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David A. Eisenhour

Audrey M. Richter

Joshua M. Shiering

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Conservation Status of the Longhead Darter, *Percina macrocephala*, in
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Conservation Status of the Longhead Darter, *Percina macrocephala*, in Kinniconick Creek, Kentucky

DAVID A. EISENHOUR^{1*}, AUDREY M. RICHTER^{1,2}, and JOSHUA M. SCHIERING¹

¹Department of Biology and Chemistry
Morehead State University
Morehead, Kentucky 40351

²Present address:
U.S. Army Corps of Engineers, Buffalo District
Buffalo, New York 14207

*Corresponding author: d.eisenhour@morehead-st.edu

ABSTRACT

Percina macrocephala, the Longhead Darter, is rare throughout its range and endangered in Kentucky. One population in Kentucky occurs in Kinniconick Creek, Lewis County, and prior to this study was known from only a few specimens, mostly collected in 1981. In summer and early fall of 2007 and 2008, 55 reaches, spanning 54 stream km of Kinniconick Creek, were surveyed by snorkeling, electrofishing, or seining for *P. macrocephala*. We encountered 104 individuals of *P. macrocephala* in a 50 stream km segment from just below the town of Kinniconick to the town of Garrison. Fifteen of the 55 sampled reaches contained *P. macrocephala*. Most individuals were encountered in a middle section between the confluences of Laurel Fork and Town Branch; this area also contained many young-of-the-year, indicating successful reproduction and recruitment. Although we judge this species to be rare to uncommon in most of Kinniconick Creek, it is locally common in the middle section, and the population seems to be stable and perhaps the most robust in the state. We conservatively estimate a total population of 2000-5000 in the stream. Because this population appears to be migratory, and exhibits source-sink dynamics, it is susceptible to anthropogenic barriers (e.g., culvert crossings) that prevent movements.

INTRODUCTION

Percina macrocephala (Cope), the Longhead Darter, is a large darter found in small to medium upland streams within the Ohio River basin (Page and Burr, 2011). However, it is sporadically distributed; the best populations appear to be in the Allegheny River drainage of Pennsylvania (D. A. Neely, pers. comm.), the Elk River of West Virginia (Stauffer et al., 1995; Welsh and Perry, 1998), and the Green River drainage in Kentucky and Tennessee

(Page, 1978; Burr and Warren, 1986). Because of its discontinuous distribution and its rarity in many areas of occurrence, it is considered threatened or endangered in most states in its range; in Ohio it is probably extirpated (Trautman, 1981; NatureServe, 2010). In the southeastern U.S. it is considered threatened (Jelks et al., 2008) and globally is considered as G3 (vulnerable) (NatureServe, 2010).

In Kentucky, *P. macrocephala* is most common in the upper Green River and Barren River systems (Burr and Warren, 1986). One early record each is available from the Cumberland River drainage (1891) and the upper Kentucky River drainage (1890) (Kirsch, 1893; Page, 1978), but the species is now considered extirpated from these drainages (Burr and Warren, 1986). It is represented in the Big Sandy River system by a 1937 record from Johns Creek in Pike County (UMMZ 154793). Its current status there is unknown. *Percina macrocephala* was first documented in Kinniconick Creek by a specimen (SIUC 23370) collected by Minor Clark in 1938 and later by seven specimens collected by L. Kornman in 1981 from three sites (Warren and Cicerello, 1983). A few additional specimens were observed or captured from one of Kornman's collection sites from 2003-2005 (R. Cicerello and D. Neely, pers. comm.). Despite Warren and Cicerello's statement that Kinniconick Creek had a healthy population, no comprehensive survey for this species had been conducted prior to this survey. In Kentucky this species is listed as endangered (KSNPC, 2010) and critically imperiled (S1) (Kentucky's Comprehensive Wildlife Conservation Strategy, 2010).

Geographic variation in morphology has been noted in this species; the Kinniconick population is the only extant one in the state belonging to an upper Ohio group (Page, 1978). However, recent analysis of molecular data shows little differentiation among specimens from the Barren River to the Allegheny River, suggesting recent, post-

Pleistocene dispersal (Page and Near, 2007). Thus, a conservation survey provides information on one of the most poorly known extant populations in Kentucky. Our goals were to determine the distribution and population size of *P. macrocephala* in Kinniconick Creek. These data are compared with historical data and observed habitat to determine changes in population size and primary threats to this species in Kinniconick Creek.

