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Distribution and Life History Characteristics of the State-Endangered Bluebreast Darter *Etheostoma camurum* (Cope) in Illinois

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ABSTRACT

The bluebreast darter *Etheostoma camurum* (Cope) has a disjunct distribution within the Ohio River drainage. I examined the distribution and life history characteristics of *E. camurum* in the Vermilion River basin (Wabash River drainage), Vermilion County, Illinois, during the summer of 2007. The darter commonly was collected in areas of moderate to swift currents over cobble and boulder. It spawned in these areas during early summer, and consumed predominately aquatic insect larvae for its diet. Because of its small range, it is recommended that *E. camurum* remain listed as state-endangered.

Key Words:
Bluebreast darter, *Etheostoma camurum*, Vermilion River, endangered species

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INTRODUCTION

The bluebreast darter *Etheostoma camurum* (Cope) is a diminutive (typically < 125 mm), short-lived (typically < 3 years) fish in the Family Percidae (Page, 1983). It is sporadically distributed in several streams in the Ohio River drainage, including the Allegheny River basin in New York and Pennsylvania, the Wabash River basin in Indiana and Illinois, and the Tennessee River basin in North Carolina and Tennessee (Zorach, 1972; Page, 1983). This range can be attributed to recent degradation and fragmentation of habitat following post-Pleistocene dispersal (Zorach, 1972). *Etheostoma camurum* is a habitat specialist usually found on the streambed in depths of 10 - 30 cm under boulder in fast riffles in large, clear streams (Page, 1983; Greenberg, 1991; Stauffer et al., 1996; Welsh and Perry, 1998). In Illinois, it is found only in the Vermilion River basin of the Wabash River drainage (Smith, 1979). No other Illinois streams contain the preferred habitat requirements of *E. camurum*, and earlier references (e.g., Large, 1903; Forbes and Richardson, 1920; O'Donnell, 1935) of the species having been collected elsewhere in central and southern Illinois were based on misidentifications (Smith, 1979). As with most benthic fishes, *E. camurum* is negatively affected by anthropogenic disturbances, including siltation and impoundments (Trautman, 1981; Etnier and Starnes, 1993). The bluebreast darter is listed as state-endangered in Illinois because of its small range in the state (IESPB, 2005).

Darters are an ecological important group of fishes. Not only are they a food source to many other animals (Page, 1983), but they also are hosts to many freshwater mussels of the Family Unionidae (OSU, 2008). The bluebreast darter is no exception. Based on data from OSU (2008), *E. camurum* is used as a host for the federally-endangered northern riffleshell *Epioblasma rangiana* (Lea) and the Illinois state-endangered rainbow *Villosa iris* (Conrad). Therefore, a reduction in *E. camurum* could have profound effects on other aquatic faunas, including freshwater mussels.

The northern riffleshell is extirpated from the state (Cummings and Mayer, 1997). Efforts are underway to propagate and reintroduce the species back into Illinois. To date, no comprehensive study has examined the distribution of *E. camurum* and compared it to the historical distribution of *E. rangiana* in the Vermilion River basin, Vermilion County, Illinois. Without such data, recovery efforts for *E. rangiana* could be unsuccessful because the host fish might not be present. The purpose of this study was to determine distribution of *E. camurum* in the Vermilion River basin and relate those data to the historical distribution of *E. rangiana* in the basin. By comparing the two data sets, natural resource managers can choose optimal reintroduction sites for *E. rangiana* in the basin. Additional objectives were to determine life history characteristics (habitat, spawning, and diet) of *E. camurum* in the Vermilion River basin, Illinois.

STUDY AREA

The Vermilion River basin of the Wabash River drainage (Figure 1) encompasses nearly 4,000 km^2 of eastern Illinois and western Indiana, and contains one of the highest quality stream systems in Illinois in terms of aquatic biodiversity (Smith, 1968; Page et al., 1992). The basin historically supported at least 45 species of freshwater mussels (Tiemann et al., 2007a) and over 100 species of fishes, including 14 darter species (INHS Fish Collection). The dominant substrates in the basin are sand, gravel, and cobble, with small amounts of localized silt (Smith, 1968; Page et al., 1992). The watershed is primarily agriculture with the two major crops being corn and soybeans and has an intact riparian zone in most areas (Smith, 1968; Page et al., 1992).

