RARE AND DECLINING FISHES OF SOUTH DAKOTA: A RIVER DRAINAGE SCALE PERSPECTIVE

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ABSTRACT

We summarized the status of fishes that have declined from one or more of the 14 major river drainages in South Dakota and of fishes that are restricted to only one river drainage in the state, even if they have not declined. These species are of conservation concern because declines indicate sensitivity to environmental change and restricted distributions indicate relatively high extinction risk. We documented 35 species that had declined from one or more river drainages and six species that have not declined, but are restricted to only one river drainage. The species were not necessarily of equal conservation concern because some had declined more than others, and some maintained greater present-day (post-1990) distributions than others. Thus, we determined relative conservation concern by combining the numeric rank of each species by the number of drainages from which it was missing with the number of drainages presently occupied. We also used a literature review to summarize impacts that affect each species elsewhere. This review suggested that impacts of erosion (siltation, pollution) and channel modification (channelization, riparian degradation, etc.) are the most substantial, but barriers to dispersal, water withdrawals, and wetland drainage are also important. This analysis is limited because it only considers declines at the river-drainage scale, but it nonetheless provides the first comprehensive summary of the status of South Dakota fishes.

Keywords

Fish conservation, South Dakota, human impacts, conservation assessment, river drainage scale

INTRODUCTION

There is increasing concern for freshwater fish conservation in North America (Pister 1999, Abell 2002, McKinney 2002). Many taxa are extinct (Miller et al. 1989), extinction rates are increasing (Wilcove et al. 1992), and may increase further (Ricciardi and Rasmussen 1999). Eight species are extinct from South Dakota (Hoagstrom 2006) and nine are state threatened or endangered, one of which is also federally endangered (SDGFP 2006). Another species, Topeka shiner *Notropis topeka*, is federally endangered, though not state endangered.

There are often no quantifiable characteristics of endangered or threatened species. That is, the status of species afforded legal protection can vary greatly and some protected species may be more secure than unprotected ones. For example, the northern redbelly dace *Phoxinus eos* is widespread throughout South Dakota and a new population has been recently discovered (Morey and Berry 2004). This species is presumably listed as state threatened because it inhabits small, isolated habitats though it has not declined in South Dakota. In contrast, the lake chub *Couesius plumbeus* was once widespread within streams of the Black Hills and was also present in the Crow Creek and Little Missouri River drainages (Bailey and Allum 1962, Isaak et al. 2003). Based on recent surveys, only one substantial population now represents the species (Isaak et al. 2003), but despite these declines, the lake chub is unprotected. The primary reasons for such discrepancies are: (1) fish species status is difficult to assess because it relies on the availability of information that varies greatly by species and location; and (2) formal protection of fish species is instituted via a political process that is subject to many factors, only one of which is scientific data.

Our purpose in this paper is to provide a perspective on species status by applying a standard assessment that treats all native South Dakota fishes equally. The intent of this approach is to provide the first statewide synthesis of native fish species declines, which we use to summarize patterns of decline, identify conservation priorities, recommend conservation strategies, and recommend research and management practices. Our hope is that this effort will improve awareness of fish conservation issues and highlight opportunities for conservation and restoration. We do not necessarily want to increase the number of species that are given legal protection. Rather, we hope that increasing knowledge of fish species status will reduce the need for legal action and focus justifiable legal action where it is most needed.

METHODS

Hoagstrom (2006) reviewed fish collection records from South Dakota and constructed a list of fish species by major river drainage. Given the sparsity of data on fish distribution and abundance throughout South Dakota, we considered the river drainage scale to be the smallest spatial scale suitable for a statewide analysis. Hoagstrom (2006) recognized 14 major river drainages within the state and divided the Missouri River Valley (the mainstem Missouri River with minor direct tributaries) into two sections with Fort Randall Dam as the boundary (Figure 1). We used his list to identify native fish species that have declined or are rare at the river drainage scale. Declines and rarity at the river drainage scale are

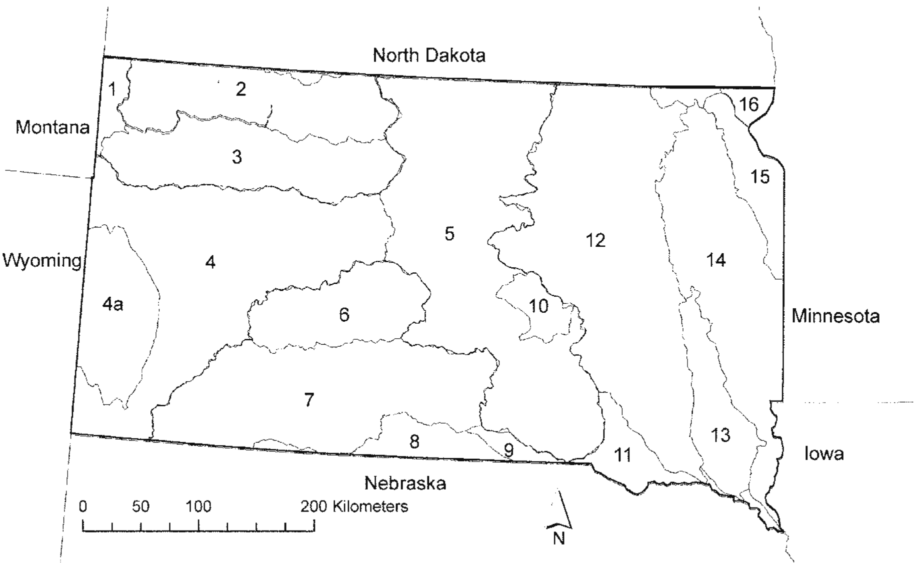

Figure 1. Map of South Dakota and adjacent areas that shows the 14 river drainages and two sections of the Missouri River Valley. River drainages are the (1) Little Missouri River, (2) Grand River, (3) Moreau River, (4) Cheyenne River (drainage 4a represents the Black Hills, a unique physiographic regions lying entirely within the Cheyenne River drainage), (5) upper Missouri River valley, (6) Bad River, (7) White River, (8) Niobrara River, (9) Ponca Creek, (10) Crow Creek, (11) lower Missouri River valley, (12) James River, (13) Vermillion River, (14) Big Sioux River, (15) upper Minnesota River, (16) Bois de Sioux River.

a concern because they represent substantial range losses (Patton et al. 1998) and restriction to a low number of river drainages increases extinction risk (Moyle and Williams 1990).

For this assessment, we used post-1990 surveys as representative of modern status because most of the major river drainages have been surveyed since that time (Kral and Berry 2005, Hoagstrom 2006). We defined rare species as native fishes that have not necessarily declined, but are restricted to one river drainage within South Dakota because restriction to one river drainage increases the risk of extinction (Moyle and Williams 1990). Our definition of declining species was native fishes that were missing from post-1990 collections in well-sampled river drainages. Well-sampled drainages were those in which post-1990 surveys were clearly more extensive than historical (pre-1990) surveys. We reasoned that if a fish species was documented by sparse historical surveys, but undetected by relatively extensive recent surveys, then there was legitimate reason to consider a species as truly 'missing'. However, it is always possible that future surveys will discover undocumented populations of species we report as missing (Hayer et al. 2006).

All river drainages of South Dakota were more extensively sampled recently than historically, except for the Bois de Sioux River, Crow Creek, and the Little Missouri River (Hoagstrom 2006). Species missing only from recent collections in one or more of these three poorly sampled drainages were not considered declining. However, we noted declines from the three poorly sampled river drainages for species that were missing from one or more well sampled drainages.

We present a review of the distribution for each declining and rare fish species and a general review of the biology of each species in relation to conservation in South Dakota and range-wide. Based on this literature review, we summarize impacts that affect declining and rare fish species and rank the impacts based on the number of species affected. We also summarize patterns of species declines and of species persistence by river drainage. These summaries are used to recommend priorities for native fish conservation, restoration, and management.

RESULTS AND DISCUSSION

We documented 35 fish species that had declined within South Dakota at the river drainage scale and six species that were rare (Table 1). Eight of the 35 declining fish species were absent from all recent surveys and are presumably extinct from South Dakota. Declines of an additional seven species have restricted them to one river drainage. Below, we provide a species by species review with an accompanying review of their conservation ecology. Following the species accounts, we summarize general patterns among species.

Table 1. Status of rare and declining fish species of South Dakota by river drainage (Hoagstrom 2006). Italics = species absent from post-1990 collections, n = native species. Fish names follow Nelson et al. (2004).

FAMILIES, SPECIES, AND SUBSPECIES	CENTRAL LOWLANDS						GREAT PLAINS									
	Bois de Sioux River	Upper Minnesota River	Big Sioux River	Vermillion River	James River	Missouri Valley (lower)	Niobrara River	Ponca Creek	White River	Crow Creek	Bad River	Cheyenne River	Moreau River	Grand River	Missouri Valley (upper)	Little Missouri River
PETROMYZONTIDAE lampreys																
Ichthyomyzon unicuspis				*n*		*n*				*n*						
silver lamprey																
ACIPENSERIDAE sturgeons																
Ascipenser fulvescens						n										
lake sturgeon																
POLYODONTIDAE paddlefishes																
Polyodon spathula			*n*	*n*	n	n									*n*	
paddlefish																
LEPISOSTEIDAE gars																
Lepisosteus osseus		*n*	*n*	n	n	n				*n*						
longnose gar																
AMIIDAE bowfins																
Amia calva		*n*														
bowfin																

Table 1 continued.

FAMILIES, SPECIES, AND SUBSPECIES	CENTRAL LOWLANDS						GREAT PLAINS									
	Bois de Sioux River	Upper Minnesota River	Big Sioux River	Vermillion River	James River	Missouri Valley (lower)	Niobrara River	Ponca Creek	White River	Crow Creek	Bad River	Cheyenne River	Moreau River	Grand River	Missouri Valley (upper)	Little Missouri River
HIODONTIDAE mooneyes																
Hiodon tergisus			*n*													
mooneye																
ANGUILLIDAE freshwater eels																
Anguilla rostrata		*n*	*n*	*n*	n	n									*n*	
American eel																
CYPRINIDAE carps and minnows																
Couesius plumbeus										*n*		n				*n*
lake chub																
Hybognathus argyritis			*n*	*n*		n	n		n	*n*	*n*	n	n	n	n	n
western silvery minnow																
H. hankinsoni	*n*	n	n	n	n	n	n	n	n	*n*		n	n	n	n	*n*
brassy minnow																
H. placitus						*n*	*n*		n		n	n	n	n	n	n
plains minnow																
Macrhybopsis gelida						n			n			n		*n*	*n*	*n*
sturgeon chub																
M. meeki						n									*n*	
sicklefin chub																
M. hyostoma						n										
shoal chub																
Nocomis biguttatus	*n*	n	*n*													
hornyhead chub																
Notemigonus crysoleucas		n	*n*	n	*n*	n	n		n		n	n	n	n	n	n
golden shiner																
Notropis blennius				*n*		n										
river shiner																
N. heterodon		*n*														
blackchin shiner																
N. heterolepis	*n*	n	n		*n*	*n*	n		*n*						*n*	
blacknose shiner																
N. percobromus		n	*n*													
carmine shiner																
N. shumardi				*n*		*n*									*n*	
silverband shiner																
Phenacobius mirabilis			*n*			n				*n*					n	
suckermouth minnow																
Phoxinus erythrogaster			n													
southern redbelly dace																
Platygobio gracilis			*n*	*n*		n	n		n		n	n	n	n	n	n
flathead chub																

Table 1 continued.

