Sampling the fish community of Big Creek, Norfolk County, Ontario, 2008

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2016

Canadian Manuscript Report of
Fisheries and Aquatic Sciences 3106

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PDF version: Cat. No. Fs97-4/3106E-PDF ISBN 978-0-660-05998-3 ISSN 1488-5387

Correct citation for this publication:

Marson, S., Marson, D, Bouvier, L.D., Mandrak, N.E. 2016. Sampling the fish community of Big Creek, Norfolk County, Ontario, 2008. Can. Manuscr. Rep. Fish. Aquat. Sci. 3106: iv + 17 p.

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ABSTRACT

Fisheries and Oceans Canada conducted a fish community survey of Big Creek, Norfolk County in the summer and fall of 2008. A total of 21 sites were sampled using a variety of sampling methods, including backpack electrofishing (two sites), boat electrofishing (eight sites), bag seining (four sites), and boat seining (seven sites). The survey was focused primarily on the areas accessible by boat, resulting in more intensive sampling of the lower Big Creek watershed. However, site selection also considered locations where Lake Chubsucker had been previously recorded. A total of 919 fishes representing 34 species were captured, including four species at risk. Eastern Sand Darter, *Ammocrypta pellucida* (Threatened), Pugnose Shiner, *Notropis anogenus* (Endangered) and Grass Pickerel, *Esox americanus vermiculatus* (Special Concern) were detected at two sites each, while Lake Chubsucker, *Erimyzon sucetta* (Endangered) was detected at a single site.

RÉSUMÉ

Pêches et Océans Canada a mené un relevé de la communauté de poissons de Grand Crique, dans le comté de Norfolk, au printemps et à l'automne 2008. Un total de 21 sites ont été échantillonnés au moyen de différentes méthodes, comme la pêche électrique à l'aide d'appareils portatifs (2 sites), la pêche électrique en bateau (8 sites), la senne manuelle (4 sites) et la senne en bateau (7 sites). Le relevé portait surtout sur les zones accessibles en bateau et a donc donné lieu à un échantillonnage plus intensif du bassin versant du cours inférieur du Grand Crique. Cependant, la sélection des sites a aussi tenu compte des sites où le sucet de lac avait déjà été observé. On a capturé, au total, 919 poissons de 34 espèces, dont quatre espèces en péril. Le dard de sable (*Ammocrypta pellucida*) [menacé], le méné camus (*Notropis anogenus*) [en voie de disparition] et le crapet sac-à-lait (*Esox americanus vermiculatus*) [préoccupant] ont été détectés à deux sites chacun, et le sucet de lac (*Erimyzon sucetta*) [en voie de disparition] a été détecté à un seul site.

INTRODUCTION

Big Creek is the largest sub-watershed in the Long Point Region, consisting of a total of 750 square kilometers[1]. The creek flows south through Delhi before it enters Lake Erie near Port Rowan (Figure 1). Big Creek and its tributaries are of particular interest for fish conservationists as historical records exist from this system for four fish species at risk: Lake Chubsucker, *Erimyzon sucetta*, Eastern Sand Darter, *Ammocrypta pellucida*, Pugnose Shiner, *Notropis anogenus*, and Grass Pickerel, *Esox americanus vermiculatus*.

Lake Chubsucker was historically recorded from the Big Creek watershed in 1960, 1972-1974 and 1979 from Silverthorn Creek, Stoney Creek, Lynedock Creek, and Trout Creek (tributaries of Big Creek) (Bouvier and Mandrak 2011). Many of the historic Lake Chubsucker sites have not been re-visited since the time of the initial detection. Eastern Sand Darter was first recorded from Big Creek in 1923, and subsequently detected in 1955. Six sampling attempts occurred in this system from 1973 to 2004 and failed to detect Eastern Sand Darter. Unlike Lake Chubsucker, and Eastern Sand Darter, there are no historic records for Pugnose Shiner from the Big Creek watershed. The first detection of Pugnose Shiner in this system occurred in 2007 when individuals were recorded at the highway 59 bridge crossing (D.A.R. Drake, 867 Lakeshore Rd, Burlington ON. unpublished data). Similarly, Grass Pickerel were not historically known to occupy the Big Creek watershed. The first Grass Pickerel record was obtained when a single individual was captured in the lower section of the creek in 2002 (Beauchamp et al. 2012), while additional vouchers were recorded from the upper portion of Big Creek in 2004 near Rowan Mills (Beauchamp et al. 2012).

Sampling of historic Lake Chubsucker and Eastern Sand Darter capture sites is necessary to validate the persistence of these species in the watershed. In addition, increased sampling effort throughout the Big Creek watershed is necessary to gain a better understanding of the current distribution and abundance of all four fish species at risk known to occupy this watershed. The focus of this study was to increase our understanding of the distribution and habitat use of Lake Chubsucker, Eastern Sand Darter, Pugnose Shiner and Grass Pickerel, all of which are currently listed on Schedule 1 of the *Species at Risk Act*.

