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# HISTORICAL AND PRESENT DISTRIBUTION OF FISHES IN THE PATOKA RIVER BASIN: PIKE, GIBSON, AND DUBOIS COUNTIES, INDIANA

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ABSTRACT: Fish communities in the Patoka River have been dramatically altered by historical land use practices. Changes have resulted from coal mining and associated acid mine drainage, channelization, siltation, and oil exploration. All these changes have reduced and compromised available habitats. The Patoka River is the most extensively studied river in southwestern Indiana. Extensive surveys beginning in 1890 have documented the presence of 90 species of fish. In addition, these surveys document the change of habitat occupied by the fish community from a silt-free, lowland stream to a highly turbid stream dominated by a tolerant lowland fish community assemblage.

KEYWORDS: Acid mine drainage, distribution, fish community, Indiana, Patoka River watershed.

## INTRODUCTION

A rich legacy of information regarding fish distribution has been assembled for the Patoka River, which enables comparisons of fish community composition over time. Jordan (1890) collected from the Patoka River at Patoka (Gibson County); Moenkhaus (1896) collected from two sites near Huntingburg (Dubois

County); and Hubbs and Lagler (1942) and Lagler and Ricker (1942) collected from Foots Pond (Gibson County). Gerking (1945) collected from eight sites, including three sites on the Patoka River mainstem. More recently, Hottell (1978) evaluated 12 mainstem sites on the Patoka River, Houchins Ditch, and 12 tributaries; Stefanavage (1991) collected from 8 mainstem localities. The current study evaluated 13 mainstem and 36 tributary sites and was supplemented by unpublished information from Lawrence M. Page of the Illinois Natural History Survey (11 tributary sites) and the Indiana Department of Transportation (2 mainstem and 13 tributary sites). As a result, information from a total of 15 mainstem and 60 tributary sites on the Patoka River drainage are reported.

The U.S. Fish and Wildlife Service established the Patoka River National Wildlife Refuge in Pike and Gibson Counties in southwestern Indiana on 7 September 1994. The refuge consists of more than 22,000 acres, including 6,800 acres set aside as wildlife management areas. The project encompasses one of the last remaining stretches of bottomland hardwood forest in the Midwest. The objectives for establishing the Patoka River National Wildlife Refuge included the preservation, restoration, and enhancement of bottomland hardwood wetlands, uplands, migratory bird habitat, and threatened or endangered species habitat. The project area provides excellent production habitat for many species of migratory waterfowl, such as the wood duck (*Aix sponsa*), and includes areas used by Indiana bat (*Myotis sodalis*), a federally endangered species. In addition, populations of the copperbelly water snake (*Nerodia erythrogaster neglecta*), which the U.S. Fish and Wildlife Service is currently proposing as threatened pursuant to the Endangered Species Act of 1973, are known to occur within the refuge's boundary.

The purpose of this study was to evaluate the current condition of the aquatic communities and to identify potential point and non-point sources of contamination in the watershed. A second objective was to document the historical and present distribution of fishes in the Patoka River drainage and to evaluate the changes in fish community composition from a historical land use perspective.

**Watershed Description.** The Patoka River is a tributary of the Wabash River, originating near Danner's Cemetery near the town of Valeene, Orange County, Indiana. The river flows west for 162 miles across two physiographic units, the Crawford Upland and the Wabash Lowland (Schneider, 1966). The basin includes an area of extensive lacustrine deposits and minimal glacial deposits. The Patoka River watershed includes 862 $mi^2$ (551,680 acres) in 8 counties in southwestern Indiana. At the upper, eastern end of the watershed, the Patoka River flows rapidly through a narrow floodplain of forested uplands and has a gradient of 12 feet per mile (U.S. Fish and Wildlife Service, 1994). Several small farms are scattered throughout the upper watershed. West of Jasper, Indiana, the flow velocity of the Patoka River quickly diminishes as the river's gradient decreases to 1 foot per mile. The predominant land use changes from forested uplands in the headwaters to agriculture in the lowlands downstream. The Wildlife Refuge is located in this slow, meandering, lowland stretch of the river, which includes a wide floodplain, numerous oxbows, and low, rolling uplands. Major tributaries to the Patoka River include the South Fork Patoka River (with a

drainage area of 76.3 $mi^2$) and Flat Creek (with a drainage area of 58.9 $mi^2$), both of which were channelized in the early part of this century.

A drainage project in the 1920s and the U.S. Army Corps of Engineers' construction of Patoka Lake in the late 1970s both affected current flow in the Patoka River. In the early 1920s, nearly 100,000 acres of forested wetlands were drained in the floodplain of the lower reaches of the river to advance farming (U.S. Fish and Wildlife Service, 1994). The drainage project changed 36 miles of meandering river into an approximately 17-mile long, dredged, channelized ditch. Nearly 19 miles of natural river meanders were isolated from the main channel, creating oxbow ponds. Water exchange within these man-made oxbows is now limited to periods of high water. Heavy sediment loads carried during these high water periods result in increased sediment deposition in the oxbows. Consequently, the hydrology of these ecologically important units is continually being altered.

