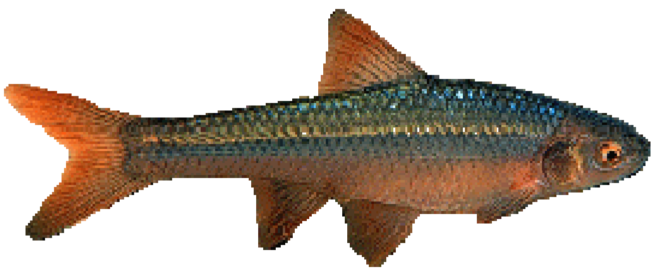
Topeka Shiner
(*Notropis topeka*)

5-Year Review:
Summary and Evaluation



U.S. Fish and Wildlife Service
Kansas Ecological Services Field Office
Manhattan, Kansas

December 2009

5 –YEAR REVIEW
Topeka shiner (*Notropis topeka*)

1.0 GENERAL INFORMATION

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1.2 Methodology used to complete review:

On December 08, 2004, we published a Notice of Review in the *Federal Register* (69 FR 71071) soliciting information from the public, concerned governmental agencies, tribes, the scientific community, industry, environmental entities, and other interested parties pertaining to the Topeka shiner. We also contacted State fishery/natural resource agencies, applicable U.S. Fish and Wildlife Service (USFWS) Field and Regional offices, knowledgeable individuals from academia, and the Topeka Shiner Recovery Team. Information received included: recent and ongoing research; information on population trends; analysis and interpretation of ongoing and future threats; and information on conservation actions.

On February 1-2, 2005, we held a Topeka Shiner Recovery Team meeting to facilitate coordination and the sharing of information on the status of the Topeka shiner for inclusion in the 5-year review. This meeting, held at DeSoto National Wildlife Refuge in Iowa, included a variety of participants including members of the Topeka Shiner Recovery Team, biologists from affected USFWS offices and state wildlife conservation agencies, and researchers.

On May 23-24, 2007, we sponsored a workshop to obtain updated information on the status of the Topeka shiner. DeSoto National Wildlife Refuge again hosted this meeting. The meeting was coordinated and facilitated by the U.S. Geological Survey's Cooperative Fish and Wildlife Research Units from Kansas, Nebraska, and South Dakota. Participants included representatives from State conservation agencies, USFWS regional and field offices, members of the Topeka Shiner Recovery Team, and associated researchers from across the species' six State range. The information and biological interpretation provided at this workshop helped inform this 5-year review (Paukert et al. 2007)

This 5-year review was primarily written by the Kansas Field office with substantive contributions and review by cooperating field and regional offices. An early draft of the document went through peer review in which five of six solicited reviewers responded. Substantive comment appropriate to the 5-year review was incorporated into the document.

1.3 Background:

1.3.1 Federal Register notice citation announcing initiation of this review:

69 FR 71071, December 08, 2004

1.3.2 Listing History

Original Listing
FR notice: 63 FR 69008, December 15, 1998
Entity listed: Species
Classification: Endangered rangewide

1.3.3 Associated Rulemakings:

Critical habitat for the Topeka shiner was designated on July 27, 2004 (69 FR 44736). This rule designated critical habitat in Iowa, Minnesota, and Nebraska. Habitat in Kansas, Missouri, and South Dakota was excluded from the designation.

1.3.4 Review History:

November 21, 1991 – Following a status review initiated in March 1990, the USFWS included the Topeka shiner as a category 2 candidate species in the Animal Candidate Review for Listing as Endangered or Threatened Species (56 FR 58816, November 21, 1991).

February 16, 1993 – The USFWS prepared and distributed a status report on the species (USFWS 1993).

November 15, 1994 – The USFWS assigned the Topeka shiner a category 1 candidate species status in the Animal Candidate Review for Listing as Endangered or Threatened Species (59 FR 58982, November 15, 1994).

February 28, 1996 – Under new guidance, the species was reaffirmed as a candidate for listing in the Candidate Notice of Review (61 FR 7596, February 28, 1996).

October 24, 1997 – The USFWS published a proposed rule to list the Topeka shiner as an endangered species (62 FR 55381, October 24, 1997).

December 15, 1998 – The USFWS published a final rule listing the Topeka shiner as an endangered species (63 FR 69008, December 15, 1998).

August 21, 2002 – In compliance with a Federal District Court settlement, the USFWS published a proposed rule to designate critical habitat for Topeka shiner (67 FR 54262, August 21, 2002).

July 27, 2004 – The USFWS published a final rule designating critical habitat for the Topeka shiner (69 FR 44736, July 27, 2004).

December 8, 2004 – The USFWS published a notice requesting information on the status of the Topeka shiner, and announced the initiation of a 5-year status review (69 FR 71071, December 8, 2004).

1.3.5 Species Recovery Priority Number at Start of 5-year Review:

At the start of the 5-year review, the recovery priority number for Topeka shiner was 8C. This indicated that: (1) populations face a moderate degree of threat; (2) recovery potential is high; (3) the entity is listed at the species level; and (4) the species is in conflict with construction or other development projects or other forms of economic activity.

Degree of Threat	Recovery Potential	Taxonomy	Priority	Conflict
High	High	Monotypic Genus	1	1C
		Species	2	2C
		Subspecies/DPS	3	3C
	Low	Monotypic Genus	4	4C
		Species	5	5C
		Subspecies/DPS	6	6C
Moderate	**High**	Monotypic Genus	7	7C
		Species	8	**8C ***
		Subspecies/DPS	9	9C
	Low	Monotypic Genus	10	10C
		Species	11	11C
		Subspecies/DPS	12	12C
Low	High	Monotypic Genus	13	13C
		Species	14	14C
		Subspecies/DPS	15	15C
	Low	Monotypic Genus	16	16C
		Species	17	17C
		Subspecies/DPS	18	18C

1.3.6 Recovery Plan or Outline:

Name of Outline: Recovery outline for the Topeka shiner
Date Issued: January 1999

Recovery Plan: Not yet completed

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) Policy:

2.1.1 Is the species a vertebrate? Yes

2.1.2 Is the species under review listed as a distinct population segment? No

2.1.3 Is there relevant new information for this species regarding the application of the distinct population segment policy?

While we believe there is sufficient evidence to support multiple DPSs within this listed species range (see Map 1), we are not currently recommending a formal revision to the listing to recognize these potential DPSs. For the time being, we believe continued listing at the species level is the most straight forward way to manage this listed species under the

Endangered Species Act (Act). This issue will be further evaluated in the recovery plan, including consideration of whether potential DPSs could be delisted independently once recovery is achieved in each unit.

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria?

No. Recovery planning was halted to allow us to focus on the 5-year review. Now that this process has reached a conclusion, the recovery planning process will be reinitiated.

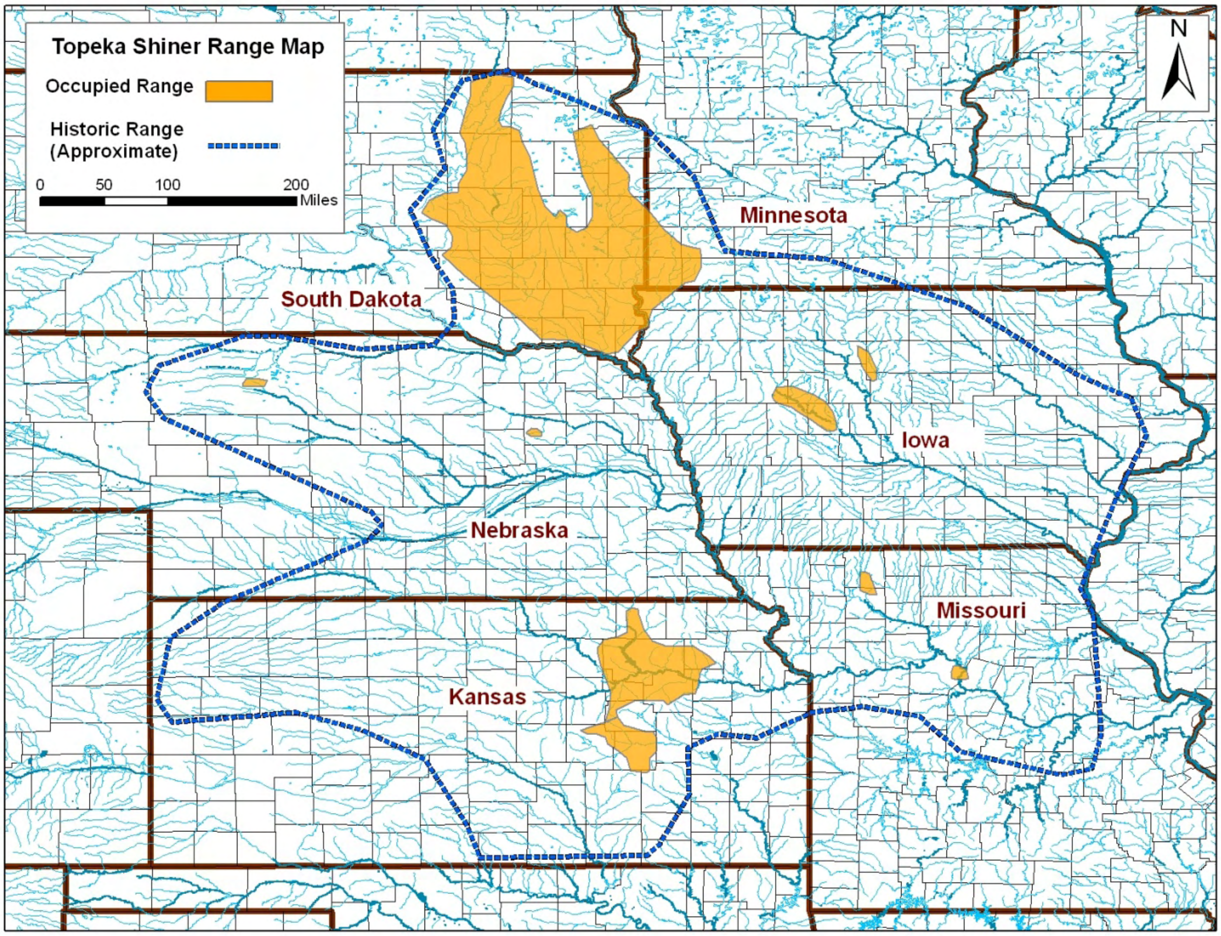
2.3 Updated information and current species status

