery 1996). The proportion of the population that is breeding is unknown, but there is some evidence that non-breeding birds are present. For example, the removal of breeding birds in Alberta resulted in other birds coming in and replacing them (Ealey 1977). Characteristics of non-breeders are unknown, other than they do not have a suitable territory.

Juvenile movements are not well understood. The three-month post-fledging period is quite active for this age group (Ealey 1977). Significantly more juveniles moved upstream than downstream in studies in Colorado (Price 1975; Price and Bock 1983) and Alberta (Ealey 1977). In another study, juveniles were found up to a mile away from their nests within a couple of weeks of leaving the nest (Hann 1950).

### *Survival And Reproduction*

In a Colorado study (Price 1975; Price and Bock 1983), mortality rates varied by year and age class with juveniles having higher mortality rates than adults (see Table 2). Mortalities in that study were attributed to starvation and disease and to the stresses from winter, since winter had significantly greater mortality than spring and summer. These numbers are somewhat confounded by the possibility of juveniles not observed again actually successfully emigrating somewhere away from the study site. The key assumption of the study was that birds not returning died, so mortality rates would be lower if some of the juveniles successfully reached other territories away from the study site.

**Table 2.** Mortality Rates in a Colorado Study (Price 1975; Price and Bock 1983)

| | **1971-1972** | **1972-1973** |
|---|---|---|
| Adults | 47.5% | 61.4% |
| Juveniles | 67.1% | 77.3% |
| Whole Population | 60.0% | 70.9% |

Note: These rates are based on sample sizes of 40 breeding birds and 70 fledglings banded in 1971, 44 breeding birds and 66 fledglings banded in 1972, and 32 breeding birds in 1973.

These rates are similar to those in an Alberta study where the annual adult mortality was 56.2% (Ealey 1977). Ealey (1977) also noted adult overwinter mortality was 53%. Bakus (1959b) speculated that the habit of juveniles allowing close approaches may lead to increased predation.

Productivity varies slightly among regions and between years. Table 3, which summarizes productivity information from several studies, shows that slightly more than 2 fledglings result from an average clutch. The number of fledglings is related to clutch size, high levels of precipitation that can flood the nest during the nestling stage, and territory quality (including measures of food availability, stream quality, and the availability of protected nest sites) (Price 1975; Price and Bock 1983). Productivity was higher in clutches of five or more in Montana (Sullivan 1973).

These results are similar to those of other hole-nesting altricial birds which average 66% fledging success (Nice 1957). Adding mortality of juveniles, these data support the observations of Hann (1950) that normally only two or fewer dippers reach independence (out of the nest and no longer being fed).

**Table 3.** Productivity

| Mean Clutch Size | Mean # Nestlings/ Clutch | Mean # Fledglings/ Brood (% fledged) | Fledglings/ Breeding Adult | Location of Study | Citation |
|---|---|---|---|---|---|
| 4.3 (n=68) | 2.67 | 2.16 (61.8%) | 1.63 | Colorado | (Price 1975; Price and Bock 1983). |
| 4.3 (n est. 37)1 | --- | (72.2%) | 1.21 | Alberta | (Ealey 1977) |
| 4.1 (3 nests even had 6 eggs) (n=46) | 3.3 | 2.8 per nest (86%) | 1.45 | Montana | (Sullivan 1973) |
| 4.8 (n=4) | 3.4 (n=7) | 1.9 (57%) | 1.67 (1956, n=6) 0.375 (1957, n=8) | Montana | (Bakus 1959b) |
| --- | 2.2 (1996, n=11) 2.8 (1997, n=40) | (80.0%) n=67 | 1.37 | Montana | (Osborn 1999) |

[1] N is not given for these calculations in Ealey's tables. The estimate is calculated from the number of breeding females listed. This is a minimum since some pairs re-nested.

Known causes of nest failure include: abandonment or death of adults, flooding, nest destroyed, genetically damaged female (none of her clutches hatched), and starvation/disease (Price 1975; Price and Bock 1983). Dippers occasionally kill other dippers; for example, dippers were observed pulling apart a nest in an adjacent territory, although the adults had apparently already abandoned the nest (Price and Bock 1983). Productivity decreased in a year with heavy spring flooding (Ealey 1977). Sullivan (1973) noted humans, flooding, predators (probably mink or long-tailed weasels), and other dippers caused a nest loss of 21.5% (n=79) in Montana. Most failed nests were due to predation and flooding in a recent Montana study (Osborn 1999). Although flooding can cause nest-loss, some nests do survive being flooded and can be successfully used for raising chicks (Mowbray 1941). Birds that lose their first nest do re-nest (Sullivan 1973). However, birds forced to re-nest usually do so in areas not rated as high in quality (Ealey 1977). (See Habitat section for discussion of nest quality.)

