

Supplemental Material

Nearshore Fish Species Richness and Species-Habitat Associations in the St. Clair-Detroit River System

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Table S1. Number of each fish species collected during a shoreline seine survey at sites in the St. Clair-Detroit River System 2013–2019. Sites are arranged from upstream to downstream (left to right).

Species	S-001	S-002	S-003	S-004	S-005	S-006	S-007	S-008	S-009	S-010	Total
Atherinopsidae											
Brook Silverside <i>Labidesthes sicculus</i>	0	0	397	91	132	227	131	160	398	569	2,105
Catostomidae											
Northern hogsucker <i>Hypentelium nigricans</i>	0	0	0	8	66	0	2	60	0	0	136
Quillback <i>Carpriodes cyprinus</i>	0	0	0	0	0	0	11	0	0	9	20
Golden redhorse <i>Moxostoma erythrurum</i>	0	0	0	0	2	0	0	0	0	0	2
Shorthead redhorse <i>Moxostoma macrolepidotum</i>	0	0	4	0	0	0	0	0	0	0	4
Silver redhorse <i>Moxostoma anisurum</i>	0	0	0	0	0	0	0	1	0	0	1
Spotted sucker <i>Minytrema melanops</i>	0	0	0	0	0	0	0	8	7	0	15
White sucker <i>Catostomus commersonii</i>	0	0	0	0	0	1	0	12	45	0	58
Lake chubsucker <i>Erimyzon succetta</i>	0	0	0	0	0	9	0	0	0	0	9
Centrarchidae											
Black crappie <i>Pomoxis nigromaculatus</i>	0	0	0	0	0	1	0	0	1	0	2
Bluegill <i>Lepomis macrochirus</i>	0	0	0	0	0	5	0	0	166	238	409
Green sunfish <i>Lepomis cyanellus</i>	0	0	0	0	0	0	0	1	14	0	15
Largemouth bass <i>Micropterus salmoides</i>	0	0	0	2	1	44	0	18	178	79	322
Northern sunfish <i>Lepomis megalotis</i>	0	0	0	0	0	0	0	0	148	0	148
Pumpkinseed sunfish <i>Lepomis gibbosus</i>	0	0	0	0	0	27	0	1	66	84	178
Rock bass <i>Ambloplites rupestris</i>	0	0	1	0	0	12	2	84	513	6	618
Smallmouth bass <i>Micropterus dolomieu</i>	0	0	9	0	9	0	67	22	1	2	110
Clupeidae											
Alewife <i>Alosa pseudoharengus</i>	2	0	0	0	0	1	0	0	0	4	7
Gizzard shad <i>Dorosoma cepedianum</i>	0	0	0	0	3	0	0	9	12	3	27
Cyprinidae											
Goldfish <i>Carassius auratus</i>	0	0	0	0	0	0	0	0	147	0	147

Table 2 Continued

Common carp <i>Cyprinus carpio</i>	0	0	0	0	0	0	0	0	1	0	1
Esocidae											
Grass pickerel <i>Esox americanus</i>	0	0	0	0	0	2	0	0	0	0	2
Muskellunge <i>Esox masquinongy</i>	0	0	0	0	0	0	0	2	1	0	3
Northern pike <i>Esox lucius</i>	0	0	0	0	0	1	0	0	0	0	1
Fundulidae											
Banded killifish <i>Fundulus diaphanus</i>	0	0	0	0	0	293	2	6	24	199	524
Gobiidae											
Round goby <i>Neogobius melanostomus</i>	11	4	211	13	101	23	141	314	380	718	1,916
Tubenose goby <i>Proterorhinus marmoratus</i>	0	0	153	2	7	303	20	18	31	92	626
Ictaluridae											
Black bullhead <i>Ameiurus melas</i>	0	0	0	0	0	1	0	0	3	0	4
Brown bullhead <i>Ameiurus nebulosus</i>	0	0	0	0	0	0	0	0	2	0	2
Channel catfish <i>Ictalurus punctatus</i>	0	0	0	0	0	0	0	0	0	7	7
Tadpole madtom <i>Noturus gyrinus</i>	0	0	0	0	0	2	0	0	0	7	9
Yellow bullhead <i>Ameiurus natalis</i>	0	0	0	0	0	2	0	0	2	0	4
Leuciscidae											
Blackchin shiner <i>Notropis heterodon</i>	0	0	65	3	0	57	0	3	0	0	128
Blacknose shiner <i>Notropis heterolepis</i>	0	0	0	2	0	993	0	0	0	0	995
Bluntnose minnow <i>Pimephales notatus</i>	0	0	18	1	0	1,486	7	566	759	1,356	4193
Emerald shiner <i>Notropis atherinoides</i>	862	436	9,321	267	435	0	70	62	26	189	11,668
Ghost shiner <i>Notropis buchanani</i>	0	0	0	0	0	0	1	0	18	0	19
Golden shiner <i>Notemigonus crysoleucas</i>	0	0	0	0	0	0	2	1	5	0	8
Hornyhead chub <i>Nocomis biguttatus</i>	0	0	4	1	1	15	0	98	5	0	124
Longnose dace <i>Rhinichthys cataractae</i>	0	0	1	0	2	0	0	0	0	0	3
Mimic shiner <i>Notropis volucellus</i>	9	8	0	51	0	0	22	4	1	72	167
Pugnose minnow <i>Opsopoeodus emiliae</i>	0	0	0	0	0	61	0	1	1	0	63
Pugnose shiner <i>Notropis anogenus</i>	0	0	0	0	0	614	0	0	0	0	614
Sand shiner <i>Notropis stramineus</i>	256	4	39	57	228	20	395	33	0	21	1,053
Spotfin shiner <i>Cyprinella spiloptera</i>	6	0	25	0	6	34	94	3	2	212	382
Spottail shiner <i>Notropis hudsonius</i>	14	11	439	1,014	201	84	2	7	1	26	1,799