2.3.1 Biology and habitat

2.3.1.1 New information on the species' biology and life history:

Life history and food use studies have been completed, including age composition, growth curves, spawning studies, clutch sizes, and diet composition. The Topeka shiner is an opportunistic omnivore, feeding on aquatic insects, microcrustaceans, larval fish, algae, and detritus (Hatch and Besaw 2001). Dahle (2001) discovered 4-year classes in individuals from Minnesota, dominated by age 0- and age 1-year classes. He also found that: the species is a multiple clutch spawner; clutch size was smaller than previous studied specimens from Kansas; and that relative abundance was higher in off-channel habitat than instream habitat. Kerns and Bonneau (2002) reported: the number of mature ova increased with length, weight, and age of the female; and that only 62 percent of age-1 females were mature, compared with 100 percent of age-2 females. Stark et al. (2002) studied the natural history of an isolated population in Kansas, documenting feeding, reproduction, and interspecies activities from spring through summer. Winston (2002) observed the spatial and temporal associations of other stream species with the Topeka shiner, suggesting interspecific actions with other species during some life stages of the Topeka shiner.

MAP 1. Map of Present and Historic Geographic Range of Topeka Shiner



2.3.1.2 Distribution, Abundance, and Trends:

The Topeka shiner is known to occur in portions of South Dakota, Minnesota, Kansas, Iowa, Missouri, and Nebraska (see Map 1 above). The status in each state is briefly summarized below.

<u>South Dakota</u> – In South Dakota, new information indicates a much larger distribution of the species than was known at the time of listing (69 FR 71071, December 08, 2004; Wall et al. 2001; Wall and Thompson 2007). Topeka shiners were known at 11 localities in the Vermillion and James River watershed at the time of listing, and were believed extirpated from the Big Sioux River drainage (69 FR 71071, December 08, 2004). Since listing, Topeka shiners have been captured from an additional 48 streams, including many from the Big Sioux River watershed (Wall pers. comm. 2006). A South Dakota State University/U.S. Geological Survey Geographic Information Systems modeling study helped identify many of the potential sites now known to be occupied (Wall et al. 2001). Off-channel sites in the form of livestock watering holes (dugouts) have been

found to harbor Topeka shiners in South Dakota. These off-channel sites may represent important habitat for the species within the floodplains of occupied streams (Thomson 2008).

Resampling at various levels (ranges from 2- to 9-years of collection data per stream) has occurred at 28 (46 percent) of the 59 known occupied streams in South Dakota. Topeka shiner records were collected in these streams at numerous locations, during different seasons and various years with no loss of occupied waterways detected in South Dakota since the species was listed. Of the remaining 31 streams lacking resampling data, 10 were found to be occupied only recently (2004-2007); additional occupied streams may be identified with future survey efforts. The present distribution encompasses most of the known historic range of the species in this State (Wall et al. 2004; Wall and Thompson 2007).

From 2004 to 2006, the South Dakota Department of Game, Fish and Parks conducted a 3-year monitoring study. Three sites within each of eleven known occupied streams were sampled over the course of 3 years. Topeka shiners were found to be present in all 11 streams and at 76 percent (25 of 33) of sample sites. Sample sites included both new areas and locations where Topeka shiners had previously been documented. Topeka shiners were discovered at 12 (67 percent) of 18 new sampling locations and at 12 (86 percent) of 14 sites where Topeka shiners had previously been documented. Collection records at 5 sampling sites exceeded the highest number of Topeka shiners previously caught at single sites in each of their respective streams, including 1 record of 964 individuals (Wall and Thomson 2007).

Additional monitoring is planned from 2010 to 2012 (Wall and Thompson 2007). This monitoring program was implemented as part of the State's management plan (Shearer 2003).

<u>Minnesota</u> – In Minnesota, Topeka shiners were known from 15 locales in 8 streams in the Rock and Big Sioux River watersheds at the time of listing (69 FR 71071, December 08, 2004). The species is now known from 75 sites in at least 17 named streams (Baker pers. comm. 2006). The species is now believed to be widely distributed in the Rock and Big Sioux River watersheds in Pipestone, Nobles, and Rock counties, with an additional number of occurrences in adjoining Murray and Lincoln Counties (Ceas and Larson 2008). The species also has been discovered to inhabit off-channel floodplain pools adjacent to these streams (Berg and Anderson 2004).

An annual monitoring program to determine population distribution and trends in Minnesota began in 2004 (Ceas and Anderson 2004). After 5 years of monitoring, these researchers concluded that: the species has a widespread distribution across its known historical range; stream segments that do not produce Topeka shiners tend to be continuously flowing "raceways;" and stream segments with an abundance of suitable habitat produced higher numbers of specimens (Ceas and Larson 2008).

Kansas – In Kansas, Topeka shiners were extant in several watersheds within the Kansas and Cottonwood River basins at the time of listing (69 FR 71071, December 08, 2004). These populations were largely restricted to portions of the Flint Hills region. An additional isolated population was known from Wallace County, near the Colorado border in the Smoky Hill River watershed. Since listing, portions of these watersheds have been sampled. Topeka shiners in the Kansas River watershed appear stable in most areas sampled (Kansas Department of Wildlife and Parks 2006; Kansas Department of Wildlife and Parks 2007; Stark 2007; Davis 2008). However, several sub-basins of Mill Creek sampled by Davis in 2008 yielded no specimens (Davis 2008). These areas are scheduled for resampling in 2009 (Tabor pers. comm. 2009).

Collections from the Cottonwood River basin suggest a contraction in range and distribution (Simmons pers. comm. 2006). The Wallace County population is now believed extirpated, resulting in the elimination of the last known population of the species in Kansas west of the Flint Hills (Tabor pers. comm. 2009). The Kansas Department of Wildlife and Parks' Comprehensive Wildlife Conservation Plan (2005) lists the Topeka shiner as declining in Kansas.

Iowa – At the time of listing, the Topeka shiner was known extant at 10 sites in 4 tributaries to the North Raccoon River watershed, from 2 sites in the Boone River watershed, and 1 site immediately adjacent to the Minnesota border in the Big Sioux/Rock River watershed (63 FR 69008, December 15, 1998). Since 1999, the species has been captured from streams or off-channel pools of 16 tributaries to the North Raccoon River and from 5 off-channel pools adjacent to the mainstem North Raccoon River. The species also has been captured in low numbers from 2 tributaries in the Des Moines River and in 5 tributaries of the Boone watershed (Menzel pers. comm. 2002; Clark 2000; 67 FR 54262, August 21, 2002; Bogenschutz pers. comm. 2005; Howell pers. comm. 2006). Within Big Sioux/Rock River watershed, the species has been captured in low numbers in 2 other tributaries of the Big Sioux/Rock River watershed (Menzel pers. comm. 2002; Clark 2000; 67 FR 54262, August 21, 2002; Bogenschutz pers. comm. 2005; Howell pers. comm. 2006). The North Raccoon River watershed currently comprises approximately 95 percent of the Topeka shiner's current geographic range in Iowa.

Between 2001 and 2007, the USFWS coordinated with several landowners in the North Raccoon River watershed, restoring eight areas of off-channel habitat, and one in-channel structure to create additional pool habitat for Topeka shiner. Additionally in 2007, the USFWS's Rock Island Field Office began a formal study of off-channel habitats to determine population abundance and trend information, including both restored and natural occurring off-channel habitat. In 2007, 18 off-channel habitats were sampled with a total of 2,486 fish captured (25 Topeka shiners); in 2008, 11 areas were sampled resulting in a total of 4,030 fish (28 Topeka shiners); and in 2009, 10 areas were sampled, capturing 8,608 fish (630 Topeka shiners) (McPeek in litt. 2009). However, it was noted that 2 oxbows restored in 2001 contributed 591 of the total 630 Topeka shiners captured. This annual study is planned to continue into the future. Twelve additional off-channel restorations were completed in 2008-2009, with more planned. Iowa State University plans to begin a 2-year study in 2010, analyzing both off-channel and in-channel habitat types; and also plans to resample sites visited in 1997-2001 (McPeek in litt. 2009).

In 2005, 42 sites in the East Des Moines and Winnebago River watersheds were sampled (Howell 2007). Approximately 3.5 miles of stream (349 seine hauls) were sampled, and no Topeka shiners were captured (Howell 2007). Efforts to capture the species elsewhere in the Des Moines, Boone, Big Sioux/Rock River, and Iowa watersheds have been unsuccessful. Surveys for the species in the Cedar and Shell Rock River watersheds (presently assumed extirpated) are planned, but have not been implemented.

<u>Missouri</u> – In Missouri, three populations were believed extant at the time of listing (69 FR 71071, December 08, 2004). At present, two populations exist in the wild (Missouri Department of Conservation1999; Paukert et al. 2007). The Bonne Femme Creek watershed population is now presumed extirpated (Paukert et al. 2007). The last collection of the species from this stream occurred in 1997 (Kerns pers. comm. 2006). The Missouri Department of Conservation completes annual surveys to determine population distribution and trends per their State Action Plan for the Topeka Shiner (Missouri Department of Conservation 1999; Kerns pers. comm. 2006). The distribution of the species is stable in Moniteau Creek, and the species appears to be in decline in the Sugar Creek watershed (Kerns pers. comm. 2007).

