
River Redhorse (*Moxostoma carinatum*) and Channel Darter (*Percina copelandi*) Populations along the Trent-Severn Waterway

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Abstract

*The Trent-Severn Waterway (National Historic Site of Canada) has been highly fragmented by hydroelectric and navigational dams. Two fish species at risk, the channel darter (*Percina copelandi*) and the river redhorse (*Moxostoma carinatum*), are found along the Trent River. Field studies were undertaken to describe their distribution, habitat and population characteristics, and management concerns.*

Keywords: *channel darter, river redhorse, species at risk, Trent-Severn Waterway, habitat characteristics, population characteristics*

Introduction

Meandering 386 km across Ontario, the Trent-Severn Waterway (National Historic Site of Canada) links the Bay of Quinte (Lake Ontario) with Georgian Bay. The lower section (Trent River) is heavily fragmented by hydroelectric and navigational dams. Past sampling of the Trent River by the Royal Ontario Museum and the Ontario Ministry of Natural Resources collected two fish species at risk: channel darter (*Percina copelandi*) and river redhorse (*Moxostoma carinatum*). The channel darter is a small-bodied fish (< 70 mm total length (TL)). In small- to medium-sized rivers, it is typically found in pools and riffles over sand and gravel substrate. It has been designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as “Threatened.” River redhorse is a large-bodied sucker found in medium to large rivers with clear fast flowing water and cobble, rubble, and bedrock substrates. It is designated as a species of “Special Concern.”

In Canada, the two species are near their northern range limits and exist as regionally isolated and locally fragmented populations. Both species are

vulnerable to the impoundment of rivers, siltation of habitats, and pollution (Trautman, 1981; Jenkins and Burkhead, 1993), and they may be adversely affected by barriers preventing movement between habitats and populations. A lack of information on their distribution, habitat requirements, and population ecology limits our ability to manage these species. This paper provides an overview of field studies undertaken in the Trent River to describe their distribution, habitats and population characteristics, and management concerns.

Methods and Materials

Between 2001 and 2004, ten sites (dam tailwaters) along a 49 km reach along the lower Trent River between the Hagues Reach Hydro-electric Generating Station and Trenton were sampled using a boat electro-fishing unit. Sampling objectives included describing the distribution of river redhorse among river fragments and characteristics of spawning runs. Habitats sampled were shallow, fast flowing areas with coarse bed material and runs or pools downstream. Sampling occurred during May and June (spring) and September and October (fall).

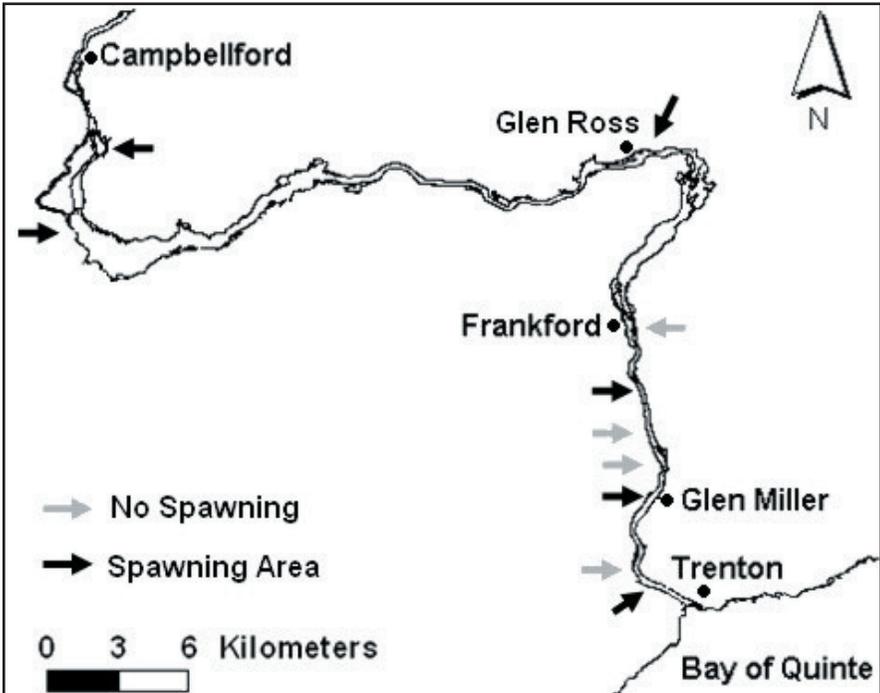
In 2001, 18 sites in the Trent River (Campbellford downstream to the Bay of Quinte), Cold Creek, Percy Creek, and the Crowe River were sampled using a backpack electro-fisher unit to improve channel darter distribution information. During 2002 and 2003, a shoal at Glen Miller was sampled with a backpack electro-fisher to describe habitat associations and population characteristics. At each capture location, water depth (m), water velocity (m/s), and the composition of surficial bed material were measured. Water velocity and depth were measured with a water velocity meter and a top-setting wading rod. Bed material was visually classified using the Wentworth scale (< 4 mm diameter), gravel (4-64 mm), cobble (64-256 mm), and boulder (> 256 mm).