**Water Quality.** The Patoka River watershed is affected by acid mine drainage (Corbett, 1969; Renn, 1989). From the 1800s to the early 1900s, almost all the coal produced in Indiana was from underground mines. Then, surface mining steadily increased until it became the only current mining practice (Powell, 1972). From 1941 to 1980, 16% of Pike County's acres were disturbed by surface mining (Renn, 1989). A significant portion of Pike County (62%) was mined prior to Indiana's comprehensive reclamation law of 1968, resulting in 186 acres of refuse piles, 129 acres of slurry ponds, 3,113 acres of land with less than 75% vegetation cover, and 375 acres of surface water impoundments affected by drainage from the coal-mined areas (Allen, *et al.,* 1978).

The detrimental effects of coal production on water quality in the watershed were first documented in the early 1960s by Corbett (1969). Acid mine drainage from underground and surface mining has altered water quality in the Patoka watershed. Corbett (1969) found a range in pH from 2.6 to 5.5, in alkalinity from 0 to 4 mg/L, in acidity from 38 to 554 mg/L, and in sulfate from 138 to 4400 mg/L based on 37 water samples from the South Fork Patoka River at the SR 57 bridge during the period from 9 April 1962 to 8 July 1968. In addition to coal mining, oil-well-waste pollution is a problem. Corbett (1969) found that during low flows, the Patoka River (in the vicinity of Wheeling) had high chloride concentrations. In 1969, chloride concentrations ranged from 3 to 952 ppm with an average of 47 ppm (sample size = 110). The mean chloride concentration in river water in North America is 8 ppm (Livingstone, 1963). In 1989, Renn reported that acid mine drainage continued to impair water quality in the South Fork Patoka River. Surface water screening toxicity test results, invertebrate community assessments, and water quality data show that acid mine drainage still impairs water quality in the watershed (U.S. Fish and Wildlife Service, unpub. data).

## MATERIALS AND METHODS

The Patoka River was evaluated using samples from a variety of habitat types ranging from mainstem segments and large tributary branches such as the South Fork Patoka River to numerous tributary segments that are included in the Patoka River Wildlife Refuge. A total of 118 sites (Table 1) were sampled using either a T&J pulsed DC electroshocker capable of a 300 volt output and 8-10 Amps or,

Table 1. List of collecting localities sampled from the Patoka River drainage (CR = County Road; SR = State Road; IDOT = Indiana Department of Transportation; u/s = upstream; d/s = downstream).

| Site Number | County | Site | Collector |
|---|---|---|---|
| 1 | Gibson | Patoka River at Patoka | Jordan, 1890 |
| 2 | Dubois | Patoka River near Huntingburg | Moenkhaus, 1896 |
| 3 | Dubois | Short Creek, Huntingburg | Moenkhaus, 1896 |
| 4 | Gibson | Foots Pond, 1 mile south of Jimtown | Hubbs and Lagler, 1942; Lagler and Ricker, 1942 |
| 5 | Gibson | Patoka River at Patoka | Gerking, 1945 |
| 6 | Pike | Patoka River, 1 mile east Winslow | Gerking, 1945 |
| 7 | Dubois | Hunley Creek, 3 miles north of Huntingburg | Gerking, 1945 |
| 8 | Dubois | Indian Creek, 2 miles east of Huntingburg | Gerking, 1945 |
| 9 | Dubois | Hall Creek, 2 miles south of Jasper | Gerking, 1945 |
| 10 | Dubois | Patoka River, Dubois | Gerking, 1945 |
| 11 | Crawford | Little Patoka River, 12 miles northwest of English | Gerking, 1945 |
| 12 | Orange | Patoka River, 10 miles south of Paoli | Gerking, 1945 |
| 13 | Gibson | Patoka River, immediately u/s mouth | Hottell, 1978 |
| 14 | Gibson | Patoka River, US 41 bridge | Hottell, 1978 |
| 15 | Pike | Patoka River, u/s South Fork to SR 57 bridge | Hottell, 1978 |
| 16 | Pike | Patoka River, 0.5 mile south of Winslow | Hottell, 1978 |
| 17 | Pike | Patoka River, SR 257 bridge | Hottell, 1978 |
| 18 | Dubois | Patoka River, 2.5 miles east-northeast of Millersport | Hottell, 1978 |
| 19 | Dubois | Patoka River, SR 162 bridge, Jasper | Hottell, 1978 |
| 20 | Dubois | Patoka River, 3.5 miles northeast of Jasper | Hottell, 1978 |
| 21 | Dubois | Patoka River, 0.5 mile northwest of Dubois | Hottell, 1978 |
| 22 | Dubois | Patoka River, 2 miles north-northeast of Dubois | Hottell, 1978 |
| 23 | Dubois | Patoka River, below Patoka Reservoir | Hottell, 1978 |
| 24 | Gibson | Keg Creek, 1 mile u/s mouth | Hottell, 1978 |
| 25 | Gibson | South Fork, 1 mile u/s mouth | Hottell, 1978 |
| 26 | Pike | South Fork, 9.5 miles u/s mouth | Hottell, 1978 |
| 27 | Pike | Cup Creek, mouth | Hottell, 1978 |
| 28 | Pike | Cup Creek, 1 mile u/s mouth | Hottell, 1978 |
| 29 | Pike | Flat Creek, 5 miles u/s mouth | Hottell, 1978 |
| 30 | Dubois | Hunley Creek, 5 miles u/s mouth | Hottell, 1978 |
| 31 | Dubois | Straight River, 1 mile u/s mouth | Hottell, 1978 |
| 32 | Pike | Flat Creek, 7 miles u/s confluence Hall Creek | Hottell, 1978 |

