EUREKA, TOPEKA!
(SHINER, THAT IS)

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One magnificent aspect of the fish-keeping hobby is that with all the biodiversity Mother Earth has to offer, there is little danger of becoming jaded about it. An enlightening surprise always seems to appear around the next bend, or in the next stream or pet shop. After more than forty years of keeping and breeding North American native fishes, my enthusiasm has not diminished, and the Topeka Shiner (*Notropis topeka*) is an endearing case in point.

In 1996 NANFA member Konrad Schmidt sent me a baker's dozen of young-of-the-year Topeka Shiners, which he caught in the Rock River in southwestern Minnesota. Up to that point, the only photographs and illustrations I had seen of Topeka Shiners showed a fair amount of red in their fins, but nothing like the color of the live specimens. In recent years, the situation has improved dramatically, but it is often difficult finding a good color representation of our North American ichthyofauna.

Female and juvenile Topeka Shiner are rather nondescript, with mostly silver sides and a faint lateral black line. Unlike most shiners (family Cyprinidae), which are long and slender, they are slab-sided and chubby. The fins are usually clear. Males can become quite colorful and are reminiscent of the more common and well-known Red Shiner (*Cyprinella lutrensis*). Fins of the male Topeka Shiner can be cherry red with fin bases usually clear. Nuptial males display more red within the fins and a faint blue lateral stripe that replaces the black one. They also have a rosy cheek. During peak coloration, the fish's whole side has a blue luminance. Nuptial males—as in most minnow species—develop small breeding tubercles on the forehead (Figure 1). One last marking worthy of mention is a small black wedge mark, or chevron, located at the caudal fin base. Typical of many North American minnow species, males can attain chromatic nuptial colors that fade to varying degrees outside the spawning season. Also typical of these minnows, Topeka Shiners can be coaxed into prolonging their nuptial colors by maintaining a rich diet, (glassworms [phantom midge larvae], mosquito larvae, daphnia, quality flake foods, etc.) and either maintaining an optimum temperature or fluctuating from cooler temps and rising up to prime breeding temps of 76° to 78° F.

Breeding this species presents no real challenges, though this account is likely the first written report of their captive spawning and subsequent culture. The "brood stock" I received in 1996 were barely one inch in length and rather nondescript, but one male displayed hints of red at this half-grown size. In May 1997, I prepared a 26-gallon breeding aquarium. Fine black gravel overlay undergravel filter plates. A powerhead supplied the current, for which the Topeka Shiners displayed an affinity. In nature, they were observed spawning over the nests of Orangespotted Sunfish (*Lepomis humilis*) and Green Sunfish (*L. cyanellus*) (Pflieger, 1997). No details on egg deposition placement were observed. It was not feasible for me to provide host (sunfish) spawners while preparing the spawning tank, but that ultimately proved unnecessary. I did provide a simulated sunfish nest of pebbles and also provided other potential spawning substrates, including plastic aquarium plants, green yarn spawning mops, and even a cave on the outside chance they proved to be spatial spawners. They were fed both freeze-dried and frozen bloodworms, live mosquito larvae, whiteworms, and various flake foods. The females quickly assumed a distended appearance, but after a month of waiting, no spawning had

Author's Note: The U. S. Fish and Wildlife Service added the Topeka Shiner to the federal endangered species list in December 1998. This once very common minnow was little known to North American fish hobbyists even though they could have been legally collected in many states where they occurred. Sadly, current federal and state laws prohibit collecting or keeping this species and vanquish any hope Topekas may again be available to the hobbyist in the foreseeable future. However, there is a very peculiar "Catch-22" regulation on the books that allows angling for "minnows" as bait within the species' Minnesota range. The Topeka Shiner is a very colorful minnow that is hardy, peaceful, and (once upon a time) an ideal candidate for not only native fish community aquariums, but some tropical fish set ups as well. I feel very fortunate to have had this unique opportunity to keep and breed this species in captivity and can now share my observations so others might appreciate this small but incredible wonder.

Reprinted from *Tropical Fish Hobbyist* (December, 1998) and revised in 2015.

