

Gauging the Threat of Predation on the Topeka Shiner (*Notropis topeka*) in Minnesota

FINAL REPORT

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Introduction

The Topeka shiner (*Notropis topeka*) is a small, stout minnow that inhabits slow-flowing habitats of headwater streams in the central prairie regions of the United States (Tabor 1998). In Minnesota, this species exists only in the Missouri River drainage, located in the southwestern corner of the state (Phillips et al. 1982). Topeka shiners have relatively stable populations in Minnesota (Dahle 2001); however, their distribution and abundance have greatly declined over most of their range during this century, leading to their listing as federally endangered (Tabor 1998). Although habitat destruction and degradation are thought to be the primary causes for this decline (Tabor 1998), predation by introduced piscivorous species (particularly largemouth bass, *Micropterus salmoides*), following the construction of impoundments in streams containing Topeka shiners, has also been implicated (Prophet et al. 1981, Layher 1993, Schrank et al. 2001). There have been no studies on the impacts of predation on the Topeka shiner, thus the significance of this threat is currently unknown (Tabor 1998). The purpose of this study was to determine which syntopic fishes prey on Topeka shiners in Minnesota and to gauge the impact of such predation by means of predator gut content analysis.

Methods

This study was conducted within the Big Sioux and Rock River watersheds of southwestern Minnesota between April 1999 and July 2000. These are the only two watersheds in Minnesota where Topeka shiners are known to exist (Dahle 2001). Potential predators of Topeka shiners (i.e., piscivores and omnivores) were collected during concurrent distribution surveys for this species. Sampling was conducted using two types of seines: a 6.1 x 1.2 m bag seine (3.2 mm mesh) was used during 1999 and a 3.7 x 1.8 m straight seine (4.8 mm mesh) was used during 2000. Predators considered large enough to consume Topeka shiners were euthanized in a toxic solution of MS222 and preserved in 10% formalin. In the lab, predators were measured (± 0.1 cm) using a tape measure and weighed (± 0.1 g) using a Sartorius

electronic scale. Predators were then dissected and their gut contents were identified by visual examination. Fish prey were examined using a microscope and identified to the lowest recognizable taxon. Due to the difficulty in positively identifying partially digested prey, three categories of fish prey were used in reporting: Topeka shiner, Not Topeka shiner, or Unknown. The average number of Topeka shiners consumed per predator was calculated by species to determine which predator species presented the greatest threat to the Topeka shiner.

Results

A total of 148 predators from 20 sites was examined (Table 1). The majority (82%) of the predators were either black bullhead (*Ameiurus melas*) or creek chubs (*Semotilus atromaculatus*). Other predators examined were 13 green sunfish (*Lepomis cyanellus*), four largemouth bass, three yellow perch (*Perca flavescens*), three common shiners (*Luxilus cornutus*), two stonecats (*Noturus flavus*), and one northern pike (*Esox lucius*).

The gut contents of 34 predators contained fish prey, including four Topeka shiners, 45 Not Topeka shiners, and 13 Unknown fish prey (Table 1). Thus, only 6.5% of the fish prey were definitely Topeka shiners. Since Topeka shiners were only found in black bullheads, the average number of Topeka shiners per gut was zero for all other species (Table 2). Therefore, to gauge the threat of predation by predator species, all fish prey were included in the analysis. The results showed that largemouth bass exhibited the highest average number of fish prey per gut, followed by yellow perch and northern pike, green sunfish, black bullhead, and creek chubs (Table 2). Common shiners and stonecats did not contain any fish prey. Complete results of this study are provided in Appendix I.

Discussion

The threat of predation is low for Topeka shiners in Minnesota. While common shiners and stonecats do occasionally eat small fish, it is highly unlikely that they have an impact as piscivorous predators. The most common predators in these watersheds (i.e., black bullhead, creek chubs, and green sunfish) are also not considered highly piscivorous (Phillips et al. 1982; Harlan et al. 1987). This was supported by their relatively low average number of fish prey per gut results (Table 2). While these predators probably do eat Topeka shiners on occasion, it is unlikely that they have a serious impact on Topeka shiner populations. The fact that these species have coexisted syntopically in headwater streams for thousands of years supports this claim. The three highly piscivorous species examined (i.e., largemouth bass, yellow perch, and northern pike) are not common in these watersheds. Only eight of these fishes were collected during sampling for this study. Their rarity is likely due to the small number of lakes and impoundments in this region, which would provide the main habitat from which such species would temporarily enter headwater stream reaches. At present, these predators probably have very limited impacts on Topeka shiners in Minnesota.