METHODS

SAMPLING

Electrofishing sampling

Backpack electrofishing was conducted using a Smith-Root Model LR24 backpack unit (Appendix 1). Sampling effort ranged from 521 to 843 s of electrofishing, generally at a rate of 2-4 s/m. Sampling effort was variable among sites due to habitat complexity and the amount of habitat available to sample (e.g., less habitat to sample during low water depths). Fishes were captured in nets as they were stunned, and were placed in buckets filled with water.

Boat electrofishing was conducted using a 4.27 m jon boat equipped with a Smith Root 5.0 GPP (gas powered pulsator, 5.0 kW generator, a single-boom anode, and a single netter). Sampling

[1] http://www.sourcewater.ca/swp_watersheds_longpoint/Characterization_summary_LPR.pdf

effort varied between sites from 422 to 499 s of electrofishing. Stunned fishes were captured by the netter.

Seine sampling

Two types of seining occurred. The first involved an 8.5 m x 2 m bag seine with 6.35 mm ace mesh. The second type involved a 15.24 m by 2.67 m boat seine with 6.35 mm ace mesh (Appendix 1). A total of three hauls were performed at each of the four sites sampled by bag seine. The number of hauls varied from one to four at the seven sites sampled by boat seine. This variability was due to the amount of habitat that could be effectively sampled (i.e., additional hauls were completed at sites where habitat was abundant or when SAR were observed, less hauls were completed when debris limited the habitat that could be sampled). All hauls were performed in the direction of flow, from upstream to downstream. Fishes were transferred from the seine net into bins filled with water.

For all gear types (electrofishing/seining), fishes were identified, measured, and returned to the creek. Voucher specimens of each species were preserved in 10% formalin for laboratory verification.

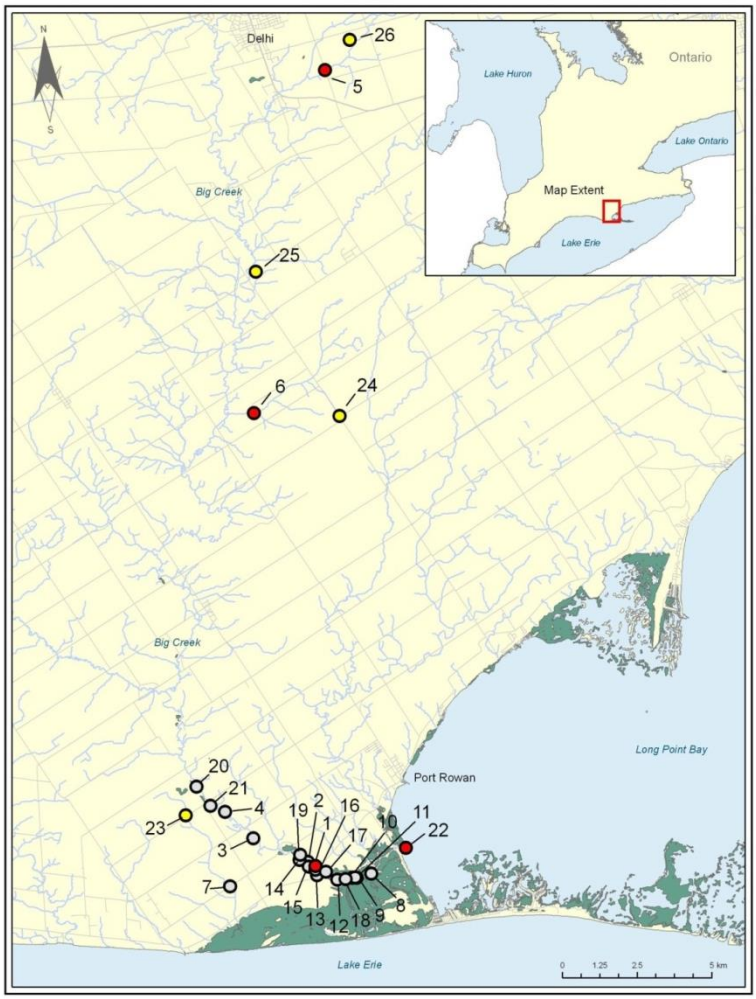

Figure 1. Sites sampled in Big Creek watershed in 2008. See Appendix 6 for detailed site descriptions. Map numbers correspond to site numbers in Appendix 1-6. Red sites are historical locations not sampled, and yellow are historical sites where sampling occurred.

HABITAT DATA COLLECTION

Habitat variables recorded at each site included: air temperature (°C), water temperature (°C), conductivity (µS), Secchi depth (m), aquatic vegetation (% emergent, % floating, % submergent) (Appendix 2), water depth (m), sampling depth (m), sampling distance from shore (m), substrate components (% based on the Wentworth scale), stream width (m), flow rate (subjectively classified as no flow, slow flow, medium flow, or fast flow), habitat type (riffle, run, pool) (Appendix 3), riparian vegetation (%), bank slope (%) and channel cover (%) (Appendix 4).