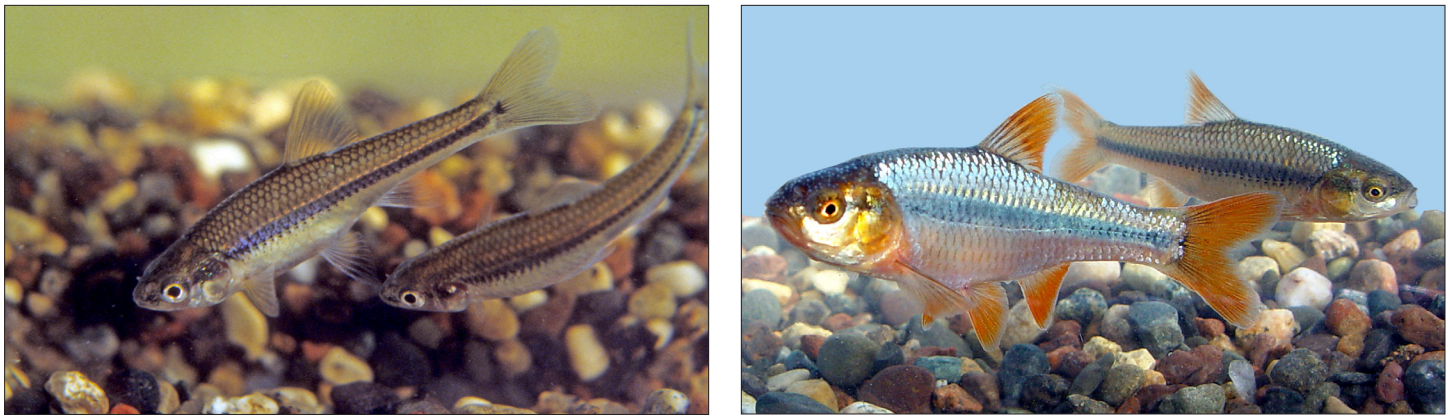

Figure 1. Left: typical coloration of females, males, and juveniles. Right: nuptial males. Blue Mounds State Park, Rock County, MN. (Photos by Konrad Schmidt)

commenced. The aquarium was initially maintained at 70° F, and this proved to be the limiting factor. After slowly increasing the temperature to 76° F, eggs started to appear. On July 4, the first eggs were discovered. The eggs were adhesive and were scattered about the substrate with the vast majority being found within the pebbled nest, although small numbers were found virtually throughout the aquarium.

Males were extremely territorial while spawning. An alpha male assumed the prime spawning location (in this case over the sunfish nest) and allowed no other fish to intrude upon its territory. He even chased away willing females, but if a female persisted in intruding on the male's turf, spawning soon commenced. The male would swim alongside the female, head to head, and vibrate. Several eggs would then fall to the substrate well below the mid-water spawning fish. A female would repeat this process two to four times, then, once disinterested in spawning, would resume swimming with other females and non-spawning males. While spawning other species of minnows, I have often seen several males spawning with a single female, even in territorial species, but this was never evident in my observations of this species. Males were very adamant about spawning alone.

The eggs hatched in five days at 72° F. On July 13, about 75 Topeka Shiner fry were observed free swimming. Two subsequent attempts to induce spawning succeeded later in the summer. The aquarium was cooled off for several weeks, reheated to 76° F to 78° F, and optimum spawning ensued. For each of the last two spawning attempts, only one male was introduced to the spawning tank in order to keep him focused on breeding activity rather than chasing away competing males.

The fry were fed microworms and prepared powdered dry foods. In another 16 days, the first fry began accepting live brine shrimp nauplii. They grew rather slowly, due primarily to a low culture temperature of 70^0 F. By December, they had achieved a size of one inch, slightly less than half their adult size. The fry, much like the adults, proved to be quite hardy once the first several weeks of life were behind them. At weekly intervals larvae and young fry were preserved and sent to the University of Minnesota for their life history studies.

PLIGHT OF THE TOPEKA SHINER

The Topeka Shiner was historically found throughout the lower Missouri River drainage, from southeastern South Dakota, extreme southwestern Minnesota, south to Kansas and central Missouri. A few populations are located in the upper Arkansas River drainages of southern Kansas. There was one population known from a Mississippi River tributary in extreme northeastern Missouri, but it is now presumed extirpated. Topeka Shiners currently occupy about 20% of their historic range (Figure 2).

The Topeka Shiner drastically declined in the late 1900s from intensive agriculture, depletion of aquifers for irrigation, construction of impoundments, and stocking of predatory species such as the Largemouth Bass (*Micropterus salmoides*). Topeka Shiners have disappeared from Shunganunga Creek in Topeka, Kansas, where the first specimens were discovered and described. This disappearance is rather surprising because in the aquarium these minnows require minimal care and are incredibly hardy. Another Topeka Shiner irony discovered shortly after federal listing was that the healthiest populations remained on the periphery of the species' range (i.e., Iowa, Minnesota, and South Dakota). Typically, a species' distribution (whether plant or animal) is rare and spotty at the edge of its range, and these are usually the first to vanish when declines occur.

