NOAA Technical Memorandum GLERL-140

ABUNDANCE AND DISTRIBUTION OF BENTHIC MACROINVERTEBRATE POPULATIONS IN LAKE HURON IN 1972 AND 2000-2003

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March 2007

UNITED STATES
DEPARTMENT OF COMMERCE

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Secretary

NATIONAL OCEANIC AND
ATMOSPHERIC ADMINISTRATION

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Abundance and Distribution of Benthic Macroinvertebrate Populations in Lake Huron in 1972 and 2000-2003

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1. INTRODUCTION

This technical report gives results of benthic macroinvertebrate surveys conducted in Lake Huron between 2000 and 2003, and in 1972. Objectives of the former surveys were to document the status of benthic communities, and to assess changes over time. Over the past 20-30 years, the benthic community of Lake Huron has been the least studied of all the Great Lakes. While a number of benthic surveys were conducted in Lake Huron in the early 1970s (Schelske and Roth 1972; Shrivastava 1974; Loveridge and Cook 1976; Great Lakes Research Division-University of Michigan, unpublished data), no wide-scale surveys have been conducted in the lake since this time period. With broad changes now occurring in many of the other Great Lakes because of phosphorus abatement and the introduction of invasive species, an assessment of the benthic community in Lake Huron is both timely and needed. Of particular interest is the status of the benthic amphipod *Diporeia* spp. This ecologically-important organism has declined dramatically in Lakes Erie, Michigan, and Ontario (Dermott and Kerec 1997, Nalepa et al. 1998, Lozano et al 2001, Nalepa et al 2006) since the introduction and spread of *Dreissena polymorpha* (zebra mussel) and *Dreissena bugensis* (quagga mussel), and information is needed to determine if similar declines have occurred in Lake Huron.

While the 2000-2003 surveys provide recent data on benthic macroinvertebrate populations, the 1972 survey provides a baseline to which the 2000-2003 data might be compared. This earlier survey was conducted by the Great Lakes Research Division (GLRD), University of Michigan, but the data have never been published and therefore have not been readily available.

This report provides details of sampling design, station locations, sampling methods, and laboratory procedures of each survey. It also gives the raw data, that is, the number of each taxon found in each sample taken. All data are presented with little attempt at analysis or interpretation. Detailed analysis and discussion of trends will be provided in other publications.

2. METHODS

Station Locations, Field Procedures

Benthic macroinvertebrate surveys were conducted in the main basin of Lake Huron in 2000 and 2003, and in Georgian Bay and North Channel in 2002. In the main basin, which can be defined as the lake area excluding Saginaw Bay, Georgian Bay, and North Channel, samples were collected at 65 sites in August, 2000, and at 85 sites in late July/August 2003 (Table 1 and Figure 1). In the latter year, sampled sites included all but two sites sampled in 2000, plus an additional 22 sites, some of which were sampled as

*Note: The 1972 data was collected by the last two authors while at the Great Lakes Research Division, University of Michigan.

part of a study to assess benthic prey available to lake whitefish (Pothoven and Nalepa 2006). Among the 65 sites sampled in both 2000 and 2003, 25 sites were the same sites as sampled in 1972 by GLRD (Table 1). A total of 50 sites were sampled in the main basin in 1972, thus 25 sites sampled in 1972 were not re-sampled in 2000 or 2003 (Table 2, Figure 2).

Samples were collected at 17 sites in Georgian Bay and at 13 sites in North Channel in August 2002 (Table 3, Figure 1). These sites were a subset of sites sampled as part of the long-term monitoring program of water quality parameters by Environment Canada.

In each of the surveys in 2000-2003, triplicate samples were taken at each site with a Ponar grab (area = 0.047 m^2). Each replicate was washed into an elutriation device (funnel-shaped hopper) fitted with a nitex sleeve having 0.5-mm openings. Grab contents were placed into the elutriation device, gently stirred, and then washed through the sleeve into a collection jar. Retained material was immediately preserved in 5% buffered formalin containing rose bengal stain.

Sampling procedures in 1972 (month of collection: September) were the same as in 2000-2003. Samples were taken in triplicate with a Ponar grab, and then washed into an elutriation device similar to the one used in 2000-2003. The device was fitted with a cylindrical wire screen having 0.5 mm openings. Retained material was preserved in 5% buffered formalin.

Laboratory Procedures

Retained material was placed into a white enamel pan and organisms were picked, counted, and sorted into major taxonomic groups (Amphipoda, Oligochaeta, Chironomidae, *Dreissena*, Sphaeriidae, and other) under a low-power magnifier lamp (1.5 x). All organisms collected in the main basin in 2000 and in Georgian Bay/North Channel in 2002 were identified to the lowest practical taxonomic level. For oligochaetes, between 75 and 100 individuals in a replicate (proportionately split with a Folsom plankton splitter when numbers were higher) were cleared in lacto-nophenol, and mounted on slides prior to identification. Only oligochaetes with a prostomium were included in abundance estimates. Chironomid head capsules were mounted mentum side up prior to identification. In 2003, organisms were only identified to group level (see above). The exception was dreissenids, which were separated into the two species (*D. polymorpha* and *D. bugensis*). Since oligochaete fragments (without prostomium) can only be recognized during the process of species identification and not when counted and sorted, the total number of oligochaetes at each site in 2003 was corrected based on the mean proportion of fragments found at the same site in 2000 (see Nalepa et al. 1998). For the 20 sites sampled in 2003 and not in 2000, a mean proportion for all sites in the same depth interval was used as the oligochaete correction factor. Retained material collected in 1972 was sorted under 16x magnification and all organisms were identified to the lowest practical taxonomic level.

Spatial distributions of *Diporeia* spp., Oligochaeta, Chironomidae, Sphaeriidae, *D. bugensis*, *D. polymorpha* in the main basin in 2000 and 2003 were plotted using a natural neighbor spatial interpolation method and IDL software. Distributions of *Diporeia* spp., *D. bugensis*, and *D. polymorpha* in 2003 not only reflect mean densities at the 85 sites sampled, but also mean densities at an additional 23 sites that were sampled and provided to us by National Water Research Institute, Canada. These sites were located in the northeastern portion of the lake at depths < 35 m. The samples were taken in duplicate with a Ponar grab and washed through a screen with 0.5 mm openings. Organisms were counted as described previously.

3. RESULTS AND DISCUSSION

Data collected in each of the surveys are given in a series of four excel files: 2000 survey (Appendix 1), 2002 survey (Appendix 2), 2003 survey (Appendix 3), and 1972 survey (Appendix 4). The data are presented as the number of each taxon found in each replicate Ponar grab. To convert to number per m^2, multiply values by 21.42 for surveys in 2000-2003, and by 21.50 for the 1972 survey. Individual taxa within the data files are represented by a four letter code (Table 4). Codes are consistent across surveys, but in some cases more specific details are provided for some taxa. For instance, *Diporeia* collected in 1972 were divided into categories based on size and sex, and these categories were kept intact in the file. Note also that 2003 data are given only for the major taxa (*Diporeia*, Oligochaeta, Chironomidae, and Sphaeriidae) plus *D. bugensis* and *D. polymorpha*.

As mentioned, the purpose of this report is to document site locations, methods, and basic data for each individual survey. Since an objective of the surveys in 2000-2003 was to assess changes over time, a summary table is provided to show changes at common sites sampled in 1972, 2000, and 2003 (Table 5). The 25 sites were placed into three depth intervals (18-30 m, 31-50 m, 51-90 m) and mean (± SE) densities (no. m^{-2}) of the four benthic major groups (*Diporeia*, Oligochaeta, Chironomidae, and Sphaeriidae) in each interval were determined. Differences between years were tested for each depth interval with a one-way ANOVA after ln+1 transformation followed by a Tukey LSD. Densities of the major groups were significantly lower ($P < 0.05$) in 2000 or 2003 compared to 1972, mostly at the two deeper depth intervals (Table 5). Declines were most evident for *Diporeia*, with significantly lower densities in all three depth intervals. Overall, mean density of *Diporeia* at the 25 sites was 4,765 m^{-2} in 1972, 1,031 m^{-2} in 2000, and 466 m^{-2} in 2003. Densities of oligochaetes and sphaeriids were also clearly lower in 2000 compared to 1972, although differences were not as extensive as for *Diporeia* (Table 5).

Lakewide distributions of the four major taxa, as well as *D. bugensis* and *D. polymorpha*, in 2000 and 2003 are given in Figures 3-8. In addition, mean densities at four depth intervals (18-30 m, 31-50 m, 51-90 m, and > 90 m) are given in Table 6. Whereas lower densities were apparent in 2003 compared to 2000 for each taxon, densities of the two dreissenid species were stable or increased. The mean lakewide density of *D. bugensis* increased from < 1 m^{-2} in 2000 to 553 m^{-2} in 2003, while the lakewide density of *D. polymorpha* was 61 m^{-2} in 2000 and 68 m^{-2} in 2003.

