

## CURRENT STATUS AND DISTRIBUTION OF INDIANA'S SEVEN ENDANGERED DARTER SPECIES (PERCIDAE)

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**ABSTRACT.** At the beginning of this study seven darter species (Bluebreast, Harlequin, Spotted, Spottail, Tippecanoe, Variegated, and Gilt) were on Indiana's list of endangered fish species; and up-to-date, statewide distributional information was lacking. All known historical and recent records were compiled; and 350 original sites were sampled between 1996 and 2006 in an attempt to determine the accurate, current distribution of each species. Many were found to be more widely-distributed than expected; likely the result of very species-specific sampling techniques used during this study rather than actual range expansions. Harlequin Darter was collected from many previously unknown tributaries, as well as new locations on the mainstems, of the East Fork White River, West Fork White River, and lower Wabash River drainages. Spottail Darter is now known from more locations than it ever has been, although it is still restricted to small streams of the extreme southwestern portion of Indiana. Bluebreast Darter, although once known from many more locations, still maintains populations in several watersheds. Spotted Darter and Tippecanoe Darter were recorded for the first time from the East Fork White River and Wabash River, respectively. Of the species sampled, Gilt Darter and Variegated Darter maintain the most restricted ranges in the state. Gilt Darter, once found in several of the larger rivers of the Wabash River and Lake Erie drainages, is now only found in the upper Tippecanoe River. Variegated Darter is now restricted to the Whitewater River drainage in Indiana. Dams, as well as natural habitat barriers, are limiting further range expansions for many of the darters sampled during this study. As a result of this study, Bluebreast Darter, Harlequin Darter, Spotted Darter, Spottail Darter, and Tippecanoe Darter were removed from Indiana's endangered fish list (Spotted Darter and Tippecanoe Darter were retained as species of special concern). Variegated Darter and Gilt Darter remain on the endangered list.

**Keywords:** Darters, Indiana, distribution

Gerking (1945) was the first to provide a statewide look at darter (Percidae) distribution in Indiana, compiling all historical fish data known at the time and sampling 412 sites across Indiana between 1940 and 1943. Whitaker & Gammon (1988) reviewed the distribution of Indiana's endangered fish species, including several darter species, and gathered new information since Gerking (1945). They included darter distribution information from Baker et al. (1984), Keevin et al. (1985), Baker & Forsyth (1986), and Grannan & Lodato (1986). Several additional regional surveys specifically targeting darter species in Indiana were completed since Whitaker & Gammon (1988), including those by Seegert (1987), Gammon & Gammon (1989), Seegert (1990), Simon (1993a, 1993b), and Bandoli (1998). Lee

et al. (1980), Page (1983), Kuehne & Barbour (1983), and Page & Burr (1991) provided a North American perspective on darter distribution, although they included little new information specific for Indiana species, rather relying mainly on museum and literature records already included in Gerking (1945).

The aforementioned studies provided invaluable information on the distribution of darters in Indiana; however, they were somewhat limited in scope. They either concentrated sampling in one watershed or region of Indiana, or conversely, sampled only a few sites in multiple watersheds over a large region of the state. The distributions represented in many of these publications did not actually represent the species' current distribution in the state; many watersheds lacked current information, and distributions were often based on very old historical records. For example, Kuehne & Barbour (1983) stated that the Vermillion River basin in Illinois probably contained the last population of Bluebreast

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Darter in the entire Wabash River basin, and that Spotted Darter was likely extinct from the drainage. This revealed an obvious lack of new data, as both still occurred in multiple watersheds in the Wabash River basin in Indiana at the time of their publication. An accurate depiction of the current, statewide distribution of Indiana's endangered darter species is not available.

Prior to the current study, there had been no comprehensive, statewide, species-specific surveys for darters completed in Indiana. This information was needed in order to assess the status of each of Indiana's seven endangered darter species [Bluebreast Darter (*Etheostoma camurum*), Harlequin Darter (*E. histrio*), Spotted Darter (*E. maculatum*), Spottail Darter (*E. squamiceps*), Tippecanoe Darter (*E. tippecanoe*), Variegate Darter (*E. variatum*) and Gilt Darter (*Percina evides*)], and to determine if their current status was warranted. The purpose of the current study was to: 1) compile all known records, 2) survey all historical locations, and 3) survey other surrounding areas in order to determine the current and complete statewide distribution for each of Indiana's seven endangered darter species.

## METHODS

Prior to sampling, all known records were compiled for the seven darter species of interest in this study. These known locations were then sampled first to determine if the populations were still extant. If the species was found to be present, subsequent sampling was then continued further upstream or downstream from the collection point to determine to what extent each species currently inhabited the watershed. Sampling continued in this way until the species was absent from two consecutive sites, in most cases. It was then assumed that this was a break in the species' distribution and further sites upstream/downstream were not sampled. Sites were sampled between 1996 and 2006, using the following techniques.

All darters were collected using a backpack electrofisher (Smith-Root Type VII) or seine (various sizes, although most commonly a knotless 1.6 mm Delta mesh seine of 1.8 m × 1.8 m), although most sites were sampled using the "kick-shock" technique (Fisher et al. 2001), which utilized a combination of both gears. Using this method, one person positioned/secured a small seine in the stream channel

while a second person, using a backpack electrofisher, shocked their way downstream to the seine, disturbing the substrate with their feet as they went. This technique was very effective in collecting darter and madtom species adapted to fast water habitats and that are normally found hiding under rocks; these species were not collected as easily using either method individually. This method was especially useful in deep, fast, large river habitats that do not normally get sampled adequately using other more standard methods such as boat electrofishing or seining alone. The desired habitat (described in the following species accounts) of each darter species was specifically targeted at each site in order to determine their presence or absence.

Each year, throughout the course of this study, literature and scientific purpose license reports were reviewed in an attempt to identify all new records by other researchers. These records, along with those compiled prior to and collected during the course of this study were then used to depict as accurately as possible the historical and current distribution of each species.

Specimens vouchered during the course of this study are currently housed at the Atterbury Fish and Wildlife Area, Edinburgh, Indiana.

## RESULTS

During the course of this study, 418 sampling events were completed at 350 locations to delineate the distribution of each of Indiana's seven endangered darter species (Fig. 1). For the purposes of reporting on the known records for each of the seven darter species, the records were divided into two time periods: 1) pre-1980, and 2) 1980–2006. Collections prior to 1980 were considered 'historical' data. For the most part this consisted of information compiled by Gerking (1945) as well as a few other literature/museum records that he did not include. It is important to note that Gerking (1945) included several 'dots' on his distribution maps that do not correlate with any of his actual sample locations. These, in most instances, were from records he included from the University of Michigan Museum of Zoology fish collection. There was very little additional collection activity between Gerking (1945) and 1980, except for an occasional Indiana DNR survey report and miscellaneous museum collections.

1. St. Joseph River
2. St. Marys River
3. Maumee River
4. Eel River
5. Deer Creek
6. Tippecanoe River
7. Big Pine Creek
8. Sugar Creek
9. Patoka River
10. Black River
11. Wabash River
12. Sugar Creek
13. Big Blue River
14. Flatrock River
15. Driftwood River
16. Muscatatuck River
17. East Fork White River
18. Richland Creek
19. West Fork White River
20. White River
21. Whitewater River
22. Blue River
23. Little Pigeon Creek

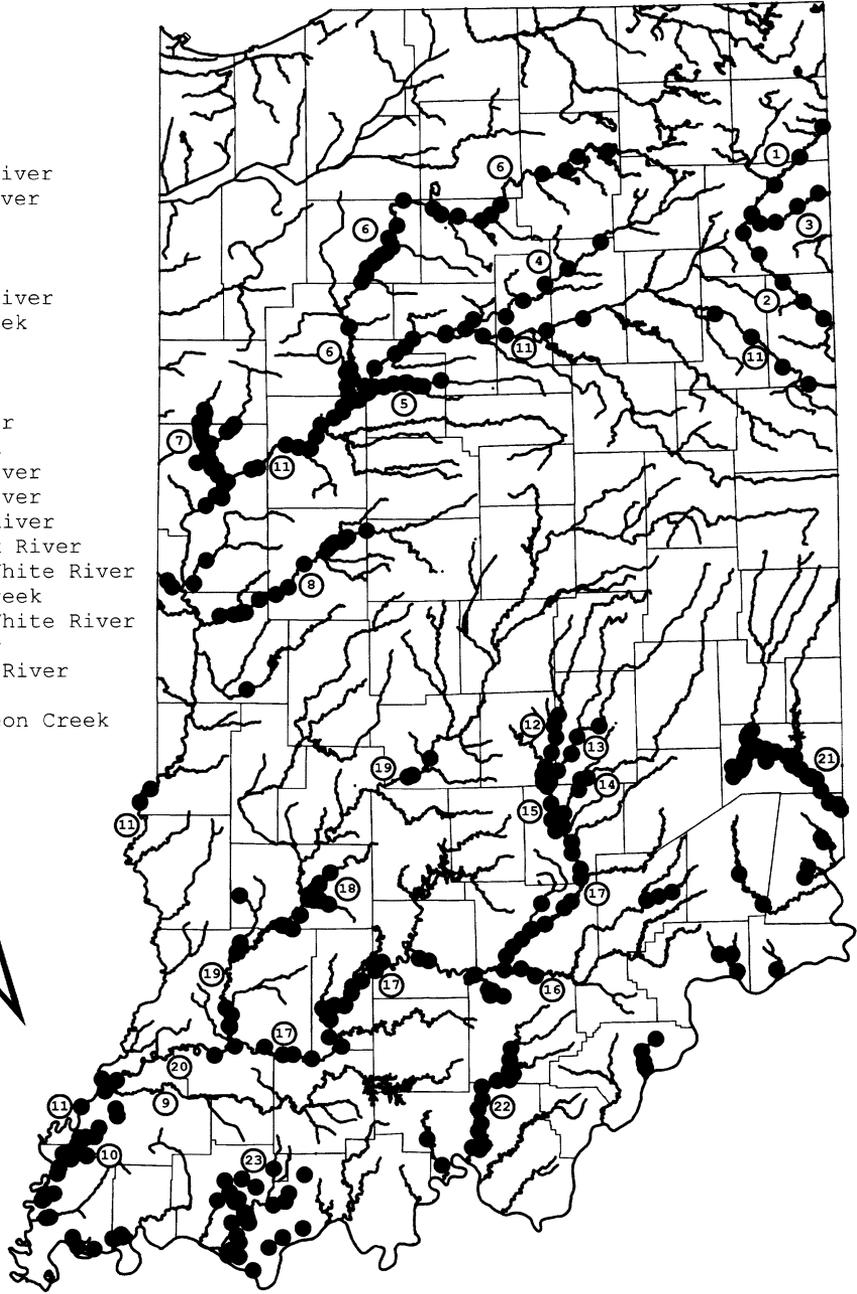
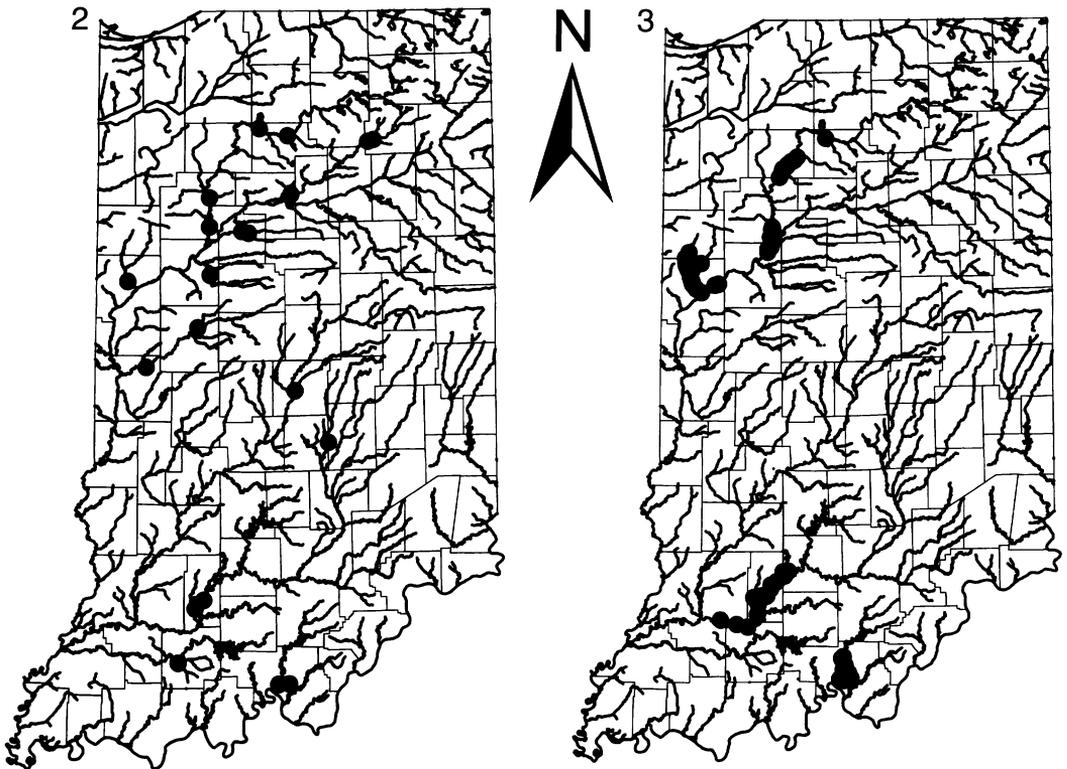


Figure 1.—All collection locations sampled between 1996–2006, with major streams in which these collections took place identified.

