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Telemetry narrows the search for sea lamprey spawning locations in the St. Clair-Detroit River System

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ABSTRACT

Adult sea lamprey (*Petromyzon marinus*) abundance in Lake Erie has remained above targets set by fishery managers since 2005, possibly due to increased recruitment in the St. Clair-Detroit River System (SCDRS). Sea lamprey recruitment in the SCDRS poses an enormous challenge to sea lamprey control and assessment in Lake Erie because the SCDRS contains no dams to facilitate capture and discharge is at least an order of magnitude larger in the SCDRS than most other sea lamprey-producing tributaries in the Great Lakes. As a first step toward understanding population size, spatial distribution, and spawning habitat of adult sea lampreys in the SCDRS, we used acoustic telemetry to determine where sea lampreys ceased migration (due to spawning, death, or both) among major regions of the SCDRS. All tagged sea lampreys released in the lower Detroit River ($N = 27$) moved upstream through the Detroit River and entered Lake St. Clair. After entering Lake St. Clair, sea lampreys entered the St. Clair River ($N = 22$), Thames River ($N = 1$), or were not detected again ($N = 4$). Many sea lampreys (10 of 27) were last observed moving downstream ("fallback") but we were unable to determine if those movements occurred before or after spawning, or while sea lampreys were dead or alive. Regardless of whether estimates of locations where sea lampreys ceased migration were based on the most upstream region occupied or final region occupied, most sea lampreys ceased migration in the St. Clair River or Lake St. Clair. Results suggest that spawning and rearing in the St. Clair River could be an important determinant of sea lamprey recruitment in the SCDRS and may direct future assessment and control activities in that system.

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Introduction

Sea lamprey (*Petromyzon marinus*) entered the Laurentian Great Lakes through shipping canals in the early 1900s and contributed to the decimation of native fish populations (Smith and Tibbles, 1980). Since the 1950s, sea lamprey control has facilitated recovery and promoted sustainability of many native and economically valuable fishes (Cornelius et al., 1995; Hansen, 1999). Until recently, sea lamprey control in Lake Erie supported restoration of lake trout (*Salvelinus namaycush*), lake whitefish (*Coregonus clupeaformis*), burbot (*Lota lota*), and other fishes by maintaining sea lamprey abundance below targets set by fishery managers (Adair and Sullivan, 2015). However, estimates of adult sea lamprey abundance in Lake Erie have remained above the target since 2005 despite increased effort to control sea lamprey in known producing streams and to identify new sources (Adair and Sullivan, 2013).

Success of the sea lamprey control program in the Great Lakes has been attributed to knowledge of sea lamprey life history and ecology during the earliest (larval) and latest (adult) stream-dwelling life stages. The sea lamprey is an anadromous, parasitic fish, native to the Atlantic Ocean that depends on both streams for spawning and rearing and on oceans or lakes for somatic growth. Spawning occurs on nests with gravel substrate and steady flow, beginning when water temperatures reach about 10 °C and ending at water temperatures below 26 °C, typically June–July in Great Lakes tributaries (Applegate, 1950; Manion and Hanson, 1980). Sea lampreys are nocturnal during stream entry and initial migration, but become more active during the daytime as they approach spawning (Applegate, 1950). During maturation, adults also experience irreversible degeneration of visual and digestive systems and die shortly after spawning (Beamish, 1980). Unsuccessful spawners also die during the same time period (Applegate, 1950). Larval sea lampreys hatch in mid- to late summer, drift downstream, and burrow into soft sediment, where they filter-feed on drifting algae and plankton. After three to eight years in the stream, larvae undergo a physiological transformation and migrate into lakes where they will either find and

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parasitize a host fish or die. Parasitic sea lampreys remain in the lake for 12 to 18 months before entering streams to spawn. Timing of stream entry is largely unknown but adults have been seen arriving in Great Lakes tributaries between April and July (Applegate, 1950). Unlike other anadromous fishes, sea lampreys do not home to their natal streams (Bergstedt and Seelye, 1995; Waldman et al., 2008), but use chemical cues emitted by larvae to locate suitable streams for spawning and rearing (Bjerselius et al., 2000; Sorensen and Vrieze, 2003). Despite rich understanding of sea lamprey ecology, cost-effective control and assessment strategies remain elusive in large rivers, particularly those lacking migration barriers (Jones, 2007; McLaughlin et al., 2007).