Based on trends in Lakes Ontario and Michigan (Mills et al. 1999, Nalepa unpublished data), the *D. bugensis* population in Lake Huron will continue to increase, while the *D. polymorpha* population will likely decline. With a higher assimilation rate and a lower metabolic rate, *D. bugensis* can outcompete *D. polymorpha* for available food resources (Stoeckmann 2003). These physiological attributes also allow it to colonize deepwater habitats unsuitable for *D. polymorpha*. Since there is a strong negative link between dreissenids and *Diporeia* (Nalepa et al. 2006), the expected, continued expansion of *D. bugensis* in deep habitats of Lake Huron will most likely lead to further declines in *Diporeia* and perhaps other major benthic taxa.

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Table 1. Location and depth of stations sampled in August 2000 and July/August, 2003 in the main basin of Lake Huron. Stations are arranged in alpha-numeric order. Stations with an "MZ" designation were first sampled in September, 1972 by the Great Lakes Research Division, University of Michigan.

Station	Depth (m)	Latitude	Longitude
AL20*	20.0	44 57.140	83 16.250
AL30*	30.0	44 56.070	83 14.810
AL45*	45.0	44 55.080	83 11.460
AL60*	60.0	44 51.740	83 06.780
AL80*	80.0	44 49.120	83 01.910
AP1*	23.0	45 25.000	83 42.730
FI2	30.0	45 29.987	81 56.495
FI3	46.0	45 29.975	82 02.776
FI4	61.0	45 29.999	82 16.687
FI5	82.0	45 30.008	82 20.383
HB1*	20.0	45 36.830	84 10.190
HB3*	45.0	45 38.156	84 07.764
HB4*	58.0	45 39.600	84 05.300
HB5*	80.0	45 43.373	83 58.820
HU6	50.9	43 27.970	82 00.020
HU9	58.9	43 38.020	82 13.008
HU12	90.0	43 53.393	82 03.371
HU15	66.0	43 59.991	82 21.023
HU27	57.0	44 11.919	82 30.169
HU32	80.0	44 27.205	82 20.471
HU37	71.8	44 45.658	82 46.974
HU38	133.0	44 44.393	82 03.583
HU45	91.0	45 08.203	82 59.059
HU48	112.0	45 16.673	82 27.188
HU53	91.0	45 27.010	82 54.885
HU54	139.4	45 30.990	83 24.952
HU61	116.0	45 44.989	83 54.980
HU93	87.0	44 05.988	82 07.055
HU95	66.0	44 19.994	82 49.954
HU97	45.0	44 54.953	83 09.973
HU325	58.0	45 48.996	84 23.258
HU329	37.0	45 54.760	84 18.126
HU429P[#]	19.0	45 49.311	84 26.219
HU429	33.4	45 49.447	84 26.208
MZ12	21.0	43 16.181	82 25.705
MZ13	30.5	43 16.170	82 20.439
MZ14	28.8	43 16.188	82 12.044
MZ22	18.5	43 30.303	82 30.155
MZ23	33.0	43 30.419	82 27.265
MZ24	43.0	43 30.601	82 23.268
MZ25	52.0	43 31.180	82 12.250

*Denotes stations sampled in 2003 but not in 2000.

[#]Denotes stations sampled in 2000 but not in 2003.

Table 1. Continued.

Station	Depth (m)	Latitude	Longitude
MZ34	45.0	43 52.617	82 31.737
MZ43	29.5	44 04.009	82 44.775
MZ44	39.0	44 05.705	82 43.063
MZ45	58.0	44 14.505	82 32.993
MZ72	24.0	44 24.279	83 12.484
MZ73	31.8	44 25.397	83 10.515
MZ74	42.0	44 26.304	83 08.802
MZ75	67.0	44 30.924	83 00.174
MZ76	79.0	44 43.487	82 35.500
MZ87	54.7	45 05.854	83 03.497
MZ88	47.0	45 05.341	83 04.643
MZ89	32.0	45 04.771	83 05.781
MZ93	32.0	45 26.469	83 44.591
MZ94	40.0	45 26.304	83 44.304
MZ95	64.0	45 28.688	83 42 208
MZ96	81.0	45 40.641	83 28.575
MZ123	54.0	45 53.661	84 09.611
MZ125	81.0	45 50.712	84 11.575
PT2[#]	30.0	45 00.049	81 32.991
PT3	45.0	45 00.057	81 35.192
PT5	80.0	44 59.998	81 40.479
PT6	136.0	45 00.023	81 42.495
SB23	28.0	44 13.306	83 15.761
SO2	31.0	44 34.992	81 23.478
SO3	40.0	44 35.036	81 29.993
SO4	57.0	44 35.002	81 31.978
SO5	80.7	44 35.007	81 34.983
SR3*	32.0	45 19.203	83 25.323
SR4*	45.0	45 19.203	83 22.707
SR5	55.4	45 19.203	83 20.165
SR6*	77.0	45 19.203	83 14.503
SR10	56.0	44 49.482	83 06.555
TA20*	20.0	44 09.154	83 20.739
TA45*	45.0	44 18.107	83 11.055
TN1	20.8	43 16.343	82 00.361
TN2	51.0	43 41.800	82 25.000
TN3	65.5	43 41.782	81 55.995
TN4	47.5	44 13.344	81 50.480
TN5	170.0	45 12.447	82 42.492
TN6*	31.0	43 30.002	81 53.489
TN7*	21.0	43 30.037	81 50.558
TN8*	44.0	43 41.800	81 53.734
TN9*	32.0	43 41.800	81 52.421
TN10*	22.0	43 41.800	81 50.366
TN11*	30.0	44 13.406	81 39.987
TN12*	20.0	44 13.458	81 39.121

*Denotes stations sampled in 2003 but not in 2000.

[#]Denotes stations sampled in 2000 but not in 2003.

Table 2. Stations sampled in September, 1972 by the Great Lakes Research Division, University of Michigan that were not re-sampled in 2000 or 2003.

Station	Depth (m)	Latitude	Longitude
MZ11	10.7	43 16.20	82 29.40
MZ21	11.9	43 30.20	82 32.30
MZ31	12.8	43 51.00	82 37.10
MZ32	21.0	43 51.40	82 35.60
MZ33	36.6	43 52.10	82 33.50
MZ42	19.8	44 03.60	82 45.40
MZ51	11.9	44 02.20	83 09.40
MZ52	15.2	44 04.00	83 11.80
MZ53	21.0	44 06.00	83 14.40
MZ54	22.0	44 08.60	83 17.70
MZ55	22.6	44 10.90	83 21.10
MZ56	20.1	44 13.10	83 24.10
MZ57	11.9	44 14.70	83 26.30
MZ61	11.6	44 00.80	83 31.60
MZ62	18.3	44 07.00	83 30.20
MZ63	20.1	44 10.60	83 27.40
MZ71	10.7	44 21.80	83 16.70
MZ91	14.9	45 25.10	83 46.30
MZ92	22.9	45 25.60	83 45.70
MZ122	26.5	45 54.00	84 09.40
MZ124	62.8	45 52.90	84 10.30
MZ126	59.5	45 47.60	84 13.60
MZ127	42.4	45 45.70	84 14.80
MZ128	25.9	45 43.40	84 16.40
MZ129	16.8	45 41.10	84 17.80

Table 3. Location and depth of stations sampled in August 2002 in Georgian Bay and North Channel. Stations arranged in alpha-numeric order. Stations with a "GB"designation were located in Georgian Bay and stations with a "NC" designation were located in North Channel.

Station	Depth (m)	Latitude	Longitude
GB1	89.0	44 43.05	80 51.40
GB3	32.0	44 43.50	80 37.00
GB4	57.0	44 38.75	80 10.00
GB5	57.6	44 47.80	80 14.60
GB6	86.0	44 44.20	80 26.10
GB8	51.0	44 57.16	80 08.93
GB9	32.0	44 52.30	79 58.08
GB11	61.0	44 55.25	80 36.35
GB12	87.0	44 55.20	80 52.50
GB17	77.5	45 14.70	80 52.50
GB24	39.0	45 44.73	80 50.33
GB26	26.0	45 50.00	80 54.00
GB29	42.0	45 35.00	81 05.00
GB35	33.4	45 31.65	81 40.17
GB36	52.0	45 42.50	81 37.20
GB39	28.0	45 52.40	81 15.50
GB42	26.0	45 54.77	81 35.70
NC68	16.7	46 02.50	83 51.20
NC70	21.5	46 08.20	83 40.30
NC71	35.0	46 14.00	83 44.80
NC73	18.7	46 11.20	83 21.30
NC76	58.0	46 00.00	83 26.00
NC77	77.8	45 58.20	83 11.90
NC79	25.4	46 07.40	82 53.15
NC82	27.2	45 56.20	82 45.50
NC83	30.4	46 00.00	82 33.00
NC84	35.3	46 05.50	82 33.40
NC87	32.0	46 03.67	82 11.83
NC88	33.9	46 03.33	82 00.00
NC89	38.8	45 55.00	82 09.67

Table 4. List of taxa collected in each of the yearly surveys. The four-letter code identifies the corresponding taxa in the excel files given in Appendices 1-4.

