Targeted Sampling for Redside Dace (*Clinostomus elongatus*) in Two Tree River, Ontario, 2018

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ABSTRACT

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Targeted sampling for Redside Dace (*Clinostomus elongatus*), a species listed as *Endangered* under Canada's *Species at Risk Act*, was undertaken in Two Tree River near Sault Ste. Marie, Ontario, during 2018. Because relatively little information exists about the physiological tolerances of Redside Dace, sampling was conducted to evaluate thermal requirements of the species through streamside experiments, in partnership with the University of Toronto Scarborough. The results of thermal experiments have been disseminated in the primary literature; this data report summarizes field collections of Redside Dace to undertake the experiments over the course of five sampling periods between June and October, 2018. Seining was conducted in deep pool habitat between June and September and backpack electrofishing was conducted in shallow habitats with ample in-stream cover in October. Overall, 156 Redside Dace were captured between 42 and 107 mm total length, likely representing multiple year classes. Seining (13 sampling days, 82 total hauls) resulted in the capture of 128 individuals, and backpack electrofishing (four sampling days) resulted in the capture of 28 individuals.

RÉSUMÉ

Gáspárdy, R.C. and Drake, D.A.R. 2021. Targeted Sampling for Redside Dace (*Clinostomus elongatus*) in Two Tree River, Ontario, 2018. Can. Data Rep. Fish. Aquat. Sci. 1325: v + 17 p.

En 2018, on a mené des activités d'échantillonnage ciblant le méné long (*Clinostomus elongatus*), une espèce en voie de disparition en vertu de la *Loi sur les espèces en péril* du Canada, dans la rivière Two Tree située près de Sault Ste. Marie, en Ontario. Étant donné qu'il existe relativement peu de renseignements sur les seuils de tolérance physiologique du méné long, on a réalisé ces activités d'échantillonnage pour capturer des individus en vue de mener des expériences en milieux riverains. Réalisées en collaboration avec l'Université de Toronto, à Scarborough, ces expériences visaient à évaluer les besoins thermiques de l'espèce. Les résultats des expériences thermiques ont été publiés dans des documents primaires. Le présent rapport de données résume les captures de ménés longs qui ont été réalisées sur le terrain pendant cinq périodes d'échantillonnage, de juin à octobre 2018, en vue de mener ces expériences. Entre juin et septembre, on a mené des activités de pêche à la senne dans des fosses profondes et, en octobre, on a mené des activités de pêche à l'électricité avec un appareil portatif dans des milieux peu profonds où le couvert est abondant. Au total, on a capturé 156 ménés longs d'une longueur totale variant de 42 à 107 mm, qui représentent probablement de nombreuses classes d'âge. La capture de 128 individus découle des activités de pêche à la senne (13 jours d'échantillonnage et un total de 82 calées) et celle de 28 individus découle des activités de pêche à l'électricité réalisées avec un appareil portatif (quatre jours d'échantillonnage).

INTRODUCTION

Fisheries and Oceans Canada (DFO) has the responsibility to provide for the protection and recovery of fishes listed under the *Species at Risk Act* of 2002 (SARA). To inform scientific aspects of the recovery process, DFO regularly conducts field sampling to satisfy various research objectives for SARA-listed fishes, such as evaluating the distribution and abundance of species, determining species-habitat relationships, and better understanding the influence of threats and recovery actions. DFO data reports are published to support the Species at Risk Program by providing an overview of field activities and to provide a medium for archiving data associated with sampling SARA-listed fishes and their habitat.

Redside Dace (*Clinostomus elongatus*) is a small cyprinid with a large terminal mouth and often displays a bright red lateral stripe. The species was assessed as *Special Concern* by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2003 and was initially listed as *Special Concern* under SARA. Redside Dace was reassessed by COSEWIC as *Endangered* in 2007 and 2017 and was subsequently listed as *Endangered* under SARA in 2017 (Lebrun et al. 2020). The range of Redside Dace in Canada is limited to a few disjunct drainages within Ontario: primarily tributaries of Lake Ontario in the Greater Toronto Area (GTA), as well as several disjunct populations in Lake Huron tributaries. Degradation and alteration of aquatic habitat, riparian vegetation, and flow regimes in both urban and rural settings are considered primary threats to Redside Dace, particularly as these alterations result in warmer thermal regimes and reduced availability of terrestrial insects on which it feeds (COSEWIC 2017; Lebrun et al. 2020).

Like most SARA-listed freshwater fishes, relatively little information exists about the physiological tolerances of Redside Dace. Thermal tolerance of Redside Dace has been evaluated in a laboratory setting across various acclimation temperatures (Novinger and Coon, 2000); however, the effect of seasonal thermal variation on Redside Dace in the wild is unknown. To address this knowledge gap, streamside experiments were undertaken in Two Tree River on St. Joseph Island, Ontario, in partnership with the University of Toronto Scarborough, to evaluate the thermal requirements of the species. The results of the thermal experiment have been described by Leclair et al. (2020); this data report summarizes the field collections of Redside Dace in Two Tree River needed to undertake the physiological experiment over the course of five visits between June and October, 2018.

METHODS

STUDY SYSTEM AND SITE SELECTION

Two Tree River is a small stream located on St. Joseph Island, Ontario. St. Joseph Island is located near the confluence of the St. Marys River with Lake Huron, approximately 45 km southeast of Sault Ste. Marie, Ontario, and is the second largest island on Lake Huron, second to Manitoulin Island. Two Tree River flows westward from Richards Landing to its confluence with the St. Mary's River on the island's west coast at Richardson Point. Two Tree River is approximately 11 km long with an average gradient of 3.4 m per kilometre (Karrow 1991), and is the second longest river on St. Joseph Island. The population of Redside Dace in Two Tree River is one of few populations considered stable in Ontario and the species is widely distributed throughout the watercourse (COSEWIC 2017; Lebrun et al. 2020). Redside Dace was first detected in Two Tree River by the Ontario Ministry of Natural Resources and Forestry

(OMNRF) in 1997, and has been consistently captured at many sites throughout the waterbody, with increased sampling effort between 2009 and 2017 (COSEWIC 2017).