Results

River Redhorse

Until 1998, river redhorse were not known to be present in the Trent River. Since then river redhorse have been collected from all ten river fragments between the Bay of Quinte and the Hagues Reach GS (approximately 4 km downstream of Campbellford) (Figure 1). Other redhorse species captured were greater redhorse (*M. valenciennesi*), shorthead redhorse (*M. macrolepidotum*), and silver redhorse (*M. anisurum*). In the spring, river redhorse were between 8 and 31% of all redhorse captured at each site, and 5 to 18%

Figure 1. River redhorse spawning sites along the Trent River. Dam tailwater spawning areas indicated by black arrows. Grey arrows indicate tailwater areas not used as spawning sites.



in the fall. Mean spring catch per unit effort (CUE: fish per minute of sampling) ranged between 0.014 and 1.5 and between 0.005 and 0.17 during the fall. Compared to spring, fall CUE was 3 to 14 times lower, suggesting downstream runs or pool habitats are used during non-spawning periods. The number of river redhorse captured during spring surveys was strongly reflective of the length of individual river fragments. CUE in large river fragments (>3km in length) was double that of medium (2 to 2.5km) and almost 50 times greater than small river fragments (0.8 to 2km). Additionally, spawning-ready adults were absent or rarely captured from small fragments.

In the Trent River, river redhorse is the last redhorse species to spawn (Figure 2). Spawning-ready river redhorse have been captured from the Grand River, Ontario and the Gatineau River, Quebec at the same water temperatures and time of year (S. Reid unpublished data; Campbell, 2001). Populations in the United States spawn earlier (mid-April to mid-May) but at the same water temperatures (Jenkins and Burkhead, 1993). Aggregations of two or three adults were observed at areas of cleaned coarse gravel and cob-

ble, swift currents, and water depths of approximately 0.5 to 1 m. Nuptial males were adorned with tubercles on the snout, anal and caudal fins, scales were thick and rough and breeding males exhibited a midlateral, dark stripe. Both sexes exhibited an intensification of body and fin colour. The sex ratio of spawning ready adults was 2.3 males per female. Based on interpretations of pectoral fin ray sections, ages of males and females were similar (male: 6 to 21 years and female: 6 to 22 years). However, females were significantly larger (male mean TL: 61 cm and female mean TL: 64 cm, Mann-Whitney Test $p < 0.0001$) (Figure 3). Trent River river redhorse reach sexual maturity at an older age and larger size than populations in the United States (Jenkins and Burkhead, 1993).

Figure 2. Chronology (and associated water temperatures) of redhorse species spawning along the Trent River (2002-2004).

