

# THE STATUS OF THE REDFIN SHINER *LYTHRURUS UMBRATILIS* IN IOWA: ANOTHER ONE BITING THE DUST?



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## INTRODUCTION

I have been interested in the distributions of Iowa fishes since the early 1980s when I participated in a statewide fish survey sponsored by Iowa State University. By the time of my retirement from Iowa DNR in 2017, my impression was that the Redfin Shiner *Lythrurus umbratilis* (Girard) had undergone a significant reduction in its Iowa range. I had found this species to occur with moderate frequency in northeast Iowa streams in the early 1980s. Since that time, however, despite implementation of two relatively intensive fish survey efforts in Iowa in the mid-1990s,<sup>1</sup> relatively few records for Redfin Shiner had been reported. In addition, a recent study of the status of Iowa's fish species of greatest conservation need (SCGN) (Sindt et al. 2011) referred to the status of the Redfin Shiner as one of "extreme decline." Thus, in 2020, I submitted a proposal for a small grant to the Iowa DNR's Wildlife Diversity Program to update the status of the Redfin Shiner in Iowa; my proposal was approved for funding in spring of 2021.<sup>2</sup> The objectives of my project were to (1) update, through a review of historical records and additional field sampling, the historical and current distributions of the Redfin Shiner in Iowa and (2) provide an assessment of the status of Iowa's populations of the species. The final report (Olson 2022) was submitted to Iowa DNR in April 2022. This article is excerpted from that report.

The Redfin Shiner (Figure 1) is a small minnow (Family Leuciscidae) that is distributed throughout the Mississippi River and Great Lake basins (Figure 2). A summer spawner, Redfin Shiners typically spawn over nests of *Lepomis* spp., especially Green

Sunfish *L. cyanellus* (Hunter and Hasler 1965; Snelson and Pflieger 1975). The Redfin Shiner is a species of flowing waters and is known as a deep run or pool-dwelling species (Smith 1979, Becker 1983, Pflieger 1997, Triplett 2014), whether the pool habitat is within the stream (more typical of low gradient streams with low base flow) or in overflow pools or at stream inlets (more typical of higher gradient streams with high base flows) (Snelson and Pflieger 1975). The species is typically found in smaller streams versus larger rivers (Forbes and Richardson 1909, Harlan and Speaker 1956, Smith 1979, Robison and Buchanan 2020).

There are two recognized subspecies of Redfin Shiner (Snelson and Pflieger 1975). The western subspecies, *L. u. umbratilis*, occurs throughout the state of Missouri, in western Arkansas, and in eastern portions of Oklahoma and Kansas; its northern extent occurs in extreme south-central Iowa (Figure 2). The eastern subspecies, *L. u. cyanocephalus*, occupies most of the species' distribution in North America and is the subspecies that occurs in the north-central and northeastern portion of Iowa. In states adjacent to Iowa, the eastern subspecies occurs in eastern Missouri, southeastern Minnesota, the southern half of Wisconsin and the entire state of Illinois.

Eddy and Surber (1947) described the male Redfin Shiner's breeding coloration as "quite spectacular," and referred to the species as "a perfect gem of a minnow."

**Background on the Redfin Shiner in Iowa:** The eastern subspecies—the focus of my project—has an historical distribution in Iowa that included a large portion of the state's drainage to the Upper

<sup>1</sup> The Iowa DNR Fisheries Bureau's rivers and streams investigations and the Iowa DNR's Water Quality Bureau's biological monitoring program.

<sup>2</sup> Iowa Department of Natural Resources Wildlife Diversity Program Small Project Grant #21CRDWBKINK-0004.

### Photos by the author.

John Olson retired from the Iowa DNR, where he worked for 30 years in the Water Quality Assessment Section, in 2017. He has been involved with stream fish survey work in Iowa since attending Iowa State University, where he participated in a statewide survey of Iowa fishes from 1981–84. He has a degree in Animal Ecology from Iowa State with an emphasis in fisheries biology. He continues to pursue his interest in Iowa (and, occasionally, Minnesota) fishes in retirement.



Figure 1. A male *L. u. cyanocephalus* that Konrad Schmidt and I collected in June 2021, from Bear Creek, Cedar River basin, Buchanan County, IA.