‘Current’ data consist of those records from between 1980 and 2006, including all original collections made during the course of this study, indicated by the prefix BEF. More detailed information on the exact location of these collections can be found in Appendix I.

The following list of historical and current records are separated by waterbody and listed in each of the species’ accounts using the following format – WATERBODY: County: Year of Collection: Reference - Museum catalogue numbers, if voucher specimens are



Figures 2, 3.—2. Historical (pre-1980) collection locations for Bluebreast Darter in Indiana; 3. Current (1980-2006) collection locations for Bluebreast Darter in Indiana.

present. Multiple collection records from the same county and from the same year are separated by a semi-colon. Collections made as part of the Indiana Department of Environmental Management's Fish Community Sampling Program are designated as 'IDEM' followed by the Event ID number and were received from S. Sobat (pers. commun.).

The following is a compilation of the historical and current distribution for each of Indiana's seven endangered darter species, with discussion of erroneous and questionable records, and notes on the habitat in which each was most often associated during this study.

**Bluebreast Darter.**—Of all the darter species sampled during this study, the Bluebreast Darter was known historically in Indiana from the most watersheds, including several if not most of the larger tributaries of the upper and middle Wabash River and parts of the East Fork White River, West Fork White River, Patoka River, and Blue River drainages (Fig. 2). Populations in several of these tributaries have seemingly become extirpated in

relatively recent times. Bluebreast Darter was last recorded from the Eel River drainage in the 1930s (Gerking 1945 and UMMZ 99923), Wildcat Creek drainage in the 1940s (Gerking 1945), Sugar Creek (East Fork White River) drainage in the 1950s (TU 19190), and Sugar Creek (middle Wabash River) and Deer Creek drainages in the 1970s (Huffaker 1973 and Robertson 1977, respectively). Even with the loss from these drainages, the Bluebreast Darter still maintains the widest range in Indiana of any of the species sampled (Fig. 3).

Whitaker & Gammon (1988) included two records for Bluebreast Darter from the Wabash River 'near Darwin and York' in Vigo and Sullivan counties, respectively. These were unpublished records from 1975 from the 'Illinois D.O.C.' that cannot be verified and are not included as valid records here. Bluebreast Darter was first verifiably recorded from the mainstem Wabash River by Fisher et al. (2001) in Tippecanoe County. During the current study, they were collected at a few more locations between the Tippecanoe River

mouth and Big Pine Creek mouth. In these locations, they were still associated with larger rock. Lack of boulder riffles may be limiting their distribution in this system, as riffles containing boulders become very limited as one goes further downstream on the Wabash River.

There is a single specimen of Bluebreast Darter from the Maumee River, Indiana, in the Cornell University collection (CU 55248); it was a gift from the Carnegie Museum (CM 6520a). This would represent the only known record for Bluebreast Darter from the Great Lakes drainage. No date or collector information is included with the specimen; and it was not included in distributional information for the Bluebreast Darter in Lee et al. (1980), Page (1983), and Page & Burr (1991). The Bluebreast Darter was also not collected by Kirsch (1895b) during a survey of the Maumee River drainage. There are some other unusual species' records in the Cornell University collection from the Maumee River (see CU 55195, CU 55216) that came in the same accession from the Carnegie Museum as CU 55428 (J. Friel pers. commun.). Until more information can be substantiated for this record, it should not be considered valid.

Additional collections of Bluebreast Darter from the Blue River drainage are included in Summers (1999, 2001, 2003 & 2007). These are not included in the following list of current records, as they overlap with much of what is already presented, and in certain instances, specific collection location information is not included. Simon & Dufour (1997) include Bluebreast Darter in their list of fishes collected from the Eastern Corn Belt Plain; however, specific location information is not provided.

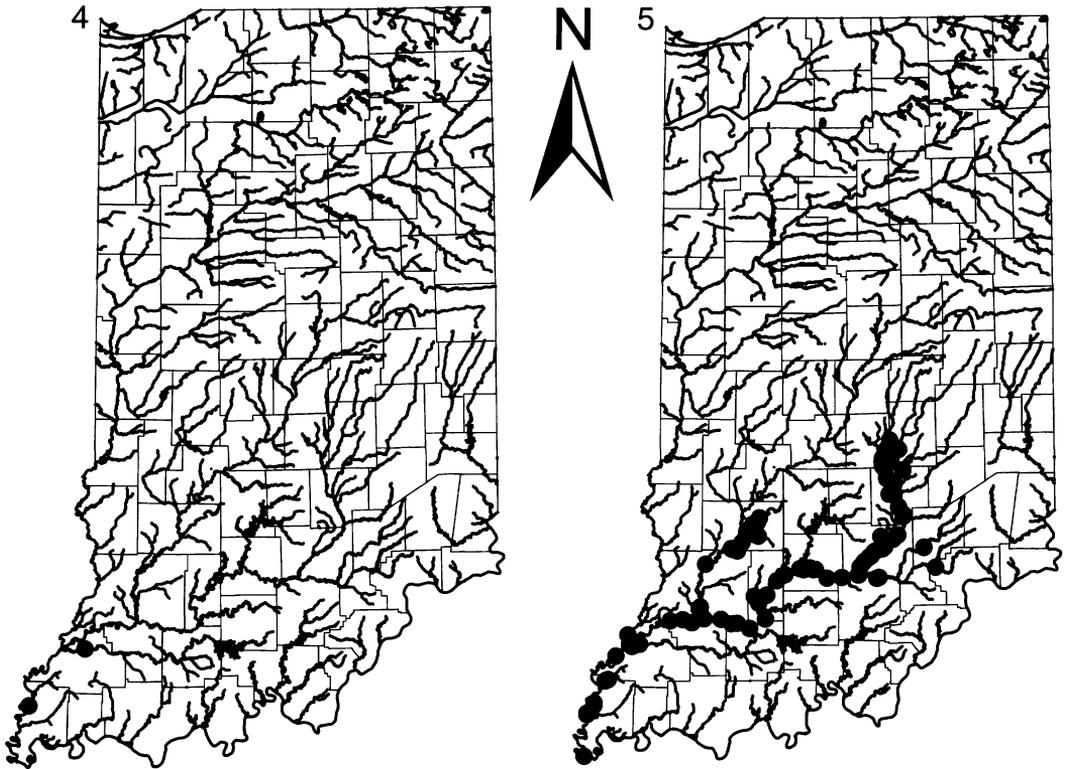
Bluebreast Darter was almost exclusively found in association with large rocks (boulders) in fast current during this study. In locations where it was collected, it was not uncommon to find one individual per each of the largest rocks on the riffle. They were most easily collected by shocking from the upstream to downstream end of each targeted boulder. Shocked individuals would be carefully watched for as they 'jumped' out from underneath it. Often times a small minnow seine would be positioned at the downstream end of the boulder, along the side being sampled, to catch the shocked individual as it was caught up in the current. Many times, however, the shocked individual would be

quickly sucked into the eddy behind the boulder where it would then have to be picked off the bottom.

Bluebreast Darter is currently found in Indiana in the Tippecanoe River upstream of Lake Shafer, the Tippecanoe River below Oakdale Dam, the mainstem Wabash River between the Tippecanoe River mouth and Big Pine Creek mouth, Big Pine/Mud Pine Creek, the East Fork White River downstream from Williams Dam to near its confluence with the West Fork White River, and the Blue River (Fig. 3).

**Pre-1980 records (Fig. 2).**—EEL RIVER: *Whitley*: 1892: Kirsch (1895a) and Kirsch (1896) - UMMZ 212973 (IU 9010), SU 693 (no date is included for these two museum records, but likely same collections as made by Kirsch), *Cass*: 1930: Gerking (1945) - UMMZ 99923. DEER CREEK: *Carroll*: 1941: Gerking (1945); 1977: Robertson (1977). TIPPECANOE RIVER: *White*, *Carroll*, and *Tippecanoe*: 1886–87: Evermann & Jenkins (1892) - USNM 39599, *Fulton*: 1888: Jordan (1890) - UMMZ 187513 (IU 4688) (no date is included with this museum record, but likely collection by B.W. Evermann in Jordan (1890); 1890: USNM 125114; 1899: USNM 69232; 1925: UMMZ 66602; 1941: Gerking (1945). PIKE CREEK (tributary to Tippecanoe River): *White*: 1925: Gerking (1945) - UMMZ 66565. SOUTH FORK WILDCAT CREEK: *Tippecanoe*: 1942: Gerking (1945) - OSM 29059. BIG PINE CREEK: *Warren*: 1964: Smith (1979) - INHS 77207. SUGAR CREEK (Middle Wabash River tributary): *Parke*: 1941: Gerking (1945), *Montgomery*: 1973: Huffaker (1973) - uncatalogued specimens in fish collection at Avoca State Fish Hatchery. WEST FORK WHITE RIVER: *Marion*: 1874: Jordan (1877a). SUGAR CREEK (Upper East Fork White River tributary): *Shelby*: 1958: TU 19190. EAST FORK WHITE RIVER: *Martin*: 1942: Gerking (1945); 1946: UGAMNH 216. PATOKA RIVER: *Dubois*: 1893: Moenkhaus (1896). BLUE RIVER: *Crawford* and *Harrison*: 1942: Gerking (1945); 1977: uncatalogued specimens in Indiana University Southeast Collection.

**1980–2006 records (Fig. 3).**—TIPPECANOE RIVER: *Fulton*: 2000: BEF00177, *Pulaski*: 1985: Keevin et al. (1985) - INHS 68811, INHS 63836; 1987: Carney et al. (1993) - INHS 63317; 1994: McWilliams-Munson & Simon (2001); 1999: BEF99081; BEF99082; BEF99083;



Figures 4, 5.—4. Historical (pre-1980) collection locations for Harlequin Darter in Indiana; 5. Current (1980-2006) collection locations for Harlequin Darter in Indiana.

BEF99084; BEF99085; 2000: BEF00178; BEF00179; BEF00185; BEF00186; BEF00187; BEF00188; 2006: BEF06170, *Carroll*: 1992: Ecological Specialists, Inc. (1993) - INBS 1247; 1994: McWilliams-Munson & Simon (2001); 1998: BEF98158; IDEM 98303; 1999: BEF99123; BEF99124; BEF99127; 2000: BEF00064; 2003: BEF03017; IDEM 03T303; 2004: BEF04032; 2006: BEF06108, *Tippecanoe*: 1999: BEF99125; 2005: BEF05252. WABASH RIVER: *Tippecanoe*: 1994: Fisher et al. (2001); 1999: BEF99126, *Warren*: 1998: BEF98148; BEF98150; 2002: BEF02215. BIG PINE CREEK: *Warren*: 1980: INHS 0 (specimens collected, but not kept by Smith and Page); 1985: Whitaker & Gammon (1988); 1998: BEF98020; BEF98078; BEF98083; BEF98084; 1999: BEF99170; 2002: BEF02214; BEF02216; 2004: IDEM 04834. MUD PINE CREEK: *Benton*: 1998: BEF98080; BEF98081; 1999: BEF99047, *Warren*: 1998: BEF98023; BEF 98082; 1999: IDEM 99017; 2006: BEF06061; BEF06064. EAST FORK WHITE RIVER: *Lawrence*: 1997: BEF97170; 1999: BEF99177;

2003: BEF03088, *Martin*: 1997: BEF97141; BEF97167; BEF97168; BEF97169; 1998: BEF98125; 1999: BEF99145; BEF99146; 2001: BEF01006; 2002: BEF02141; BEF02291; BEF02293; BEF02311; 2003: BEF03004; 2006: BEF06105; BEF06126, *Martin and Dubois*: 1999: BEF99131, *Daviess and Dubois*: 1999: BEF99129, *Daviess and Pike*: 1999: BEF99144. BLUE RIVER: *Crawford and Harrison*: 1983-84: Baker et al. (1984) - uncatalogued specimens in Indiana University Southeast Collection; 1986: Baker & Forsyth (1986) - uncatalogued specimens in Indiana University Southeast Collection; 1997: BEF97057; BEF97059; Huff et al. (1998); 1998: BEF98118; BEF98147; 1999: BEF99117; BEF99119; 2000: BEF00161; 1999-2001: Baker & Forsyth (2001); 2000: Carnahan (2001), IDEM 00056.

