A NANFA CONSERVATION RESEARCH GRANT REPORT

Status of the Stone Darter, *Etheostoma derivativum*, in Kentucky

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In 2006, I was awarded a NANFA Conservation Research Grant to complete a project on the nesting biology of the Stone Darter, *Etheostoma derivativum*. For those unfamiliar with the Stone Darter, the species was only recently described by Page et al. (2003). It is in the subgenus *Catonotus* and is a member of the barcheek group. Barcheek darters are distinguished by their unique pigment pattern on the cheek that is most evident in nuptial males. The Stone Darter occurs in the lower portion of the Cumberland River drainage (Kentucky-Tennessee) from the Red River to the Stones River systems and was originally considered a disjunct population of the Striped Darter, *E. virgatum*. The Stone Darter differs strikingly from the Striped Darter in nuptial male coloration—having a lighter-colored body, intense blue margins around the second dorsal, anal, and caudal fins, and a more darkly colored head. The Stone Darter also lacks the egg-mimics that are present on the pectoral fins of Striped Darter (Porter et al., 2002). No life history study has been completed for the Stone Darter, but Kornman (1980) completed a Master's thesis describing the life history of the closely related Striped Darter.

While the Stone Darter appears secure in Tennessee portions of the Cumberland River drainage, it is sporadic and uncommon in Kentucky with only four known localities. The species was last collected in Kentucky in 1981 in Whippoorwill Creek, a major tributary to the Red River. The species' uncertain status has prompted the Kentucky State Nature Preserves Commission to consider listing the Stone Darter as a state-imperiled species. Moreover, the species is recognized by the Kentucky Department of Fish and Wildlife Resources (KDFWR) as a species of greatest conservation need in the Comprehensive Wildlife Conservation Strategy (CWCS) program. Threats to the Stone Darter listed by the KDFWR include gravel/sand removal and quarrying, riparian zone removal, low population densities, isolated populations, stochastic events (e.g., flooding and drought), and non-point source pollution from agriculture.

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Given the uncertain status and the apparent need for conservation, efforts were aimed at working with populations in Kentucky. I wanted to improve distributional information with additional sampling and identify key spawning areas for use in deriving conservation strategies for Kentucky populations. I also wanted to describe several aspects of spawning biology, including, timing and duration, habitat, substrate and nest characteristics. The actual project turned out to have quite a different flavor.

Historical Collections

I tracked down and confirmed four vouchered historical records for the Stone Darter in the Red River drainage in Kentucky. All records are from south draining tributaries in Todd and Logan counties. Three of the records are from Whippoorwill Creek and one record is from Elk Fork (Fig. 1). The collection in Elk Fork and the 1969 collection in Whippoorwill Creek yielded two specimens each. The 1981 collections in Whippoorwill Creek yielded only a single specimen each. The Stone Darter has not been vouchered from either of these streams since 1981 despite repeated sampling efforts by the Kentucky State Nature Preserves Commission, Kentucky Department of Fish and Wildlife, and the Kentucky Division of Water. Interestingly, portions of a

