A Species on the Edge: Occurrence of *Pimephales vigilax* (Teleostei: Cyprinidae) in the Spring River Drainage, Missouri

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The bullhead minnow (*Pimephales vigilax*, Fig. 1) is a wide-ranging North American cyprinid found from the Ohio River drainage in Pennsylvania, the Mobile River drainage in Alabama, and the Rio Grande drainage in Texas and México to the Mississippi River drainage in Minnesota (Lee and Kucas, 1980). It has been introduced to the upper Rio Grande in western Texas and New Mexico, and to the Kansas River in Kansas, where it is common (Lee and Kucas, 1980; Cross and Collins, 1995). Reports from the Missouri River drainage in Iowa and Nebraska (Evermann and Cox, 1896), and South Dakota, were misidentifications and the specimens were later assigned to the bluntnose minnow (*P. notatus*) (Johnson, 1942; Bailey and Allum, 1962; Lee and Kucas, 1980).

In Missouri, *P. vigilax* is found in the Mississippi River drainage where it is common at most localities (Pflieger, 1997). It reaches its greatest abundance in the northeastern and southeastern regions of the state (Pflieger, 1971; Hrabik, unpublished data). *Pimephales vigilax* is widespread in the Upper Mississippi River where it is common in the pools, but scarce in the unimpounded or open reach (Pflieger, 1971; Pitlo et al., 1995; Gutreuter, 1997; Gutreuter et al., 1997; Burkhardt et al., 1997, 1998). *Pimephales vigilax* was reported from South Grand River and Tabo Creek in Missouri (Jordan and Meek, 1885), but these specimens were actually *P. notatus* (Hubbs and Black, 1947).

The only published record of *P. vigilax* outside the Mississippi River drainage in Missouri was from the Arkansas River basin in Spring River, Jasper County (Fowler, 1924). Fowler was reporting on a series of collections by Spencer Baird, Charles Girard, and Edward Cope that had not before appeared in publication. He noted a series of 42 specimens of *Ceratichthys* (*Pimephales*) *vigilax* from Indiana, Iowa, Arkansas, Texas, and Missouri-Carthage (presumably from Spring River). Fowler gave no dates nor did he list the collector(s). Baird and Girard were ichthyologists working for the U.S. Fish Commission who described (and redescribed) many fishes from the Midwestern United States from the 1850s through the 1860s, including *P. vigilax.* Cope, a largely self-taught naturalist, specialized in several branches of biology and paleontology. Although Cope worked under the auspices of several universities and professional societies, he was most known for his association with the Academy of National Sciences in Philadelphia. Cope began his work in the 1860s and continued until his death in the 1890s (Osborn, 1931; Davidson, 1997). The literature does not indicate that Cope collected in the vicinity of Carthage, Missouri, so I believe the collector of *P. vigilax* from Spring River was Baird, Girard, or someone under their guidance. Girard identified and described several fishes from the Arkansas River drainage in present-day Kansas, Oklahoma, and Arkansas, collected through the government-sponsored Pacific Railroad Survey from 1853-1855 (Girard, 1858). Under the command of Lt. A. W. Whipple, several presumably untrained collectors, ranging from surgeons to artists, collected fishes in this region, most notably Dr. C. B. Kennerly and H. B. Mollhausen. Unfortunately, there were many locality data errors in this work (Miller and Robison, 1973; Robison and