METHODS

Study area

The Kinniconick Creek watershed (655 km²) encompasses approximately half of Lewis County, Kentucky (USGS, 2008). This creek is 87 km long, with a gradient of approximately 2.3 m per stream km. The dominant land-cover type of the Kinniconick Creek watershed was calculated to be forested land (82%), followed by scrubby/herbaceous cover (7%), pasture/hay/crops (6%), and developed land (4%) (KGSGL, 2007). In general water is fairly clear (our measured Secchi disk visibilities were usually 2-3 m), with substrates primarily of boulder, cobble, and gravel. Submergent vegetation is occasional and emergent vegetation (*Justicia*) is common.

Sampling stations

We surveyed Kinniconick Creek, Lewis County, Kentucky from early summer to mid-fall of 2007 and 2008 for *P. macrocephala*. We established 198 sampling stations (reaches), via canoe, over a 69 stream km distance, from the confluence of Indian Creek to the town of Garrison (at the most downstream riffle before the stream enters the Ohio River). Reaches were defined as the crest of one riffle to the crest of the next riffle, and contained at least one pool. Reach length ranged from 36 to 3000 m, reach width averaged 13.4 m, and reach depth averaged 0.36 m. Because of logistical constraints and results from preliminary sampling, we sampled for darters in the lower 54 stream km (155 reaches), with the upper boundary being just above a concrete low-water farm bridge at the town of Kinniconick. We followed a stratified random design (Brown and Austen, 1996), where one of every three reaches were chosen randomly and surveyed for *P. macrocephala*. We snorkeled a total of 55 reaches (41 in 2007, 14 in 2008). In addition, 14 of these 55 reaches (selected randomly) were also sampled by backpack electrofishing and seining to evaluate the effectiveness of snorkeling.

Darter surveys

Quantitative surveys for darters were conducted by snorkeling and were accomplished by two persons moving parallel upstream through a reach. Positions of observed *P. macrocephala* were marked with a weighted flag. If multiple darters were found in a small area (< 1 m²), only one flag was dropped but the maximum number of darters visible together was recorded. For reaches less than 120 m long, the entire reach was sampled. Longer reaches

were subsampled by snorkeling 40 m at each end of the reach and 40 m near the middle of the reach. An additional criterion for the middle 40-m section was that it had to be sufficiently shallow (less than 1.5 m) to effectively snorkel, seine, and backpack electrofish. For reaches that also were sampled by backpack electrofishing and seining, the same distances were sampled. Sampling methodology of seining and electrofishing followed guidelines of KDOW (2010). Locations of darters observed while wading or canoeing in reaches or sections of reaches not sampled also were recorded.

RESULTS

We found *P. macrocephala* in 15 of the 55 reaches sampled (Fig. 1). Visibility (lateral Secchi disk distance) was not significantly different (t-test, $P=0.1851$) between reaches with and without *P. macrocephala*, suggesting differences in visibility among reaches did not affect our ability to detect darters while snorkeling. Most Longhead Darters were found in the middle part of Kinniconick Creek, between the confluences of Laurel Fork and Town Branch. A total of 104 *P. macrocephala* were encountered, which included 65 individuals from sampled reaches and 39 additional individuals (Appendix). These 39 individuals were observed, often from canoe or while wading, in reaches not sampled or in portions of reaches not sampled. Also, in 2005-2007, R. Cicerello and R. Evans, while surveying Kinniconick Creek for mussels, observed *P. macrocephala* at four sites (pers. comm.) and in 2003-2004, D. Neely collected a total of four *P. macrocephala* (pers. comm.) (Fig. 1). Our records extend the known range upstream and downstream in Kinniconick Creek to 50 stream km, from about 0.5 km below KY 10 Crossing (38.59782°, -83.18539°) upstream to about 3 km below confluence of Grassy Branch (38.50764°, -83.32468°). Both young-of-the-year and subadults-adults were found; all of the young-of-the-year were found below the confluence of Laurel Creek (Fig. 2).