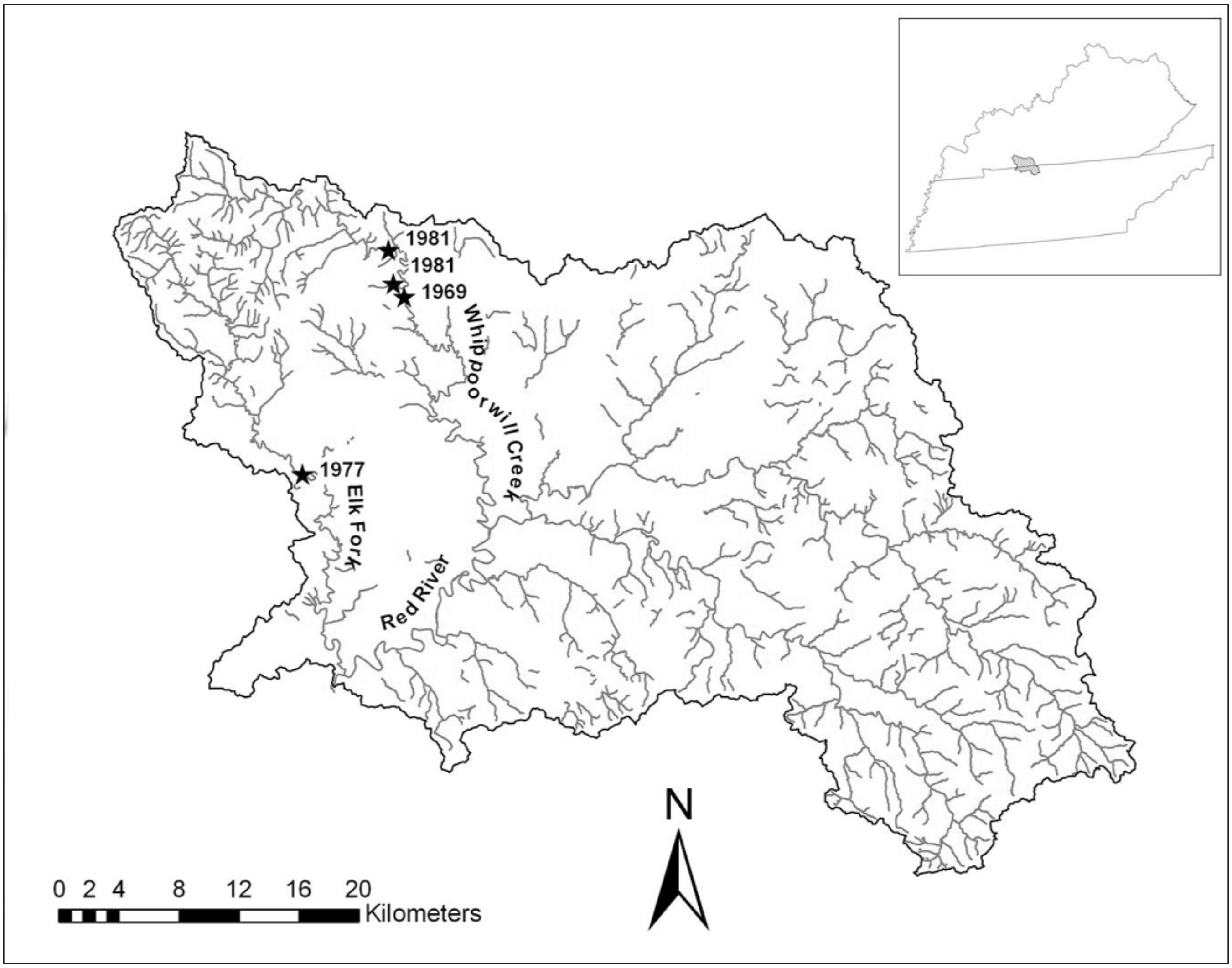

Fig. 1.
Map of historical collections of the Stone Darter in the Red River system upstream of the Elk Fork confluence.

technical report from the Kentucky Department of Fish and Wildlife Resources—found in the museum at Southern Illinois University Carbondale—show that 20 Stone Darters (then called Striped Darter) were collected during the said project in Whippoorwill Creek. The portion of the report in our possession had no title, no date and the specimens were not vouchered. However, to our good fortune, a map of the sample sites was present. Attempts to locate the original report proved futile.

Searching for the Stone Darter

A principal goal of the project was to update distributional information for the Stone Darter. Being relatively unfamiliar with the area, we first reconnoitered most of the watershed by motor vehicle on 4 June 2006 and took notes on general stream conditions and land use along the lengths of Elk Fork and Whippoorwill Creek. The most southern portions of the watershed are positioned within the Western Pennyroyal Karst Plain ecoregion. The northernmost portions are in the Crawford-Mammoth Cave Uplands ecoregion; both of these ecoregions are moderately karsted and soil fertility is high. As a result, agriculture and pasture are the dominant land use types and seem to pose a threat to aquatic systems. A majority of the headwater areas and smaller tributaries are heavily modified with increased sediment loading and denuding of the bank environment. Stream substrates within the system, especially along the main stems, are largely bedrock or cobble/boulder with little vegetation within or immediately along stream margins.

