

## LAMPREYS OF THE ST. JOSEPH RIVER DRAINAGE IN NORTHERN INDIANA, WITH AN EMPHASIS ON THE CHESTNUT LAMPREY (*ICHTHYOMYZON CASTANEUS*)

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**ABSTRACT.** This study was initiated in response to concern about parasitism by lampreys on trout in the Little Elkhart River of the St. Joseph River drainage in northern Indiana. Identification of 229 lampreys collected in the St. Joseph River drainage during 1998–2012 revealed 52 American brook lampreys (*Lethenteron appendix*), one northern brook lamprey (*Ichthyomyzon fossor*), 130 adult chestnut lampreys (*I. castaneus*), five possible adult silver lampreys (*I. unicuspis*), and 41 *Ichthyomyzon* ammocoetes. The brook lampreys are non-parasitic and do not feed as adults, so most if not all parasitism on fish in this system is due to chestnut lampreys. Electrofishing surveys in the Little Elkhart River in August 2013 indicated that attached chestnut lampreys and lamprey marks were most common on the larger fishes [trout (Salmonidae), suckers (Catostomidae), and carp (Cyprinidae)] at each of three sites. This is consistent with the known tendency for parasitic lampreys to select larger hosts. Trout in the Little Elkhart River may be more vulnerable to chestnut lamprey attacks because they are relatively large compared to alternative hosts such as suckers. Plots of chestnut lamprey total length versus date of capture revealed substantial variability on any given date. This may be due to variability among individual streams and individual years and may also result from variability among individual lampreys in when they initiate and terminate parasitic feeding.

**Keywords:** *Ichthyomyzon*, *Lethenteron*, Little Elkhart River, Petromyzontidae, Saint Joseph River

### INTRODUCTION

The chestnut lamprey (*Ichthyomyzon castaneus*) is a parasitic species that occurs throughout much of the central United States. Although Cochran (2014) recently compared its biology in the St. Croix River drainage of northwestern Wisconsin with that in tributaries to Lake Michigan in western Michigan, relatively little information is available on its distribution and life history in Indiana. This study was initiated in response to concern about parasitism by lampreys on trout in the Little Elkhart River of the St. Joseph River drainage in northern Indiana. In addition to information on the chestnut lamprey, information on the occurrence and distribution of other lamprey species in the drainage was obtained.

### METHODS

Preserved lampreys analyzed during this study were collected during the period 1998–

2012 by the City of Elkhart Public Works and Utilities during routine fish surveys in the Saint Joseph River mainstem and its tributaries (Fig. 1). For each specimen total preserved length, as well as whether or not the lamprey was in the ammocoetes or adult (i.e., transformed) stage was recorded. The presence or absence of a divided dorsal fin was used to distinguish between *Lethenteron* and *Ichthyomyzon*. Trunk myomeres were counted from the myomere partly containing the most posterior gill opening to the last myomere with posterior angle positioned above the cloaca (Hubbs & Trautman 1937). After myomere counts for all specimens were completed, they were repeated without reference to the original counts. If a lamprey was an adult *Ichthyomyzon*, bicuspid circumoral teeth were counted (Table 1).

New field data on lampreys and potential hosts in the Little Elkhart River were collected with a stream electrofisher on 17 August 2013. Three reaches were sampled, each for approximately 300 m in an upstream direction. Each lamprey captured was anesthetized, processed as described previously for the preserved

