

## THE RETURN OF *HEXAGENIA* (EPHEMEROPTERA: EPHEMERIDAE) TO THE LOWER FOX RIVER, WISCONSIN

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### ABSTRACT

Burrowing mayflies (*Hexagenia bilineata*) were collected in 1991 in the vicinity of the DePere dam on the Fox River, Brown County, Wisconsin. Because *Hexagenia* mayflies are indicators of good water quality, their emergence from the Fox River is evidence of improvement in conditions at the sediment-water interface.

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Burrowing mayflies (*Hexagenia* spp.) have become recognized as good indicators of water quality (Fremling 1964a, 1989; Fremling and Johnson 1990). Their relatively long nymphal stage is spent in organically rich sediments, where nymphs may be vulnerable to hypoxia or to the accumulation of toxins (Fremling 1989). In response to anthropogenic declines in water quality, *Hexagenia* nymphs have been eliminated from many waters, but they have also returned to some areas after pollution abatement measures have been initiated (Fremling and Johnson 1990). In habitats of high quality, *Hexagenia* adults may reach nuisance levels (Fremling 1960), but both nymphs and adults are important foods for fishes and other animals (Cochran and McConville 1983, Fremling 1989).

In Lake Michigan's Green Bay, the adults of *Hexagenia limbata* (Serville) formerly reached nuisance levels (Schuette 1928, Arnett 1985), but the population was greatly reduced by as early as 1938 and completely eliminated by 1969 (Harris et al. 1987b and references therein) in response to reductions in water quality caused by input from the lower Fox River. One management objective listed in the development of a remedial action plan for Green Bay was the reestablishment of *Hexagenia* nymphs in the inner bay at densities of 400–500 per square meter (Harris et al. 1987a). *Hexagenia* nymphs have been recently reported in the diet of yellow perch (*Perca flavescens*) from Lake Michigan's Little Bay de Noc (Schneeberger 1991). However, as of the spring of 1991, they were reported "still missing" from Green Bay and other parts of the Great Lakes where they formerly occurred (Anonymous 1991). Thus, the collection in that year of a series of adult *Hexagenia* near the DePere dam on the Fox River, 12 km upstream from Green Bay, is noteworthy.

I collected 13 adult *Hexagenia* in June and July 1991. Eleven were collected along the Claude Allouez Bridge, which passes over the Fox River on the downstream side of the DePere dam, or at intersections at either end of the bridge. Two were found on separate days on a building 0.5 km east of the dam. Dates of collection (14, 16, 26, and 27 June; 4 and 15 July) were consistent with the temporal pattern described for Mississippi River populations (Frem-

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ling 1964b, 1973), by which emergences are observed at intervals of 6–11 days. The 13 mayflies included 5 males and 7 females (one individual was not sexed). Three specimens sent to the University of Wisconsin-Madison Insect Collection were identified as *Hexagenia bilineata* (Say) (Hilsenhoff, pers. comm.). *Hexagenia bilineata* tends to be more restricted to large rivers than *H. limbata* (Fremling 1989).

*Hexagenia* apparently have returned to the lower Fox River relatively recently. I have worked in a building near the DePere dam since 1984 and I have lived several blocks from the river since 1986. Since that year I have walked across the Claude Allouez Bridge almost daily, but I observed no *Hexagenia* until 1991. Moreover, bottom sampling by St. Norbert College students in 1986 yielded no *Hexagenia* nymphs, either upstream or downstream from the dam.

It is possible that *Hexagenia bilineata* were artificially reintroduced to the Fox River. Bait shops in the Green Bay area, including a former shop in DePere that ceased operations in 1989, have been known to sell *Hexagenia* nymphs as "wrigglers" to anglers who fish through the ice, and anglers have been known to release excess bait. Substantial numbers of anglers fish through the ice each winter below the DePere dam.

The emergence of *Hexagenia bilineata* from the Fox River is evidence of improvement in conditions at the water-sediment interface sufficient to permit completion of the long nymphal stage in at least some areas of river bottom. This bodes well for the rehabilitation of the river's biological community. Auer and Auer (1990) implicated chemical suitability of the substrate as a factor limiting natural reproduction by walleye (*Stizostedion vitreum*) in the lower Fox River.

Success of *Hexagenia bilineata* in the Fox River may also be a signal for concern. Ironically, as pollution is reduced in tributaries to the Great Lakes, these tributaries are more likely to be ascended by spawning-phase sea lampreys (*Petromyzon marinus*). Like *Hexagenia*, the sea lamprey undergoes a burrowing larval stage of relatively long duration, and, judging from the frequency with which *Hexagenia* nymphs are reported during applications of chemical lampricides (Gilderhus and Johnson 1980), the two taxa overlap in their habitat requirements. It is perhaps no coincidence that, like *Hexagenia bilineata*, spawning-phase sea lampreys were first reported from the Fox River in 1991 (Cochran and Bougie, ms). It remains to be seen whether either or both taxa increase in abundance.

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- Note added in proof: Additional adult *Hexagenia* were observed at the Claude Allouez Bridge in 1992, beginning on 24 June.

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