All sampling for this project was conducted at one location in Two Tree River (46.25706, -84.02688; Figure 1), which was visited for three to five days monthly between June and October in 2018 (Table 1). The sampling location was selected due to the presence of the preferred habitat of the species (i.e., deep, cool, and clear pools with abundant overhanging riparian vegetation such as grasses and shrubs; COSEWIC 2017). Moreover, Redside Dace was detected in this location in relatively high abundance on multiple occasions in 2010 (COSEWIC 2017) and in 2017 (Castañeda et al. 2020), indicating a high likelihood of capturing a large number of individuals for thermal tolerance experiments. The 2018 sampling site was located on private property on the north side of F & G Line Road, and was accessed following landowner permission.

FISH ASSEMBLAGE SAMPLING

A targeted, opportunistic sampling approach was employed. The purpose of sampling was to capture as many Redside Dace as were required for daily physiology experiments (maximum 12) with as little sampling effort as possible; therefore, there was no set methodology in terms of a standardized approach or prescribed effort. Sampling effort concluded daily when the number of Redside Dace for stream-side experiments was reached. Each sampling visit consisted of three to five sampling days within the same week, repeated approximately monthly, or every three to five weeks between June and October, 2018 (Table 1). Both seining and backpack electrofishing were used to capture Redside Dace.

Seining

Fishes were collected using a 9.14 m long x 1.8 m tall bag seine net with 3 mm mesh. Deployment of the seine focused on a wadeable area upstream of a beaver dam and upstream of the driveway culvert where water velocity was slow, and where the water was deep with steep, vegetated banks (Figure 2). Two to three field personnel pulled the seine between 10 and 40 m within this area until the target number of Redside Dace was captured for the day (Figure 3a). Though wadeable, seining in this deep pool often resulted in field personnel topping their waders through summer months; therefore, field personnel wore dry suits when seining when water temperatures decreased during fall sampling events. The total number of hauls per day was recorded.

Backpack Electrofishing

Seining failed to produce the target number of Redside Dace during the October sampling period and also became unsafe for field operation due to increased water levels and decreased water temperatures. Backpack electrofishing was subsequently incorporated during the October period to allow sampling of shallower areas with abundant in-stream cover downstream of the beaver dam, which was downstream of the previously seined deep pool (Figure 2). As backpack electrofishing requires more equipment and places greater physical stress on captured fishes, the method was only used when seining was not effective or possible.

The section of Two Tree River where electrofishing occurred was shallower, narrower, and had higher water velocity relative to the seine location, and contained steep and undercut banks with overhanging grasses and woody vegetation. Electrofishing involved the deployment of a Smith-Root LR-24 backpack electrofisher. Two to three field personnel (one operator and one or two

netters) worked in an upstream direction to sample approximately 80 m of river (Figure 3b). The electrofisher was used to sample available in-stream structure and cover, including undercut banks, root-wads, and partially submerged woody vegetation such as dogwoods. This location was sampled repeatedly through each sampling day until the target number of Redside Dace was captured. Fishes stunned by the electrofisher were immediately netted and placed in a bucket of fresh river water until sampling was complete. Total shocking seconds or number of passes was not recorded.

Enumeration of Fishes

Following capture by seine or backpack electrofisher, fishes were immediately placed in aquaria with fresh river water. Captured Redside Dace were transferred to a flow-through holding tank prior to physiology experiments. Two flow-through holding tanks were employed, which were constructed of 52 L (56.5 x 39.3 x 30.4 cm) flip-top tote bins with many 3 mm holes drilled in two sides to allow for river water exchange. Additionally, a smaller 7.5 L bucket with slotted bottom and secure locking lid (the inside bucket of a Frabill Drainer Bait Bucket) was used inside the flow-through tank to hold small individuals (35 – 50 mm) and reduce search effort with dip net at time of use for experimental trial. Owing to the volume of fishes captured and personnel and time constraints, non-target fishes were only identified and enumerated on the first day of field sampling and the first four hauls of the second day of sampling on June 19th and 20th. Thereafter, captured non-target species were released immediately.

All captured Redside Dace were enumerated daily. On three sampling days (June 20, August 14, and October 25), a sufficient number of Redside Dace was captured for two days of physiology experiments and these individuals were held in the flow-through holding tank until the following day to minimize required sampling effort. Each Redside Dace used for an experimental trial was measured for total length (TL; mm), and received a pelvic fin clip to mark individual fish to ensure the same individual was not captured and used in a subsequent experimental trial within the same week. All Redside Dace were released in the pool upstream of the driveway culvert next to the streamside field station after a minimum recovery time of 30 minutes in a recovery flow-through tank (Figure 2).

HABITAT SAMPLING

Minimal habitat sampling was conducted for this study. Water quality parameters (surface water temperature [°C], conductivity [µS], turbidity [NTU], and dissolved oxygen [mg/L]) were measured once per sampling day following the conclusion of fish sampling. Water quality parameters were measured approximately 0.2 m beneath the water's surface using a YSI EX02 multiparameter sonde, which was deployed and allowed to stabilize for approximately one minute before measurements were recorded. Water depth (m) was measured at three representative locations within the sampled area each day. Water depth was only recorded for June to September sampling in the deep pool sampled upstream of the beaver dam, and was not recorded for the habitat below the beaver dam that was sampled in October with backpack electrofishing (Figure 2).