FAMILIES, SPECIES, AND SUBSPECIES	CENTRAL LOWLANDS						GREAT PLAINS									
	Bois de Sioux River	Upper Minnesota River	Big Sioux River	Vermillion River	James River	Missouri Valley (lower)	Niobrara River	Ponca Creek	White River	Crow Creek	Bad River	Cheyenne River	Moreau River	Grand River	Missouri Valley (upper)	Little Missouri River
Rhinichthys cataractae cataractae	*n*						n	n	n		*n*	n	n	n	*n*	n
longnose dace																
R. obtusus		n	n	n	n	*n*	n		*n*	*n*						
western blacknose dace																
CATOSTOMIDAE suckers																
Carpiodes velifer			*n*			n										
highfin carpsucker																
Catostomus catostomus												n				
longnose sucker																
Catostomus platyrhynchus												n				
mountain sucker																
Hypentelium nigricans		*n*	*n*													
northern hog sucker																
Ictiobus niger			*n*		*n*	*n*										
black buffalo																
ICTALURIDAE North American catfishes																
Ictalurus furcatus			n		*n*	*n*									n	
blue catfish																
Noturus flavus		*n*	n	n	n	n	n		n			n	n	n	n	n
stonecat																
N. gyrinus		n	n	n	n	*n*										
tadpole madtom																
Pylodictis olivaris			n	n	n	n			*n*						n	
flathead catfish																
PERCOPSIDAE trout-perches																
Percopsis omiscomaycus		*n*	n													
trout-perch																
GADIDAE cods																
Lota lota maculosa				*n*		n						*n*			n	
burbot																
FUNDULIDAE topminnows																
Fundulus kansae												n				
northern plains killifish																
F. sciadicus			n	*n*	n	*n*	n		n			n				
plains topminnow																
PERCIDAE perches																
Etheostoma exile	*n*	n	n	n	n	n	n		n	*n*		n	n	n	n	*n*
Iowa darter																
Percina phoxocephala		*n*														
slenderhead darter																

SPECIES ACCOUNTS

Silver Lamprey (*Ichthyomyzon unicuspis*).— South Dakota status: missing.

In South Dakota, the silver lamprey is missing from the ***Vermillion River, lower Missouri River valley****, and* ***Crow Creek*** *drainages (Figure 2), which it formerly occupied (Bailey and Allum 1962).*

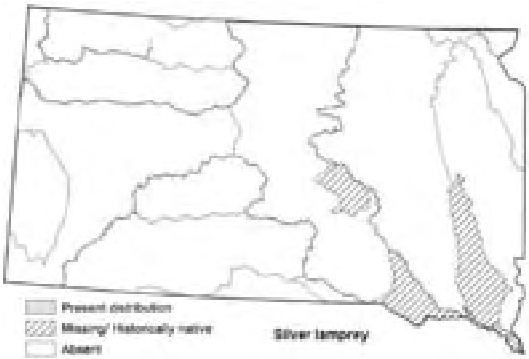

Figure 2. Silver lamprey present and historical distribution by drainage in South Dakota.

The silver lamprey is typical of large rivers and lakes (Becker 1983). It is parasitic and is most commonly associated with sturgeons and catfishes, though it may parasitize a variety of fishes (Becker 1983). Silver lamprey requires clear-water streams without excessive silt where ammocoetes (a developmental stage) can burrow (Trautman 1981). The ammocoete stage lasts 4 to 7 years (Scott and Crossman 1973). Dams impact silver lampreys by blocking migrations of adults, which drift downstream after transforming from ammocoetes and later migrate upstream to spawn (Trautman 1981). Thus, the siltation of nursery streams and dam construction presumably impacted the silvery lampreys of South Dakota.

Lake sturgeon (*Ascipenser fulvescens*).— South Dakota status: restricted native range.

In South Dakota, the lake sturgeon is present in the **lower Missouri River valley** below Gavins Point Dam (Kral personal communication), which is the extent of its known range in the state (Figure 3). Lake sturgeon captures are rare in South Dakota (Shearer personal communication) and there is no record of the species spawning in the state.

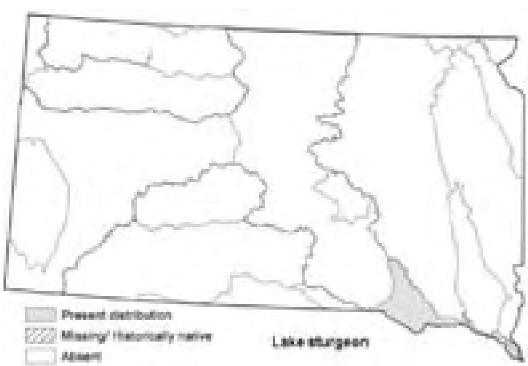

Figure 3. Lake sturgeon present and historical distribution by drainage in South Dakota.

Paddlefish (*Polyodon spathula*).— South Dakota status: declining.

In South Dakota, the paddlefish is missing from the ***Big Sioux River*** *drainage (Figure 4), which it formerly occupied (Bailey and Allum 1962).* The species is still present in the **Vermillion River** (Kral personal communication), **James River** (Berry et al. 1993), **lower Missouri River valley** (Wickstrom 1997, Berry and Young 2004), and **upper Missouri River valley** (Lott et al. 1994) drainages. It is managed as a game fish species in South Dakota.

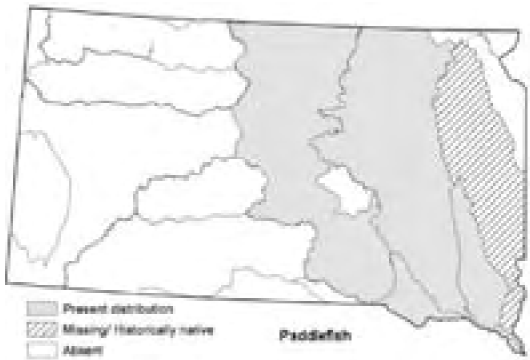

Figure 4. Paddlefish present and historical distribution by drainage in South Dakota.

Paddlefish are typical of large rivers and lakes (Becker 1983). The species undergoes spawning migrations (e.g., Lein and DeVries 1998, Paukert and Fisher 2001) and thus may be negatively impacted by dams (Trautman 1981). The decline of paddlefish from South Dakota is presumably related to dams and habitat degradation, such as siltation that impacts spawning habitat.

Longnose gar (*Lepisosteus osseus*).— South Dakota status: declining.

In South Dakota, the longnose gar is missing from the ***Upper Minnesota River, Big Sioux River****, and* ***Crow Creek*** *drainages (Figure 5), which it historically occupied (Bailey and Allum 1962).* The species is still present in the **Vermillion River** (Kral personal communication), **James River** (Shearer and Berry 2003), and **lower Missouri River valley** (Berry and Young 2004, Shuman et al. 2005) drainages.

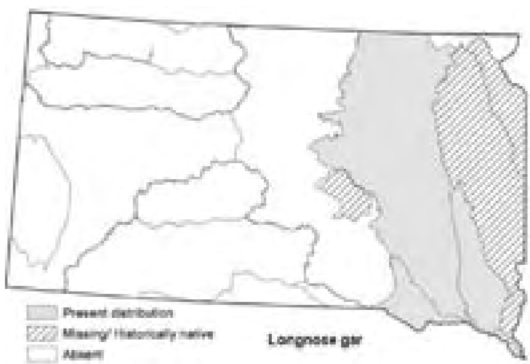

Figure 5. Longnose gar present and historical distribution by drainage in South Dakota.

The longnose gar is most successful in clear-water habitats (Trautman 1981). Spawning habitat includes either silt-free rocky stream bottoms with moderate current or calm waters with vegetation (Cross 1967) and the species may undertake migrations to reach such habitat (Netsch and Witt 1962). Thus, the decline of longnose gar from South Dakota is likely related to dams that impede migrations (if they occur) and the degradation of spawning habitat due to siltation or loss of instream vegetation. Increasing turbidity due to erosion may also impact the species.

Bowfin (*Amia calva*).— Status: missing.

In South Dakota, the bowfin was presumably present in the ***Upper Minnesota River*** *drainage (Figure 8) and may have been widespread in the eastern portion of the state (Bailey and Allum 1962).*

The western extent of the historical range of bowfin is uncertain (Bailey and Allum 1962, Cross 1967). If the species was historically present in South Dakota, it may have been eliminated by degradation of riverine wetlands such as backwaters and oxbows via drought and human impacts (Bailey and Allum 1962, Cross 1967).

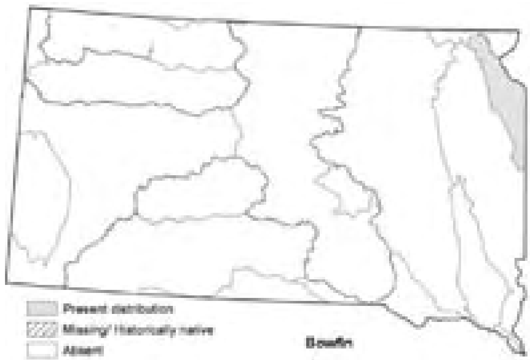

Figure 8. Bowfin present and historical distribution by drainage in South Dakota.

Mooneye (*Hiodon tergisus*).— South Dakota status: missing.

In South Dakota, the mooneye is missing from the ***Big Sioux River*** *drainage (Figure 7), where it formerly was present (Gilbert 1978).*

The mooneye occupies large rivers and lakes with clear waters (Trautman 1981). The species undergoes spring migrations for spawning (Trautman 1981, Becker 1983). Human impacts that reduced water clarity and inhibited migration, both of which have occurred in the Big Sioux River drainage (Sinning 1968), presumably eliminated the mooneye from South Dakota waters.

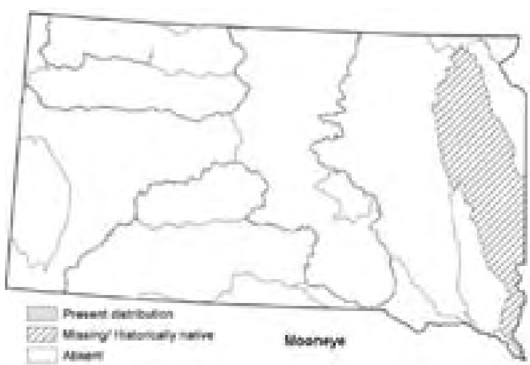

Figure 7. Mooneye present and historical distribution by drainage in South Dakota.

American eel (*Anguilla rostrata*).— South Dakota status: declining.

In South Dakota, the American eel is missing from the ***Upper Minnesota River, Big Sioux River, Vermillion River****, and* ***upper Missouri River valley*** *drainages (Figure 8), where it formerly was present (Bailey and Allum 1962, Lee 1978).* The species is still present in the **James River** and **lower Missouri River valley** drainages (Berry et al. 1993).

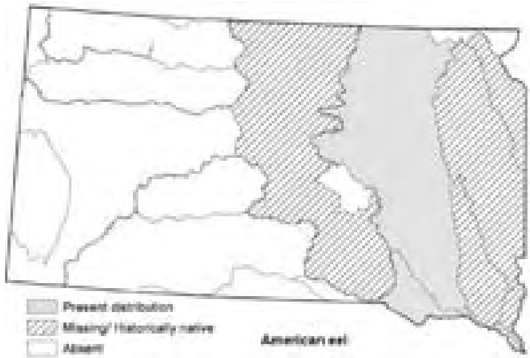

Figure 8. American eel present and historical distribution by drainage in South Dakota.

The American eel is catadromous, meaning it migrates downstream (to the sea) to spawn. Dams impede these migrations and have eliminated eels from many waters. In South Dakota, presence of dams has likely eliminated eels from the upper Missouri River valley and they presumably contributed to the decline of eels from the Upper Minnesota River, Big Sioux River, and Vermillion River drainages as well.

Lake chub (*Couesius plumbeus*).— South Dakota status: declining.

In South Dakota, the lake chub is missing from the ***Crow Creek*** *and the* ***Little Missouri River*** *drainages (Figure 9), where it formerly occurred (Bailey and Allum 1962).* The species is still present in the Cheyenne River drainage in the Black Hills, but has declined in distribution (Isaak et al. 2003). The major remnant population inhabits Deerfield Reservoir (Isaak et al. 2003).