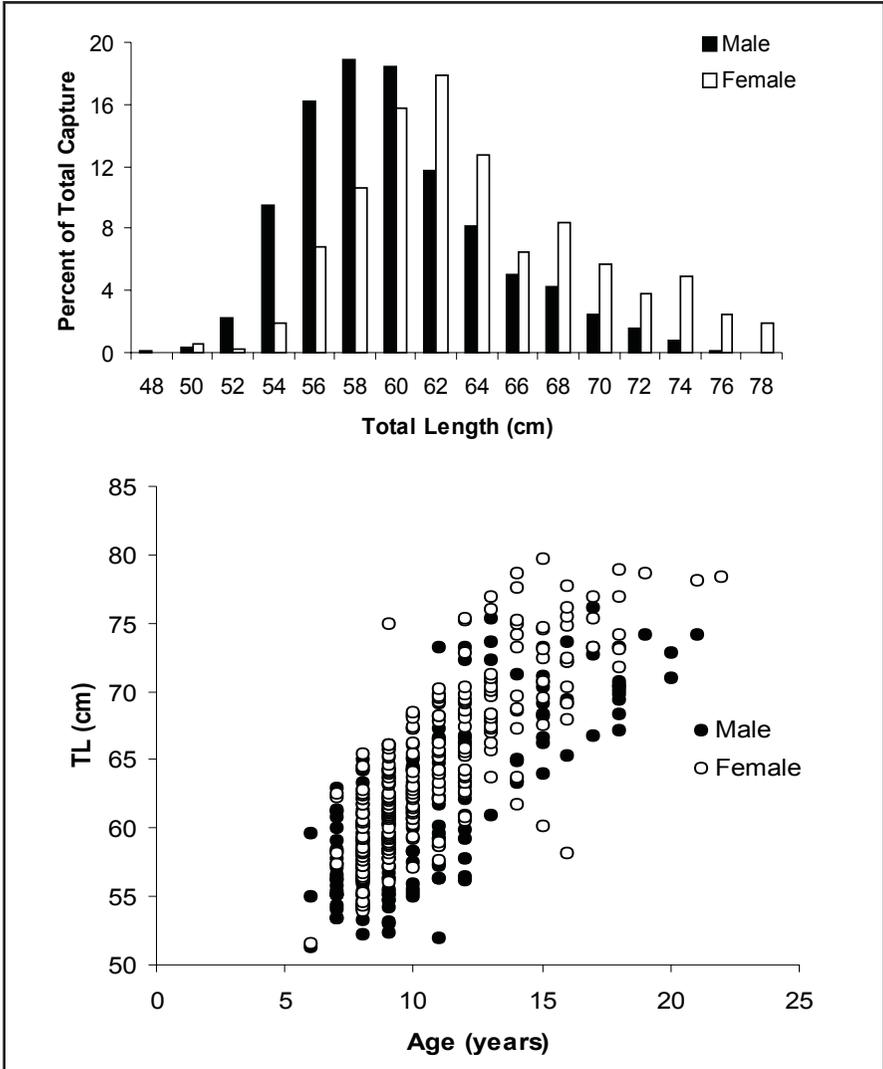
	May				June	
	1st	8th	16th	24th	1st	8th
<i>shorthead redhorse</i>		10-14° C				
<i>silver redhorse</i>		10-12° C				
<i>greater redhorse</i>			11-20° C			
<i>river redhorse</i>					16-20° C	

Channel Darter

During the late summer of 2001, channel darters were collected from three of eighteen sites sampled (Figure 4). Channel darters were collected from a small pool (< 1.0 m deep) at the upstream end of a gravel bar, shallow riffles in dam tailwaters, and shallow gravel/cobble bed shoals. Other common species included smallmouth bass (*Micropterus dolomieu*), rock bass (*Ambloplites rupestris*), pumpkinseed sunfish (*Lepomis gibbosus*), logperch (*Percina caprodes*), johnny darter (*Etheostoma nigrum*), and longnose dace (*Rhinichthys cataractae*). No channel darters were collected from Cold Creek, Percy Creek, and the Crowe River.

