

NEOSHO MADTOM DISTRIBUTION AND ABUNDANCE IN THE SPRING RIVER

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The Neosho madtom, *Noturus placidus*, is a species of catfish listed as threatened by the U.S. Fish and Wildlife Service (55 F.R. 21148). Its distribution is restricted to the Neosho River basin upstream from Lake o' the Cherokees (Grand Lake), Oklahoma. Although its historical range extended over a larger area prior to construction of mainstream impoundments, the Neosho madtom is now found almost exclusively in the Neosho and Cottonwood rivers of Kansas (USFWS, 1991). The species persists at low densities, however, in two other areas. These are a short stretch of the Neosho (Grand) River in Oklahoma upstream from Lake o' the Cherokees (Luttrell et al., 1992; Wenke et al., 1992) and a portion of the Spring River in extreme southwestern Missouri and southeastern Kansas (Fig. 1).

The Neosho madtom was first documented in the Spring River in 1963, but past records documented only 15 individuals from eight collections at four mainstream sites, two in Missouri and two in Kansas (Pflieger, 1971; USFWS, 1991). The historical population of Spring River Neosho madtoms is separated from conspecifics in the Neosho River by three dams, more than 50 river km, and the upper portion of Lake o' the Cherokees, impounded in 1941. Physico-chemical factors, including a paucity of suitable habitat, have been suggested as potential limiting factors for the Neosho madtom in the Spring River (Moss, 1983; USFWS, 1991).

Additionally, the Spring River in Cherokee Co., Kansas, and Jasper Co., Missouri, drains EPA

Superfund cleanup sites where abandoned lead, zinc, and coal mines have polluted surface and ground waters in the drainage (Spruill, 1984). The Neosho madtom recovery plan (USFWS, 1991) called for an intensive survey for the Neosho madtom in the Spring River of Missouri, Kansas, and Oklahoma. The objectives of our study were to assess Neosho madtom distribution and abundance in this river.

We sampled 106 locations along the Spring River in Missouri (53 sites), Kansas (39 sites), and Oklahoma (14 sites). Sample sites were chosen to represent the variety of habitats available from headwaters to tailwaters, and were sampled in haphazard fashion along the mainstream. Sites typically encompassed at least one riffle/run/pool series, but occasionally consisted of only one gravel bar. One crew sampled from March to September 1993 (70 sites), another from July to August 1994 (18 sites), and a third from September to October 1994 (18 sites). Sampling was performed by kick-seining with a heavily-weighted 4.7 mm-mesh seine during daylight hours. In 1993 and July through August 1994, the area of each haul (11.5 m²; 4.6-m seine with substrate disturbed starting 2.5 m upstream) was greater than that in September and October 1994 (4.5 m²; 1.5-m seine with substrate disturbed 3.0 m upstream). All fishes were identified and counted; Neosho madtoms were measured, photographed, and released alive at the site of capture following the completion of sampling at each location.

The total number of kick-hauls performed at

each site was recorded. Neosho madtom density of occurrence (species-specific density) was calculated by dividing the number of individuals captured by the area sampled in hauls that yielded the species, and overall density was calculated by dividing the number of Neosho madtoms captured by the total area sampled by kick-hauls at sites yielding the species (Wenke et al., 1992).

We collected nine Neosho madtoms at five sites in 1993, 52 at 12 sites in July and August 1994, and 26 at nine sites in September and October 1994. We captured the species at 15 of 79 different sites sampled in 1993 and July through August 1994 combined, and at nine of 18 locations in September and October 1994. All historical sites of occurrence (sites 3 and 5 in Missouri, and 11 and 13 in Kansas; Appendix 1) yielded Neosho madtoms.

Fifteen sites represented new collection localities for this species (Appendix 1): five in Missouri (sites 1, 2, 4, 6, and 7) and 10 in Kansas (sites 8 to 10, 12, and 14 to 19). Sites 1 and 2 extended the known distribution of the Neosho madtom in the Spring River 1.5 km upstream in Missouri (W.L. Pflieger, Missouri Dept. Cons., pers. comm.). Seven sites (7, 14 to 19) extended the known distribution 26 km downstream, covering virtually all but approximately the last 4 km of the Spring River in Kansas (Fig. 1). No Neosho madtoms were captured in the Spring River in Oklahoma.