<u>Nebraska</u> – In Nebraska, the Topeka shiner was believed extant in two streams in Cherry and Madison counties at the time of listing (69 FR 71071, December 08, 2004). The last capture of the species from these streams occurred in 1989 and 2000, respectively (Cunningham pers. comm. 2006). Access is now prohibited at the Cherry County site (Cunningham pers. comm. 2006). However, a single Topeka shiner was found in a small stream in Cherry County in 2006 approximately 6 miles from the previous record site as of 2006 (Fritz pers. comm. 2009). This

record confirms the continuing existence of the species in that area as of 2006 (Fritz pers. comm. 2009). It is unknown whether the species continues to exist in Madison County.

2.3.1.3 Genetics, genetic variation, or trends in genetic variation:

The most recent genetics research was completed at Black Hills State University in South Dakota. Eight polymorphic microsatellite markers were developed from a small-fragment genomic library and are being used to assess genetic population structure among Topeka shiner populations. Sample locations included: five Kansas locations, one Iowa location, two Missouri locations, two Minnesota locations, and one South Dakota location. Analysis of microsatellite genotypes revealed statistically significant differences among populations. The majority of the genetic variation was partitioned in a hierarchical manner among watersheds and among hydrological units. This work indicates that management strategies should seek to maintain and preserve the maximum number of populations, especially among major hydrologic units, to conserve the genetic diversity of the species (Sarver 2007; Anderson and Sarver 2008).

Michels (2000) used mitochondrial DNA sequence from 11 localities across the range to examine whether the population genetic structure of Topeka shiner reflects the effects of habitat fragmentation. This fragmentation occurs naturally in the species due to its preference for discontinuous habitats (i.e., headwaters). She found most populations to be genetically distinct with little gene flow. Shallow genetic differences among recently fragmented sites indicate fragmentation by human actions has not yet resulted in significant genetic divergence. Michels (2000) identified three isolated groups that had a nearly complete lack of shared haplotypes. These genetic groups corresponded to three geographic regions including: 1) Arkansas River drainage; 2) Kansas River and Lower Missouri River drainages; and 3) Upper Missouri River and Des Moines River drainages. However, the results should be reviewed with some caution as the analyses were based on a relatively low number of base pairs (303, mainly in the control loop). Michels (2000) was unable to include nuclear microsatellite DNA.

Bergstrom et al. (1999) looked at DNA from three Missouri populations and found distinct genetic variation on a fine scale, suggesting a possible historic segregation of populations in the Grand River drainage from the Lower Missouri River genome.

2.3.2 Five-factor analysis

Section 4(c)(2) of the Act requires that we, at least once every 5 years, conduct a review of each listed species to determine whether it should be delisted or reclassified. Determining whether a species should be delisted or reclassified requires consideration of the 5 categories of threats specified in section 4(a)(1) of the Act relative to the definition of threatened and endangered. Section 3 of the Act defines a species as “endangered” if it is in danger of extinction throughout all or a significant portion of its range and as “threatened” if it is likely to become endangered within the foreseeable future throughout all or a significant portion of its range. The following analysis describes all factors currently affecting, or that are likely to affect, the Topeka shiner within the foreseeable future. Tables 1 and 2 (following this analysis) summarize the immediacy, intensity, and overall level of threat from each factor by State.

2.3.2.1 Present or threatened destruction, modification, or curtailment of its habitat or range:

The 1998 listing rule indicated destruction and modification of habitat was a substantial threat to the species resulting in historic and ongoing range curtailment (63 FR 69008, December 15, 1998). The rule listed the following factors as reducing stream suitability including: sedimentation; increased nutrient loading; decreased stream flow; and increased water temperature. These changes were associated with: intensive rowcrop development and overgrazing; urbanization and highway construction; mainstem reservoir development, tributary impoundment, channelization and maintenance of altered waterways; and dewatering of streams. The 1998 rule highlighted both past and planned impacts for each of these categories (63 FR 69008, December 15, 1998).

<u>Hydrologic Changes</u>

The conversion of prairie to cropland has altered the hydrology of streams throughout much of the species’ historic and present range. Some areas where the species has declined coincide with reduced aquifers and drainage patterns affecting the quantity of water (Cross 1970). Decreased flows of springs, seeps, and other groundwater sources continue to threaten some existing populations, especially highly isolated populations (Cross 1970; Cross and Moss 1987). It is unknown at this time how much encroachment of woody vegetation and forest into former prairie has, and continues to alter stream hydrology and other ecological processes, particularly in Kansas and Missouri.

In Minnesota and South Dakota, despite impacts to stream habitat, groundwater inputs to streams (associated with geologic morainal features) remain largely intact. Groundwater potential, along with other factors including stream size, flow regime, gradient, and size discrepancy are a significant factor relating to Topeka shiner presence (Wall et al. 2001; Berg et al. 2004).

New and continued groundwater withdrawal can cause or exacerbate stream hydrologic changes, including the seasonality of flows. Ethanol production is very water intensive and generally requires 3 to 4 gallons of water per gallon of ethanol produced (Aden 2007). In Minnesota, ethanol plants in 2005 averaged 4.2 gallons of water per gallon of ethanol produced (Institute for Agriculture and Trade Policy 2006). In South Dakota, which is fourth in the nation in ethanol production, 16 ethanol plants exist within the range of the Topeka shiner and another 3 are being planned or considered (South Dakota Corn Council & South Dakota Corn Growers Association 2009). In 2010, South Dakota expects to produce 1 billion gallons of ethanol (South Dakota Corn Council & South Dakota Corn Growers Association 2009).

The Energy Independence and Security Act of 2007 (Pub.L. 110-140) requires that we increase biofuel production to 36 billion gallons by 2022, from 4.7 billion gallons in 2007. Even though 21 billion gallons must come from non-cornstarch products (e.g., sugar or cellulose) (Pub.L. 110-140), this amount still represents a potential substantial increase in ethanol production. The rate of growth for this industry has slowed substantially since the price of oil fell from its 2008 peak, but this remains a long-term concern.

Cropland irrigation and water use also have the potential to impact stream hydrology for the Topeka shiner across portions of its range (Cross and Moss 1987; Berg et al. 2004). Groundwater withdrawals for these purposes have likely been a substantial issue in irrigation-dependent areas like Kansas and Nebraska, but is also relevant across the remainder of the species' range. The severity of this threat is likely to increase over time as increasing land is cultivated for cropland use (Stubbs 2007; U.S. Department of Agriculture 2007; U.S. Department of Agriculture 2008). This impact is described further below as it relates to impacts to water quality.

Agricultural drainage tiling has increased in South Dakota and Minnesota. This process uses surface ditches, subsurface permeable pipes, or both, to remove standing or excess water from poorly drained lands, resulting in more available land for agricultural purposes. In addition to causing wetland loss, tiling can lower groundwater tables.

Climate change is expected to add to these stresses, with increasing temperatures and changing rainfall patterns altering timing and amount of evaporation, recharge, and runoff. According to the U.S. Global Change Research Program, "Projected increases in precipitation are unlikely to be sufficient to offset decreasing soil moisture and water availability in the Great Plains due to rising temperatures and aquifer depletion. In some areas, there is not expected to be enough water for agriculture to sustain even current usage" (Karl et al. 2009, p. 126). These general comments cover an area from Texas, north to the Canadian border. Given temperature and precipitation projections across the Great Plains, these comments are likely of greater concern in southern portions of the range. Nevertheless, this issue could become a significant added stress. Addition research on this subject is required. Climate change is discussed in more detail in Factor E.

In the northern portion of the range, maintaining the area's hydrology is a critical factor in maintaining the species' apparent stability across this portion of its range. In South Dakota, stream hydrology has been minimally impacted to date. Only 3.1 percent of riverine habitat in eastern South Dakota has been directly modified (channelized) (Johnson et al. 1997). Since listing, the Act's protections have minimized potential threats associated with this issue. However, pressures on the hydrologic system, including groundwater pumping, tiling, and grassland conversion, in the northern portions of the range are likely to increase over time. If unregulated, this increase could have a substantial impact on the Topeka shiner. Global climate change is expected to exacerbate this issue given projected temperature increases and precipitation changes (see section 2.3.2.5 below). In short, to date this issue has been a modest threat with minimal realized impacts in the northern portion of the range, but this issue is expected to be a meaningful threat within the foreseeable future. Further study of this issue is recommended.

In the southern portion of the species' range, stream hydrology has been substantially altered. This change appears to have negatively impacted the Topeka shiner across this portion of its range. These alterations include mainstem and tributary impoundments, groundwater pumping, grassland conversion to row cropping, landcover changes from grassland to woody vegetation, and, in Iowa, tiling and channelization. Ongoing and projected impacts to hydrology will continue to exacerbate this issue. The Act's continued protections are necessary to minimize impacts associated with this threat and preclude further range retractions across the southern portion of the species' range.

<u>Agricultural Impacts on Water Quality</u>

Sedimentation from agricultural runoff and over-grazing of riparian areas continues to impact spawning habitat and water quality across the species' range (Cross and Moss 1987). These water quality parameters include nutrient enrichment and turbidity, which decrease dissolved oxygen and increase water temperatures. Watersheds with high levels of cultivation, and subsequent siltation and domestic pollution, are unsuitable for the species (Cross and Moss 1987). These streams often cease to flow and become warm and muddy during the summer months.

Livestock grazing is considered a low-level threat in Nebraska and a low-moderate level threat across the rest of the species' range.