Taxa	Code	Survey Year			
		1972	2000	2002	2003
Amphipoda					
Pontoporeiidae					
Diporeia spp. (Total)	DIPO	X	X	X	X
Young of year (0-3 mm)	MM03	X			
Juveniles (3-5 mm)	MM35	X			
Adults (5-7 mm)	MM57	X			
Adults (> 7 mm)	MM07	X			
Females (gravid)	GRAV	X			
Females (spent)	SPEN	X			
Males	MALE	X			
Gammaridae					
Echinogammarus ischnus	EGAM		X		
Gammarus sp.	GAMM	X			
Hyalellidae					
Hyallela sp.	HYAL	X			
Isopoda					
Ascellidae					
Caecidotea sp.	CAEC	X	X	X	
Mysidacea					
Mysidae					
Mysis relicta	MYSI	X	X	X	
Hirudinea					
Erbodellidae	ERBO			X	
Glossiphoniidae	GLOS		X	X	
Helobdella stagnalis	HSTA	X			
Piscicolidae					
Piscicola sp.	PISC		X		
unknown Hirudinea	HIRU	X			
Oligochaeta					
Sparganophilidae					
Sparganophilus tamesis	SPAR	X			
Enchytraeidae	ENCH	X	X	X	
Lumbriculidae					
Stylodrilus heringianus	SHER	X	X	X	
Tubificidae					
Aulodrilus americanus	AMME	X		X	
Aulodrilus limnobius	ALIM	X	X		
Aulodrilus pigueti	APIG	X			
Aulodrilus pluriseta	APLU	X	X		
Ilyodrilus templetoni	ITEM	X	X	X	
Isochaetides freyi	IFRE	X	X		
Limnodrilus cervix	LCER		X		
Limnodrilus claparedeianus	LCLA	X	X	X	
Limnodrilus hoffmeisteri	LHOF	X	X	X	
Limnodrilus profundicola	LPRO	X	X	X	

Table 4. Continued.

Taxa	Code	Survey Year			
		1972	2000	2002	2003
Limnodrilus spiralis	LSPI	X			
Limnodrilus udekemianus	LUKE	X			
Potamothrix moldaviensis	PMOL	X	X		
Potamothrix vejdovskyi	PVEJ	X	X	X	
Rhyacodrilus coccineus	RCOC	X	X	X	
Rhyacodrilus montana	RMON	X			
Spirosperma ferox	SFER	X	X	X	
Spirosperma nikolskyi	SNIK	X	X	X	
Tasserkidrilus americanus	TAME		X	X	
Tasserkidrilus superiorensis	TSUP	X	X	X	
Tubifex tubifex	TTUB	X	X	X	
Varichaetadrilus angustipenis	VANG	X	X		
Immatures					
Without hair setae	IMWO	X	X	X	
With hair setae	IMWH	X	X	X	
Naididae					
Arcteonais lomondi	ALOM	X	X	X	
Chaetogaster sp.	CHAE	X	X		
Nais barbata	NBAR	X			
Nais behningi	NBEH	X			
Nais pardalis	NPAR	X			
Nais simplex	NSIM	X	X		
Piguetiella michiganensis	PMIC	X	X	X	
Pristina aequiseta	PAEQ	X			
Pristina foreli	PFOR	X			
Pristina osborni	POSB	X			
Slavina appendiculata	SAPP	X	X	X	
Specaria josinae	SJOS	X	X		
Stylaria lacustris	SLAC	X	X	X	
Uncinais uncinata	UUNI	X	X	X	
Vejdovskyella intermedia	VINT	X	X		
Total Oligochaeta	TOLI	X	X	X	X
Diptera					
Ceratopogonidae					
Probezzia sp.	PROB			X	
Chironominii					
Chironomus sp.	CHIR	X	X	X	
Chironomus anthracinus-gr.	CANT	X	X		
Chironomus fluviatilis-gr.	CFLU	X			
Chironomus plumosus	CPLU	X			
Chironomus salinarius-gr.	CSAL	X			
Chironomus semireductus-gr.	CSEM	X			
Cryptochironomus spp.	CRYP	X	X	X	
Demicryptochironomus sp.	DEMI	X	X	X	
Dicrotendipes sp.	DICR	X	X	X	
Dicrotendipes fumidus	DFUM			X	

Table 4. Continued.

Taxa	Code	Survey Year			
		1972	2000	2002	2003
Glyptendipes sp.	GLYP	X			
Harnischia sp.	HARN		X	X	
Hydrobaenus sp.	HYDR			X	
Microtendipes sp.	MICR	X			
Microtendipes pedellus-gr.	MPED		X		
Omisus sp.	OMIS	X			
Paracladopelma camptolabis	PCAM		X		
Paracladopelma cf. nais	PNAI				
Paracladopelma nereis	PNER	X			
Paracladopelma cf. obscura	POBS	X			
Paracladopelma winnelli	PWIN		X	X	
Paralauterborniella sp.	PLAU	X			
Paralauterborniella nigrohalteralis	PNIG		X	X	
Paratendipes sp.	PTEN	X			
Paratendipes albimanus grp.	PALB		X	X	
Phaenopsectra obediens grp.	POBE			X	
Polypedilum cf. fallax	PFAL	X		X	
Polypedilum cf. ophioidese	POPH	X			
Polypedilum cf. scalaenum	PSCA	X	X	X	
Polypedilum tuberculum	PTUB		X		
Pseudochironomus sp.	PSEU	X			
Robackia cf. demijerei	RDEM	X			
Stempellina sp.	STEM	X			
Stichochironomus sp.	STIC	X	X	X	
Tribelos jucundum	TJUC			X	
Tanytarsinii					
Cladotanytarsus sp.	CTAN	X	X		
Cladotanytarsus mancus	CMAN		X	X	
Micropsectra sp.	MICR	X	X	X	
Tanytarsus sp.	TANY	X	X	X	
Tanytarsus cfr. curticornis	TCUR	X			
Orthocladiinae					
Corynoneura sp.	CORY	X			
Cricotopus sp.	CRIC	X			
Heterotrissocladius changi	HCHA	X	X	X	
Heterotrissocladius oliveri	HOLI	X	X	X	
Orthocladius sp.	ORTH		X		
Orthoclaius obumbratus	OOBU		X		
Parakiefferiella sp.	PKIE	X	X		
Psectrocladius sp.	PSEC		X	X	
Tanypodinae					
Ablabesmyia sp.	ABAL	X			
Ablabesmyia monilis	AMON			X	
Conchapelopia sp.	CONC	X			
Procladius sp.	PROC	X	X	X	
Tanypus sp.	TNYP	X			

Table 4. Continued.

Taxa	Code	Survey Year			
		1972	2000	2002	2003
Thienemannimya grp.	THIE			X	
Diamesinae					
Monodiamesia depictinata	MDEP	X	X		
Monodiamesia tuberculata	MTUB	X	X	X	
Potthastia cf. longimanus	PLON	X			
Protanypus sp.	PROT	X	X	X	
Undetermined Chironomidae	UNDE	X	X	X	
Total Chironomidae	TCHI	X	X	X	X
Pelecypoda					
Sphaeriidae					
Pisidium sp.	PISI	X	X		
Sphaerium nitidum	SNIT	X			
Sphaerium sp.	SPHA	X	X		
Total Sphaeriidae	TSPH	X	X	X	X
Unionidae	UNIO	X			
Dreisseniidae					
Dreissena polymorpha	DPOL		X	X	X
Dreissena bugensis	DBUG		X	X	X
Gastropoda					
Hydrobiidae					
Amnicola sp.	AMNI	X			
Bythinia tentaculata	BYTH	X			
Lymnaeidae					
Lymnaea sp.	LYMN	X	X		
Valvatidae					
Valvata sp.	VALV	X			
Valvata sincera	VSIN	X	X	X	
Valvata tricarinata	VTRI	X	X		
Other Gastropoda	OGAS	X			
Ephemeroptera					
Ephemeridae					
Hexagenia sp.	HEXA		X	X	
Tricoptera					
Leptoceridae					
Oecetis sp.	OECE		X		
Other Insect	OINS	X			
Turbellaria	TURB	X	X	X	
Nemertea	NEME		X	X	
Other Fauna	OFAU	X			

Table 5. Mean (± SE) density (no. m^{-2}) of the major taxa at three depth intervals in 1972, 2000, and 2003. The exact same stations were sampled each year. Differences between years for each taxon and depth interval were tested using ANOVA on ln +1 transformed values. If years were significantly different ($P < 0.05$), then a Tukey LSD was performed. Results of the Tukey LSD are represented by subscript letters. Values with the same letter were not significantly different ($P > 0.05$). n = 5, 12, and 8 for the 18-30 m, 31-50 m, and 51-90 m intervals, respectively.