If given the opportunity, however, these piscivorous predators could seriously impact local Topeka shiner populations. For example, between 1998 and 1999, a large Topeka shiner population was extirpated from a farm pond in Minnesota following the introduction of largemouth bass (Hatch 2001). Largemouth bass, and possibly yellow perch and northern pike, are not native to the Minnesota portion of the Missouri drainage and likely are not predators with which Topeka shiners coevolved. Consequently, one would predict that a high level of mortality would be exerted by such exotic predators, even in open, stream systems. Therefore, efforts should be made to restrict the introduction of these predators into watersheds containing Topeka shiners. Likewise, efforts should be made to restrict the construction of

new impoundments in streams containing Topeka shiners, thereby limiting the amount of available habitat for existing populations of these predators to colonize.

Literature Cited

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Table 1: Summary of predator gut analyses of eight predatory species from the Big Sioux and Rock River watersheds in southwestern Minnesota, April 1999 - July 2000. TS = Topeka shiner

Predator species	# locations	# sampled	# w/fish prey	TS	# fish prey consumed	
					Not TS	Unknown
black bullhead	17	79	11	4	26	1
creek chub	7	43	12	0	13	2
green sunfish	6	13	5	0	2	4
largemouth bass	1	4	4	0	4	2
yellow perch	2	3	1	0	0	3
common shiner	1	3	0	0	0	0
stonecat	2	2	0	0	0	0
northern pike	1	1	1	0	0	1
Total	20	148	34	4	45	13

Table 2: Average number of Topeka shiners (TS) and fish prey per predator gut for eight predatory species from the Big Sioux and Rock River watersheds in southwestern Minnesota, April 1999 - July 2000.

Predator species	N	Avg. # TS per gut	Avg. # fish prey per gut
black bullhead	79	0.05	0.39
creek chub	43	-	0.35
green sunfish	13	-	0.46
largemouth bass	4	-	1.50
yellow perch	3	-	1.00
common shiner	3	-	-
stonecat	2	-	-
northern pike	1	-	1.00

Appendix I: Complete results of predator gut content analysis for Topeka shiner predation study.

TL = Total length
 TBM = Total body mass
 TS = Topeka shiner

Black bullhead

Date	Stream	TL (cm)	TBM (g)	Gut Contents
23-Apr-99	Little Beaver Creek	10.4	23.9	empty
23-Apr-99	Little Beaver Creek	10.9	28.2	plant matter
23-Apr-99	Little Beaver Creek	10.9	28.7	plant matter
23-Apr-99	Little Beaver Creek	11.7	35	adult insect
24-Apr-99	Beaver Creek	14.5	83.5	1 crayfish, plant matter
6-May-99	Beaver Creek	9.7	22.4	plant matter
6-May-99	Beaver Creek	9.9	21	digested material
6-May-99	Beaver Creek	10.7	25.3	digested material
6-May-99	Beaver Creek	10.9	30.5	digested material
6-May-99	Beaver Creek	11.4	38.4	plant matter
6-May-99	Beaver Creek	11.4	37.9	1 crayfish, worms
6-May-99	Beaver Creek	13.0	51.8	worm, plant matter
6-May-99	Beaver Creek	13.5	57.4	1 adult minnow (not TS), plant matter
6-May-99	Beaver Creek	13.7	57.1	plant matter
6-May-99	Beaver Creek	14.0	59.7	plant matter
6-May-99	Beaver Creek	14.0	60.8	plant matter
6-May-99	Beaver Creek	15.2	85.4	plant matter
6-May-99	Beaver Creek	20.3	192.6	plant matter
6-May-99	Beaver Creek	21.8	283.4	1 adult creek chub, crayfish, plant matter
7-May-99	Champepadan Creek	9.7	29.4	worms, leech
7-May-99	Champepadan Creek	16.3	61.7	worms, plant matter
7-May-99	Champepadan Creek	16.8	73.7	3 juv. sunfish, 1 adult & 2 juv. Topeka shiners, 1 adult and 2 juv. sand shiners
7-May-99	Champepadan Creek	20.3	148.7	2 insects, worms, plant matter
7-May-99	Champepadan Creek	20.6	175.5	1 juv. sunfish, worms, plant matter
7-May-99	Champepadan Creek	20.6	130.2	worms, plant matter
23-May-99	Elk Creek	11.9	47.8	plant matter
23-May-99	Elk Creek	14.5	85.5	plant matter, worm
23-May-99	Elk Creek	14.7	95.2	plant matter
23-May-99	Elk Creek	15.0	99.5	plant matter
23-May-99	Elk Creek	15.0	94.4	plant matter, 1 crayfish
23-May-99	Elk Creek	15.7	103.9	1 adult Topeka shiner, plant matter
22-Jun-99	Beaver Creek	16.5	110.1	1 crayfish