Juveniles with better body conditions (basically those individuals that have more body mass) soon after independence are able to forage more efficiently (Donnelly and Sullivan 1998). Donnelly and Sullivan (1998) suggest that more efficient foraging may be influence first-year survival. All the factors that contribute to body condition are not clear from their study.

### *Factors Influencing Species Density*

Dippers defend breeding territories which include nest sites and feeding areas. Males and females have slightly different, but overlapping breeding territories (Price and Bock 1983).

Behaviors used to defend territories include neck stretching, circling intruders with raised wings, alarm calls, pursuit in flight, and combat (including pecking, hitting with wings, and pulling feathers) (Bakus 1959a; Sullivan 1973).

Territory size is about 1 km long in California (Hansen 1980). Birds in Montana feed within 320 m of their nest, measured linearly along the stream (Bakus 1959a).

Several factors play a role in determining breeding territory size, including: the presence of a neighboring territory, the amount of food available, the age of the female, and the quality of the nest sites available (Price and Bock 1983). Size of territories in Alberta are dependent on whether or not another dipper's territory borders it (Ealey 1977). In Colorado, polygynous males, all of whom had territories without neighbors, defended larger territories than monogamous males (2031 m vs 944 m on average) (Price 1973). The significance of these variables depends on the local environment (Price and Bock 1983). For example, one creek in the Colorado study had very high levels of aquatic insects available for food, so food was not significantly correlated with territory size for that creek (Price and Bock 1983). In another area of the creek, food density was high but the sites available for nests were subject to flooding so dippers rarely attempted to make nests there.

Most studies refer to nesting territories, but Bakus (1959a) found dippers in Montana also defended territories in winter. These winter territories, which ranged in length from 46 m to 800 m, were set up in November and defended until February (Bakus 1959a). Sullivan (1973) indicates the birds defended territories year-round. Density of adult dippers tend to be higher in winter than during breeding season (Price and Bock 1983). Densities are usually higher in winter in areas where the birds must move to available open water (Warren 1914). See Table 4 for a comparison of densities during different seasons.

The spatial distribution of the birds can be used to explore when territories are being defined or when the birds are randomly dispersed throughout the habitat. Ealey (1977) observed some clumping in the dispersion of birds in October, which could have been due to birds trying to define winter territories in the available habitat. No clumping was observed during the molting period (Ealey 1977).

### *Local Density Estimates*

Data on local populations are limited. Backlund (1994) found 2 nests within 0.8 km of each other in Spearfish Canyon, but does not give overall densities. A two-year Montana study found winter densities are higher (1 bird/0.35 stream km in year one and 1 bird/0.32 stream km in year 2) than pre-nesting (1 bird/0.77 km) or post-nesting densities (1 bird/0.65 km and 1bird/0.70 km) (Bakus 1959a). Density estimates from the literature are summarized in Table 4.

**Table 4**. Estimates of Dipper Density

| Density (birds/km) | Season | Location | Citation |
|---|---|---|---|
| 7.45 | Winter, year 1 | Montana | (Bakus 1959a) |
| 8.18 | Winter, year 2 | Montana | (Bakus 1959a) |
| 3.35 | Pre-nesting (early spring) | Montana | (Bakus 1959a) |
| 3.96 | Summer post-nesting, year 1 | Montana | (Bakus 1959a) |
| 3.72 | Summer post-nesting, year 2 | Montana | (Bakus 1959a) |
| 5.0 | Summer post-breeding, 1965 | Rattlesnake Creek, Montana | (Sullivan 1973) |
| 3.9 | Summer post-breeding, 1966 | Rattlesnake Creek, Montana | (Sullivan 1973) |
| 2.9 | Summer post-breeding, 1965 | Lolo Creek, Montana | (Sullivan 1973) |
| 1.18 | Breeding season, 1971-1973 | Boulder Creek, Colorado | (Price and Bock 1983) |
| 1.58 | Breeding season, 1971-1973 | South Boulder Creek, Colorado | (Price and Bock 1983) |
| 0.66 | Breeding season, 1996-1997 | Bitteroot Creeks, Montana | (Osborn 1999) |

### *Limiting Factors*

Several factors have been suggested as limiting dipper populations. In a Colorado study, territorial behavior appears to limit population density, although this is not the only factor (Price 1975; Price and Bock 1983). Territorial behavior also is limiting in Alberta (Ealey 1977), and probably in Montana (Sullivan 1973). In Montana, birds without territories attempt to nest in unsuitable locations and are not successful (Sullivan 1973). Failed nest attempts are known from several areas in the Black Hills, even on creeks that historically supported dipper populations, may indicate that many of these areas are no longer suitable habitat (see Backlund 2001 for observations of failed nests at heavily silted sections of creeks).