**Harlequin Darter.**—Of all the species included in this study, the Harlequin Darter has the most interesting history of distribution in the state (Fig. 4). It was known historically from a single location: Patoka River, at Patoka (Jordan 1890). Smith (1979) also speculated that an

unvouchered record for *Etheostoma zonale* (Banded Darter) from the lower Wabash River, as recorded by Forbes & Richardson (1908), was actually a Harlequin Darter. Banded Darter is not known presently from this part of the state; and no other historical records exist as well, so this assumption likely is correct. Collections of Harlequin Darter from the 'Poteau R., Ind.' in the National Museum of Natural History (USNM 188972), could be confused with being collected from Indiana. However, this location information actually refers to the Indian Territory of the Poteau River in Arkansas (Jordan & Gilbert 1886).

Even with these two historical collections, Gerking (1945) did not collect it, and speculated that if it was still present, that it 'must be exceedingly rare.' It was considered extirpated from the state until 1991, when over a month period, it was found by three different collectors: Sugar Creek in the upper East Fork White River drainage (Kiley & Keller 1993), and from two locations on the mainstem White River (Simon 1992; INHS 61220). As a result of its rediscovery, it was elevated from extirpated to endangered status in 1992.

There is some confusion over the exact year that the Harlequin Darter was actually re-discovered in Indiana. Simon (1993a) mentions the collection of a Harlequin Darter from Otter Creek (upper Muscatatuck River drainage) in 1988. However, there is no mention of this collection included in Simon & Kiley (1994) when describing the re-discovery of the Harlequin Darter in the state. Sites were sampled in the Otter Creek drainage during this study (Fig. 1); however, Harlequin Darter was not found. Harlequin Darter has been collected in the Muscatatuck River drainage since 1988 (Fig. 5); however, nothing was found in the Otter Creek portion. No specimen is available for verification, so this collection was not included in the current records.

Since its re-discovery, it has been found in a variety of drainages, including sites as large as the Ohio River at the mouth of the Wabash River (Page & Retzer 2002) and as small as Doans Creek, Greene County (BEF01084). It has likely always occurred in much of its current range, but simply went unnoticed. An indication of this would be that it currently occurs in the East Fork White River both upstream and downstream of Williams Dam, Lawrence County, which was completed in

1912 (S. Fulkerson, pers. comm.). Very specific, targeted sampling was a necessity for adequately surveying for Harlequin Darter during this study. Whether in large rivers or in small streams, the Harlequin Darter was found almost exclusively in association with woody debris that occurred in fast current. Because this habitat can be difficult to sample using more standard techniques (especially in large rivers) Harlequin Darter presence has likely been grossly under-represented in both historical and more recent surveys.

During this study, Harlequin Darter was sampled specifically for by running the probe of a backpack electrofisher from the upstream to downstream end of logs, root wads or piles of woody debris and watching for it to 'shoot' out into the current. Small mesh netting was added to the anode ring of the electrofisher probe and aided in 'grabbing' the small darter as it ejected from the woody habitat. This took some practice and worked best if the area could be waded. However, at times this method was deployed from a boat, by running the boat slowly along woody debris piles and using the anode of a backpack electrofisher to shock from the boat. It seemed as though the Harlequin Darter often acted as a kind of woodpecker of the stream, working its way around large logs, presumably searching for food items. They were shocked from all locations (dorsal, ventral, or lateral sides) of the woody debris over the course of sampling. It was often found with *Percina sciera* (Dusky Darter), which also seem to have a high association with this type of habitat.

Of all the species sampled during this study, the current distribution of the Harlequin Darter is probably the most under-represented. It likely inhabits a greater extent of many of the tributaries of the East Fork White River, West Fork White River and mainstem Wabash River from which it was found. It was collected from so many more locations than expected during the course of this study, that the additional effort required to represent adequately its true distribution went beyond this study's scope. For example, little effort was extended in the Muscatatuck or Patoka River drainages (Fig. 1); however, collections by IDEM indicate that it is widespread there. It is likely found in the lower sections of many other tributaries of the East Fork and West Fork White Rivers as well.

Harlequin Darter currently inhabits more streams in Indiana than any of the other species sampled during this study. It can be found in multiple tributaries within the East Fork White River, West Fork White River and lower Wabash River drainages, as well as the mainstems of each of these (Fig. 5).

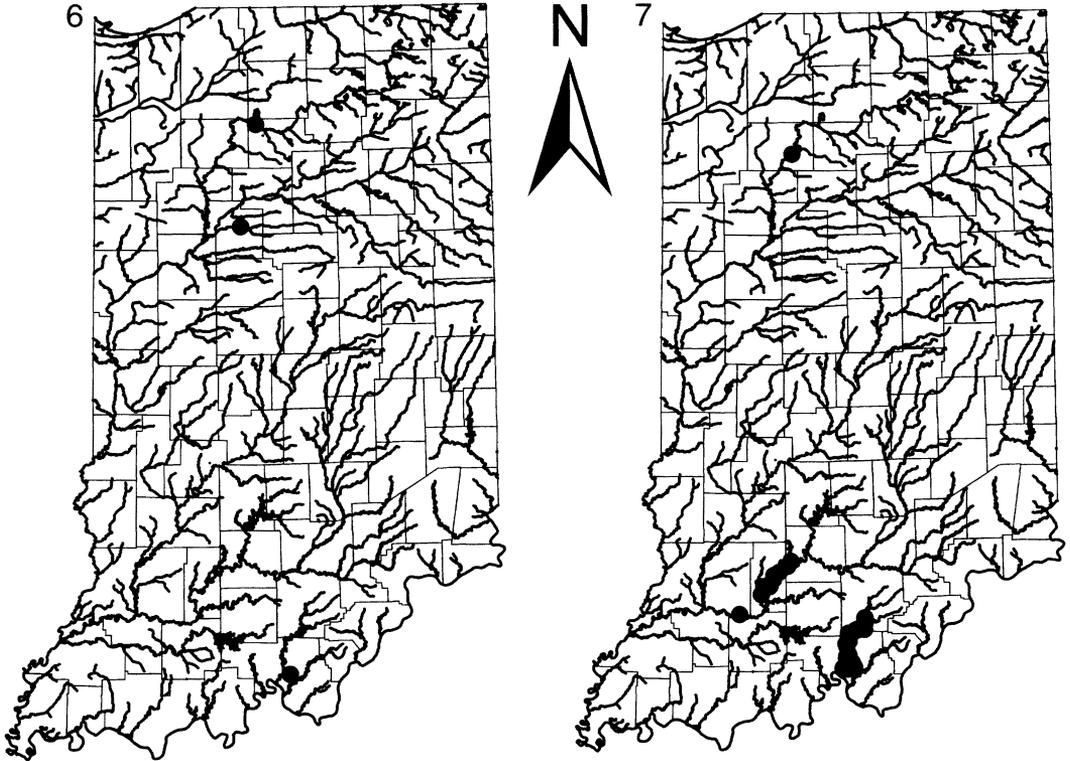
**Pre-1980 records (Fig. 4).**—PATOKA RIVER: *Gibson*: 1888: Jordan (1890) - USNM 40782, UMMZ 245307 (IU 4956), SU 1022. WABASH RIVER: *Posey*: Pre-1908: Smith (1979) and Forbes & Richardson (1908).

**1980–2006 records (Fig. 5).**—SUGAR CREEK: *Shelby*: 1998: BEF98113, *Johnson*: 1991: Kiley & Keller (1993); 1993: Simon (1993a); 1997: BEF97165; 1998: BEF98112; BEF98127; BEF98154; 2002: BEF02236; 2005: BEF05286. BIG BLUE RIVER: *Shelby*: 2000: BEF00157; BEF00158, *Johnson*: 1996: BEF96147; 2002: IDEM 02542; 2003: BEF03101. FLATROCK RIVER: *Shelby*: 2000: BEF00136, *Bartholomew*: 1999: BEF99088; 2000: BEF00087. DRIFTWOOD RIVER: *Bartholomew*: 1998: BEF98122; BEF98128; BEF98162; 2002: BEF02237. BIG CREEK: *Jefferson*: 2002: IDEM 02527. VERNON FORK MUSCATATUCK RIVER: *Jennings*: 2002: IDEM 02511. DELANEY CREEK: *Washington*: 2002: BEF02056. MUSCATATUCK RIVER: *Jackson* and *Washington*: 2002: IDEM 02536. WHITE CREEK: *Jackson*: 1998: BEF98121; 2004: BEF04057. LOST RIVER: *Martin*: 2002: BEF02308. EAST FORK WHITE RIVER: *Bartholomew*: 1998: BEF98123; 1999: BEF99042; 2003: Hoffman (2006), *Jackson*: 1998: BEF98116; BEF98117; BEF98119; BEF98120; 1999: BEF99089; BEF99090; 2000: BEF00206; 2002: BEF02149; BEF02150; 2003: Hoffman (2006), *Jackson* and *Washington*: 1997: IDEM 97068; 2000: BEF00204, *Lawrence*: 1997: IDEM 97054; 1998: BEF98166; BEF98167; 1999: BEF99092; BEF99147; 2002: IDEM 02512; IDEM 02526; M. Litwin, pers. commun., *Martin*: 1997: BEF97141; BEF97167; 1999: BEF99145; BEF99146; 2006: BEF06105, *Martin* and *Dubois*: 2003: Hoffman (2006), *Daviess* and *Dubois*: 1999: BEF99129; BEF99130, *Daviess* and *Pike*: 1998: BEF98157; 1999: BEF99144. DOANS CREEK: *Greene*: 2001: BEF01084. FIRST CREEK: *Greene*: 2001: BEF01082; BEF01083; 2004: BEF04252. RICHLAND CREEK DRAINAGE: *Greene*: 2001: BEF01078; BEF01079; BEF01085; 2002:

BEF02033; BEF02034; BEF02253; BEF02314; 2003: BEF03001; BEF03005; BEF03008; BEF03010; BEF03015; BEF03041; 2005: BEF05204; BEF05205; BEF05206; (the previous three sites also in Kittaka (2007)); BEF05277; BEF05278. BLACK CREEK: *Knox*: 2001: BEF01086. WEST FORK WHITE RIVER: *Daviess* and *Knox*: 1997: BEF97191. WHITE RIVER: *Knox* and *Pike*: 1991: Simon (1992); INHS 61220; 1995: EA Engineering, Science, and Technology (1995). PATOKA RIVER: *Gibson*: 1999: BEF99134; 2001: IDEM 01232; 2006: IDEM 06117. BLACK RIVER: *Posey*: 2000: BEF00050; BEF00051. WABASH RIVER: *Knox (IN)* and *Wabash (IL)*: 1995: Burr et al. (1996) - SIUC 24444, *Gibson (IN)* and *Wabash (IL)*: 1997: Page & Retzer (2002) - INHS 42311, *Posey (IN)* and *White (IL)*: 1995: Burr et al. (1996) - SIUC 24861; 1996: Page & Retzer (2002) - INHS 39006; 1998: Page & Retzer (2002) - SIUC 33497; 1999: Page & Retzer (2002); 2006: BEF06130. OHIO RIVER: *Posey*: 1997: Page & Retzer (2002) - SIUC 29947.

**Spotted Darter.**—There are very few historical records for Spotted Darter from Indiana (Fig. 6). Gerking (1945) relegated Spotted Darter to his list of ‘species of probable or possible occurrences in Indiana,’ not collecting it during his sampling. Interestingly, he did not recognize the collections made by Jordan (1890) in the Tippecanoe River and Deer Creek, although he included records for other species from this report. Jordan (1890) indicated that only one specimen was collected from Deer Creek; this specimen is not currently in any museum collections.

It was not until Baker et al. (1985) that Spotted Darter was once again collected in the state, from the Blue River in south-central Indiana. It had not been recorded previously from this system, even though Gerking (1945) sampled several sites in the drainage. A collection by T. Simon in Carney et al. (1993) from the Tippecanoe River represented the re-discovery of the species in that drainage. There is some ambiguity over the exact location and circumstances of this collection. Keevin et al. (1985) did not collect Spotted Darter from the Tippecanoe River, but indicated that T. Simon may have collected some from ‘2.5 mi S Winamac, Pulaski Co.’ on 27 July 1985, but that no specimens were kept for verification. However, Carney et al. (1993) includes the



Figures 6, 7.—6. Historical (pre-1980) collection locations for Spotted Darter in Indiana; 7. Current (1980–2006) collection locations for Spotted Darter in Indiana.

collection of four specimens of Spotted Darter from '6 miles south of Winamac, Pulaski County' by T. Simon on 27 July 1985. These specimens are vouchered in the Illinois Natural History Survey Collection (INHS 62625). Efforts to relocate this population in the Tippecanoe River were unsuccessful during the current study, even though many sites were sampled in the watershed. This population is likely either extirpated or reduced to a couple of isolated riffles on the Tippecanoe River. Spotted Darter was reported by Tiemann & Tiemann (2004) from the Tippecanoe River, but no picture or specimen was available for verification, so that record is not included as part of its current distribution.