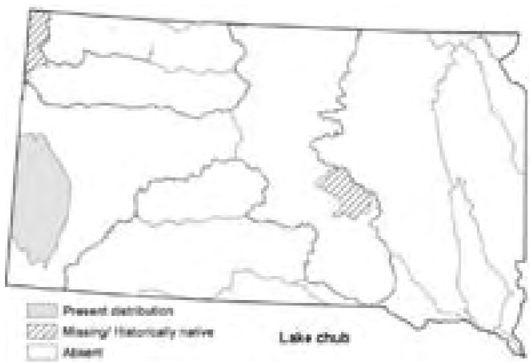

Figure 9. Lake chub present and historical distribution by drainage in South Dakota.

The lake chub may inhabit lakes or small streams (McPhail and Lindsey 1970, Brown 1971) but is typically found in cool or cold waters (Becker 1983). In South Dakota, the lake chub was known from clear and cold streams (Evermann and Cox 1896). The decline of the lake chub from the state may have resulted from stream warming due to habitat degradation such as siltation and the destruction of riparian areas. Water withdrawals may have also played a role. For example, the flow of many Black Hills streams is largely diverted (Burr et al. 1999), which certainly increases water temperatures in depleted reaches. It is also possible that introduced trout impacted lake chub via predation and competition.

Western silvery minnow (*Hybognathus argyritis*).— South Dakota status: declining.

In South Dakota, the western silvery minnow is missing from the ***Big Sioux River, Vermillion River, Crow Creek,*** *and* ***Bad River*** *drainages (Figure 10), where it formerly was present (Bailey and Allum 1962).* The species is still present in the **lower Missouri River valley** (Berry and Young 2004), **Niobrara River** (Cunningham et al. 1995), **White River** (Cunningham et al. 1995, Fryda 2001, Harland 2003), **Cheyenne River** (Cunningham et al. 1995, Hampton and Berry 1997, Doorenbos 1998, Duehr 2004, Hoagstrom 2006), **Moreau River** (Loomis et al. 1999, Duehr 2004), **Grand River** (Erickson personal communication), **upper Missouri River valley** (Harland 2003), and **Little Missouri River** drainages (Erickson personal communication).

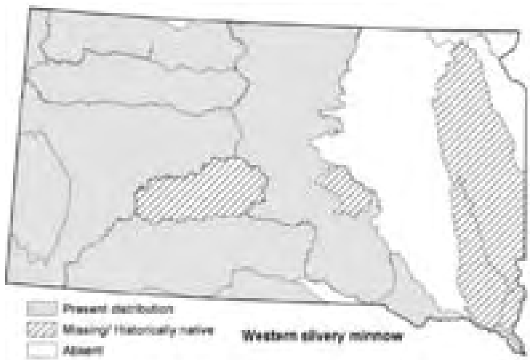

Figure 10. Western silvery minnow present and historical distribution by drainage in South Dakota.

The western silvery minnow is typical of relatively large streams of the Missouri River drainage (Baxter and Stone 1995) but is also known from some smaller tributaries (Duehr 2004). Although commonly associated with the similar plains minnow *Hybognathus placitus,* the distributions of these species in South Dakota are not identical (Bailey and Allum 1962, Hoagstrom 2006). As a large-river species, the decline of the western silvery minnow is probably associated with the upstream and downstream impacts of dams and reservoirs on the mainstem Missouri River and most of the major tributary rivers (Hesse et al. 1993). Changes associated with dams that appear to impact the western silvery minnow include sediment starvation and substrate scour, as well as the introduction of nonnative piscivorous fishes (Quist et al. 2004). The loss of shallow, low-velocity habitats due to river channel degradation or modification also impacts this species (Pflieger and Grace 1987, Welker and Scarnecchia 2004).

Dissection is necessary to distinguish the western silvery minnow from the plains minnow (Bailey and Allum 1962). This dissection is absolutely necessary to accurately document the distributions of both declining species.

Brassy minnow (*Hybognathus hankinsoni*).— South Dakota status: declining.

In South Dakota, the brassy minnow is missing from the ***Bois de Sioux River, Crow Creek****, and* ***Little Missouri River*** *drainages (Figure 11), which it historically inhabited (Bailey and Allum 1962).* The species is still present in the **Upper Minnesota River** (Dieterman and Berry 1994, USGS 2002, 2003), **Big Sioux River** (Dieterman and Berry 1998, Blausey 2001, Milewski 2001, USGS 2002, 2004, Hayer et al. 2006), **Vermillion River** (Braaten and Berry 1997, Blausey 2001, USGS 2001, 2002, 2003, 2004), **James River** (Blausey 2001, USGS 2002, 2003, Shearer and Berry 2003), **lower Missouri River valley** (USGS 2002, Berry and Young 2004, Wickstrom 2004), **Niobrara River** (Cunningham et al. 1995, USGS 2003, Harland and Berry 2004), **Ponca Creek** (USGS 2003), **White River** (Cunningham et al. 1995, USGS 2002, 2004, Harland 2003), **Cheyenne River** (Erickson personal communication), **Moreau River** (Loomis et al. 1999), **Grand River** (Erickson personal communication), and **upper Missouri River valley** (Johnson et al. 1995, Harland 2003) drainages.

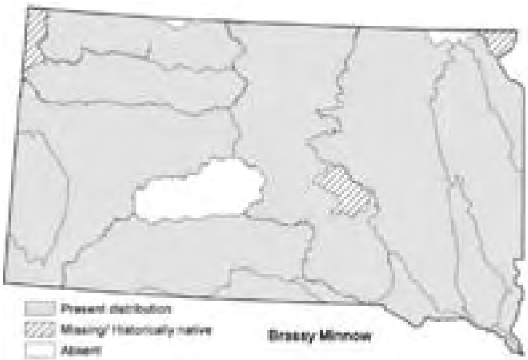

Figure 11. Brassy minnow present and historical distribution by drainage in South Dakota.

The brassy minnow is characteristic of small sluggish streams (Becker 1983). The species is highly tolerant and mobile, but is susceptible to mortality in drying pools (Scheurer et al. 2003). It is sensitive to human impacts that reduce aquatic vegetation, increase water temperature, and increase turbidity (Cross and Moss 1987). Deep pools that persist throughout dry periods, perennial stream sections, and the absence of barriers that block dispersal are necessary to maintain populations (Scheurer et al. 2003).

Plains minnow (*Hybognathus placitus*).— South Dakota status: declining.

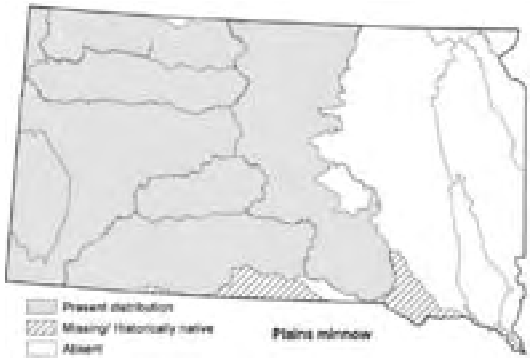

Figure 12. Plains minnow present and historical distribution by drainage in South Dakota.

In South Dakota, the plains minnow is missing from the ***lower Missouri River valley*** *and* ***Niobrara River*** *drainages (Figure 12), which it historically inhabited (Bailey and Allum 1962).* The species is still present in the **White River** (Cunningham et al. 1995, Fryda 2001, USGS 2001, Harland 2003), **Bad River** (Milewski 2001, Harland 2003), **Cheyenne River** (Cunningham et al. 1995, Hampton and Berry 1997, Doorenbos 1998, Duehr 2004, Hoagstrom 2006), **Moreau River** (Loomis et al. 1999, Duehr 2004), **Grand River** (USGS 2001), **upper Missouri River valley** (USGS 2001, Harland 2003), and **Little Missouri River** (Erickson personal communication) drainages.

The decline of the plains minnow is presumably caused by factors similar to those that have caused the decline of the western silvery minnow (see above). However, negative impacts of dams on plains minnow are better documented. The plains minnow appears to be negatively impacted by excessive dewatering by surface water diversion or groundwater pumping (Cross and Moss 1987, Bonner and Wilde 2000), sediment starvation and reduced water temperatures below dams (Anderson et al. 1983), and population fragmentation by dams (Winston et al. 1991, Pittenger and Schiffmiller 1997). Plains minnow may be particularly susceptible to population fragmentation because their semibuoyant-nonadhesive eggs and early protolarvae are susceptible to downstream drift and may be transported into reservoirs or over diversion dams (Fausch and Bestgen 1997, Platania and Altenbach 1998). Over time, downstream losses of eggs and larvae could potentially deplete upstream populations because dams and reservoirs preclude recolonization from downstream. Finally, altered flow regimes below dams may impact the plains minnow, particularly because spawning occurs in conjunction with high flow events (Cross and Moss 1987, Lehtinen and Layzer 1988). Although the early life history of the western silvery minnow is unknown, it is likely similar to that of the plains minnow and thus both species presumably are impacted similarly by dams and reservoirs.

Sturgeon chub (*Macrhybopsis gelida*).— South Dakota status: declining.

In South Dakota, the sturgeon chub is missing from the ***Grand River, upper Missouri River valley,*** *and* ***Little Missouri River*** *drainages (Figure 13), which it formerly occupied (Bailey and Allum 1962).* The species is still present in the lower **Missouri River valley** below Gavins Point Dam (Kral personal communication), the mainstem **White River** (Cunningham et al. 1995, Fryda 2001, USGS 2002, 2003), and the mainstem **Cheyenne River** (Cunningham et al. 1995, Hampton and Berry 1997, Hoagstrom 2006).

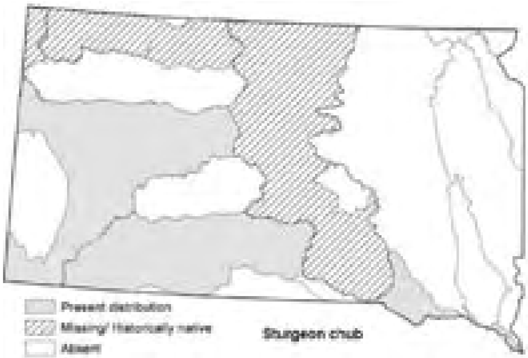

Figure 13. Sturgeon chub present and historical distribution by drainage in South Dakota.

Figure 14. Captive reared sturgeon chub from egg collected using a Moore pelagic egg collector.

Factors associated with the decline of the sturgeon chub are similar to those associated with other Great Plains fishes, such as the western silvery minnow and plains minnow (see above). The sturgeon chub is most common in turbulent, swift-water habitats where substrate is relatively coarse (Bailey and Allum 1962, Cross 1967). Thus, sturgeon chub may be less adversely affected by channel degradation and channelization than western silvery minnow and plains minnow (Pflieger and Grace 1987). However, it may be more adversely affected by dewatering than those species because it depends on swift-water habitats. For example, the combined effects of drought and habitat fragmentation by a reservoir could have led to the extinction of sturgeon chub from the Little Missouri River (Kelsch 1994). The early life-history of the sturgeon chub may be similar to that of the western silvery minnow and plains minnow (see above). In 2003, the senior author used a Moore egg collector (Altenbach et al. 2000) to collect drifting eggs from the Cheyenne River near the Plum Creek confluence (Haakon County), one of which was a sturgeon chub egg (Figure 14).

Shoal chub (*Macrhybopsis hyostoma*).— South Dakota status: restricted native range.

The shoal chub is present in the **lower Missouri River** below Gavins Point Dam (Kral personal communication), which is the extent of its known distribution in South Dakota (Figure 15). The shoal chub was formerly grouped with several closely related species under the name speckled chub *Macrhybopsis aestivalis,* but is now recognized as a distinct species (Eisenhour 1999, 2004, Nelson et al. 2004).