Temperature Data Loggers

A single Onset HOBO Water Temperature Pro v2 data logger was deployed in the pool immediately upstream of the driveway culvert for long-term in-stream measurement of water temperature at the study site (Figure 2). The temperature logger was deployed in June 2018 and recorded water temperature every 30 minutes until its retrieval in October 2019.

SAMPLING PERMITS AND DATA ARCHIVING

Sampling for this project was conducted under SARA Permit Number 18-PCAA-00022. Seining, backpack electrofishing, and fish anesthesia were conducted under Animal Use Protocol AUP 1852 and Standard Operating Protocols GWACC-116, GWACC-111, and GWACC-105, approved by the DFO and Environment and Climate Change Canada Animal Care Committee (operated under approval of the Canadian Council on Animal Care). Data associated with the collections in this report are housed under the project code “2018-RSD-CTM” in the Biodiversity Science database within the Great Lakes Laboratory for Fisheries and Aquatic Sciences. Every effort has been made to ensure the accuracy of data contained in this report. Data associated with this report may be obtained by contacting the Great Lakes Laboratory for Fisheries and Aquatic Sciences.

RESULTS

FISH ASSEMBLAGE SAMPLING

In total, sampling occurred over 14 days across five sampling periods in 2018 (Table 1, Appendix 1), which resulted in the capture of 156 Redside Dace (Figure 4a). Of these, 128 Redside Dace were captured by 82 seine hauls over 11 sampling days, while 28 Redside Dace were captured by backpack electrofisher over three sampling days.

Seining was effective at capturing Redside Dace in wadeable habitats in summer months in the deep pool upstream of the driveway culvert (Table 1). The number of seine hauls required to capture the target number of Redside Dace per day initially decreased monthly, beginning with 21 hauls to capture 38 individuals in June, to only three hauls to capture 30 individuals across two sampling days in August. However, the number of seine hauls increased thereafter, with a total of 28 hauls to capture 28 Redside Dace in September, and more than 20 seine hauls only producing two Redside Dace in October. Backpack electrofishing proved to be more effective than seining in October, where several hours of electrofishing over two field days captured 25 Redside Dace.

Overall, mean size of Redside Dace captured was 72.07 mm TL (range: 42 – 107 mm TL), with the largest two individuals captured in June and August, and smallest two individuals captured in September and October, which were likely young-of-the-year (Table 2, Figure 5, Appendix 2). Mean size of Redside Dace was similar by monthly sampling event, except in August when mean size of Redside Dace was highest (78.7 mm TL; Table 2). Based on the absence of captured fish with clipped fins, no individuals were identified as recaptures within a single sampling week. Field crews did not seek to identify partially healed fins, which prevented assessment of recaptures from previous sampling periods.

A total of 172 fishes were enumerated representing 12 species in the first five seine hauls of the field project (Table 3). The most abundant captured non-target species were Brook Stickleback (*Culaea inconstans)*, Creek Chub (*Semotilus atromaculatus*), Mottled Sculpin (*Cottus bairdii*), Northern Redbelly Dace (*Chrosomus eos*), and Brassy Minnow (*Hybognathus hankinsoni*; Figure 4b).

HABITAT SAMPLING

Redside Dace was captured in water temperatures ranging from 5.8 °C (mean daily water temperature in October when air temperature averaged 20.8 °C), to the warmest mean daily

water temperature of 20.3 °C in August, when daily air temperature averaged 30.0 °C (Table 4, Appendix 3). Mean conductivity across all sampling events was 300.8 µS, and was lowest in October (mean: 188.8 µS) and highest in August (mean: 452.8 µS). Mean daily dissolved oxygen by monthly sampling event ranged from 4.9 to 7.0 mg/L from June to September in the deep pool sampled upstream of the beaver dam, and was significantly higher in October (mean 12.4 mg/L) in shallower, flowing habitat downstream of the beaver dam. Overall, mean turbidity by sampling event was 78.6 NTU (range: 16.7 – 195.4 NTU) and mean water clarity (Secchi tube) was 0.4 m (range: 0.3 – 0.5 m). Mean pH was 8.7 (range: 8.1 – 9.5). Overall, mean water depth during sampling was 1.22 m (range of mean monthly depth: 1.04 – 1.29 m), with the minimum single depth measurement within sampled area of 0.63 m in June and maximum single depth measurement within sampled area of 1.52 m in September (Table 5, Appendix 3).