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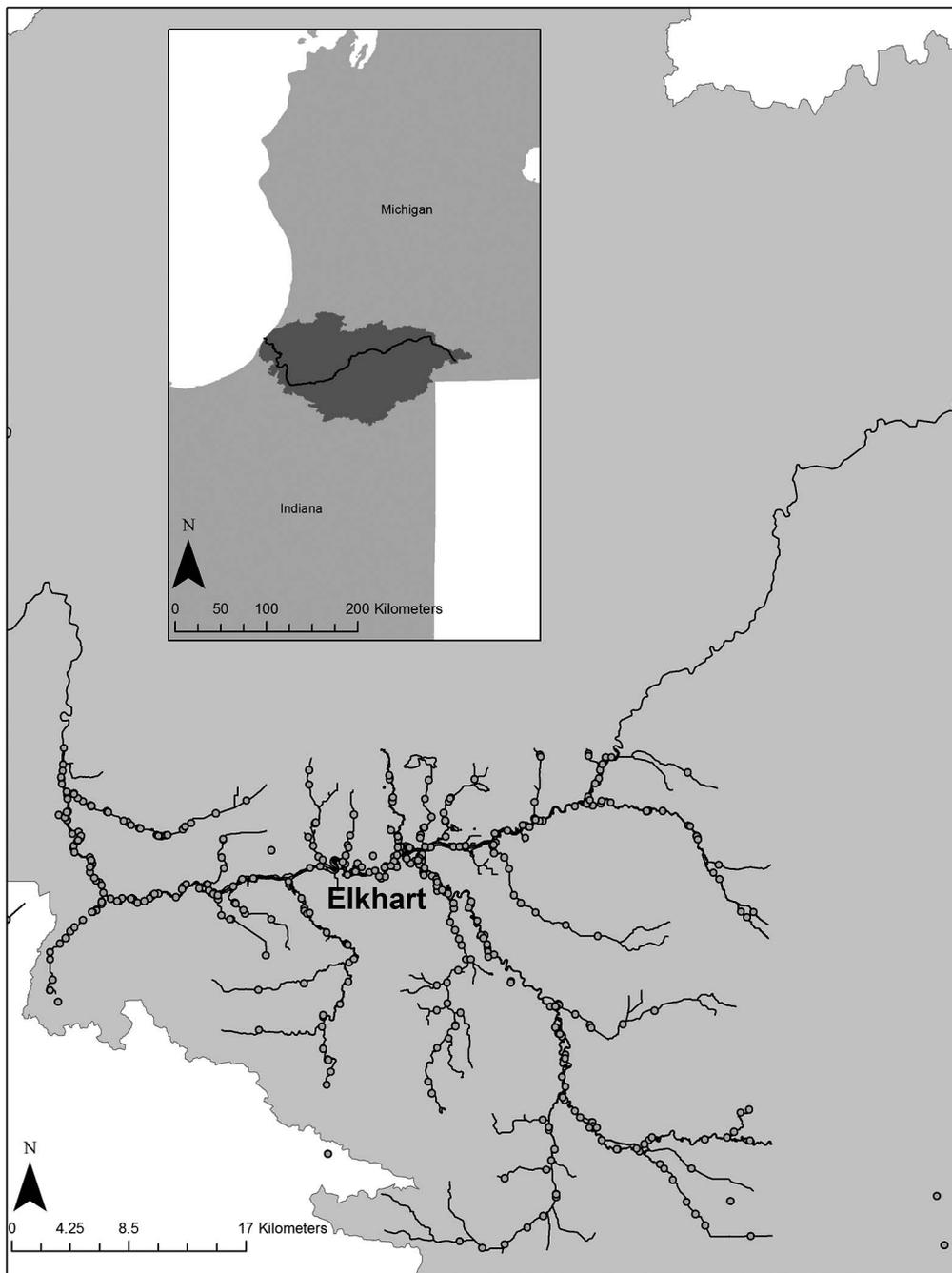


Figure 1.—The St. Joseph River drainage in Michigan and Indiana (inset), including sites in the St. Joseph River drainage where lampreys were collected by the City of Elkhart Public Works and Utilities during the period 1998–2012.

lampreys, and released at the site of its capture. All potential hosts were identified to species, measured for total length, and examined for lamprey marks.

## RESULTS AND DISCUSSION

**Lamprey fauna of the Saint Joseph River drainage.**—The lamprey fauna of the St. Joseph River drainage is diverse. The 229 lampreys

Table 1.—Characters and counts used to distinguish lamprey species.