| Site Number | County | Site | Collector |
|---|---|---|---|
| 33 | Dubois | Hall Creek, 4 miles u/s confluence Flat Creek | Hottell, 1978 |
| 34 | Dubois | Polson Creek, 0.5 mile u/s mouth | Hottell, 1978 |
| 35 | Dubois | Davis Creek, mouth | Hottell, 1978 |
| 36 | Pike | Patoka River, RM 30.5 | Stefanavage, 1991 |
| 37 | Pike | Patoka River, RM 31.5 | Stefanavage, 1991 |
| 38 | Pike | Patoka River, RM 33.5 | Stefanavage, 1991 |
| 39 | Pike | Patoka River, RM 34.7 | Stefanavage, 1991 |
| 40 | Dubois | Patoka River, RM 42.3 | Stefanavage, 1991 |
| 41 | Dubois | Patoka River, RM 43.5 | Stefanavage, 1991 |
| 42 | Dubois | Patoka River, RM 53.7 | Stefanavage, 1991 |
| 43 | Dubois | Patoka River, RM 55.0 | Stefanavage, 1991 |
| 44 | Gibson | Patoka River, CR 850 west of the bridge east of Mount Carmel | Current study, 1992 |
| 45 | Gibson | Patoka River, CR 50 west of the bridge, Patoka | Current study, 1992 |
| 46 | Gibson | Patoka River, CR 50 E, 2 miles east of Patoka | Current study, 1992 |
| 47 | Pike/ Gibson | Patoka River, Mitchell Road, 2 miles southeast of Oatsville | Current study, 1992 |
| 48 | Pike | Patoka River, 3 miles north of Oakland City | Current study, 1992 |
| 49 | Pike | Patoka River, SR 61 bridge, Winslow | Current study, 1992 |
| 50 | Pike | Patoka River, 0.25 mile south of Survant | Current study, 1992 |
| 51 | Pike | Patoka River, 0.75 mile north of Pikeville | Current study, 1992 |
| 52 | Dubois | Patoka River, CR 600 W, Department of Natural Resources access site | Current study, 1992 |
| 53 | Dubois | Patoka River, 2.5 miles south of Jasper | Current study, 1992 |
| 54 | Dubois | Patoka River, d/s Jasper WWTP Outfall | Current study, 1992 |
| 55 | Dubois | Patoka River, northwest of Beaver Creek Reservoir | Current study, 1992 |
| 56 | Gibson | Patoka River, d/s South Fork Patoka River | Current study, 1992 |
| 57 | Pike | Lick Creek, unnamed Road, 2 miles west of Arthur | Current study, 1992 |
| 58 | Pike | Unnamed tributary, South Fork Patoka River, CR 900 S | Current study, 1992 |
| 59 | Gibson | Lost Creek, CR 650 E, 1.75 miles north of Francisco | Current study, 1992 |
| 60 | Pike | Rock Creek, 1.5 miles east of Pikesville | Current study, 1992 |
| 61 | Pike | Unnamed tributary, Sugar Ridge Road | Current study, 1992 |