Table 2 Continued

Striped shiner <i>Luxilus chrysocephalus</i>	0	0	0	0	0	0	6	311	9	2	328
Lepisosteidae											
Longnose gar <i>Lepisosteus osseus</i>	0	0	0	0	0	0	0	0	0	1	1
Moronidae											
White bass <i>Morone chrysops</i>	1	0	4	1	2	0	0	0	0	0	8
White perch <i>Morone americana</i>	15	0	28	9	0	0	0	4	20	0	76
Osmeridae											
Rainbow smelt <i>Osmerus mordax</i>	1	0	0	0	0	0	0	0	0	0	1
Percidae											
Johnny darter <i>Etheostoma nigrum</i>	0	0	0	0	0	14	0	10	0	0	24
Least darter <i>Etheostoma microperca</i>	0	0	0	0	0	52	0	1	1	3	57
Logperch <i>Percina carprodes</i>	0	2	93	1	16	0	1	102	14	183	412
Rainbow darter <i>Etheostoma caeruleum</i>	0	0	0	0	0	0	0	2	0	0	2
Walleye <i>Sander vitreus</i>	0	0	0	0	0	0	0	0	0	1	1
Yellow perch <i>Perca flavescens</i>	1	1	80	11	64	728	22	21	349	36	1,313
Salmonidae											
Brown trout <i>Salmo trutta</i>	0	2	0	0	0	0	0	0	0	0	2
Total	1,178	468	10,892	1,534	1,276	5,112	998	1,945	3,351	4,119	30,873

Table S2. Model selection results and model-averaged slope parameter estimates based on 256 candidate generalized linear mixed models to understand habitat associations of 33 fishes in the St. Clair and Detroit rivers based on a shoreline seine survey from 10 sites sampled 2013–2019. Column headings are predictor variables. Values in predictor variable columns are model-averaged slope parameters (unconditional SE in parentheses). Bolded model-averaged slope parameters indicated a significant difference from zero based on lacking overlap with zero of 95% confidence intervals. Values with an asterisk denote presence of a predictor variable in the best AICc-selected model. Grassy/Woody Shoreline represent levels of the predictor variable “Shoreline Vegetation Type” and High/Low Veg. Rich. represent levels of “Aquatic Macrophyte Richness.” In both cases “None” was estimated as part of the model intercept.