At the Glen Morris shoal, channel darters in spawning condition were collected throughout June as water temperatures increased from 14.5 to 25°C. None in spawning condition were collected after July 4th (water temperature: 27°C). The male to female sex ratio was 0.7 (male: $n = 36$; female: $n = 51$). Mean length of males and females in spawning condition was 57.3 mm TL (range: 46 to 71 mm) and 58.3 mm TL (range: 47 to 65 mm), respectively. The difference was not statistically significant (unpaired t-test: $p = 0.245$). Few individuals were less than 45 mm TL. Based on length at age

Figure 3. Length distributions (a) and length at age relationship (b) of spawning ready male (n=769) and female (n=369) river redhorse captured from the Trent River (2002-2004).



data (Figure 5), the channel darter is estimated to be sexually mature by age 2. United States populations have been reported to reach 40 mm standard length (SL) and sexual maturity after their first year of growth (Etnier and Starners, 1993; Jenkins and Burkhead, 1993). Although not observed directly, habitat measurements suggest that spawning is associated with moderate to swift mid-column water velocities, moderate water depths, and coarse bed material (Table 1).

Figure 4. Locations of channel darter collections from fall 2001 survey along the Trent River. Site descriptions: 1 (Glen Ross): riffles downstream of Lock 7 dam; 2 (Glen Miller): shoal downstream of Sonoco dam; and, 3 (Trenton): shoal and pool habitats downstream of Lock 1 dam.