Conversion to croplands is a more substantial issue. The conversion of grasslands and Conservation Reserve Program (CRP) lands to cropland substantially expanded when demand for corn related to ethanol spiked, increasing corn prices. In 2005-2006, over 102,000 acres of native grasslands were converted to cropland in South Dakota (Stubbs 2007). Similarly, between December 2006 and December 2007, approximately 225,000 acres of land were removed from CRP in South Dakota (U.S. Department of Agriculture 2007; U.S. Department of Agriculture 2008). These conversion figures are Statewide and not specific to the range of the Topeka shiner.

Land use analysis in South Dakota reveals that watersheds in eastern South Dakota are covered by approximately 60 percent cultivated land, 30 percent pasture, 8 percent wetlands, and 2 percent other types (Wall et al. 2001). The range in cultivation among Topeka shiner watersheds varies from 37.9 percent to 82.3 percent. Within 330 feet stream-side buffers, approximately 1/3 is cropland and 2/3 grass or wetlands; and within areas of 100 foot buffers, cropland comprises approximately 20 percent and grass or wetlands approximately 80 percent (Wall et al. 2001). This indicates that "…cultivation practices have been done in ways to protect streams from sedimentation and altered hydrology (Wall et al. 2001)." Furthermore, land cover in the James, Vermillion, and Big Sioux watersheds in South Dakota did not change significantly between 1992 and 2001 (Wall et al. 2001).

Rowcrop agriculture and conversion to rowcrop agriculture is considered a moderate to high level threat across the southern portions of the range and a moderate level threat across the northern portions of the range. The level of grassland conversion in the future is likely to depend largely on farm policy and economic factors.

Agricultural drainage tiling (discussed above) can also impact water quality by allowing runoff events to enter directly into nearby streams and lakes. This practice causes increased peak flows of shorter duration. Agricultural drainage tiling can also decrease stream temperatures. This impact changes the fish community makeup frequently precluding warm water fish like the Topeka shiner. Finally, these flows often carry high levels of nitrates, sediment and pesticides.

Confined animal feeding operations occur throughout the Topeka shiner range. These operations vary from large corporate operations producing hogs and poultry to small scale winter feeding areas on family farms. Large confined animal feeding operations are regulated under the National Pollution Discharge Elimination System (see section 2.3.2.4 below). Nevertheless, manure lagoon failures and accidents occasionally occur, often resulting in catastrophic impacts to stream habitat and organisms. Small scale (less than 200 cattle) winter feeding lots are generally not regulated and can introduce large amounts of sediment and nutrients to streams during precipitation events (Bayless and McManus 2001). These spills can result in isolated fish kill events in some stream segments. Threats from confined animal feeding operations are considered a low to moderate level threat across the northern portions of the range and a moderate level threat across the southern portions of the range.

Road and Bridge Construction

Highway and bridge construction and repair actions continue to impact habitat downstream despite active consultation with the action agencies. These activities inherently disturb in-channel and riparian areas, which are then subject to weather-related events during and immediately following construction. In many cases, heavy rains with associated runoff will release large volumes of sediment to the channel despite use of best management practices for erosion control. Pflieger (in litt. 1992) reported that a population in Boone County, Missouri, was extirpated in the mid-1970s by sedimentation resulting from road construction. In South Dakota, a programmatic formal consultation is in place. The resulting biological opinion under with the South Dakota Department of Transportation requires implementation, monitoring, and maintenance of comprehensive and effective sediment and erosion control measures. Elsewhere in the species’ range, similar requirements for effective sediment and erosion control are required via section 7 consultation. However, heavy rain and associated runoff events can overwhelm these control measures, particularly during construction and revegetation phases.

The placement of culverts associated with road and bridge work also can impact Topeka shiner. Throughout much of the species’ range there are culverts that inhibit or prohibit fish passage due to extreme stream elevation changes and/or high water velocities (Bouska 2008). This impact should be diminished by the implementation of best management practices requiring on-grade installation of culverts as they are replaced over time. Impacts from this activity are believed less in the low gradient stream habitats of South Dakota, as opposed to the higher gradient headwater streams typical of Topeka shiner habitat through most of its range.

Within the northern portions of the range, road and bridge construction are considered a low level threat in South Dakota (Gates pers. comm. 2009) and a low-moderate level threat in Minnesota. Within the southern portions of the range, these activities vary between a low to moderate level threats, dependent on the State (McPeek pers. comm. 2009; Tabor pers. comm. 2009).

Urbanization

Urbanization continues to impact the species and its habitat. Impacts include nutrient enrichment, hydrologic changes and the related need for future channelization and bank stabilization, and the escapement of predacious fishes from many newly constructed small impoundments in the watershed (Keller 1985). Residential development in the Bonne Femme watershed near Columbia, Missouri, likely contributed greatly to the recent extirpation of Topeka shiners from that drainage (Kerns pers. comm. 2005). Increased urbanization is considered a major threat in Kansas and Missouri. In 2005, repeated heavy rains in the Wildcat Creek watershed near Manhattan, Kansas led to large volumes of sediment being eroded from a large construction site. This caused habitat degradation downstream (Tabor pers. comm. 2005).

Residential development in the Deep Creek watershed near Manhattan, Kansas, also is occurring, and will likely increase in intensity within the foreseeable future. Rural residential development also is occurring in portions of the Mission and Mill Creek watersheds west of Topeka, Kansas. In South Dakota, development in and near Sioux Falls has greatly increased within the period of the 1990s to present, and growth is expected to continue. This development similarly threatens the Topeka shiner and its habitat in several tributary watersheds to the Big Sioux River in this area (Hatch in litt. 2005). However, this area represents only a small portion of the overall South Dakota range of the species.

Within the northern portions of the range, urbanization is considered a low level threat. Within the southern portions of the range, urbanization is considered a moderate to high level threat in Kansas and Missouri, but not applicable in Iowa and Nebraska.

Impoundments

In the 30 years prior to listing, large numbers of tributary impoundments were constructed in portions of the species' Kansas, Missouri, and Nebraska range. These impoundments are strongly suspected in the extirpation of the species from many streams and watersheds (Pflieger in litt. 1992; Layher 1993). During times of diminished flows or drought, Topeka shiner populations upstream from impoundments attempt to use these water bodies as refuges. These populations are then subject to predation by piscivorous fishes in these ponds and lakes (Layher 1993; Mammoloiti 2002). In unaltered systems, stream fishes move downstream to find suitable habitat (Deacon 1961). Tributary dams also prevent upstream migration of fishes following drought, prohibiting recolonization of upstream reaches. At present, several now isolated populations of Topeka shiners in Kansas occupy habitat upstream and downstream of impoundments (Tabor pers. comm. 2009). These populations continue to be threatened by present conditions and may be extirpated during future periods of protracted drought.

Populations remaining downstream of impoundments face additional threats from altered flow regimes and the degradation of habitat related to changed hydrologic regimes. An abundant population of the species in Missouri was extirpated following construction of a tributary impoundment (Pflieger in litt. 1992). This population, located downstream from the dam site, was not present when revisited several years after construction. In this case, the habitat had changed from clear rocky pools, to pools filled with silt-layered gravel that were choked with filamentous algae. The immediate threat from future tributary dam construction has decreased as the result of consultation with the sponsoring or permitting agencies. However, long-term threats persist as continued impoundment development in watersheds with Topeka shiners remain in planning documents. Similarly, Tuttle Creek Reservoir, a mainstem impoundment in Kansas, continues to isolate two streams with remnant populations of Topeka shiner, threatening them with extirpation, especially during periods of prolonged drought (Tabor pers. comm. 2009).

Ten large impoundments occur within Topeka shiner watersheds in South Dakota. Small impoundments are limited and are not stocked with predatory fish to the extent they are in the southern portions of the range. However, Topeka shiners have not been found upstream of Lake Vermillion, an impoundment on the East Fork Vermillion River, while they continue to exist in the watershed downstream (Wall et al. 2001).

Consultations with the Natural Resources Conservation Service and the USFWS Partners Program have largely addressed current impoundment related impacts to Topeka shiner waterways resulting from their respective agency actions.

In the northern portions of the range, stream impoundment is considered a low level threat. In the southern portions of the range, this issue is considered a moderate threat in Iowa and a moderate to high threat in Kansas and Missouri. In these areas numerous existing impoundment structures are impacting the species and additional structures are being planned. This threat is not presently applicable in Nebraska.

Dredging

In-channel dredging continues to impact habitat in portions of the species' range. In Kansas and Missouri, instream gravel mining/dredging can release large volumes of sediment into downstream habitat impacting water quality and spawning substrate (Cross et al. 1982). Dredging/mining alters stream morphology, by reducing pool and riffle complexes, and encourages upstream head-cutting which releases additional sediment to the stream as the streambed is eroded and streambanks collapse. In Iowa and Minnesota, periodic dredging of accumulated sediment from drainage ditches upstream can similarly release large sediment loads to downstream habitat, impacting water quality and spawning substrate (McPeek pers. comm. 2006). This threat is higher during periods of heavy rainfall when runoff increases and previously dredged spoils wash back into the stream system.

This issue is not considered a threat in the northern portions of the range. In the southern portions of the range, dredging is considered a low level threat in Iowa, a moderate level threat in Nebraska, and a moderate to high level threat in Kansas and Missouri.

Summary

In the northern portions of the range, the species continues to exist across nearly all of its historic range despite widespread land-cover and land-use changes. Ongoing and future threats to the species' habitat have been identified; however these threats are not believed to be meaningfully impacting the species' status in the northern portions of the range at this time (U.S. Geological Survey 2007a). No threats in this portion of the range are thought to currently exceed a moderate overall threat level. While the species appears less vulnerable to known threats in this portion of the range, projected impacts to habitat may meaningfully impact water quantity and the suitability of stream habitat within the foreseeable future.