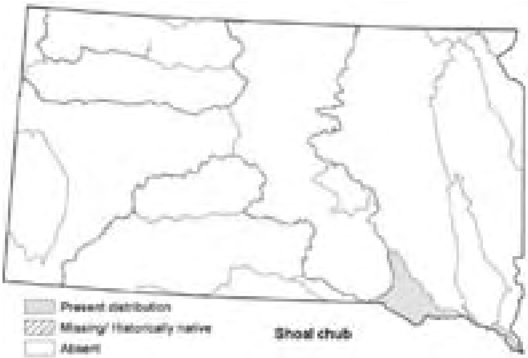

Figure 15. Shoal chub present and historical distribution by drainage in South Dakota.

Sicklefin chub (*Macrhybopsis meeki*).— South Dakota status: declining.

In South Dakota, the sicklefin chub is missing from the ***upper Missouri River valley*** *drainage (Figure 16), where it was previously present (Bailey and Allum 1962).* The species is still present in the **lower Missouri River valley** drainage below Gavins Point Dam (Berry and Young 2004, Kral personal communication).

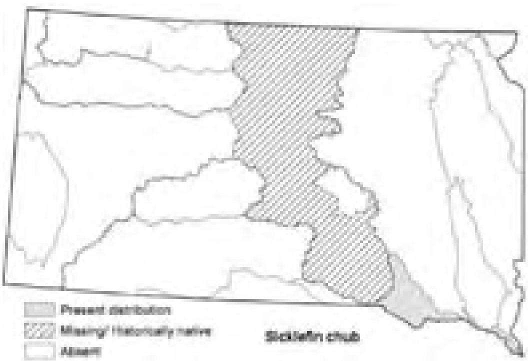

Figure 16. Sicklefin chub present and historical distribution by drainage in South Dakota.

Given that the sicklefin chub is restricted to only the largest rivers of the Missouri River drainage, it is likely that major modifications to these rivers, primarily dams and reservoirs, have caused the decline of this species. Remaining populations of sicklefin chub are largest where rivers are least modified (Welker and Scarnecchia 2004). Like the sturgeon chub, the species is not as impacted by river channelization as western silvery minnow and plains minnow, presumably because benthic swift-water habitat is still available (Pflieger and Grace 1987).

Hornyhead chub (*Nocomis biguttatus*).— South Dakota status: declining.

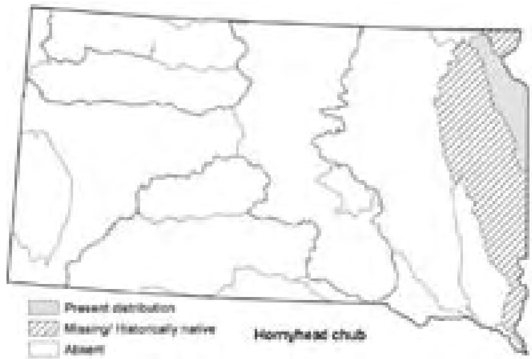

Figure 17. Hornyhead chub present and historical distribution by drainage in South Dakota.

*In South Dakota, the hornyhead chub is missing from the **Bois de Sioux River** and **Big Sioux River** drainages (Figure 17), where it was historically present (Bailey and Allum 1962).* It is still present in the **Upper Minnesota River** drainage (Dieterman and Berry 1994, Shearer unpublished data).

The hornyhead chub commonly inhabits small to medium-sized streams with clear water and gravel substrate (Cross 1967, Scott and Crossman 1973, Becker 1983). The species is impacted by siltation (Trautman 1981). In the Upper Minnesota River drainage of South Dakota, the hornyhead chub is associated with relatively cool waters and moderately sized streams (Dieterman and Berry 1994). Thus, siltation due to upland erosion, degradation to riparian vegetation, and depletion of water flows most likely explain the decline of hornyhead chubs within the state, similar to findings in Kansas (Cross 1967, Cross and Moss 1987).

Golden shiner (*Notemigonus crysoleucas*).— South Dakota status: declining.

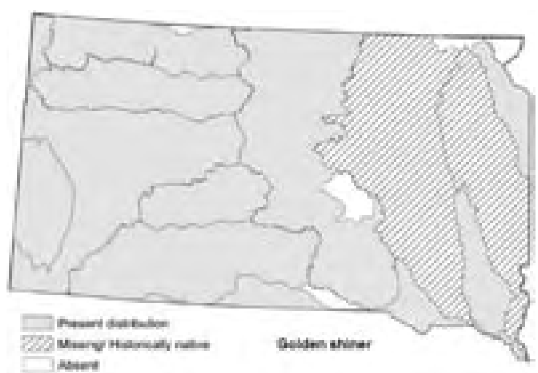

Figure 18. Golden shiner present and historical distribution by drainage in South Dakota.

*In South Dakota, the golden shiner is missing from the **Big Sioux River** and **James River** drainages (Figure 18), where it was historically present (Bailey and Allum 1962).* The species is still present in the **Vermillion River** (Braaten 1993), **Upper Minnesota River, lower Missouri River valley** (Berry and Young 2004), **Niobrara River** (Cunningham et al. 1995, Harland and Berry 2004), **White River** (Cunningham et al. 1995, USGS 2003), **Bad River** (Milewski 2001), **Cheyenne River** (Duehr 2004), **Moreau River** (Loomis et al. 1999, Duehr 2004), **Grand River** (USGS 2001, 2003), **upper Missouri River valley** (Johnson et al. 1995, Lott et al. 2004), and **Little Missouri River** (Berry and Young 2004, Wickstrom 2004) drainages.

Low-gradient streams and wetlands with clear water and abundant vegetation characterize the habitat of the golden shiner (Scott and Crossman 1973, Trautman 1981, Becker 1983). As a result, this species is impacted by increased turbidity and siltation, wetland drainage, and channelization (Trautman 1981). Thus, it is unsurprising the golden shiner has declined from the river drainages of eastern South Dakota where wetland drainage, channelization, and siltation caused by erosion are widespread. The golden shiner is a commonly used baitfish and introduced populations may become established in ponds, lakes, and impoundments (Eddy and Underhill 1974, Trautman 1981, Baxter and Stone 1995). As a result, this species may be more widespread than our records indicate because isolated populations may be present in lakes and impoundments.

River shiner (*Notropis blennius*).— South Dakota status: declining.

In South Dakota, the river shiner is missing from the ***Vermillion River*** *drainage (Figure 19), where it was once present (Bailey and Allum 1962).* The species is still present in the **lower Missouri River valley** (Berry and Young 2004, Shuman et al. 2005).

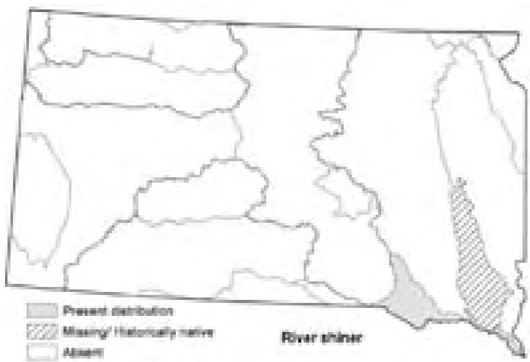

Figure 19. River shiner present and historical distribution by drainage in South Dakota.

Little is known about the river shiner except that it typically inhabits large rivers and lakes (Becker 1983). In the lower Missouri River, river shiner abundance increased after the river was channelized and impounded upstream, possibly because decreased turbidity favored it (Pflieger and Grace 1987). Thus, the decline of river shiner from the Vermillion River may have resulted from siltation and pollution that increased turbidity.

Blackchin shiner (*Notropis heterodon*).— South Dakota status: missing.

In South Dakota, the blackchin shiner may have been present in the ***upper Minnesota River*** *drainage (Bailey and Allum 1962, Figure 20).*

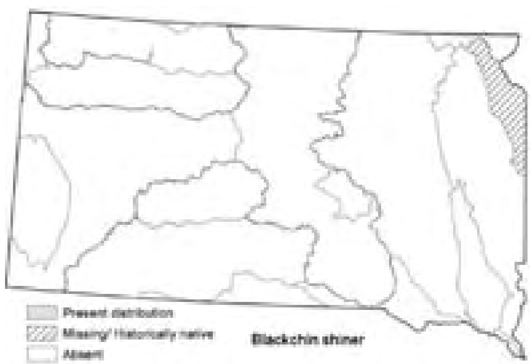

Figure 20. Blackchin shiner present and historical distribution by drainage in South Dakota.

The blackchin shiner is characteristic of glacial lakes and is very sensitive to human impacts (Trautman 1981, Becker 1983). It typically occupies clear, quiet waters with abundant vegetation (Scott and Crossman 1973, Trautman 1981). The rapid rate of its disappearance from throughout its historic range (Harlan and Speaker 1956, Eddy and Underhill 1974, Trautman 1981, Becker 1983) supports the supposition that this species was once present in South Dakota, but rapidly declined following human settlement.

Blacknose shiner (*Notropis heterolepis*).— South Dakota status: declining.

In South Dakota, the blacknose shiner is missing from the ***Bois de Sioux River, James River, lower Missouri River valley, White River,*** *and* ***upper Missouri River valley*** *drainages (Figure 21), which it formerly occupied (Bailey and Allum 1962, Fryda 2001).* The species is still present in the **Upper Minnesota River** (USGS 2004), **Big Sioux River** (USGS 2004), and **Niobrara River** (Cunningham et al. 1995) drainages.

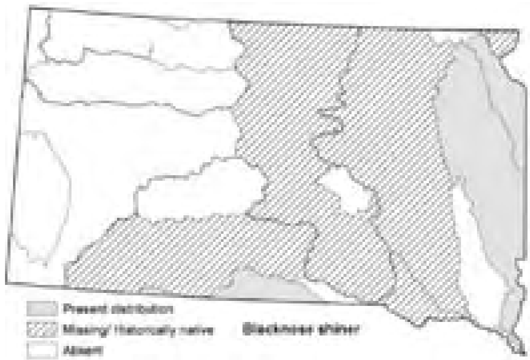

Figure 21. Blacknose shiner present and historical distribution by drainage in South Dakota.

The blacknose shiner typically inhabits clear waters with abundant vegetation and clean substrates in glacial lakes and low gradient streams (Trautman 1981, Becker 1983). As with the blackchin shiner, the blacknose shiner has rapidly declined throughout its range due to wetland loss, increased water turbidity, and siltation caused by erosion and pollution (Hubbs 1951, Harlan and Speaker 1956, Cross 1967, Smith 1979, Trautman 1981, Becker 1983, Cross and Moss 1987). These impacts most likely explain the dramatic decline of blacknose shiner from South Dakota (Bailey and Allum 1962).

Carmine shiner (*Notropis percobromus*).— South Dakota status: declining.

In South Dakota, the carmine shiner is missing from the ***Big Sioux River*** *drainage (Figure 22), where it formerly occurred (Dieterman and Berry 1998).* The species is still present in the **Upper Minnesota River** drainage (Dieterman and Berry 1994, USGS 2004). The carmine shiner was formerly grouped with several other species under the name rosyface shiner (*Notropis*

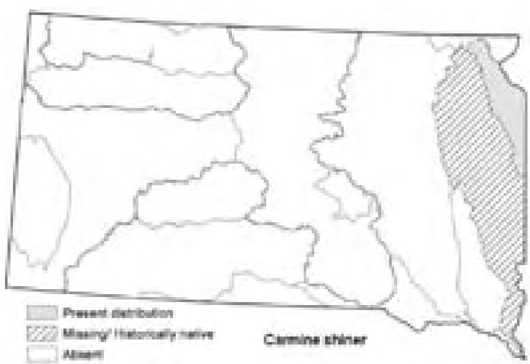

Figure 22. Carmine shiner present and historical distribution by drainage in South Dakota.

rubellus) but is now recognized as a distinct species (Wood et al. 2001, Nelson et al. 2004).