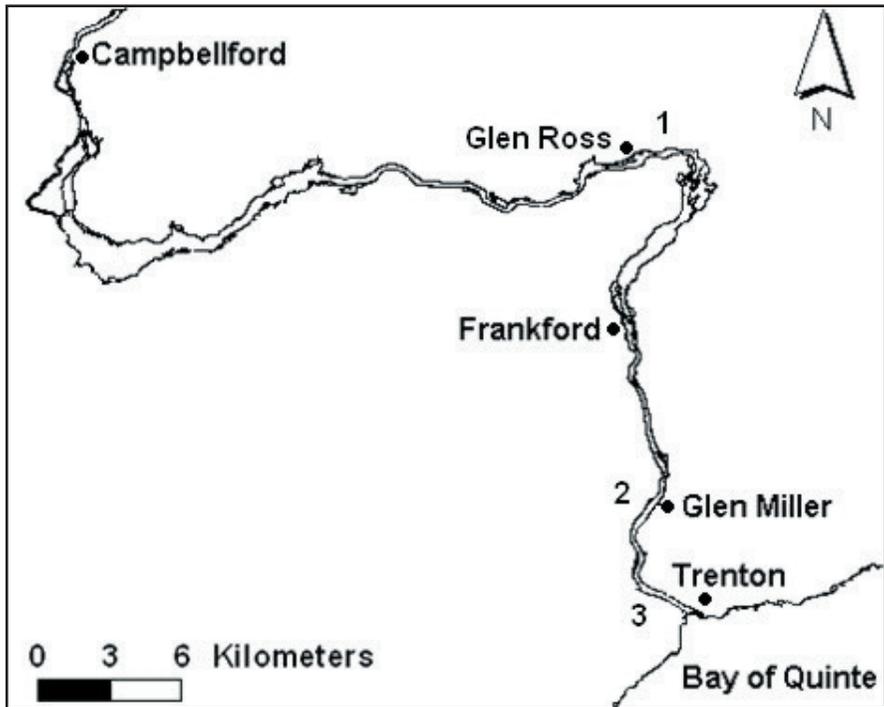
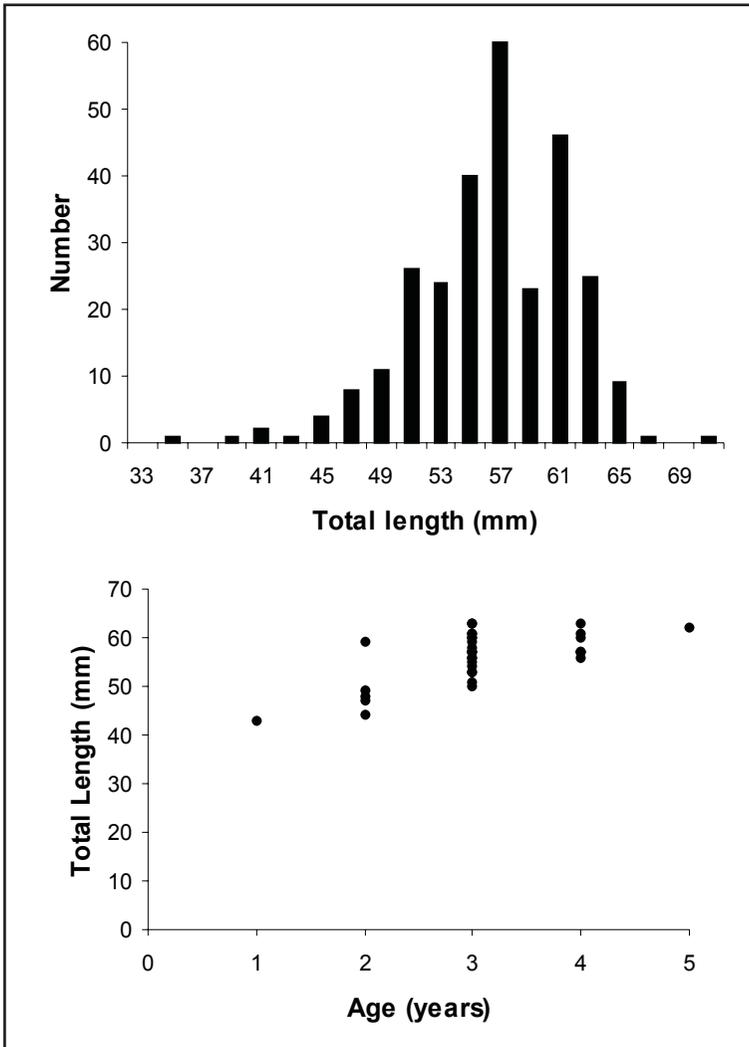


Table 1. Seasonal habitat and abundance (CUE) measurements for channel darters at Glen Morris shoal, Trent River. Mean and standard error (in parentheses) values are presented.

	Spring	Summer	Fall
Habitat Measurement	n = 141	n = 56	n = 23
Fines (%)	5.5 (1.3)	8.1 (0.93)	11 (2.7)
Gravel (%)	21.6 (1.7)	19 (1.5)	14 (1.6)
Cobble (%)	63.9 (2.2)	80.2 (14.1)	72 (3.9)
Boulder (%)	10.3 (1.8)	6.2 (2.0)	22 (0.2)
Water depth (m)	0.46 (0.01)	0.30 (0.01)	0.15 (0.03)
Water velocity (m/s)	0.49 (0.02)	0.02 (0.01)	0.14 (0.01)
Water temperature (°C)	12.5 - 25	22 - 24	5 - 9.5
CUE (fish/min)	0.62 (0.08)	0.21 (0.04)	0.07 (0.02)

Figure 5. Length distribution (a) and length at age relationship (b) for channel darters collected from the Glen Morris shoal, Trent River. Age estimates are based on otolith interpretations.