Species	Trunk myomeres	Circumoral teeth	Dorsal fin	Lateral line pores
American Brook Lamprey	64-75	Unicuspid	Separate	None
Northern Brook Lamprey	47-56	Unicuspid	Connected	None
Silver Lamprey	47-55	Unicuspid	Connected	Black
Chestnut Lamprey	49-56	Bicuspid	Connected	Black

collected during 1998–2012 included 52 American brook lampreys (*Lethenteron appendix*), one adult northern brook lamprey (*Ichthyomyzon fossor*), 130 adult chestnut lampreys (*I. castaneus*), five putative adult silver lampreys (*I. unicuspis*), and 41 *Ichthyomyzon* ammocoetes (Table 2).

*Lethenteron appendix*: The American brook lamprey, a non-parasitic species, is considered to be common in Indiana and occurs in both the northern and southern portions of the state (Simon 2011). Simon (2011) did not include the St. Joseph River drainage within its Indiana distribution, but it was reported from this system by Marenchin & Sever (1981) while Wesley & Duffy (1999) implied that it was widely distributed. All American brook lampreys identified during this study were ammocoetes. No adults would have been present during the time of year collections were made since adult American brook lampreys spawn and die during the spring (Cochran et al. 2012).

*Ichthyomyzon fossor*: The single northern brook lamprey was collected in Christiana Creek. The northern brook lamprey is a non-parasitic species considered by Simon (2011) to

be rare to occasional in occurrence in Indiana. He did not include the St. Joseph River drainage within its Indiana range. Earlier reports (Marenchin & Sever 1981, and references therein), however, suggested that ammocoetes collected in Christiana Creek and Turkey Creek might be northern brook lampreys. In addition Wesley & Duffy (1999) depicted a distribution that included several tributaries to the St. Joseph River.

*Ichthyomyzon unicuspis*: A few parasitic-phase *Ichthyomyzon* were provisionally identified as silver lampreys rather than chestnut lampreys because they lacked bicuspid circumoral teeth. Simon (2011) considered the silver lamprey to be occasional to common in occurrence in Indiana but did not include the St. Joseph River drainage as part of its Indiana range. Although earlier workers considered silver lampreys to be absent from the eastern shoreline of Lake Michigan (Hubbs & Trautman 1937; Morman 1979), Schuldt et al. (1987) enumerated small numbers of specimens in the Muskegon and St. Joseph Rivers. These specimens would have been collected downstream from any barrier dams and may have completed their parasitic phase in Lake Michigan. By contrast,

Table 2.—Lampreys collected and preserved by biologists of the City of Elkhart Public Works and Utilities during 1998–2012.

Stream	American brook lamprey	Northern brook lamprey	Silver lamprey	Adult chestnut lamprey	<i>Ichthyomyzon</i> ammocoetes
Saint Joseph River	6	-	3	59	9
Elkhart River	19	-	1	34	6
Little Elkhart River	6	-	-	13	7
Pine Creek	4	-	-	2	-
Yellow Creek	-	-	1	8	-
Christiana Creek	-	1	-	7	15
Cobus Creek	7	-	-	1	-
Puterbaugh Creek	8	-	-	-	-
Rock Run Creek	1	-	-	2	-
Rowe Eden	-	-	-	-	1
Turkey Creek	-	-	-	-	3
Trout Creek	1	-	-	2	-
Baugo Creek	-	-	-	2	-

Wesley & Duffy (1999) mapped two apparently disjunct populations upstream from barrier dams in the St. Joseph River drainage, one in the vicinity of Elkhart in Indiana waters (the source area for the specimens examined during the current study) and one upstream from Union City in Michigan.

*Ichthyomyzon castaneus*: The chestnut lamprey was the most abundant lamprey identified during this study. It was first reported from the St. Joseph River drainage in Indiana by Sever & Mould (1982). Simon (2011) considered this parasitic species to be common in Indiana and included the St. Joseph River drainage within its mapped distribution. Wesley & Duffy (1999) mapped a broad distribution within the drainage. Nevertheless, the specimens we examined extend this distribution to include Christiana Creek, Cobus Creek, and the Little Elkhart River from Middlebury downstream to the dam at Bonneyville Mills.