RESULTS

SAMPLING

Backpack electrofishing

Two sites were sampled by backpack electrofishing on August 20, 2008 and resulted in a total effort of 1364 sec. Site 5 was shocked for 843 s and Site 6 for 521 s. A total of 22 fishes representing five species were captured (Tables 1 and 2, Appendix 5). The catch per unit effort (CPUE) was 0.016 fishes/sec (Table 1). No species at risk were captured by backpack electrofishing.

Boat electrofishing

A total of eight sites were sampled by boat electrofishing on October 15, 2008. The total boat electrofishing effort was 3740 s, with an average of 467.5 s/site (Table 1). A total of 346 fishes, representing 16 species were captured (Tables 1 and 2, Appendix 5). The CPUE was 0.093 fishes/sec (Table 1). One species at risk, Grass Pickerel, was captured at two sites (11 and 16) while boat electrofishing (Figure 2).

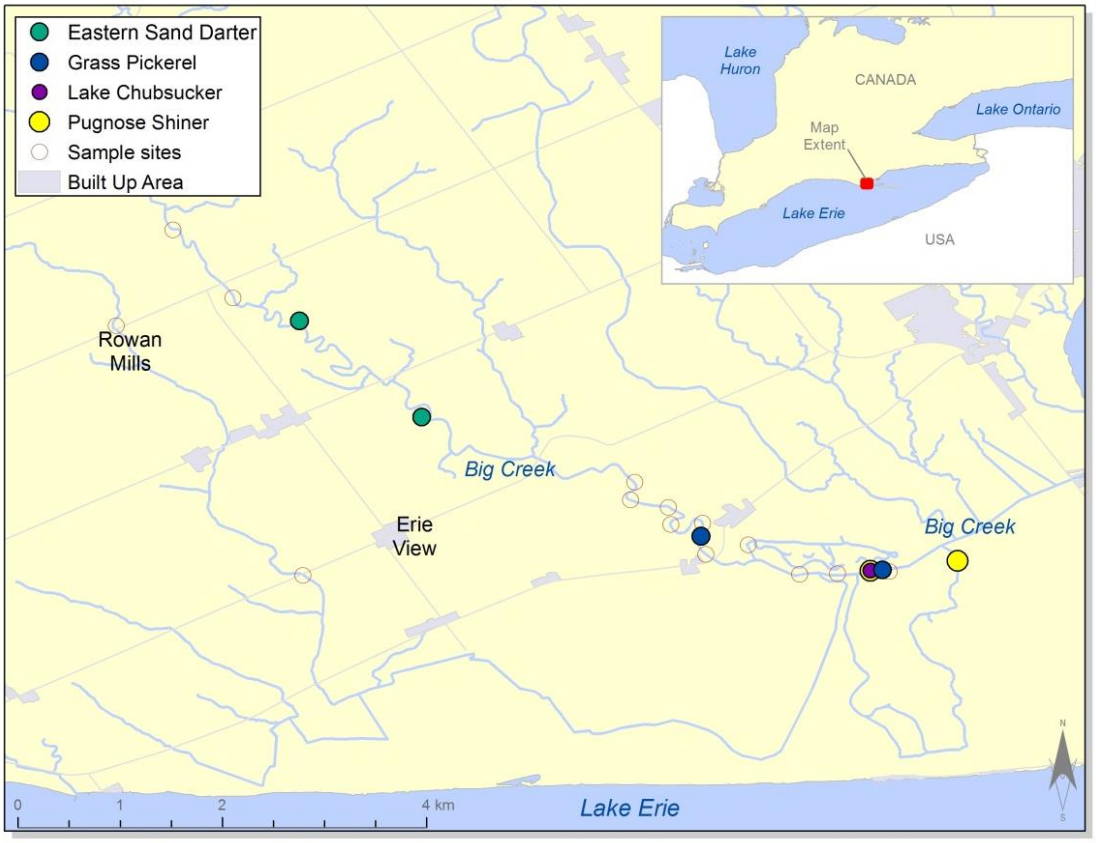

Figure 2. Sites where species at risk were detected during the 2008 survey of the Big Creek watershed.

Bag seine

A total of four sites were sampled by bag seine. Sampling occurred on August 20, and October 16, 2008. A total of twelve seine net hauls were complete - three at each site. A total of 85 fishes were captured, representing seven species and a CPUE of 7.08 fishes/haul (Table 1 and 2, Appendix 5). No species at risk were captured.

Boat seine

A total of seven sites were sampled by boat seine. Effort was not recorded for Site 9 or Site 10; therefore, these sites were omitted from the sampling effort calculations. A total of 463 fishes were captured, representing 22 species, including three species at risk (Eastern Sand Darter, Lake Chubsucker, and Pugnose Shiner; Table 1 and 2, Figure 2, Appendix 5). The total effort, excluding sites 9 and 10, was 14 hauls, averaging 2.8 hauls per site. The CPUE was 24.21 fishes/haul.