Our collections of Spotted Darter from the East Fork White River represent the first ever recorded from that system. Spotted Darter was first collected in 1997 (BEF97141) and subsequently found in a long stretch of the East Fork White River from below Williams Dam, Lawrence County, to nearly the junction of the East Fork White River and West Fork

White River (Fig. 7). These collections were somewhat of a surprise, considering that past efforts by Gerking (1945) and others failed to discover it, even though Bluebreast Darter and Tippecanoe Darter were found.

Additional collections of Spotted Darter from the Blue River drainage are included in Summers (1999, 2001, 2003 & 2007). These are not included in the following list of current records, as they overlap with much of what is already presented, and in certain instances, specific collection location information is not included.

During the course of this study, Spotted Darter was often found in similar habitats as the Bluebreast Darter (boulder riffles in fast current); however, it seemed to have preference for a wider range of rock size and current speed. Spotted Darter was more often associated with slower currents and smaller substrate than the Bluebreast Darter. It was also occasionally found along edges of riffles and not necessarily in the fastest section.

Spotted Darter is currently found in Indiana in the East Fork White River downstream from

Williams Dam to near its confluence with the West Fork White River and the Blue River (Fig. 7). A third population of unknown status may still remain in the Tippecanoe River upstream of Lake Shafer.

**Pre-1980 records (Fig. 6).**—DEER CREEK: *Carroll*: 1888; Jordan (1890). TIPPECANOE RIVER: *Fulton*: 1888; Jordan (1890) - UMMZ 213114 (IU 4689); 1890: FMNH 1838; 1899: USNM 69233. BLUE RIVER: *Harrison*: 1976–79; Baker et al. (1985) - uncatalogued specimens in Indiana University Southeast Collection.

**1980–2006 records (Fig. 7).**—TIPPECANOE RIVER: *Pulaski*: 1985; Keevin et al. (1985) - INHS 62625. EAST FORK WHITE RIVER: *Lawrence*: 1999: BEF99147; BEF99177; 2003: BEF03106 (also in Hoffman (2006)), *Martin*: 1997: BEF97141; 1999: BEF99145; 2001: BEF01006; 2002: BEF02207; BEF02291; BEF02293; BEF02311; 2003: BEF03004; 2006: BEF06105; BEF06126, *Daviess* and *Dubois*: 1999: BEF99129. SOUTH FORK BLUE RIVER: *Washington*: 2000: BEF00196. BLUE RIVER: *Washington*: 1984; Baker et al. (1985); 1997: Huff et al. (1998); 1999: BEF99121; BEF99122; 2000: BEF00198; *Carnahan* (2001), *Crawford* and *Harrison*: 1980–84; Baker et al. (1985) - uncatalogued specimens in Indiana University Southeast Collection; 1986: Baker & Forsyth (1986); uncatalogued specimens in Indiana University Southeast Collection; 1987: INHS 62872; 1993: Stefanavage (1995); 1996: BEF96012; 1997: BEF97047 - INHS 41400; BEF97057; BEF97059; Huff et al. (1998); 1998: BEF98147; 1999: BEF99117; BEF99118; BEF99119; BEF99120; 2000: BEF00161; BEF00162; 2001: BEF01065; 1999–2001: Baker & Forsyth (2001); 2000: IDEM 00056; 2005: IDEM 05179; IDEM 05103; IDEM 05179.5; IDEM 05185.

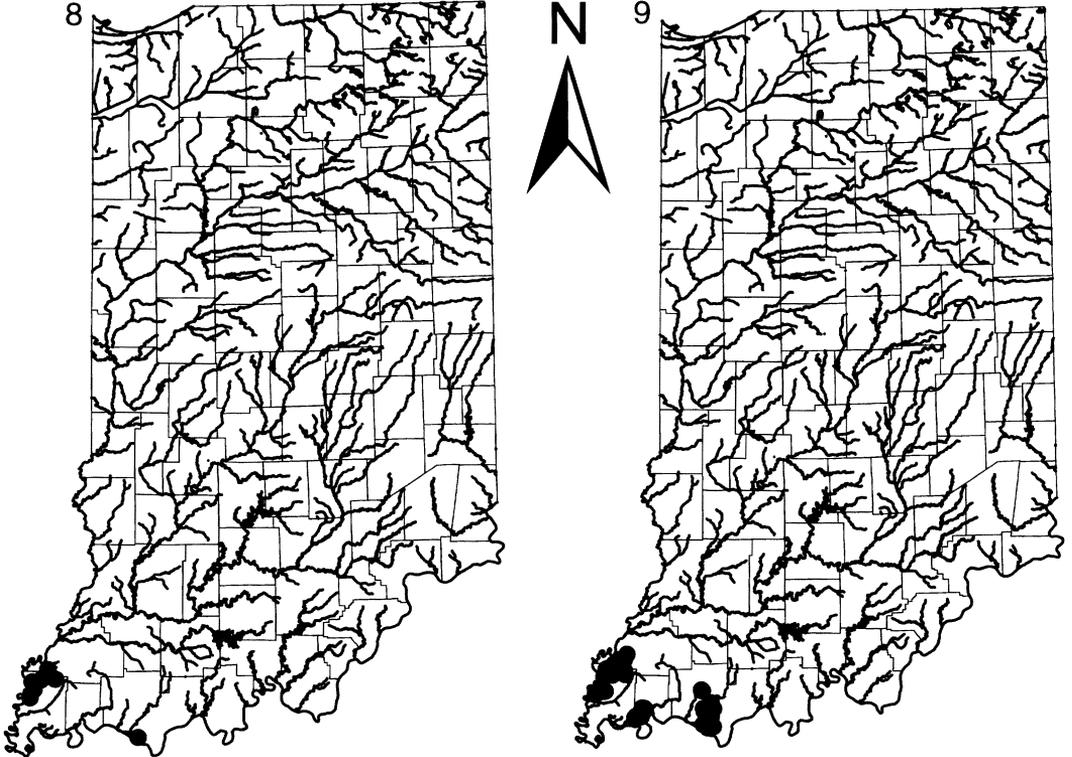
**Spottail Darter.**—The Spottail Darter has always been restricted to the extreme southwest portion of Indiana, recorded only from Posey, Vanderburgh, Warrick, Spencer, and Gibson counties (Figs. 8, 9). Jordan (1890) was the first to record it from Indiana, from the Black River and Gresham's Creek in Posey County. Gerking (1945) was unable to collect Spottail Darter during his collections, even though as he stated, 'southwestern Indiana where Jordan caught this species was intensively collected.' Gerking (1945) actually only sampled two locations on the lower Black River and one site in Rush Creek; he did not sample in the Bayou Creek

drainage or any of the smaller tributaries of the Little Pigeon Creek watershed, from where it is now known. There are records from the Black River drainage from the same time period (FMNH 43949; FMNH 43953; FMNH 43952), so they undoubtedly were still present when Gerking collected.

Spottail Darter is now known from more watersheds in Indiana than ever. Page (1974) was the first to record it from the Rush Creek drainage in Harmonie State Park, Posey County. It was found subsequently from another nearby stream, Road Brook (Grannan & Lodato 1986). Grannan & Lodato (1986) were also the first to record it from the Bayou Creek drainage, Vanderburgh County. Hottell (1980), although unwittingly, was the first to record it from the Little Pigeon Creek drainage. Hottell (1980) recorded *Etheostoma flabellare* (Fantail Darter) from Willow Pond Ditch, Spencer County. Luckily, these specimens were kept in a small collection used for identification purposes at the Avoca State Hatchery. They were later correctly identified as Spottail Darter (T. Simon, pers. commun.). Simon (unpubl. data) extended its range in this drainage to several other tributaries. Interestingly, Spottail Darter has never been recorded from the Big Creek or Pigeon Creek drainages in southwestern Indiana, which occur between the other concentrations (Fig. 9).

There are two specimens in the Smithsonian Fish Collection (USNM 40798 and USNM 1156) that are not specifically included in the historical records here. USNM 40798 is identified as being collected in 1888 by B.W. Evermann from the Wabash River, Posey County. Jordan (1890) does not indicate that Spottail Darter was collected from the mainstem Wabash River, but only from the Black River and Gresham's Creek in Posey County. There are no specimens from these two locations currently present in any museum collections. USNM 40798 was undoubtedly from one of these two locations and not the Wabash River. USNM 1156 has no date or waterbody information included with it, only that it was collected from New Harmony. It is likely from one of the small streams in the New Harmony area, although the exact location cannot be determined.

FMNH 43949 and 43953 are both Spottail Darter collected on the same date from the same location in the Black River drainage. FMNH



Figures 8, 9.—8. Historical (pre-1980) collection locations for Spottail Darter in Indiana; 9. Current (1980–2006) collection locations for Spottail Darter in Indiana.

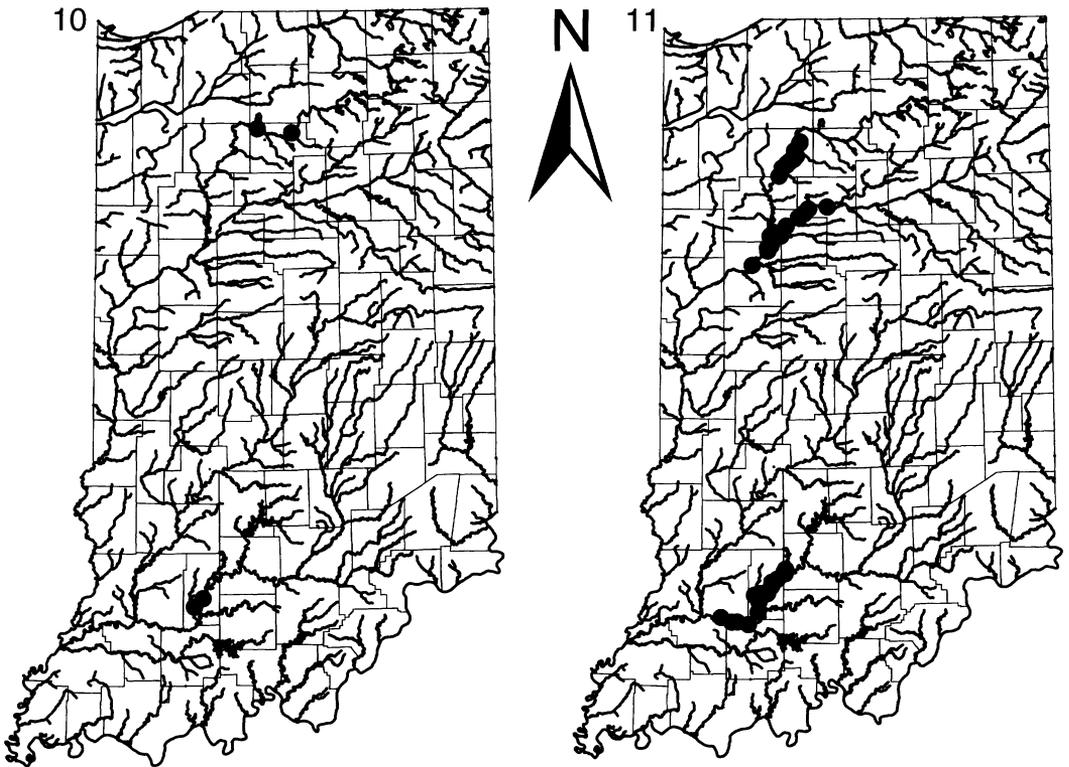
43949 was originally identified as Fantail Darter. This likely misidentification was brought to the attention of P. Willink (The Field Museum of Natural History) who, upon inspection, correctly identified it as Spottail Darter.

The Spottail Darter is strictly a small-stream species; it was not found during the current study in a stream with a drainage area of greater than 100 mi<sup>2</sup>. It is normally highly associated with slab-rock pools and riffles (Page 1974). This habitat is limited in many of the streams in which Spottail Darter is found in Indiana. Most are sandy or contoured, hardpan bottomed with a short supply of slab-rock. Rock of any kind is often limited to rip-rap found at bridge crossings. In areas of streams where rock was lacking, Spottail Darter was often found in small woody debris piles or even clumps of algae during this study. Many of the streams they currently inhabit have been highly altered by dredging or channelization, and the watersheds also have been impacted by oil wells and mining.

Spottail Darter is currently found in Indiana in the Black River drainage, some small direct Wabash River tributaries in Harmonie State Park, the Bayou Creek drainage, and several tributaries in the lower portion of the Little Pigeon Creek drainage (Fig. 9).

**Pre-1980 records (Fig. 8).**—BLACK RIVER DRAINAGE: *Gibson*: 1924: UMMZ 65040 (location only described as ‘creeks in Gibson County’, but most likely tributary of Black River), *Posey*: 1888: Jordan (1890); 1942: FMNH 43949, FMNH 43953, FMNH 43952; 1974: Page et al. (1976) - INHS 73680. GRESHAM’S CREEK (HARMONY CREEK): *Posey*: 1888: Jordan (1890). RUSH CREEK DRAINAGE: *Posey*: 1963: Page (1974) - INHS 75747; 1974: Page et al. (1976) - INHS 73681. LITTLE PIGEON CREEK DRAINAGE: *Spencer*: 1979: Hottell (1980) - uncatalogued specimens in fish collection at Avoca State Fish Hatchery.