The carmine shiner typically occupies large streams and small rivers with clear water and clean substrates (Harlan and Speaker 1956, Smith 1979). The species is normally found in habitats with moderate flow and high gradients (Cross 1967, Smith 1979, Becker 1983). Overall, the species is sensitive to turbidity, though some populations may be more tolerant than others (Harlan and Speaker 1956, Becker 1983). The decline of carmine shiner from the Big Sioux River drainage was presumably associated with stream modifications and siltation.

Silverband shiner (*Notropis shumardi*).— South Dakota status: missing.

In South Dakota, the silverband shiner is missing from the ***Vermillion River, lower Missouri River valley,*** *and* ***upper Missouri River valley*** *drainages (Figure 23), which it formerly occupied (Bailey and Allum 1962).*

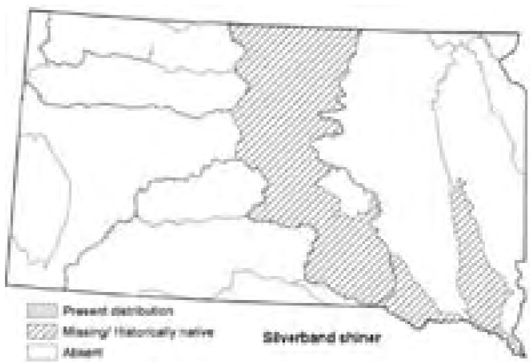

Figure 23. Silverband shiner present and historical distribution by drainage in South Dakota.

The silverband shiner is only known from large rivers and is tolerant of turbidity (Gilbert and Bailey 1962, Cross 1967, Smith 1979). It was a typical inhabitant of the historical Missouri River prior to human modifications for navigation and flood control but has declined since (Cross and Moss 1987). The decline of this species from the Missouri River and its major tributaries was apparently associated with the construction of dams and reservoirs, alteration of flow regimes, and degradation of riverine habitats.

Suckermouth minnow (*Phenacobius mirabilis*).— South Dakota status: declining.

In South Dakota, the suckermouth minnow is missing from the ***Big Sioux River*** *and* ***Crow Creek*** *drainages (Figure 24), which it formerly occupied (Bailey and Allum 1962, Dieterman and Berry 1998).* The species is still present in the **lower Missouri River valley** (Lott et al. 1994) and **upper Missouri River valley** (Lott et al. 2004) drainages.

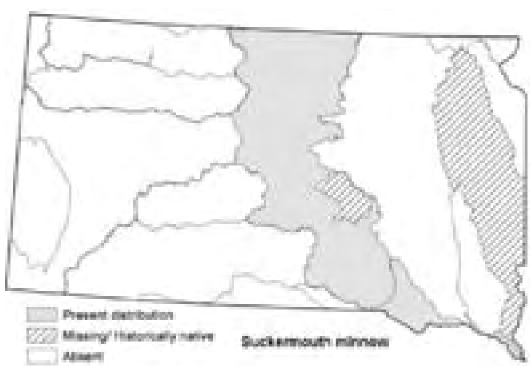

Figure 24. Suckermouth minnow present and historical distribution by drainage in South Dakota.

The suckermouth minnow primarily inhabits riffles in prairie streams with turbid waters, rich deposits of organic material, and clean gravel substrates (Cross 1967, Trautman 1981, Becker 1983). In the eastern portions of its range, the species has expanded its distribution in association with agricultural expansion (Trautman 1981, Becker 1983). The suckermouth minnow has declined from the western edge of its range due to declining base flows (Cross and Moss 1987). The reasons for the decline of this species from South Dakota are most likely associated with siltation of riffles or declining streamflow.

Southern redbelly dace (*Phoxinus erythrogaster*).—Status: restricted native range.

In South Dakota, the southern redbelly dace is only known from the **Big Sioux River** drainage (Springman and Banks 2005, Figure 25). It was first collected from the state in 2003 (Shearer, personal communication), but was historically present nearby in the Big Sioux River drainage of Minnesota (Underhill 1957, Springman and Banks 2005).

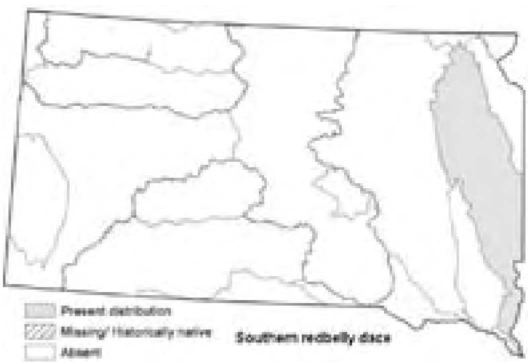

Figure 25. Southern redbelly dace present and historical distribution by drainage in South Dakota.

Flathead chub (*Platygobio gracilis*).—Status: declining.

*In South Dakota, the flathead chub is missing from the **Big Sioux River** and **Vermillion River** drainages (Figure 26), where it was once present (Bailey and Allum 1962).* The species is still present in the **lower Missouri River valley** (USGS 2002, Berry and Young 2004), **Niobrara River** (Harland and Berry 2004), **White River** (Cunningham et al. 1995, Fryda 2001, USGS 2001, 2002, 2003, 2004, Harland 2003), Bad River (Milewski 2001, Harland 2003), **Cheyenne River** (Cunningham et al. 1995, Hampton and Berry 1997, Doorenbos 1998, USGS 2001, 2002, 2004, Duehr 2004), **Moreau River** (Loomis et al. 1999, USGS 2002, 2003, Duehr 2004),

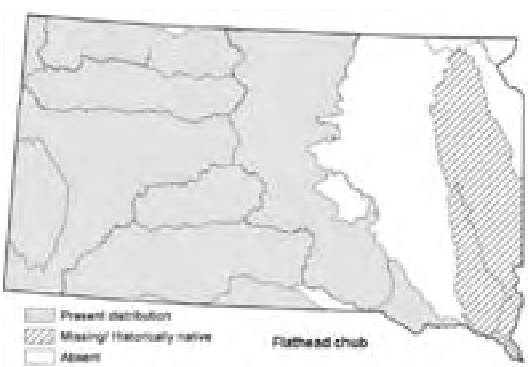

Figure 26. Flathead chub present and historical distribution by drainage in South Dakota.

Grand River (USGS 2001, 2002, 2004), **upper Missouri River valley** (Johnson et al. 1995, Harland 2003), and **Little Missouri River** drainages.

The flathead chub occupies a wide range of stream sizes (Brown 1971) but is most typical of turbid rivers (McPhail and Lindsey 1970, Baxter and Stone 1995). It was a typical inhabitant of the Missouri River basin prior to human modifications for navigation and flood control, but has recently declined (Cross and Moss 1987, Pflieger and Grace 1987, Hesse et al. 1993). Range-wide declines are associated with changes in flow regimes and substrate caused by dams and reservoirs (Quist et al. 2004, Welker and Scarnecchia 2004). In South Dakota, the flathead chub is still widely distributed among western rivers, but has declined from eastern rivers, perhaps due to river channel modifications (e.g., channelization). It declined from the lower Missouri River following channelization, presumably because habitat suitability declined (Pflieger and Grace 1987).

Longnose dace (*Rhinichthys cataractae*).— South Dakota status: declining.

In South Dakota, the longnose dace is missing from the ***Bois de Sioux River, Bad River,*** *and* ***upper Missouri River valley*** *drainages (Figure 27), where it was historically present (Bailey and Allum 1962).* It is still present in the **Niobrara River** (Cunningham et al. 1995, Harland and Berry 2004), **Ponca Creek** (USGS 2001), **White River** (Cunningham et al. 1995, Fryda 2001, USGS 2002, 2003, 2004, Harland 2003), **Cheyenne River** (Cunningham et al. 1995, Hampton and Berry 1997, Doorenbos 1998, USGS 2001, 2002, 2003, 2004, Duehr 2004), **Moreau River** (Loomis et al. 1999, USGS 2002, 2004, Duehr 2004), **Grand River** (USGS 2001, 2002, 2003, 2004), and **Little Missouri River** (Erickson personal communication) drainages.

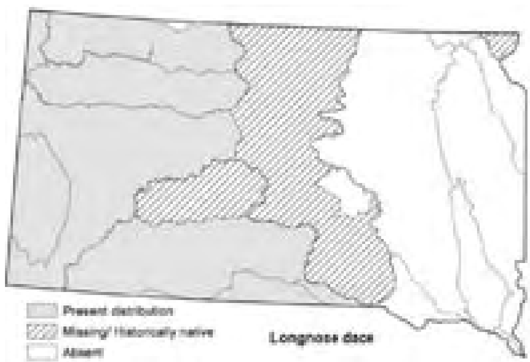

Figure 27. Longnose dace present and historical distribution by drainage in South Dakota.

The longnose dace is normally found in flowing water and is most abundant in riffles (McPhail and Lindsey 1970, Becker 1983, Baxter and Stone 1995). The species is tolerant of turbidity and fluctuating environmental conditions (McPhail and Lindsey 1970, Becker 1983). Presumably, reservoirs have impacted longnose dace in the upper Missouri River valley drainage and siltation and channel degradation have impacted it in the Bois de Sioux and Bad River drainages.

Western blacknose dace (*Rhinichthys obtusus*).— South Dakota status: declining.

In South Dakota, the western blacknose dace is missing from the ***lower Missouri River valley, White River,*** *and* ***Crow Creek*** *drainages (Figure 28), where it was historically present (Bailey and Allum 1962, Fryda 2001).* It is still present in the **Upper Minnesota River** (Dieterman and Berry 1994, USGS 2002, 2003, 2004), **Big Sioux River** (Dieterman and Berry 1998, Blausey 2001, Milewski 2001, USGS 2002, 2004, Hayer et al. 2006), **Vermillion River** (Blausey 2001), **James River** (Blausey 2001, Shearer and Berry 2003, mislabeled as longnose dace), and **Niobrara River** (Cunningham et al. 1995, Harland and Berry 2004) drainages. The western blacknose dace was once grouped with the eastern blacknose dace (*Rhinichthys atratulus*), but is now considered a distinct species (Nelson et al. 2004).

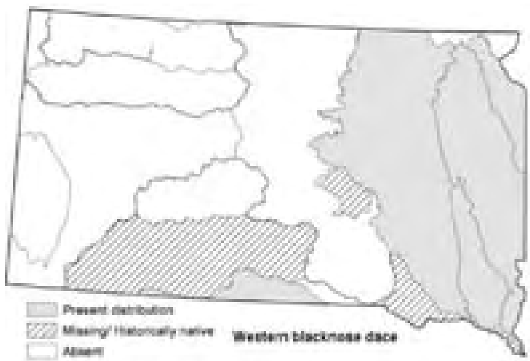

Figure 28. Western blacknose dace present and historical distribution by drainage in South Dakota.

The western blacknose dace typically inhabits permanent streams with moderate to high gradients, cool and clear waters, and clean substrates (Trautman 1981, Becker 1983). It is sensitive to human impacts such as siltation and deforestation (Trautman 1981). Declines of the western blacknose dace from South Dakota are presumably associated with increased turbidity and siltation due to erosion, the degradation of riparian vegetation, and reductions in base flows.

Highfin carpsucker (*Carpiodes velifer*).— South Dakota status: declining.

In South Dakota, the highfin carpsucker is missing from the ***Big Sioux River*** *drainage (Figure 29), where it was formerly present (Lee and Platania 1978).* The species is still present in the **lower Missouri River valley** (Berry and Young 2004).

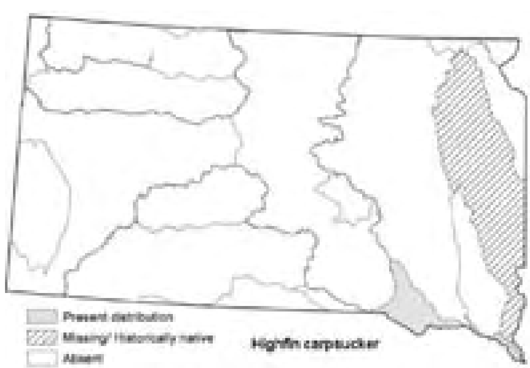

Figure 29. Highfin carpsucker present and historical distribution by drainage in South Dakota.