Table 1. Summary of sampling effort during 2008 Big Creek sampling.

Gear type	Bag Seine	Boat seine	Backpack electrofishing	Boat electrofishing
Number of sites sampled	4	7	2	8
Total number of fishes	85	463	22	348
Species richness	7	22	5	16
Fish species at risk detected	0	3	0	1
Unique species	1	13	2	6
Total effort (hauls or seconds)	12	14*	1364	3740
Mean effort (hauls or seconds)	3	2.8**	682	467.5
CPUE (fish/haul, fish/sec)	7.08	24.21**	0.016	0.093

*effort was not recorded for Sites 9 and 10; **excluding Sites 9 and 10

Table 2. Summary of species captured during the 2008 Big Creek sampling by backpack electrofishing (BPEF), boat electrofishing (BEF), bag seine (BaS), and boat seine (BoS). Current status under the Species at Risk Act *are provided, where EN: Endangered; TH: Threatened; and, SC: special concern. Common and scientific names are provided according to Page et al. (2013) and are listed in taxonomic order.*

Common name	Scientific name	Status	BPEF	BEF	BaS	BoS	Total
Gizzard Shad	Dorosoma cepedianum		0	0	0	1	1
Spotfin Shiner	Cyprinella spiloptera		0	0	0	7	7
Common Carp	Cyprinus carpio		0	12	0	0	12
Golden Shiner	Notemigonus crysoleucas		0	0	0	1	1
Pugnose Shiner	Notropis anogenus	EN	0	0	0	6	6
Emerald Shiner	Notropis atherinoides		0	5	0	7	12
Blacknose Shiner	Notropis heterolepis		0	0	0	11	11
Spottail Shiner	Notropis hudsonius		0	1	0	1	2
Mimic Shiner	Notropis volucellus		0	4	2	23	29
Bluntnose Minnow	Pimephales notatus		0	1	0	111	112
Fathead Minnow	Pimephales promelas		0	0	1	0	1
Blacknose Dace	Rhinichthys atratulus		4	0	0	0	4
Creek Chub	Semotilus atromaculatus		1	0	56	0	57
White Sucker	Catostomus commersonii		3	2	18	0	23
Lake Chubsucker	Erimyzon sucetta	EN	0	0	0	2	2
Brown Bullhead	Ameiurus nebulosus		0	1	0	0	1
Rainbow Trout	Oncorhynchus mykiss		7	1	0	0	8
Grass Pickerel	Esox americanus vermiculatus	SC	0	2	0	0	2
Northern Pike	Esox lucius		0	6	4	5	15
Central Mudminnow	Umbra limi		0	1	0	0	1
Brook Silverside	Labidesthes sicculus		0	307	3	162	472
Banded Killifish	Fundulus diaphanus		0	1	0	0	1
Mottled Sculpin	Cottus bairdii		8	0	0	0	8
Rock Bass	*Ambloplites rupestris*		0	1	0	5	**6**
Pumpkinseed	*Lepomis gibbosus*		0	0	0	33	**33**
Bluegill	*Lepomis macrochirus*		0	0	0	8	**8**
Sunfish hybrid	*Lepomis sp.*		0	0	0	1	**1**
Largemouth Bass	*Micropterus salmoides*		0	2	0	25	**27**
Eastern Sand Darter	*Ammocrypta pellucida*	TH	0	0	0	2	**2**
Johnny Darter	*Etheostoma nigrum*		0	0	0	16	**16**
Yellow Perch	*Perca flavescens*		0	0	1	22	**23**
Blackside Darter	*Percina maculata*		0	0	0	1	**1**
Freshwater Drum	*Aplodinotus grunniens*		0	1	0	0	**1**
Round Goby	*Neogobius melanostomus*		0	0	0	13	**13**
Total			**23**	**348**	**85**	**463**	**919**

Grass Pickerel was detected at two sites, each of which was a shallow (2 m), heavily vegetated site with low flow. Pugnose Shiner was detected at two heavily vegetated sites with silt substrate, low flow velocity and secchi depths ranging from 0.29 m to 0.35 m. Lake Chubsucker was detected at a single site that was dominated by submerged vegetation (90% coverage), had silt substrate, and slow flow. Eastern Sand Darter was detected at two sites in slow flowing runs with silt substrate and that had no aquatic vegetation coverage.

DISCUSSION

The 2008 sampling of the Big Creek watershed in Norfolk County was conducted to evaluate the current status of species at risk known to be present in the watershed. Sampling was conducted using a variety of gears, including bag seine, boat seine, backpack electrofishing, and boat electrofishing. The sampling of Big Creek was primarily conducted in the lower navigable reaches of the watershed. While boats were used to access the majority of sites, sampling with seines or by backpack electrofishing was restricted to wadeable areas. While several sites were sampled throughout the lower reaches of Big Creek, water depth, substrate composition, and woody debris limited wadeable sampling throughout much of the navigable waters (Appendix 3). Additionally, low water levels in 2008 left several sites in the upper reaches of the Big Creek watershed dry; therefore, sampling could not be conducted at all the sites with historical species at risk records (Appendix 6).

