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Topeka Shiner (Notropis topeka): Species Conservation Assessment

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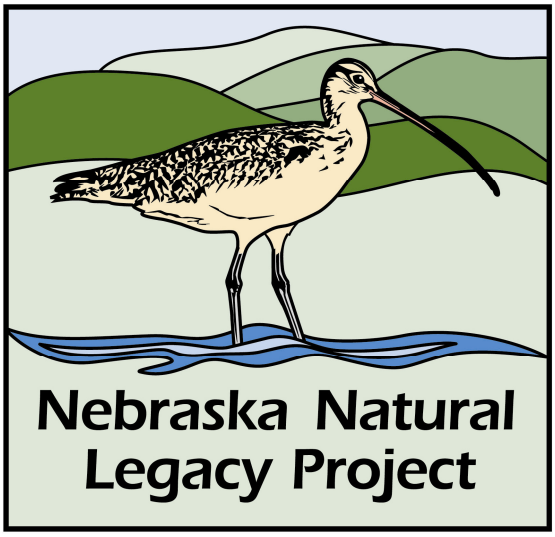
Topeka Shiner
(*Notropis topeka*)

A Species Conservation Assessment
for
The Nebraska Natural Legacy Project



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The mission of the Nebraska Natural Legacy Project is to implement a blueprint for conserving Nebraska's flora, fauna and natural habitats through the proactive, voluntary conservation actions of partners, communities and individuals.

Purpose

The primary goal in development of at-risk species conservation assessments is to compile biological and ecological information that may assist conservation practitioners in making decisions regarding the conservation of species of interest. The Nebraska Natural Legacy Project recognizes the Topeka shiner (*Notropis topeka*) as a Tier I at-risk species of high priority for conservation. Some general management recommendations are made here regarding Topeka shiners; however, conservation practitioners will need to use professional judgment to make specific management decisions based on objectives, location, and a multitude of variables. This resource was designed to share available knowledge of the Topeka shiner that will aid in the decision-making process or in identifying research needs to benefit the species. Species conservation assessments will need to be updated as new relevant scientific information becomes available. The Nebraska Natural Legacy Project focuses efforts in the state's Biologically Unique Landscapes (BULs), but it is recommended that whenever possible, practitioners make considerations for a species throughout its range in order to increase the outcome of successful conservation efforts.

Common Name	Topeka Shiner
Scientific Name	*Notropis topeka*
Order	Cypriniformes
Family	Cyprinidae
G-Rank	G3
S-Rank	S1
Goal	10
Distribution	Limited
Criteria for selection as Tier I	State and federally listed as Endangered, G3 (Federal Register 69:143-44736)
Trends since 2005 in NE	Declining
Range in NE	Very localized: Cherry, Madison, and Stanton counties
Habitat	Cold/cool clear water streams with gravel, low gradient
Threats	Sedimentation, exotics, channelization, stocking of sport fish, row crop agriculture, flow modification de-watering, dams, loss of off-channel quiet-water habitats, degradation of riparian areas Climate Change Vulnerability Index: Extremely Vulnerable
Research/Inventory	Determine age structure, recruitment, population dynamics, seasonal movements, and potential for reintroduction including identifying potential reintroduction sites
Landscapes	Cherry County Wetlands, Upper Loup Rivers and Tributaries

Status

The Topeka shiner was state and federally listed as an endangered species on 15 December 1998, Federal Register 63-69008 (USFWS 1998). According to NatureServe's last review in 2007, the state of Nebraska Heritage status rank for Topeka shiner is S1, U.S. national status is N3, and global conservation rank is G3 (2009). Experts in Nebraska believe there may be as few as 200 of the fish in the state, and the Nebraska Natural Legacy Science Team has set a goal of maintaining ten populations in the state (Schneider et al. 2011).

Causes of Endangerment

Just like any species, the Topeka shiner is not immune to degradation and destruction of its habitat. Degraded riparian corridor, gravel removal, construction, vegetation clearing, stream channelization, groundwater withdrawals, and reduced flows threaten Topeka shiners (USFWS 2009, MDC 2012). Runoff from excessive chemical application, unrestricted access of livestock to streams and their waste, and non-point pollution reduce water quality for Topeka shiners and other aquatic species (MDC 2012). Furthermore, over-grazing of riparian areas can contribute to sedimentation of streams, reduced water quality, and impacted spawning habitat (Cross and Moss 1987). Native grassland conversion to crops is the most substantial threat to Topeka shiners in Nebraska because of the associated impacts to streams that typically accompany row-crop agriculture (e.g., drainage tiling, runoff) (USFWS 2009). One such risk is indirect atrazine exposure via effects on vegetation and food sources (USEPA 2007).