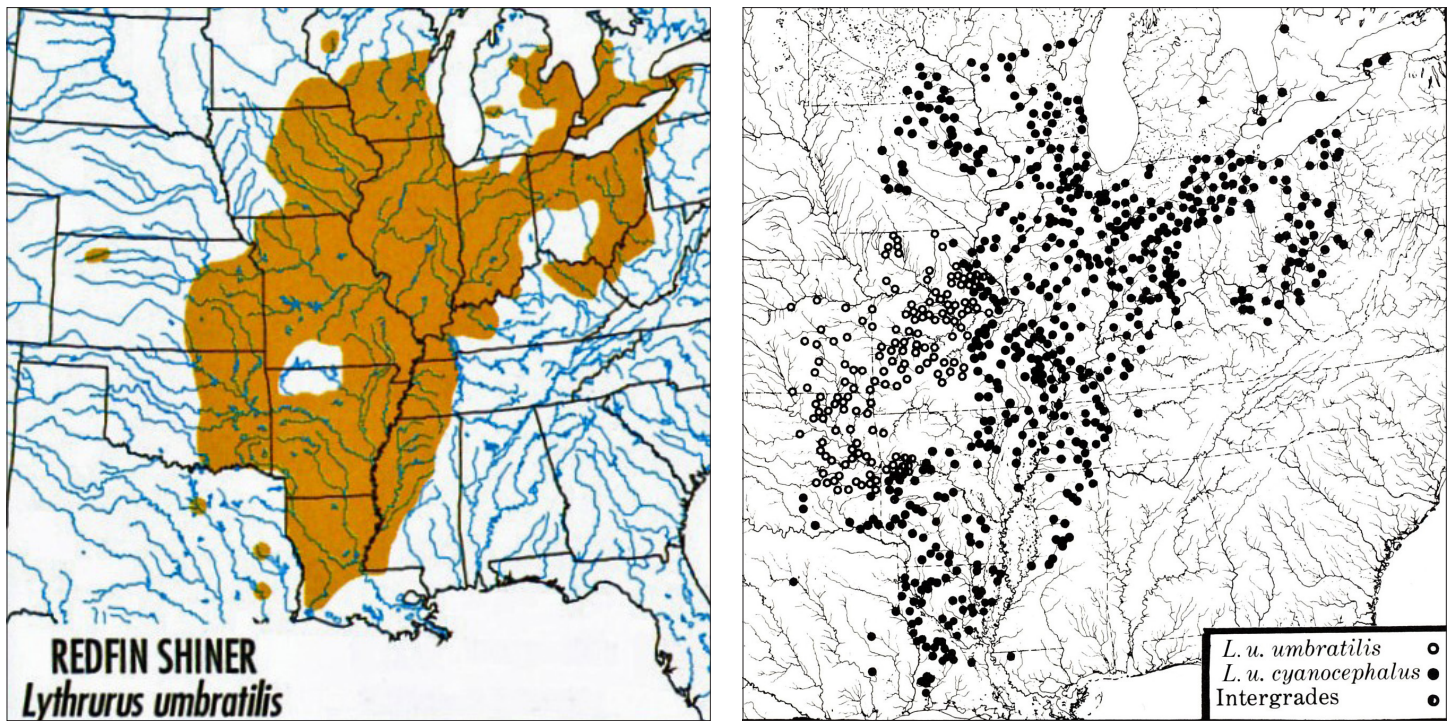


Figure 2. Distribution of the Redfin Shiner in North America. Left: distribution of both the eastern and western subspecies (from Page and Burr 2011); right: the distributions of the eastern and western subspecies of the Redfin Shiner (from Lee et al. 1980). Open circles show the distribution of the western subspecies (*L. u. umbratilis*) and the solid circles show the distribution of the eastern subspecies (*L. u. cyanocephalus*).

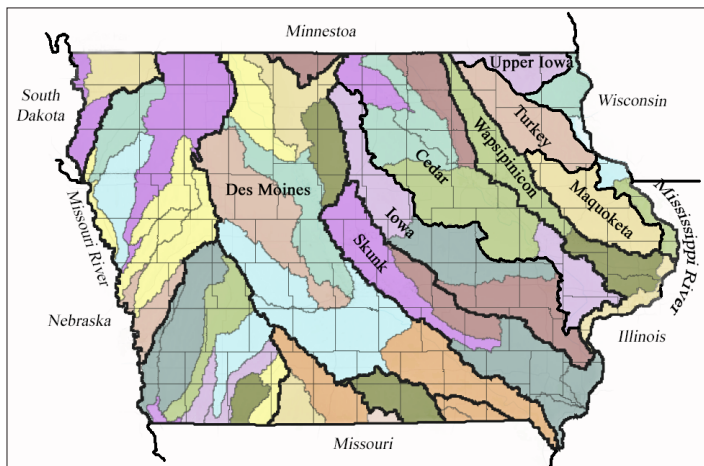
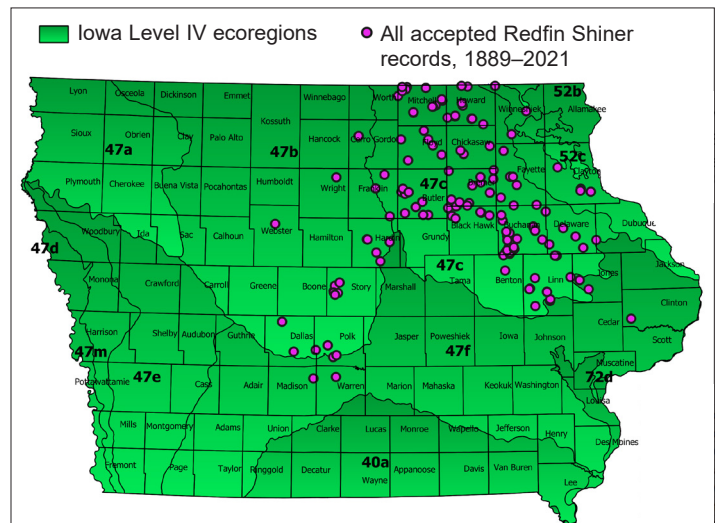


Figure 3: River basin in central and northeastern Iowa with historical records for Redfin Shiner (*L. u. cyanocephalus*).