| Site Number | County | Site | Collector |
|---|---|---|---|
| 62 | Pike | Robinson Creek, CR 125 S, 2.75 miles northwest of Winslow | Current study, 1992 |
| 63 | Pike | Stone Coe Creek, SR 61, 0.75 mile northwest of Winslow | Current study, 1992 |
| 64 | Pike | South Fork Patoka River, CR 1200 S | Current study, 1992 |
| 65 | Pike | South Fork Patoka River, CR 900 | Current study, 1992 |
| 66 | Pike | South Fork Patoka River, Scottsburg Road | Current study, 1992 |
| 67 | Pike | South Fork Patoka River, u/s Durham Ditch | Current study, 1992 |
| 68 | Pike | South Fork Patoka River, d/s Durham Ditch | Current study, 1992 |
| 69 | Gibson | South Fork Patoka River, SR 57, 3 miles north of Oakland | Current study, 1992 |
| 70 | Pike | Barren ditch, unnamed CR, 2 miles southwest of Winslow | Current study, 1992 |
| 71 | Pike | Beadens Creek, north of Cup Creek Church Road | Current study, 1992 |
| 72 | Pike | Big Creek, CR 625 W bridge, 0.75 mile east of Oatsville | Current study, 1992 |
| 73 | Pike | Bruster Branch, CR 200 S, 1.5 miles east of Winslow | Current study, 1992 |
| 74 | Pike | Cup Creek, SR 257, 0.3 mile southwest of Pikeville | Current study, 1992 |
| 75 | Pike | Durham Ditch, 0.25 mile northwest of Scottsburg | Current study, 1992 |
| 76 | Pike | Flat Creek, Sugar Ridge Road, 1 mile south of Glezon | Current study, 1992 |
| 77 | Dubois | Flat Creek, CR 50 N, 7.25 miles west of Jasper | Current study, 1992 |
| 78 | Pike | Flat Creek, Flat Creek Road, 2.6 miles south of Otwell | Current study, 1992 |
| 79 | Pike | Hog Branch, Sugar Ridge State Park, 0.75 mile southwest of Survant | Current study, 1992 |
| 80 | Pike | Houchin Ditch, CR 400 E, 3 miles southeast of Coe | Current study, 1992 |
| 81 | Gibson | Keg Creek, CR 50 N, 3.75 miles west of Oakland City | Current study, 1992 |
| 82 | Pike | Sugar Creek, CR 150 S bridge, 3 miles west of Winslow | Current study, 1992 |
| 83 | Gibson | Turkey Creek, CR 1275 E, 0.75 mile east of Oakland City | Current study, 1992 |
| 84 | Pike | Unnamed tributary, SR 364, 2 miles south of Winslow | Current study, 1992 |
| 85 | Pike | Unnamed tributary, 0.25 mile north of Enos Lake | Current study, 1992 |
| 86 | Pike | Unnamed tributary, Sugar Ridge Road | Current study, 1992 |
| 87 | Pike | Unnamed tributary, Liberty Road bridge | Current study, 1992 |

| Site Number | County | Site | Collector |
|---|---|---|---|
| 88 | Pike | Wheeler Creek, Kays Road, 1 mile east of Coe | Current study, 1992 |
| 89 | Gibson | Yellow Creek, CR 400 N | Current study, 1992 |
| 90 | Pike | Mill Creek, SR 364 bridge, 2 miles southeast of Winslow | Current study, 1992 |
| 91 | Gibson | Ditch, 2 miles east of Francisco, Route 64 | Page, *et al.*, unpublished |
| 92 | Gibson | Ditch, 2 miles east of Kirkville | Page, *et al.*, unpublished |
| 93 | Gibson | Tributary of the Patoka River, 2.5 miles northeast of Princeton | Page, *et al.*, unpublished |
| 94 | Gibson | Tributary of the Patoka River, 3.5 miles west of Wheeling | Page, *et al.*, unpublished |
| 95 | Orange | Bacon Creek, Bacon | Page, *et al.*, unpublished |
| 96 | Orange | Tributary of the Patoka River, 5 miles southwest of French Lick | Page, *et al.*, unpublished |
| 97 | Pike | Flat Creek, 3 miles northwest of Otwell | Page, *et al.*, unpublished |
| 98 | Pike | Tributary of the Patoka River, 0.5 mile west of Pikeville, Highway 257 | Page, *et al.*, unpublished |
| 99 | Pike | Tributary of the Patoka River, 1 mile southwest of Glezon, Rt 57 | Page, *et al.*, unpublished |
| 100 | Crawford | Tributary of Patoka Lake, 1.5 miles southwest of Wickliff | Page, *et al.*, unpublished |
| 101 | Dubois | Tributary of the Patoka River, Ireland | Page, *et al.*, unpublished |
| 102 | Pike | Hat Creek, CR 50 E, 1 mile east of Coe | Current study, 1992 |
| 103 | Pike | Honey Creek, Blackfoot Road, 2.5 miles north of Spurgeon | Current study, 1992 |
| 104 | Gibson | West Fork Keg Creek, SR 64 | IDOT, unpublished 1993 |
| 105 | Gibson | East Fork Keg Creek, CR 125 S | IDOT, unpublished 1993 |
| 106 | Gibson | East Fork Keg Creek, CR 1050 E | IDOT, unpublished 1993 |
| 107 | Gibson | Turkey Creek, SR 64, 0.5 mile east of Oakland City | IDOT, unpublished 1993 |
| 108 | Gibson | Old Wabash and Erie Canal, CR 50 N | IDOT, unpublished 1993 |
| 109 | Gibson | East Fork Keg Creek, Claybank Road | IDOT, unpublished 1993 |
| 110 | Pike | Robinson Creek, CR 100 S | IDOT, unpublished 1993 |
| 111 | Pike | Flat Creek, Winslow-Patoka Road | IDOT, unpublished 1993 |
| 112 | Pike | Flat Creek, SR 57, 1 mile north of Glezen | IDOT, unpublished 1993 |
| 113 | Pike | Flat Creek, CR 50 S, east of Glezen | IDOT, unpublished 1993 |
| 114 | Pike | Flat Creek, CR 275 W | IDOT, unpublished 1993 |
| 115 | Gibson | Hurricane Creek, 0.75 mile west of Dongola | IDOT, unpublished 1993 |
| 116 | Gibson | East Fork Keg Creek, McCullough Road | IDOT, unpublished 1993 |
| 117 | Pike | Lick Creek, CR 300 S, 0.5 mile west of Survant | Current study, 1993 |