Long-term habitat degradations resulting from historical changes in land-cover and land-use are still believed to be the major contributing factors in the long-term decline of Topeka shiner across the southern portions of the range (U.S. Geological Survey 2007b). Many of the threats from this long-term degradation are still current and have continued to impact the species and its habitat since listing. Within the southern portions of the range, threats to habitat are substantially more severe than in the northern portions of the range.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

The 1998 listing rule indicated some collection of Topeka shiners by individuals for use as bait fish and for display in home aquaria (63 FR 69008, December 15, 1998). In 1998, overutilization was not considered a factor in the decline of the Topeka shiner (63 FR 69008, December 15, 1998).

Since then, use for bait harvest has been documented in Iowa (Howell pers. comm. 2007). However, overutilization is still not considered a meaningful factor impacting the viability of the Topeka Shiner in any of its range.

2.3.2.3 Disease or predation:

<u>Disease and Parasites</u>

In 1998, the original listing rule concluded disease was not likely a significant threat to the Topeka shiner except during certain habitat conditions (63 FR 69008, December 15, 1998). This remains the case. Poor water quality and crowding can occur during periods of reduced flows (USFWS 1990). Specifically, low dissolved oxygen, high water temperatures, and elevated nutrient levels can cause increased stress to fishes, reduce resistance to pathogens and promote disease outbreaks (USFWS 1990). Parasitic, bacterial, fungal, and viral outbreaks may occur. For example, scoliosis was observed in the species in the mid-1990s from a stream in Missouri. This disease occurrence, in combination with other factors like urbanization, likely led to the apparent extirpation of this population (Kerns pers. comm. 2004). However, on the whole, new observations of the species indicate a higher acute tolerance to these conditions than previously believed (Hatch pers. comm. 2005). Asian tapeworm (*Bothriocephalus acheilognathi*) has been reported to negatively affect Topeka shiner growth and survival (Koehle 2006). Asian tapeworm was discovered in a captive population of Topeka shiner at the University of Kansas experimental ponds facility in 1995. It was believed that this population was likely exposed to the parasite as a result of the ponds previously holding grass carp (*Ctenopharyngodon idella*) (Campbell pers. comm. 2006). In 2006, field collections were made from the source stream of the captive population and from a stream in a separate nearby watershed. Asian tapeworm was discovered in two specimens of fish (red shiner (*Cyprinella lutrensis*) and redfin shiner (*Lythurus umbratilis*)) from each of the streams, demonstrating the possibility that the organism could have come into the experimental pond facility with the source fish. Further investigation found the parasite in 5 of 12 golden shiners (*Notemigonus crysoleucas*) purchased at a local bait dealer. The source of origin for the golden shiners was reportedly a bait farm in Arkansas (Campbell pers. comm. 2006). At this time, the level of threat to Topeka shiner from the Asian tapeworm is not known.

Predation

The 1998 listing rule described predation by a number of picivorous (fish eating) fish species including the green sunfish (*Lepomis cyanellus*) found throughout the range of the Topeka shiner and other predatory species less common in the species' known range (63 FR 69008, December 15, 1998). Predation of Topeka shiners by introduced piscivores is now believed to provide a greater threat to the species than previously known. The green sunfish is the most common predator typically occurring with Topeka shiner across its range, often being found in the same pools (Tabor pers. comm. 2009). The spotted bass (*Micropterus punctulatus*) and largemouth bass (*M. salmoides*) also are naturally occurring predators of the Topeka shiner in the southern portions of its range. However, these basses' natural range typically overlapped only the downstream extremes (typically larger, deeper pools) of the Topeka shiner's characteristic small stream, headwater pool habitats (Cross and Collins 1995; Pflieger 1997).

The construction of tributary impoundments on streams with Topeka shiners, and the subsequent introduction of piscivorous fishes not typically found in headwater habitats, such as largemouth bass and crappies (*Pomoxis spp.*) can seriously impact the species (Layher 1993; Winston 2002). During drought or periods of low flows, Topeka shiners seek refuge in permanent stream pools or impoundments now occupied by these introduced fishes. Some of the most common fishes typically captured in streams directly upstream and downstream of tributary impoundments in Kansas and Missouri are largemouth bass, bluegill (*Lepomis macrochirus*), and crappie. These species predate and typically eliminate Topeka shiners and other stream cyprinids (minnow species) (Mammoliti 2002; Kerns pers. comm. 2005). Tabor and McKenzie (in litt. 1994) captured only largemouth bass from a stream segmented by numerous dams in southeastern Iowa.

Layher (1993) and Pflieger (in litt. 1992) documented the extirpation of Topeka shiner following stream impoundment in Kansas and Missouri, respectively. Mammoliti (2002) describes the extirpation of several populations of Topeka shiner in Kansas following impoundment and subsequent stocking of largemouth bass. Kerns (pers. comm. 2005) partially attributes the extirpation of the species from the Bonne Femme watershed in Missouri to largemouth bass escapement from ponds into streams, in combination with drought conditions that resulted in the elimination of nearly all small fishes from the isolated pools.

Direct stocking of piscivorous fishes into or near Topeka shiner habitat for sportfishing benefit also can impact the species. It appears that the high plains remnant population of Topeka shiner was eliminated following the introduction of largemouth bass into stream habitat in Wallace County, Kansas (Tabor pers. comm. 2005). These fish were stocked by private individuals into this isolated habitat. As a result, the Topeka shiner and seven other species of small prairie fishes were extirpated from the area. The Iowa DNR has annually stocked walleye (*Stizostedion vitreum*) into the North Raccoon River. While the mainstem North Raccoon is not considered suitable habitat for the Topeka shiner, small walleyes will enter and use tributary streams and off-channel pools as feeding habitat, potentially affecting Topeka shiners in these habitats (Howell pers. comm. 2004).

Overall, the threat of disease remains poorly understood, but is believed a minor issue except when habitat conditions are compromised. Predation is considered a low level threat in South Dakota, Minnesota, and Iowa and a moderate to high level threat in Kansas and Missouri. Predation is poorly understood in Nebraska.

2.3.2.4 Inadequacy of existing regulatory mechanisms:

There are several Federal and State laws and regulations that are pertinent to Topeka shiner. These different statutes contribute in varying degrees to the conservation of the Topeka shiner.

<u>Federal Endangered Species Act (Act)</u>

The Act is the primary Federal law that provides protections for the Topeka shiner. The Act provides several tools to conserve the species. These are discussed below. Section 7(a)(2) requires Federal agencies to consult with the USFWS to ensure any project funded, authorized, or carries out by such agency does not jeopardize the continuing existence of a listed species, or result in the destruction or adverse modification of designated critical habitat for the species. The Topeka shiner has designated critical habitat in Iowa, Minnesota, and Nebraska. Section 9 of the Act provides for direct protection of a federally-listed species by prohibiting “take” (i.e., to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct). Section 10(a)(1)(B) allows us to permit incidental take where a Habitat Conservation Plan minimizes and mitigates the effects of authorized incidental take. To date, there is one USFWS approved Habitat Conservation Plan for the Topeka shiner. Section 6 of the Act allows for cooperation between the USFWS and States in the management and funding of projects designed to enhance the conservation of federally-listed species. To date, numerous research and conservation projects involving Topeka shiner have been funded through section 6 including captive propagation, status surveys, genetics research, and habitat and life history research. In the absence of the Act's protections, Federal protections of the species or consideration for the species' biological needs would be limited, as described below.

Federal Clean Water Act

Section 404 of the Clean Water Act affords some protections for the Topeka shiner. The U.S. Army Corps of Engineers (Corps) issues permits for the discharge of dredged or fill materials into "Waters of the United States." The Corps interprets this phrase to include not only navigable waters, but also other defined waters that are adjacent or hydrologically connected to traditional navigable waters. The basic premise of the program is that no discharge of dredged or fill material may be permitted into such waters if: (1) a practicable alternative exists that is less damaging to the aquatic environment; or (2) the nation's waters would be significantly degraded. In other words, permitees must show that they have, to the extent practicable: taken steps to avoid wetland impacts; minimized potential impacts on wetlands; and provided compensation for any remaining unavoidable impacts. Because of the Topeka shiner's listed status, the Corps is required under section 7 of the Act to consult with the USFWS before issuing a 404 permit to a project applicant that may affect the species. If the Act's protections were removed, Section 404 of the Clean Water Act protections involving the conservation of the Topeka shiner would likely decrease significantly.

Section 402 of the Clean Water Act governs National Pollution Discharge Elimination System permits for point sources such as confined animal feeding operations discussed in above. While this system is managed by the Environmental Protection Agency, most States are authorized to implement the program in their State. This means the States issue the permits directly to the discharging facilities. These permits require the use best management practices to reduce pollutants to the "maximum extent practicable." Programs delegated to the States are not required to consult with the USFWS, nor are they required to specifically consider the impact of permitted actions to the Topeka shiner. If the Act's protections were removed, there would be no impact to the National Pollution Discharge Elimination System permitting process. With or without the Act's protections, the standards put in place through this permitting process likely benefit the species by providing protection to water quality.

National Environmental Policy Act

The National Environmental Policy Act (42 U.S.C. 4371 *et seq.*) provides some protections for listed species that may be affected by activities undertaken, authorized, or funded by Federal agencies. Prior to implementation of such projects with a Federal nexus, the National Environmental Policy Act requires an agency to analyze the project for potential impacts to the human environment, including natural resources. In cases where the analysis reveals significant environmental effects, the Federal agency must discuss mitigation that could offset those effects (40 C.F.R. 1502.16). These mitigations usually provide some protections for listed species. However, the National Environmental Policy Act does not require that adverse impacts be mitigated, only that impacts be assessed and the analysis disclosed to the public. In the absence of the Act's protections, it is unclear what level of consideration and protection Federal agencies would provide through the National Environmental Policy Act process.