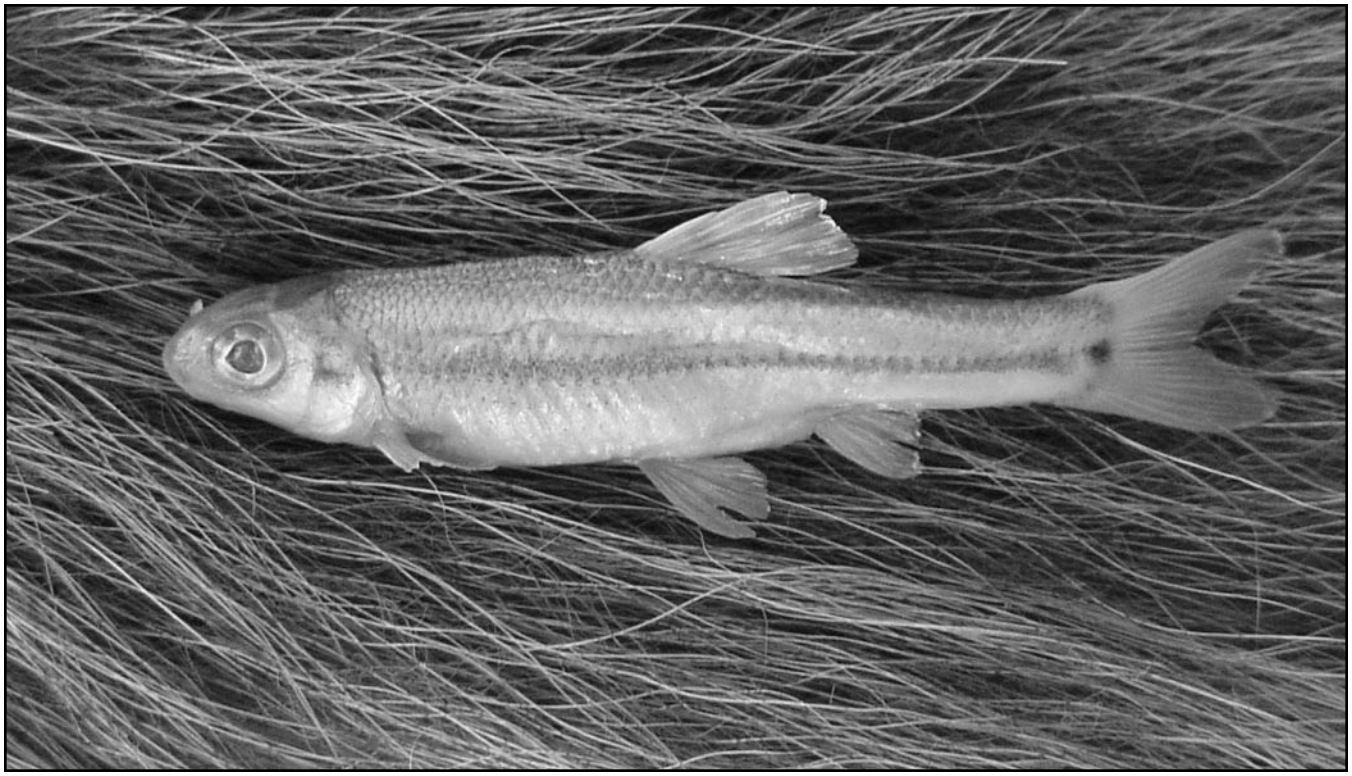


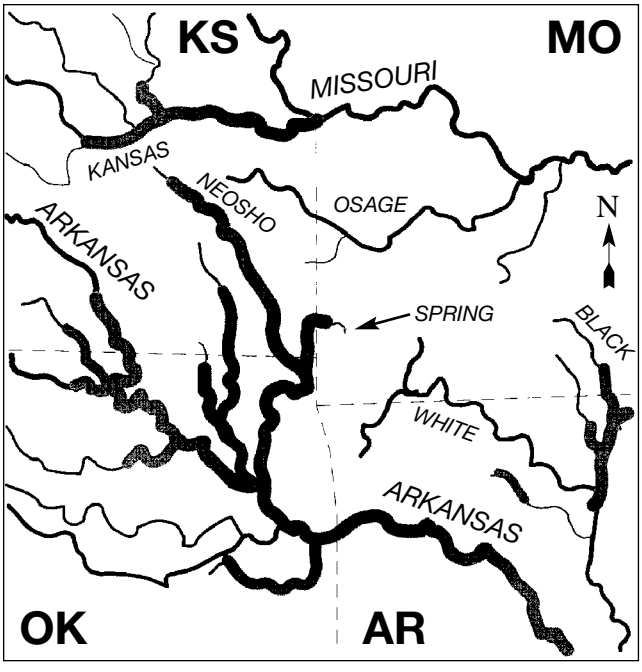
Fig. 1. Bullhead minnow, *Pimephales vigilax.* Missouri: Stoddard County: Unnamed ditch to Little River (1996). Photo by Robert A. Hrabik.

Buchanan, 1988). It is not known whether the specimen(s) from Carthage, Missouri, were collected during the Pacific Railroad Survey or at some later date. Therefore, it is possible that the *P. vigilax* specimens collected at Carthage, Missouri, may date from as early as 1853-55 or sometime later during the tenure of Baird and Girard.