Food, nest site quality and dispersion, stream width, and cover also have a limiting role in some areas (Price 1975; Price and Bock 1983). Areas used as territories usually have lots of nest sites, and data from some studies indicates, that at least in some areas, nest sites may be limiting. For example, Tyler and Ormerod (1994) cite two German studies where nest boxes increased European dipper populations (Kaiser 1988; Staedtler and Bremshey 1988). The American dipper population along one creek in California doubled with the addition of 12 nest boxes (Hawthorne 1979).

Food availability is very important. European dippers are absent or low in numbers in areas without abundant invertebrate prey (Tyler and Ormerod 1994). Streams that dry up in the summer can be used if sufficient invertebrates are available (Tyler and Ormerod 1994). Studies in Britain found most of the areas with few invertebrates have low pH (mean 6.0-6.5, but minimum measurements are as low as 4.5 to 5.0) (Tyler and Ormerod 1994). Successful management of dippers cannot occur if stream conditions are not maintained for invertebrate survival.

### *Patterns Of Dispersal*

Dispersal in American dippers is not well understood. For a discussion of this topic, see the sections on Movements and Broad Scale Movement Patterns above.

## Community Ecology

### *Predators And Relationships To Habitat Use*

Dippers' escape *behaviors* include diving into the water, flattening themselves on a rock while remaining still so they are hard to see, and flight (Sullivan 1973). Ealey (1977) observed predation attempts by hawks (*Accipiter* sp.), and one Cooper's hawk (*A. cooperi*) succeeded in killing a fledgling. A Cooper's hawk and a sharp-shinned hawk (*A. striatus*) were both observed chasing dippers in another study (Sullivan 1973). A great blue heron, *Ardea herodias*, was observed catching and eating a dipper in California (Parker 1993). A dipper was also found in the stomach of a brook trout, *Salvelinus fontinalis*, that was caught by a fisherman (Johnson 1953). Knowledge of American dipper predators is limited, but they are likely to be similar to the European dipper's predators, which include rodents (Rodentia), mink (*Mustela* sp.), cats (Felidae), crows (*Corvus* sp.), kestrels (*Falco* sp.), merlins (*Falco columbarius*), and hawks (*Accipiter* sp. and *Buteo* sp.) (Tyler and Ormerod 1994).

### *Competition*

Suggested potential competitors include: black phoebes (*Sayornis nigricans*), Louisiana waterthrushes (*Seiurus motacilla*), northern waterthrushes (*Seiurus noveboracensis*), spotted sandpipers (*Actitis macularia*), solitary sandpipers (*Tringa solitaria*), great blue herons (*Ardea herodias*), mallards (*Anas platyrhyachos*), harlequin ducks (*Histrionicus histrionicus*), belted kingfishers (*Megaceryle alcyon*), and other passerines (Sullivan 1973; Tyler and Ormerod 1994). Territory defense behaviors were observed directed towards robins (*Turdus migratorius*) and spotted sandpipers (*Actitis macularia*) (Bakus 1959a). However, no studies actually demonstrate competition for any of these species. Dippers feed in three general ways, on the shoreline, flycatching low over water, and in the water itself and none of these species seriously overlap the dipper in more than one category (Sullivan 1973).

### *Parasites And Disease*

Several reports of various parasites are found in the literature. Halstead (1988) reported nestlings were infected by blowfly larvae (*Protocalliphora aenea* and *P. braueri*), including one who died after larvae infected its head, limiting its jaw movement and possibly affecting its vision or hearing. Fowl mites (*Ornithonyssus sylviarum*) also infected one nest and the nestling within it (Halstead 1988). Intestinal trematodes are also known to infect dippers. In Oregon, trematodes *Metoliophilus uvaticus* were found within dipper chicks, presumably ingested within stoneflies *Acroneuria pacifica*, which serve as secondary hosts (Macy and Bell 1968). Trematodes *Laterotrema cascadensis* were also found in dippers in Washington and Oregon

(Macy and Strong 1967). Protozoan blood parasites, *Trypanosoma avium*, are known from an American dipper in Colorado (Stabler and others 1966). Feather lice, *Mallophaga* sp., were present on birds in Colorado (Price 1975; Price and Bock 1983). These birds did not seem adversely affected by this infection.

Death of several dippers in Colorado was linked to infection by the fungus, *Aspergillosis* sp. (Price 1975; Price and Bock 1983). Neither the overall rate of infections nor the overall rate of mortality from these incidents is known for any of these parasites or diseases.

### *Other Complex Interactions*

Humans can inadvertently injure these birds through their activities. One researcher left a long cotton string, called a hip chain, used to measure linear stream distances in the field, and later found an adult dipper had died after becoming entangled in the string (Loegering 1997). Another incident occurred when a sports fisherman hooked a dipper in Utah (Chatwin 1956).