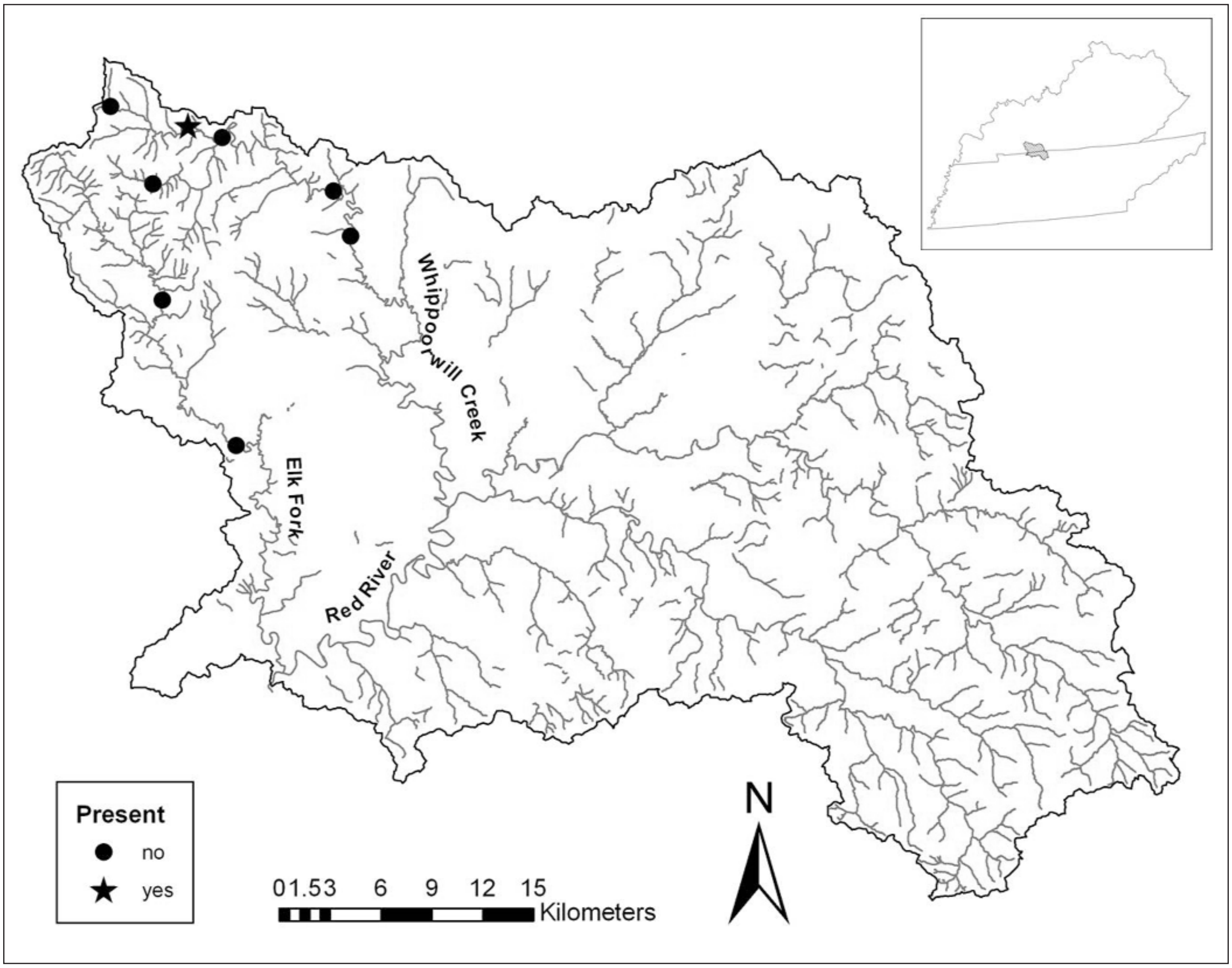

Fig. 2.
Map of collection sites for current project. Symbols indicate presence or absence of Stone Darter.

The KDFWR provide a species account for the Stone Darter in the CWCS report based upon literature available for the Striped Darter. They describe the species as inhabiting shallow pools, the bases and margins of riffles, and/or the margins of rocky banks over gravel and sand with slab rocks present. Using these data and historical collection maps as reference, we surveyed several candidate sites throughout the Elk Fork and Whippoorwill Creek drainages. Many sites were degraded and/or contained inadequate habitat; abbreviated sampling efforts yielded very few fish at these localities. Eventually, eight sample sites were selected that fit the criteria of the CWCS report (Fig. 2). Four of the sites were the historical localities.