*Taxonomic questions*: Trunk myomere counts have been used to distinguish species of lampreys (Table 1). However, counts were more variable than expected. The range in counts for all adult *Ichthyomyzon* was 46–61, with modes at 49 and 53. The count for the adult *I. fossor* was 53, and the counts for the putative *I. unicuspis* were 46, 48, 53, 55, and 56 (mean = 51.6). Hubbs & Trautman (1937) reported ranges of 49–56 (mean = 52.6) for *I. castaneus*, 47–55 (mean = 50.5) for *I. unicuspis*, and 47–56 (mean = 50.9) for *I. fossor* (data summarized by Docker 2009). We hypothesize that hybridization among *Ichthyomyzon* species has occurred in this system, resulting in some lampreys that combine the presence of bicuspid circumoral teeth with relatively low trunk myomere counts; this possibility may be enhanced when one species outnumbers the others by a great margin. In addition, we suggest that the gene pool of *Ichthyomyzon castaneus* in the St. Joseph River drainage may have incorporated alleles from the Ohio lamprey (*I. bdellium*), a parasitic species with higher myomere counts (range: 53–62, mean = 56.9; Hubbs & Trautman 1937). Ohio lampreys occur in the Tippecanoe River drainage (Ohio River basin), which borders the St. Joseph River drainage to the south (Simon 2011), and they may have used minor postglacial connections to pass between the two drainages (Gerking 1947; Burr & Page 1986).

An additional question concerns whether parasitic species and their non-parasitic derivatives

are in fact distinct species (Docker 2009). The non-parasitic northern brook lamprey is considered to be the derivative of the parasitic silver lamprey and conventionally treated as a separate species. However, Docker et al. (2012) found evidence for gene flow between the two forms and, based upon limited genetic analysis, suggested that they may represent ecotypes of a single species. If northern brook and silver lampreys are indeed one species that might explain the occasional collection of silver lampreys in the St. Joseph River drainage above barrier dams that would prevent upstream dispersal from Lake Michigan.

**Biology of the chestnut lamprey.**—Electrofishing surveys in the Little Elkhart River in August 2013 indicated that attached chestnut lampreys and lamprey marks were common on the larger fishes at each of three sites, including trout (Salmonidae), suckers (Catostomidae), and carp (Cyprinidae). At the most upstream site, Riverbend Park in Middlebury, where trout are stocked in a catch-and-release program, lamprey marks were observed on brown trout and white suckers (Fig. 2), and we received anecdotal accounts of rainbow trout attacked within 24 hours of being stocked (J. Phillips, pers. comm.). At the intermediate site, the County Road 35 crossing, one chestnut lamprey (188 mm, 11.4 g) attached to a brown trout was collected (Fig. 3). The most downstream site was the impounded area above the dam at Bonneyville County Park, where we collected a chestnut lamprey (201 mm, 16.0 g) on a common carp and observed lamprey marks on another carp and possibly a white sucker (Fig. 4). Chestnut lamprey attachments or marks tended to be on the largest hosts at each site, a pattern consistent with other parasitic lampreys (Cochran 1985; Swink 1991). In addition to chestnut lamprey, *Ichthyomyzon ammocoetes* were observed at all three sites, and one larval *L. appendix* was collected at the County Road 35 crossing.

A plot of chestnut lamprey total length versus date of capture revealed substantial variability on any given date (Fig. 5). A similar plot was obtained by Cochran (2014) for chestnut lampreys from the St. Croix River drainage in Wisconsin. This variability may be due in part to differences among individual streams and individual years, but it may also result from variability among individual lampreys in when they initiate and terminate parasitic feeding

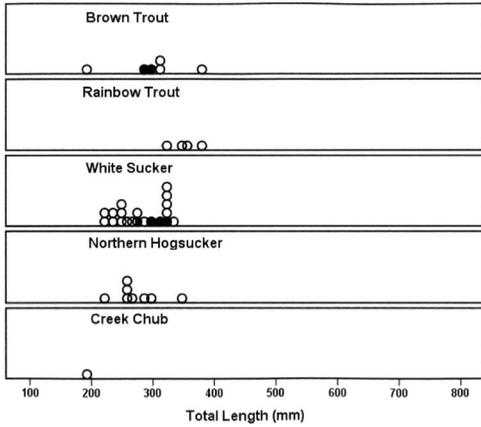


Figure 2.—Total length of fish sampled in the Little Elkhart River at Riverbend Park. Individuals bearing marks caused by lampreys are indicated by solid circles.