**1980–2006 records (Fig. 9).**—BLACK RIVER DRAINAGE: *Gibson*: 2000: BEF00044;



Figures 10, 11.—10. Historical (pre-1980) collection locations for Tippecanoe Darter in Indiana; 11. Current (1980–2006) collection locations for Tippecanoe Darter in Indiana.

BEF00045; BEF00046, *Posey*: 1985: Grannan & Lodato (1986); 1991: Stefanavage (1993); 1993: INHS 30311; T. Simon, unpublished data; 1997: BEF97056; 1998: Bandoli (1998); 1999: BEF99040; 2000: BEF00048; BEF00049; BEF00051; J. Bandoli, unpublished data; 2004: IDEM 04832; 2006: BEF06133. WABASH RIVER (unnamed tributary): *Posey*: 1993: T. Simon, unpublished data; 2001: BEF01013. RUSH CREEK DRAINAGE: *Posey*: 1998: Bandoli (1998); 2001: BEF01010; 2004: IDEM 04812; 2006: BEF06132. ROAD BROOK: *Posey*: 1985: Grannan & Lodato (1986); 1998: Bandoli (1998). BAYOU CREEK DRAINAGE: *Vanderburgh*: 1985: Grannan & Lodato (1986); 1986: Cervone et al. (1989); 1987–89: Bandoli (1988); Bandoli (1989); Bandoli et al. (1992); 1990–91: Strange (1993); Bandoli (1999); 1991: SIUC 20248; SIUC 20249; 1998: BEF98012; BEF98013; BEF98014; Bandoli (1998); uncatalogued specimens from unknown date in Indiana University Southeast Collection. LITTLE PIGEON CREEK DRAINAGE: *Warrick* and *Spencer*: 1993: T. Simon,

unpublished data; 1997: BEF97119; 1999: BEF99033; BEF99035; BEF99036; BEF99037; BEF99108; BEF99110; BEF99113.

**Tippecanoe Darter.**—Historical records for Tippecanoe Darter from Indiana are limited, with only a few collections from the Tippecanoe River and East Fork White River (Fig. 10). Tippecanoe Darter was originally described from Indiana collections from the Tippecanoe River, at Marshland in Fulton County (Jordan & Evermann 1891). Interestingly, the picture used in the description actually represents a Bluebreast Darter (from UMMZ 187513 (IU 4688)) collected at the same time (Jordan & Evermann 1896; Collette & Knapp 1967). It is still found in these same rivers and maintains a much wider range now than was known historically (Fig. 11). This may only be a perceived range expansion, however, as its historical distribution may be under-represented because of the difficulty in collecting it. As described below, unless very specific sampling techniques are utilized, this diminutive species can be easily overlooked.

Prior to this study, Tippecanoe Darter had never been collected from the mainstem Wabash River. They likely have always inhabited this area; however, sampling designed specifically to collect them had never been attempted prior to this study. Traditional boat-shocking or seining would not encounter this species. In the most upstream locations on the Wabash River where Tippecanoe Darter was collected they were restricted to very small 'islands' of desired habitat, often surrounded by large expanses of undesirable bedrock. These refugia were often located on the upstream and downstream areas of actual islands, where gravel and cobble had accumulated.

During this study, Tippecanoe Darter was always associated with a mix of unconsolidated, loose gravel and cobble that was in moderate-to-fast current. Individuals would literally be buried in the substrate. The kick-shock method (as described in Fisher et al. 2001) was the only way to adequately sample for this species. Deep kicking was required; burying and kicking the foot into the substrate up to the ankle. Kicked up and shocked Tippecanoe Darter would then be easily captured in a small seine just downstream of the kicking area.

Tippecanoe Darter is currently found in Indiana in the Tippecanoe River upstream of Lake Shafer, the Tippecanoe River below Oakdale Dam, the mainstem Wabash River from just upstream of Wea Creek mouth to the Eel River mouth, and the East Fork White River downstream from Williams Dam to near its confluence with the West Fork White River (Fig. 11).

**Pre-1980 records (Fig. 10).**—TIPPECANOE RIVER: *Fulton*: 1888: Jordan (1890) and Jordan & Evermann (1891) - USNM 40080 (lectotype), USNM 197919 (paralectotype); 1891: USNM 125103; 1925: Gerking (1945) - UMMZ 66560. EAST FORK WHITE RIVER: *Martin*: 1936: Gerking (1945) - UMMZ 103361; 1942: Gerking (1945); 1946: UGAMNH 216.

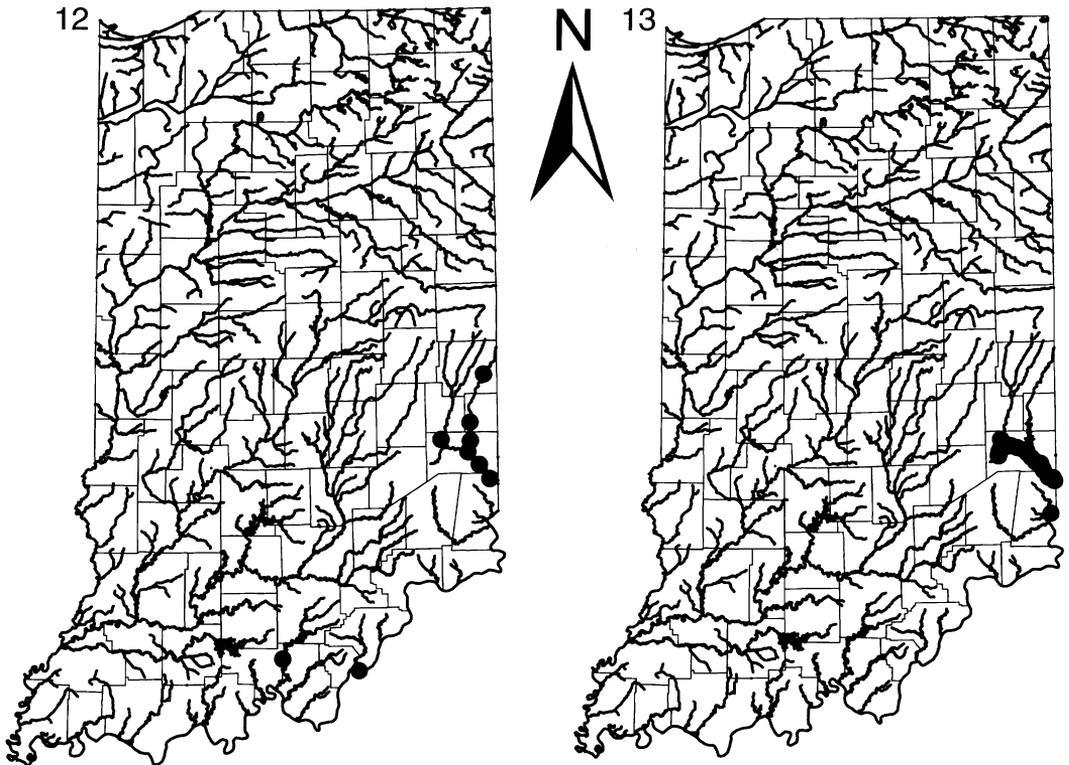
**1980–2006 records (Fig. 11).**—TIPPECANOE RIVER: *Pulaski*: 1985: Keevin et al. (1985) - INHS 68939, INHS 63837, INHS 68893; 1987: Carney et al. (1993) - INHS 63322; 1992: Ecological Specialists, Inc. (1993); 1999: BEF99079; BEF99080; BEF99081; BEF99082; BEF99083; BEF99085; 2000: BEF00178; BEF00179; BEF00185; BEF00186; BEF00187; BEF00188; 2006: BEF06170, *Carroll*: 1985:

Keevin et al. (1985) - INHS 68830; 1991–92: Ecological Specialists, Inc. (1993) - INBS 1207, INBS 1248; 1994–95: Simon (1995); McWilliams-Munson & Simon (2001); 1996: BEF96041; 1998: BEF98158; IDEM 98303; 1999: BEF99124; BEF99127; 2000: BEF00064; 2003: BEF03017; IDEM 03T303; 2004: BEF04032; 2006: BEF06108, *Tippecanoe*: 1999: BEF99125; 2005: BEF05252. WABASH RIVER: *Cass*: 1999: BEF99099; BEF99100, *Carroll*: 1999: BEF99097; BEF99098; BEF99128; 2000: BEF00033, *Tippecanoe*: 1999: BEF99126; 2000: BEF00032; BEF00133. EAST FORK WHITE RIVER: *Lawrence*: 1999: BEF99147; BEF99178, *Martin*: 1997: BEF97141; BEF97167; BEF97168; BEF97169; 1998: BEF98125; 1999: BEF99145; BEF99146; 2001: BEF01006; 2002: BEF02141; BEF02291; BEF02293; BEF02311; 2003: BEF03004; 2006: BEF06105; BEF06126, *Dubois* and *Martin*: 1999: BEF99131, *Daviess* and *Dubois*: 1999: BEF99129; BEF99130, *Daviess* and *Pike*: 1999: BEF99144.

**Variegate Darter.**—Variegate Darter has been recorded in Indiana only from the mainstem Ohio River, and two other direct Ohio River tributaries; the Whitewater River in southeastern and the Blue River in southcentral Indiana (Figs. 12, 13). It may have at one time inhabited other direct Ohio River tributaries in southeastern Indiana, although no records exist. Its range may have been similar to that of *Cryptobranchus alleganiensis alleganiensis* (Hellbender) (Minton 2001), which has some similarities in habitat preference.

Baker & Forsyth (1986) cite collections from Fourteen Mile Creek, Clark County, although these vouchered specimens were examined in the Indiana University Southeast collection and are actually *Etheostoma caeruleum* (Rainbow Darter). Whitaker & Gammon (1988) cite Twin Creek, Washington County, in the upper East Fork White River drainage as a location for Variegate Darter. This would represent the only known collection of Variegate Darter from the entire Wabash River drainage. There is no way to verify this record, as specimens do not exist; however, it is unlikely that this collection is valid.

A substantial amount of sampling was conducted on the Blue River during the course of this survey (Fig. 1), as well as by Summers (1999, 2001, 2003 & 2007), Carnahan (2001), and IDEM; and Variegate Darter was not collected. Gerking (1945) likely represents the



Figures 12, 13.—12. Historical (pre-1980) collection locations for Variegate Darter in Indiana; 13. Current (1980-2006) collection locations for Variegate Darter in Indiana.

last collection of Variegate Darter from this drainage. There have been several more recent records for Variegate Darter from the Blue River, Crawford and Harrison counties, (Baker & Forsyth 1986; Huff et al. 1998; Baker & Forsyth 2001); however, these have never been verified by voucher specimens or photographs. Until a collection can be verified for this species from the Blue River, it should not be considered among its current inhabitants. Its loss from the Blue River is somewhat difficult to explain, considering both the Bluebreast Darter and Spotted Darter maintain stable populations. It is also interesting that Gerking (1945) collected Variegate Darter, but not Spotted Darter, as previously discussed.

There is only one recent record for Variegate Darter from the mainstem Ohio River; Pearson & Krumholz (1984) cite a record from Geomarine (1982). This record is also not substantiated with a voucher specimen and may not be accurate, but its vicinity to the Great Miami River, into which the Whitewater River flows, makes the record believable. Impoundment of

the Ohio River has likely caused it to become a much less desirable habitat for Variegate Darter. It is unlikely that a reproducing population of Variegate Darter is currently inhabiting the mainstem Ohio River; however, it is possible that occasionally a few individuals enter it from the Great Miami River watershed.

Variegate Darter likely only remains in the Whitewater River drainage in Indiana. Prior to this study, few records existed for this watershed since Gerking (1945). Baker & Forsyth (1986) and Seegert (1990) both recorded a single location (actually the same location) for Variegate Darter, even though in Seegert's case, many sites were sampled in the watershed. Seegert (1990) only utilized seining during his collections and may have under-represented its actual abundance and distribution. In 1997, both the Indiana Department of Environmental Management (IDEM 97079) and Keller (1998) collected Variegate Darter from Salt Creek, a tributary of the West Fork Whitewater River in Franklin County. During the current study, Variegate Darter was collected from

every riffle sampled on the Whitewater River and West Fork Whitewater River from the Ohio-Indiana state-line upstream to the dam that forms the Whitewater Canal, just downstream of Laurel. Sites on the East Fork Whitewater River where Gerking (1945) collected it are now impounded by Brookville Reservoir; Variegated Darter is no longer found in this Fork. Also, it is not currently inhabiting the short, lowest section of the East Fork Whitewater River downstream of Brookville Reservoir, likely because of the coldwater discharge from the reservoir.