23-Jun-99	Champepadan Creek	17.8	204.1	1 adult fathead minnow, plant material
28-Jul-99	Willow Creek	21.8	408.8	1 crayfish
17-Aug-99	Poplar Creek	15.2	98.1	1 adult br. stickleback, 1 juv. sunfish, 4 adult & 4 juv. fathead minnows, plant matter
17-Aug-99	Poplar Creek	15.2	66.1	1 juv. sunfish, 1 juv. fathead minnow, 1 juv. minnow (not TS), plant matter
31-Aug-99	Rock River	14.7	58.6	plant matter
5-May-00	Rock River	14.2	86.5	empty
6-May-00	trib. to Kanaranzi Creek	11.2	43.6	empty
6-May-00	trib. to Kanaranzi Creek	15.0	112.7	empty
16-May-00	Elk Creek	16.0	122.2	empty
16-May-00	Mound Creek	12.7	59	empty
16-May-00	Mound Creek	13.2	63.5	1 unidentified animal (possible fish or crayfish)
16-May-00	Mound Creek	14.5	84	empty
16-May-00	Mound Creek	14.7	81.7	empty
16-May-00	Mound Creek	15.0	84.8	empty
16-May-00	Mound Creek	15.2	103.7	empty
16-May-00	Mound Creek	16.0	134.1	empty
16-May-00	Mound Creek	16.8	123.4	empty
16-May-00	Mound Creek	17.8	218.7	empty
16-May-00	Mound Creek	17.8	129.2	empty
24-May-00	Rock River	16.8	152.3	empty
30-May-00	Elk Creek	14.7	87.6	empty
30-May-00	Elk Creek	16.0	111.0	empty
30-May-00	Elk Creek	20.3	189.7	empty
30-May-00	Elk Creek	20.3	241.8	empty
30-May-00	Rock River	14.2	81.7	empty
30-May-00	Rock River	15.2	96.7	empty
30-May-00	Rock River	16.5	110.6	empty
30-May-00	Rock River	17.0	127.1	empty
30-May-00	Rock River	19.3	185	empty
30-May-00	Rock River	20.1	237.3	empty
30-May-00	Rock River	20.1	186.9	2 juv. orangespotted sunfish
31-May-00	Poplar Creek	16.3	140.8	empty
1-Jun-00	Rock River	19.6	225.9	empty
13-Jun-00	Rock River	14.0	69.4	empty
13-Jun-00	Rock River	14.2	73.7	empty
13-Jun-00	Rock River	14.2	83.4	empty
13-Jun-00	Rock River	14.2	85.3	1 adult minnow (not TS)
13-Jun-00	Rock River	14.5	73.8	empty

27-Jun-00	Rock River	13.5	71.4	plant matter
27-Jun-00	Rock River	17.5	106.7	empty
27-Jun-00	Rock River	18.0	153.1	plant matter
27-Jun-00	Rock River	18.3	154.2	empty
27-Jun-00	Rock River	19.6	179.1	plant matter
27-Jun-00	Rock River	19.6	215.4	1 crayfish
27-Jun-00	Rock River	19.8	190.8	plant matter
27-Jun-00	Rock River	21.1	201.6	digested material
29-Jun-00	Rock River	16.0	102.9	empty
Creek chub				
Date	Stream	TL (cm)	TBM (g)	Gut Contents
23-Apr-99	Little Beaver Creek	10.9	26.3	worms, plant matter
23-Apr-99	Little Beaver Creek	14.2	58.6	plant matter
23-Apr-99	Little Beaver Creek	15.2	69	worms
23-Apr-99	Little Beaver Creek	18.3	118.6	worms, plant matter
24-Apr-99	Beaver Creek	9.9	19.3	empty
24-Apr-99	Beaver Creek	9.9	17.3	1 unidentified animal (possible worm or larval fish)
24-Apr-99	Beaver Creek	11.2	22.3	worms
24-Apr-99	Beaver Creek	11.7	30.5	worms
24-Apr-99	Beaver Creek	12.2	34.6	worms, plant matter
24-Apr-99	Beaver Creek	14.2	46.3	worms, 1 insect
24-Apr-99	Beaver Creek	15.5	63.4	1 crayfish
24-Apr-99	Beaver Creek	23.4	46.9	1 adult minnow (not TS)
6-May-99	Beaver Creek	9.1	14.1	digested material
6-May-99	Beaver Creek	10.2	19.7	2 insects
6-May-99	Beaver Creek	10.4	23	digested material
6-May-99	Beaver Creek	10.4	19	digested material
6-May-99	Beaver Creek	10.9	24.6	plant matter
6-May-99	Beaver Creek	11.7	25.3	plant matter
6-May-99	Beaver Creek	11.7	27.5	digested material
6-May-99	Beaver Creek	12.2	34.7	plant matter
6-May-99	Beaver Creek	15.5	69.1	worms
6-May-99	Beaver Creek	16.8	96.2	worm
7-May-99	Champepadan Creek	13.0	35.8	worms
7-May-99	Champepadan Creek	14.7	66.1	empty
7-May-99	Champepadan Creek	15.7	77	worms
7-May-99	Champepadan Creek	21.3	223	1 adult fathead minnow, worms