Species	In-river substrate						Shoreline vegetation type		Aquatic macrophyte richness		
	Silt	Sand	Gravel	Cobble	Organic	Algae	Grassy	Mixed	Woody	High	Low
Atherinopsidae											
Brook Silverside	-0.38 (0.58)	-1.93 (0.64)*	-2.55 (0.66)*	-0.46 (0.61)	-0.03 (0.55)	-7.57 (2.75x10 ³)	0.21 (0.77)	-7.59 (2.25x10 ⁴)	0.46 (1.03)	-0.20 (0.48)	0.05 (0.25)
Catostomidae											
Northern hogsucker	-0.56 (0.97)	-0.12 (0.63)	0 (0.44)	0.15 (0.63)	-6.70 (3.79x10 ⁵)	-1.91 (7.61x10 ⁵)	0.28 (1.11)	-2.29 (2.45x10 ⁴)	0.51 (1.54)	-0.07 (0.42)	-0.04 (0.25)
Spotted sucker	1.05 (0.76)	-1.08 (728.78)	-3.6 (728.78)	-0.96 (2.48x10 ⁵)	1.63 (728.78)*	-0.61 (2.52x10 ⁶)	-8.23 (1.99x10 ⁶)*	-6.85 (2.04x10 ⁶)*	38.66 (6.64x10 ⁴)*	-7.37 (1.23)*	-6.23 (1.12)*
White sucker	-0.01 (0.77)	0.42 (6.54x10 ⁴)	0.38 (6.54x10 ⁴)	-0.91 (3.81x10 ⁵)	0.60 (6.54x10 ⁴)	28.05 (2.10x10 ⁶)*	-3.94 (2.10x10 ⁶)*	-5.01 (3.28x10 ⁶)*	23.31 (4.20x10 ⁴)*	2.24 (1.11x10 ⁵)	2.37 (1.11x10 ⁵)
Centrarchidae											
Bluegill	-0.32 (0.68)	2.67 (8.20x10 ⁴)*	-5.21 (1.08x10 ⁶)	-1.89 (1.35x10 ⁴)	0.02 (8.20x10 ⁴)	0.16 (8.20x10 ⁴)	1.22 (1.46x10 ³)	-0.37 (5.18x10 ⁵)	1.28 (1.46x10 ³)	4.58 (1.03)*	2.92 (1.24)*
Green sunfish	0.49 (0.44)	-0.42 (277.19)	-0.01 (277.19)	-1.95 (2.47x10 ⁵)	0.32 (277.19)*	-0.85 (1.26x10 ⁶)	-12.62 (6.28x10 ⁶)*	-2.74 (1.47x10 ⁵)*	20.25 (9.79x10 ³)*	4.38 (1.90x10 ⁵)	4.44 (1.90x10 ⁵)
Largemouth bass	-0.4 (0.36)*	0.21 (0.98)	0.38 (0.86)	3.44 (1.56)*	0.59 (0.94)	2.47 (0.82)*	3.89 (2.32)*	-11.14 (5.45x10 ³)*	6.59 (2.93)*	-0.05 (0.19)	-0.03 (0.18)

Table 2 Continued

Species	In-river substrate					Shoreline vegetation type				Aquatic macrophyte richness	
	Silt	Sand	Gravel	Cobble	Organic	Algae	Grassy	Mixed	Woody	High	Low
Northern sunfish	-1.78 (3.19)	0.46 (1.03x10 ⁵)	-7.26 (5.92x10 ⁵)	-5.17 (5.43x10 ⁴)	1.13 (1.03x10 ⁵)	-0.45 (1.20x10 ⁶)	-2.06 (1.20x10 ⁶)	-0.14 (5.93x10 ⁴)	2.73 (3.53x10 ³)	2.62 (2.26x10 ⁵)	3.06 (2.26x10 ⁵)
Pumpkinseed	0.21 (0.55)	0.02 (655.93)	-0.11 (655.93)	-4.28 (1.74x10 ⁴)	-0.23 (655.93)	1.12 (655.93)*	5.61 (3.40x10 ⁴)	-1.28 (2.84x10 ⁵)	5.83 (3.40x10 ⁴)	3.77 (0.94)*	2.86 (1.05)*
Rock bass	-0.11 (0.37)	-0.13 (0.35)*	0.63 (0.69)	0.83 (1.05)	0.07 (0.51)	4.49 (1.44)*	2.70 (1.48)*	-15.22 (4.0x10 ⁴)*	7.63 (1.49)*	0.00 (0.26)	0.01 (0.27)
Smallmouth bass	-0.31 (0.76)	1.08 (0.86)*	-0.08 (0.40)	0.18 (0.61)	-0.36 (1.01)	-4.06 (7.56x10 ⁵)	0.51 (1.05)	-4.58 (9.93x10 ⁴)	0.68 (1.33)	0.41 (0.85)*	1.02 (0.81)*
Clupeidae											
Gizzard shad	-0.18 (0.43)	4.00 (3.85x10 ⁴)	-15.00 (1.25x10 ⁵)*	12.75 (3.82x10 ²)*	5.26 (3.85x10 ⁴)*	-2.59 (1.46x10 ⁵)	52.45 (2.63x10 ⁴)*	-5.45 (3.46x10 ⁶)*	60.88 (4.64x10 ⁴)*	-6.21 (3.82x10 ⁴)	-6.22 (3.82x10 ⁴)
Cyprinidae											
Goldfish	-0.04 (0.90)	0.46 (2.21x10 ⁴)	-4.55 (9.39x10 ³)	-5.33 (5.57x10 ⁵)	0.08 (2.21x10 ⁴)	-3.83 (2.77x10 ⁵)	-1.39 (2.79x10 ⁵)	-0.32 (6.03x10 ⁴)	1.54 (792.65)	7.18 (1.21x10 ⁴)	7.14 (1.21x10 ⁵)
Gobiidae											
Round goby	-0.15 (0.37)	0.47 (0.52)*	0.01 (0.29)	0.57 (0.5)*	0.05 (0.39)	-11.74 (3.15x10 ³)*	0.97 (0.89)*	-0.58 (1.25)*	1.92 (1.33)*	-0.23 (0.44)	-0.22 (0.35)
Tubenose goby	-0.13 (0.47)	0.29 (0.81)	-0.08 (0.51)	3.79 (0.99)*	0.52 (0.77)	0.26 (0.98)	1.79 (1.36)*	-9.88 (4.40x10 ³)*	1.54 (1.41)*	2.66 (0.93)*	1.67 (0.65)*
Fundulidae											
Banded killifish	-0.73 (0.81)	-2.13 (130.85)*	-0.12 (130.85)	-2.68 (1.31x10 ⁴)	-0.13 (130.85)	-0.12 (130.85)	21.11 (6.28x10 ³)*	-8.5 (2.58x10 ⁶)*	20.16 (6.28x10 ³)*	1.44 (0.62)*	1.63 (0.69)*