	Depth		
Taxa/Year	**18-30 m**	**31-50 m**	**51-90 m**
Diporeia			
1972	1,896 ± 1,008[a]	5,892 ± 750[a]	4,867 ± 551[a]
2000	3 ± 2[b]	592 ± 394[b]	2,332 ± 365[ab]
2003	16 ± 10[b]	120 ± 88[c]	1,267 ± 374[b]
Oligochaeta			
1972	2,664 ± 919	2,831 ± 414[a]	1,545 ± 475[a]
2000	1,493 ± 259	1,029 ± 292[b]	723 ± 173[ab]
2003	1,308 ± 251	731 ± 135[b]	378 ± 107[b]
Sphaeriidae			
1972	609 ± 402	1,275 ± 210[a]	462 ± 104[a]
2000	187 ± 147	233 ± 44[b]	243 ± 70[ab]
2003	14 ± 11	44 ± 16[c]	81 ± 25[b]
Chironomidae			
1972	419 ± 149	134 ± 28	65 ± 14[ab]
2000	121 ± 45	146 ± 55	75 ± 9[a]
2003	224 ± 114	62 ± 16	35 ± 10[b]

Table 6. Mean (± SE) density (no. m^{-2}) of the major macroinvertebrate taxa found at four depth intervals in Lake Huron in 2000 and 2003. Standard errors based on station means. n = 10, 19, 28, and 8 for the 18-30 m, 31-50 m, 51-90 m, and > 90 m depth intervals in 2000, respectively, and n= 17, 27, 33, and 8 for the same intervals in 2003.

		Depth Interval							
		18-30 m		31-50 m		51-90 m		> 90 m	
Taxa	**Year**	**2000**	**2003**	**2000**	**2003**	**2000**	**2003**	**2000**	**2003**
Diporeia		244 ± 237	97 ± 92	876 ± 287	248 ± 103	1,918 ± 177	900 ± 130	1,646 ± 254	984 ± 65
Oligochaeta		1,648 ± 410	1,783 ± 417	1,196 ± 314	1,460 ± 368	792 ± 87	374 ± 41	661 ± 69	443 ± 74
Sphaeriidae		457 ± 196	47 ± 21	237 ± 37	67 ± 13	323 ± 44	106 ± 17	104 ± 35	80 ± 42
Chironomidae		883 ± 451	238 ± 55	379 ± 1402	62 ± 14	73 ± 11	27 ± 5	53 ± 12	17 ± 5
Dreissena polymorpha		386 ± 342	297 ± 209	6 ± 2	7 ± 4	0 ± 0	18 ± 17	0 ± 0	0 ± 0
Dreissena bugensis		3 ± 2	297 ± 180	2 ± 1	1,469 ± 757	0 ± 0	70 ± 44	0 ± 0	1 ± 1

Figure 1. Location of sampling sites for surveys in 2000, 2002, and 2003. Not all sites were sampled each year (see text for details). Some sites were located so close that a similar mark was shared. Those sites were HU429 and HU429P, and MZ93 and MZ94.

Figure 2. Locations of sampling sites in the 1972 survey that were not re-sampled in 2000 or 2003. Sites that were re-sampled are given in Figure 1 and have the "MZ" designation.

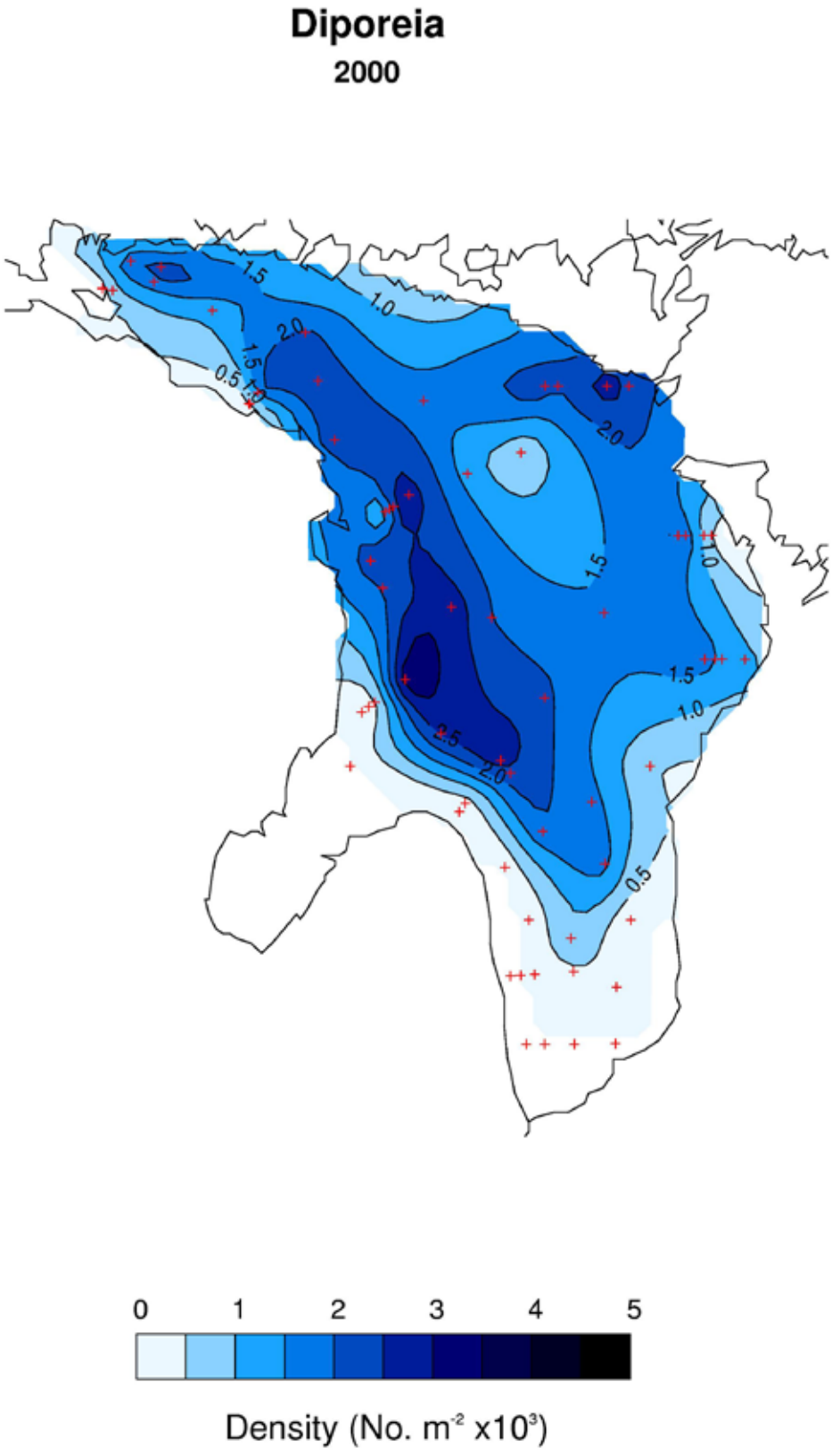

Figure 3a. Density (no.m^{-2} x10^{3}) of *Diporeia* spp. found in the main basin of Lake Huron in 2000. Small crosses denote locations of sampling sites