Longhead Darters most frequently were found in areas just above riffles where there was little or no flow (0-0.22 m/sec, mean = 0.027 m/sec), low to moderate silt (<1 mm on rocks), abundant boulders and cobbles, and depths of 0.4-0.8 m. We occasionally encountered *P. macrocephala* below riffles and rarely encountered them in the middle of long pools, usually when shallow water (a "saddle") created slight flow (Eisenhour et al., 2009).

DISCUSSION

Status in Kinniconick Creek

Prior to 2003, *P. macrocephala* was known from only eight specimens, mostly collected by L. Kornman in 1981 (Warren and Cicerello, 1983) from a 25 stream km reach. We document the species from about 50 stream km and found it to be locally common in some areas. Because of the difficulty in capturing *P. macrocephala* in Kinniconick

Creek, mark-and-recapture studies are not useful for estimating populations. Based on a combination of snorkeling surveys and mark-and-recapture methods, a population of Gilt Darters (*Percina evides*) in Tellico Creek, North Carolina, was estimated to be about 2.7 times larger than the number of individuals encountered (Skyfield and Grossman, 2008). Our snorkeling efforts appear a little less intense than theirs, but we judge that *P. macrocephala* is more likely to be observed, because of its large size and pelagic habits. Assuming the detection probability of *P. evides* and *P. macrocephala* by snorkeling is similar, we estimate 20-50% of the individuals present were seen in the sections sampled. Extrapolating from the 5700 m sampled to the 54 total km in our survey area, a conservative population estimate for Kinniconick Creek is 2000-5000 *P. macrocephala*. There is no evidence to suggest that *P. macrocephala* has declined in Kinniconick Creek. We judge *P. macrocephala* to be uncommon to locally common in Kinniconick Creek below the confluence of Laurel Fork and rare above the confluence of Laurel Fork.

The population of *P. macrocephala* in Kinniconick Creek may be one of the most robust in the state. This species formerly was common in the upper Green and Barren River systems (Page, 1978), and remains locally common there in Russell Creek, Trammel Fork, and Drakes Creek (D. A. Neely, pers. comm.). Other recent, intensive surveys of areas in the Green River where it was formerly common revealed very few specimens (M. Thomas, B. M. Burr, and R. Hopkins, pers. comm.), suggesting some populations in the Green River drainage have declined. Although this study documented a Kinniconick population larger than previously presumed and relatively stable, *P. macrocephala* is still uncommon there, and one of the rarest darters in Kinniconick Creek. We recommend maintaining the endangered status of this species in Kentucky.

Management implications

1. *Snorkeling is an effective sampling technique.* Most Longhead Darters were seen while snorkeling (74%), many were seen while canoeing or wading (20%), but only a few were captured by electrofishing or seining (6%). These darters are large and typically suspend in midwater, making them fairly easy to see by snorkeling or from the surface. In many reaches we saw numerous *P. macrocephala* while snorkeling, but were unable to collect any with a seine or backpack electrofisher only minutes later. We sometimes observed *P. macrocephala* moving away from an active backpack electrofisher, apparently sensing the electrical field from a distance and escaping before they could be stunned, as do pelagic minnows.

2. *Priority protection.* The most important section of Kinniconick Creek that should be protected is the middle section, between the confluences of Laurel Fork and Town Branch. This area has the highest concentrations of *P. macrocephala*, and nearly all of the young-of-the-year. In addition, this is the only section where we encountered another rare fish (*Notropis ariommus*, Popeye Shiner), and where we most frequently observed live mussels.

Riparian zones along this section are almost entirely intact and land cover is almost entirely forested. Our preliminary observations suggest a study comparing the relationship of *P. macrocephala* abundance to land use practices and riparian zone width would likely be informative.