Topeka Shiners were once believed to inhabit only small clear streams that drain prairie regions with substrates of sand, gravel, bedrock, and rubble. Increased siltation and turbidity were considered to be the leading causes of their decline. Some streams where they occur dry up during the driest summer months, but Topeka Shiners survive drought by residing in low-lying pools, where groundwater perco-

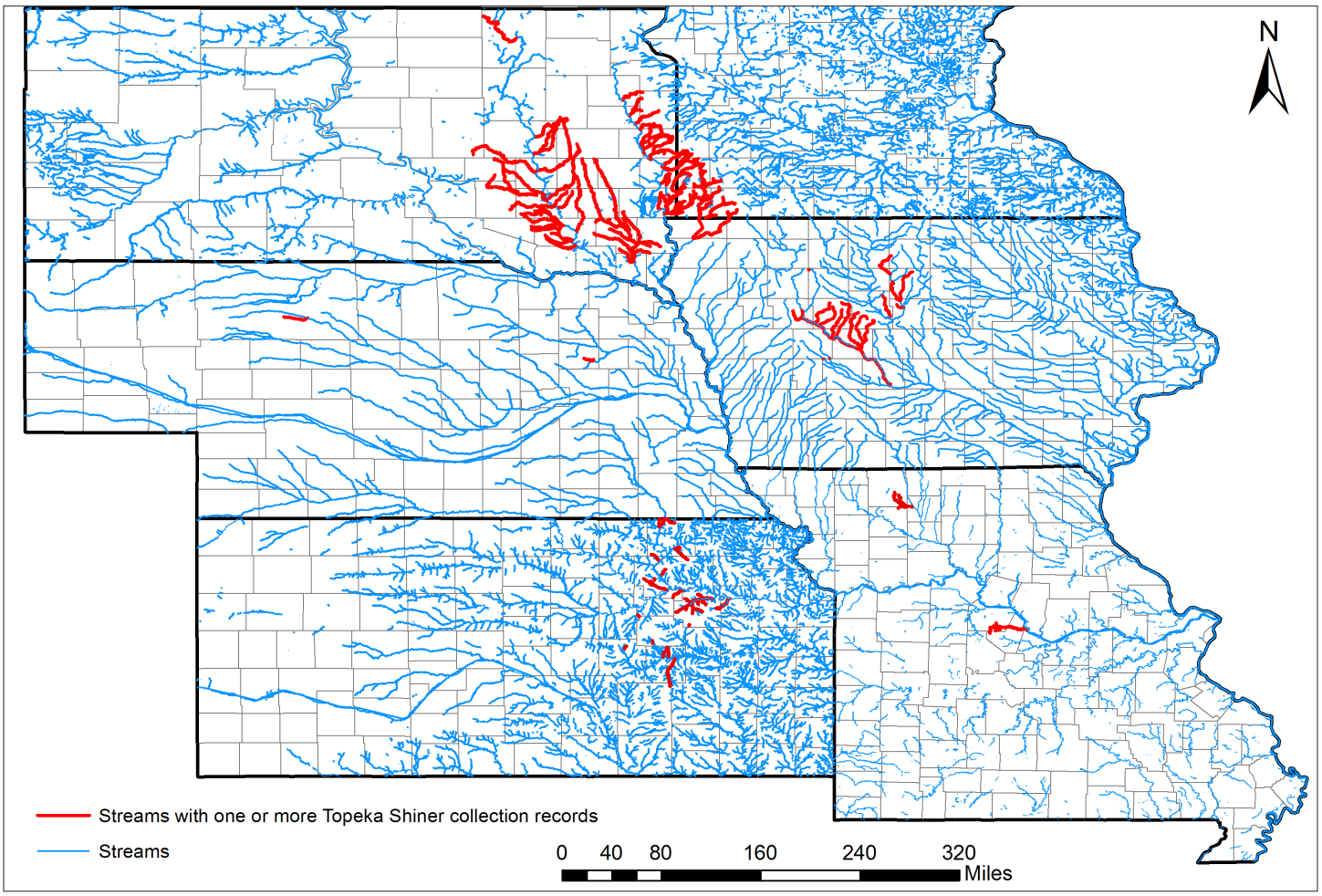

Figure 2. Topeka Shiner collections, 1999–2014. Highlighted streams indicate one or more Topeka Shiner collection records from that stream; the map does *not* imply the species occupies the entire length of the stream system. (USFWS)

lates through the substrate. Tramer (1977) reported that Topeka Shiners survived prolonged drought conditions better than any other resident species. Lab research trials support these findings with estimates of the species' maximum tolerable temperature ranging between 91–95° F and dissolved oxygen concentrations down to 1.2 ppm (Koehle, 2006). Other suspected causes for the Topeka's decline are species competition from the introduced Blackstripe Topminnow (*Fundulus notatus*) and Western Mosquitofish (*Gambusia affinis*); urbanization also has reduced or eliminated some populations.