During the course of this study, Variegated Darter was almost exclusively associated with cobble to boulder sized slab-rock in fast current. The only exception was during low water periods in Salt Creek, when riffles slowed. Several of the other tributaries of the Whitewater and West Fork Whitewater Rivers in Franklin County were also sampled (Fig. 1), but Variegated Darter was not collected. Many of these streams either become de-watered during the driest times of the year, or convert to a series of isolated pools, with little riffle habitat.

Variegated Darter is currently restricted in Indiana to Salt Creek, the Whitewater River, and the West Fork Whitewater River upstream to the dam that forms the Whitewater canal, with the possibility that some individuals can occasionally be found in the Ohio River (Fig. 13).

**Pre-1980 records (Fig. 12).**—OHIO RIVER: *Clark* (IN) and *Jefferson* (KY): pre-1892: Woolman (1892). WHITEWATER DRAINAGE: *Wayne*: pre-1851: Plummer (1851). WHITEWATER RIVER: *Franklin*: 1885: Jordan (1886) - UMMZ 245309 (IU 4813), SU 1020; 1941: OSM 28185 (collected by Gerking, but not listed in Gerking (1945)), *Dearborn*: 1941: Gerking (1945) - OSM 28154. WEST FORK WHITEWATER RIVER: *Franklin*: 1941: Gerking (1945), OSM 28240. EAST FORK WHITEWATER RIVER: *Union*: 1941: Gerking (1945) - OSM 28295, *Franklin*: 1941: Gerking (1945) - OSM 28257, KU 33811. BLUE RIVER: *Crawford* and *Harrison*: 1942: Gerking (1945) - OSM 28710.

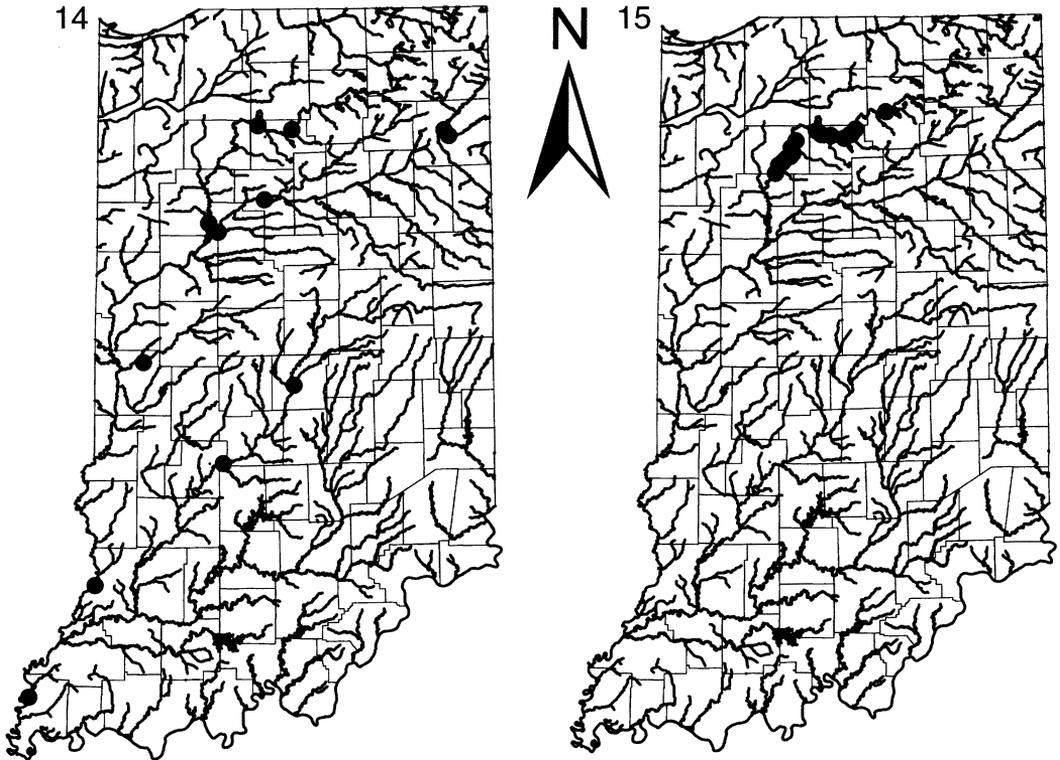
**1980–2006 records (Fig. 13).**—OHIO RIVER: *Dearborn*: 1981: Geo-Marine (1982) in Pearson & Krumholz (1984). WHITEWATER RIVER: *Dearborn*: 1999: BEF99050; BEF99051; BEF99052; 2002: BEF02002, *Franklin*:

1986: Baker & Forsyth (1986) - uncatalogued specimens in Indiana University Southeast Collection; 1989: Seegert (1990); 1999: BEF99053; BEF99101; BEF99102; BEF99103; BEF99104; BEF99105; 2000: BEF00001; 2002: D. Keller (pers. comm.); 2003: BEF03129; 2005: BEF05023. WEST FORK WHITEWATER RIVER: *Franklin*: 1998: BEF98073; BEF98075; BEF98106; 2000: BEF00110; BEF00111; BEF00113; BEF00114; BEF00118; BEF00119; 2005: Long (2007). SALT CREEK: *Franklin*: 1997: IDEM 97079; Keller (1998) - uncatalogued specimen in fish collection at Avoca State Fish Hatchery; 1998: BEF98065; BEF98066; BEF98071; BEF98072; BEF98077; 2000: BEF00121; 2003: BEF03130.

**Gilt Darter.**—Of all the species surveyed during this study, the Gilt Darter has likely lost the most of its historical range in Indiana, and along with Variegated Darter, maintains one of the most restricted distributions in the state (Figs. 14, 15). It once inhabited many of the larger tributaries of the upper Wabash River drainage (Jordan 1890; Evermann & Jenkins 1892; INHS 58697) and the mainstem Wabash (Jordan 1890; Evermann & Jenkins 1892) and West Fork White (Jordan 1877a, 1877b; Eigenmann & Beeson 1894) rivers (Fig. 14). It is also the only species in this study that historically inhabited the Great Lakes drainage, recorded from the Maumee and St. Joseph rivers (Kirsch 1895b).

Gerking (1945) did not collect Gilt Darter and speculated that its abundance may have 'greatly decreased in recent years.' Of all the historical locations that Gilt Darter was once known in Indiana, only one relatively recent record, from the West Fork White River (Margulies et al. 1980), exists from anywhere other than the Tippecanoe River. Most of these historical locations, including the West Fork White River, were sampled during the current study (Fig. 1) and Gilt Darter was not collected.

There are records from a few references and museums that are not included in the historical records for Gilt Darter that follow. Evermann & Jenkins (1892) list in the table for their report a collection of '*Etheostoma evides*' from Deer Creek, but there is no mention of it under the species description, where other locations are discussed. This is likely an error as no specimens are known from any museums from this location. Jordan (1877b) includes '*Alvor-*



Figures 14, 15.—14. Historical (pre-1980) collection locations for Gilt Darter in Indiana; 15. Current (1980-2006) collection locations for Gilt Darter in Indiana.

*dius evides*' as being collected from some tributaries of the St. Joseph River (Lake Michigan drainage). This was also undoubtedly an error. A record for Gilt Darter from the Wabash River exists in the Academy of Natural Sciences collection (ANSP 109793), but no other date, collector, or location information accompanies the specimen.

UMMZ 213126 (IU 4536) from the Wabash River at New Harmony was identified as a Gilt Darter in the original ledger for Indiana University material (D. Catania pers. commun.). It was later re-identified as *Percina shumardi* (River Darter) by Reeve Bailey when the Indiana University material donated to the University of Michigan Museum of Zoology by the California Academy of Science (1952 accession) was catalogued into the collection (D. Nelson pers. commun.).

McWilliams-Munson & Simon (2001) include two records for Gilt Darter from the very upper portion of the Tippecanoe River watershed. These are likely erroneous and were not included in the following list of current

records. Simon & Dufour (1997) include Gilt Darter in their list of fishes collected from the Eastern Corn Belt Plain (presumably from the Tippecanoe River); however, specific location information is not included.

During the course of this study, Gilt Darter was normally collected in the fastest, deepest portion of a riffle over a gravel/cobble mix that was unconsolidated. Gilt Darter was not highly associated with larger, boulder-sized rocks, although larger rocks were normally present on the riffle in which they were collected. Gilt Darter was often found in association with Tippecanoe Darter and Bluebreast Darter, although the Gilt Darter's range extended further upstream on the Tippecanoe River than either of these species (Figs. 3, 10, 15).

Currently, a single population of Gilt Darter remains in Indiana, in the portion of the Tippecanoe River upstream of Lake Shafer (Fig. 15). This population will remain completely isolated, with no chance of expanding its range further downstream because of Lake Shafer and Norway Dam (and then further

downstream by Lake Freeman and Oakdale Dam).

**Pre-1980 records (Fig. 14).**—EEL RIVER: *Cass*: 1888: Jordan (1890) - USNM 40745. TIPPECANOE RIVER: *Fulton*: 1888: Jordan (1890) - UMMZ 61577 (IU 5459), UMMZ 213115 (IU 5459), USNM 66824, USNM 40852; 1890: USNM 125358, USNM 66825; 1891: USNM 44433, UMMZ 167077; 1899: USNM 69099, USNM 69210; no date is provided for the following museum records, but all are from the same location as the preceding records: SU 3864, MCZ 4998, MCZ 149953, CU 72084; 1925: Gerking (1945) - UMMZ 66561, OSM 9270, *White, Carroll*, and *Tippecanoe*: 1886–87: Evermann & Jenkins (1892) - USNM 39611. SUGAR CREEK: *Parke*: 1931: Whitaker & Gammon (1988) - INHS 58697. WABASH RIVER: *Carroll*: 1887: Evermann & Jenkins (1892), *Knox*: 1888: Jordan (1890) - USNM 40750, USNM 66828; 1890: USNM 66826; no date is provided with the following museum records, but they are from the same location as the preceding record - SU 3322, UMMZ 187258 (IU 4981), *Posey*: 1888: Jordan (1890) - USNM 40903. WEST FORK WHITE RIVER: *Marion*: 1874–77: Jordan (1877a and 1877b) - MCZ 24399, MCZ 35957, USNM 17872, USNM 20119; 1879: MCZ 4994; no date is provided for the following museum record but it is from the same location as the preceding record - SU 2298, *Morgan*: 1977: Margulies et al. (1980) - UT 91.1770, *Owen* and *Monroe*: 1893: Eigenmann & Beeson (1894) - no date is provided for the following museum records, but all are from the same location as Eigenmann & Beeson (1894) - SU 1435, SU 3799, UMMZ 61565 (IU 5340), USNM 36496. ST. JOSEPH RIVER: *Allen*: 1893: Kirsch (1895b). MAUMEE RIVER: *Allen*: 1893: Kirsch (1895b) - UMMZ 63038 (IU 8999).

**1980–2006 records (Fig. 15).**—TIPPECANOE RIVER: *Kosciusko*: 1985: Keevin et al. (1985) - INHS 68760, *Fulton*: 1985: Keevin et al. (1985) - INHS 68850, INHS 68779, INHS 68740, INHS 68876, INHS 69000; 1987: Carney et al. (1993) - INHS 63569, INHS 63433, INHS 63547; 1988: UAIC 8435.17; 1991: UAIC 10308.20; 1992: UAIC 10314.14; Ecological Specialists, Inc. (1993) - INBS 1232; 1998: BEF98164; IDEM 98020; 1999: BEF99076; BEF99077; 2000: BEF00175; BEF00176; BEF00177; 2001: BEF01021;

BEF01403; BEF01404; 2002: BEF02070; BEF02072; BEF02103; BEF02105, *Pulaski*: 1985: Keevin et al. (1985) - INHS 69036; 1987: Carney et al. (1993) - INHS 63323; 1999: BEF99079; BEF99080; BEF99081; BEF99082; BEF99083; 2000: BEF00185; BEF00186; BEF00187; BEF00188; 2006: BEF06170.

## DISCUSSION

Although it may already be evident from the previous discussion, the importance of targeting and adequately sampling the specific habitat for each species of interest cannot be overstated. At locations where several of the darter species targeted during this study coexisted, it was very important to make sure that the exact, specific habitat of each of the species was sampled adequately in order to determine if they were present. For example, at many sample locations on the East Fork White River, it was possible to collect Bluebreast Darter, Harlequin Darter, Spotted Darter, and Tippecanoe Darter all from the same riffle. Bluebreast Darter was almost always associated with the largest rocks in the fastest current. Tippecanoe Darter would be found buried in unconsolidated gravel/cobble mix in moderate-to-fast current. Spotted Darter was somewhat more general in its distribution on the riffle, associated with a variety of rock sizes and current speeds. Harlequin Darter was most often associated with woody debris that was in fast current. Without sampling each of these specific microhabitats on each riffle, species would be missed.