3. *Road crossings should allow instream movements of Longhead Darters.* Populations appear to be seasonally migratory. At two sites that each yielded more than 10 individuals during the regular sampling protocol (August 2007), no individuals were found at two other surveys (June 2007 and September 2009), despite similar, intensive efforts. Kinniconick Creek experienced severe drought both sampling seasons, with record to near-record low flows recorded at the USGS gaging station. Flows fell to zero, or nearly so, by mid-July in 2007 and by late August in 2008. At this time, lower Kinniconick Creek (below confluence of Laurel Fork) flow was mainly interstitial seepage through riffles; upper Kinniconick Creek consisted of isolated pools, with intervening, completely dewatered sections as long as 500 m. We suspect that periodic local extirpations or poor recruitment occurs in the upper portion of the stream during severe droughts; immigration from downstream areas is needed for recolonization. Phylogeographic studies support the hypothesis that this species has substantial potential for migration. Specimens spanning a geographic range from the Barren River of Kentucky to the Allegheny River of Pennsylvania exhibit almost no divergence in mtDNA, which suggests a recent population bottleneck followed by rapid, postglacial dispersal (Page and Near, 2007). In addition, the distribution of adult and young *P. macrocephala* (Fig. 2) suggest that source-sink dynamics (Pulliam, 1988; Dias, 1996) are present, at least during our sample period, which were both severe drought years. Downstream areas which have a high density of *P. macrocephala* and evidence of successful reproduction may act as source populations that supplement populations, by migration, in upper Kinniconick Creek, a sink. The upper Kinniconick populations may require immigration to supplement limited reproduction (acting as a pseudosink) or no reproduction (acting as a true sink).

Some road crossings, especially culverts, affect fish movements by blocking or limiting migration (Warren and Pardew, 1998; Schaefer et al., 2003; Benton et al., 2008). Many road crossings over Kinniconick Creek are high bridges, such as those at KY 10 and KY 59, which do not impair fish movement. However, two crossings at the upstream limit of the range of *P. macrocephala* in Kinniconick Creek are low-water concrete bridges with perched culverts. Upstream passage by fishes is impossible at low to moderate flows, and difficult at high flow, because flow is funneled through culverts, creating rapid currents with no cover. Sampling above the most downstream culvert was less intensive (five sites quantitatively sampled, plus about 12 km of survey by canoe and wading), than in the rest of the stream, but no *P. macrocephala* were found in this area. This suggests that construction of road crossings be engineered to permit upstream and downstream movement of fishes.

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APPENDIX

TABLE A1. *Percina macrocephala* found within quantitatively sampled reaches in Kinniconick Creek. Reaches are listed from upstream to downstream.

Date	Reach	# of YOY	# of adults	Method	Latitude and Longitude
13 October 2007	50		1	Snorkel	38.50764°, -83.32468°
			1	Seine	
23 September 2007	91		2	Snorkel	38.48405°, -83.27621°
			1	Shock	
14 August 2007	104		1	Snorkel	38.48222°, -83.25028°
22 June 2007	106		1	Snorkel	38.48444°, -83.24694°
			1	Shock	
25 July 2007	112	12		Snorkel	38.49722°, -83.25637°
24 July 2007	123	6	2	Snorkel	38.52222°, -83.24861°
24 July 2007	125		3	Snorkel	38.52278°, -83.24986°
31 August 2007	132		2	Snorkel	38.51579°, -83.23318°
9 September 2007	138	2	4	Snorkel	38.53078°, -83.24277°
31 August 2007	140	1	6	Snorkel	38.53401°, -83.23682°
			7	Snorkel	38.53376°, -83.23737°
16 August 2007	143	4		Snorkel	38.54194°, -83.23806°
8 Aug 2007	148		1	Snorkel	38.55066°, -83.23826°
30 July 2008	K23	2		Snorkel	38.57521°, -83.19028°
			1	Snorkel	38.5726°, -83.19028°
			1	Snorkel	38.57509°, -83.19016°
8 August 2008	K34		1	Snorkel	38.58294°, -83.19058°
23 August 2008	K38	2		Snorkel	38.59782°, -83.18539°

TABLE A2. *Percina macrocephala* found during non-quantitative surveys (either in reaches not sampled or in parts of reaches not quantitatively sampled) in Kinniconick Creek. Reaches are listed from upstream to downstream.