when conductivity was greater than 1000 μS, using various length seines with a 1/8-inch mesh. Sample distances were at least 15 times the wetted stream width with a minimum distance of 50 m. Sample distances for larger mainstem sites ranged from 500-1000 m and included two boat passes on both shores. Sampling was conducted in an upstream direction in small- to mid-sized streams and in both directions in large mainstem segments. The objective of collecting this data was to document species occurrence in a representative sample of a particular reach, recognizing that all rare species may not be collected as stream size increases. In conjunction with the fish community collections, habitat was assessed by the qualitative habitat evaluation procedure (Rankin, 1989).

## RESULTS AND DISCUSSION

The Patoka River is a very diverse stream represented historically by 90 species of fish (Table 2). This represents 22.6% of the entire State fauna (Simon, *et al.*, 1992). Significant portions of the community have remained stable during the last century. However, some community changes have occurred which are important to document in light of the addition of the lower Patoka River as a National Wildlife Refuge.

**Historical Distribution (Pre-1900).** The Patoka River before 1900 contained several species characteristic of the clear streams of the Wabash River Lowlands. Data from the turn of the century are limited and are based on only three localities (Jordan, 1890; Moenkhaus, 1896). Species such as flier (*Centrarchus macropterus*), brindled madtom (*Noturus miurus*), bluebreast darter (*Etheostoma camurum*), harlequin darter (*Etheostoma histrio*), slenderhead darter (*Percina phoxocephala*), and dusky darter (*P. sciera*) were present in the drainage. Judging from the extant museum specimens, Patoka River sites were sampled frequently, and the number of specimens seems adequate to document the majority of species previously occurring in the lower Patoka River. The only species not represented by multiple collections is the bluebreast darter (Simon, pers. obs.). Based on historical information (Jordan, 1890), the bluebreast darter was probably not a significant component of the Patoka River fauna. The bluebreast darter is usually associated with gravel-cobble riffle habitats (Trautman, 1982) and usually requires the clean interstitial spaces of elevated cobble and boulders to clump eggs during reproduction (Page and Simon, 1988). Typically, the bluebreast darter occurs in the glacial till areas of the last Wisconsian advance. The Patoka River probably never had significant amounts of this microhabitat, because it was dominated by lowland habitats and shale outcrops. The presence of the other five species, which are characteristic of clear streams, is consistent with the expected fauna of the Wabash River lowlands.

**Community Changes Between 1940 and 1945.** Hubbs and Lagler (1942), Lagler and Ricker (1942), and Gerking (1945) made 7 collections between 1940 and 1945. The loss of brindled madtom, bluebreast darter, harlequin darter, and dusky darter prior to this time indicates that significant changes were already occurring in the drainage. Species such as brindled madtom, slenderhead darter, and sand shiner (*Notropis ludibundis*) were collected for the last time during this period. Additional species documented by these investigators include paddlefish (*Polyodon spathula*), yellow bass (*Morone mississippiensis*), rock bass (*Ambloplites rupestris*), smallmouth bass (*Micropterus dolomieui*), rainbow darter (*Etheostoma*

Table 2. A listing of historical and present fish species collected from the Patoka River drainage. The numbers represent sites listed in Table 1. The sequence of species follows Simon, *et al.* (1992).