During the past 150 y, the Wabash River drainage has experienced significant physical and biological changes as a result of anthropogenic disturbances (Simon, 2006), and the Vermilion River basin is no exception. Human induced modifications include draining of wetlands, dredging of streams, pollution from agriculture and industrial sources, removal of riparian areas, development of floodplains, and impounding of streams (Smith, 1968; Larimore and Bayley, 1996). The mainstem and its three largest tributaries (Salt Fork, Middle Fork, and North Fork) are relatively free-flowing, but several dams, including three in the Danville area, occur throughout the basin. However, despite these anthropogenic disturbances, which have been shown to cause alterations in fish assemblages (Smith, 1968; Tiemann et al., 2004; Santucci et al., 2005), the Vermilion River basin is one of the least altered basins in Illinois, and the fish fauna is still relatively intact (Page et al., 1992; Retzer, 2005).

METHODOLOGY

Fish sampling

Thirty sites were sampled in the Vermilion River basin (Table 1; Figure 1) from 12 May 2007 – 21 Aug 2007. Sites were established based on either habitat characteristics (e.g., moderate to swift flows and cobble/boulder substrates) or historical records for *E. camurum* or *E. rangiana*. At each site, at least five transects were uniformly spaced 5-m apart, perpendicular to the river channel along the length of the gravel bar, and up to ten points were evenly established 0.5-m apart along the length of each transect. The number of transects was dependent upon the length of the gravel bar, and the length of transects was from bank to bank. Fishes were collected from a 4.5 m^2 area at each point by kicking the substrate 3-m upstream from a stationary 1.5-m wide, 3-mm mesh seine and proceeding downstream to the seine in a back and forth path covering the width of the seine. To minimize disturbance, transects were sampled from downstream to upstream and points were sampled near shore to far shore. This kick-seining method has been shown to be an appropriate quantitative method for sampling benthic fishes, including darters (Tiemann et al., 2004). Fishes were identified, counted, and released upon completion of sampling at a site; only four *E. camurum* were vouchered because they either represented an upstream distribution records of the species (one fish each at two sites) or were crushed while kick-seining (two fish at one site).

Natural history observations

Subsequent to fish sampling, natural history (habitat, reproduction, and diet) observations were made. For habitat, depth and substrate composition was assessed visually at each point where fishes were collected (Tiemann et al., 2004). Depth was measured with a meter stick, and substrate composition was visually estimated as the percentage of clay/silt, sand, gravel, pebble, cobble, and boulder. The fredle index was calculated for substrate composition at each point at each site (McMahon et al., 1996). A high fredle index score represents the predominance of larger substrates. Mean fredle index scores of occupied points were subtracted from those of unoccupied points for each site, and then the resulting values were pooled among sites. A one-sample *t* -test was then used to test for non-random use of available habitat (Gillette et al., 2006). If *E. camurum* randomly chose substrates then the expected value for the difference between occupied and unoccupied would be close to zero and the *t* would be non-significant; however, a significant positive *t* would indicate occupied > unoccupied and suggest that habitat is non-random. Pearson's correlation coefficient also was calculated to examine potential relationships of habitat variables (depth and substrate composition percentages) with *E. camurum* abundance. Substrate variables were arcsine–square-root transformed because they were proportional data (Zar, 1999), and sequential Bonferroni-correction of $\alpha = 0.05$ was applied to help limit the Type I error of multiple tests (Rice, 1989). Statistical analyses were performed with SAS, Version 8 (SAS Institute Inc., Cary, NC).

Reproductive and feeding behaviors were observed three times by snorkeling during the study period (May 24, June 22, and July 20). Fish were observed for 4 hr during each event at Site 12 (Table 1). Site 12 was chosen because of public access and habitat characteristics (e.g., clear, shallow water with cobble/boulder substrates and moderate flows). Additional sites were not observed because of time constraints. After approximately 5 min of being in the water, fish seemed disinterested in my presence and continued with apparently normal activities.

RESULTS / DISCUSSION

Bluebreast darter distribution and habitat preference

Forty-seven species from 11 families were collected at the 30 sites (794 points) sampled in the Vermilion River basin (Table 2). Seventy-nine bluebreast darters were found at 17 sites (Table 1; Table 2). Densities ranged from 0.000 to 0.074 indiv/m^2 (mean: 0.021 ± 0.0232 indiv/m^2 SD – Table 1), and it was the 4th most abundant darter and 10^{th} most abundant fish collected (Table 2). The bluebreast darter was found in all three forks of the Vermilion River and in the mainstem itself (Table 1; Figure 1). Based on literature reviews (e.g., Larimore et al., 1952; Larimore and Smith, 1963; Smith, 1968; Larimore and Bayley, 1996) and museum records (e.g., INHS Fish Collection, which has >3,500 records from >100 sites in the basin), it appears that *E. camurum* does not occur elsewhere in the Vermilion River basin.