Mississippi River, including the Des Moines, Skunk, and Iowa river basins in central Iowa as well as portions of the Cedar, Wapsipicon, Maquoketa, Turkey, and Upper Iowa river basins in northeast Iowa (see Figure 3 for the location of these river basins in Iowa). Historically and currently, the center of distribution of species in Iowa is in the basins of the middle and upper Cedar River and the Wapsipicon River in northeastern Iowa with most populations occurring in the Eastern Iowa and Minnesota Drift Plains Level IV ecoregion, 47c (Figure 4). The species appears to avoid the Driftless Area Level III ecoregion of extreme northeast Iowa (ecoregion 52), possibly due to the predominance of spring-fed streams there and the Redfin Shiner’s avoidance of cooler waters (Snelson and Pflieger 1975). While there have been no studies focused on this species in



No.	Ecoregion Name	No.	Ecoregion Name
40a	Loess Flats & Till Plains	47f	Rolling Loess Prairies
47a	Loess Prairies	47m	Western Loess Hills
47b	Des Moines Lobe	52b	Blufflands & Coulees
47c	Eastern Iowa & Minnesota Drift Plains	52c	Rochester/Paleozoic Plateau
47d	Missouri Alluvial Plain	72d	Upper Mississippi Alluvial Plain
47e	Steeply Rolling Loess Prairies		

Figure 4. Level IV ecoregions in Iowa and records for Redfin Shiner, 1889–2021.

Iowa, the species accounts written for Redfin Shiner published in the 1956 and 1987 editions of *Iowa Fish and Fishing* (Harlan and Speaker 1956, Harlan et al. 1987) mention its “widely scattered” distribution and its rarity in Iowa collections. The species is not state-

listed in Iowa (IAC 2003), but it is one of 79 fish species identified as “species of greatest conservation need” (SGCN) in Iowa’s Wildlife Action Plan (Iowa DNR 2015).

**A poorly known species in Iowa:** Even among state fisheries biologists, the Redfin Shiner is not a well-known fish species in Iowa. Several persons familiar with the fish fauna of the northeastern quarter of Iowa have never knowingly collected the Redfin Shiner. Former NANFA member Jim Russell (1949–2009), who grew up in Cedar Rapids, IA, collected statewide and was an authority on rare fishes in Iowa. In a 1981 interview (Russell 1981), he noted that he had never collected the Redfin Shiner. Neil Bernstein of Mount Mercy University in Cedar Rapids (retired)<sup>3</sup> has collected fishes in the Cedar Rapids area for many years (an area with historical records for Redfin Shiner) and has surveyed streams across the state, yet he has never encountered the Redfin Shiner (Neil Bernstein, personal communication, February 16, 2022). Iowa DNR fisheries research biologist Greg Gelwicks and his river research team have sampled many streams and rivers across Iowa over the last 20 years, but they have not encountered a Redfin Shiner (Greg Gelwicks, personal communication, April 12, 2022). The lack of familiarity with the species may stem from its rarity and its infrequent occurrence within its Iowa range. The lack of encounters with the species in recent decades may also reflect its ongoing decline in Iowa.

**Field sampling:** To determine the current distribution of the Redfin Shiner in Iowa, I developed a list of the 37 stream/river sites where the species was collected from 1981 to 1983 as part of Iowa State University’s statewide fish survey conducted from 1981–1984.<sup>4</sup> My rationale was that a targeted sampling of sites known to have supported Redfin Shiners in the past could serve as the basis for updating the Iowa distribution of this species.

The 37 historical sites are distributed across twelve Iowa counties in river basins in central, east-central, and northeastern Iowa

<sup>3</sup> Now adjunct professor, Department of Earth and Environmental Sciences, University of Iowa.

<sup>4</sup> In 1981 and 1982, as part of my participation in this statewide survey, I collected Redfin Shiners at 21 of the 37 sites that I designated for resampling in 2021. Other statewide survey records for Redfin Shiner from 1982, and all the 1983 records, resulted from surveys by another Iowa State student.

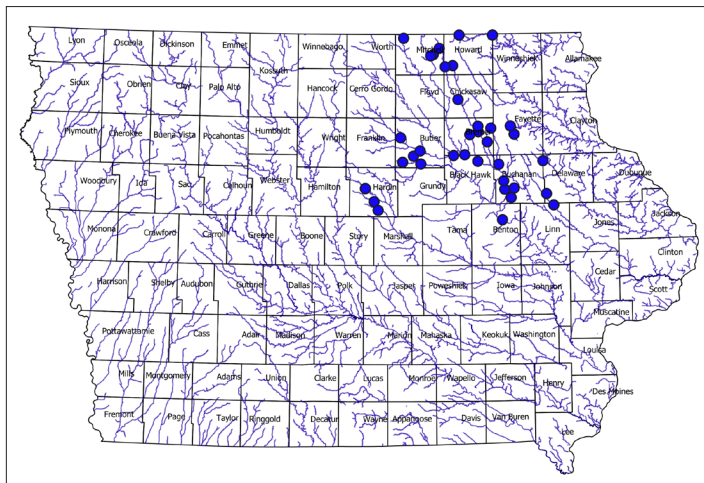


Figure 5. Locations of the 37 sample sites where Redfin Shiners were collected from 1981–83 during Iowa State University’s statewide fish survey.