It may seem that the distribution for several of the species surveyed during this study (Harlequin Darter, Spotted Darter, Spottail Darter, Tippecanoe Darter) has actually increased over time, as these species are now known from more watersheds and river miles than ever. However, it is very hard to distinguish between actual range expansions or whether increased effort and more species-specific sampling techniques have simply discovered species where they have always been. For most, they have likely always inhabited many of the areas where they were found during this study, but were overlooked during past sampling due to inadequate sampling techniques and effort.

Many of the darter species of this study maintain populations that are isolated from

each other. For example, populations of Bluebreast Darter from the Blue River, the East Fork White River, and the upper Wabash River drainage will never interbreed, simply as a result of natural habitat barriers. Desirable habitat can be highly separated in these large rivers. Boulder/cobble riffles become less and less common as one goes downstream on the East Fork White River towards its confluence with the West Fork. The river widens, and large expanses of sand become more common. Species such as the Bluebreast Darter, Spotted Darter, Tippecanoe Darter will never inhabit the lower mainstem White River because the habitat they require is not present. Similar habitat restrictions likely preclude Bluebreast Darter and Tippecanoe Darter from moving further downstream on the mainstem Wabash River. It is also highly unlikely that Spottail Darter will expand its range on its own, due to its isolation in smaller streams.

Besides natural barriers, dams are also currently impacting the range expansion and maintaining the isolation of populations of several of the darter species sampled during this study. Williams Dam, Lawrence County, provides a barrier to further upstream movement of Bluebreast Darter, Spotted Darter, and Tippecanoe Darter in the East Fork White River drainage. Norway and Oakdale dams on the Tippecanoe River, in White and Carroll counties, continue to separate Bluebreast Darter and Tippecanoe Darter populations from the lower and upper Tippecanoe River. They also restrict any further downstream expansion by Gilt Darter. The dam on the West Fork Whitewater River, Franklin County, used to form the Whitewater Canal is eliminating further upstream expansion of Variegated Darter. The dam forming the Brookville Reservoir and subsequent cold water discharge is restricting Variegated Darter use of and upstream movement into the East Fork Whitewater River. The dam at Milltown on the Blue River, Crawford and Harrison counties, could be restricting further upstream movement of the Bluebreast Darter, if it is no longer found upstream of the dam. Impoundment of the Ohio River also restricts species such as the Bluebreast Darter and Spotted Darter (from the Blue River) and the Variegated Darter (from the Whitewater River) from inhabiting it, as well as using it as a conduit for migrating to other direct Ohio River tributaries.

The results of this study do provide some insight into those drainages/ivers that may have been the most or least impacted over the years, by revealing which ones have lost or retained the greatest number of the darter species sampled. Several upper Wabash River tributaries (Eel River, Deer Creek, Sugar Creek) and the upper mainstem West Fork White River once contained Bluebreast Darter and Gilt Darter or Spotted Darter, but now have none of these species. The lower mainstem Wabash River still has Harlequin Darter inhabiting its waters, but has lost Gilt Darter, as well as other rare/extirpated species not found during this study such as Crystal Darter (*Crystallaria asprella*), Channel Darter (*Percina copelandi*), Saddleback Darter (*P. vigil*), and Stargazing Darter (*P. uranidea*). The East Fork White River and Tippecanoe River have for the most part maintained the species that were known historically (Spotted Darter is questionably hanging on in the Tippecanoe River). The distribution of the species in these drainages has, however, diminished as the result of the dams they contain.

As a result of surveys completed during this study, the following changes were recommended by the Fish Technical Advisory Committee of the Indiana DNR in 2002, and adopted as administrative rule changes (to 312 IAC 9-6-9) in 2004. The Bluebreast Darter, Harlequin Darter, Spotted Darter, Spottail Darter, and Tippecanoe Darter were removed from Indiana's list of endangered fish species. Spotted Darter and Tippecanoe Darter were downlisted to Special Concern status, while Bluebreast Darter, Harlequin Darter, and Spottail Darter were removed from all lists. Variegated Darter and Gilt Darter were retained as endangered species. One additional darter species, Channel Darter, was added to the endangered list. It was not collected during the sampling completed for this study, and is likely restricted to the mainstem Ohio River in Indiana.

#### ACKNOWLEDGMENTS

The following individuals and institutions provided invaluable information on the holdings of Indiana specimens in their collections: David Etnier, The University of Tennessee (UT); Lee Hartle, Georgia Museum of Natural History (UGAMNH); Hank Bart, Tulane University Museum of Natural History (TU); Jeff Stewart and Brooks Burr, Southern Illinois University at Carbondale (SIUC); Phil Willink,

Field Museum of Natural History (FMNH); John Friel, Cornell University (CU); Doug Nelson, University of Michigan Museum of Zoology (UMMZ) - includes collection from Indiana University (IU); Bernie Kuhajda, University of Alabama (UAIC); Karsten Hartel, Museum of Comparative Zoology, Harvard University (MCZ); Dave Catania, California Academy of Sciences (CAS) - includes collection from Stanford University (SU); Jeff Williams, Kris Murphy, and Erika Wilbur, Smithsonian - National Museum of Natural History (USNM); Mike Retzer and Chris Mayer, Illinois Natural History Survey (INHS); Marc Kibbey and Ted Cavender, Museum of Biological Diversity, The Ohio State University (OSM); Gail Emmert and Claude Baker, Indiana University Southeast; Andy Bentley, Natural History Museum &

Biodiversity Research Center, University of Kansas (KU); Mark Sabaj Pérez, The Academy of Natural Sciences, Philadelphia (ANSP); Indiana Biological Survey (INBS).

Funding for completion of this study by the Wildlife Diversity Section, Division of Fish and Wildlife, Indiana Department of Natural Resources, was provided through the Indiana Nongame Fund. This study could not have been completed without the assistance of the following naturalist aides: Jana K. Smith, Kathy M. Eddy, Kevin L. Rowe, Amelia R. Barnett, Kara L. Bieker, Ted V. Briggs, Melissa R. Jones, and Sarah A. Bales. Invaluable sampling assistance along the lower Wabash River was provided by Les Frankland. Many thanks are also expressed to Larry M. Page and Brooks M. Burr for their review of this manuscript and suggestions for improvements.

## APPENDIX I

Detailed location information for sampling sites where endangered darter species were collected during the completion of this study. (SR = state road, br = bridge, CR = county road, d/s = downstream, u/s = upstream, rd = road, mi = mile, FWA = Fish & Wildlife Area). All original collections made during the course of this study are indicated by the prefix 'BEF.'

Site #	Date	County	Waterbody	Location
BEF96012	07/08/1996	Crawford/Harr.	Blue River	Horseshoe Bend
BEF96041	10/24/1996	Carroll	Tippecanoe River	SR 18 br
BEF96147	09/04/1996	Johnson	Big Blue River	SR 252 br
BEF97047	07/12/1997	Crawford/Harr.	Blue River	Horseshoe Bend
BEF97056	08/12/1997	Posey	Unnamed trib. Black River	along CR 600E
BEF97057	08/14/1997	Crawford/Harr.	Blue River	d/s Milltown Dam
BEF97059	08/18/1997	Harrison	Blue River	Stagestop Access
BEF97119	09/09/1997	Spencer	Baker Creek	SR 66 br
BEF97141	10/06/1997	Martin	East Fork White River	along Williams rd
BEF97165	11/18/1997	Johnson	Sugar Creek	Hospital rd br
BEF97167	11/19/1997	Martin	East Fork White River	d/s Hindostan Falls
BEF97168	11/19/1997	Martin	East Fork White River	US 150 br
BEF97169	11/19/1997	Martin	East Fork White River	Shoals Public Access
BEF97170	12/09/1997	Lawrence	East Fork White River	Chase Riffle
BEF97191	08/07/1997	Daviess/Knox	West Fork White River	Veale Creek mouth
BEF98012	03/24/1998	Vanderburgh	Unnamed trib. Bayou Creek	old SR 62 br
BEF98013	03/24/1998	Vanderburgh	Unnamed trib. Bayou Creek	Nurrenbern rd br
BEF98014	03/24/1998	Vanderburgh	Unnamed trib. Sanders Creek	old Mt Vernon rd br
BEF98020	04/07/1998	Warren	Big Pine Creek	Moore Hill rd br
BEF98023	04/07/1998	Warren	Mud Pine Creek	CR 650N br
BEF98065	07/10/1998	Franklin	Salt Creek	Bull Fork rd br
BEF98066	07/10/1998	Franklin	Salt Creek	SR 229 br
BEF98071	07/14/1998	Franklin	Salt Creek	Dodson Branch mouth
BEF98072	07/14/1998	Franklin	Salt Creek	Whistle Creek mouth
BEF98073	07/14/1998	Franklin	West Fork Whitewater River	Salt Creek mouth
BEF98075	07/14/1998	Franklin	West Fork Whitewater River	end of Silver Creek rd
BEF98077	07/14/1998	Franklin	Salt Creek	Marlin Branch mouth

## APPENDIX I—Continued.

Site #	Date	County	Waterbody	Location
BEF98078	07/16/1998	Warren	Big Pine Creek	SR 55 br
BEF98080	07/16/1998	Benton	Mud Pine Creek	CR 125W br
BEF98081	07/16/1998	Benton	Mud Pine Creek	CR 850S br
BEF98082	07/16/1998	Warren	Mud Pine Creek	CR 850N br
BEF98083	07/16/1998	Warren	Big Pine Creek	CR 00 br
BEF98084	07/16/1998	Warren	Big Pine Creek	CR 450N br
BEF98106	08/07/1998	Franklin	West Fork Whitewater River	along Levee rd
BEF98112	08/17/1998	Johnson	Sugar Creek	Greensburg rd br
BEF98113	08/17/1998	Shelby	Sugar Creek	SR 44 br
BEF98116	08/18/1998	Jackson	East Fork White River	0.75 mi d/s SR 235 br
BEF98117	08/18/1998	Jackson	East Fork White River	3.0 mi u/s SR 235 br
BEF98119	08/21/1998	Jackson	East Fork White River	1.5 mi d/s US 50 br
BEF98120	08/21/1998	Jackson	East Fork White River	1.5 mi u/s US 50 br
BEF98121	08/21/1998	Jackson	White Creek	u/s mouth
BEF98122	08/24/1998	Bartholomew	Driftwood River	CR 625N br
BEF98123	08/24/1998	Bartholomew	East Fork White River	CR 800S br
BEF98125	08/27/1998	Martin	East Fork White River	0.5 mi u/s Beech Creek
BEF98127	09/01/1998	Johnson	Sugar Creek	Hospital rd br
BEF98128	09/01/1998	Bartholomew	Driftwood River	d/s county line
BEF98147	09/30/1998	Crawford/Harr.	Blue River	d/s Milltown Dam
BEF98148	10/01/1998	Fountain/Warren	Wabash River	Opossum Hollow mouth
BEF98150	10/02/1998	Fountain/Warren	Wabash River	Dry Branch mouth
BEF98154	10/05/1998	Johnson	Sugar Creek	old dam Atterbury FWA
BEF98157	10/06/1998	Daviess/Pike	East Fork White River	SR 57 br
BEF98158	10/21/1998	Carroll	Tippecanoe River	CR 150N br
BEF98162	10/28/1998	Bartholomew	Driftwood River	US 65 br
BEF98164	10/30/1998	Fulton	Tippecanoe River	old US 31 br
BEF98166	11/30/1998	Lawrence/Wash.	East Fork White River	White River rd br
BEF98167	11/30/1998	Lawrence	East Fork White River	CR L4S1 br
BEF99033	06/16/1999	Spencer	Willow Pond Ditch	CR 800W br
BEF99035	06/16/1999	Spencer	Baker Creek	CR 800W br
BEF99036	06/16/1999	Spencer	Hooppole Ditch	CR 850W br
BEF99037	06/16/1999	Spencer	Lake Drain	SR 116 br
BEF99040	06/17/1999	Posey	Unnamed trib. Black River	CR 210E br
BEF99042	06/21/1999	Bartholomew	East Fork White River	CR 400S br
BEF99047	06/23/1999	Benton	Mud Pine Creek	CR 100W br
BEF99050	06/24/1999	Dearborn	Whitewater River	along Pinhook rd
BEF99051	06/24/1999	Dearborn	Whitewater River	Pinhook Creek mouth
BEF99052	06/24/1999	Dearborn	Whitewater River	SR 46 br
BEF99053	06/24/1999	Franklin	Whitewater River	St Peters rd br
BEF99076	07/19/1999	Fulton	Tippecanoe River	CR 375W br
BEF99077	07/20/1999	Fulton	Tippecanoe River	CR 900W br
BEF99079	07/20/1999	Pulaski	Tippecanoe River	CR 250N br
BEF99080	07/20/1999	Pulaski	Tippecanoe River	Winamac City Park
BEF99081	07/20/1999	Pulaski	Tippecanoe River	US 35 br
BEF99082	07/20/1999	Pulaski	Tippecanoe River	along CR 350S
BEF99083	07/21/1999	Pulaski	Tippecanoe River	CR 575S br
BEF99084	07/21/1999	Pulaski	Tippecanoe River	CR 825S br
BEF99085	07/21/1999	Pulaski	Tippecanoe River	u/s county line
BEF99088	08/02/1999	Bartholomew	Flatrock River	d/s dam Noblitt Park
BEF99089	08/03/1999	Jackson	East Fork White River	d/s dam d/s CR 725N br
BEF99090	08/03/1999	Jackson	East Fork White River	SR 258 br
BEF99092	08/04/1999	Lawrence	East Fork White River	railroad br u/s SR 37
BEF99097	08/11/1999	Carroll	Wabash River	French Post Park
BEF99098	08/12/1999	Carroll	Wabash River	along Towpath rd
BEF99099	08/12/1999	Cass	Wabash River	CR 675W br