The bluebreast darter was found in depths varying from 7 to 43 cm (mean: 27.5 ± 8.32 cm SD). Although flow was not measured, individuals were found in areas with moderate to swift currents (estimated as >4.5 m/s). Non-random habitat use was evident for *E. camurum*, which is common in lotic fishes. Individuals were found in areas with higher fredle index scores (t = 6.46, P = 0.0002), which is indicative of areas with larger substrates. Bluebreast darter abundance was positively correlated with percent cobble (r = 0.54, P < 0.0001) and boulder (r = 0.34, P = 0.0003) substrates; no other correlations were significant. *Etheostoma camurum* was seldom collected in other habitats. Only two individuals were found in points that lacked cobble/boulder and moderate to swift flows (individuals were found in sandy gravel area with no flow). These accounts are similar to those previously reported (e.g., Mount, 1959; Smith, 1968; Trautman, 1981; Page, 1983).

Densities of *E. camurum* in the Salt Fork varied from 0.000 indiv/m^2 to 0.071 indiv/m^2 (mean: 0.025 ± 0.0282 indiv/m^2 SD – Table 1). In the Salt Fork, the darter was found from just south of Muncie to the confluence with the mainstem (Table 1; Figure 1). The habitat in this area was sand and gravel with several large areas of moderate to swift currents over cobble and boulder; upstream of this area was predominately sand and gravel with very little cobble and boulder. Goodnight and Wright (1940) reported *E. camurum* from the Salt Fork, but Smith (1979) believed this population became extirpated as a result of anthropogenic disturbances. The Salt Fork basin historically has been affected by industrial and agricultural pollution, impoundments, and strip-mining, all of which cause detrimental effects to freshwater ecosystems (Baker, 1922; Larimore and Smith, 1963; Larimore and Bayley, 1996). Downstream portions of the Salt Fork are protected by Kickapoo State Park.

The Middle Fork had the highest densities of *E. camurum* collected during this survey with values ranging from 0.000 to 0.074 indiv/m^2 (mean: 0.032 ± 0.0233 indiv/m^2 SD – Table 1). In the Middle Fork, which supports one of the healthiest aquatic ecosystems in the state (Smith, 1971), the darter was collected from the Potomac area to the confluence with the mainstem (Table 1; Figure 1). The habitat in this area was sandy gravel with large areas of swift currents over cobble and boulder; upstream of this area was mostly sand and gravel with very little cobble and boulder. The water quality of the Middle Fork has deteriorated over time, primarily as a result of agricultural and industrial runoff

(Smith, 1968; Smith, 1971). Other disturbances occurring in the Middle Fork include dredging, strip-mining, and impoundments (Smith, 1968). Portions of the Middle Fork are protected by Middle Fork State Fish and Wildlife Area and Kickapoo State Park.

This survey was the first to document *E. camurum* in the North Fork. One individual (INHS 101616) was collected in a small patch of cobble downstream of the lowhead dam beneath the US Hwy 150 bridge (Table 1; Figure 1). This dam (~1 km upstream from the confluence) is the most downstream of three dams on the North Fork Vermilion River, all of which are in Danville. The habitat in the North Fork is mostly sand and gravel with very little cobble and boulder. If *E. camurum* is expanding its range in the North Fork Vermilion River, it seems likely the lowhead dams will prevent further upstream movement. Impoundments fragment populations of aquatic organisms by not only altering their habitats, but also by blocking their upstream dispersal capabilities (Tiemann et al., 2004; Santucci et al., 2005; Tiemann et al., 2007b).

Etheostoma camurum was sporadically distributed in the mainstem of the Vermilion River. Densities ranged from 0.000 to 0.044 indiv/m^2 (mean: 0.012 ± 0.0175 indiv/m^2 SD – Table 1). In the mainstem, the darter was found infrequently downstream to the state line (Table 1; Figure 1), and it does not appear to occur beyond the state line in Indiana (B.E. Fisher, Indiana Department of Natural Resources, pers. comm.) The reason for the low densities and patchy distribution appears to be related to habitat. The habitat in the mainstem was predominately sandy gravel with small patches of cobble and boulder. As with other areas in the Vermilion River basin, the mainstem is affected by agricultural and industrial pollution and impoundments (Smith, 1968; Smith, 1971).