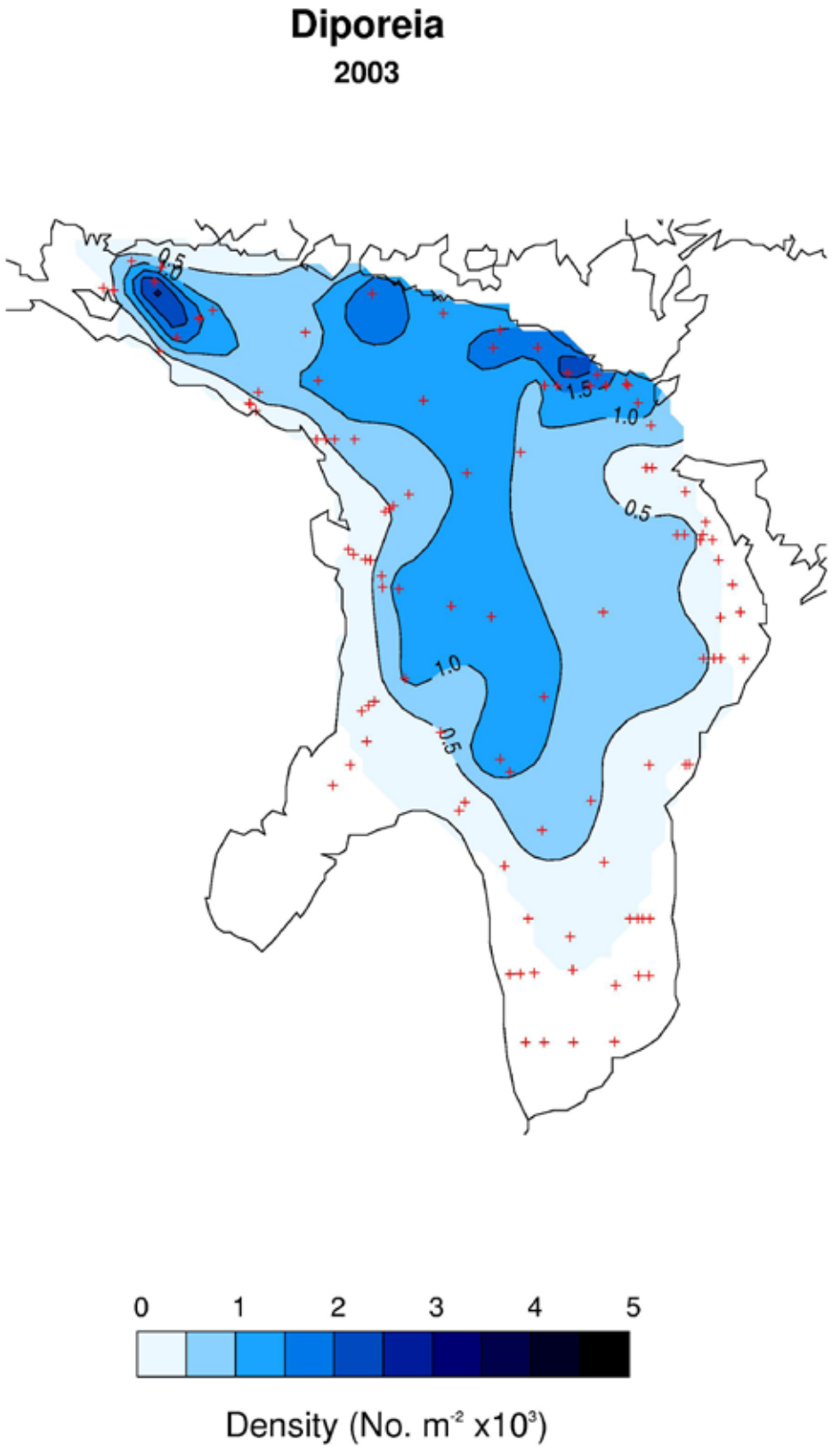

Figure 3b. Density (no.m^{-2} x10^{3}) of *Diporeia* spp. found in the main basin of Lake Huron in 2003. Small crosses denote locations of sampling sites.

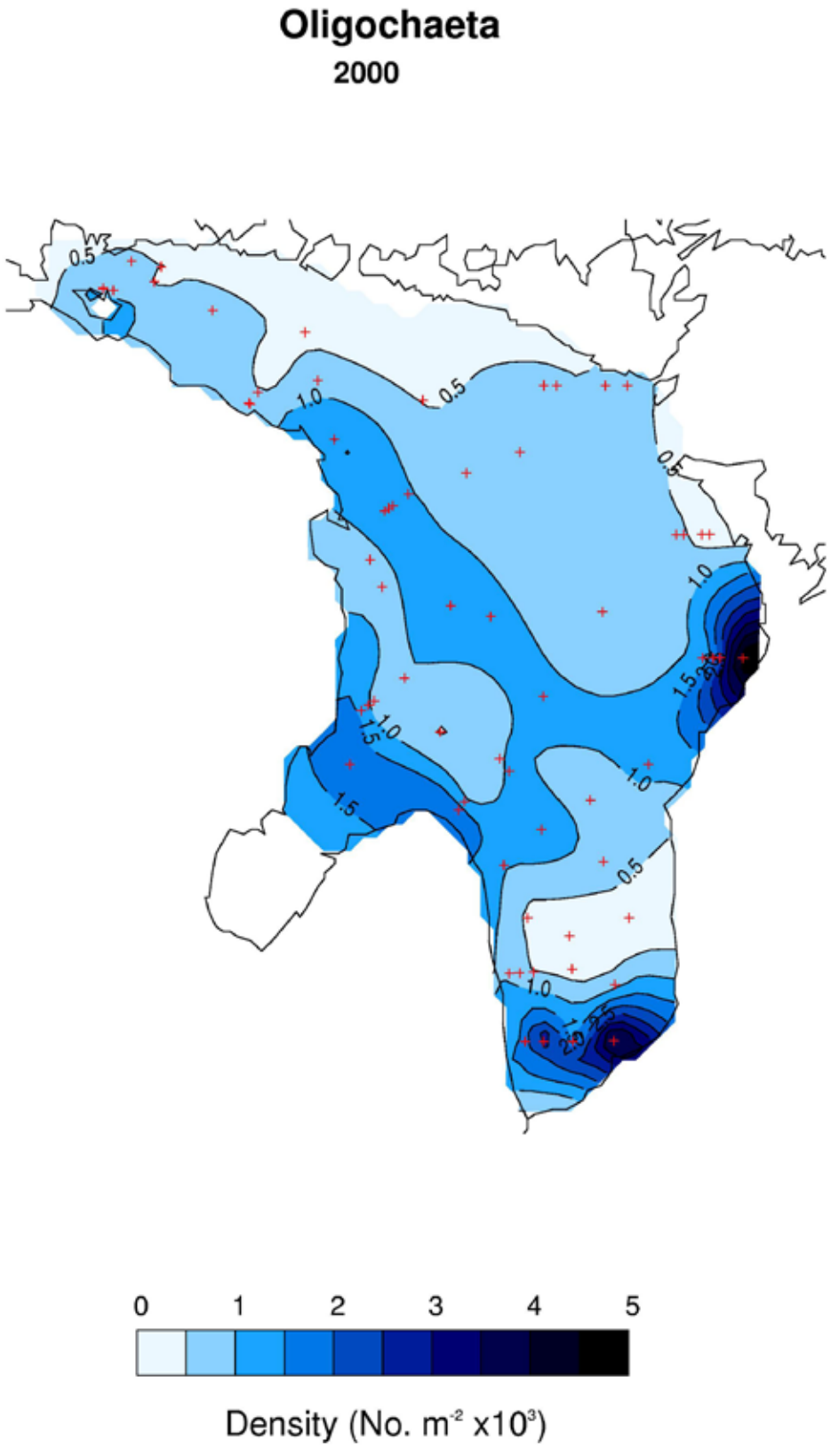

Figure 4a. Density (no.m^{-2} x10^{3}) of Oligochaeta found in the main basin of Lake Huron in 2000. Small crosses denote locations of sampling sites