Construction projects, particularly for highways and bridges can severely impact streams. Even if some preventative measures have been taken during construction projects, sediment can still be deposited in the channel and riparian areas if there are severe weather events (USFWS 2009). Furthermore, installation of culverts may impede Topeka shiner movements (USFWS 2009). In other parts of Topeka shiner range, urbanization is a growing threat but this is currently not a significant concern in Nebraska (USFWS 2009). Dredging is a moderate threat to Topeka shiners in Nebraska (USFWS 2009).

Topeka shiners may fall prey to larger fish species like black bullhead (*Ameiurus melas*) (Dahle and Hatch 2002) and the introduced, popular largemouth bass (*Micropterus salmoides*) (Prophet et al. 1981, Graham 1993, Dahle and Hatch 2002). It does not seem that largemouth bass prefer Topeka shiners, but they will randomly prey on minnow species and can steepen population declines of the endangered fish (Layne Knight and Gido 2005). Impoundments, increased pool size, and game fish stocking support piscivorous fishes that exacerbate predation on Topeka shiners (Tabor 1992, Layher 1993, Tabor 1993, Dahle 2001, Schrank et al. 2001, Winston 2002). Additionally, impoundments can limit dispersal of Topeka shiners (MDC 2012).

In general, disease has not been indicated as a major contributor to reducing Topeka shiner populations, but individuals that become overcrowded and stressed because of severely reduced habitat and water quality may be more susceptible to diseases (USFWS 2009). Asian tapeworm may be a risk to Topeka shiners causing reduced fish growth and survival (Koehle 2006, USFWS 2009). Infected fish should not be used for repopulation of streams (Koehle 2006).

Topeka shiners are extremely vulnerable to climate change (USFWS 2009, Young et al 2010). Even with predicted seasonal increases in precipitation for the Great Plains, Topeka

shiners are threatened by reduced soil moisture, decreased availability of water, rising temperatures, lowered groundwater, and reduced flows (Karl et al. 2009, USFWS 2009). Optimum water temperature for Topeka shiner growth is between 27-31 degrees C; however, Topeka shiners appear to be somewhat tolerant of warmer temperatures and reduced oxygen levels (Koehle 2006). During periods of drought, Topeka shiners need to be able to swim to downstream or off-channel refuges in order to survive until conditions improve. Long-term droughts and the need for shiners to traverse expanses of unsuitable habitat could cause extirpations of populations (USFWS 2009), particularly if fish are forced to become dependent on off-channel sites that are likely to dry out over time (Dahle 2001).