Overall density per 100 m² ranged from 0.3 to 1.8 ($\bar{X} = 0.9$) in 1993, 0.3 to 4.6 ($\bar{X} = 2.1$) in July and August, 1994, and 1.5 to 13.3 ($\bar{X} = 4.3$) in September, 1994. Density of occurrence per 100 m² ranged from 8.7 to 10.9 ($\bar{X} = 9.1$) in 1993, 8.7 to 17.4 ($\bar{X} = 11.3$) in July and August, 1994, and 22.2 to 66.7 ($\bar{X} = 30.0$) in September and October, 1994. Maximum overall density (13.3) was documented in 15 4.5-m² kick hauls, and maximum density of occurrence (66.7) was based on nine individuals in three 4.5-m² kick hauls; both occurred at site 4 in October, 1994. Thirty-nine of the 87 Neosho madtoms captured were judged to be young-of-year, based on lengths. Young-of-year ranged 26 to 43 mm total length in 1993, 27 to 50 mm in July and August 1994, and 30 to 59 mm in September and October 1994.

Our survey indicates that density of Neosho madtoms in the Spring River is low. Their distribution in this river generally extended from downstream of the mouth of the North Fork of Spring River in Jasper Co., Missouri, through

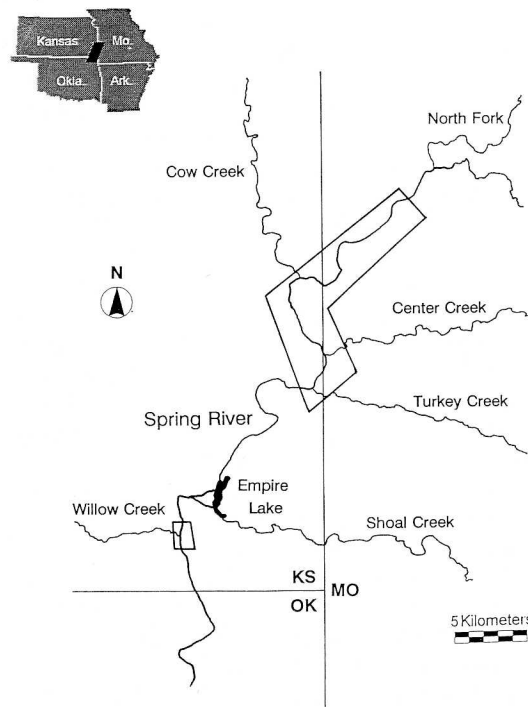


FIG. 1.—Map of the Spring River Basin, with polygons enclosing Spring River mainstream locations where Neosho madtoms were collected during 1993 to 1994 (Appendix 1).

the area near the mouth of Turkey Creek in Cherokee Co., Kansas. Additionally, young-of-year Neosho madtoms captured for the first time upstream from the mouth of Willow Creek near Baxter Springs, Kansas, (site 19) may represent an isolated population separated from other Spring River collection localities by Empire Lake (Lowell Reservoir) and from Neosho River populations by Lake o' the Cherokees. The Neosho madtom has never been documented from the Spring River in Oklahoma (USFWS, 1991; Luttrell et al., 1992).

Collections of Neosho madtoms at 15 new locations in the Spring River was likely due, at least in part, to our intensive sampling effort over a 19-month period. Previous surveys have not specifically examined the distribution and abundance of this species in the Spring River. Lower mean densities in 1993 might have been the result of summer floods which could have hampered Neosho madtom reproduction, recruitment, or both, and might also have limited sampling effectiveness. Higher density estimates in the rel-

actively dry summer of 1994 could have been the result of river conditions that favored recruitment, enhanced sampling effectiveness, or both. M. Eberle and W. Stark (Natural Science Research Associates, Hays, Kansas), in a 1995 report to Kansas Department of Wildlife and Parks, documented higher numbers of Neosho madtoms in the Neosho and Cottonwood rivers in 1994, compared to previous years, and suggested that higher densities in 1994 might reflect improved habitat conditions due to freshly deposited, loose gravel from 1993 floods. Though difficult to judge, given the lack of sufficient previous data for comparison, it is possible that low densities of Neosho madtoms in the Spring River in 1993 are normal for that river (M. Eberle, pers. comm.).

Mean estimates of densities of Neosho madtoms in the Spring River for both years were lower than those reported from the Neosho and Cottonwood rivers by other investigators. Moss (1983) recorded a mean density of occurrence of 43.3/100 m² and a mean overall density of 32.4/100 m² from four night-time electroshocking samples at one Neosho River riffle west of Erie, Kansas, sampled seasonally during 1975 to 1976. Wenke et al. (1992) documented a mean density of occurrence of 17.0/100 m² and a mean overall density of 6.8/100 m² in the Neosho and Cottonwood rivers in 1989 to 1990. Fuselier and Edds (1994) noted a mean density of occurrence of 15.5/100 m² and a mean overall density of 3.3/100 m² in the Cottonwood River in 1992 to 1993. One exception was the mean density of occurrence of 30.0/100 m² for September and October 1994. This estimate was made from a small area sampled in each kick-haul (4.5 m²), where the minimum density of occurrence possible was 22.2/100 m² (i.e., one fish per haul). Nevertheless, Neosho madtom densities may typically be highest in fall, after young-of-year are added to the population.