(Figure 5). Twenty-three of these stream sites are on private land. Thus, I conducted site reconnaissance in April and May 2021 for all potential sample sites to determine stream access points and, if necessary, to obtain permission from landowners to sample streams on their land. Most landowners that I contacted were cooperative and granted permission to sample on their property.

Fish sampling in 2021 was conducted under authority of a state of Iowa scientific collector’s permit. The initial round of sampling of the 37 stream sites began on June 2, 2021, and continued through June 30. Follow-up sampling was conducted at nine sites in September and October 2021 and included re-sampling at four of the 37 sites as well as at five new sites with post-1995 records for Redfin Shiner. Thus, a total of 46 fish surveys at 41 sites were conducted in 2021 to help determine the current distribution of the Redfin Shiner in Iowa. Sampling conditions in Iowa streams in summer and fall 2021 were generally good, with average to low streamflow conditions encountered at nearly all sample sites.

Typically, about an hour was spent sampling at each site. This per-site level of effort was similar to that used for Iowa State University’s 1981–84 statewide survey of fishes. The primary sampling gear was a 4-foot by 15-foot (1/8-inch mesh) seine. Seines were used

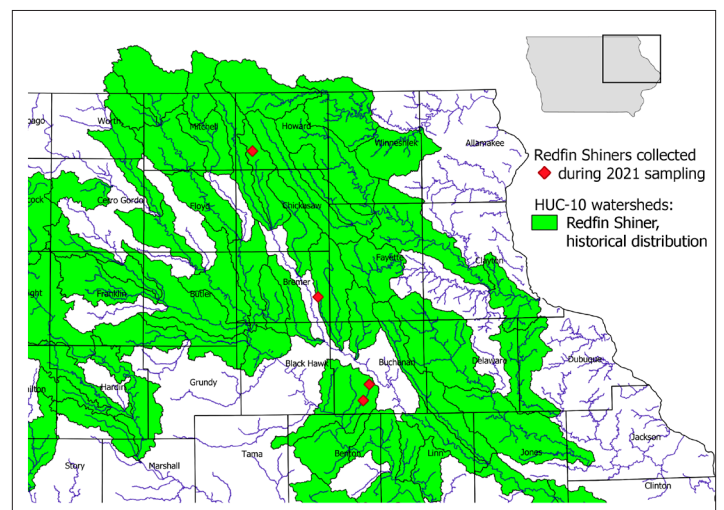
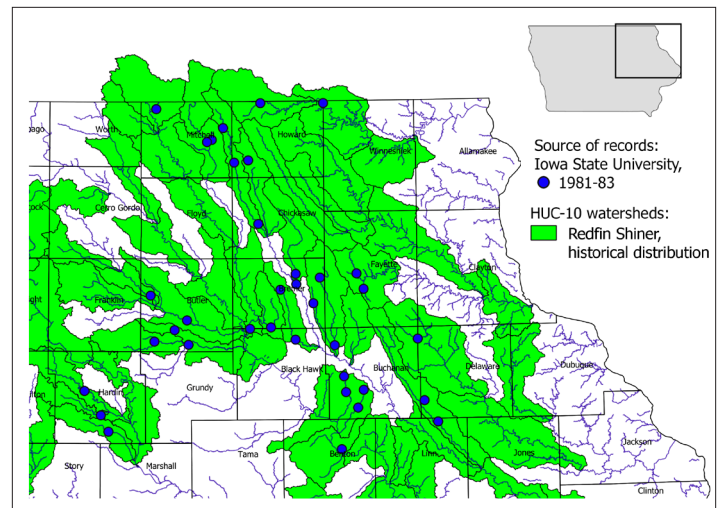


Figure 6. Top: the 37 sites where Redfin Shiners were collected from 1981–83; bottom: the four of the resampled 37 sites where Redfin Shiners were collected in 2021.



Figure 7. Field photographs of specimens of Redfin Shiners collected in 2021 at the four of 37 historical (1981–83) sites where Redfin Shiners were found. Top left: Little Waspsinicon River, 2.3 mi. NW of Elma, Howard Co., IA, 9 June 2021. Top right: Bear Creek, 3.5 mi. S of Independence, Buchanan Co. IA, 23 June 2021. Bottom left: Bear Creek, 4 mi. WSW of Rowley, Buchanan Co., IA, 23 June 2021. Bottom right: Buck Creek, 4.5 mi. NE of Readlyn, Bremer Co., IA 30 June 2021.

at 43 of the 46 sites. At sites with deeper water, a 6-foot by 15-foot ( $\frac{1}{8}$ -inch mesh) seine or a 6-foot by 20-foot ( $\frac{3}{8}$ -inch mesh) seine was used. Backpack electrofishing was also conducted, with both seining and backpack electrofishing used at 23 of the 46 survey sites. Electrofishing alone was used for three of the 46 surveys.