| | |
|---|---|
| *Lepisosteus platostomus* | 4, 14, 16, 17, 19, 24, 27, 36-43, 47, 56 |
| *L. osseus* | 4, 17, 20, 42, 56 |
| *L. oculatus* | 4, 23, 37, 38, 42, 54, 56, 57 |
| *Amia calva* | 3, 4, 8, 13, 15-23, 27, 36, 37, 39, 41, 43, 51, 54, 56, 77 |
| *Polyodon spathula* | 4 |
| *Esox americanus* | 2, 3, 8-12, 22-25, 27-31, 54, 62, 70, 73, 74, 76, 78, 83, 84, 98, 102, 111 |
| *E. lucius* | 23 |
| *Umbra limi* | 3, 8 |
| *Dorosoma cepedianum* | 2, 4, 5, 13, 14, 16, 18-21, 24, 27, 36-40, 42-51, 54, 56, 77 |
| *D. petenense* | 89 |
| *Campostoma anomalum* | 2, 6, 11, 30-33, 35, 60, 71, 84, 93, 95, 98, 100, 104, 109, 110, 116 |
| *Cyprinella spiloptera* | 4, 5, 10, 13, 42-48, 50-55, 78, 115 |
| *C. whipplei* | 4, 5, 42, 44, 45, 48-51, 55, 115 |
| *Cyprinus carpio* | 4, 5, 13-17, 19-24, 27, 29, 31, 36-43, 45, 47-51, 56, 59, 115 |
| *Ericymba buccata* | 5, 6, 9, 20, 28, 30-33, 35, 74, 106 |
| *Hybognathus hayi* | 94 |
| *H. nuchalis* | 2-9, 24, 28, 30, 31, 33, 44-46, 56 |
| *Luxilus chrysocephalus* | 1, 6, 9, 11, 12, 22, 23, 32-35, 71, 74, 95, 113 |
| *Lythrurus fumeus* | 45, 50, 51, 54, 55, 56, 78 |
| *Lythurus umbratilis* | 2, 3, 8-12, 28-30, 32, 33, 35, 60, 76, 78, 97, 113 |
| *Notemigonus crysoleucus* | 3, 4, 5, 7, 8, 14, 19, 21, 24, 28, 29, 33, 34, 36, 40, 78, 107, 109, 115 |
| *Notropis anogenus* | 55 |
| *N. atherinoides* | 1, 2, 4, 13, 21, 24, 44-46, 51, 56 |
| *N. blennius* | 4, 49, 55, 89 |
| *N. ludibundus* | 5 |
| *N. texanus* | 22(?), 28(?), 30(?), 43(?) |
| *N. volucellus* | 2, 10, 36, 37, 41 |
| *Opseopodeus emiliae* | 2-4, 8, 30 |
| *Phenacobius mirabilis* | 2, 5, 6, 9, 28-31, 33, 46, 49, 50, 55, 105, 106 |
| *Phoxinus erythrogaster* | 95, 96 |
| *Pimephales notatus* | 2-6, 8, 9, 11, 12, 17, 19, 20, 22-24, 28, 30-35, 43, 44, 47, 50-55, 59, 60, 71, 74, 81, 89, 91, 96, 104-106, 116 |
| *P. promelas* | 59 |
| *P. vigilax* | 2, 4-6, 44-47, 51 |
| *Rhinichthys atratulus* | 96 |
| *Semotilus atromaculatus* | 9, 28-35, 50, 60, 62, 63, 71, 73, 74, 76, 83, 84, 89, 91-93, 95-97, 100, 102, 104, 106, 107, 109, 110, 112-114, 116 |

| | |
|---|---|
| *M. punctulatus* | 5, 6, 12-14, 17, 20, 22, 23, 31, 32, 40-42, 44, 45, 47-49, 51, 54-57, 62, 78, 106 |
| *M. salmoides* | 4, 16, 17, 20, 23, 24, 27-29, 34, 36, 37, 42, 43, 49, 97 |
| *Pomoxis annularis* | 2-4, 6-8, 13-16, 18, 19, 21, 22, 27, 38, 39, 41-45, 49, 56 |
| *P. nigromaculatus* | 1, 4, 6, 14, 15, 17, 19-21, 23, 24, 27, 28, 36, 49 |
| *Etheostoma asprigene* | 4, 22, 29, 47, 48, 51, 54, 55 |
| *E. caeruleum* | 12 |
| *E. camurum* | 2 |
| *E. chlorosoma* | 2, 4, 5, 24, 28, 29, 34 |
| *E. gracile* | 2, 5, 47, 60, 78, 94, 98, 99, 104, 106, 107, 109, 111, 112, 114, 116 |
| *E. histrio* | 1 |
| *E. nigrum* | 1, 3, 6-9, 11, 12, 28-31, 60, 71, 74, 97 |
| *E. spectabile* | 31, 35, 95, 96, 100 |
| *Percina caprodes* | 1, 4, 12, 23 |
| *P. maculata* | 2, 3, 5-9, 53, 55, 97 |
| *P. phoxocephala* | 1, 3, 8 |
| *P. sciera* | 1 |
| *P. shumardi* | 4, 22 |
| *Stizostedion canadense* | 4, 13, 47 |
| *Aplodinotus grunniens* | 1, 4, 6, 20, 37, 44, 45, 47-49, 54 |
| *Cottus bairdi* | 12 |