Table 2 Continued

Species	In-river substrate						Shoreline vegetation type			Aquatic macrophyte richness	
	Silt	Sand	Gravel	Cobble	Organic	Algae	Grassy	Mixed	Woody	High	Low
Leuciscidae											
Blackchin shiner	1.74 (308.31)*	-1.73 (308.31)	13.24 (5.04x10 ⁴)*	-0.54 (308.31)*	-0.33 (2.96)*	1.98 (2.56)	-13.58 (1.11x10 ⁵)*	-20.02 (3.82x10 ⁶)*	-23.68 (1.22x10 ⁵)*	58.84 (4.81x10 ⁵)*	34.22 (4.70x10 ⁵)*
Blacknose shiner	0.19 (1.34x10 ³)	0.23 (3.39x10 ⁵)	-7.27 (3.20x10 ⁶)	-11.63 (1.44x10 ⁶)*	0.30 (3.38x10 ⁴)	-0.04 (3.38x10 ⁴)	-0.13 (1.34x10 ³)	-0.53 (6.28x10 ⁵)	-1.17 (4.38x10 ⁵)	13.92 (1.51x10 ⁵)*	14.07 (1.51x10 ⁵)*
Bluntnose minnow	0.09 (0.37)	-5.62 (5.83x10 ³)*	-3.43 (5.83x10 ³)	-10.72 (9.69x10 ³)*	-3.71 (5.83x10 ³)	3.42 (5.83x10 ³)	3.03 (1.87)*	-14.73 (2.96x10 ⁵)*	4.35 (2.31)*	0.57 (0.58)*	0.88 (0.59)*
Emerald shiner	0.57 (0.90)	-2.03 (0.66)*	-0.26 (0.64)*	3.41 (0.79)*	-1.70 (1.10)*	-3.10 (2.52x10 ³)	-1.47 (0.70)*	1.05 (1.00)*	-1.61 (0.89)*	-3.09 (0.79)*	0.10 (0.63)*
Hornyhead chub	0.51 (0.58)*	-3.55 (1.08)*	-0.36 (0.98)	4.6 (0.92)*	-3.96 (1.14)*	7.25 (1.66)*	0.97 (0.72)*	-13.94 (5.92x10 ³)*	2.58 (0.90)*	4.15 (1.02)*	1.72 (0.98)*
Mimic shiner	0.28 (1.03)	-1.47 (1.61)*	1.01 (1.13)	0.69 (1.29)	0.99 (1.57)	-3.85 (4.31x10 ³)	0.02 (0.50)	0.08 (0.75)	0.00 (0.58)	0.22 (0.78)	0.14 (0.66)
Pugnose minnow	0.28 (0.95)	-1.13 (956.35)*	-0.35 (956.35)	-4.08 (3.88x10 ⁴)	0.33 (956.35)	5.46 (956.35)*	2.9 (8.0x10 ³)	-0.6 (2.32x10 ⁵)	2.9 (8.0x10 ³)	0.12 (0.81)	-0.03 (0.64)
Pugnose shiner	0.35 (1.12)	0.68 (6.34x10 ⁴)	-3.77 (2.76x10 ³)	-2 (1.54x10 ⁵)	1.32 (6.34x10 ⁴)	1.52 (6.34x10 ⁴)*	0.29 (774.64)	-0.21 (3.54x10 ⁴)	-0.56 (3.80x10 ⁵)	14.01 (4.20x10 ³)*	-19.98 (6.18x10 ⁶)*
Sand shiner	-3.12 (0.98)*	-0.13 (0.49)	0.11 (0.39)	-0.46 (0.7)	-5.1 (1.5)*	-1.51 (1.54x10 ³)	2.02 (0.64)*	-1.26 (1.03)*	-2.26 (1.46)*	1.69 (1.19)*	-0.31 (0.5)*
Spotfin shiner	-0.25 (0.82)	-2.39 (1.13)*	0.37 (0.68)	2.72 (1.02)*	3.22 (1.35)*	-7.28 (8.91x10 ⁴)	0.96 (1.35)	-7.01 (9.33x10 ⁴)	-0.12 (1.11)	-0.19 (0.55)	-0.09 (0.38)
Spottail shiner	1.78 (1.10)*	-2.3 (0.92)*	0.67 (0.76)*	0.06 (0.52)	-0.43 (1.00)	0.62 (1.65)	-0.22 (0.90)	-0.67 (1.49)	-1.39 (1.98)	-1.29 (1.13)*	0.95 (0.71)*
Striped shiner	0.00 (0.64)	-1.47 (774.45)	-0.77 (774.45)	-3.01 (2.65x10 ⁵)	-1.44 (774.45)	-2.13 (8.45x10 ⁴)	24.49 (2.61x10 ⁴)	-9.91 (6.02x10 ⁶)*	28.02 (2.61x10 ⁴)*	0.13 (0.44)*	0.06 (0.31)