State Protections

In the States of Iowa, Kansas, Missouri, and Nebraska, the species is listed under State endangered species or other conservation legislation which afford some protections to the species. These protections in Iowa, Missouri, and Nebraska are primarily restricted to direct take and/or transportation of the species. Kansas State statute provides for designation of State critical habitat, and review of habitat impacts when State resources or permits are required for a project, as well as prohibiting take and transportation of State listed endangered or threatened species. The species is designated a species of special concern in Minnesota, but the designated status does not provide protection by Minnesota's Endangered Species Statute or the associated rules. Due to its widespread range in South Dakota, the species has no State protections there. The States of Kansas, Missouri, and South Dakota provide for management of the species through the creation and implementation of State management or recovery plans. These plans have been implemented in varying degrees. If the Act's protections were lifted, these limited State regulatory mechanisms would likely remain unchanged.

Summary

Prior to listing, the Topeka shiner had no significant State or Federal protections. Listing enabled the USFWS to provide some oversight of Federal actions potentially impacting the species, particularly through section 7 consultation. Through this function, many impacts affecting the species have been lessened or avoided. These actions include several ongoing threats to the species in its southern range (i.e. dam construction, road and bridge construction, gravel mining), and potential or ongoing threats in the northern range (i.e. wetland drainage (tiling), grassland conversion with associated Federal subsidized groundwater withdrawal for irrigation, road and bridge construction). Without protections afforded by the Act, these actions would likely occur without Federal review of impacts to the species.

The majority of habitat occupied by the Topeka shiner is under private ownership and long-term impacts from land-use and land-cover changes persist. Many actions impacting the species are not included under the venue of existing Federal or State regulatory mechanisms including the clearing and cropping of riparian areas, small winter cattle feeding operations, urban/suburban development, and small pond construction. However, regulated activities vary by state.

In summary, the current Federal regulatory oversight has minimized many impacts across the range. However, current Federal oversight has not been sufficient to prevent the species' continued decline and loss in some areas. Such continued losses have largely been limited to the southern portion of its range where threats appear more severe and habitat appears more susceptible to detrimental changes. In the absence of the Act's protections, we believe the species' decline in southern portions of its range would be greatly expedited as other protective regulatory mechanisms appear limited. While it is also likely the Act's protections have benefited the species in the northern portion of its range, ongoing threats in this portion of the range appear less immediate.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

Interspecific Competition

The 1998 listing rule's discussion of Factor E only addressed interspecific competition (competition arising between species) (63 FR 69008, December 15, 1998). This discussion was largely speculative in nature considering potential competition with such species as blackstripe topminnow (*Fundulus notatus*), red shiner (*Cyprinella lutrensis*), southern redbelly dace (*Phoxinus erythrogaster*), and cardinal shiner (*Luxilus cardinalis*). Little more is known about this issue today than at the time of listing. A variety of other natural or manmade factors potentially affecting the species' continued existence, not considered in the original listing, are discussed below.

Drought

The occurrence of drought in the prairie landscape is a natural phenomenon historically tolerated by the Topeka shiner in unaltered habitat. Drought has an increasing impact on the species as watershed development and land-use changes occur, decreasing the connectivity and increasing the isolation of existing populations. In its natural environment, the Topeka shiner was able to disperse downstream or off-channel to areas with suitable waters during dry periods. Conversely, the species was able to return to its headwater habitats when flows returned.

Much of the remaining range of the Topeka shiner in Iowa, Kansas, Missouri, and Nebraska consists of highly fragmented, isolated populations with long distances of altered or unsuitable habitat between them, prohibiting redistribution. Many of these populations do not have the necessary downstream or off-channel refuges available to them to survive long-term drought conditions at this time. Increased periods of protracted drought, potentially resulting from climate change, would exacerbate the impacts of habitat fragmentation and isolation (Deacon 1961; Cross 1967; Mammoliti 2002; Knight and Gido 2005; Karl et al. 2009). Increased drought could also impact presently stable population complexes, forcing these populations to seek refuge downstream into larger streams with more predacious fishes and diminished habitat value. This threat is applicable to both the northern and southern portions of the Topeka shiner's current range.

Climate Change

According to the Intergovernmental Panel on Climate Change (IPCC) (2007, p. 1) "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level." Average Northern Hemisphere temperatures during the second half of the 20th century were very likely higher than during any other 50-year period in the last 500 years and likely the highest in at least the past 1300 years (IPCC 2007). It is very likely that over the past 50 years: cold days, cold nights and frosts have become less frequent over most land areas, and hot days and hot nights have become more frequent (IPCC 2007). It is likely that: heat waves have become more frequent over most land areas, and the frequency of heavy precipitation events has increased over most areas (IPCC 2007).

The IPCC (2007) predicts that changes in the global climate system during the 21st century are very likely to be larger than those observed during the 20th century. For the next two decades a warming of about 0.4°F per decade is projected (IPCC 2007). Afterwards, temperature projections increasingly depend on specific emission scenarios (IPCC 2007).

The average temperature in the Great Plains already has increased roughly 1.5°F relative to a 1960s and 1970s baseline (Karl et al. 2009). Localized projections suggest that much of the range of the Topeka shiner may experience temperature increases of 4°F to 6°F under the lower emissions scenario or increases of 7°F to 11°F under the higher emissions scenario before the end of the century (Karl et al. 2009).

Summer temperatures across the range of the Topeka shiner are projected to increase 6°F by the end of the century under a lower emissions scenario with increases of more than 10°F by the end of the century under a higher emissions scenario (Karl et al. 2009). Extreme heat events (a one in twenty-year event) are projected to occur every 2 to 3 years across the Topeka shiner's range under a higher emissions scenario by the end of the century (Karl et al. 2009).

Northern portions of the range are projected to have 45 to 60 days above 90°F by the end of the century under a lower emissions scenario and 60 to 90 days above 90°F by the end of the century under a higher emissions scenario (Karl et al. 2009). Southern portions of the range are projected to have 45 to 105 days above 90°F by the end of the century under a lower emissions scenario and 75 to 120 days above 90°F by the end of the century under a higher emissions scenario (Karl et al. 2009).

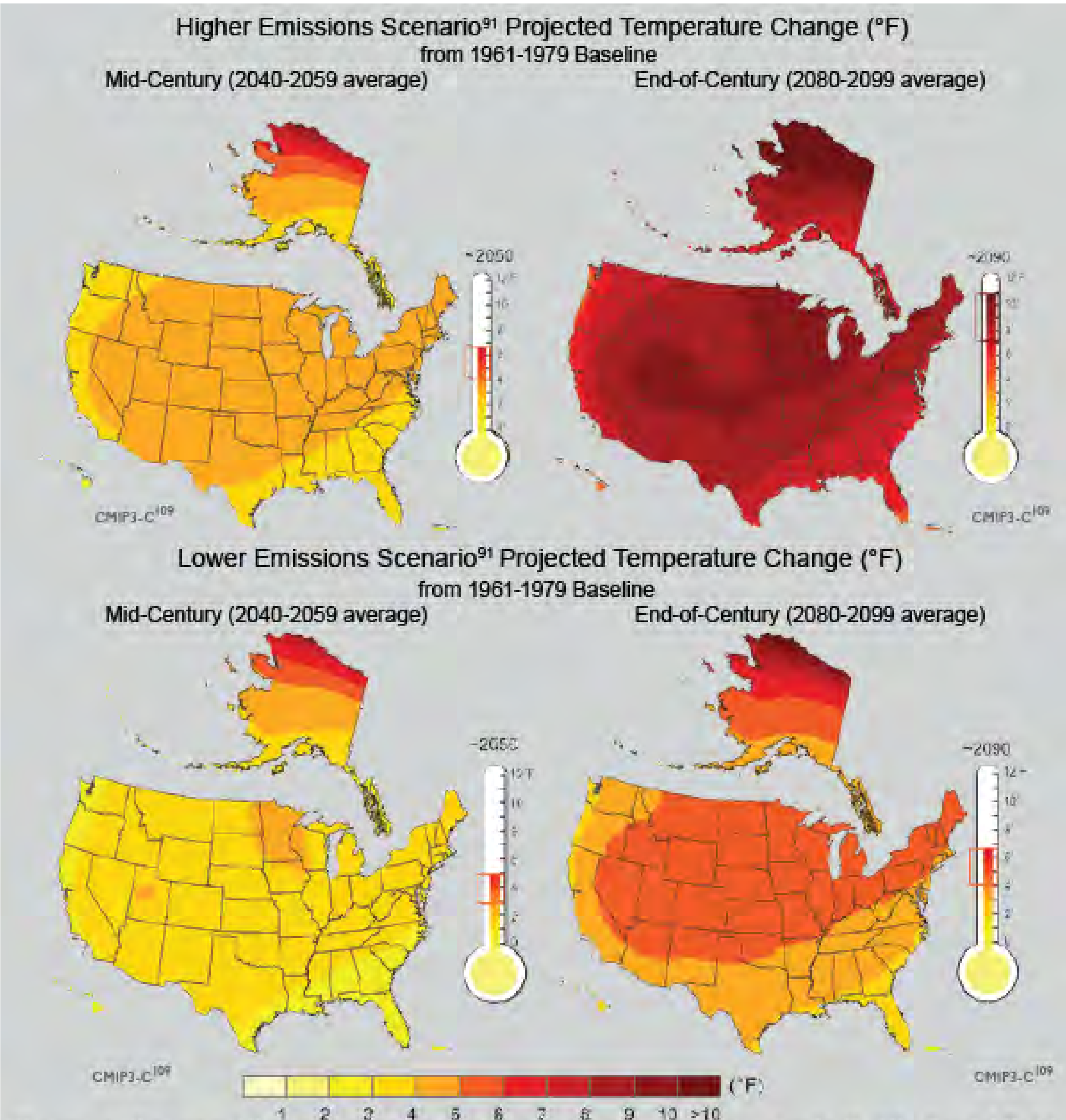
Precipitation has also been impacted by climate change. In the last 50 years, total precipitation has increased up to 20 percent across northern portions of the range, while changes in the southern areas have ranged from declines of up to 5 percent to increases up to 20 percent (Karl et al. 2009). Heavy precipitation events have increased between 15 and 31 percent over the last 50 years (Karl et al. 2009).