In 1998 Jay Hatch (NANFA member and University of Minnesota professor) and Shawn Dahle (his graduate student) began a life history study of the species in southwestern Minnesota and very soon found some jaw-dropping revelations (Dahle, 2001). The streams Topeka Shiners called home in Minnesota didn't come close to the habitat described in the literature. These were turbid and carried a heavy sediment load. At first, many hours of effort expended in flowing streams would yield at best a few specimens. Thinking a little outside-the-box, their focus switched to small, isolated, off-channel pools and large oxbows, sometimes a half-mile or more from the present-day stream course (Figure 3). In many of these atypical habitats, a single, short seine haul would yield 100–200 Topeka Shiners. The water transparency could sometimes be good later in the summer when flooding frequency was low. Nevertheless, these habitats almost always had wader-sucking muck bottoms and were exhausting to survey. On one joint Minnesota-Iowa outing, Bruce Menzel (formerly of Iowa State University) needed the strong arms of his graduate student to extricate him from a glue-like quagmire. On another trip, one of Jay's undergraduate student helpers aptly coined the name Shit Hole Shiner after finding Topeka Shiners in a man-made livestock watering pond. Shawn's icing on the cake came in the last year of his study, extending the known distribution of Topeka Shiners in Minnesota significantly eastward to the Little Sioux River (Jackson County, MN).

Perhaps the most bizarre and serendipitous discovery in the Topeka Shiner research was Ladd's Pond near Luverne, Minnesota, in 1998 (Figure 4). The pond has an intermittent outlet that is dry most of the year and descends 30 feet over 0.3 miles to the nearest point on the Rock River. Taking a break from his Topeka Shiner research, Jay and his wife Su-

Figure 3. Topeka Shiner off-channel habitats. Former channel of Rock River (left) and seasonal high flow channel of Champepadan Creek, Rock County, MN (right). (Photos by Konrad Schmidt)

san decided to do a little shopping. Jay's recollection of his first visit to Ladd's Pond follows:

> Susan and I went to the Ladds' place because they were advertised as Hillside Antiques. They had lots of nice old furniture. We ended up buying a table and chairs, a secretary, and an antique wall phone from them over the years. On that first visit, as we were touring the place, Frank (Francis Ladd) asked what brought us there. The answer eventually revealed that I was trying to find Topeka Shiners in the area. As I described the fish, their 11-year-old grandson said, 'Oh yeah, I've seen them. I get them in my minnow traps out in the pond.' I did not want to pop his bubble by telling him that they didn't live in ponds nor had they been shown very amenable to capture by minnow trap. So, I just said, 'Wow, you really have an eye for detail. Do you think you could catch some in your traps while I'm here today?' He said he was sure he could and raced off to try. About an hour and half later, when he could not wait any longer, he tugged me away to check on the traps. I was thinking about what species might be in there that made him think of Topekas and how I would tell him he had done a good job of translating my verbal description into a visual image. Anybody might have made such a mistake. (I wanted to keep that enthusiasm going.) He pulled the first trap, and I nearly fainted. Four big, bright huge males and several (I forget the exact number now) very gravid females. I think we had 16 total Topekas in the 3 traps he set. Frank said that the only fish he had ever put in were Goldfish and couple of Koi. We eventually pulled 20-some species from the pond the first year, including some young of the year Largemouth Bass. By the time Shawn was finishing his work, the numbers of Topekas were way down. I think the last year's total was about one-tenth the number we got in one seine haul the first year.

In 1998, Jay seined the pond eight times from late April to mid-September. The first effort had the best results for Topeka Shiners (262) and the last was the worst (7). Shawn

Figure 4. Ladd's Pond, Rock County, MN. (Aerial view from google.com; photo on right by Konrad Schmidt)

surveyed the pond in July 1999, but his catch was not entered in the Fishes of Minnesota database. Konrad Schmidt returned in 2007 as part of a Minnesota Department of Natural Resources survey effort to find listed species, but no fish were found. The pond was almost entirely choked with exotic water lilies. He suspected the abundance of vegetation, which produces oxygen during daylight, but then converts to carbon dioxide at night, created anoxic conditions (i.e., near zero dissolved oxygen levels). Frank was very disheartened to hear the news. Konrad suggested he might be able to start over by removing the water lilies either manually or with herbicide, but Frank had been collecting different varieties for years and really enjoyed seeing brilliant flowers of so many colors in bloom.