Table 2 Continued

Species	In-river substrate					Shoreline vegetation type				Aquatic macrophyte richness	
	Silt	Sand	Gravel	Cobble	Organic	Algae	Grassy	Mixed	Woody	High	Low
Moronidae											
White perch	-0.17 (0.59)	2.41 (0.45)*	-0.22 (0.34)	0.5 (0.38)	0.16 (0.37)	-0.63 (1.92x10 ⁵)	-34.23 (1.53x10 ⁶)*	-50.03 (4.18x10 ⁵)*	2.19 (0.42)*	-1.31 (0.65)*	0.33 (0.36)*
Percidae											
Johnny darter	-14.29 (6.13x10 ⁵)*	-1.38 (2.06x10 ⁴)	-0.25 (2.06x10 ⁴)	-3.54 (2.89x10 ⁴)	-0.09 (2.06x10 ⁴)	-10.07 (8.68x10 ⁴)	4.31 (1.83x10 ⁵)	-0.45 (2.59x10 ⁶)	4.54 (1.83x10 ⁵)	1.18 (2.47)	-0.61 (1.74)
Least darter	3.5 (2.88)*	-3.88 (2.92x10 ⁴)*	-1.34 (2.92x10 ⁴)	-4.01 (2.30x10 ⁴)	-0.95 (2.92x10 ⁴)	-12.11 (1.14x10 ⁷)	7.2 (2.87x10 ⁴)	-1.37 (319x10 ⁶)	6.69 (2.87x10 ⁴)	13.91 (212400)	13.63 (212400)
Logperch	-0.11 (0.42)	0.06 (0.38)	-0.29 (0.5)	0.03 (0.37)	0.28 (0.59)	-2.57 (4.15x10 ⁴)	0.1 (0.74)	0.08 (1.06)	0.43 (1.33)	-0.95 (0.69)*	-0.09 (0.45)*
Yellow perch	-1.7 (0.88)*	0.29 (0.57)	-0.23 (0.37)	1.61 (0.68)*	-2.65 (1.12)*	3.2 (1.5)*	1.84 (1.87)*	-0.77 (2.16)*	2.51 (2.42)*	-1.54 (0.61)*	-1.38 (0.48)*