In total, 34 species of fishes were recorded. Four species at risk were detected during the sampling: Eastern Sand Darter, Lake Chubsucker, Grass Pickerel and Pugnose Shiner. Boat seining was successful in capturing three of these species at risk, while boat electrofishing was the only other sampling gear successful at detecting a species at risk (i.e., Grass Pickerel).

Eastern Sand Darter was captured at two sites (Sites 3, 4). Both sites were free of aquatic vegetation, had substrates composed primarily of silt, and were located in runs with low flow. Two Eastern Sand Darters were detected during this survey. Previous records indicated that Eastern Sand Darter had been captured both upstream and downstream of the 2008 collection sites (Bouvier and Mandrak 2010).

Lake Chubsucker was only detected at one site (Site 10). It has also been previously recorded in Big Creek (COSEWIC 2008), and is known to have similar habitat preferences as Pugnose Shiner, which was also caught at Site 10. While Lake Chubsucker had been historically recorded from the upper tributaries of the Big Creek watershed, none were collected during the 2008 sampling, and the species is presumed to be extirpated from the upper watershed (COSEWIC 2008). Unfortunately, four historical sampling sites could not be sampled because there was no water present during the site visit (Sites 23-26; Figure 1, Appendix 6). This highlights the ongoing threat of habitat degradation and loss due to agricultural drainage activities (Bouvier and Mandrak 2011). Sampling of the tributaries has not produced any additional records since those collected between 1960 and 1979 (COSEWIC 2008).

Grass Pickerel was caught at two sites (Sites 11, 16). A single Grass Pickerel was captured at both sites, which were sampled by boat electrofishing. Both sites were 100% vegetated, exhibited low flow, and had a water depth of 2 m. Grass Pickerel has been documented in the Long Point area (COSEWIC 2005a), and are associated with shallow, heavily vegetated areas with low flow.

Pugnose Shiner was captured at two sites (Sites 8, 10). Both sites were 100% vegetated, had low flow and were dominated by silt substrates, with secchi depth readings of 0.29 m and 0.35 m, respectively. Pugnose Shiner presence in Long Point Bay (and Big Creek) has been previously documented (Holm and Mandrak 2002) and, specifically, in heavily vegetated areas with low flow and clear water. The continued presence of Pugnose Shiner in the Long Point Bay area, and specifically in the Big Creek watershed, is a positive result following the failure to collect any specimens during 2002 sampling (Holm and Mandrak 2002). The presence of Pugnose Shiner in Big Creek appears to be an extension of the population known to persist in Long Point Bay (COSEWIC 2013).

The fish community sampling of Big Creek in 2008 was successful in detecting four fish species at risk (one Endangered species, two Threatened species, and a species of Special Concern, currently listed under the *Species at Risk Act*). Lake Chubsucker is presumed to be extirpated from the upper tributaries of the Big Creek watershed as historic sites no longer provide suitable habitat for this species. Further sampling of the Big Creek watershed is recommended to determine the distributional extent of all species at risk, including Spotted Gar, *Lepisosteus oculatus*, and Warmouth, *Lepomis gulosus*, that were not detected during this survey but are known to occupy the watershed (COSEWIC 2005b, c).

ACKNOWLEDGMENTS

This study was funded by the Fisheries and Oceans Canada Species at Risk Program.

REFERENCES

Beauchamp, J., Boyko, A., Dunn, S., Hardy, D., Jarvis, P.L., and Staton, S.K. 2012. Management Plan for the Grass Pickerel (*Esox americanus vermiculatus*) in Canada. Species at Risk Act Management Plan Series. Fisheries and Oceans Canada, Ottawa.

Bouvier, L.D., and Mandrak, N.E. 2010. Information in support of a Recovery Potential Assessment of Eastern Sand Darter (*Ammocrypta pellucida*) in Ontario. DFO Can. Sci. Advis. Sec. Res. Doc. 2010/093.

Bouvier, L.D., and Mandrak, N.E. 2011. Information in support of a Recovery Potential Assessment of Lake Chubsucker (*Erimyzon sucetta*) in Canada. DFO Can. Sci. Advis. Sec. Res. Doc. 2011/048.

COSEWIC. 2005a. COSEWIC assessment and status report on the grass pickerel *Esox americanus vermiculatus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 27 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

COSEWIC. 2005b. COSEWIC assessment and update status report on the Spotted Gar (*Lepisosteus oculatus*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 17 p.

COSEWIC. 2005c. COSEWIC assessment and update status report on the Warmouth *Lepomis gulosus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 16 p.

COSEWIC. 2008. COSEWIC assessment and update status report on the Lake Chubsucker, *Erimyzon sucetta*, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 29 p.