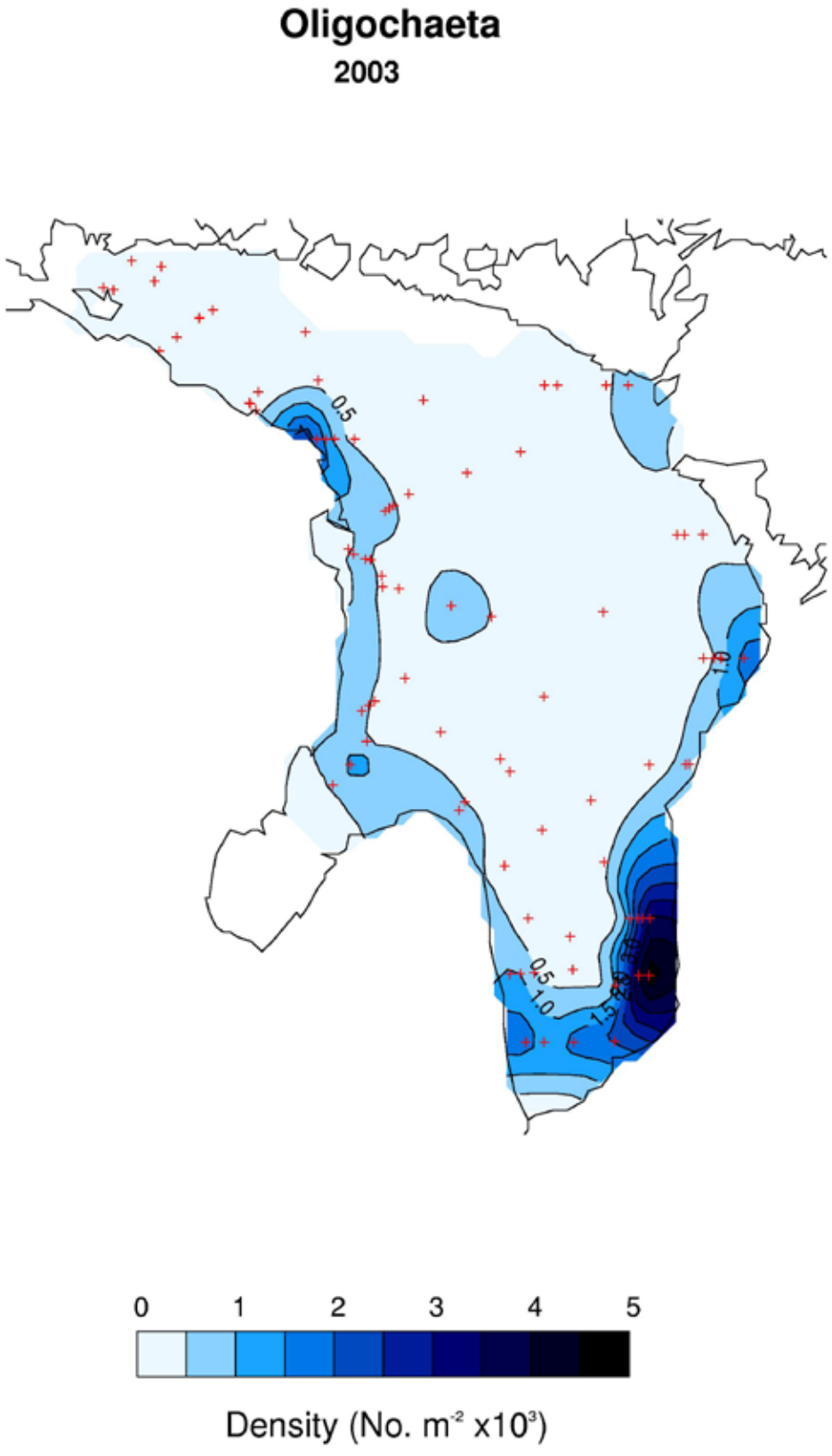

Figure 4b. Density (no.m^{-2} x10^{3}) of Oligochaeta found in the main basin of Lake Huron in 2003. Small crosses denote locations of sampling sites.

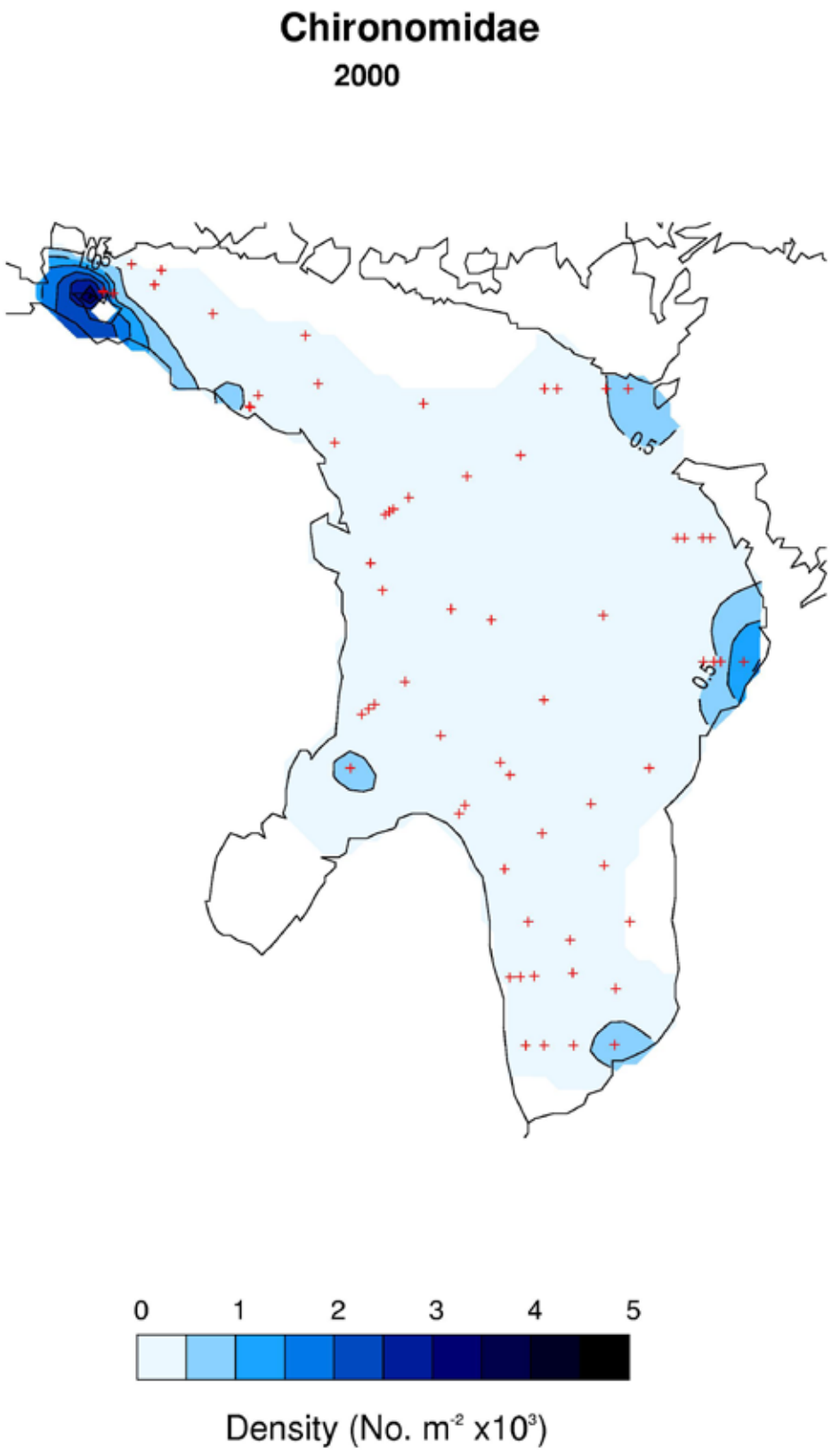

Figure 5a. Density (no.m^{-2} x10^{3}) of Chironomidae found in the main basin of Lake Huron in 2000. Small crosses denote locations of sampling sites.