Based on information in field notes, an attempt was made to sample the same stream segment (usually, either upstream or downstream from a road crossing) that was sampled during the 1981–83 surveys. All habitat types were sampled at each site (e.g., pools, riffles, runs, eddies, and shoals). The literature suggests that the Redfin Shiner is a pool-dwelling species whether in protected inlets, backwaters, or overflow pools, and it is often found in association with aquatic vegetation. My experience collecting this species in Iowa streams is consistent with the literature; that is, I have most often collected the Redfin Shiner from slow, deep runs and pools; some specimens have been collected near woody debris in pools. Iowa streams where I have found Redfin Shiners have typically had at least small amounts of aquatic vegetation. Thus, sampling for Redfin Shiners in 2021, although it included sampling of all habitat types present at a given location, was focused on deeper and slower runs, pools, backwaters, and stream inlets that I considered most likely to hold Redfin Shiners.

**Results of surveys for the Redfin Shiner in 2021:** Redfin Shiners were found at four of the 37 Iowa stream sites sampled in 2021 where this species had been collected from 1981–83 (Figure 6). Follow-up sampling in September and October 2021 at nine sites (repeat sampling at four of the 1981–83 sites and sampling at five

new sites) did not produce Redfin Shiners. Field photographs were taken of specimens of Redfin Shiners from all four sites (Figure 7); Figure 8 shows the four Iowa streams and habitats from which Redfin Shiners were collected. Although sampling at all four sites was conducted with both seines and a backpack electrofisher, seining resulted in capture of Redfin Shiners at three of the four sites. At three of the four sites where Redfin Shiners were collected in 2021, sampling had been conducted from about 45 minutes to over an hour before specimens of Redfin Shiner were encountered. This pattern is similar to that mentioned 130 years ago by Call (1892) in his account for Redfin Shiner (as *Notropis umbratilis*) found in the Des Moines River basin in central Iowa: “This small but well-defined form is common in occurrence but somewhat rare in point of numbers, three or four specimens alone rewarding patient and continued search.”

**Review of historical records:** Updating the status of a species requires careful review of historical records of its occurrence. A review of Iowa’s fish databases,<sup>5</sup> as well as a review of both non-databased records from the literature and field notes, produced a total of 194 Iowa records for Redfin Shiner from 1889 to 2021. My review of these 194 historical records produced several questionable unvouchered records. Most of the questionable records were generated as part of fish surveys after 1950, with several reports of Redfin Shiner from watersheds where the species had neither been reported before nor

<sup>5</sup> Iowa’s Aquatic Gap database (Loan-Wilsey et al. 2005) and the Iowa DNR’s BioNet database (<https://programs.iowadnr.gov/bionet/>).

Figure 8. The four (of the 37 historical) sample sites where Redfin Shiners were collected during June 2021.



Little Wapsipinicon R. at Lylahs Marsh Pk., 3.2 mi. NW of Elma, Howard Co, IA. One Redfin Shiner was collected on 9 June 2021 below the marsh outflow in pool at left.



Bear Creek 3.5 mi. S of Independence, Buchanan Co., IA. Nineteen Redfin Shiners were collected on 23 June 2021 but only under the bridge.



Bear Creek, 4 mi. WSW of Rowley, Buchanan Co., IA. Five Redfin Shiners were collected on 23 June 2021 from a pool near where Konrad Schmidt is standing in the photo on the right.



Buck Creek, 4.5 mi. NE of Readlyn, Bremer Co., IA. Four Redfin Shiners were collected on 30 June 2021 but only in an isolated bridge pool.



Figure 9. Similar species: comparison of field photos of Redfin Shiners (top row) and Red Shiners (bottom row). Left photos show breeding colors; right photos show non-breeding colors.

had it been reported since, despite relatively good sampling coverage both before and after the questionable occurrence. In contrast, records from before 1950, including those from the late 1800s, were often supported by preserved specimens in fish collections including those of the Chicago Field Museum, the University of Michigan Museum of Zoology, and Iowa State University. I place all 194 historical records into one of four categories: vouchered, accepted, provisional, and rejected.

1. **Vouchered (57 records):** a record supported by preserved material cataloged in a museum collection.
2. **Accepted (99 records):** an unvouchered record within the known Iowa range of the Redfin Shiner as defined in Harlan et al (1987); no concerns regarding correct identification.
3. **Provisional (of questionable validity but used for this project) (16 records):** unvouchered record within the known Iowa range of the Redfin Shiner with evidence suggesting the possibility of misreporting.
4. **Rejected (not used for this report) (22 records):** a geographically and historically isolated and unvouchered record occurring outside the known historical Iowa range of the Redfin Shiner where there are no accepted or provisional post-1900 records occurring in the same HUC-10 watershed.<sup>6</sup>

Based on a review of individual fish survey records, my presumption is that the majority (20 of 22) of the rejected records for

<sup>6</sup> A HUC (hydrologic unit code) is a unit in a hierarchical system of watersheds created by the US Geological Survey and refined by individual states. Hydrologic unit codes range from two digits (HUC-2) for very large river basins (e.g., the entire Missouri River basin of more than 500,000 square miles) down to 12 digits (HUC-12) for very small subwatersheds that, nationwide, average about 40 square miles in size. HUC-10 watersheds average about 225 square miles in size. Source: Wikipedia.