The first focused collection efforts were made on 14-15 October 2006. On this trip, we collected at the four historical collection sites. Despite sampling by seine for 1-2 hours at each site, Stone Darter were not collected. Three of the historical sites yielded a few species, including Tennessee Snubnose Darter, Saffron Darter, Scarlet Shiner, Spottail Darter, Striped Shiner, Redtail Chub, Banded Sculpin, Rainbow Darter, Bluntnose Minnow, and Bluegill. However, the entire reach of the site near Gordonville, Kentucky, was channelized and very deep and no fish were collected. In portions of this reach where flow slowed a bit, a layer of sediment 1-2 inches deep had accumulated.

A second collection trip was made on 19 April 2007. During this trip we made collection attempts at all of the sites in Whippoorwill Creek. The results were much the same as the trip in October—very few species. Collections at the first three sites on Whippoorwill Creek were unsuccessful.

Fig. 3.
Photo of the Stone Darter captured in North Fork Whippoorwill Creek.

However, when we arrived at the site on the North Fork of Whippoorwill Creek we immediately noticed a difference in stream structure. The riparian zone was intact, the substrate was a mixture of pebble, cobble and slab-rock. There were riffles present as well as shallow runs and pools. We collected a project high of 16 species at this site, compared to 6-10 at other sites. We collected a reach of about 250 meters and, while we were getting many fish, we still had no Stone Darter. Oddly, we had encountered several dead Yellow Bullhead catfish and were uncertain of their significance, if any.

We were on our way back to the vehicle when we decided to sample the head of the riffle system once more. The habitat was ideal—a gently flowing riffle with slab-rock and slightly deeper sections at the head and base of the riffle. We sampled the riffle a fourth, fifth and finally a sixth time. While sorting through the debris and fishes from the sixth seine haul I spotted an adult fish with distinctive horizontal lines across the body. I had never seen a live Stone Darter but I knew this fish looked a lot like the Striped Darter and no other barcheeks occur in the drainage. Excitedly, I quickly preserved the specimen. With our new-found energy we collected at this site for 40 more minutes before moving on to other sites. We had caught only a single individual adult (Fig. 3).

The last site we collected was the most upstream and we expected the site to be in fairly good condition, but it turned out that it was perhaps the most heavily modified. The stream was used as a road-crossing, portions had been dug out with a dozer and converted to a deeper pool, a bridge was built that had a concrete ledge that served to dam upstream portions, and it appeared that many sport fishes were introduced to the area. The most abundant fishes were Spotted Bass, Bluegill and Longear Sunfish.

On the trip home I called my Ph.D. advisor, Brooks Burr, and told him of the specimen and he was eager to see it. That evening we made a stop at Brooks' house and with a quick look he confirmed my identification. It was definitely a Stone Darter! I gave him an overview of the trip and quickly began planning the next outing.

Fig. 4.
Photos of deforested drainage ditch (top) and chemical application truck (bottom) in North Fork Whippoorwill Creek drainage.

A last collection attempt was made 16 May 2007. During this trip the two Elk Fork sites, the four historical sites, and the North Fork Whipporwill site were collected. Given our previous success, albeit limited, at the North Fork site, we collected there first. Upon arrival our energy immediately dampened. A major series of thunderstorms had occurred in the area the week before and a large tree had fallen just downstream of the riffle and the entire reach was under 2-4 feet of water! Despite a major collection effort in the flooded riffle and upstream areas no Stone Darter were collected. In fact, only a few juvenile Longear Sunfish were collected. The site that was previously the most species-rich yielded very little. Perhaps flash flooding was the reason for the general lack of fish but there was no evidence of major scour—no major sediment shifting, no debris—only the large fallen tree that was now damming the riffle. The lack of fish perplexed us so we began sampling for macroinvertebrates and we caught only a couple of damselfly larvae and midges. The site was seemingly sterile.