*caeruleum*), and mottled sculpin (*Cottus bairdi*). The clearing of land for agriculture between 1900 and 1940 probably increased sediment loadings and turbidity in the drainage. Paddlefish and yellow bass were collected from Foots Pond, which was never connected with the Patoka River drainage. The fact that these species occurred in the Wabash River lowlands suggests that these species may have occurred in the Patoka River drainage, but the collection methods utilized in the Patoka River in the past would have made capture in an open system unlikely. The rock bass, smallmouth bass, rainbow darter, and mottled sculpin are all characteristic of upland, cool-water streams (Table 2). The change from clear, well-oxygenated waters to more turbid waters which absorb heat eliminated these species.

**Community Changes Between 1945 and 1978.** Hottell (1978) evaluated 23 stations in the mainstem Patoka River and its tributaries. During this period, four species were added to the faunal list, including redear sunfish (*Lepomis microlophus*), bluntnose darter (*Etheostoma chlorosoma*), northern pike (*Esox lucius*), and orangethroat darter (*Etheostoma spectabile*). After the creation of Patoka Lake, northern pike were stocked in the reservoir. Hottell's specimens were undoubtedly stocked specimens, since neither the previous investigators nor subsequent ones have ever found northern pike. The bluntnose darter is a lowland species, occurring over woody debris and heavy organic sediments. Watershed changes resulting from drastic land use modifications (i.e., channelization, oil exploration, and coal mining had increased turbidity, siltation of sediments, lateral erosion of the banks, and acidity during this period) may have enabled several species to invade the watershed and caused the demise of others.

**Community Changes Between 1978-1994.** Three times as much work has been conducted in the drainage since 1991 than had previously occurred over the last century. Stefanavage (1991), the current study, unpublished records by Lawrence Page (Illinois Natural History Survey), and unpublished records from the Indiana Department of Transportation (IDOT) have increased our knowledge of this drainage substantially. Nine new species were collected between 1978 and 1994 (Table 2): threadfin shad (*Dorosoma petenense*), cypress minnow (*Hybognathus hayi*), ribbon shiner (*Lythrurus fumeus*), pugnose shiner (*Notropis anogenus*), southern redbelly dace (*Phoxinus erythrogaster*), fathead minnow (*Pimpehales promelas*), blacknose dace (*Rhinichthys atratulus*), shorthead redhorse (*Moxostoma macrolepidotum*), and starhead topminnow (*Fundulus dispar*). The ribbon shiner was previously known only from a few small creeks in southwestern Indiana (Gerking, 1945). However, the significant range extension of the ribbon shiner documented during this study is probably a result of the previous misidentification of the ribbon shiner as the redfin shiner (*L. umbratilis*). Transport of fathead minnow into the drainage may be a result of bait-bucket release. Threadfin shad introductions were probably a result of immigration from reservoir habitats. Pugnose shiner, starhead topminnow, and shorthead redhorse represent species sensitive to siltation and acidity and are characteristic of reference conditions (Simon, 1991). The increased occurrrence of these species in the watershed may be an environmental indicator of recovery.

Significant effects of acid mine drainage have been observed throughout the South Fork Patoka River. No fish were found at any of the six South Fork Patoka River locations (sites 64-69) or in Houchin Ditch (site 80). No aquatic life was found at the unnamed tributary at CR 900 S bridge (site 58), the unnamed tributary at Sugar Ridge Road (site 61), Big Creek near Oatsville (site 72), Durham Ditch northwest of Scottsburg (site 75), the unnamed tributary north of Enos Lake (site 85), the unnamed tributary at Liberty Road (site 87), or Mill Creek at SR 364 (site 90). These stations were impacted by a variety of factors, including acid mine leachate, oil exploration, and significant erosion. Several stations with intermittent flow reflected heavily disturbed conditions due to the lack of water during most of the year. Hog Branch (site 79), the unnamed tributary at Sugar Ridge Road (site 86), Wheeler Creek (site 88), the old Wabash and Erie Canal (site 108), and Lick Creek (site 117) were dry during the sampling period.

The authenticity of several records are suspect. The weed shiner, *Notropis texanus,* was reported by Hottell (1978) and Stefanavage (1991) from the Patoka River (sites 22 and 43), Cup Creek (site 28), and Hunley Creek (site 30). The weed shiner typically occurs in habitats with an abundance of aquatic vegetation. This shiner is similar to the pugnose minnow in appearance. During the current investigations, no weed shiners were collected. Hottell (1978) reported pugnose minnow to be sympatric with the weed shiner at the Hunley Creek site (site 30). Until voucher specimens of the weed shiner are collected, the presence of this species is considered speculative. White bass (*Morone chrysops*) was reported from the mouth of the Patoka River by Hottell (1978). Although this record is probable, white bass is probably not a significant resident of the Patoka River. White bass has been reported as far upstream as Patoka River mile 33.5 (site 38) and from Foots Pond (site 4). The paddlefish reported from Foots Pond suggests that this species may have occurred at least in the mouth of the Patoka River

mainstem. Both paddlefish and white bass should be considered tentative residents of the Patoka River, because they are more representative of the larger Wabash River.