COSEWIC. 2013. COSEWIC assessment and status report on the Pugnose Shiner (*Notropis anogenus*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

Holm, E., and Mandrak, N.E. 2002. Update COSEWIC status report on the Pugnose Shiner (*Notropis anogenus*) in Canada, in COSEWIC assessment and update status report on the Pugnose Shiner (*Notropis anogenus*) in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, Ontario, Canada.

Page, L.M., Espinosa-Pérez, H., Findley, L.T., Gilbert, C.R., Lea, R.N., Mandrak, N.E., Mayden, R.L., and Nelson, J.S. 2013. Common and Scientific Names of Fishes from the United States, Canada, and Mexico. American Fisheries Society, Bethesda, Maryland.

Appendix 1. Description of sampling methods for 2008 Big Creek sampling. Site # corresponds to Figure 1.

Site #	Date	Capture method	Duration	Quantification of effort	Description of method
1	19-Aug-08	Boat seine	3	Haul	Boat Seine, 6.35mm Ace mesh, Length - 15.24m
2	19-Aug-08	Boat seine	3	Haul	Boat Seine, 6.35mm Ace mesh, Length - 15.24m
3	19-Aug-08	Boat seine	1	Haul	Boat Seine, 6.35mm Ace mesh, Length - 15.24m
4	19-Aug-08	Boat seine	3	Haul	Boat Seine, 6.35mm Ace mesh, Length - 15.24m
5	20-Aug-08	Backpack electrofisher	843	Seconds	Smith-Root, Model LR-24 Backpack Electrofishing Unit
6	20-Aug-08	Backpack electrofisher	521	Seconds	Smith-Root, Model LR-24 Backpack Electrofishing Unit
7	20-Aug-08	Bag seine (1)	3	Haul	Bag Seine, 6.35mm Ace mesh, Length - 8.5m
8	21-Aug-08	Boat seine	4	Haul	Boat Seine, 6.35mm Ace mesh, Length - 15.24m
9	21-Aug-08	Boat seine	not recorded		Boat Seine, 6.35mm Ace mesh, Length - 15.24m
10	21-Aug-08	Boat seine	not recorded		Boat Seine, 6.35mm Ace mesh, Length - 15.24m
11	15-Oct-08	Boat electrofisher (1)	468	Seconds	E-fishing Boat, Small - 4.27m, 5.0 GPP, single boom
12	15-Oct-08	Boat electrofisher (2)	499	Seconds	E-fishing Boat, Small - 4.27m, 5.0 GPP, single boom
13	15-Oct-08	Boat electrofisher (3)	470	Seconds	E-fishing Boat, Small - 4.27m, 5.0 GPP, single boom
14	15-Oct-08	Boat electrofisher (4)	490	Seconds	E-fishing Boat, Small - 4.27m, 5.0 GPP, single boom
15	15-Oct-08	Boat electrofisher (5)	474	Seconds	E-fishing Boat, Small - 4.27m, 5.0 GPP, single boom
16	15-Oct-08	Boat electrofisher (6)	440	Seconds	E-fishing Boat, Small - 4.27m, 5.0 GPP, single boom
17	15-Oct-08	Boat electrofisher (7)	422	Seconds	E-fishing Boat, Small - 4.27m, 5.0 GPP, single boom
18	15-Oct-08	Boat electrofisher (8)	477	Seconds	E-fishing Boat, Small - 4.27m, 5.0 GPP, single boom
19	16-Oct-08	Bag seine (2)	3	Haul	Bag Seine, 6.35mm Ace mesh, Length - 8.5m
20	16-Oct-08	Bag seine (3)	3	Haul	Bag Seine, 6.35mm Ace mesh, Length - 8.5m
21	16-Oct-08	Bag seine (4)	3	Haul	Bag Seine, 6.35mm Ace mesh, Length - 8.5m

Appendix 2. Summary of aquatic vegetation data for 2008 Big Creek sampling. Site # corresponds to Figure 1.

Site #	Field number	Air temperature (°C)	Water temperature (°C)	Conductivity (µS)	Secchi depth (m)	Aquatic Veg Type1	Aquatic Veg 1 (%)	Aquatic Veg Type2	Aquatic Veg 2 (%)
1	BGCK001	21.4	20	466		None	100		
2	BGCK002	22.4	20.5	485		Submergent	20	Emergent	20
3	BGCK003	26	20.5	492		None	100		
4	BGCK004	25	21.5	496		None	100		
5	BGCK005	16.3	12.4	165	1.23	Emergent	60		
6	BGCK006	19.1	15.8	397	0.35	None	100		
7	BGCK007	20.6	16.8	633	0.08	None	100		
8	BGCK008	23.2	19	524	0.29	Emergent	90	Submergent	10
9	BGCK009	23.8	19.4	518	0.31	Emergent	80	Submergent	20
10	BGCK010	22.8	20	516	0.35	Emergent	50	Floating	50
11	BGCK001	15.9	13.5	550		Submergent	90	Floating	10
12	BGCK002	17.4	13.6	547		Submergent	100		
13	BGCK003	19.3	14.2	546		Emergent	60	Submergent	40
14	BGCK004	21.4	13.8	542					
15	BGCK005	19.2	13.7	545		None	100		
16	BGCK006	19	14.3	532		Emergent	60	Submergent	40
17	BGCK007	20.8	13.7	557		None	100		
18	BGCK008	21.1	14.1	542		Submergent	100		
19	BGCK001	14.8	12.9	550		None	100		
20	BGCK002	14.4	12.9	550		None	100		
21	BGCK003	14.1	13.4	527		None	100		

Appendix 3. Summary of substrate, width, depth, habitat, and flow data for 2008 Big Creek sampling. Site # corresponds to Figure 1.