Date	Reach	# of YOY	# of adults	Method	Latitude and Longitude
31 May 2007	106		1	Canoe	38.48417°, -83.2544°
			2	Snorkel	
31 May 2007	106		1	Canoe	38.48472°, -83.25361°
25 July 2007	109	1		Wading	38.49171°, -83.25097°
25 July 2007	110		2	Canoe	38.49444°, -83.25°
25 July 2007	111	1		Canoe	38.49667°, -83.25806°
25 July 2007	111	3		Canoe	38.49692°, -83.25802°
		3		Wading	38.49707°, -83.25725°
23 July 2007	122		1	Wading	38.52155°, -83.24861°
24 July 2007	126	10	6	Wading	38.52333°, -83.24444°
1 August 2007	126	3		Wading	38.52333°, -83.2444°
		1		Shock	
			2	Shock	
			1	Wading	
31 August 2007	131	1		Canoe	38.51674°, -83.23483°

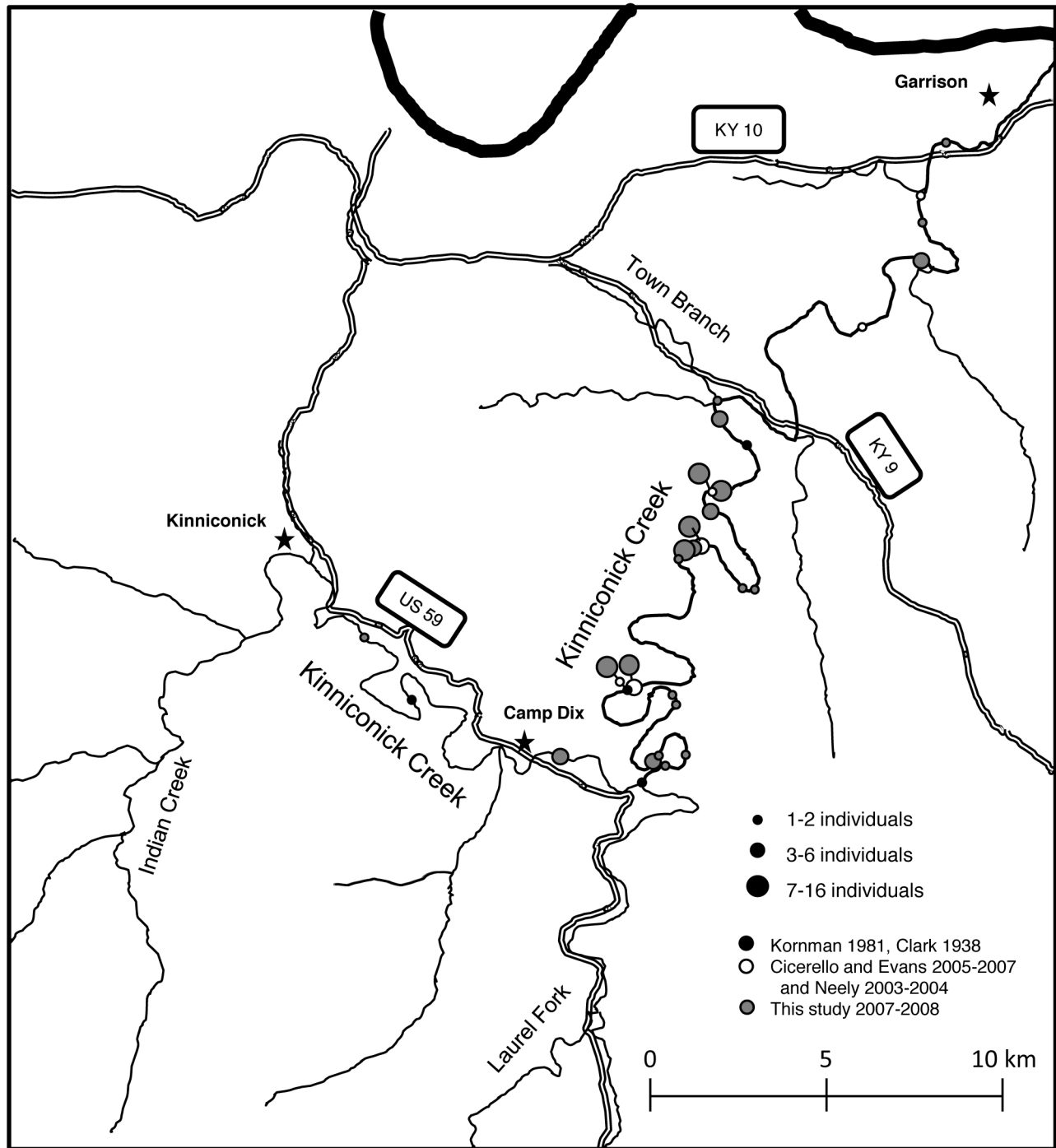


FIGURE 1. Distribution of *Percina macrocephala* in Kinniconick Creek, Lewis County, Kentucky.