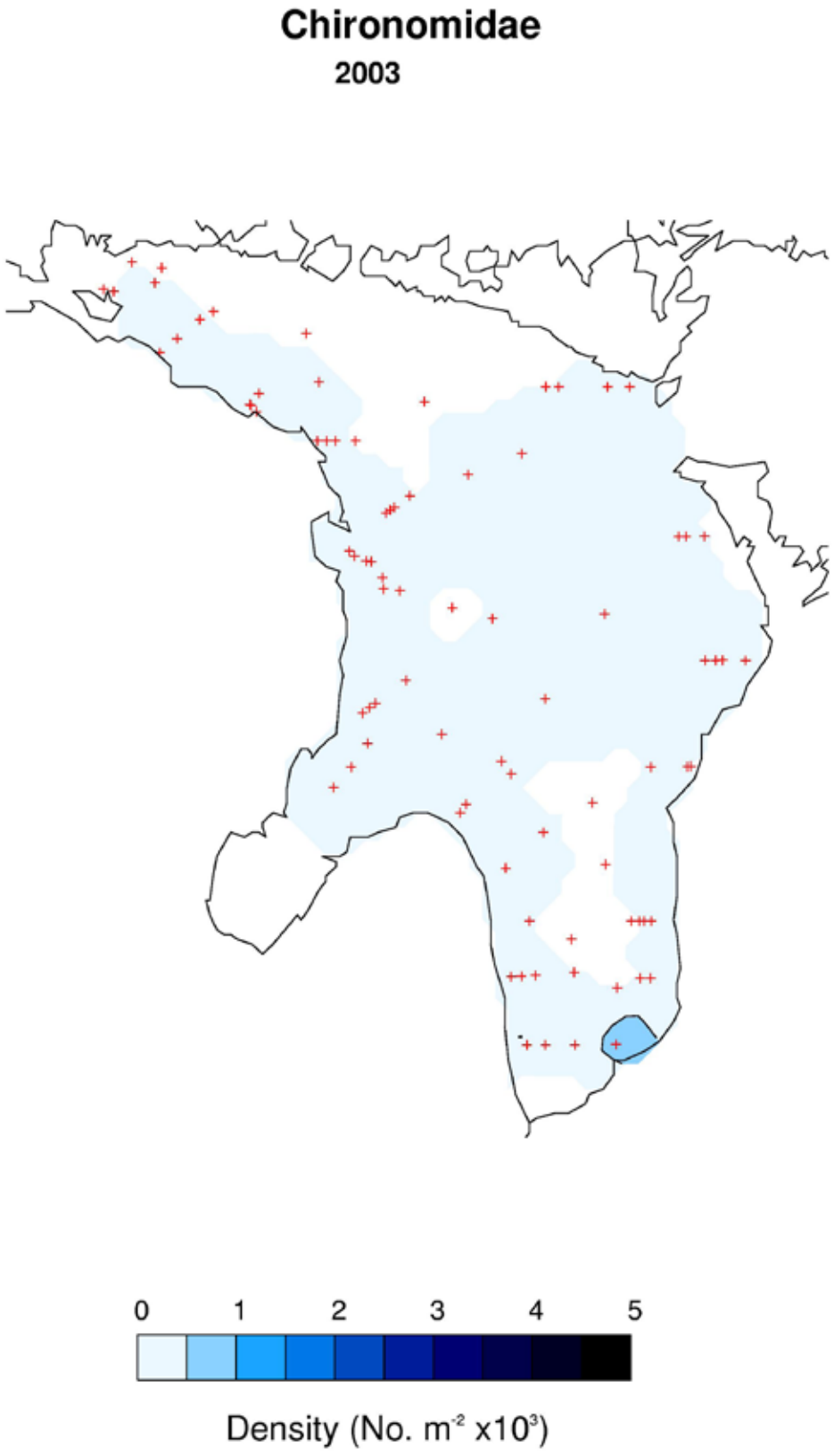

Figure 5b. Density (no.m^{-2} x10^{3}) of Chironomidae found in the main basin of Lake Huron in 2003. Small crosses denote locations of sampling sites.

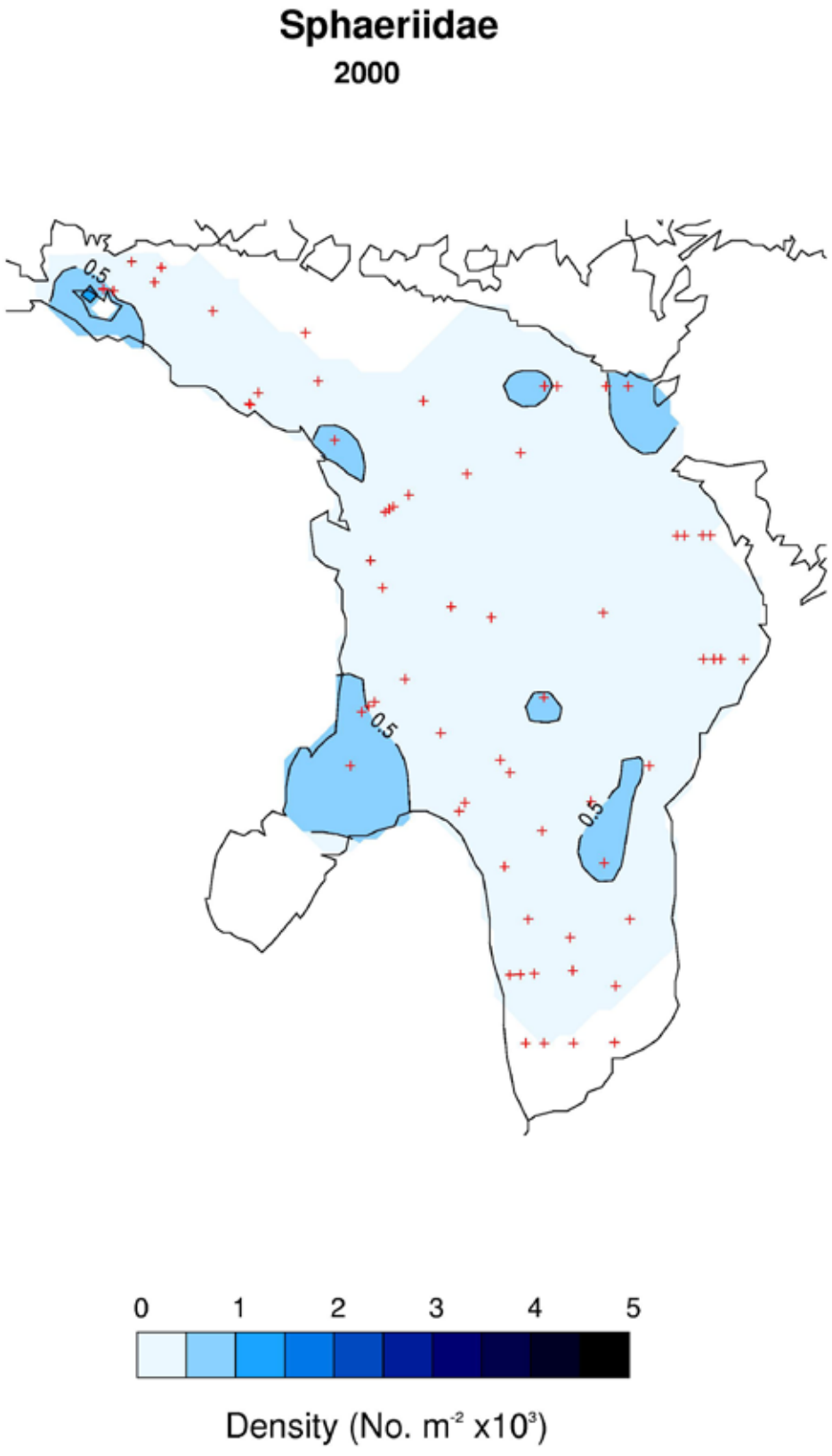

Figure 6a. Density (no.m^{-2} x10^{3}) of Sphaeriidae found in the main basin of Lake Huron in 2000. Small crosses denote locations of sampling sites.

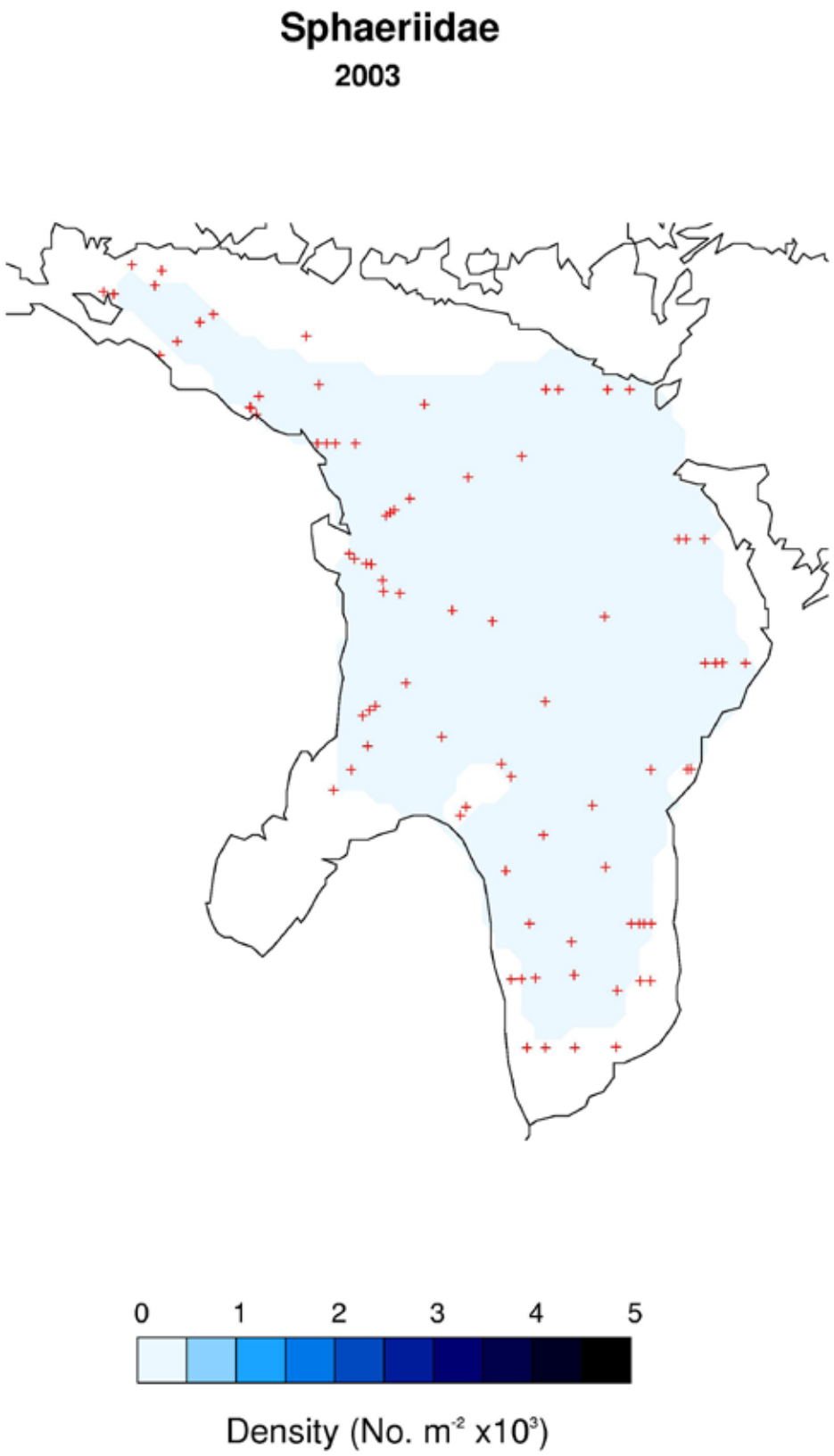

Figure 6b. Density (no.m^{-2} x10^{3}) of Sphaeriidae found in the main basin of Lake Huron in 2003. Small crosses denote locations of sampling sites.