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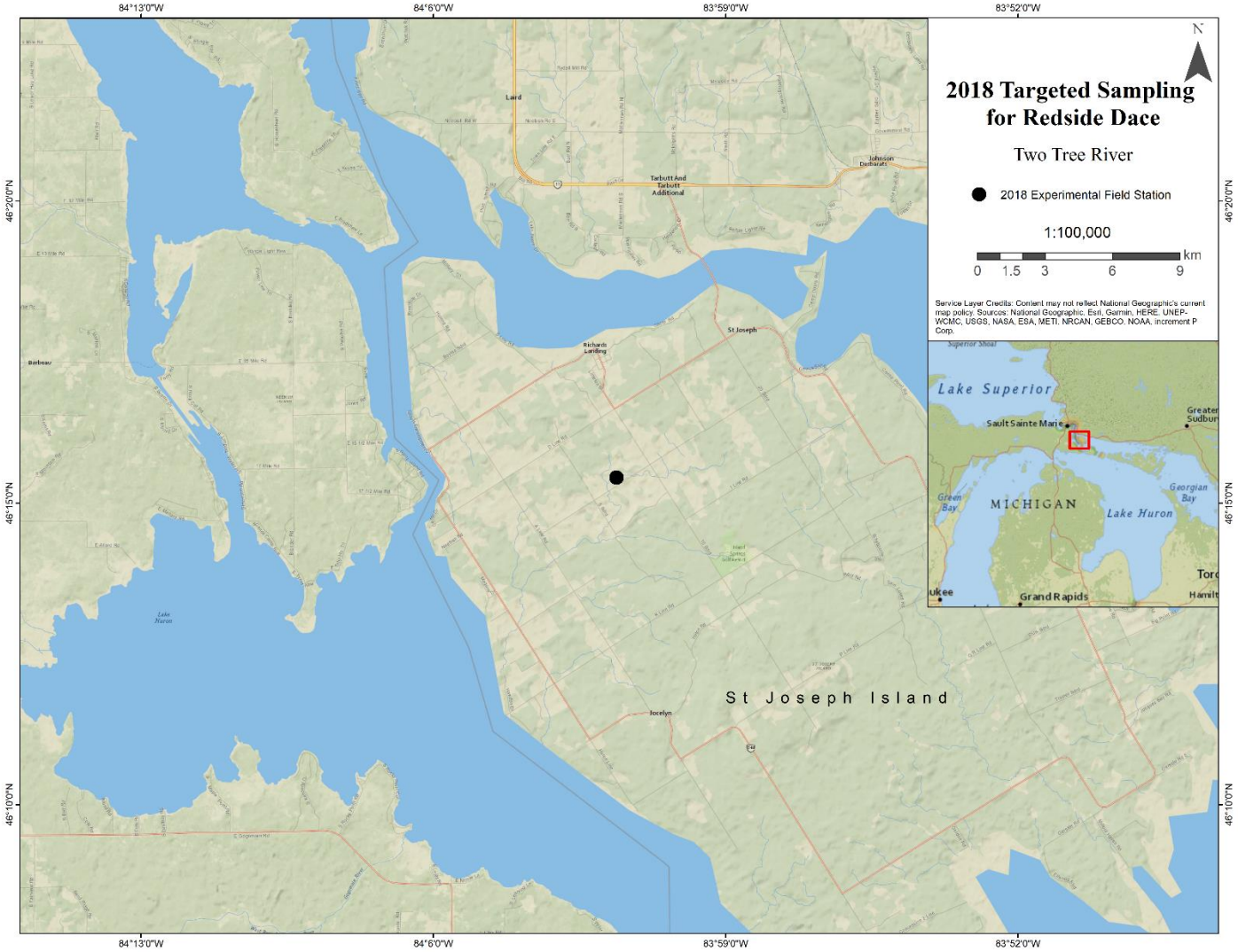


Figure 1. *Location of Redside Dace detections using seining and backpack electrofishing in Two Tree River, on St. Joseph Island, Ontario, June-October, 2018.*

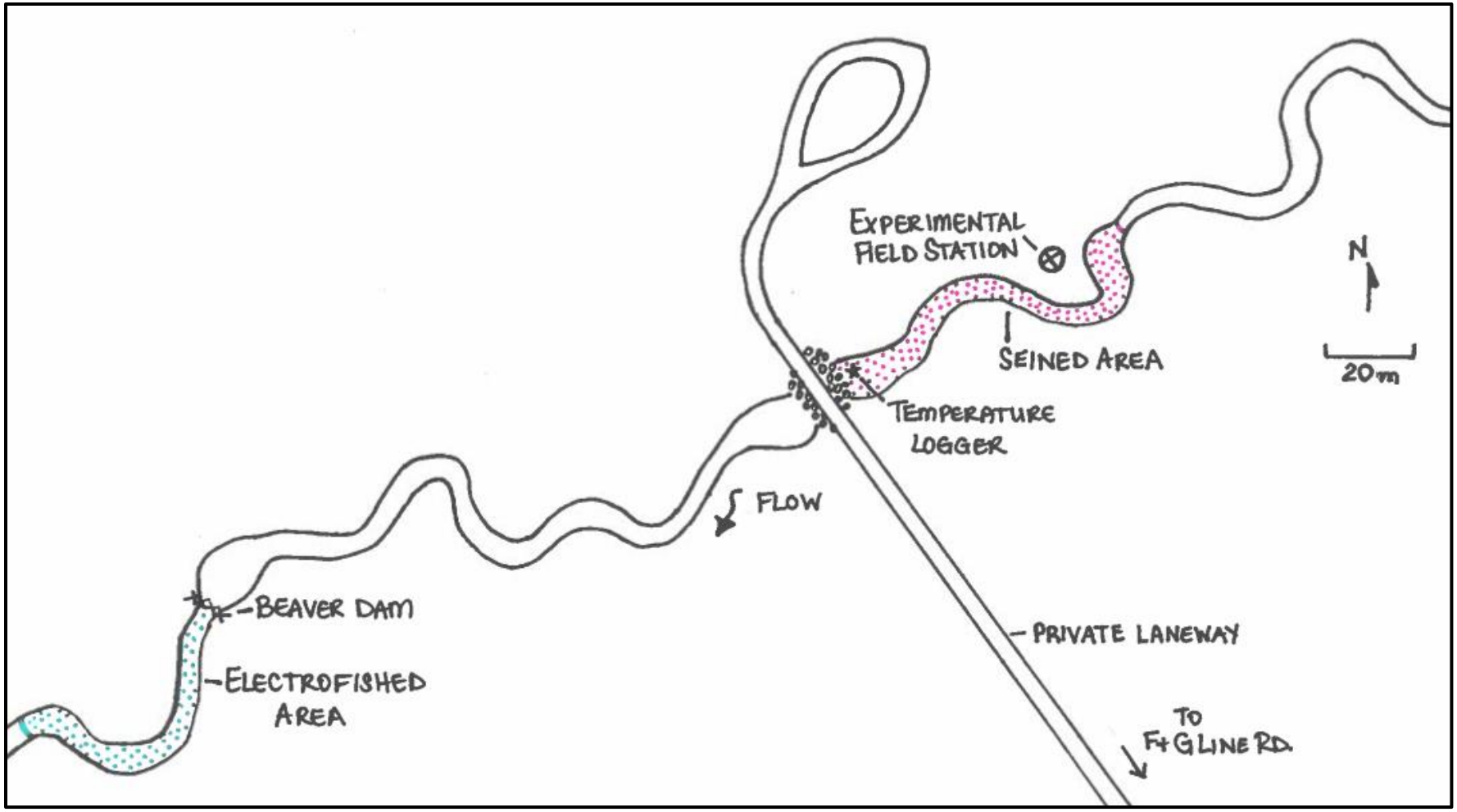


Figure 2. *Site map of experimental field station, located on private property north of F & G Line Road where Redside Dace was captured in Two Tree River, Ontario, 2018. Site map indicates seined area sampled using a bag seine from June to September, electrofished area sampled using backpack electrofisher in October, beaver dam, laneway crossing, and location of in-stream temperature data logger.*

a)