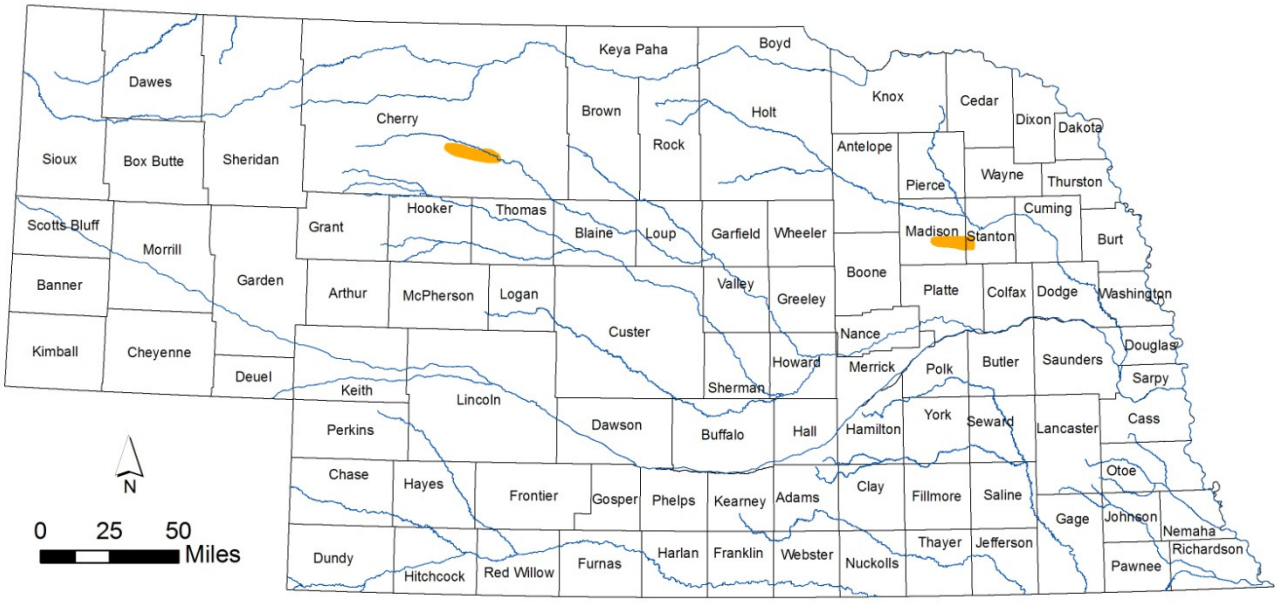
Species Description

The Topeka shiner is a minnow with a yellow to olive colored back and silver to white side and belly. Its dark lateral line extends from head to tail fin. It also has a dark stripe on its back in front of the dorsal fin. Breeding males have orange tinted heads and bodies and orange to red fins with numerous bumps found on most of the body (Kerns and Bonneau 2002, USFWS 2010). The Topeka shiner has a mean length of 34.6 mm (age 12 months), 42.5 mm (age 24 months), and 53.2 mm (age 36 months) (Kerns and Bonneau 2002). Mature males may be larger than females (Kerns and Bonneau 2002).

Habitat and Range

Although the Topeka shiner's habitat has become more restricted, it still occurs in the six states where it has historically been present: Kansas, Missouri, Iowa, Nebraska, South Dakota, and Minnesota with most of the remaining populations in Kansas (Cross and Collins 1995). On 27 July 2004, critical habitat was designated for Topeka shiners in Nebraska, Iowa, and Minnesota (Federal Register 69-44736) (USFWS 2010). In Nebraska, Topeka shiners occur in the landscapes of the Cherry County Wetlands and North Loup River (Panella 2010, Schneider et al. 2011).

Topeka shiners are normally found in slow-flowing, cool, clear, prairie creeks or spring-fed pools in larger streams (Minckley and Cross 1959, Cross and Collins 1995, Pflieger 1997, Tabor 1998, Dahle and Hatch 2002). Fish-habitat modeling and inventory suggest that Topeka shiner occurrence is associated with stream size class, streamflow, parent material, and groundwater potential (Wall et al. 2004). Substrates of its habitat are gravel, rubble, sand, or bedrock with some silt (MDC 2012). Adults generally swim mid-water or near the substrate in search of food (Kerns and Bonneau 2002). They are sometimes found in riffles if pursued (Kerns and Bonneau 2002). The Topeka shiner is often one of the last of the fish species to persist in drying pools, because it is somewhat drought tolerant (Kerns and Bonneau 2010).



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Nebraska Natural Heritage Program,
Nebraska Game and Parks Commission
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FIGURE 1. Current range of Topeka shiners in Nebraska based on field observations, museum specimens, and expert knowledge. Map courtesy of Nebraska Natural Heritage Program, Nebraska Game and Parks Commission.

Dispersal

Dispersal ability of the Topeka shiner is moderate. It is unknown if Topeka shiners can 'tributary hop" as needed to escape adverse conditions (USFWS 2004). It's generally believed that movement over long distances is not likely (Michels 2000).

Diet

Topeka shiners are opportunistic omnivores (Hatch and Besaw 2001, USFWS 2009). They frequently consume insects such as midges and mayflies (Kerns and Bonneau 2010). Food items also may include plant matter, algae, and eggs of other fishes (Kerns and Bonneau 2010, Panella 2010). Topeka shiners feed primarily near the substrate during daylight hours (Kerns and Bonneau 2002).

Reproduction

Topeka shiners spawn May to summer (Kerns and Bonneau 2002). Males establish and defend territories of approximately 0.5 m in diameter (Kerns and Bonneau 2002). Males sometimes even chase females out of their spawning territories. Females that swim into a territory repeatedly will spawn. Topeka shiner males are known also to defend territories

around two species of sunfish: green (*Lepomis cyanellus*) and orangespotted (*L. humilis*) (MDC 2012). Approximately 150-800 eggs are in a Topeka shiner clutch (Panella 2010). Average fecundity of a female that reproduces two seasons is 1040 eggs, with more ova produced the second season from larger females (Kerns and Bonneau 2002). Eggs hatch after five days; larvae begin to feed in four more days and mature at 11-13 months (Paulson and Hatch 2002). The lifespan of an individual Topeka shiner is approximately three years (Kerns and Bonneau 2002, Paulson and Hatch 2002).