Historically, 90 species have resided in the Patoka River drainage (Table 2). Significant land use changes over the last 100 years have reduced the number of residents (since 1991) to 70 fish species. Local species extinctions and rare occurrences of some taxa suggest that the Patoka River bottomlands and adjacent habitats are important for maintaining and preserving stable biological function and structure. The formation of the Patoka River National Wildlife Refuge will help preserve this fragile ecotype and enable species which need periodic bottomland hardwood forest flooding to complete their life history.

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## LITERATURE CITED

Allen, J.H., T.C. Thomas, and R.R. Kelly. 1978. A survey to determine the extent and environmental effect of derelict lands resulting from the surface extraction of coal, P.L. 62, Acts of 1976. Indiana Dep. Natur. Res., Indianapolis, Indiana, 46 pp.

Corbett, D.M. 1969. Acid mine-drainage problem of the Patoka River watershed, southwestern Indiana. Water Res. Research Center, Indiana University, Bloomington, No. 4, 173 pp.

Gerking, S.D. 1945. The distribution of the fishes of Indiana. Invest. Indiana Lakes Streams 3: 1-37.

Gray, H.H. 1979. Indiana. U.S. Geol. Surv. Prof. Pap. 1110: K1-K20.

Hottell, H.E. 1978. Fisheries survey of the Patoka watershed above, in and below Patoka Lake. Indiana Dep. Natur. Res., Div. Fish Wildl., Fish. Sec., Indianapolis, Indiana, 77 pp.

Hubbs, C.L. and K.F. Lagler. 1942. Annotated list of fishes of Foots Pond, Gibson County, Indiana. Invest. Indiana Lakes Streams 2: 73-83.

Jordan, D.S. 1890. Report of explorations made during the summer and autumn of 1888, in the Allegheny region of Virginia, North Carolina, and Tennessee, and in western Indiana, with an account of the fishes found in each of the river basins. Bull. U.S. Fish. Comm. 8: 97-173.

Lagler, K.F. and W.E. Ricker. 1942. Biological fisheries investigations of Foots Pond, Gibson County, Indiana. Invest. Indiana Lakes Streams 2: 47-72.

Livingstone, D.A. 1963. Chemical composition of rivers and lakes. Chapter 6. Data on Biochemistry. 6th ed. U.S. Geol. Surv. Prof. Pap. 440-G, 64 pp.

Moenkhaus, W.J. 1896. Notes on a collection of fishes of Dubois County, Indiana. Proc. Indiana Acad. Sci. 11: 159-162.

Page, L.M. and T.P. Simon. 1988. Observations on the reproductive behavior and eggs of four species of darters, with comments on *Etheostoma tippecanoe* and *E. camurum*. Trans. Illinois State Acad. Sci. 81: 205-210.

Powell, R.L. 1972. Coal strip-mined land in Indiana. Environ. Data Serv., Asheville, North Carolina, 89(12): 1-15.

Renn, D.E. 1989. Streamflow and stream quality in the coal-mining region, Patoka River basin, southwestern Indiana, 1983-85. U.S. Geol. Surv. Water Res. Invest. Rep. 88-4150, 68 pp.

Schneider, A.F. 1966. Physiography. *In:* A.A. Lindsey (Ed.), *Natural Features of Indiana,* pp. 40-56, Indiana Acad. Sci., Indianapolis, Indiana, 597 pp.

Simon, T.P. 1991. Development of index of biotic integrity expectations for the ecoregions of Indiana. 1. Central corn belt plain. U.S. Environ. Prot. Agency, Region 5, Chicago, Illinois, EPA 905/9-91/025, 93 pp.

Simon, T.P., J.O. Whitaker, Jr, J.S. Castrale, and S.A. Minton. 1992. Checklist of the vertebrates of Indiana. Proc. Indiana Acad. Sci. 101: 95-126.

Stefanavage, T. 1991. Fishes of Patoka River. Indiana Dep. Natur. Res., Div. Fish Wildlife, Sugar Ridge Fish and Wildlife Area, Winslow, Indiana, 16 pp.
Trautman, M.B. 1981. The fishes of Ohio. Ohio State Univ. Press, Columbus, Ohio, 782 pp.
U.S. Fish and Wildlife Service. 1994. Patoka River National Wetlands project environmental impact statement. U.S. Fish Wildlife Serv., Fort Snelling, Minnesota, 574 pp.