## Risk Factors

Osborn (1999) believes dippers may be vulnerable to habitat degradation because they occupy a very specific niche: they rarely leave the stream corridor so they are unlikely to move to other areas, they have many specific physical adaptations to their environment, and their main food source is aquatic invertebrates. Backlund (2001) makes the case that human activities including dam-building, pollution, cattle grazing, and other activities that increase sedimentation have led to the decline and/or elimination of dipper populations on many creeks in the Black Hills.

Osborn (1999) attempted to determine the effect of development on dipper populations in Montana by rating the amount of development within 50 m of the stream bank. Development included houses, agricultural land, grazing, roads, logging, irrigation diversions, and trash dumps. Overall development rating was not significantly related to use of a territory by dippers (Osborn 1999). One year of the study did show a significant decrease when the most developed creek was taken out of the analysis. However, there was no difference in fledging success or productivity between developed and undeveloped areas. Neither was there a significant difference in fledging success or productivity between bridge sites and natural sites.

Several factors confounded Osborn's (1999) attempt to examine the effects of development, making it difficult to conclude that development's affects are limited. First, birds were absent in areas with stream damage from heavy grazing. Second, the study was conducted in a high-water year, so the effects of irrigation was mitigated. Small sample sizes of the different categories of development made it impossible to tease apart differences in their influences. Also, the presence of roads was confounded with the presence of bridges which provided nest sites. Further study in this area is needed to determine exactly which activities affect these birds. Osborn (1999) suggests that dippers may be useful as indicator species that may signify when human activity has reached a critical level.

Hunting and harassment has historically been a problem in other countries, and may occasionally be a problem in the United States. In North Africa, dippers are hunted for aphrodisiacs (Tyler and Ormerod 1994). At least historically, humans have singled out these birds because they consume fish. Mitchell (1898) states, "The Dipper is persecuted by the Mexicans who say it destroys young trout". Prior to 1900, bounties were offered in areas of Europe--presumably these were *C. cinclus* (Tyler and Ormerod 1994). Nor is the harassment of dippers limited to pre-twentieth century eras. In California, one pair's nesting success was prevented by humans' target practice (Hansen 1980). Shooting and nest destruction are listed as problems by Sullivan (1973).

Old stone bridges are often used as nest sites (Sullivan 1973; Osborn 1999), so building these types of bridges may have positive effects on dippers. However, newer concrete "box bridges" are not used by dippers in Europe (Tyler and Ormerod 1994). Some bridge sites may be more susceptible to predation, but this may be mitigated by opportunities for second broods if the bridges are in warm areas (Osborn 1999). Tyler and Ormerod (1994) suggests that dams damage habitat for dippers by changing water flow amounts, altering water temperature, creating sudden increases of water, or drying up water ways. The decline of dippers in several European areas is linked to hydroelectric facilities construction (Tyler and Ormerod 1994). Disappearance of dippers in established territories along Grant Creek in Montana was attributed to diverting water from part of the creek (Sullivan 1973).

Pollution is apparently a major risk factor for dippers. Direct, acute discharges of PCBs, iron, lead, zinc, nickel, aluminum, and copper restrict invertebrates and fish on which dippers feed and have been linked to dipper declines in several river drainages in Europe and South America (Tyler and Ormerod 1994). DDE, HEOD, and PCB have been found in European dipper eggs (Tyler and Ormerod 1992), although their effects in dippers are unknown.

Sulfur dioxide and nitrogen oxide (from power station chimneys, vehicle exhaust, etc.) are often carried in the air to streams and lowers the pH, in a process referred to as acidification (Tyler and Ormerod 1994). European dippers' breeding densities and abundance have been significantly correlated with low pH (Ormerod and others 1985; Vickery and Ormerod 1990; Vickery 1991). Negative impacts on dippers at low pH include: delayed egg-laying (Vickery and Ormerod 1990; Tyler and Ormerod 1992), required longer territories (Vickery and Ormerod 1990; Vickery 1991), obtained significantly smaller body mass (Tyler and Ormerod 1992), reduced clutch size (Vickery and Ormerod 1990), significantly smaller egg mass (Tyler and Ormerod 1992), no second clutches (Tyler and Ormerod 1992), more time spent foraging and feeding and less time spent resting (O'Halloran and others 1990; Tyler and Ormerod 1992), and significantly lower blood calcium levels which may stress females' systems when making eggs (Tyler and Ormerod 1992). In the opinion of the author of this assessment, American dippers are likely to respond in a similar way to pollutants.