The highfin carpsucker inhabits streams and rivers (Harlan and Speaker 1956, Cross 1967, Trautman 1981, Becker 1983). It has declined throughout its range (Becker

1983) and especially from the western edge of its historical distribution (Cross 1967). Its decline is associated with siltation and water pollution (Smith 1979) and it is sometimes migratory (Trautman 1981). Thus, dams and siltation in the Big Sioux River drainage may explain the decline of the species in South Dakota.

A major issue in documenting the range of the highfin carpsucker is that small juveniles (< 7.6 cm) cannot be visually distinguished from the river carpsucker (*Carpiodes carpio*) or quillback carpsucker (*Carpiodes cyprinus*; Trautman 1981). Thus, adult carpsucker captures should be inspected closely to search for the presence of highfin carpsuckers. Alternatively, molecular analyses can be conducted on juveniles where the presence of more than one carpsucker species is suspected.

Longnose sucker (*Catostomus catostomus*).—South Dakota status: restricted native range.

In South Dakota, the longnose sucker is present in the **Cheyenne River** drainage (Figure 30), which is the extent of its known range within the state (Bailey and Allum 1962). It is mainly restricted to tributary streams that issue from the Black Hills (Isaak et al. 2003).

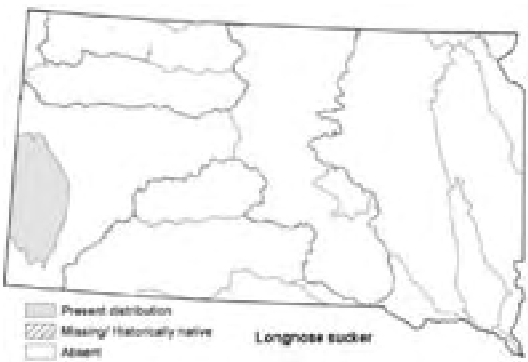

Figure 30. Longnose sucker present and historical distribution by drainage in South Dakota.

Mountain sucker (*Catostomus platyrhynchus*).—South Dakota status: restricted native range.

In South Dakota, the mountain sucker is present in the **Cheyenne River** drainage (Figure 31), which is the extent of its known range within the state (Bailey and Allum 1962). It is restricted to mountainous streams of the Black Hills (Isaak et al. 2003).

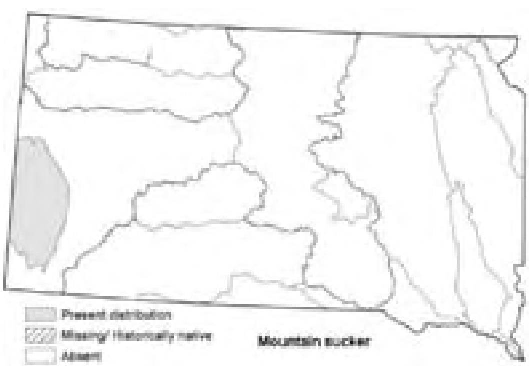

Figure 31. Mountain sucker present and historical distribution by drainage in South Dakota.

Northern hog sucker (*Hypentelium nigricans*).— South Dakota status: missing.

In South Dakota, the northern hog sucker is missing from the ***upper Minnesota River*** *and* ***Big Sioux River*** *drainages (Figure 32), where it was formerly present (Bailey and Allum 1962, Dieterman and Berry 1998).*

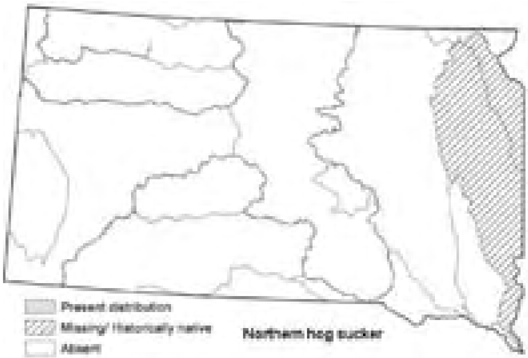

Figure 32. Northern hog sucker present and historical distribution by drainage in South Dakota.

The northern hog sucker is an inhabitant of swift-water habitats in clear-water streams with clean substrate (Cross 1967, Trautman 1981). The species is impacted by siltation, pollution, channel modification, and depleted base flows (Cross 1967, Eddy and Underhill 1974, Smith 1979, Trautman 1981). Because the northern hog sucker migrates between summer habitat in small streams to winter habitat in larger streams and rivers (Harlan and Speaker 1956, Smith 1979, Trautman 1981), it may also have been impacted by dams, which are barriers to dispersal.

Black buffalo (*Ictiobus niger*).— South Dakota status: missing.

In South Dakota, the black buffalo is missing from the ***Big Sioux River, James River,*** *and* ***lower Missouri River valley*** *drainages (Figure 33), where it once was present (Moen 1970, Shute 1978).*

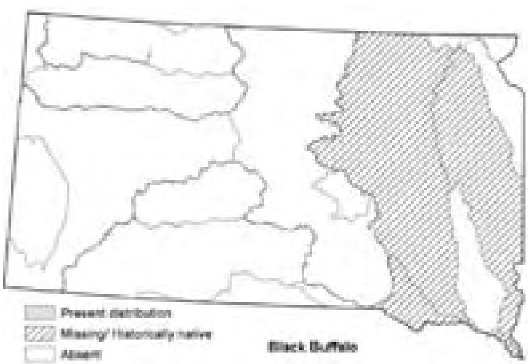

Figure 33. Black buffalo present and historical distribution by drainage in South Dakota.

The black buffalo commonly inhabits large rivers and reservoirs (Cross 1967, Becker 1983). The decline of this species from South Dakota is most likely associated with modification of the Big Sioux, James, and Missouri rivers for navigation, flood control, and water withdrawal.

The black buffalo is commonly confused with the smallmouth buffalo (*Ictiobus bubalus*) and bigmouth buffalo (*Ictiobus cyprinellus*), so care must be taken in their identification (Smith 1979, Trautman 1981).

Blue catfish (*Ictalurus furcatus*).— South Dakota status: declining.

In South Dakota, the blue catfish is missing from the ***James River*** *and* ***lower Missouri River valley*** *drainages (Figure 34), where it was formerly collected (Bailey and Allum 1962, Berry et al. 1993).* It is still present in the **Big Sioux River** (Dieterman and Berry 1998) and **upper Missouri River valley** (Johnson et al. 1995) drainages.

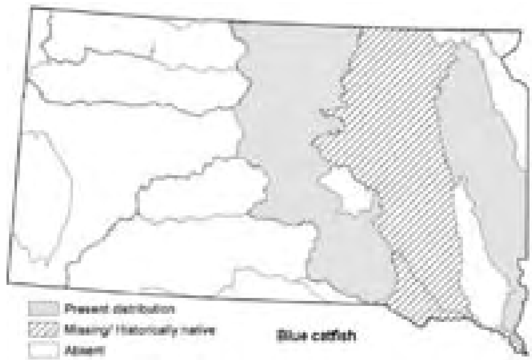

Figure 34. Blue catfish present and historical distribution by drainage in South Dakota.

The blue catfish inhabits large rivers and reservoirs (Harlan and Speaker 1956, Cross 1967, Smith 1979). It may be impacted by river modifications for navigation (Trautman 1981). The species has been stocked into the Missouri River on the Nebraska border and into Lewis and Clark reservoir (Hesse et al. 1989). The overall rarity of the blue catfish in South Dakota despite stocking suggests that modern habitat conditions are poor for this species.

Stonecat (*Noturus flavus*).— South Dakota status: declining.

In South Dakota, the stonecat is missing from the ***Upper Minnesota River*** *drainage (Figure 35), where it was formerly present (Bailey and Allum 1962).* The species is still present in the **Big Sioux River** (Dieterman and Berry 1998, Blausey 2001, Milewski 2001, Hayer et al. 2006), **Vermillion River** (Braaten and Berry 1997, Blausey 2001), **James River** (Blausey 2001, USGS 2002, Shearer and Berry 2003), **lower Missouri River valley** (Berry and Young 2004, Shuman et al. 2004), **Niobrara River** (Cunningham et al. 1995), **White River** (Cunningham et al. 1995, Fryda 2001, USGS 2001, 2002, 2003, 2004, Harland 2003), **Cheyenne River** (Cunningham et al. 1995, Hampton and Berry 1997, Doorenbos 1998, USGS 2001, 2003, Duehr 2004), **Moreau River** (Loomis et al. 1999, USGS 2002, 2004), **Grand River** (USGS 2001, 2002, 2004), **upper Missouri River** (Johnson et al. 1995), and **Little Missouri River** (Erickson personal communication) drainages.

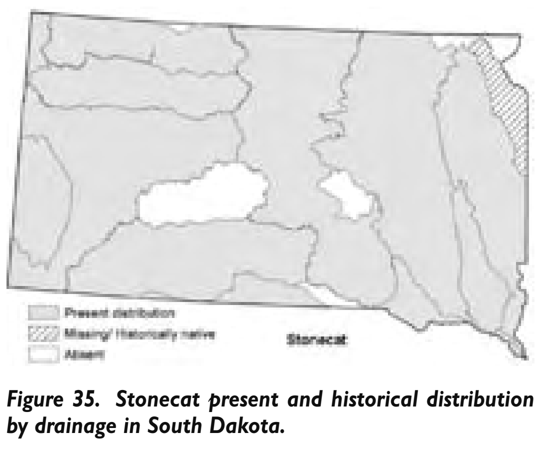

Figure 35. Stonecat present and historical distribution by drainage in South Dakota.

The stonecat typically occupies swift-water habitats in larger streams and rivers (Scott and Crossman 1973). The species is susceptible to pollution and siltation caused by erosion (Cross 1967, Eddy and Underhill 1974, Trautman 1981). It does not survive in impoundments but may occur downstream from dams (Trautman 1981). The loss of the stonecat from the Upper Minnesota River drainage in South Dakota presumably resulted from increased siltation or pollution.

Tadpole madtom (*Noturus gyrinus*).— South Dakota status: declining.

*In South Dakota, the tadpole madtom is missing from the **lower Missouri River valley** (Figure 36), which it formerly occupied (Bailey and Allum 1962).* The species is still present in the **Upper Minnesota River** (Dieterman and Berry 1994), **Big Sioux River** (Dieterman and Berry 1998, Blausey 2001, Milewski 2001, USGS 2002, 2004, Hayer et al. 2006), **Vermillion River** (Braaten 1993, Blausey 2001, USGS 2002, 2004), and **James River** (Blausey 2001, Shearer and Berry 2003) drainages.

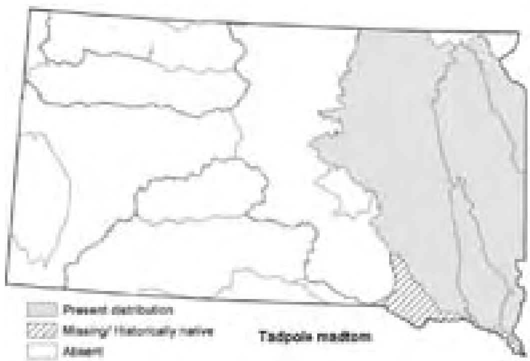

Figure 36. Tadpole madtom present and historical distribution by drainage in South Dakota.

The tadpole madtom inhabits calm waters in lakes and streams and is somewhat tolerant of increasing turbidity (Cross 1967, Trautman 1981, Becker 1983). Wetland drainage, siltation, and stream channelization impact the habitats of this species (Trautman 1981). Improving water quality in the Big Sioux River drainage apparently benefited this species (Dieterman and Berry 1998). The absence of the tadpole madtom from the lower Missouri River valley presumably resulted from erosion and siltation, which degrades tributary streams, and channel scour and flood control in the mainstem Missouri River, which eliminates floodplain habitats and habitat connectivity.