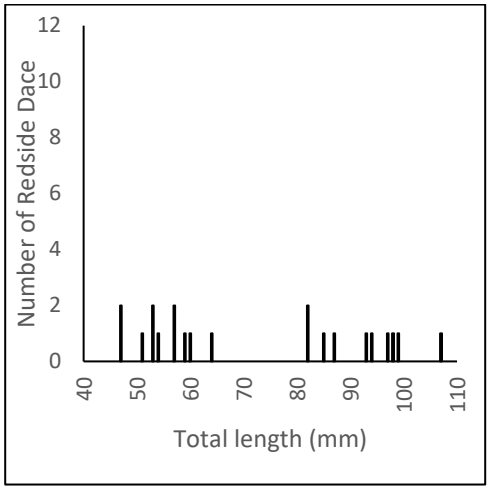
b)

Figure 3. *Photograph of field personnel conducting targeted sampling for Redside Dace in Two Tree River by a) seining in the deep pool upstream of beaver dam and driveway in spring 2018, and b) backpack electrofishing downstream of beaver dam in fall 2018.*

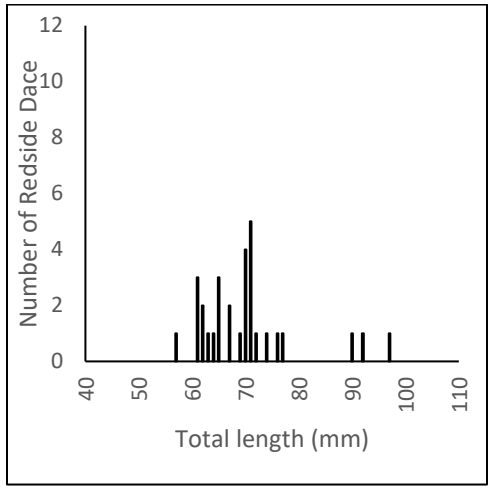
a)

b)

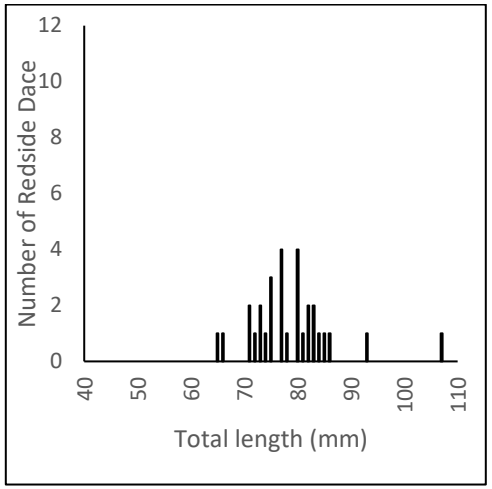
Figure 4. *Photograph of a) adult Redside Dace captured during October backpack electrofishing, and b) Brassy Minnow (*Hybognathus hankinsoni*) captured during June seining in Two Tree River, 2018.*



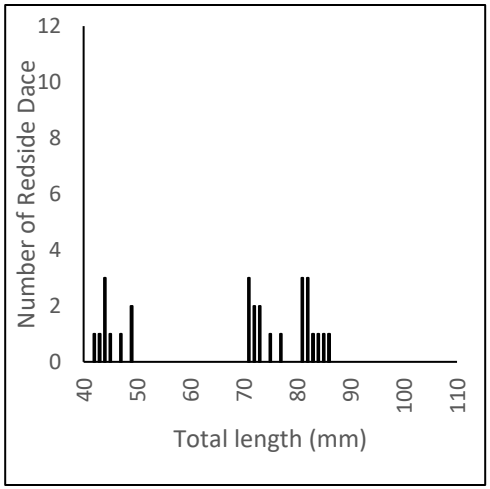
a) June mean TL 72.7 mm (n=21)



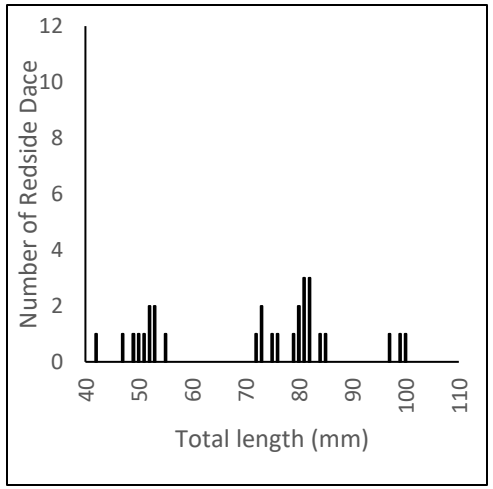
b) July mean TL 70.1 mm (n=30)