These impacts may be secondary results of reductions in number or changes in the species composition of the invertebrates in these streams. Acidification has been shown to decrease numbers of fish and some invertebrate species (Tyler and Ormerod 1994). In Scotland, the main difference between acidic (pH $< 6.5$) and non-acidic sites (pH $> 7$) was the makeup of the invertebrate community. Ephemeroptera (mayflies), which are often utilized by dippers, were much reduced at acidic sites, while Plecoptera (stoneflies) increased in prevalence (Vickery 1991). On an acidic site in another study, Plecoptera (stoneflies) were used but not preferred, and the dippers switched over to Ephemeroptera (mayflies) when the pH reached 6 (Tyler and Ormerod 1992). The abundance of Ephemeroptera (mayflies), Trichoptera (caddisflies), and crustaceans significantly increased as pH increased (Tyler and Ormerod 1992). Rivers in Britain with suitable gradients had scarce dipper populations, and this has been attributed to the scarcity of invertebrates due to minimum pH levels down to 4.5 (Ormerod and others 1985).

Even 'temporary' pollution may have lasting effects on these birds. Gold mining chased dippers from two creeks in Idaho, and despite the cessation of operations the birds had not returned twenty years later (as reported by Steiger (1940), without further details).

## Response To Habitat Changes

### *Management Activities*

**Timber Harvest**

Harvesting near waterways used by dippers is likely to have a negative effect on the water quality and the dippers themselves. Phillips and others (1964) cited a possible example of the disappearance of dippers on a stream polluted with sawdust. Sullivan (1973) speculates clear-cutting near streams would open habitat and reduce the levels of nutrients desired by the dippers.

A study in New Hampshire (Likens and others 1970) illustrates the effects of harvesting too close to a stream. Vegetation was clear-cut alongside a Hubbard Brook watershed and herbicide application prevented regrowth for two years. Water levels increased 33cm over forested levels in the first year. Ion concentrations greatly increased in the water, due to increased runoff. Greater temperature fluctuations occurred. Turbidity remained about the same, but inorganic proportion of particulates increased. The pH of the streams decreased from approximately 5.1 to 4.3. Although this was not an area with dippers, it illustrates the impact harvesting regimes can have on waterways.

Sediment from logging has a major impact on stream dynamics. Fish abundance decreased as the length of the deforested areas along a North Carlolina stream increased (Jones and others 1999). Jones and others (1999) found that riffle areas downstream from long deforested regions (2.5 km in length or longer) had significantly more fine sediment than in areas downstream from shorter deforested areas or forested areas. Since dippers forage extensively in riffle areas, they are likely to be affected by logging along streams.

Harvesting along waterways in the Black Hills is unlikely to be as severe as a clear-cut situation. However, care must be taken that clarity and pH of streams remain acceptable to dippers, perhaps by maintaining uncut buffer strips along streams.

**Recreation**

Dippers are not terribly disturbed by human activity. For example, an active nest was located in a very popular fishing stream in Colorado (Barber 1996). Many other observers indicate the dippers ignored them as they approached or repeatedly returned for observations (e.g. Ehinger 1930). However, some implicate increased human recreational activity as leading to the decline of dippers in some areas (Carty 1994). A lack of response does not indicate whether production is reduced due to potential stress caused by the presence of humans.

**Livestock Grazing**

Over-grazing has a negative effect on dippers. Birds were absent in areas with stream damage from heavy grazing in a Montana study (Osborn 1999). Fleischner (1994) reviews the effects of livestock on riparian areas, including: changing or removing streamside vegetation, increasing sedimentation due to erosion, and changing water chemistry and temperature.

**Mining**

Various aspects of mining may negatively affect dippers by changing water quality. Direct, acute discharges of iron, lead, zinc, nickel, aluminum, and copper restrict invertebrates and fish on which dippers feed and have been linked to dipper declines in several river drainages in Europe and South America (Tyler and Ormerod 1994). Even 'temporary' pollution may have lasting effects on these birds. Gold mining chased dippers from two creeks in Idaho, and despite the cessation of operations the birds had not returned twenty years later (Steiger 1940). Mining activities that involved dredging can also be detrimental to riparian habitat (USDA Forest Service 1996). Any mining activity that decreased the clarity of streams occupied by dippers would also be detrimental.

**Prescribed Fire**

It is the opinion of this author that low-intensity fires would have little impact on dipper populations because dipper activity does not ordinarily extend beyond the stream bed into the adjacent upland vegetation. Severe fires, however, may increase erosion, which may damage streams (USDA Forest Service 1996).

**Fire Suppression**

It is the opinion of this author that fire suppression would have little impact on dipper populations, again because dipper activity is usually restricted to the stream bed.