Site #	Substrate type 1	Substrate 1 (%)	Substrate type 2	Substrate 2 (%)	Stream width (m)	Max stream depth (m)	Distance from shore (m)	Max sampling depth (m)	Habitat type	Flow rate
1	Silt	100			20	2	15	2+	not recorded	
2					25	2+	15	2	Run	Slow
3	Silt	90	Clay	10	25	7.25	17	na	Run	Slow
4	Silt	100			15	2+	10	2	Run	Medium
5	Silt	80	Sand	20	2	5.6				Slow
6	Sand	100			2	0.34		0.34	Run	Medium
7	Sand	80	Silt	20		0.81			Pool	None
8	Silt	100			44	2	1.5	na	Run	Slow
9	Silt	80	Organic	20	30					
10	Silt	100			31	2+	15	2	Run	Slow
11					29	2	0	2	Run	Slow
12					25	2	0-10	2	Run	Slow
13					32	2	0-10	2	Run	Slow
14					15	1.8	0-5	1.8	Run	Slow
15					22			2	Run	Slow
16					26	2	0-10	2	Run	Slow
17					19	2	0-5	2	Run	Slow
18					33	2+	0-10	2	Run	Slow
19					15	2+	0-15	1.5	Run	Slow
20									Run	Slow
21					18	2+	0-15	1.5	Run	Medium

Appendix 4. Summary of riparian vegetation, bank slope, and channel cover for 2008 Big Creek sampling. Site # corresponds to Figure 1.

Site #	Riparian veg type1	Riparian veg 1 (%)	Riparian veg type2	Riparian veg 2 (%)	Riparian veg type3	Riparian veg 3 (%)	Bank slope (%)	Channel cover (%)
1	Deciduous	80	Grasses	20			15	
2	Deciduous	70	Grasses	20	Shrubs	10	not recorded	
3	Grasses	70	Deciduous	30			30	30
4	Deciduous	80	Grasses	20			25	60
5	not recorded						20	20
6	Deciduous	100					60	95
7	Deciduous	90	Grasses	10			30	80
8	not recorded							
9	Deciduous	100					0	0
10	Deciduous	60	Grasses	40			0	0
11	Deciduous	60	Grasses	30	Shrubs	10	0	0
12	Deciduous	60	Grasses	30	Shrubs	10	10	15
13	Deciduous	60	Shrubs	30	Grasses	10	15	5
14	not recorded							
15	Deciduous	80	Grasses	10	Shrubs	10	5	10
16	Deciduous	70	Grasses	30	not recorded			
17	Deciduous	70	Grasses	30			20	50
18	Deciduous	70	Grasses	20	Shrubs	10	25	20
19	Deciduous	20	Grasses	30			30	5
20	Deciduous	60	Shrubs	30	Grasses	10	80	25
21	Grasses	70	Shrubs	20	Deciduous	10	45	0

Appendix 5. Summary of species collected by site in the 2008 Big Creek sampling. Scientific and common names according to Page et al. (2013). Sites 1-21 correspond to numbers in Figure 1. Species currently listed under the Species at Risk Act *have been greyed out.*

		Sites																				
Common Name	**Scientific Name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**Total**
Gizzard Shad	*Dorosoma cepedianum*								1														**1**
Spotfin Shiner	*Cyprinella spiloptera*			7																			**7**
Common Carp	*Cyprinus carpio*												11	1									**12**
Golden Shiner	*Notemigonus crysoleucas*										1												**1**
Pugnose Shiner	*Notropis anogenus*								5		1												**6**
Emerald Shiner	*Notropis atherinoides*	1							2	2	2		4						1				**12**
Blacknose Shiner	*Notropis heterolepis*								11														**11**
Spottail Shiner	*Notropis hudsonius*		1									1											**2**
Mimic Shiner	*Notropis volucellus*	1	2						6	13	1			3				1		2			**29**
Bluntnose Minnow	*Pimephales notatus*								110	1			1										**112**
Fathead Minnow	*Pimephales promelas*							1															**1**
Blacknose Dace	*Rhinichthys atratulus*					4																	**4**
Creek Chub	*Semotilus atromaculatus*					1		56															**57**
White Sucker	*Catostomus commersonii*					2	1	18								1		1					**23**
Lake Chubsucker	*Erimyzon sucetta*										2												**2**
Brown Bullhead	*Ameiurus nebulosus*																	1					**1**
Rainbow Trout	*Oncorhynchus mykiss*					1	6									1							**8**
Grass Pickerel	*Esox americanus vermiculatus*											1					1						**2**
Northern Pike	*Esox lucius*							4	1	3	1	3		1	1			1					**15**
Central Mudminnow	*Umbra limi*													1									**1**
Brook Silverside	*Labidesthes sicculus*		2	123					19	10	8	57	139	11	35	16	23	12	14	3			**472**
Banded Killifish	*Fundulus diaphanus*											1											**1**
Mottled Sculpin	*Cottus bairdii*					8																	**8**
Rock Bass	*Ambloplites rupestris*								1	4				1									**6**
Pumpkinseed	*Lepomis gibbosus*								7	25	1												**33**