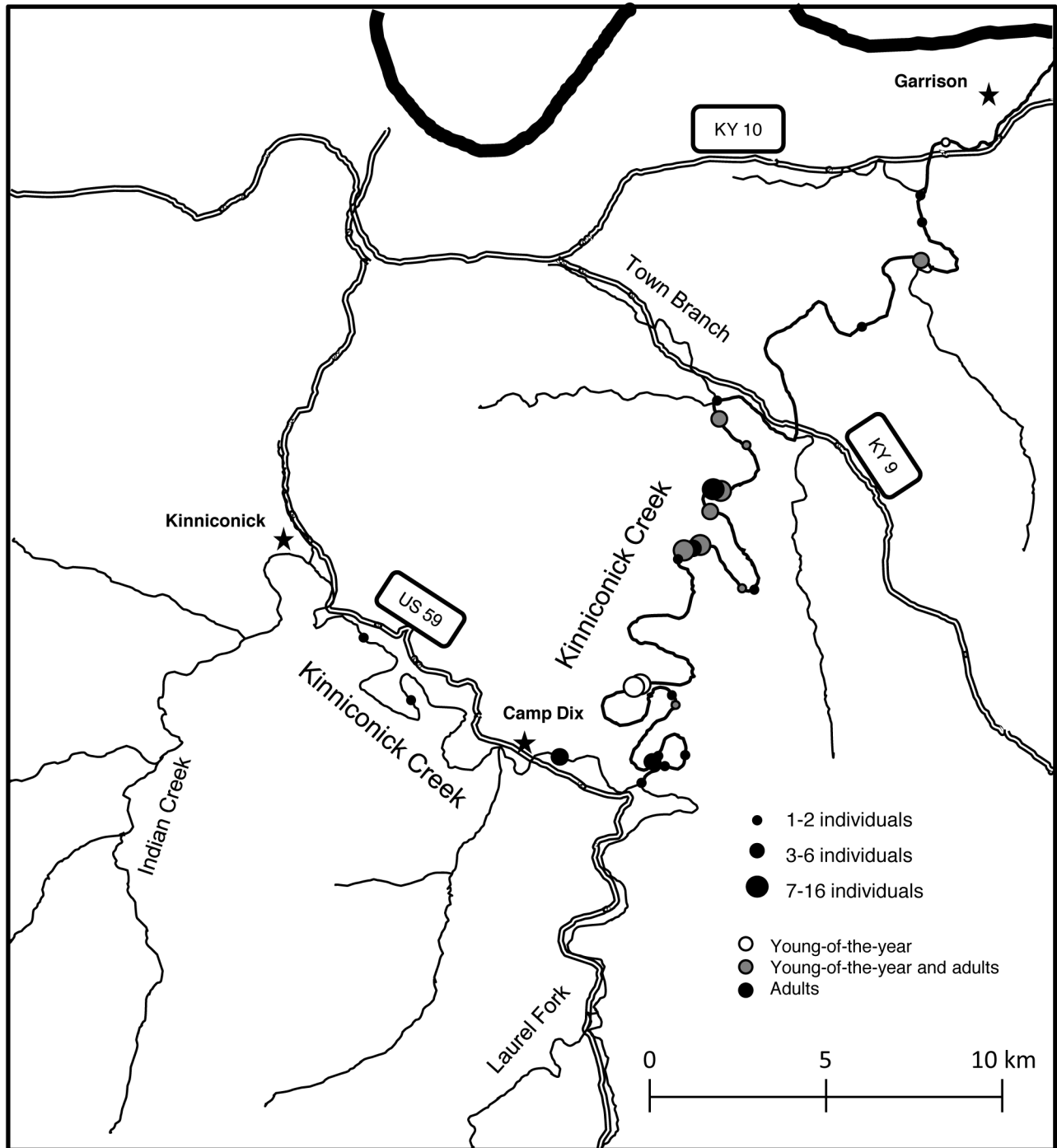


FIGURE 2. Adult and young *Percina macrocephala* encountered in Kinniconick Creek, 2007-2008.