Flathead catfish (*Pylodictis olivaris*).— South Dakota status: declining.

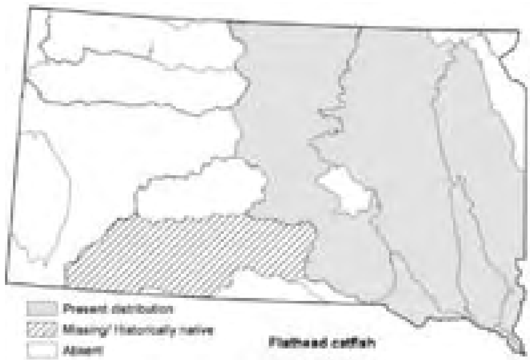

Figure 37. Flathead catfish present and historical distribution by drainage in South Dakota.

In South Dakota, the flathead catfish is missing from the ***White River*** *drainage (Figure 37), where it was formerly present (Bailey and Allum 1962).* The species is still present in the **Big Sioux River** (Dieterman and Berry 1998, Kirby 2001), **Vermillion River** (Braaten 1993), **James River** (Shearer and Berry 2003), **lower Missouri River valley** (Wickstrom 1997, Berry and Young 2004, Shuman et al. 2005), and **upper Missouri River valley** (Lott et al. 1994) drainages.

The flathead catfish inhabits large rivers and their reservoirs (Cross 1967, Eddy and Underhill 1974). The species is impacted by pollution (Trautman 1981). Reasons for their absence from the White River are unknown. However, it may only occupy the river during high flow years, as suggested by Cross (1967) for streams in western Kansas.

Trout-perch (*Percopsis omiscomaycus*).— South Dakota status: declining.

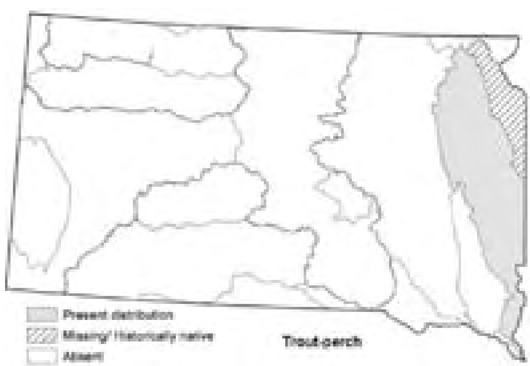

Figure 38. Trout-perch present and historical distribution by drainage in South Dakota.

In South Dakota, the trout-perch is missing from the ***Upper Minnesota River*** *drainage (Figure 38), where it was formerly present (Bailey and Allum 1962).* The species is still present in the **Big Sioux River** drainage (Dieterman and Berry 1998, Hayer et al. 2006).

The trout-perch typically occupies lakes and streams (Scott and Crossman 1973, Trautman 1981, Becker 1983), but may also occupy large rivers and floodplain lakes (Smith 1979). In lakes, the species makes daily migrations from deep water in the day to shallow water at night and may migrate from lakes into tributary streams to spawn (Harlan and Speaker 1956, Scott and Crossman 1973, Becker 1983). In streams, trout-perch are associated with clean substrates and deep pools with cover for hiding during the day (Trautman 1981). The decline of trout-perch from the Upper Minnesota River drainage in South Dakota may be related to the loss of deep stream pools for cover or the loss of spawning habitat for lake populations.

Burbot (*Lota lota maculosa*).— South Dakota status: declining.

In South Dakota, the burbot is missing from the ***Vermillion River*** *and* ***Cheyenne River*** *drainages (Figure 39), where it was formerly present (Bailey and Allum 1962).* The species is still present in the **lower Missouri River valley** (Berry and Young 2004) and **upper Missouri River valley** (Johnson et al. 1998) drainages.

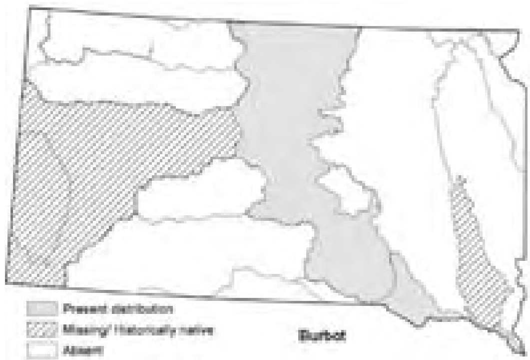

Figure 39. Burbot present and historical distribution by drainage in South Dakota.

The burbot occurs in large rivers, lakes, and reservoirs (Cross 1967, Smith 1979, Becker 1983). It is associated with cold-deep waters (Trautman 1981). It may ascend tributaries to spawn (Harlan and Speaker 1956, Eddy and Underhill 1979). The species may not have been a permanent inhabitant of the Vermillion or Cheyenne rivers, making migrations only when conditions were optimal (e.g., high flows) as suggested by Cross (1967) for the Kansas River. Dams on tributary rivers may impact spawning migrations.

Northern Plains killifish (*Fundulus kansae*).— South Dakota status: restricted native range.

In South Dakota, the northern plains killifish is present only in the **Cheyenne River** drainage (Hampton and Berry 1997, USGS 2001, 2002, 2004, Duehr 2004, Figure 40), which is the extent of its known range in the state. Some researchers consider the northern plains killifish to be nonnative in the Cheyenne River drainage (e.g., Miller 1955, Kreiser et al. 2001), but we disagree with this view because there is no evidence of introduction and there is biogeographical support for the native presence of the species (Hoagstrom 2006). For a time, this species was grouped with the south-

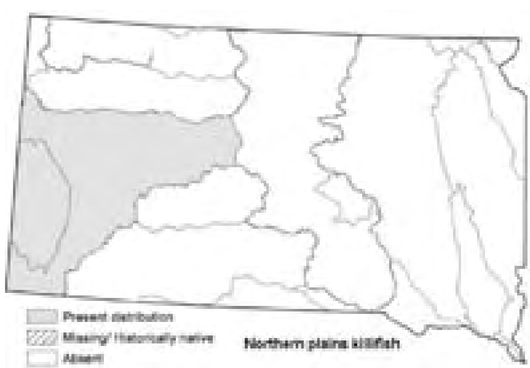

Figure 40. Northern plains killifish present and historical distribution by drainage in South Dakota.

ern plains killifish, (*Fundulus zebrinus*) but presently it is considered a distinct species (Kreiser et al. 2001, Nelson et al. 2004).

Plains topminnow (*Fundulus sciadicus*).—South Dakota status: declining.

In South Dakota, the plains topminnow is missing from the ***Vermillion River*** *and* ***lower Missouri River valley*** *drainages (Figure 41), where it was formerly present (Bailey and Allum 1962).* The species is still present in the **Big Sioux River** (Morey personal communication), **James River** (Blausey 2001), **Niobrara River** (Cunningham et al. 1995, USGS 2002, 2003, Harland and Berry 2004), **White River** (Cunningham et al. 1995, USGS 2003), and **Cheyenne River** (Hampton and Berry 1997, Duehr 2004, Hoagstrom 2006) drainages.

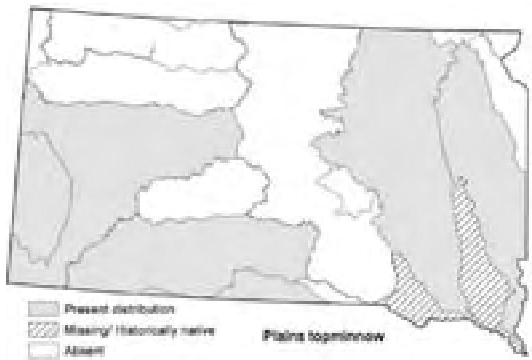

Figure 41. Plains topminnow present and historical distribution by drainage in South Dakota.

The plains topminnow typically occupies small streams and wetlands with abundant aquatic vegetation and clean substrates (Miller 1955, Baxter and Stone 1995). The species has declined throughout much of its range (Harlan and Speaker 1956, Bailey and Allum 1962, Baxter and Stone 1995). Declines presumably are related to the loss of wetland habitats and degradation of stream channels. Kazmierski (1966) studied plains topminnow of Say Brook, a Vermillion River tributary, and concluded the species was largely confined to one sampling station due to degraded habitat conditions elsewhere.

Iowa darter (*Etheostoma exile*).— South Dakota status: declining.

In South Dakota, the Iowa darter is missing from the ***Bois de Sioux River, lower Missouri River valley, Crow Creek,*** *and* ***Little Missouri River*** *drainages (Figure 42), where it was formerly present (Bailey and Allum 1962, Bich and Scalet 1977).* The species is still present in the **Upper Minnesota River** (Dieterman and Berry 1994, USGS 2002, 2003), **Big Sioux River** (Dieterman and Berry 1998, Blau-

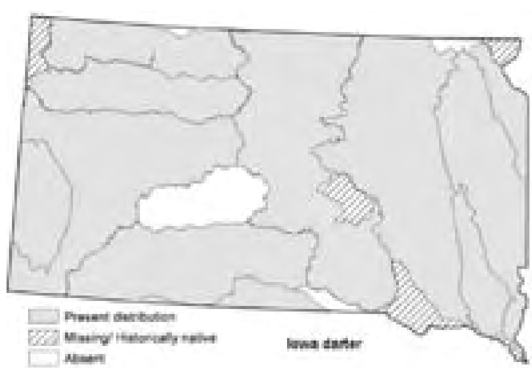

Figure 42. Iowa darter present and historical distribution by drainage in South Dakota.

sey 2001, Milewski 2001, Hayer et al. 2006), **Vermillion River** (Schmulbach and Braaten 1993), **James River** (USGS 2003), **Niobrara River** (Cunningham et al. 1995, Harland and Berry 2004), **White River** (Cunningham et al. 1995, USGS 2003), **Cheyenne River** (Duehr 2004), **Moreau River** (Loomis et al. 1999), **Grand River** (Erickson personal communication), and **upper Missouri River valley** (Johnson et al. 1995) drainages.

The Iowa darter is typical of low gradient streams and wetlands with abundant aquatic vegetation (Smith 1979, Becker 1983) and inhabits cool waters (Trautman 1981). Wetland drainage, increasing turbidity, and siltation due to erosion impact this species (Scott and Crossman 1973, Smith 1979, Trautman 1981).

Slenderhead darter (*Percina phoxocephala*).— South Dakota status: missing.

*In South Dakota, the slenderhead darter is missing from the **Upper Minnesota River** drainage (Figure 43), where it was historically collected (Bailey and Allum 1962).*

The slenderhead darter typically occupies swift water habitats of relatively large, permanent streams that have clean substrate (Cross 1967, Trautman 1981, Becker 1983). The species is declining throughout its range (Becker 1983). Siltation of gravel and sand substrates have led to the decline of the species in Illinois (Smith 1979) and Ohio (Trautman 1981), which may explain the loss of slenderhead darter from South Dakota.

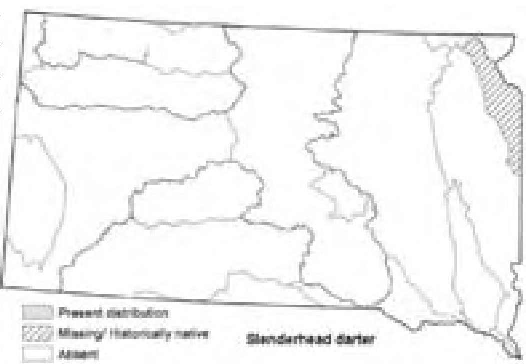

Figure 43. Slenderhead darter present and historical distribution by drainage in South Dakota.