Though sample sizes, timing, and investigators differed among the studies noted here, densities of Neosho madtoms in the Spring River appear to be less than elsewhere in its range. Ongoing projects are directed at understanding why Neosho madtom numbers differ between the Spring River and the Neosho and Cottonwood rivers. Continued research into the effects of environmental factors on the density, distribution, relative abundance, recruitment, and year-to-year variation of the disjunct Spring River Neosho

madtom population is vital to our understanding of this threatened species and its eventual recovery.

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APPENDIX 1

Spring River Neosho madtom collection localities and dates of collections.

Jasper Co., Missouri: **Site 1)** 0.4 km downstream from county bridge, 2.5 km east of Waco; NE $\frac{1}{4}$ Sec. 18, T29N, R33W; 10 and 12 August and 10 October 1994. **Site 2)** 0.4 km upstream from MO Hwy 171 bridge; SW $\frac{1}{4}$ Sec. 18, T29N, R33W; 11 August 1994. **Site 3)** 0.2 km downstream from MO Hwy 171 bridge; NE $\frac{1}{4}$ Sec. 24, T29N, R34W and NW $\frac{1}{4}$ Sec. 19, T29N, R33W; 11 August 1994. **Site 4)** 0.4 km upstream from county bridge, 2.8 km south of Waco; SW $\frac{1}{4}$ Sec. 23, T29N, R34W; 9 August and 3 October 1994. **Site 5)** 0.2 km downstream from county bridge, 2.8 km south of Waco, 0.8 km east of KS-MO state line; NW $\frac{1}{4}$ Sec. 26, T29N, R34W; 8 August and 4 October 1994. **Site 6)** 2 km downstream from county bridge, 2.8 km south of Waco, 0.8 km east of KS-MO state line; NE $\frac{1}{4}$ Sec. 35, T29N, R34W; 2 October 1994. **Site 7)** 5 km SW of Carl Junction, just downstream from Center Creek confluence; SW $\frac{1}{4}$ Sec. 14, T28N, R34W; 15 August 1993.

Cherokee Co., Kansas: **Site 8)** 0.2 km downstream from KS-MO state line, in right channel of river; SE $\frac{1}{4}$ Sec. 1, T33S, R25E; 26 July 1994. **Site 9)** 0.7 km downstream from KS-MO state line, in right channel

of river; SE $\frac{1}{4}$ Sec. 1, T33S, R25E; 27 July 1994. **Site 10)** 0.9 km downstream from KS-MO state line, in right channel of river; NW $\frac{1}{4}$ and SW $\frac{1}{4}$ Sec. 1, T33S, R25E; 20 July 1994. **Site 11)** 0.6 km upstream from mouth of Cow Creek, at bottom of island in both channels of river; SW $\frac{1}{4}$ Sec. 1 and SE $\frac{1}{4}$ Sec. 2, T33S, R25E; 5 September 1993 and 27-28 July 1994. **Site 12)** 0.3 km upstream from KS Hwy 96 bridge; SW $\frac{1}{4}$ Sec. 11, T33S, R25E; 4 September 1993 and 21 September 1994. **Site 13)** immediately upstream from KS Hwy 96 bridge; SW $\frac{1}{4}$ Sec. 11, T33S, R25E; 4 September 1993 and 19 July and 22 September 1994. **Site 14)** 0.7 km downstream from KS Hwy 96 bridge, in right channel of river; NE $\frac{1}{4}$ Sec. 14, T33S, R25E; 3 August and 28 September 1994. **Site 15)** 1.4 km downstream from KS Hwy 96 bridge, in left split of river; SE $\frac{1}{4}$ Sec. 14, T33S, R25E; 3 August 1994. **Site 16)** 2.3 km downstream from KS Hwy 96 bridge; NW $\frac{1}{4}$ Sec. 24, T33S, R25E; 27 September 1994. **Site 17)** 1 km upstream from Turkey Creek confluence; SE $\frac{1}{4}$ Sec. 25, T33S, R25E; 5 September 1993. **Site 18)** immediately downstream from Turkey Creek confluence; NW $\frac{1}{4}$ Sec. 36, T33S, R25E; 6 September 1993. **Site 19)** 0.6 km upstream from Willow Creek confluence, in left channel of river; NE $\frac{1}{4}$ Sec. 36, T34S, R24E; 6 October 1994.