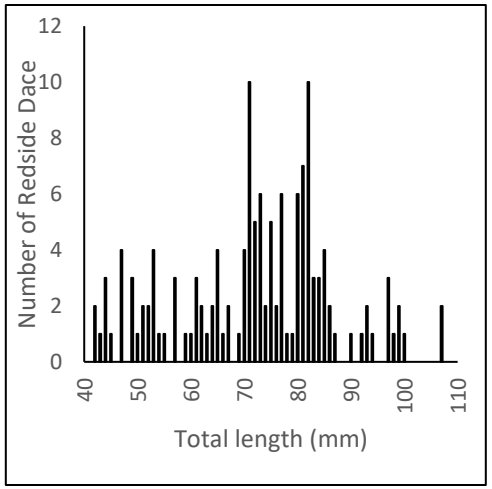
c) August mean TL 78.7 mm (n=30)



d) September mean TL 67.5 (n=28)



e) October mean TL 71.2 mm (n=29)



f) Overall mean TL 71.2 mm (n=138)

Figure 5. *Length-frequency of total lengths (TL; mm) of Redside Dace captured in a) June, b) July, c) August, d) September, e) October, and f) overall in Two Tree River, Ontario in 2018.*

Table 1. *Summary of sampling events, effort, gear type (SN = seining, BPEF = backpack electrofishing), and number of Redside Dace captured in 2018. Effort is displayed as number of seine hauls or total backpack electrofishing seconds.*

Sampling event	Dates	Sampling days	Gear type	Effort	Redside Dace captured
June	June 19-21	2	SN	21	38
July	July 17-19	3	SN	10	30
August	August 14-16	2	SN	3	30
September	September 25-27	3	SN	28	28
October	October 23	1	SN	> 20	2
October	October 23-26	3	BPEF	not recorded	28
Total by gear type		11	SN	82	128
		3	BPEF	not recorded	28
Total Redside Dace captured					**156**

Table 2. *Summary of total length (TL; mm) of Redside Dace captured during monthly sampling events. Total length (mm) only measured for individuals used for physiological tolerance trials (n=138).*

Sampling event	Number of Redside Dace	Minimum TL (mm)	Maximum TL (mm)	Mean TL (mm)
June	21	47	107	72.67
July	30	57	97	70.07
August	30	65	107	78.73
September	28	42	86	67.46
October	29	42	100	71.24
Overall	**138**	**42**	**107**	**72.07**

Table 3. *List of non-target species detected in Two Tree River on June 19 and 20, 2018. Due to sampling objectives and personnel and time constraints, non-target species were not identified and enumerated during the majority of sampling events in 2018.*

Scientific Name	Common Name
Catostomus commersonii	White Sucker
Chrosomus eos	Northern Redbelly Dace
Cottus bairdii	Mottled Sculpin
Culaea inconstans	Brook Stickleback
Etheostoma nigrum	Johnny Darter
Hybognathus hankinsoni	Brassy Minnow
Notropis volucellus	Mimic Shiner
Pimephales promelas	Fathead Minnow
Rhinichthys atratulus	Blacknose Dace
Semotilus atromaculatus	Creek Chub
Umbra limi	Central Mudminnow

Table 4. *Summary of mean daily abiotic habitat values, aggregated over each sampling event.*

Sampling event	Air temp. (°C)	Water temp. (°C)	Conductivity (µS)	Dissolved oxygen (mg/L)	pH	Secchi tube (m)	Turbidity (NTU)
June	20.8	17.63	328.87	6.62	8.05	0.3	16.7
July	24.6	14.17	309.33	4.89	8.28	0.5	77.0
August	30.0	20.33	452.75	5.10	8.91	0.5	22.7
September	15.8	13.24	312.33	6.96	-	0.3	23.7
October	4.7	5.78	188.83	12.45	9.47	-	195.4
Overall	**17.5**	**13.26**	**300.8**	**7.69**	**8.72**	**0.4**	**78.6**

Table 5. *Summary of water depth (m) in sampled area, aggregated over each each monthly sampling event.*

Sampling event	Minimum depth (m)	Maximum depth (m)	Mean depth (m)
June	0.63	1.33	1.04
July	1.08	1.45	1.25
August	1.13	1.40	1.28
September	1.05	1.52	1.29
October	-	-	-
Overall	**0.63**	**1.52**	**1.22**

Appendix 1. *Daily sampling summary including field code unique to daily sampling, gear type (SN=seining, BPEF=backpack electrofishing), sampling effort, and number of Redside Dace captured daily. Seining effort is number of seine hauls conducted. BPEF effort was not recorded (NR).*

Date	Unique field number	Gear type	Description of gear	Effort	Number of Redside Dace captured
19-Jun-18	2018-RSD-CTM-190618-001A	SN	Bag seine (9.14 m, 3 mm mesh)	1	6
20-Jun-18	2018-RSD-CTM-200618-001A	SN	Bag seine (9.14 m, 3 mm mesh)	20	32
21-Jun-18	2018-RSD-CTM-210618-001A	N/A	Not sampled	N/A	0
17-Jul-18	2018-RSD-CTM-170718-001A	SN	Bag seine (9.14 m, 3 mm mesh)	4	10
18-Jul-18	2018-RSD-CTM-180718-001A	SN	Bag seine (9.14 m, 3 mm mesh)	3	11
19-Jul-18	2018-RSD-CTM-190718-001A	SN	Bag seine (9.14 m, 3 mm mesh)	3	9
14-Aug-18	2018-RSD-CTM-140818-001A	SN	Bag seine (9.14 m, 3 mm mesh)	2	22
15-Aug-18	2018-RSD-CTM-150818-001A	N/A	Not sampled	N/A	0
16-Aug-18	2018-RSD-CTM-160818-001A	SN	Bag seine (9.14 m, 3 mm mesh)	1	8
25-Sep-18	2018-RSD-CTM-250918-001A	SN	Bag seine (9.14 m, 3 mm mesh)	15	9
26-Sep-18	2018-RSD-CTM-260918-001A	SN	Bag seine (9.14 m, 3 mm mesh)	12	9
27-Sep-18	2018-RSD-CTM-270918-001A	SN	Bag seine (9.14 m, 3 mm mesh)	1	10
23-Oct-18	2018-RSD-CTM-231018-001A	SN	Bag seine (9.14 m, 3 mm mesh)	20	2
23-Oct-18	2018-RSD-CTM-231018-001A	BPEF	Smith-Root LR-24 Backpack Electrofisher	NR	3
24-Oct-18	2018-RSD-CTM-241018-001A	BPEF	Smith-Root LR-24 Backpack Electrofisher	NR	9
25-Oct-18	2018-RSD-CTM-251018-001A	BPEF	Smith-Root LR-24 Backpack Electrofisher	NR	16
26-Oct-18	2018-RSD-CTM-261018-001A	N/A	Not sampled	N/A	0