Research and Conservation Strategies

A multitude of factors should be considered before implementing any conservation actions for species. Within the guidelines of state and federal law, the Nebraska Natural Legacy Project recommends: 1) consider, but do not limit options to, scenarios that benefit both the species of interest and property owners, 2) consider species dispersal and landscape context, 3) plan for multiple years, and 4) do no harm.

Because the Topeka shiner is a federally listed species, its "unauthorized taking, possession, sale, and transport" is prohibited; any management actions or manipulative research methods implemented for Topeka shiner are subject to policies of the Endangered Species Act of 1973 - ESA (16 U.S.C. 1531-1544, 87 Stat. 844), as amended – Public Law 93-20. ESA - Section 7 requires that "any action authorized, funded or carried out…is not likely to jeopardize the continued existence of listed species or modify their critical habitat" (ESA 1973). Furthermore, the Nebraska Game and Parks Commission (NGPC) has responsibility for protecting endangered and threatened species under authority of the Nongame and Endangered Species Conservation Act (NESCA),(Neb. Rev. Stat. § 37-801 to 37-811) (NESCA 1975). Nebraska Game and Parks Commission (NGPC) has entered into a Programmatic Agreement (PA) with the U.S. Fish and Wildlife Service (USFWS) to conserve threatened and endangered species (NGPC and USFWS 2008). In some cases, other agencies have developed PAs with NGPC for these species as well. Habitat work for the species must be in compliance with the most current PA, as amended. Any management actions outside the parameters of the PA that directly impact threatened and endangered species (e.g., the Topeka shiner) require environmental review and approval from the NGPC Environmental Analyst. Refer to the PA and obtain appropriate approval and permits for work that takes place within 0.25 miles of known occurrences of Topeka shiner.

It will be challenging to increase the number of Topeka shiner to meet the goal set forth in the Nebraska Natural Legacy Project of 10 populations. In Nebraska, conservation considerations should be made for the Topeka shiner in at least two Biologically Unique Landscapes: Upper Loup Rivers and Tributaries and Cherry County Wetlands. These landscapes offer the best opportunities for Topeka shiner conservation within Nebraska based on current knowledge. Given the principal threats identified, conservation efforts for Topeka shiner (summarized in Table 2) may want to employ the following management strategies:

1) Prioritize conservation efforts in the uppermost reaches of watersheds where Topeka shiners are normally present (Kerns and Bonneau 2010).

2) Maintain and restore hydrology to streams with Topeka shiners. Strategies may include identification of altered hydrographs in the Topeka shiner's former range, wetland creation and restoration to recharge groundwater and reduce runoff, and rehabilitation of vegetative riparian corridor (USFWS 2011, Shearer 2003).

3) Help protect water quality and habitat by avoiding the overuse of fertilizers and pesticides, reducing the amount of animal waste entering the stream system, reducing amount of gravel removed from streams, and upgrading and maintaining septic systems (Shearer 2003, USFWS 2009).

4) Take necessary measures (e.g., installation and monitoring of silt fences) to avoid sedimentation of streams and avoid erosion, particularly during construction projects (MDC 2012).

5) Stream work above high bank level should be avoided during the Topeka shiner spawning period (approximately mid May to end of July) (MDC 2012). If a coffer dam is needed to facilitate a construction project, it should be placed in late summer/early fall and removed prior to mid May (MDC 2012). Obtain necessary project reviews.

6) Discourage installation of impoundments in Topeka shiner strongholds and associated headwater areas (Shearer 2003, MDC 2012).

7) For permanent road crossings over streams, bridges are generally a better option than culverts to avoid restricting Topeka shiner migration (MDC 2012).

8) For species in dire straits, captive propagation and release into suitable habitat should be considered as an option to meet population goals. While ex situ conservation may be criticized, it has demonstrated success in the recovery of many species. Fish hatcheries have a long history of propagating game fishes, but some are now propagating minnow species. Kansas Biological Survey and University of Kansas have developed and refined techniques for captive breeding of Topeka shiners (Campbell et al. 2012). Missouri Department of Conservation is evaluating habitat suitability in several streams for Topeka shiner reintroductions (MDC 2010). Nebraska may want to partner with other state agencies and organizations to assist in efforts to increase the range-wide stability of the Topeka shiner. In addition to the identification of high-quality streams, removal of predatory fishes may be warranted before Topeka reintroductions (MDC 2010). In order to maintain genetic variation, conserve the maximum number of Topeka shiner populations (Sarver 2007, Anderson and Sarver 2008, USFWS 2009). Because Topeka shiner reintroduction is experimental, monitor released populations so that conservation strategies can be adjusted accordingly to maximize successful outcomes.