Carney et al. (1993) stated that the range of *E. camurum* has diminished in portions of the Wabash River drainage. However, this does not appear to be the case in the Vermilion River basin. It appears that *E. camurum* is expanding its range in the basin based on the fact that it has a larger distribution than what was reported by Smith (1968) or Smith (1979). Perhaps this pattern is the result of sampling effort. Goodnight and Wright (1940) and Fisher et al. (1998) suggested that the preferred habitats of *E. camurum* (e.g., fast flowing riffles containing boulders) might have been inadequately sampled during previous surveys, and might be a factor accounting for the infrequency with which they were taken. Goodnight and Wright (1940) suggested that, in order to collect *E. camurum*, it is "necessary to dislodge the rocks and drive the darters into the net." During the 2007 survey, the systematic kick-seining method of transects and points allowed sampling throughout the entire streambed, including those areas that had swift currents over boulder and therefore could account for the new distribution records.

<u>Reproduction</u>

Spawning was witnessed for *E. camurum* on 22 June 2007 when water temperatures were 24° C. Males did not develop breeding tubercles, as is seen with some darters (Page, 1983). Males established territories in crevices created by cobble and boulder and became aggressive (e.g., chasing and fin biting) when other males neared their territories. I did not witness if the coloration of the males intensified during the aggressive behavior as reported by Mount (1959). The genital papillae of the females were conical tubes, which aids in burying eggs (Page, 1983). Although not witnessed during this study, Mount

(1959) reported that females become aggressive toward other females and develop black bands behind the pectoral fins during the aggressive behavior.

Females enticed males to spawn by darting over gravel near cobble and boulder at the head of the riffle. These areas appear to offer refuge from the swift current (Etnier and Starnes, 1993). When ready to spawn, a female raised her tail and put her head down into the gravel and then swam forward to bury herself. As this act was occurring, a male partially wrapped himself around her and then released sperm. During spawning, the pair vibrated and the female deposited eggs in the gravel. The vibration lasted <10 sec and occurred multiple times during the spawning act, which lasted ≤1 hr. The demersal eggs, which adhered in large clumps to the substrate, were 2 mm in diameter, transparent, spherical, and had colorless yolks. The number of eggs could not be determined but Mount (1959) reported that a female can lay approximately 100 eggs. It did not appear that the males guard the nest as reported in Etnier and Starnes (1993).

The above breeding account agrees with those reported by Mount (1959) and Etnier and Starnes (1993). Spawning season for *E. camurum* can run from mid-May to early August (Page, 1983). However, no spawning activities were witnessed on 24 May 2007 when water temperatures were 19° C or on 20 July 2007 when water temperatures were 27° C. Mount (1959) reported that the incubation period lasts 7-10 d at 19-23° C. The bluebreast darter has been shown to hybridize with other darters, including the Tippecanoe darter *Etheostoma tippecanoe* (Jordan and Evermann) and the greenfin darter *Etheostoma chlorobranchium* Zorach (Mayden and Burr, 1980; Eisenhour, 1995).

<u>Diet</u>
The bluebreast darter was witnessed eating aquatic insects, including midge larvae and small mayfly and stonefly nymphs. These food items agree with previous accounts for the species (Page, 1983; Etnier and Starnes, 1993; van Snik Gray et al., 1997). van Snik Gray et al. (1997) suggested that *E. camurum* specializes on prey <6 mm and potentially could compete for food resources with several darters, including greenside darter *Etheostoma blennioides* (Rafinesque), which is found in the Vermilion River basin. Also witnessed during my study were three separate, unsuccessful attempts made by *E. camurum* to eat the aquatic snail *Elimia livescens* (Menke) of the Family Pleuroceridae. It appeared that the fish's gape size was too small to consume the snails, which were about 8 mm in length. Darters have been shown to consume aquatic snails (Page, 1983; Etnier and Starnes, 1993), although it is unknown what percentage of snails, if any, comprises the diet of *E. camurum*.