Appendix 2. *Individual total length (mm) of Redside Dace captured in Two Tree River, 2018 (n=138) measured on completion of individual experimental trials. Where capture and trial dates differ for one individual, the fish was captured on one sampling day, held in an in-stream flow-through aquaria, and used for experimental trial and measured the next day. Unique individual code (RSD-ID; ddmmyy-XXX) correlates to the date of experimental trial and trial number (XXX).*

Capture date	Trial date	Unique individual code (RSD-ID)	Total length (mm)
19-Jun-18	19-Jun-18	190618-001	93
19-Jun-18	19-Jun-18	190618-002	97
19-Jun-18	19-Jun-18	190618-003	87
19-Jun-18	19-Jun-18	190618-004	82
19-Jun-18	19-Jun-18	190618-005	85
20-Jun-18	20-Jun-18	200618-001	107
20-Jun-18	20-Jun-18	200618-002	99
20-Jun-18	20-Jun-18	200618-003	54
20-Jun-18	20-Jun-18	200618-004	94
20-Jun-18	20-Jun-18	200618-005	98
20-Jun-18	20-Jun-18	200618-006	53
20-Jun-18	20-Jun-18	200618-007	47
21-Jun-18	21-Jun-18	210618-001	53
21-Jun-18	21-Jun-18	210618-002	64
21-Jun-18	21-Jun-18	210618-003	47
21-Jun-18	21-Jun-18	210618-004	51
21-Jun-18	21-Jun-18	210618-005	57
21-Jun-18	21-Jun-18	210618-006	57
21-Jun-18	21-Jun-18	210618-007	82
21-Jun-18	21-Jun-18	210618-008	59
21-Jun-18	21-Jun-18	210618-009	60
17-Jul-18	17-Jul-18	170718-001	71
17-Jul-18	17-Jul-18	170718-002	65
17-Jul-18	17-Jul-18	170718-003	90
17-Jul-18	17-Jul-18	170718-004	67
17-Jul-18	17-Jul-18	170718-005	63
17-Jul-18	17-Jul-18	170718-006	57
17-Jul-18	17-Jul-18	170718-007	61
17-Jul-18	17-Jul-18	170718-008	64
17-Jul-18	17-Jul-18	170718-009	76
17-Jul-18	17-Jul-18	170718-010	77
18-Jul-18	18-Jul-18	180718-001	69
18-Jul-18	18-Jul-18	180718-002	71
18-Jul-18	18-Jul-18	180718-003	72
18-Jul-18	18-Jul-18	180718-004	69
18-Jul-18	18-Jul-18	180718-005	70
18-Jul-18	18-Jul-18	180718-006	70
18-Jul-18	18-Jul-18	180718-007	70
18-Jul-18	18-Jul-18	180718-008	62
18-Jul-18	18-Jul-18	180718-009	61
18-Jul-18	18-Jul-18	180718-010	65
18-Jul-18	18-Jul-18	180718-011	71

Capture date	Trial date	Unique individual code (RSD-ID)	Total length (mm)
19-Jul-18	19-Jul-18	190718-001	74
19-Jul-18	19-Jul-18	190718-002	71
19-Jul-18	19-Jul-18	190718-003	70
19-Jul-18	19-Jul-18	190718-004	92
19-Jul-18	19-Jul-18	190718-005	61
19-Jul-18	19-Jul-18	190718-006	97
19-Jul-18	19-Jul-18	190718-007	71
19-Jul-18	19-Jul-18	190718-008	62
19-Jul-18	19-Jul-18	190718-009	65
14-Aug-18	14-Aug-18	140818-001	82
14-Aug-18	14-Aug-18	140818-002	75
14-Aug-18	14-Aug-18	140818-003	80
14-Aug-18	14-Aug-18	140818-004	82
14-Aug-18	14-Aug-18	140818-005	77
14-Aug-18	14-Aug-18	140818-006	78
14-Aug-18	14-Aug-18	140818-007	81
14-Aug-18	14-Aug-18	140818-008	84
14-Aug-18	14-Aug-18	140818-009	71
14-Aug-18	14-Aug-18	140818-010	107
14-Aug-18	15-Aug-18	150818-001	71
14-Aug-18	15-Aug-18	150818-002	74
14-Aug-18	15-Aug-18	150818-003	77
14-Aug-18	15-Aug-18	150818-004	85
14-Aug-18	15-Aug-18	150818-005	75
14-Aug-18	15-Aug-18	150818-006	77
14-Aug-18	15-Aug-18	150818-007	75
14-Aug-18	15-Aug-18	150818-008	80
14-Aug-18	15-Aug-18	150818-009	83
14-Aug-18	15-Aug-18	150818-010	93
14-Aug-18	15-Aug-18	150818-011	86
14-Aug-18	15-Aug-18	150818-012	80
16-Aug-18	16-Aug-18	160818-001	80
16-Aug-18	16-Aug-18	160818-002	77
16-Aug-18	16-Aug-18	160818-003	73
16-Aug-18	16-Aug-18	160818-004	72
16-Aug-18	16-Aug-18	160818-005	66
16-Aug-18	16-Aug-18	160818-006	73
16-Aug-18	16-Aug-18	160818-007	65
16-Aug-18	16-Aug-18	160818-008	83
25-Sep-18	25-Sep-18	250918-001	84
25-Sep-18	25-Sep-18	250918-002	49
25-Sep-18	25-Sep-18	250918-003	83
25-Sep-18	25-Sep-18	250918-004	47
25-Sep-18	25-Sep-18	250918-005	81
25-Sep-18	25-Sep-18	250918-006	44
25-Sep-18	25-Sep-18	250918-007	73
25-Sep-18	25-Sep-18	250918-008	43
25-Sep-18	25-Sep-18	250918-009	71
26-Sep-18	26-Sep-18	260918-001	71
26-Sep-18	26-Sep-18	260918-002	44