**Non-Native Plant Establishment And Control**

It is the opinion of this author that non-native terrestrial plant establishment would have little effect on dippers. Chemical control methods could negatively affect dippers if the chemicals entered the water and affected water quality. Thick invasions of aquatic vegetation may have a negative effect, since dippers do not tend to use areas with such vegetation (Kingery 1996).

**Fuelwood Harvest**

It is the opinion of this author that fuelwood harvest would have little impact on the dippers unless stream banks were cleared to such an extent that erosion increased.

**Roads**

Roads can severely impact streams and riparian habitat through erosion, sedimentation, change in vegetation, and changes in stream morphology (USDA Forest Service 1996). These changes could affect the pH or clarity of the water or the bottom substrate, which in turn may reduce the invertebrates on which dippers feed. Such changes could have a large negative impact on the dippers. Osborn (1999) found more dippers in areas with roads, presumably due to the presence of bridges that the dippers used for nest sites. Osborn's study did not look at long-term effects due to roads, nor could it tease apart the effect of bridges from that of roads.

**Water Regulation Structures**

Structures such as dams, hydroelectic plants, and irrigation canals can negatively impact dipper populations. Tyler and Ormerod (1994) speculates dams damage habitat for dippers by changing flow amounts, temperatures, allowing sudden increases of water, and drying up the waterway.

The decline of dippers in several European areas is linked to hydroelectric construction (Tyler and Ormerod 1994). Osborn (1998) was not able to detect any effects from irrigation, but since it was a high-water year, she could not necessarily eliminate the possibility of effects either. Building of dams on French Creek and Rapid Creek in the Black Hills are likely to be contributing factors to the reduction and/or disappearance of dippers on these creeks (Backlund 2001).

**Pollution**

Pollution has a demonstrated negative effect on dippers by decreasing water quality. (See discussion of pollution under Risk Factors). In the Black Hills, pollution is the likely cause of declines in suitable dipper habitat on French Creek, Whitewood Creek and Bear Butte Creek (Backlund 2001).

### *Natural Disturbance*

**Insect Epidemics**

It is the opinion of this author that since dippers feed mostly on aquatic insects, epidemics of terrestrial insects would have no effect.

**Wildfire**

Severe fires may increase erosion and thereby damage riparian zones (USDA Forest Service 1996). If clarity of water is degraded or runoff changes the pH of the water, dippers may be affected.

**Wind Events**

It is the opinion of this author that most wind events would have no effect on dippers. However, a severe blowdown adjacent to a stream could have the same negative effects of a clearcut, as described above in the Timber Harvest section.

**Flooding**

Spring flooding events were a major cause of direct nest loss in several studies (Sullivan 1973; Ealey 1977; Osborn 1999).

**Other Events**

In general, events that cause the degradation of the waterway will negatively affect the dipper.

## SUMMARY

The American dipper is considered a threatened species in South Dakota. Currently, only a small population is known in the Spearfish Canyon area of the Black Hills, but historically the birds thrived on several area streams. The Black Hills dippers are isolated from the main part of the range so these habitats are not likely to be recolonized if the current population is lost.

Dippers are an "aquatic songbird" and are dependent on clean, fast-moving streams with abundant aquatic insect prey. These birds do not migrate, although they do move up and down a particular stream as water freezes and thaws. These birds nest in crevices in cliffs, on rocks, or under bridges. In the Black Hills nesting takes place from April to July. Main causes of mortality and nest loss are starvation, winter stress, and spring flooding. These birds defend territories which contain feeding areas and nest sites.

Territorial behavior, availability of nest sites, and availability of food are likely limiting factors. Major risk factors for these birds are pollution and degradation of their watersheds. Activities such as timber harvesting along streams, overgrazing, mining, pollution, water regulation structures, and severe fires may negatively impact these birds.

The ecological relationships important to American dippers are shown in the envirogram (after Andrewartha and Birch 1984) in Figure 1.

# REVIEW OF CONSERVATION PRACTICES

## Management Practices

Kingery (1996) states, "… Management practices that protect, for any purpose, riparian areas from overgrazing, silting, overlogging, and pollution will also protect [dippers] in both summer and winter." Due to dippers' nest-site fidelity (Kingery 1996), protecting existing nest sites is very important.

Backlund (1994, 2001) considers the Black Hills population to be at risk due to declining water quality and the limited number of nest sites. Although dippers were historically found on many Black Hills waterways, and were common on French Creek, Rapid Creek, and Spearfish Creek, they are now mainly restricted to Spearfish Creek (Backlund 2001). Dams have affected the aquatic ecosystems on French Creek and Rapid Creek (Backlund 2001). Increased sedimentation, from cattle grazing and road building, and pollution from mines are also common problems along French Creek and Rapid Creek, as well as several other creeks that could be potential dipper habitat (Backlund 2001). Without restoration of these other creeks, the dipper population will likely be limited to the number that can find suitable nesting territories along Spearfish Creek.