Pimephales vigilax is common in parts of the Arkansas River drainage (Miller and Robison, 1973; Lee and Kucas, 1980; Robison and Buchanan, 1988; Cross and Collins, 1995). It is tolerant of turbidity and siltation (Robison and Buchanan, 1988; Pflieger, 1997) and can be found in strong current or sluggish pools, over sand or mud, conditions prevalent in the Arkansas River drainage. *Pimephales vigilax* is also common in the Neosho River of Oklahoma and Kansas (Miller and Robison, 1973; Cross and Collins, 1995), which drains Spring River.

Spring River, a 7th-order stream below its confluence with the North Fork Spring River, originates in Barry County, Missouri, and flows generally in a northwesterly direction for 91 km before turning south near the Kansas border (Fig. 2). Spring River flows to the south in Kansas and Oklahoma before it joins the Neosho (Grand) River above Lake of the Cherokees (Grand Lake) in northeastern Oklahoma. The fish community of Spring River is unusually diverse for this region. Of the 135 fish species known from Kansas, more than 100 have been found in the Spring River

Fig. 2. Generalized distribution of *Pimephales vigilax* in the Arkansas River system based on Lee and Kucas (1980), Cross and Collins (1995), and Miller and Robison (1973).



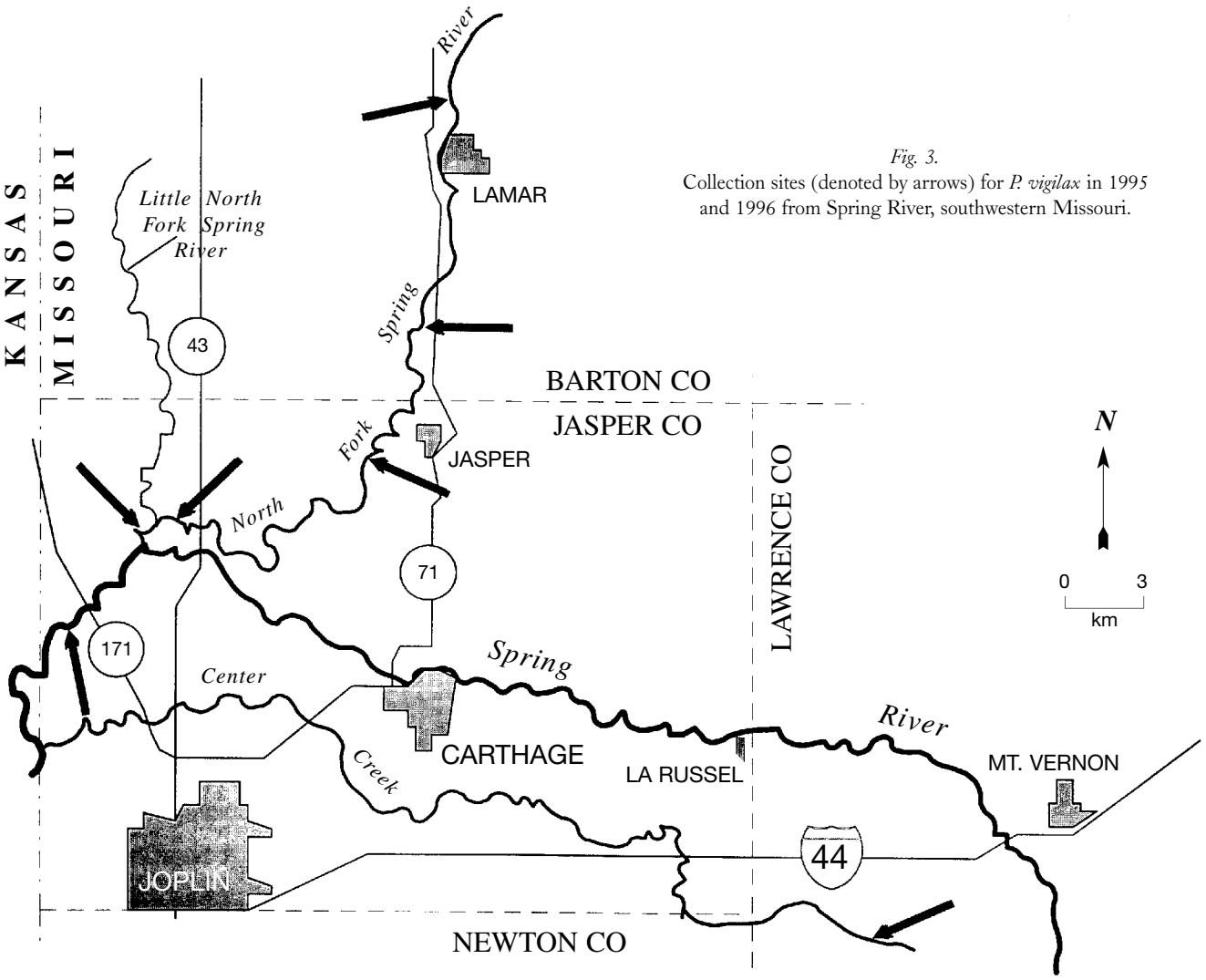


Fig. 3.
Collection sites (denoted by arrows) for *P. vigilax* in 1995 and 1996 from Spring River, southwestern Missouri.

basin with 20 that are endemic to that drainage (Cross and Collins, 1995; Wilkinson and Edds, 1996). This region also contains diverse and distinctive fish assemblages in Missouri and Oklahoma (Miller and Robison, 1973; Pflieger, 1997).

I collected a single specimen of *P. vigilax* from Spring River, Jasper County, Missouri, at ne1/4, Sec. 24, R33W, T29N on 9 August 1996 (Fig. 3). This was believed to be the first collection of *P. vigilax* from Spring River in Missouri since the 1800s. However, after consulting with other ichthyologists and biologists with the Missouri Department of Conservation, I learned that Edds and Dorlac (1995) and Wilkinson and Edds (1996) reported collections of *P. vigilax* at six sites from the Spring River basin in Missouri (Table 1, Fig. 3).