Information Gaps

Studies could evaluate optimal wetland design for Topeka shiners (Shearer 2003). And, predation risks to Topeka shiners in Nebraska are still poorly understood (USFWS 2009).

Information regarding potential interspecific competition from minnows such as red shiner (*Cyprinella lutrensis*) is also lacking (USFWS 2009). Little information is available on the dispersal ability of Topeka shiners (USFWS 2004). As researchers try to determine where Topeka shiners are located, they may want to consider employing a new DNA stream sampling method under evaluation in South Dakota by the Colorado State University Water Institute for ability to determine presence of the endangered minnow.

Considerations for Additional Species

At-risk species and keystone species that share habitat with Topeka shiners should be considered in management plans for the fish. Conservation for Topeka shiners may affect or be influenced by at-risk species that can be found in the same Biologically Unique Landscapes as the fish. Table 1 lists a sample of at-risk species you may want to consider while planning for Topeka shiner in-stream habitat and on the landscape. This list will not apply to all Topeka shiner sites of occupancy nor is the list all-inclusive.

TABLE 1. Tier I at-risk species identified in the Nebraska Natural Legacy Project that inhabit biologically unique landscapes with Topeka shiners (Schneider et al. 2011), particularly the aquatic and riparian species, may necessitate consideration in habitat management plans.

Animals

- Blacknose Shiner (*Notropis heterolepis*)
- Finescale Dace (*Chrosomus neogaeus*)
- Northern Redbelly Dace (*Chrosomus eos*)
- Plains Topminnow (*Fundulus sciadicus*)
- Bell's Vireo (*Vireo bellii*)
- Interior Least Tern (*Sternula antillarum athalassos*)
- Piping Plover (*Charadrius melodus*)
- Trumpeter Swan (*Cygnus buccinator*)
- Whooping Crane (*Grus americana*)
- Blanding's Turtle (*Emydoidea blandingii*)
- American Burying Beetle (*Nicrophorus americanus*)
- Iowa Skipper (*Atrytone arogos iowa*)
- Regal Fritillary (*Speyeria idalia*)
- Northern River Otter (*Lontra canadensis*)

Plants

- Hall's Bulrush (*Schoenoplectus hallii*)
- Western Prairie Fringed Orchid (*Platanthera praeclara*)
- Wolf Spikerush (*Eleocharis wolfii*)

TABLE 2. Summary of suggested management for Topeka shiners in Nebraska. The following should be interpreted as general guidelines based on the best available knowledge at the time of this publication. See Research and Conservation strategies section of this document for more detail and Reference section for sources of additional information.

FOCUS	STRATEGIES	MITIGATION and CONSIDERATIONS
Avoid disrupting spawning habitat	No stream work below high bank should take place between mid May and end of July.	Consult environmental analyst for review of any construction projects that impact habitat for Topeka shiner
Apply conservation efforts to watersheds most likely to support Topeka shiners	Target conservation efforts in upper reaches of watersheds where Topeka shiners already occur; evaluate habitat suitability for reintroductions	Degradation of headwater streams will most likely harm Topeka shiners
Maintain high water quality	Prevent waste and pollutants from entering stream (e.g., use herbicides and pesticides sparingly, install silt fences, fence livestock from stream)	Condition of various fencing should be monitored to prevent silt and livestock from polluting streams
Discourage further impoundment and channelization of stream; explore restoration opportunities	Restore/maintain stream meander; deepen degraded oxbows and allow for water exchange with primary channel; remove dams that are in disrepair and/or no longer serve their intended purpose; increase pool depth for refuge from drought; provide gravel for spawning	Impoundments create bodies of water where increased numbers of large fish can prey on Topeka shiners. Removing barriers that prevent flows from reaching side channels will provide additional habitat.
Minimize culverts	Where road crossings are needed, recommend bridges instead of culverts; investigate better designed culverts	Culverts can function as barriers to fish movement and spawning and isolate populations
Maintain genetic diversity	Preserve multiple populations of Topeka shiners; evaluate captive propagation possibilities/techniques	Look for possibilities to increase genetic exchange and be aware of barriers to gene flow

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