Artificial nests have been used successfully in several areas to increase populations (Price 1975; Hawthorne 1979; Price and Bock 1983; Kaiser 1988 as cited in Tyler and Ormerod, 1994; Staedtler and Bremshey 1988 as cited in Tyler and Ormerod, 1994; Carty 1994). Nest boxes were established by the South Dakota Game, Fish and Parks Department in 1997 and have been used by dippers along Spearfish Creek, but remain unused on other area streams (Backlund 2001).

## Models

No models are available for American dipper habitat. No Habitat Suitability Index models have been developed for this species.

## Survey And Inventory Approaches

Many dipper studies have successfully captured birds with mist nests and banded them in order to observe individuals (i.e. Bakus 1959a; Price 1975; Hansen 1980; Price and Bock 1983). This is the most expensive way to survey individuals because it is the most time-intensive method. However, only with banded or radio-tagged individuals can movement patterns be determined confidently.

Osborn (1999) was able to count nests by observing birds and following them when they were feeding young. Backlund (1994) traveled along streams and investigated potential nest sites to determine if they were being used. If nest boxes are established, they can be checked to see if they are being used. The South Dakota Game, Fish and Parks Department has had good survey results with a monitoring route designed specifically to follow dipper habitat, where observed dippers are counted at stops along the route (Backlund 2001). These methods are much cheaper but cannot be used to determine movements.

## Monitoring Approaches

Several difficulties exist in trying to obtain an accurate population estimate. Breeding Bird Surveys are not the most informative because methods that include only short listening periods make it difficult to pick up dipper calls and the routes usually do not follow streams closely enough to provide enough samples (Kingery 1996). Christmas Bird Counts rarely include very much dipper habitat (Kingery 1996). Winter counts can also be affected by variations in when and what portions of streams freeze (Kingery 1996).

Some studies showed winter densities at particular locations are higher than breeding season density (Warren 1914; Bakus 1959a). It may be easier to monitor birds in winter if most of their habitat freezes up and they concentrate at a few open areas or a few roosting areas. This type of monitoring would require an understanding of the population's winter activities and some indication that winter locations did not vary too much from year to year.

The South Dakota Game, Fish and Parks Department has had good survey results with a monitoring route designed specifically to follow dipper habitat, where observed dippers are counted at stops along the route (Backlund 2001). Another possibility for monitoring during breeding season is to identify active nests or territories and check them each year.

# ADDITIONAL INFORMATION NEEDS

Several pieces of information are needed to more effectively manage American dippers in the Black Hills. First, information on the population distribution and movements in the Black Hills must be obtained. Information is currently available on nesting sites (Backlund 1994, 2001), but little is understood about how the population changes over time, where the birds spend the winter, and whether production is high enough for the population to be maintained. Initial cost of obtaining this information may be expensive as birds would need to be captured and banded. Subsequent monitoring of these birds would be of moderate cost as only new individuals would need to be banded.

Another area where information is needed is the water quality of the streams that the dipper is using. What are the flow regimes, invertebrate abundance, and levels of pollution in these streams? Hard data on how human activities are affecting the water quality in the Black Hills essential. Once birds are located, monitoring water quality on those streams would be of low cost, but would be very important to maintaining dipper populations.