MANAGEMENT CONSIDERATIONS

<u>Potential recovery efforts for the northern riffleshell</u>
Based on literature reviews (e.g., Smith, 1979; Cummings and Mayer, 1997) and museum records (e.g., INHS Fish Collection; INHS Mollusk Collection), *E. rangiana* and *E. camurum* co-occurred in only the Vermilion River basin in Illinois. In the Wabash River drainage, *E. rangiana* is extant in the Tippecanoe and White river basins (Fisher, 2006), whereas *E. camurum* is extant in the Tippecanoe River basin (Carney et al., 1992) and Wabash mainstem (Fisher et al., 1998). Potential source populations for *E. rangiana* propagation could be the Tippecanoe River basin, and optimal relocation sites in Illinois

are in the lower Middle Fork. These areas offer the highest densities of *E. camurum* and preferred habitat (e.g., gravel riffles) for *E. rangiana* (Cummings and Mayer, 1992). These areas are located in state park systems, and therefore offer instream protection. However, because they are in public areas, there is potential for interference in propagation methods (e.g., tampering of cages) from park users.

Bluebreast darter status

Etheostma camurum should remain listed as state-endangered. Because of its small range in Illinois and its affinity for specialized habitats, the species easily could be extirpated from the state by catastrophic events (e.g., a chemical spill). If this disaster were to occur, it would be unlikely that *E. camurum* could repopulate the Vermilion River basin naturally. With its sporadic distribution in the Wabash River drainage, the closest source population would be the Big Pine Creek basin in Indiana (B.E. Fisher, Indiana Department of Natural Resources, pers. comm.), a distance of >70 km. Although *E. camurum* can migrate if suitable substrates are present (Trautman, 1981), the habitat from the lower Big Pine Creek basin to the lower Vermilion River is mostly sandy gravel with very little cobble and boulder (pers. obser.; B.E. Fisher, Indiana Department of Natural Resources, pers. comm.). Therefore, all efforts should be taken to protect its habitat and prevent future disasters from occurring.

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Table 1. Sampling locations and densities of *Etheostoma camurum* during the 2007 survey in the Vermilion River basin (Wabash River drainage), Vermilion County, Illinois. Stream includes Salt Fork (SF), Middle Fork (MF), North Fork (NF), and mainstem Vermilion River (VR). Lat / Long is in decimal degrees. Densities are the number of individuals / meter^2.

Site #	Stream	Common location	Lat / Long	Density
1	SF	3.0 mi S DeLong, CR 200 E bridge	40.0694. -87.9016	0.000
2	SF	3.0 mi S Fithian, CR 400 E bridge	40.0649, -87.8629	0.000
3	SF	1.5 mi S Muncie, near CR 500 E	40.0891, -87.8421	0.009
4	SF	3.0 mi N Fairmount, CR 1500 N bridge	40.0943, -87.8161	0.044
5	SF	2.0 mi S Oakwood, CR 850 E bridge	40.0828, -87.7807	0.071
6	SF	1.0 mi S Bucktown, near park trail	40.1020, -87.7393	0.026
7	MF	1.0 mi S Armstrong, CR 350 E bridge	40.2988, -87.8776	0.000
8	MF	2.5 mi SE Armstrong, near CR 2950 N	40.2936, -87.8371	0.000
9	MF	1.0 mi S Potomac, CR 750 E bridge	40.2965, -87.8017	0.052
10	MF	2.0 mi S Potomac, CR 2900 N ford	40.2840, -87.7948	0.000
11	MF	2.5 mi W Jamesburg, near CR 2750 N	40.2604, -87.7959	0.027
12	MF	1.5 mi W Higginsville, CR 2600 N ford	40.2421, -87.7757	0.037
13	MF	2.5 mi E Collison, near CR 2400 N	40.2192, -87.7509	0.040
14	MF	2.0 mi W Snider, CR 2300 N bridge	40.2027, -87.7345	0.056
15	MF	2.5 mi NE Newton, CR 2100 N bridge	40.1767, -87.7342	0.037
16	MF	2.0 mi ESE Newton, CR 2000 N bridge	40.1599, -87.7400	0.074
17	MF	0.5 mi E Belgium Row, CR 1875 N bridge	40.1355, -87.7460	0.028
18	MF	1.5 mi E Bucktown, US Hwy 150 bridge	40.1167, -87.7261	0.028
19	NF	1.0 mi SW Alvin, CR 3025 N bridge	40.3037, -87.6220	0.000
20	NF	1.5 mi W Bismarck, CR 2750 N bridge	40.2658, -87.6427	0.000
21	NF	Danville, Harrison Park	40.1499, -87.6573	0.000
22	NF	Danville, Hungry Hollow Road	40.1335, -87.6548	0.000
23	NF	Danville, US Hwy 150 bridge	40.1233, -87.6385	0.008
24	VR	2.0 mi SE Bucktown, CR 1200 E bridge	40.1024, -87.7155	0.000
25	VR	0.5 mi S Batestown, I-74 bridge	40.1156, -87.6940	0.044
26	VR	0.5 mi E South Danville, RR bridge	40.1157, -87.6458	0.000
27	VR	Danville, I-74 bridge	40.1112, -87.6152	0.014
28	VR	2.5 mi E Hegeler, CR 1810 E bridge	40.0842, -87.5928	0.000
29	VR	4.0 mi E Westville, RR bridge	40.0380, -87.5577	0.027
30	VR	4.5 mi E Midway, Forest Glen Preserve	40.0176, -87.5498	0.000