The largest reported collection of *P. vigilax* in Spring River, Missouri, was 52 specimens in Lawrence County on 18 May 1993 (Edds and Dorlac, 1995). This apparently was either a misidentification by a student worker or a typographical error, because the voucher specimens were actually creek chubs, *Semotilus atromaculatus* (David Edds, Emporia State University, pers. comm.). The largest verifiable collection of *P. vigilax* in Spring River, Missouri, was 18 specimens from North Fork Spring River in Barton County on 19 June 1995. Abundant species in association with *P. vigilax* at that site (including their relative abundance) were *Lepomis macrochirus* (25.7% of the total sample), *Lythrurus umbratilis* (18.6), *Labidesthes sicculus* (14.9), *Cyprinella lutrensis* (9.7), *Percina copelandi* (7.8), and *Lepomis humilis* (4.1). Other species found with *P. vigilax* at the other six sites were *Notropis rubellus*, *Pimephales tenellus*, *Luxilus cardinalis*, *Cyprinella camura*, *Noturus exilis*, *Notropis buchanani*, *Pimephales notatus*, *Cyprinella spiloptera*, *Etheostoma zonale*, and *Etheostoma spectabile*.

The significance of finding *P. vigilax* in the Spring River system of Missouri is not that it is there, but that it had been over 100 (possibly 145) years between documented occurrences. Dr. William L. Pflieger and his associates of the Missouri Department of Conservation sampled Spring River at 52 sites

Table 1. Collections of *Pimephales vigilax* from the Spring River basin, Missouri, 1995-1996.

Date	Stream	County	Legal Description	Number Collected
26 May 1995	Center Creek	Lawrence	se1/4, Sec. 25, R28W, T27N se1/4, Sec. 30,R28W, T27N	1
19 June 1995	North Fork Spring River	Barton	nw1/4, Sec. 18, R30W, T32N	18
7 July 1995	North Fork Spring River	Jasper	Sec. 4, R33W, T29N	2
10 July 1995	North Fork Spring River	Barton	Sec. 26, R31W, T31N Sec. 35, R31W, T31N	4
11 July 1995	North Fork Spring River	Jasper	Sec. 3, R33W, T29N	4
7 August 1995	North Fork Spring River	Jasper	nw1/4, Sec. 22, R31W, T30N	4
9 August 1996*	Spring River	Jasper	ne1/4, Sec. 24, R33W, T29N	1

All voucher specimens are in ichthyology collections at Emporia State University except (*), which was deposited at the University of Nebraska State Museum (ZM-8566).

from 1962 to 1997, but never collected *P. vigilax*. Similarly, the U.S. Fish and Wildlife Service sampled the Missouri portion of Spring River several times looking for *Noturus placidus* (Wildhaber et al., 1996), but never captured *P. vigilax*.