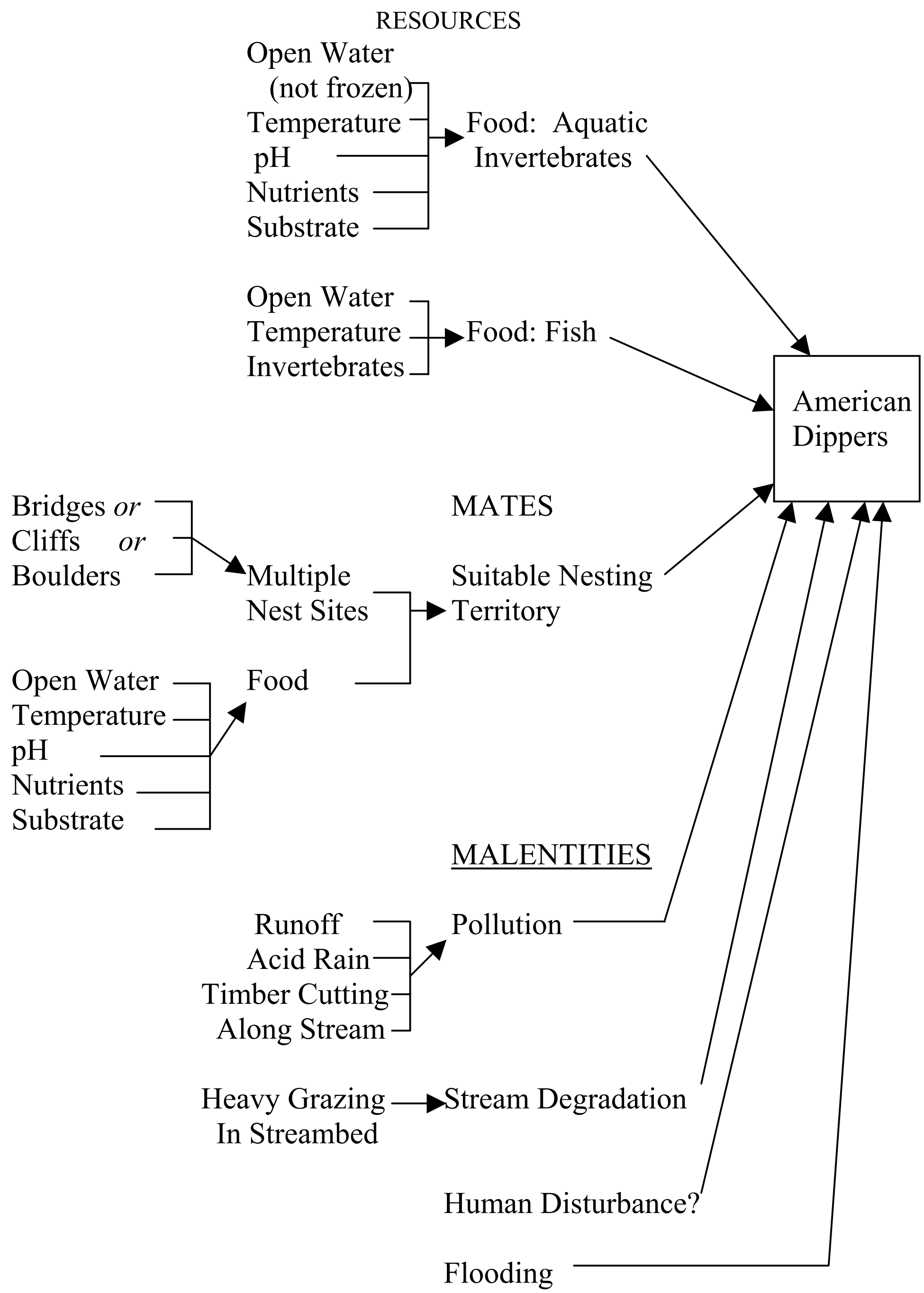
Movements of the birds in the Black Hills is not well understood. Current work is underway to investigate genetic ties to other dipper populations (Shane Sarver, personal communication). This will indicate the historical ties of the dipper population. If no genetic ties exist, the population in the Black Hills would gain additional significance as a genetically unique population. Should genetic ties be found, it may be possible to introduce dippers from other areas to supplement the Black Hills population. However, a better understanding is still needed of movements within the Hills.

Backlund (2001) discusses numerous sightings on creeks outside of Spearfish Canyon but almost no nests, even in areas where the birds thrived historically. Nest boxes on the other streams have not resulted in nesting in the other areas (Backlund 2001). Two possibilities to explain this phenomenon need further study. First, are the Black Hills birds so restricted in movement that they rarely leave their natal watershed? This seems unlikely, but could be determined by the use of radio tags to track the movements of the birds. Radio-tracking is quite time consuming and expensive, but may be necessary to answer this question.

A second possibility, suggested by Backlund (2001), is that these other creeks are no longer able to provide suitable habitat for the dippers due mainly to pollution and sedimentation. Restoration of these creeks may be necessary to enable them to support dippers. The expansion of the dippers to include more of their historic habitats in the Black Hills is important to the long-term survival of this population.

**Figure 1.** Envirogram of the American Dipper in the Black Hills National Forest. Predators are not well enough understood to include.

| WEB | | | | CENTRUM |
|---|---|---|---|---|
| 4 | 3 | 2 | 1 | |



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## DEFINITIONS

Altricial - young that are basically helpless at birth.

Breeding Bird Survey - an annual survey of birds during the breeding season conducted across North America. The survey consists of over 4,100 routes that are each 24.5 miles long. Every 0.5 miles, birds within a 0.25-mile radius are counted for 3 minutes. (see Sauer and others 2001).

Christmas Bird Count - an annual survey of birds at Christmastime across North America. The survey consists of approximately 2,000 circles, each 15 miles in diameter, where birds are counted in December and January. Various ways of counting the birds are used. (Audubon Society 2001).

Fledgling - young birds that have left the nest.

Monophyletic - all of the members of a group that are descended from a common ancestor.

Passerine - a song bird.

Phenology - the timing of events.