During summer and fall, channel darters were collected from locations with similarly sized bed material as the spring but water depth and velocities were lower (Table 1). Compared to spring, CUE was 66% lower in August and 90% lower in October. The seasonal decline in abundance in shallow habitats was also reported for channel darters sampled from a river in Tennessee (Etnier and Starnes, 1993). The importance of deeper habitats is poorly understood. Water depth and obstructions prevent the use of sampling gear effective in shallower habitats (i.e., backpack electro-fishing unit

and seine nets). Sampling of habitats up to 5.2 m deep adjacent to the Glen Morris shoal with small-mesh (6 and 8 mm diameter) gill-nets and minnow traps was of limited success. Only a single channel darter was captured during 60 one-hour gill-net sets.

Management and Future Monitoring

River redhorse

Canadian rivers with river redhorse are generally fragmented by hydro-electric, navigational, or flood control dams. Impoundments have been shown to limit distribution (Etnier and Starnes, 1993; Quinn and Kwak, 2003) and prevent population recovery after fish kills (Jenkins and Burkhead, 1993). Spawning populations of river redhorse along the Trent River are limited to larger fragments. Within these fragments, spawning habitat is limited to dam tailwater areas. As well, large abrupt increases in discharge have been reported to prevent spawning of other redhorse species (Bowman, 1970; Cooke and Bunt, 1999). Maintenance of appropriate flows during spawning is necessary for successful reproduction. River redhorse spawn at water depths of 0.2 to 1.2 m at relatively swift surface water velocities (0.6 to 1.0 m/s) (Jenkins and Burkhead, 1993).

Boat-electrofishing surveys have resulted in new site records in Ohio (Yoder and Beaumier, 1986) and Illinois rivers (Retzer and Kowalik, 2002). In this study, boat-electrofishing was effective at characterizing the distribution and relative abundance of adult river redhorse along the Trent River. However, river redhorse smaller than 420 mm TL were not collected. A similar absence of small river redhorse occurred during boat-electrofishing surveys of the Grand River, Ontario and Muskegon River, Michigan (S. Reid, personal observation). Along the Richelieu River, Quebec, young-of-year and juveniles have been collected from vegetated shores with fine sediments (silt, clay, and sand) (Vachon, 1999). There is a need to identify nursery and rearing habitats along the Trent River in order to ensure protection of areas critical for recruitment.

Channel darter

In addition to considering the fragmented nature of Trent River populations, successful channel darter management will require appropriate flow management and an assessment of the risk of the round goby (*Neogobius melanostomus*) to the channel darter. The shallow depth of non-winter habitats makes them vulnerable to water level fluctuations. During spawning, abrupt flow reductions can cause cessation of courtship activities (Winn, 1953).

During spring and summer, shallow shoal habitats along the Trent River were affected by changes in water level as a consequence of flow regulation. Several times over the course of sampling, water levels downstream of lock dams were observed to drop (~0.3 to 0.5 m) temporarily (1 to 2 hours) and expose large portions of shoal and nearshore habitat. During October, mid-channel shallow summer channel darter habitats near Trenton were dry. Therefore, flow management along the Trent River in support of navigation and hydro-electric production needs to consider the sensitivity of channel darter habitats.

The round goby has recently become established near Hastings between Locks 17 and 18 (personal communication, Dave Brown, Ontario Federation of Anglers and Hunters). It has been captured by anglers at Trenton and is abundant in the Bay of Quinte. It is an aggressive, rapidly colonizing, invasive species that disrupts spawning of other benthic fishes and may eat the eggs and fry of native fishes. In parts of the Great Lakes, it has been implicated in the decline of mottled sculpin (*Cottus bairdii*), logperch, and johnny darter (Jude *et al.*, 1995; Thomas and Haas, 2001). There is an abundance of suitable round goby habitat (areas with gravel, cobble, and boulder-sized bed material) along the Trent River and expansion of their distribution will likely adversely affect native benthic fishes. It is not known whether the channel darter is equally vulnerable to impacts associated with round goby. Monitoring round goby distribution along the Trent River is therefore needed.

Acknowledgments

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