Appendix 5. Continued

		Sites																					
Common Name	**Scientific Name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**Total**
Bluegill	*Lepomis macrochirus*								1	5	2												**8**
Sunfish Hybrid	*Lepomis* sp.										1												**1**
Largemouth Bass	*Micropterus salmoides*			3					10	10	2	2											**27**
Eastern Sand Darter	*Ammocrypta pellucida*			1	1																		**2**
Johnny Darter	*Etheostoma nigrum*			13	3																		**16**
Yellow Perch	*Perca flavescens*		1		2				5	11	3									1			**23**
Blackside Darter	*Percina maculata*		1																				**1**
Freshwater Drum	*Aplodinotus grunniens*															1							**1**
Round Goby	*Neogobius melanostomus*				1				5	7													**13**
Total		**2**	**7**	**147**	**7**	**16**	**6**	**79**	**184**	**91**	**25**	**65**	**155**	**18**	**36**	**19**	**24**	**16**	**15**	**6**	**0**	**0**	**873**

Appendix 6. Site location data for 2008 Big Creek sampling. Site # corresponds to Figure 1.Geographic coordinates (latitude and longitude) are provided in decimal degrees (dd).

Site #	Field number	Date	Waterbody name	Narrative locality description	Latitude (dd)	Longitude (dd)
1	BGCK001	19-Aug-08	Big Creek	350m u/s of Port Royal bridge	42.59769	-80.48656
2	BGCK002	19-Aug-08	Big Creek		42.59909	-80.48956
3	BGCK003	19-Aug-08	Big Creek	500m d/s of concession road 1	42.60705	-80.51130
4	BGCK004	19-Aug-08	Big Creek		42.61553	-80.52209
5	BGCK005	20-Aug-08	Big Creek	Fertilizer Road	42.83581	-80.46359
6	BGCK006	20-Aug-08	Big Creek		42.73436	-80.50089
7	BGCK007	20-Aug-08	Hahn's Ditch		42.59309	-80.52177
8	BGCK008	21-Aug-08	Big Creek	Big Creek channel appox. 1 km u/s of Hwy. 59 bridge 1	42.59437	-80.46412
9	BGCK009	21-Aug-08	Big Creek		42.59344	-80.47011
10	BGCK010	21-Aug-08	Big Creek		42.59348	-80.47177
11	BGCK001	15-Oct-08	Big Creek	just u/s of NWA boundary	42.59354	-80.47072
12	BGCK002	15-Oct-08	Big Creek		42.59319	-80.47800
13	BGCK003	15-Oct-08	Big Creek		42.59494	-80.48626
14	BGCK004	15-Oct-08	Big Creek		42.59975	-80.49289
15	BGCK005	15-Oct-08	Big Creek		42.59759	-80.48934
16	BGCK006	15-Oct-08	Big Creek		42.59655	-80.48670
17	BGCK007	15-Oct-08	Big Creek		42.59577	-80.48254
18	BGCK008	15-Oct-08	Big Creek		42.59323	-80.47466
19	BGCK001	16-Oct-08	Big Creek		42.60132	-80.49253
20	BGCK002	16-Oct-08	Big Creek		42.62357	-80.53319
21	BGCK003	16-Oct-08	Big Creek		42.61757	-80.52791
22	NA	20-Aug-08	Big Creek	Historical location; near the mouth of Big Creek. Did not sample.	42.60156	-80.44934

Site #	Field number	Date	Waterbody name	Narrative locality description	Latitude (dd)	Longitude (dd)
23	NA	20-Aug-08	Big Creek	Historical location; Concession Road 2, by Rowan Mills. Site was dry.	42.61511	-80.53820
24	NA	20-Aug-08	Big Creek	Historical location; near Forestry Farm Road and St. John's Rd. W intersection. Site was dry.	42.73199	-80.46604
25	NA	20-Aug-08	Big Creek	Historical location; site located off of Rhineland Road. Site was dry.	42.77667	-80.49667
26	NA	20-Aug-08	Big Creek	Historical location; Windham W. ¼ Line; south of Wilson Avenue; east of Delhi. Site was dry.	42.84444	-80.45278