Sea lamprey abundance may have increased in Lake Erie if sea lamprey recruitment, survival, or both, increased in the St. Clair-Detroit River System (SCDRS) that flows into Lake Erie from Lake Huron (Fig. 1). The SCDRS, which includes the Detroit River, Lake St. Clair, St. Clair River, and (for the purposes of this study) their tributaries, had historically not been considered an appreciable source of sea lampreys to Lake Erie based on previous surveys (Sullivan et al., 2003) and because Lake Erie tributary treatments during the 1990s were highly effective and did not include treatment of the SCDRS (Jeff Slade, USFWS, personal communication). Therefore, increased recruitment of sea lampreys to Lake Erie from the SCDRS may be a recent phenomenon and important new source. Indeed, assessments during 2011–2015 showed that larval sea lampreys were broadly distributed in the St. Clair River and the St. Clair River delta (Adair and Sullivan, 2013, 2015). Coded-wire-tagged juvenile sea lampreys released in the St. Clair River were also caught in traps in eastern Lake Erie (Barber et al., 2015), confirming that juvenile sea lampreys released in the St. Clair River survived downstream migration through Lake St. Clair, the Detroit River, and western Lake Erie to contribute to the population in Lake Erie.

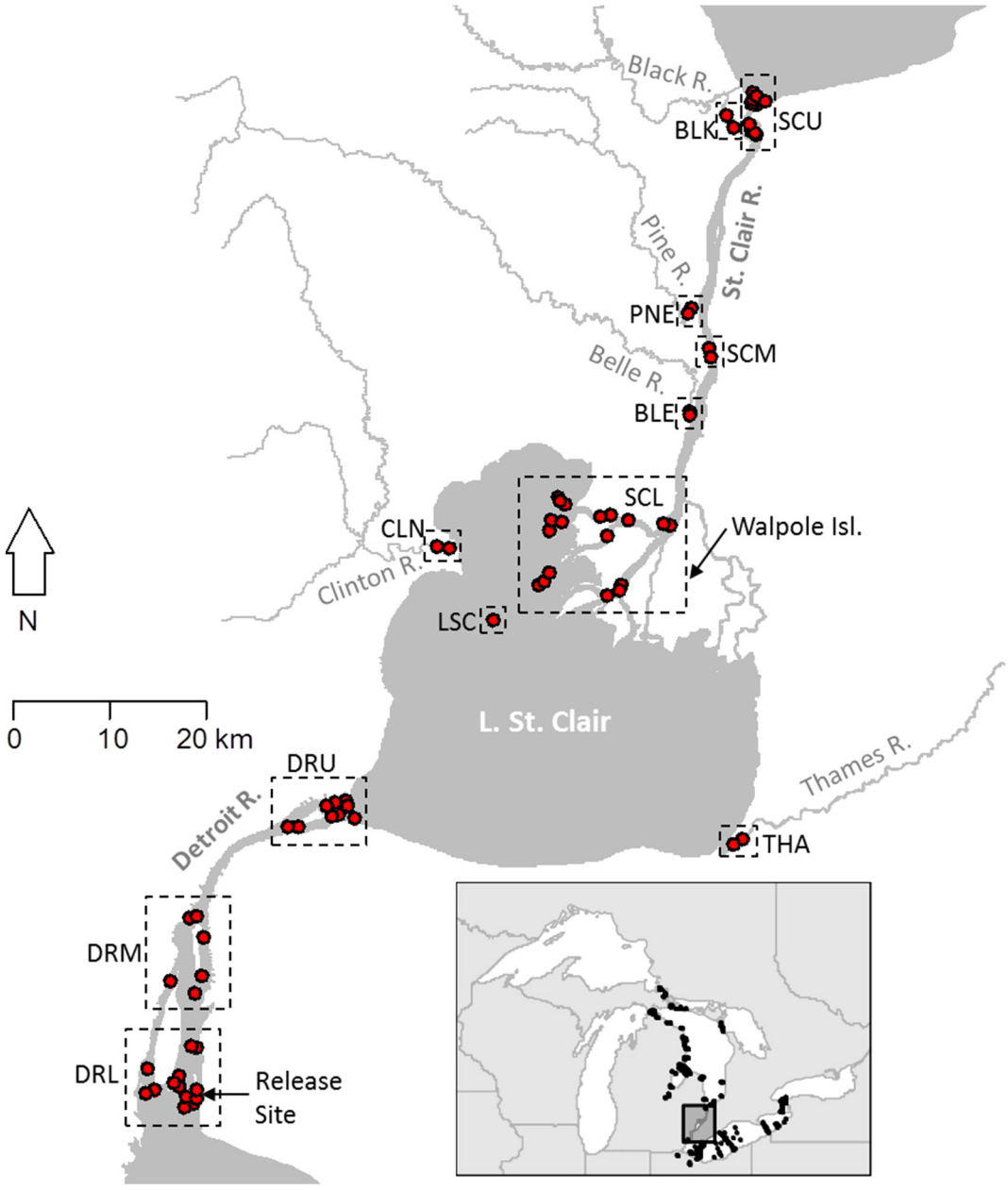

Fig. 1. Map of the St. Clair-Detroit River System (SCDRS) with release site of acoustic-tagged sea lampreys ($N = 27$) and locations of acoustic telemetry receivers (red symbols), grouped by location (rectangles), used to track sea lamprey during May–July 2014. ESM file kmz-1 also shows these locations on Google Earth. Inset shows location of the study site (rectangle) in the Great Lakes basin and locations of acoustic telemetry receivers outside the SCDRS during the study. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

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