Model projections for future precipitation are presented below, but are considered less reliable than model projections for temperature (Ray et al. 2008). Precipitation projections depend largely on the season. In northern portions of the range, under a higher emissions scenario, winter precipitation is expected to increase 5 to 20 percent (Karl et al. 2009). However, summer precipitation is expected to decline 5 to 10 percent across northern portions of the range under the same emissions scenario (Karl et al. 2009).

In southern portions of the range, under a higher emissions scenario, winter precipitation is expected to increase 5 to 20 percent (Karl et al. 2009). However, summer precipitation is expected to decrease 5 to 20 percent across southern portions of the range with the most severe reductions in precipitation occurring in the most southern areas (Karl et al. 2009).

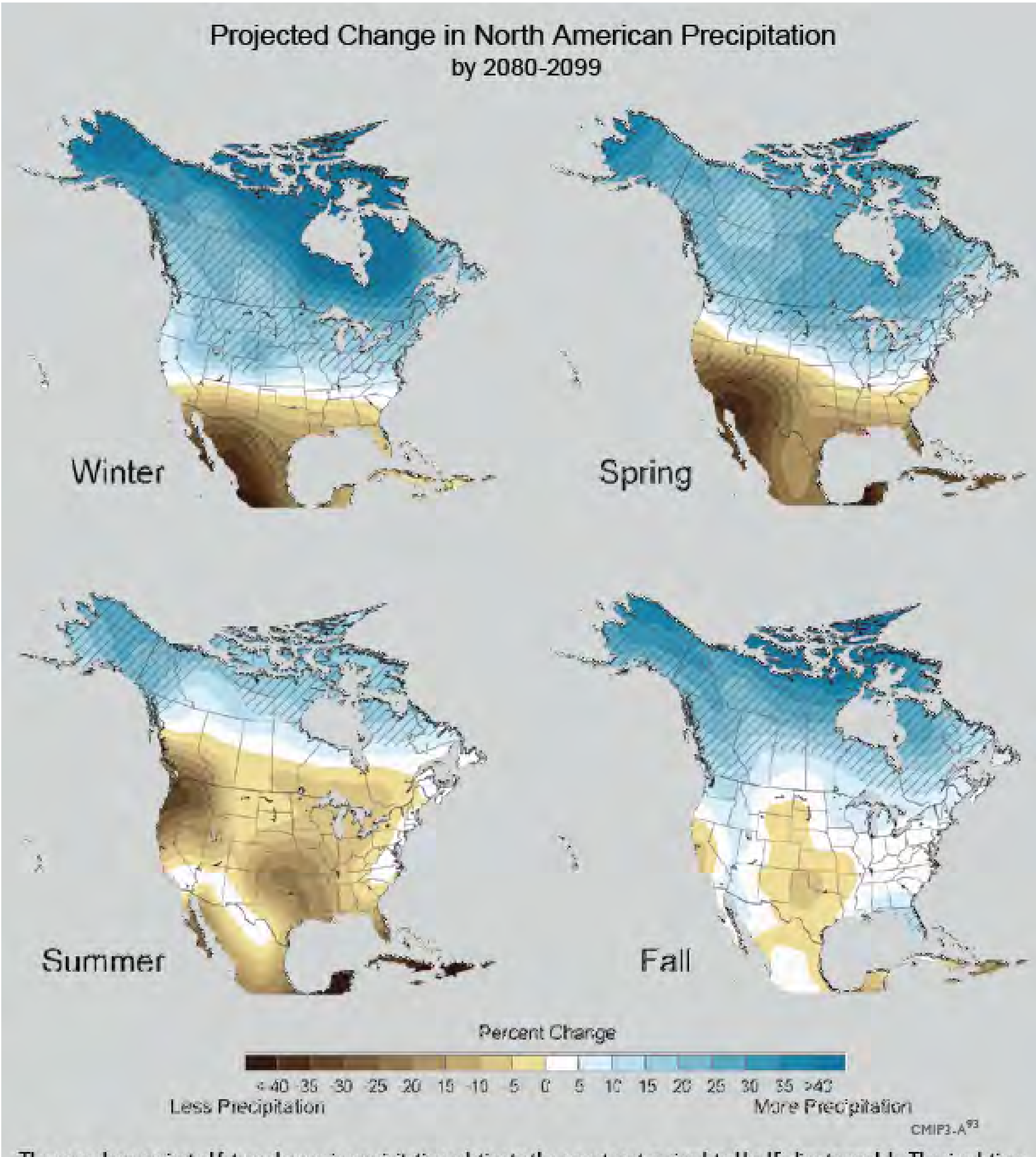
Climate-driven changes are likely to combine with human stresses to further increase the vulnerability of natural ecosystems (Karl et al. 2009). Changes in temperature and precipitation affect the composition and diversity of native animals and plants through altering their breeding patterns, water and food supply, and habitat availability (Karl et al. 2009).

If these projections prove accurate, the long-term impacts to Topeka shiner could be substantial. Impacts in summer are of particular concern. Increased air temperatures will lead to higher water temperatures, especially during low-flow periods. Reduced summer precipitation and increased evaporation is likely to reduce flows. Such conditions cause increased stress to fish. The timing and amount of precipitation will also impact groundwater recharge rates. Finally, substantially hotter summers would likely increase agricultural demand for surface-water and ground-water resources. Thus, the available information indicates climate change is a substantial long-term risk factor which could meaningfully impact water quantity and the suitability of stream habitat. More study of this issue is recommended.



The maps on this page and the previous page are based on projections of future temperature by 16 of the Coupled Model Intercomparison Project Three (CMIP3) climate models using two emissions scenarios from the Intergovernmental Panel on Climate Change (IPCC), *Special Report on Emission Scenarios* (SRES).[91] The "lower" scenario here is B1, while the "higher" is A2.[91] The brackets on the thermometers represent the likely range of model projections, though lower or higher outcomes are possible. Additional information on these scenarios is on pages 22 and 23 in the previous section, *Global Climate Change*. These maps, and others in this report, show projections at national, regional, and sub-regional scales, using well-established techniques.[110]

Source: Karl et al. 2009



The maps show projected future changes in precipitation relative to the recent past as simulated by 15 climate models. The simulations are for late this century, under a higher emissions scenario.[91] For example, in the spring, climate models agree that northern areas are likely to get wetter, and southern areas drier. There is less confidence in exactly where the transition between wetter and drier areas will occur. Confidence in the projected changes is highest in the hatched areas.

Source: Karl et al. 2009.

TABLE 1. Five Listing Factors Threats Assessment Summary Table: Minnesota and South Dakota

FACTORS	MINNESOTA			SOUTH DAKOTA		
	Immed	Intens	Overall Threat	Immed	Intens	Overall Threat
Factor A						
Rowcrop Agriculture/Grassland Conversion	Ongoing	Mod	Mod	Ongoing	Mod	Mod
Livestock Grazing	Ongoing	Low-Mod	Low-Mod	Ongoing	Low-Mod	Low-Mod
Confined Animal Feeding Operations	Ongoing	Mod	Mod	Ongoing	Low-Mod	Low-Mod
Groundwater Withdrawal Stream Hydrology	Ongoing	Low-Mod	Mod	Future	Low-Mod	Mod
Road and Bridge Construction	Ongoing	Mod	Mod	Ongoing	Low-Mod	Low
Urbanization	Ongoing	Low	Low	Ongoing	Low-Mod	Low
Dams/Stream Hydrology	Ongoing	Low	Low	Ongoing	Low	Low
Dredging/Gravel Mining	n/a	n/a	n/a	n/a	n/a	n/a
Factor B						
Bait Harvest	n/a	n/a	n/a	n/a	n/a	n/a
Factor C						
Disease and Parasites	Not Known	Not Known	Not Known	Not Known	Not Known	Not Known
Predation	Ongoing	Low	Low	Ongoing	Low	Low
Factor D						
No Federal Nexus/ Regulatory Changes	Ongoing	Not Known	Not Known	Ongoing	Not Known	Not Known
Factor E						
Population Fragmentation/Drought	Future	Not Known	Not Known	Future	Not Known	Not Known
Climate Change	Ongoing	Mod	Mod-High	Ongoing	Mod	Mod-High

*Immediacy:
1. Future (future effects anticipated)
2. Ongoing (effects imminent)
3. Historic (effects realized, but restorative action necessary)

**Intensity (strength of stressor):
1. Low
2. Moderate
3. High

Overall Threat Level:
1. Low (no action needed at this time)
2. Moderate (action is needed)
3. High (immediate action needed)
4. Severe (action essential for survival of species)

TABLE 2. Five Listing Factors Threats Assessment Summary Table: Iowa, Kansas, Missouri, and Nebraska