(Cochran 2014). It is possible that some newly transformed lampreys begin parasitic feeding in the fall, whereas other may begin feeding the following spring. Swink & Johnson (2014), however, found no difference in sizes achieved by sea lampreys (*Petromyzon marinus*) that migrated downstream to Lake Huron in the fall and those that migrated down in the spring, even though the former presumably fed parasitically for a longer period.

Cochran (2014) noted that much of what is known about the chestnut lamprey is based on data collected in two regions, the St. Croix River drainage of Wisconsin and Minnesota

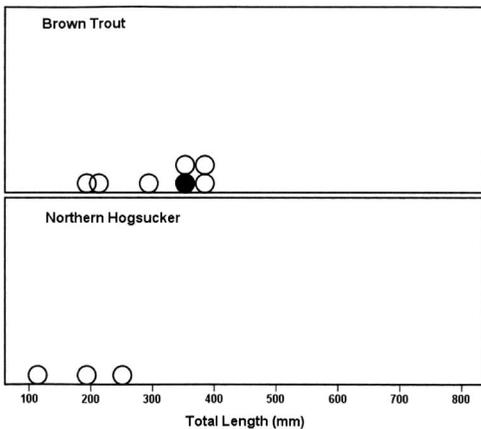


Figure 3.—Total length of fish sampled in the Little Elkhart River above the County Road 35 crossing. Individuals bearing marks caused by lampreys are indicated by solid circles.

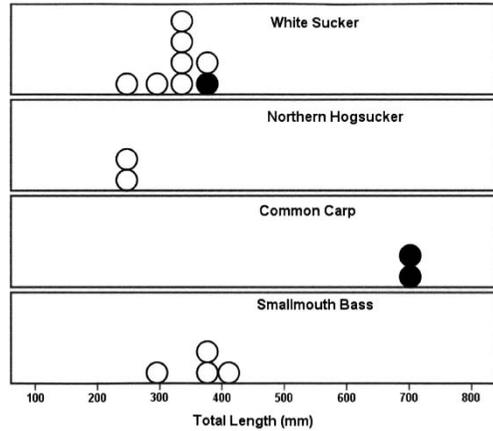


Figure 4.—Total length of fish sampled in the Little Elkhart River at Bonneyville Mills. Individuals bearing marks caused by lampreys are indicated by solid circles.

and the tributaries to Lake Michigan in western Michigan (especially the Manistee River). In the St. Croix River drainage, redhorse (*Moxostoma* spp.) are relatively abundant and may buffer the impact of chestnut lampreys on trout and other gamefish, whereas in the Manistee River, fewer large catostomids were available as alternatives during the time of annual plantings of thousands of catchable-sized trout. Our results for the Saint Joseph River drainage in Indiana are, as expected, more consistent with the Manistee River. Because trout in the Little Elkhart River are stocked at relatively large size in a system where catostomids are relatively small, they

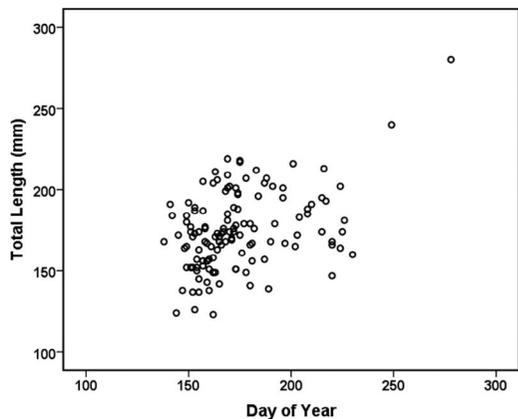


Figure 5.—Total length (mm) of preserved adult (i.e., parasitic-phase) chestnut lampreys from the St. Joseph River drainage versus date of capture (day of year).

may be more vulnerable to lamprey attack (Cochran 2014).

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