Capture date	Trial date	Unique individual code (RSD-ID)	Total length (mm)
26-Sep-18	26-Sep-18	260918-003	49
26-Sep-18	26-Sep-18	260918-004	42
26-Sep-18	26-Sep-18	260918-005	44
26-Sep-18	26-Sep-18	260918-006	71
26-Sep-18	26-Sep-18	260918-007	45
26-Sep-18	26-Sep-18	260918-008	81
26-Sep-18	26-Sep-18	260918-009	75
27-Sep-18	27-Sep-18	270918-001	72
27-Sep-18	27-Sep-18	270918-002	82
27-Sep-18	27-Sep-18	270918-003	86
27-Sep-18	27-Sep-18	270918-004	82
27-Sep-18	27-Sep-18	270918-005	85
27-Sep-18	27-Sep-18	270918-006	73
27-Sep-18	27-Sep-18	270918-007	81
27-Sep-18	27-Sep-18	270918-008	82
27-Sep-18	27-Sep-18	270918-009	77
27-Sep-18	27-Sep-18	270918-010	72
23-Oct-18	23-Oct-18	231018-001	42
23-Oct-18	23-Oct-18	231018-002	79
23-Oct-18	23-Oct-18	231018-003	80
23-Oct-18	23-Oct-18	231018-004	84
23-Oct-18	23-Oct-18	231018-005	-
24-Oct-18	24-Oct-18	241018-001	50
24-Oct-18	24-Oct-18	241018-002	53
24-Oct-18	24-Oct-18	241018-003	85
24-Oct-18	24-Oct-18	241018-004	99
24-Oct-18	24-Oct-18	241018-005	80
24-Oct-18	24-Oct-18	241018-006	47
24-Oct-18	24-Oct-18	241018-007	52
24-Oct-18	24-Oct-18	241018-008	73
24-Oct-18	24-Oct-18	241018-009	75
25-Oct-18	25-Oct-18	251018-001	49
25-Oct-18	25-Oct-18	251018-002	81
25-Oct-18	25-Oct-18	251018-003	53
25-Oct-18	25-Oct-18	251018-004	82
25-Oct-18	25-Oct-18	251018-005	55
25-Oct-18	25-Oct-18	251018-006	73
25-Oct-18	25-Oct-18	251018-007	51
25-Oct-18	25-Oct-18	251018-008	100
25-Oct-18	25-Oct-18	251018-009	52
25-Oct-18	26-Oct-18	261018-001	97
25-Oct-18	26-Oct-18	261018-002	82
25-Oct-18	26-Oct-18	261018-003	72
25-Oct-18	26-Oct-18	261018-004	81
25-Oct-18	26-Oct-18	261018-005	82
25-Oct-18	26-Oct-18	261018-006	81
25-Oct-18	26-Oct-18	261018-007	76

Appendix 3. *Daily abiotic habitat assessment measurements, collected immediately after collection of fishes using a YSI EXO2 multiparameter sonde, and metre stick.*

Date	Air temp. (°C)	Water temp. (°C)	Conductivity (µS)	Dissolved oxygen (mg/L)	pH	Secchi tube (m)	Turbidity (NTU)	Stream depth (m) 1	Stream depth (m) 2	Stream depth (m) 3
19-Jun-18	24.9	18.56	315.3	8.88	8.0	0.32	14.72	0.92	1.02	0.63
20-Jun-18	20.7	16.75	325.2	5.78	8.0	0.36	17.69	1.33	1.10	1.25
21-Jun-18	16.8	17.59	346.1	5.20	8.1	0.29	17.59	-	-	-
17-Jul-18	22.8	20.19	423.7	4.32	8.2	0.45	51.22	1.20	1.33	1.08
18-Jul-18	25.1	2.80	46.5	5.53	8.3	0.50	108.94	1.33	1.10	1.13
19-Jul-18	25.9	19.51	457.8	4.81	8.4	0.50	70.75	1.45	1.28	1.31
14-Aug-18	31.2	20.00	439.5	5.14	8.9	0.38	34.43	1.13	1.30	1.25
15-Aug-18	-	-	-	-	-	0.60	-	-	-	-
16-Aug-18	28.7	20.66	466.0	5.06	8.9	-	11.00	1.20	1.38	1.40
25-Sep-18	16.0	14.12	326.2	7.34	-	0.21	25.41	1.37	1.05	1.51
26-Sep-18	14.2	13.23	349.7	7.27	-	0.22	22.98	1.31	1.15	1.52
27-Sep-18	17.3	12.37	261.1	6.27	-	0.45	22.78	1.21	1.07	1.42
23-Oct-18	5.1	5.88	197.0	12.69	9.5	-	194.40	-	-	-
24-Oct-18	5.1	5.52	179.9	12.15	9.1	-	197.53	-	-	-
25-Oct-18	4.3	5.97	183.2	12.35	9.6	-	192.31	-	-	-
26-Oct-18	4.2	5.73	195.2	12.59	9.7	-	197.25	-	-	-