Redfin Shiner were erroneous reports due to presence in surveys of morphologically similar and commonly occurring *Cyprinella* species in Iowa (Red Shiner, *C. lutrensis* and Spotfin Shiner, *C. spiloptera*) (Figure 9). A contributing problem—and possibly the primary problem—appears to have been the use by fisheries biologists of the informal common name “redfin shiner” for Iowa’s *Cyprinella* species, especially the Red Shiner. Persons databasing fish records from field notes or unpublished lists of fish species may have entered the informal “redfin shiner” as *L. umbratilis*.

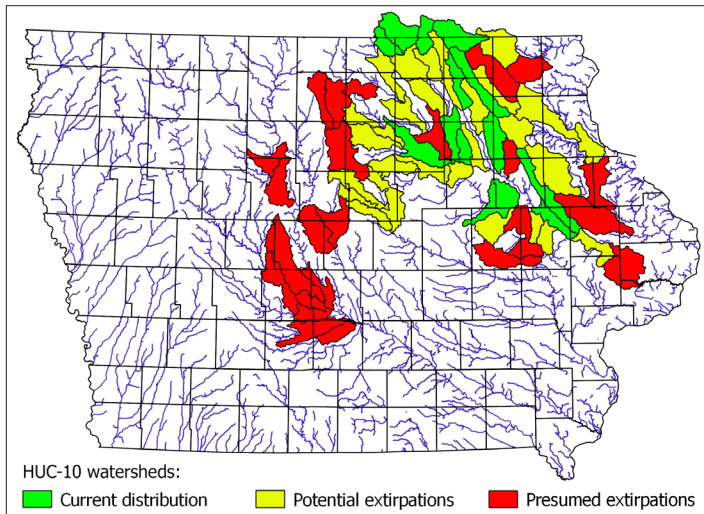
#### PRESUMED AND POTENTIAL EXTIRPATIONS OF THE REDFIN SHINER IN IOWA WATERSHEDS:

The poor success of finding Redfin Shiners in 2021 where they were collected from 1981–83 (found only at four of 37 sites) raises the issue of whether their absence at these historical sites indicates an actual decline in the distribution of the species. As the saying goes, *absence of evidence is not evidence of absence*. In addition to actual absence from an historical site, other reasons for failing to find the species could include gear selectivity or disrepair, the known pattern of scattered occurrence of Redfin Shiners within a watershed, or the variation in population size from year to year.

For purposes of this report, however, the Redfin Shiner was presumed extirpated from HUC-10 watersheds that lacked a valid record for the species during the last 65 years (i.e., since 1955). Potential extirpations were identified in HUC-10 watersheds that lacked a valid record since 2005. HUC-10 watershed with valid records for Redfin Shiner from 2006 to 2021 were included in the current distribution of the species. Based on the results of field work in 2021 and my review of historical fish survey records, I considered the Redfin Shiner as “presumed extirpated” from 23 of the 63 HUC-10 watersheds in Iowa with historical records and as “potentially extirpated” in an additional 29 watersheds (Table 1, Figure 10). The relatively thorough post-1955 fish survey coverage

**Table 1. Approach used to identify Iowa HUC-10 watersheds where the Redfin Shiner is presumed extirpated, is potentially extirpated, or is currently distributed.**

Watershed Status	Criteria	No. of Iowa HUC-10 watersheds
Presumed extirpation	Valid record from 1890–1955 but no valid records after 1955	23
Potential extirpation	Valid record from 1956–2005 but no valid records after 2005	29
Current distribution	Valid record from 2006–2021	11



**Figure 10. HUC-10 watersheds in Iowa where the Redfin Shiner is either currently distributed, considered potentially extirpated, or considered presumed extirpated.**

of Iowa's watersheds suggests that, if the Redfin Shiner was extant in those presumed and potentially extirpated HUC-10 watersheds, it would have been reported as part of post-1955 fish survey work.

My level of confidence in identifying Iowa HUC-10 watersheds as either presumed extirpated or potentially extirpated for the Redfin Shiner varies with (1) the number of years since the most recent record, (2) the number of subsequent fish surveys conducted since the last record for Redfin Shiner, and (3) the source of the information. My confidence is much higher for watersheds where over 100 years have elapsed since the most recent record for the Redfin Shiner. My confidence is lower for lightly surveyed watersheds identified as potentially extirpated with a post-1995 record for Redfin Shiner but no record after 2005. Given the relatively large amount of fish survey work in Iowa, however, especially since the mid-1990s, I feel justified in identifying a potential extirpation for HUC-10 watersheds with an historical record for Redfin Shiner but with no record after 2005. Admittedly, the 15-year timeframe (2006–2021) for identifying the current distribution of the Redfin Shiner in Iowa is brief. Nonetheless, this species has a history in Iowa of relatively rapid elimination from watersheds (e.g., present in the early 1940s in the upper Skunk River basin near Ames and apparently gone by 1950s (Harrison 1950); present in three tributaries of the Iowa River in Hardin County in the early 1980s and apparently gone by 1995 (Kaminski et al. 1995). That is, based on my experience, presence of the Redfin Shiner in a watershed in 2000 in no way suggests that it will be present in 2020. Thus the 15-year window seems reasonable.