Table 2. Fishes collected during the 2007 survey in the Vermilion River basin (Wabash River drainage), Vermilion County, Illinois. Special status: [SE] = state-endangered.

Family	Common name	Scientific name	No. indiv.
Lepisosteidae	Longnose gar	*Lepisosteus osseus*	1
Clupeidae	Gizzard shad	*Dorosoma cepedianum*	8
Cyprinidae	Central stoneroller	*Campostma anomalum*	258
	Spotfin shiner	*Cyprinella spiloptera*	19
	Steelcolor shiner	*Cyprinella whipplei*	17
	Bigeye chub	*Hybopsis amblops* [SE]	1
	Striped shiner	*Luxilus chrysocephalus*	7
	Redfin shiner	*Lythrurus umbratilis*	12
	Hornyhead chub	*Nocomis biguttatus*	21
	Golden shiner	*Notemigonus crysoleucas*	3
	Emerald shiner	*Notropis atherinoides*	18
	Bigeye shiner	*Notropis boops* [SE]	3
	Silverjaw minnow	*Notropis buccatus*	16
	Carmine shiner	*Notropis percobromus*	51
	Sand shiner	*Notropis stramineus*	72
	Suckermouth minnow	*Phenacobius mirabilis*	6
	Bluntnose minnow	*Pimephales notatus*	341
	Creek chubsucker	*Semotilus atromaculatus*	223
Catostomidae	Quillback	*Carpoides cyprinus*	1
	White sucker	*Catostomus commersonii*	3
	Northern hogsucker	*Hypentelium nigricans*	218
	Black redhorse	*Moxostoma duquesnei*	1
	Shorthead redhorse	*Moxostoma macrolepidotum*	5
Ictaluridae	Yellow bullhead	*Ameiurus natalis*	26
	Channel catfish	*Ictalurus punctatus*	17
	Stonecat	*Noturus flavus*	362
	Tadpole madtom	*Noturus gyrinus*	22
	Brindled madtom	*Noturus miurus*	49
	Flathead catfish	*Pylodictis olivaris*	3
Esocidae	Grass pickrel	*Esox americanus*	7
Atherinidae	Brook silverside	*Labidesthes sicculus*	21
Fundulidae	Blackstripe topminnow	*Fundulus notatus*	19
Centrarchidae	Rock bass	*Ambloplites rupestris*	5
	Green sunfish	*Lepomis cyanellus*	17
	Orangespotted sunfish	*Lepomis humilis*	8
	Bluegill	*Lepomis macrochirus*	31
	Longear sunfish	*Lepomis megalotis*	92
	Smallmouth bass	*Micropterus dolomieu*	29
Percidae	Greenside darter	*Etheostoma blennioides*	517
	Rainbow darter	*Etheostoma caeruleum*	481
	Bluebreast darter	*Etheostoma camurum* [SE]	79
	Fantail darter	*Etheostoma flabellare*	212
	Johnny darter	*Etheostoma nigrum*	72
	Logperch	*Percina caprodes*	7
	Slenderhead darter	*Percina phoxocephala*	19
	Dusky darter	*Percinia sciera*	3
Sciaenidae	Freshwater drum	*Aplodinotus grunniens*	11

Figure 1. Station locations of the 2007 survey of Vermilion River (Wabash River drainage), Vermilion County, Illinois. Circles indicate where *Etheostoma camurum* was collected and X's indicate sites where it was not.