22-May-99	Beaver Creek	11.7	30.5	digested material
22-May-99	Beaver Creek	15.7	76.6	1 adult fathead minnow
23-Jun-99	Champepadan Creek	14.7	65.4	digested material
23-Jun-99	Champepadan Creek	16.0	73	1 juv. minnow (not TS), worms
23-Jun-99	Champepadan Creek	16.8	78.9	1 adult bluntnose minnow, plant material
23-Jun-99	Champepadan Creek	16.8	112.9	1 juv. bluntnose minnow, 1 juv. fish (unknown), worms, mollusk shell
23-Jun-99	Champepadan Creek	16.8	92.4	digested material, worms
23-Jun-99	Champepadan Creek	17.0	89.5	1 juv. bluntnose minnow, worms
23-Jun-99	Champepadan Creek	18.8	114.4	1 adult sand shiner, worms, plant matter
16-May-00	Mound Creek	17.0	96	empty
25-May-00	N. branch of Pipestone Cr.	22.9	275.7	1 adult minnow (not TS)
31-May-00	Poplar Creek	15.5	71.6	1 adult darter
31-May-00	Poplar Creek	15.5	92.1	empty
31-May-00	Poplar Creek	16.3	96.8	empty
31-May-00	Poplar Creek	17.3	112	empty
?? – 1999	Unknown	17.5	129.4	empty
?? – 1999	Unknown	18.0	102.9	1 adult bigmouth shiner, 1 adult sand shiner, 1 juv. fathead minnow
Green sunfish				
Date	Stream	TL (cm)	TBM (g)	Gut Contents
7-May-99	Champepadan Creek	16.0	88.5	worms
23-May-99	Elk Creek	10.7	51.1	digested material
23-May-99	Elk Creek	11.7	57.3	insects
23-May-99	Elk Creek	12.2	70.3	1 unidentified animal (possible fish)
23-May-99	Elk Creek	13.2	96.8	1 adult common shiner, 1 juv. fish (unknown)
23-May-99	Elk Creek	13.2	77.2	1 unidentified animal (possible fish), fish eggs
23-May-99	Elk Creek	13.5	79.2	digested material
31-Aug-99	Rock River	10.7	51.9	1 adult johnny darter, 2-3 gastropods
31-Aug-99	Rock River	11.7	66.6	1 adult minnow (unknown)
30-May-00	Elk Creek	13.2	102.7	1 crayfish
30-May-00	Rock River	13.7	94.5	empty
1-Jun-00	Rock River	13.5	107.9	empty
1-Jun-00	Rock River	14.0	123.8	empty
Largemouth bass				
Date	Stream	TL (cm)	TBM (g)	Gut Contents
16-May-00	Mound Creek	18.3	171.2	1 juv. fish (unknown)

16-May-00	Mound Creek	18.5	192	1 adult minnow (not TS)
16-May-00	Mound Creek	19.1	213.6	1 adult minnow (unknown)
16-May-00	Mound Creek	22.4	349.4	1 adult creek chub, 1 adult minnow (not TS), 1 juv. bullhead
Yellow perch				
Date	Stream	TL (cm)	TBM (g)	Gut Contents
8-Jul-99	Kanaranzi Creek	12.4	49	3 larval fish (unknown)
16-May-00	Mound Creek	12.7	52.3	empty
16-May-00	Mound Creek	13.5	56.8	empty
Common shiner				
Date	Stream	TL (cm)	TBM (g)	Gut Contents
23-Apr-99	Little Beaver Creek	9.9	22.2	plant matter
23-Apr-99	Little Beaver Creek	10.7	25.2	plant matter
23-Apr-99	Little Beaver Creek	11.2	30.1	plant matter
Stonecat				
Date	Stream	TL (cm)	TBM (g)	Gut Contents
6-May-99	Beaver Creek	13.2	42.4	plant matter
7-May-99	Champepadan Creek	12.7	45.7	digested material
Northern pike				
Date	Stream	TL (cm)	TBM (g)	Gut Contents
24-May-99	Rock River	27.4	275	1 adult minnow (unknown)