## CURRENT DISTRIBUTION OF THE REDFIN SHINER IN IOWA

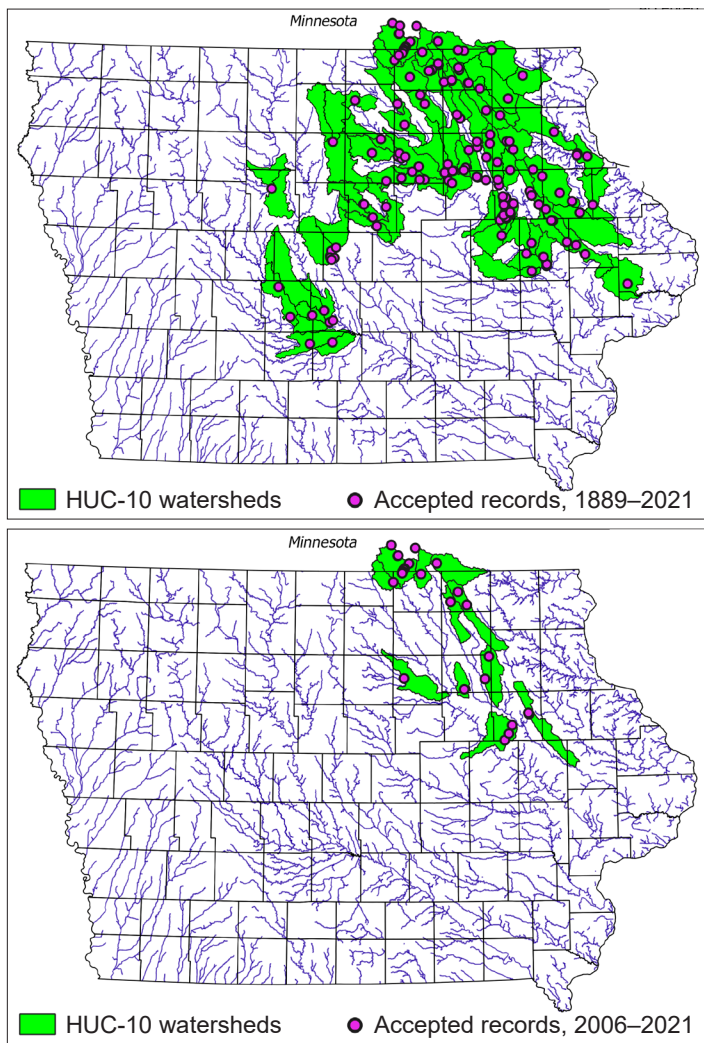
By my estimate, the Redfin Shiner now occupies 11 HUC-10 watersheds: six in the middle and upper portions of the Cedar River basin, three in the Wapsipinicon River basin, and one each in the upper Turkey River basin and the upper portion of the Upper Iowa River (Figure 11). All these HUC-10 watersheds are in Level IV ecoregion 47c (Eastern Iowa & Minnesota Drift Plains) (Figure 12). My estimate of the current distribution is possibly too restrictive, and I expect (hope) that records for the species will be produced in future fish surveys in watersheds I have identified as potentially extirpated for Redfin Shiner. Nonetheless, considerable fish survey work has been conducted in these watersheds in recent decades, and the results of those surveys suggest the limited distribution of the Redfin Shiner shown in Figure 11.

Based on a comparison of the number of HUC-10 watersheds in Iowa known to have historically supported Redfin Shiner (63) and the number that currently support the Redfin Shiner (11), the areal decline in its Iowa range likely approaches 80 percent. This is a worst-case scenario. A best-case scenario is that the Redfin Shiner continues to occur in all 29 HUC-10 watersheds where I identified it as potentially extirpated (Figure 10). Although unlikely, this best-case scenario would still suggest an approximately 35 percent areal decline (i.e., gone from 23 of 63 HUC-10 watersheds with historical records).

**Potential causes of decline:** Although several authors have noted a decline in the distribution of the Redfin Shiner in their respective states, few have offered specific reasons for its decline. Typically, causes identified for declines of Redfin Shiner are the same causes identified for declines of other Midwestern fish species: increasingly intensive agricultural activity in watersheds causing degradation to stream habitats through excessive sediment delivery to, and accumulation in, stream channels (e.g., Smith 1979). The Minnesota DNR notes that the Redfin Shiner is a peripheral species in the state and acknowledges a “definite decline in both distribution and abundance” of the species in southeastern Minnesota (Minnesota Rare Species Guide). In its list of species of greatest conservation need, the Minnesota DNR describes the status of the Redfin Shiner as follows: “extensive surveys indicate a decline of unknown cause” (Minnesota DNR 2015).

Some authors have suggested more specific causes that are related to the decline of the Redfin Shiner. For Wisconsin, Becker (1983) attributed the elimination of the Redfin Shiner from portions of the upper Rock River system to widespread use of toxicants in a carp control program. Harlan and Speaker (1956) identified the decline in aquatic vegetation in Iowa streams as a factor causing the range of the species in Iowa to decline: “the species has an affinity for stream vegetation, which probably limits its distribution because vegetation in Iowa streams is very rare.” Almost certainly, aquatic vegetation in Iowa streams is rarer today than it was in the 1950s. Other authors have also mentioned the association between the Redfin Shiner and aquatic vegetation (e.g., Tomelleri and Eberle 2011, Pflieger 1997, Trautman 1981, and Balon 1975). Trautman (1981) emphasized the importance of riffle

<sup>7</sup> Balon (1975) identifies the Redfin Shiner as a representative of the phytolithophilous guild of non-guarding fishes, thus suggesting an association with both aquatic vegetation and coarse (rocky) substrates.