General trends

Status varied among declining fish species (Figure 44). Species varied both in the number of drainages from which they declined and in the number of drainages where they persisted. We used the combination of these two factors to rank declining and rare fish species by river drainage status (i.e., level of conservation concern, Table 2). Four extinct species that were historically present in more than one of the river drainages (silver lamprey, silverband shiner, northern hog sucker, black buffalo) ranked as highest conservation concern because they had declined from several drainages and were extinct. The second highest conservation concern was for a group of four fishes that were missing from two or more river drainages, but were persistent in three or less river drainages (American eel, lake chub, hornyhead chub, blacknose shiner). Third highest conservation concern was for extinct species that historically occupied only one river drainage (bowfin, mooneye, blackchin shiner, slenderhead darter). Fourth was species

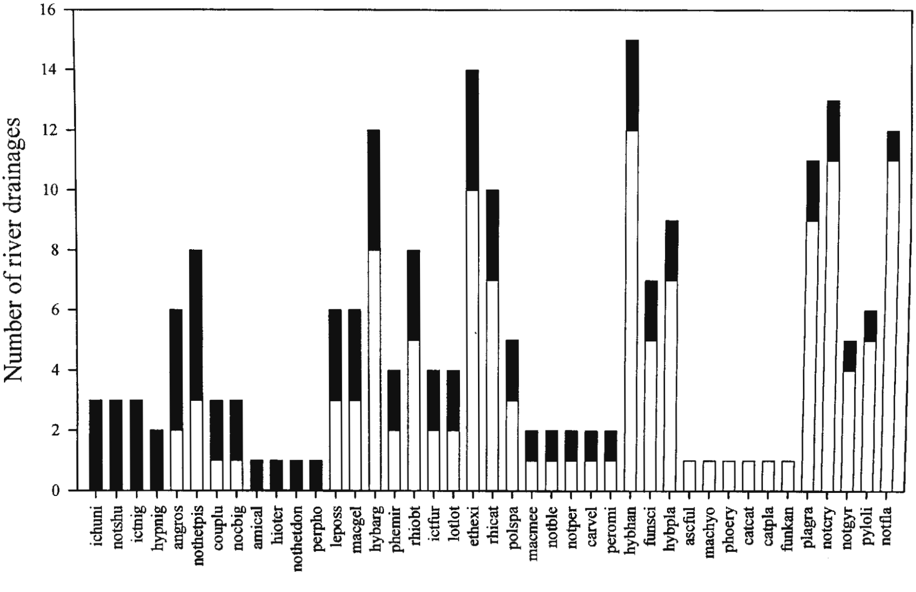

Figure 44. Level of concern for fish species based on the combined rank among species of number of drainages where missing in recent collections and number of drainages where present. Species abbreviations are the first three letters of the generic epithet and first three letters of the species epithet, except for blackchin shiner* Notropis heterodon *(abbreviation = nothetdon) and blacknose shiner* Notropis heterolepis *(abbreviation = nothetpis). See Table 1 for generic and species epithets.

that persisted in roughly the same number of river drainages from which they were missing (19 species). Fifth was rare species that have not declined but were restricted to a single river drainage (lake sturgeon, shoal chub, southern redbelly dace, mountain sucker, longnose sucker, northern plains killifish). Sixth (and last) was a group of species that declined from two or less river drainages and were widespread in recent surveys.

River drainages of eastern South Dakota (Central Lowlands geomorphic province) and both sections of the Missouri River valley exhibited relatively high numbers of species losses (Figure 45). Poorly-sampled river drainages (Bois de Sioux River, Crow Creek, Little Missouri River) also appeared to have high numbers of species losses, but this result may be an artifact of limited recent sampling. On the other hand, well-sampled river drainages of western South Dakota (Great Plains geomorphic province) had relatively few species losses. This suggests that habitat restoration and conservation may be most critical in the Central Lowlands and Missouri River valley.

Most river drainages had eight or more declining or rare fish species present in recent surveys (Figure 45). Exceptions were poorly-sampled river drainages (Bois de Sioux River, Crow Creek, Little Missouri River) and the Ponca Creek and Bad River drainages. Reasons that the Ponca Creek and Bad River drainages supported few declining or rare species are uncertain, but likely have to do with the small size of these river drainages (Hoagstrom and Berry 2006) and human

Table 2. Level of concern (1 through 6, highest to lowest) for declining South Dakota fishes and summary of impacts that have affected each species outside of South Dakota. Impacts are: 1-channel changes, 2-erosion, 3-dispersal barriers, 4-water withdrawal/drought, 5-wetland drainage.

FAMILIES, SPECIES, AND SUBSPECIES	LEVEL OF CONCERN	IMPACTS
PETROMYZONTIDAE lampreys		
Ichthyomyzon unicuspis silver lamprey	1	2, 3
POLYODONTIDAE paddlefishes		
Polyodon spathula paddlefish	4	2, 3
LEPISOSTEIDAE gars		
Lepisosteus osseus longnose gar	4	2, 3
AMIIDAE bowfins		
Amia calva bowfin	3	1, 4, 5
HIODONTIDAE mooneyes		
Hiodon tergisus mooneye	3	2, 3
ANGUILLIDAE freshwater eels		
Anguilla rostrata American eel	2	3
CYPRINIDAE carps and minnows		
Couesius plumbeus lake chub	2	1, 2, 4
Hybognathus argyritis western silvery minnow	4	1, 3
H. hankinsoni brassy minnow	4	1, 2, 3, 4
H. placitus plains minnow	4	1, 3, 4
Macrhybopsis gelida sturgeon chub	4	1, 3, 4
M. meeki sicklefin chub	4	1, 3, 4
Nocomis biguttatus hornyhead chub	2	1, 2, 4
Notemigonus crysoleucas golden shiner	6	1, 2, 5
Notropis blennius river shiner	4	2
N. heterodon blackchin shiner	3	2, 5
N. heterolepis blacknose shiner	2	2, 5
N. percobromus carmine shiner	4	1, 2
N. shumardi silverband shiner	1	1, 2, 3
Phenacobius mirabilis suckermouth minnow	4	2, 4
Platygobio gracilis flathead chub	6	1
Rhinichthys cataractae cataractae longnose dace	4	1, 2
R. obtusus western blacknose dace	4	1, 2, 4
CATOSTOMIDAE suckers		
Carpiodes velifer highfin carpsucker	4	2, 3
Hypentelium nigricans northern hog sucker	1	1, 2, 3, 4
Ictiobus niger black buffalo	1	1, 3, 4
ICTALURIDAE North American catfishes		
Ictalurus furcatus blue catfish	4	1
Noturus flavus stonecat	6	2
N. gyrinus tadpole madtom	6	1, 2, 5
Pylodictis olivaris flathead catfish	6	?
PERCOPSIDAE trout-perches		
Percopsis omiscomaycus trout-perch	4	1, 2
GADIDAE cods		
Lota lota maculosa Burbot	4	1, 3
FUNDULIDAE topminnows		
F. sciadicus plains topminnow	4	1, 5
PERCIDAE perches		
Etheostoma exile Iowa darter	4	2, 5
Percina phoxocephala slenderhead darter	3	2

impacts. This suggests that conservation would be beneficial in all major river drainages of South Dakota.

Based on our literature review, human impacts elsewhere that have led to declines of the species we studied in other portions of their range can be grouped into five broad categories (listed in order of importance): (1) *erosion*, which causes siltation of aquatic substrates and increased turbidity due to suspended sediment; (2) *channel alteration,* which includes stream inundation, stream channelization, flow regime manipulation, and riparian vegetation removal; (3) *dispersal barriers,* which include dams and road crossings; (4) *water withdrawals/drought;* and (5) *wetland drainage.* Erosion may negatively affect many fishes, but our literature review indicated that at least 23 of the declining fish species were susceptible to erosion elsewhere within their ranges (Table 2). Similarly, channel alteration likely has negative affects on many fishes, but our literature review indicated that at least 21 of the declining fish species of South Dakota were sensitive to channel changes in other regions (Table 2). According to our review, at least 15 species that have declined from South Dakota are migratory, which makes them susceptible to the impacts of dispersal barriers (Table 2). However, barriers may affect non-migratory fishes as well (Wall and Berry 2004). Ultimately, water withdrawals and drought affect all fishes, but our literature review suggests that 11 of the declining South Dakota fishes are very sensitive to reduced water supplies (Table 2). Wetland drainage also has many impacts on streams, but presumably was most detrimental to seven declining South Dakota fishes that typically inhabit wetlands (Table 2). The decline of many of the fishes we studied was likely attributable to a suite of impacts, but our analysis suggests that erosion control and river channel conservation and restoration should be a high priority for native fish conservation in South Dakota, followed by improved fish passage, increased base flows, and wetland restoration.

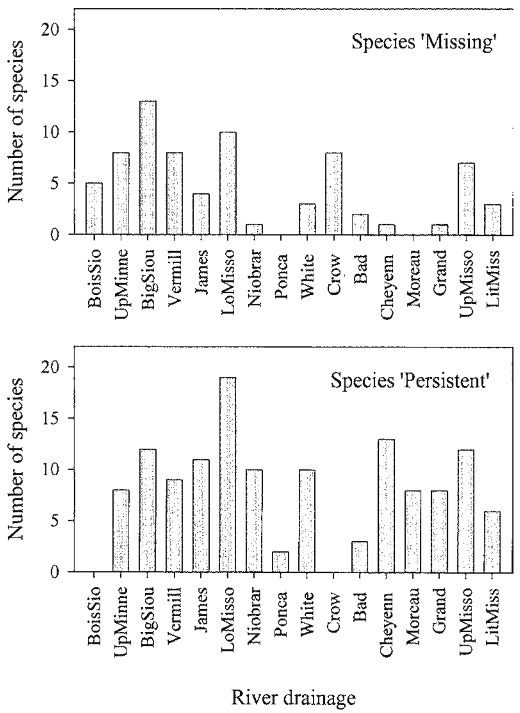

Figure 45. Number of species missing from each major South Dakota river drainage (top) and number of declining or rare species persisting in major South Dakota river drainages (bottom) based on recent (post-1990) fish surveys.

CONCLUSIONS

This analysis considers only river drainage scale declines and is not intended to represent all potential conservation concerns. Particularly, status assessments at smaller spatial scales, such as Gap analysis, provide additional perspectives on the status of each fish species (Sylvester 2004). For example, flathead chub and longnose dace have declined from some South Dakota river drainages, but they remain widespread in the state and are abundant throughout many river drainages (Kral and Berry 2005, Hoagstrom 2006). Thus, even though they have exhibited declines at the river drainage scale, their overall distribution and their abundance within river drainages persist suggest the level of concern for these species should be relatively low.

Nonetheless, we believe that our ranking of fish species by level of concern (Figure 2, Table 2) provides a useful summary of fish species status at the river drainage scale and may be useful for determining which fishes require additional study or legal protection. For example, species in the level of concern group two may require specific attention because they have declined from multiple drainages and their present distribution is limited. Further, recent studies in river drainages where these species are present indicate that they are not locally abundant. Studies focusing on the local distribution and abundance of these species (e.g., Wall et al. 2004) would be beneficial because they better delineate the status of the species of concern and provide justification either for or against legal protection, depending on findings.

ACKNOWLEDGEMENTS

Federal Aid in Sport Fish Restoration funds administered by the South Dakota Department of Game, Fish and Parks (Project Number F-21-R and F-15-R) supported this research. The South Dakota Cooperative Fish and Wildlife Research Unit is jointly supported by the South Dakota Department of Game, Fish and Parks, U.S. Geological Survey, U.S. Fish and Wildlife Service, and South Dakota State University. We thank Jack Erickson and Jeff Shearer of the South Dakota Department of Game, Fish and Parks and Greg Wanner of the U.S. Fish and Wildlife Service for providing us up-to-date information on fish collections throughout the state and Steven Herrington and Jeff Shearer for providing editorial comments.

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