## APPENDIX I—Continued.

Site #	Date	County	Waterbody	Location
BEF99100	08/12/1999	Cass	Wabash River	Eel River mouth
BEF99101	08/13/1999	Franklin	Whitewater River	along US 52
BEF99102	08/13/1999	Franklin	Whitewater River	SR 1 br
BEF99103	08/13/1999	Franklin	Whitewater River	old SR 1 br
BEF99104	08/13/1999	Franklin	Whitewater River	Little Cedar Cr mouth
BEF99105	08/13/1999	Franklin	Whitewater River	Stavetown rd br
BEF99108	08/17/1999	Warrick	Caney Creek	CR 300S br
BEF99110	08/17/1999	Warrick	Otter Creek	SR 161 br
BEF99113	08/17/1999	Warrick	Otter Creek	CR 00 br
BEF99117	08/18/1999	Crawford/Harr.	Blue River	along SR 62
BEF99118	08/18/1999	Harrison	Blue River	Rothrocks Mill
BEF99119	08/18/1999	Crawford/Harr.	Blue River	d/s Milltown Dam
BEF99120	08/18/1999	Crawford/Harr.	Blue River	Horseshoe Bend
BEF99121	08/18/1999	Washington	Blue River	along Hunter Spring rd
BEF99122	08/18/1999	Washington	Blue River	Mt Carmel rd br
BEF99123	08/19/1999	Carroll	Tippecanoe River	CR 725N br
BEF99124	08/19/1999	Carroll	Tippecanoe River	Horseshoe Bend
BEF99125	08/19/1999	Tippecanoe	Tippecanoe River	d/s Moots Creek mouth
BEF99126	08/19/1999	Tippecanoe	Wabash River	Sugar Creek mouth
BEF99127	08/27/1999	Carroll	Tippecanoe River	SR 18 br
BEF99128	08/27/1999	Carroll	Wabash River	SR 18 br
BEF99129	08/30/1999	Daviess/Dubois	East Fork White River	Sugar Creek mouth
BEF99130	08/30/1999	Daviess/Dubois	East Fork White River	Glendale Public Access
BEF99131	08/30/1999	Dubois/Martin	East Fork White River	US 231 br
BEF99134	08/31/1999	Gibson	Patoka River	CR 875W br
BEF99144	09/09/1999	Daviess/Pike	East Fork White River	SR 257 br
BEF99145	09/10/1999	Martin	East Fork White River	d/s Hindostan Falls
BEF99146	09/10/1999	Martin	East Fork White River	SR 550 br
BEF99147	09/10/1999	Lawrence	East Fork White River	Chase Riffle
BEF99170	10/06/1999	Warren	Big Pine Creek	CR 300N br
BEF99177	11/16/1999	Lawrence	East Fork White River	d/s Williams Dam
BEF99178	11/16/1999	Lawrence	East Fork White River	Williams rd br
BEF00001	01/11/2000	Franklin	Whitewater River	SR 1 br
BEF00032	05/10/2000	Tippecanoe	Wabash River	Mascouten Park
BEF00033	05/10/2000	Carroll	Wabash River	Carrollton rd br
BEF00044	06/14/2000	Gibson	Higginbotham Ditch	CR 1000W br
BEF00045	06/14/2000	Gibson	Barren Creek	CR 700S br
BEF00046	06/14/2000	Gibson	Higginbotham Ditch	CR 700S br
BEF00048	06/14/2000	Gibson/Posey	Higginbotham Ditch	CR 1300S br
BEF00049	06/14/2000	Posey	Unnamed trib. Black River	CR 1000N br
BEF00050	06/14/2000	Posey	Black River	CR 210E br
BEF00051	06/14/2000	Posey	Black River	CR 1100N br
BEF00064	06/30/2000	Carroll	Tippecanoe River	SR 18 br
BEF00087	07/19/2000	Bartholomew	Flatrock River	CR 400N br
BEF00110	08/16/2000	Franklin	West Fork Whitewater River	St Marys rd br
BEF00111	08/16/2000	Franklin	West Fork Whitewater River	along St Marys rd
BEF00113	08/16/2000	Franklin	West Fork Whitewater River	along Std Materials rd
BEF00114	08/16/2000	Franklin	West Fork Whitewater River	along SR 121
BEF00118	08/17/2000	Franklin	West Fork Whitewater River	end of Dam rd
BEF00119	08/17/2000	Franklin	West Fork Whitewater River	Whitewater Canal dam
BEF00121	08/17/2000	Franklin	Salt Creek	Bull Fork rd br
BEF00133	08/23/2000	Tippecanoe	Wabash River	Mascouten Park
BEF00136	08/24/2000	Shelby	Flatrock River	CR 900N br
BEF00157	09/20/2000	Shelby	Big Blue River	US 65 br
BEF00158	09/20/2000	Shelby	Big Blue River	CR 550S br
BEF00161	10/02/2000	Crawford/Harr.	Blue River	Babcocks Mill

## APPENDIX I—Continued.

Site #	Date	County	Waterbody	Location
BEF00162	10/02/2000	Crawford/Harr.	Blue River	Totten Ford rd br
BEF00175	10/11/2000	Fulton	Tippecanoe River	CR 525E br
BEF00176	10/11/2000	Fulton	Tippecanoe River	CR 350E br
BEF00177	10/11/2000	Fulton	Tippecanoe River	CR 750W br
BEF00178	10/12/2000	Pulaski	Tippecanoe River	along CR 350S
BEF00179	10/12/2000	Pulaski	Tippecanoe River	Mud Creek mouth
BEF00185	10/23/2000	Pulaski	Tippecanoe River	SR 119 br
BEF00186	10/23/2000	Pulaski	Tippecanoe River	along CR 350S
BEF00187	10/23/2000	Pulaski	Tippecanoe River	u/s Dickey Creek mouth
BEF00188	10/23/2000	Pulaski	Tippecanoe River	u/s county line
BEF00196	10/26/2000	Washington	South Fork Blue River	Horners Chapel rd br
BEF00198	10/26/2000	Washington	Blue River	Grandview rd br
BEF00204	10/31/2000	Jackson/Wash.	East Fork White River	Muscatatuck River
BEF00206	10/31/2000	Jackson	East Fork White River	CR 180E br
BEF01006	04/02/2001	Martin	East Fork White River	Shoals Public Access
BEF01010	05/03/2001	Posey	Rush Creek	SR 69 br
BEF01013	05/04/2001	Posey	Unnamed trib. Wabash River	CR 70E br
BEF01021	07/17/2001	Fulton	Tippecanoe River	CR 750W br
BEF01065	10/01/2001	Harrison	Blue River	Blue River Chapel
BEF01078	11/08/2001	Greene	Richland Creek	CR 390N br
BEF01079	11/08/2001	Greene	Richland Creek	SR 54 br
BEF01082	11/15/2001	Greene	First Creek	CR 700S br
BEF01083	11/15/2001	Greene	First Creek	CR 300W br
BEF01084	11/15/2001	Greene	Doans Creek	CR 150W br
BEF01085	11/15/2001	Greene	Plummer Creek	along CR 150S
BEF01086	11/16/2001	Knox	Black Creek	CR 725N br
BEF01403	10/09/2001	Fulton	Tippecanoe River	old US 31 br
BEF01404	10/09/2001	Fulton	Tippecanoe River	CR 750W br
BEF02002	01/29/2002	Dearborn	Whitewater River	along Pinhook rd
BEF02033	06/19/2002	Greene	Plummer Creek	CR 490E br
BEF02034	06/19/2002	Greene	Plummer Creek	CR 150E br
BEF02056	07/10/2002	Washington	Delaney Creek	Mt Eden rd br
BEF02070	07/15/2002	Fulton	Tippecanoe River	CR 525E br
BEF02072	07/16/2002	Fulton	Tippecanoe River	old US 31 br
BEF02103	08/06/2002	Fulton	Tippecanoe River	CR 375W br
BEF02105	08/06/2002	Fulton	Tippecanoe River	CR 750W br
BEF02141	08/16/2002	Martin	East Fork White River	Barn Run mouth
BEF02149	08/20/2002	Jackson	East Fork White River	CR 180E br
BEF02150	08/20/2002	Jackson	East Fork White River	d/s dam d/s CR 725N br
BEF02207	09/05/2002	Martin	East Fork White River	US 150 br
BEF02214	09/10/2002	Warren	Big Pine Creek	Pot Holes rd br
BEF02215	09/10/2002	Fountain/Warren	Wabash River	Big Pine Creek mouth
BEF02216	09/10/2002	Warren	Big Pine Creek	Moore's Hill rd br
BEF02236	09/23/2002	Johnson	Sugar Creek	Hospital rd br
BEF02237	09/23/2002	Bartholomew	Driftwood River	d/s county line
BEF02253	09/30/2002	Greene	Richland Creek	US 231 br
BEF02291	10/18/2002	Martin	East Fork White River	Indian Creek mouth
BEF02293	10/18/2002	Martin	East Fork White River	Freemans Spring
BEF02308	11/07/2002	Martin	Lost River	br u/s mouth
BEF02311	10/18/2002	Martin	East Fork White River	0.5 mi u/s Beech Creek
BEF02314	12/06/2002	Greene	Richland Creek	along CR 275E
BEF03001	01/07/2003	Greene	Plummer Creek	CR 150E br
BEF03004	02/11/2003	Martin	East Fork White River	US 150 br
BEF03005	02/11/2003	Greene	Richland Creek	US 231 br
BEF03008	04/28/2003	Greene	Plummer Creek	CR 150E br
BEF03010	04/28/2003	Greene	Plummer Creek	CR 300E br

## APPENDIX I—Continued.

Site #	Date	County	Waterbody	Location
BEF03015	05/27/2003	Greene	Plummer Creek	along CR 150S
BEF03017	06/10/2003	Carroll	Tippecanoe River	SR 18 br
BEF03041	07/03/2003	Greene	Richland Creek	SR 54 br
BEF03088	08/25/2003	Lawrence	East Fork White River	1.0 mi d/s Williams br
BEF03101	09/16/2003	Johnson	Big Blue River	SR 252 br
BEF03106	09/25/2003	Lawrence	East Fork White River	Chase Riffle
BEF03129	10/31/2003	Franklin	Whitewater River	St Peters rd br
BEF03130	10/31/2003	Franklin	Salt Creek	Bull Fork rd br
BEF04032	05/11/2004	Carroll	Tippecanoe River	SR 18 br
BEF04057	06/09/2004	Jackson	White Creek	SR 258 br
BEF04252	10/06/2004	Greene	First Creek	SR 57 br
BEF05023	05/23/2005	Franklin	Whitewater River	SR 1 br
BEF05204	08/29/2005	Greene	Richland Creek	CR 175S br
BEF05205	08/29/2005	Greene	Richland Creek	CR 240N br
BEF05206	08/29/2005	Greene	Richland Creek	SR 54 br
BEF05252	09/15/2005	Tippecanoe	Tippecanoe River	Pretty Prairie rd br
BEF05277	10/25/2005	Greene	Richland Creek	US 231 br
BEF05278	10/25/2005	Greene	Richland Creek	CR 275E br
BEF05286	11/03/2005	Johnson	Sugar Creek	Hospital rd br
BEF06061	07/10/2006	Warren	Mud Pine Creek	SR 26 br
BEF06064	07/10/2006	Warren	Mud Pine Creek	Kiger Ditch mouth
BEF06105	08/01/2006	Martin	East Fork White River	US 150 br
BEF06108	08/02/2006	Carroll	Tippecanoe River	SR 18 br
BEF06126	08/21/2006	Martin	East Fork White River	US 150 br
BEF06130	08/23/2006	Posey	Wabash River	Mink Island
BEF06132	08/23/2006	Posey	Rush Creek	Harmonie State Park
BEF06133	08/24/2006	Gibson	Higginbotham ditch	CR 1300S br
BEF06170	09/28/2006	Pulaski	Tippecanoe River	US 35 br

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*Manuscript received 18 June 2008, revised 15 October 2008.*