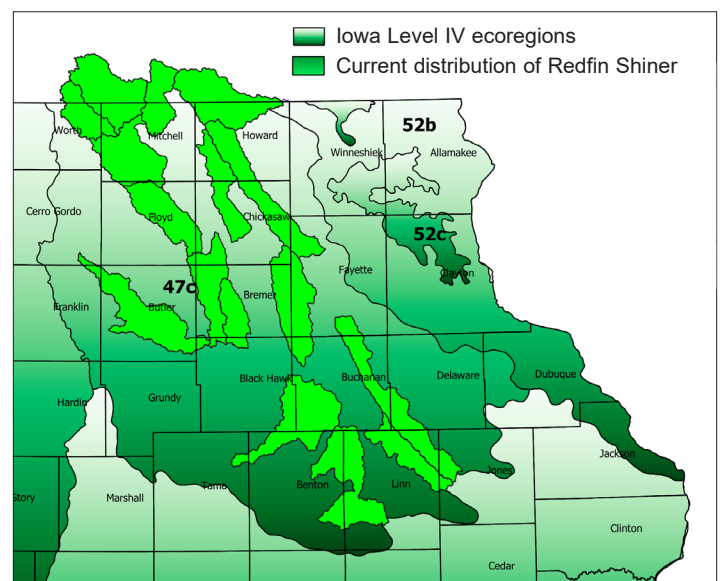
**Figure 11.** Comparison of historical distribution of the Redfin Shiner in Iowa (top) to the current distribution (bottom). In addition to this project, Iowa records from 2006–2021 are from Berendzen et al. (2008), Sindt et al. (2011), and Iowa DNR Bio-Net. Minnesota records are from 2006–2021 on both maps.

quality to the Redfin Shiner’s spawning success:

It spawned over sand and gravel in sluggish riffles and in pools having currents, apparently utilizing the swifter riffles only when the slower ones had their bottoms silt-covered. It was essentially a pool species after spawning and displayed a preference for submerged aquatic vegetation. When not spawning, it was rather tolerant of turbidity and silted bottoms and displayed marked decreases in abundance in a locality only after the faster riffles became silt-covered.

Given the typically high silt loads of Iowa streams and the resulting embeddedness of riffle substrates, even in higher quality streams, Trautman’s statements regarding the spawning success of Redfin Shiners may help explain both the low numbers of specimens per site and the decline of the species in Iowa since the late 19th century.

Although not mentioned in the literature on potential declines in the Redfin Shiner, altered hydrology may play a role in the demise of this species in Iowa. Having sampled 21 of the 37 stream



**Figure 12.** Relationship between the current distribution of the Redfin Shiner in Iowa and Level IV ecoregion 47c (Eastern Iowa & Minnesota Drift Plains).

sites where Redfin Shiners were found in 1981, my impression on revisiting these sites in 2021—approximately 40 years later—was that a general widening and shallowing of the streams had occurred. Descriptions of negative impacts to Iowa fishes from the widening and shallowing of the state’s streams go back to the late 19th century (Meek 1892) and have continued through the 20th century (Menzel et al. 1984). The exceptionally high and prolonged stream flows during Iowa’s recent record flood events (for example, in 1993 and 2008) may have further altered (widened) stream channels. Increased base flows in Iowa streams in the last half of the 20th century, as described by Schilling (2004) and Ayers et al. (2019), may also adversely affect the Redfin Shiner. Changes in channel form and flow regime may disrupt Redfin Shiner spawning or reduce the quantity of its preferred habitat (slow, deep runs and pools) at critical times of the year.

### CONCLUSIONS

The lack of familiarity in Iowa with the Redfin Shiner has allowed the species to decline without much notice. The species has no state listing and was placed on Iowa’s list of SGCN species in 2015 primarily due to my recommendation. Based on a worst-case (but certainly plausible) scenario, the distribution of the Redfin Shiner in Iowa has declined to the point that, given a decline over the next 30 years commensurate with the decline over the last 30 years, extirpation from the state’s waters is possible. Results of ongoing fish survey programs in Iowa showing few records for Redfin Shiner add support to my conclusions that the Iowa range of this species has decreased significantly since 1990 and that the species is vulnerable to extirpation. An alternative scenario is that the Iowa distribution of the Redfin Shiner has not declined to the degree suggested by my project. That is, this species seems to occur in low numbers at scattered locations within a watershed and thus can be difficult to locate during fish surveys. Thus, Redfin Shiners may be extant in several, if not a significant number, of the HUC-10 watersheds where I have identified the species as potentially extirpated, and its current distribution in the state may thus exceed that presented in Figure 11.



Nonetheless, the factors that have led to the Redfin Shiner's decline in Iowa—a decline that began approximately 100 years ago—will likely continue to adversely affect the species. I feel that listing the Redfin Shiner as state-threatened would be appropriate. Future fish survey work will hopefully improve the accuracy of the distributional picture for this species in Iowa.

#### ACKNOWLEDGEMENTS

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