Three plausible explanations for this phenomenon are: 1) all previous researchers misidentified *P. vigilax* in their samples; 2) *P. vigilax* was absent from the basin and has only recently returned; or 3) *P. vigilax* persisted in the basin in very low numbers and was not collected.

I dismiss the first explanation because most previous samples, especially since 1962, were conducted by respected ichthyologists who well understood the taxonomy of *Pimephales* species. I dismiss the second explanation because there seems to be no evidence of a major disturbance, which might have eliminated *P. vigilax* from the Missouri portion of the Spring River basin. Although the drainage had been mined for coal, zinc and other metals for many years (Wildhaber et al., 1996), there is insufficient evidence that mining operations would have affected *P. vigilax* to its exclusion, yet allowed other less-tolerant species to have persisted. The North Fork of the Spring River (North Fork), where we collected most *P. vigilax* specimens in Missouri, does not have the same history of coal, lead, and zinc mining activity that characterizes other portions of the Spring River drainage (Davis and Schumacher, 1992). Neither do I believe that land use is a significant factor in limiting the distribution of *P. vigilax* in the Missouri portion of Spring River. Land use in the North Fork has been primarily restricted to agriculture, with approximately 85% of the drainage converted to crops (Davis and Schumacher, 1992). Similarly, land use in the Kansas portion of the Spring River drainage, in which *P. vigilax* is common, is approximately 84% agricultural (Davis and Schumacher, 1992). I must also rule out competitive exclusion with other members of *Pimephales* or other cyprinids given that *P. vigilax* is common in Kansas and Oklahoma portions of Spring River where fish communities are much the same as in the Missouri portion below Missouri Highway 43.

It is possible, however, that *P. vigilax* has always inhabited the Missouri portion of the Spring River basin in low numbers. It seems that only a small area of the Missouri portion of Spring River contains habitat suitable for *P. vigilax*: downstream from the North Fork, which is much like the Spring River in Kansas (Davis and Schumacher, 1992). Eastward flowing streams in the Kansas portion of the Spring River basin, as well as the North Fork in Missouri, drain the Central Lowlands physiographic province. These are characteristically low gradient, sluggish streams with higher turbidity than most streams flowing out of the Missouri portion of the basin (Davis and Schumacher, 1992; Adamski et al., 1995). The North Fork is a rather typical prairie-converted-to-agriculture system, where the channel is unstable and the substrate is primarily sand and silt. These conditions are suitable for *P. vigilax*, which may explain why *P. vigilax* was collected from the North Fork with greater frequency than Spring River in Missouri. A narrower channel, clearer water, and a greater proportion of gravel substrate characterize Spring River above its confluence with the North Fork. In contrast to the lowland streams, most westward flowing streams in the Spring River basin drain the Ozark Plateau physiographic province (Adamski et al., 1995). The streams, including Spring River upstream from the North Fork, are typically spring-fed with high gradients and low turbidity (Davis and Schumacher, 1992). The fish community seems to reflect these physicochemical differences because silt and turbidity intolerant species such as *Luxilus cardinalis*, *Nocomis asper*, *Notropis nubilus*, *Minytrema melanops*, *Cottus carolinae*, *Micropterus dolomieu*, and *Oncorhynchus mykiss* generally increase in abundance the further they occur above the North Fork confluence (Chris Vitello, Missouri Dept. of Conservation, unpub. data).

Organisms at the periphery of their native range may increase or decrease in abundance depending on local perturbations and environmental conditions. For example, Pflieger (1997) noted several species' ranges have diminished in the Ozark-prairie border. Species with an affinity for the Ozark region are presently less common in the Ozark-prairie border. However, the relative abundance of these species varies depending on land use and natural environmental conditions in particular drainages (Hrabik, pers. observation). The lower Spring River and tributaries in Missouri are at the edge of the native range of *P. vigilax*. It may be possible that current conditions are such that they favor higher numbers of *P. vigilax*. It may also be possible that *P. vigilax* may seasonally be more abundant in certain reaches of the basin. Although speculation, these possibilities could explain why previous researchers did not collect *P. vigilax*.

Based on the information available, I do not believe that *P. vigilax* has recently reinvaded or recolonized the Missouri portion of Spring River. I believe it has always been there, but may increase or decrease its range and abundance depending on local physicochemical conditions.

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