With less zeal but adequate determination we moved on to other sites and the results were the same as before—no

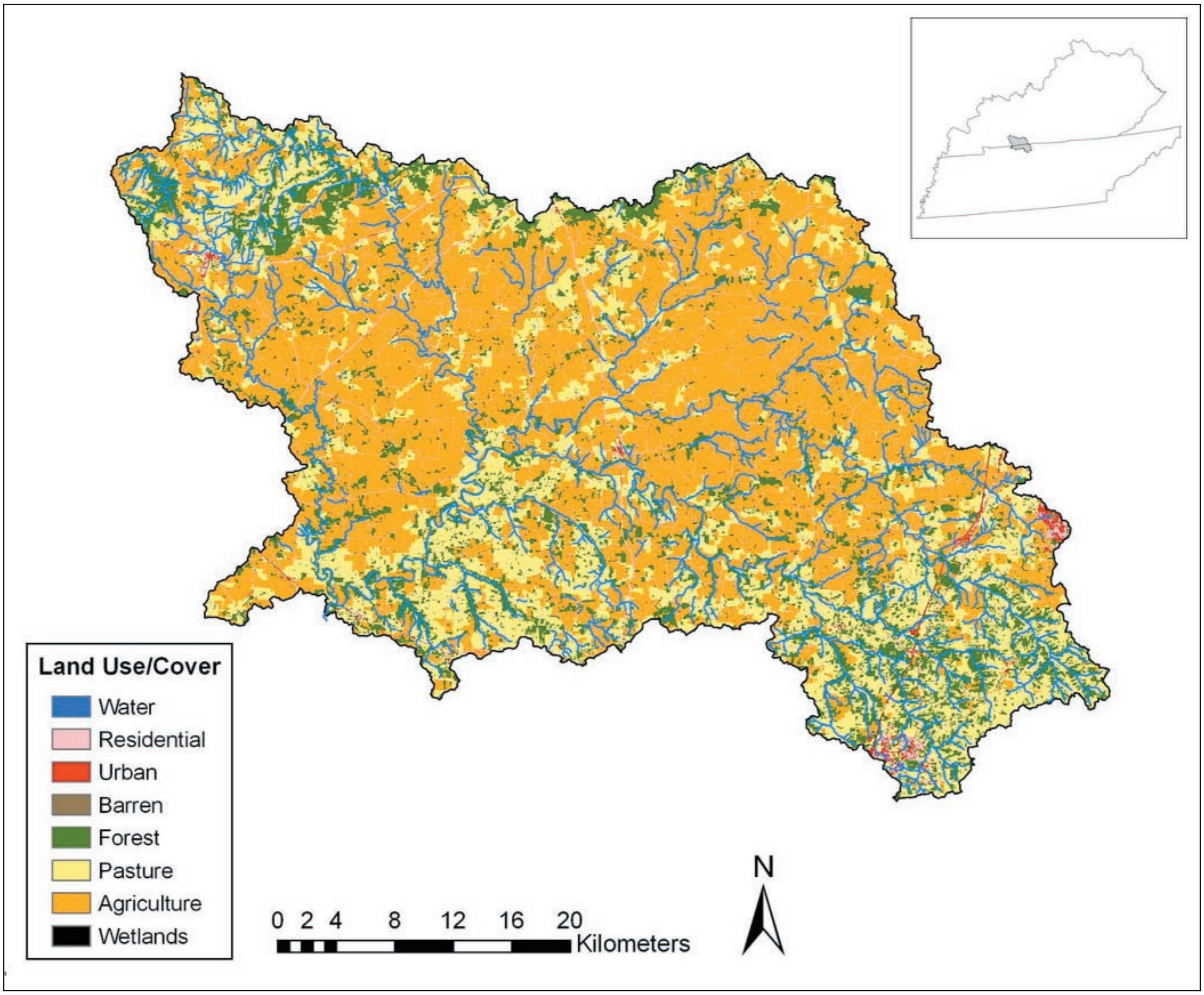

Fig. 5.
Map of land use/cover in the Red River drainage upstream of the Elk Fork confluence.

Stone Darter. The upstream Elk Fork site was deeply incised and sedimentation was heavy whereas the lower site was in good condition. The stream was larger at the downstream site and had an intact riparian zone but had a mostly bedrock substrate and yielded very few fish. Several slab-rocks were present. *Catonotus* darters build nests on the underside of these rocks over a bedrock substrate, but an examination of several rocks showed no egg layers of any sort.