FACTORS	IOWA			KANSAS			MISSOURI			NEBRASKA		
	Immed	Intens	Overall Threat	Immed	Intens	Overall Threat	Immed	Intens	Overall Threat	Immed	Intens	Overall Threat
FACTOR A												
Rowcrop Agriculture – Grassland Conversion	Ongoing	Mod-High	Mod-High	Ongoing	Mod-High	Mod-High	Ongoing	Mod-High	Mod-High	Ongoing	Mod-High	Mod-High
Livestock Grazing	Ongoing	Low	Low-Mod	Ongoing	Low-Mod	Low-Mod	Ongoing	Low-Mod	Low-Mod	Ongoing	Low	Low
Confined Animal Feeding Operations	Ongoing	Mod	Mod	Ongoing	Mod	Mod	Ongoing	Mod	Mod	Ongoing	Mod	Mod
Groundwater Withdrawal Stream Hydrology	Future	Not Known	Not Known	Future	Not Known	Not Known	Future	Not Known	Not Known	Ongoing	Mod	Mod
Road and Bridge Construction	Ongoing	Low-Mod	Low-Mod	Ongoing	Mod	Mod	Ongoing	Mod	Mod	Ongoing	Low	Low
Urbanization	n/a	n/a	n/a	Ongoing	Mod	Mod-High	Ongoing	Mod	Mod-High	n/a	n/a	n/a
Dams/Stream Hydrology	Ongoing	Mod	Mod	Ongoing	Mod	Mod-High	Ongoing	Mod	Mod-High	n/a	n/a	n/a
Dredging/Gravel Mining	Ongoing	Low	Low-Mod	Ongoing	Mod	Mod-High	Ongoing	Mod	Mod-High	Ongoing	Low	Mod
FACTOR B												
Bait Harvest	Ongoing	Low	Low	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
FACTOR C												
Disease and Parasites	Not Known	Not Known	Not Known	Ongoing	Not Known	Not Known	Ongoing	Not Known	Not Known	Not Known	Not Known	Not Known
Predation	Ongoing	Low	Low	Ongoing	Mod-High	Mod-High	Ongoing	Mod-High	Mod-High	Not Known	Not Known	Not Known
FACTOR D												
No Federal Nexus/ Regulatory Changes	Future	Not Known	Not Known	Future	Not Known	Not Known	Future	Not Known	Not Known	Future	Not Known	Not Known
FACTOR E												
Population Fragmentation/Drought	Ongoing	Not Known	Not Known	Ongoing	Mod-High	Mod-High	Ongoing	Mod-High	Mod-High	Ongoing	Mod-High	Mod-High
Climate Change	Ongoing	Mod	Mod-High	Ongoing	Mod	Mod-High	Ongoing	Mod	Mod-High	Ongoing	Mod	Mod-High

*Immediacy:
1. Future (future effects anticipated)
2. Ongoing (effects imminent)
3. Historic (effects realized, but restorative action necessary)

**Intensity (strength of stressor):
1. Low
2. Moderate
3. High

Overall Threat Level:
1. Low (no action needed at this time)
2. Moderate (action is needed)
3. High (immediate action needed)
4. Severe (action essential for survival of species)

2.4 Synthesis

As required by the Act, we considered the five potential threat factors to assess whether the Topeka shiner is threatened or endangered. At the time of listing, we concluded that the species was endangered (i.e., in danger of extinction in all or a significant portion of its range) (69 FR 71071, December 08, 2004). We concluded that the species' recent significant reduction in range and the extirpation of the species throughout most of its historic range, within the context of the continuing and expected impacts from present and planned projects and activities, supported the determination of endangered status.

This conclusion has proven accurate in southern portions of the range (i.e., Kansas, Missouri, Nebraska, and most of Iowa) where historic changes in land-use, land-cover, and hydrology have largely reduced the species to small, isolated populations susceptible to ongoing and projected threats (Menzel pers. comm. 2002; 69 FR 44736, July 27, 2004; Howell pers. comm. 2006; Kansas Department of Wildlife and Parks 2006; Kansas Department of Wildlife and Parks 2007; McPeek pers. comm. 2007; Stark 2007; Davis 2008). Even with Federal protection, it is likely that additional sites in this portion of the range will be lost within the foreseeable future, consistent with extirpations in the recent past (Missouri Department of Conservation 1999; Stark et al. 1999; Kerns pers. comm. 2007; Tabor pers. comm. 2009).

However, new distributional data and a better understanding of threats in the northern portion of the species' range has altered our perception of the species' status on the whole. At the time of listing, the Topeka shiner was known from 20 stream sites in Minnesota, South Dakota, and Iowa's Rock River watershed (69 FR 71071, December 08, 2004). This apparently limited distribution and the assumption that the species had been lost from so many areas, supported our assertion that the species was highly susceptible to documented threats across its range and trending toward extinction. Since listing, additional survey work has resulted in a 7-fold increase in the number of occupied stream sites across this portion of the species' range. Topeka shiner populations in Minnesota and South Dakota now appear to be closely representative of the species' known historic range (Ceas and Anderson 2004; Wall et al. 2004; Wall and Thompson 2007; Ceas and Larson 2008). Such data indicates the species continues to be widespread despite impacts to stream habitat (Ceas and Monstad 2005; Wall and Thompson 2007; Ceas and Larson 2008). While the reason for this apparent resiliency is not certain, it may be related to ecological differences caused by the area's geologic morainal features (Clark 2000; Wall et al. 2004). These features appear to have positively influenced groundwater inputs to streams and perennial pools in intermittent streams benefiting the species' ability to persist (Berg et al. 2004; Wall et al. 2004).

This area represents approximately 70 percent of the species' current range over approximately 20 percent of the species' historic range. The number of local populations of Topeka shiner in the northern range is presently redundant within their watersheds of occurrence, suggesting a wide distribution of usable habitat meeting the species' biological requirements (Ceas and Anderson 2004; Wall et al. 2004; Wall and Thompson 2007; Ceas and Larson 2008).

While the Topeka shiner appears minimally impacted by historic and current threats in northern portions of the range, several foreseeable threats concern us. Maintaining the area's hydrology is a critical factor in maintaining the species' apparent resiliency to threats and stability in this area. The available information indicates that pressures on the hydrologic system (e.g., groundwater withdrawals, agricultural drainage, and climate change) are expected to increase over-time. If unregulated, this could meaningfully impact water quantity and the suitability of stream habitat. This would, in the long-term, increase the species' vulnerability to other threats discussed above. While we lack data to suggest these or any threats place the species in danger of extinction currently, we believe these potential impacts may place the species at risk of extinction within the foreseeable future. Further study of these issues is warranted.

In conclusion, given the Topeka shiner's widespread distribution and apparent resilience to threats across northern portions of its range, an endangered determination no longer seems appropriate. At the time of listing, we stated that "threatened status (was) not appropriate considering the extent of the species' population decline and the vulnerability of the remaining populations" (69 FR 71071, December 08, 2004). We now know that the extent of the species' population decline is not as severe as originally presumed and that vulnerability of the many of the remaining populations is substantially lower than presumed at the time of listing. Although vulnerability is not uniform across the range, on the whole, we believe a threatened status (likely to become endangered within the foreseeable future throughout all or a significant portion of its range) is more appropriate than the current endangered status (in danger of extinction throughout all or a significant portion of its range). Thus, we recommend downlisting to threatened.

We recommend downlisting instead of delisting because of the species' current vulnerability in southern portions of the range and potential long-term impacts to the hydrology in the northern portion of the range.

3.0 RESULTS

3.1 Recommended Classification

3.2 New Recovery Priority Number:

The recovery priority number for Topeka shiner remains an 8C, indicating that: (1) populations face a moderate degree of threat; (2) recovery potential is high;

(3) the entity is listed at the species level; and (4) the species is in conflict with construction or other development projects or other forms of economic activity.

3.3 Reclassification (from Endangered to Threatened) Priority Number:

When species are identified in the course of a 5-year review as warranting deletion from the lists or reclassification from Endangered to Threatened, priority for preparation of regulations are assigned according to the system here, employing two criteria, yielding six categories (48 FR 43098, September 21, 1983).

In this case, we believe downlisting would have a moderate management impact. Specifically, the creation of a 4(d) rule may somewhat reduce the regulatory impact of the listing in the portions of the range where the species is doing well. As this action is not a petitioned action, it has a priority score of four.

Management impact	Petition status	Priority
High	Petitioned action	1
	Unpetitioned action	2
Moderate	Petitioned action	3
	Unpetitioned action	4
Low	Petitioned action	5
	Unpetitioned action	6

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

1. Prepare a downlisting package when sufficient resources (funding and personnel) are available, including a 4(d) rule to limit the regulatory impacts of the listing in portions of the Topeka shiner range where the species is doing well.

2. Develop a draft and final recovery plan for the Topeka shiner. The recovery plan should include objective, measurable delisting criteria. The recovery plan will not include downlisting criteria as the species already warrants threatened status. The recovery plan will consider whether it is appropriate to identify multiple DPSs with independent delisting criteria (see Section 2.1.3 above). The recovery plan will also consider whether we should identify recovery units or management units related to drainages and species' genetics. Recovery criteria should address all threats meaningfully impacting the species. The recovery plans also should estimate the time required and the cost to carry out those measures needed to achieve the goal for recovery and delisting.

3. Develop and implement a standardized and, to the extent practical, quantitative method for prioritizing recovery actions and tracking recovery implementation so that progress toward eliminating threats can be regularly summarized.

4. Improve and standardize the monitoring process for Topeka shiner populations' distribution, abundance, and trends.

5. Enlist and support the full engagement of Federal, State, local, tribal, and private partners in Topeka shiner recovery.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Topeka Shiner (*Notropis topeka*)

Current Classification: Endangered range-wide

Recommendation resulting from the 5-Year Review:

_X_ Downlist to Threatened
____ Uplist to Endangered
____ Delist
____ No change is needed

Appropriate Listing/Reclassification Priority Number: 4

Review Conducted By: Kansas Ecological Services Field Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, U.S. Fish and Wildlife Service

Approve Daniel W Mulhern / Acting Date 01/07/10
Field Supervisor, Kansas Ecological Services Office

REGIONAL OFFICE APPROVAL:

Lead Regional Director, U.S. Fish and Wildlife Service

Approve Noreen E Walsh Date 1/07/10
Acting Regional Director, Region 6

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