After federal listing, annual monitoring surveys by the Minnesota Department of Natural Resources initially revealed that the Topeka Shiner remained high in abundance and widespread in distribution. These results and Shawn Dahle's thesis research supported the rationale not to rubber stamp federal designation as a state-endangered species and its status remains special concern to this day. However, a decline began in 2009, and the steep slide continued through 2013 (Nagle, 2014). In 2013, six sites on four streams were surveyed in the Missouri River drainage of Minnesota where Topeka Shiners had been reported after the federal listing (Schmidt, 2013). The species was found in the Rock and Little Rock rivers, but the cumulative catch was only five individuals. The North Branch of Chanarambie Creek was visited, but not surveyed, in October 2013. This had been a reliable site for finding Topeka Shiners for decades, often in good numbers. The stream was almost always turbid during previous visits, but dense algal mats had never been observed (Figure 5). The image and coordinates were forwarded to George Cunningham, a member of the Topeka Shiner Recovery Team and an environmental consultant for EcoCentrics in Omaha, Nebraska. Before checking aerial photographs, his immediate response to the image was, "Somewhere upstream a lot of manure, nitrogen runoff is pouring into the system." His summary of the aerial photos follows:

> Upstream from this location five new hog facilities have come in since 2004, three of which came in last year. Also, appears to be a lot more erosion off some of the farm fields last year than in previous years. This is probably because their management has been continuous corn, i.e., corn grown for several years in a row. This leads to a lot of erosion, even with no-till practice. Also, continuous corn requires more inputs than rotational management. That management combined with more concentrated animal feeding operations (CAFO) manure that is spread on fields probably accounts for the excess nitrogen you are seeing. Another factor is last year's dry conditions. The same inputs were applied to these fields in the spring of 2012, but because of the dry conditions, the plants were stressed and did not metabolize much of the fertilizer. Now with wetter conditions in 2013, along with this year's input because they applied fertilizer like any other year, two years' worth of nutrient material is flowing down the stream systems.

Figure 5. North Branch of Chanarambie Creek, Murray County, MN. (Photo by Konrad Schmidt)

In the Missouri River drainage of northwestern Iowa, 15 off-channel sites along three streams were surveyed for Plains Topminnow (*Fundulus sciadicus*) in 2011 (Hrabik and Schmidt, 2012). This species is a common associate of the Topeka Shiner, which was found at only two sites along the Little Rock River in Lyon County and comprised another sparse cumulative catch of just five shiners.

MISSED OPPORTUNITY

Jenny Kruckenberg, Minnesota's NANFA rep, learned late in the game that a large number of Topeka Shiners held at the University of Minnesota for research were scheduled to be euthanized as stipulated in that institution's U. S. Fish and Wildlife Service permit. These fish had survived temperature, dissolved oxygen, and mussel host trials. Jenny had previously volunteered with Dr. Pat Ceas (St. Olaf College) who headed monitoring surveys in Minnesota. She cherished the opportunity to work with Topeka Shiners and believed these doomed inmates could serve another purpose by helping to educate the public about Minnesota's only federally endangered fish. She hustled for a reprieve by contacting the Minnesota Zoological Gardens about the possibility of a new exhibit. Though there was interest, her hopes were soon dashed when she learned that the deed had been done.

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(**Eureka Topeka,** continued from page 7)

ADDENDUM

Following publication of the original version of this article, I found that I was considered something of an expert on Topeka Shiners. At the opposite end of Minnesota, Konrad Schmidt was electrofishing the Cannon River when a couple in a canoe paddled over to ask what species he had found. The canoeist mentioned that he and his wife were on vacation and that he worked at the Blind Pony State Hatchery near Sweet Springs, Missouri, where they would soon be culturing Topeka Shiners for reintroduction. Konrad, of course, insisted he contact me.

The hatchery crew showed up not long afterwards at my house in Wisconsin with a tanker truck full of Lake Sturgeon they were delivering to the Genoa National Fish Hatchery. I have always wondered what my neighbors thought! The crew had had a long ride and I offered them some beverages, which they were eager to accept. We talked for several hours about what might work for hatchery culture on a larger scale than mine. I suggested a pebble-nest method and flow-through systems where they could move newly hatched fry to rearing aquariums or tubs. Later, NANFA member Jan Jeffery Hoover called me for input on designing road culverts that would allow Topeka Shiners passage to upstream habitats (Adams et al., 2000).

I'd like to acknowledge Konrad Schmidt, Harold Kerns, Larry Page, Richard Mayden, George Cunningham, Jay Hatch, Jenny Kruckenberg, and Bruce Bauer for their help in preparing this article.

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