The Role of the Landscape

While driving across the landscape we noticed that much of the area had been converted to use for agriculture or pasture, but we didn't realize the extent of the conversion. A common occurrence among the middle reaches of Elk Fork and Whippoorwill Creek was the degradation of tributaries via removal of the riparian zone and conversion to agriculture to very near the stream edge. Sedimentation and erosion were evident in these smaller tributaries. In contrast, the main stems of Elk Fork and Whippoorwill Creek had relatively intact riparian zones; sedimentation, while a local problem, was not widespread. In 2002, the Kentucky Division of Water assessed water quality conditions in the Red River and, among the streams surveyed, 73.1% were determined to be fully supportive, 17.6% partially supportive, and 9.4% not supportive of aquatic life. Even the undated KDFWR report in our museum noted that Whippoorwill Creek displayed siltation problems and no longer supported a good sport fishery.

Conversations with colleagues revealed an enigmatic collection history for the Red River drainage. Each reported experiencing an extreme variability in collection results similar to what we had experienced. Most of them suspected that agrochemical pollution is a problem in much of the Red River watershed. While completing our field work we had witnessed farmers applying agrochemicals to fields and noted several areas throughout the watershed where riparian zones were essentially denuded (Fig. 4).

To better visualize the Red River landscape, we created a thematic land use map from the 2001 National Land Cover Dataset using ArcGIS (Fig. 5). Our map confirmed our speculation that more than 85% of the Elk Fork and Whippoorwill Creek watersheds have been converted to row-crop agriculture or pasture. For reference, the undated KDFWR report estimated the percentage at 75%. Less than 2% of the watershed is urban and the remaining ~10% is forested. The forested areas are small, isolated patches in the main stem interior and, as aforementioned, a strip of riparian buffer has been left intact and seems to be protecting the stream from widespread degradation. Most of the larger patches of forest are located in portions of the headwater areas where the slope increases and the terrain is hillier. The single site where the Stone Darter was captured is located in a stream reach with an intact riparian buffer and interior land usage is predominantly pasture. Many researchers have determined that pasture usage is much less damaging to stream environments than row-crop agriculture. This could explain why, despite the high degree of landscape modification, the stream at North Fork Whippoorwill Creek was in pretty good condition.

The Stone Darter's Future

Our capture of a single specimen lends hope that a population of Stone Darter persists in North Fork Whippoorwill Creek. However, the population is apparently very small and is nearly undetectable. A more comprehensive sampling effort along the entire stream length may reveal more populations. With regard to the results of the current project, the Stone Darter should most certainly receive conservation protection in Kentucky.

The site at which the Stone Darter was collected was classical habitat as described for Striped Darter by Kornman (1980) and the KDFWR. The specimen was captured at the head of a riffle at the margin of the stream channel where there were a series of slab-rocks and only a minor current. The water was perhaps only six inches deep in this area. The substrate consisted of clean pebbles and gravel with a little sand. However, an examination of the undersides of several slab-rocks showed no egg layers and we are uncertain if the individual was spawning. The spawning season for Striped Darter typically lasts from mid-March until mid-May so it is possible that there were nests within the area that we did not detect.

When reviewing the collection history for the Red River drainage it was revealed that there is one tributary parallel to Elk Fork and Whippoorwill Creek that has scant collection records—the West Fork. We did not target this tributary during our project because we were focused on sampling in areas of historical records. The West Fork seems to have all the geological and topographical characteristics as Elk Fork and Whippoorwill Creek and we initially suspected this stream would be a good candidate site for future collecting efforts. However, a review of the KDFWR report showed that the West Fork was the most heavily modified of the streams surveyed and showed severe signs of degradation even during that time period.

Perhaps more intensive sampling needs be done along the entire lengths of Elk Fork and Whippoorwill Creeks. The Striped Darter inhabits some fairly large streams and Page et al. (2003) note at least two historical collections in the Tennessee portion of the Red River drainage including one from the Red River proper. Given the intact nature of the riparian zone along much of the main stems of Elk Fork and Whippoorwill Creek, it is quite possible that some of these areas are in good condition, contain adequate habitat and support a larger population of Stone Darter. The stream habitat at many bridge sites surveyed was not ideal but a canoe trip downstream may reveal candidate sites with potential habitat that are otherwise inaccessible.

The Stone Darter still swims in the waters of Kentucky and we will continue our search for a larger population.

Acknowledgments

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Hopkins and Fisk, "Stone Darter," cont. from p. 19

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