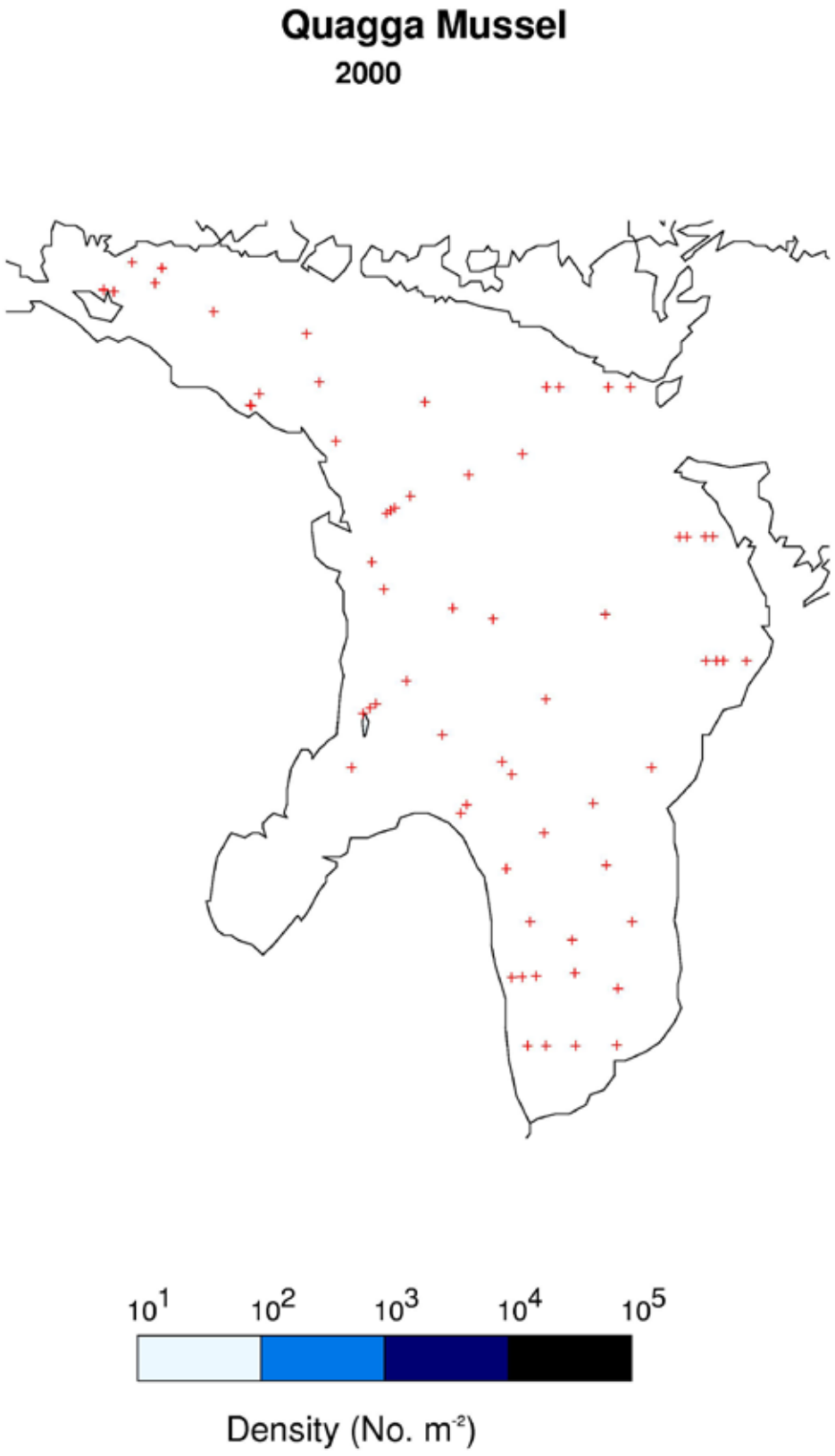

Figure 7a. Density (no.m^{-2} x10^{3}) of *Dreissena bugensis* (quagga mussel) found in the main basin of Lake Huron in 2000. Small crosses denote locations of sampling sites.

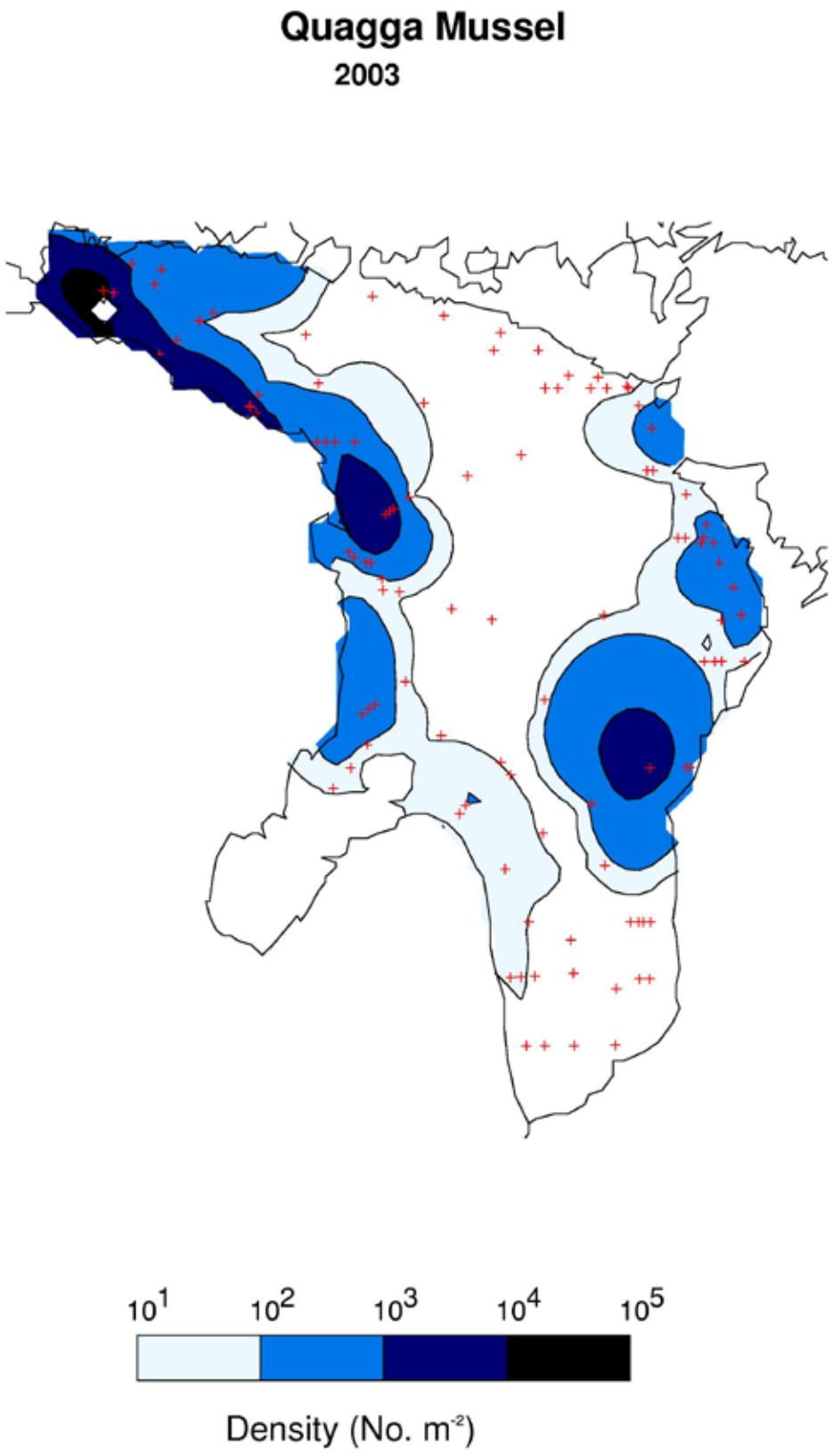

Figure 7b. Density (no.m^{-2} x10^3) of *Dreissena bugensis* (quagga mussel) found in the main basin of Lake Huron in 2003. Small crosses denote locations of sampling sites.

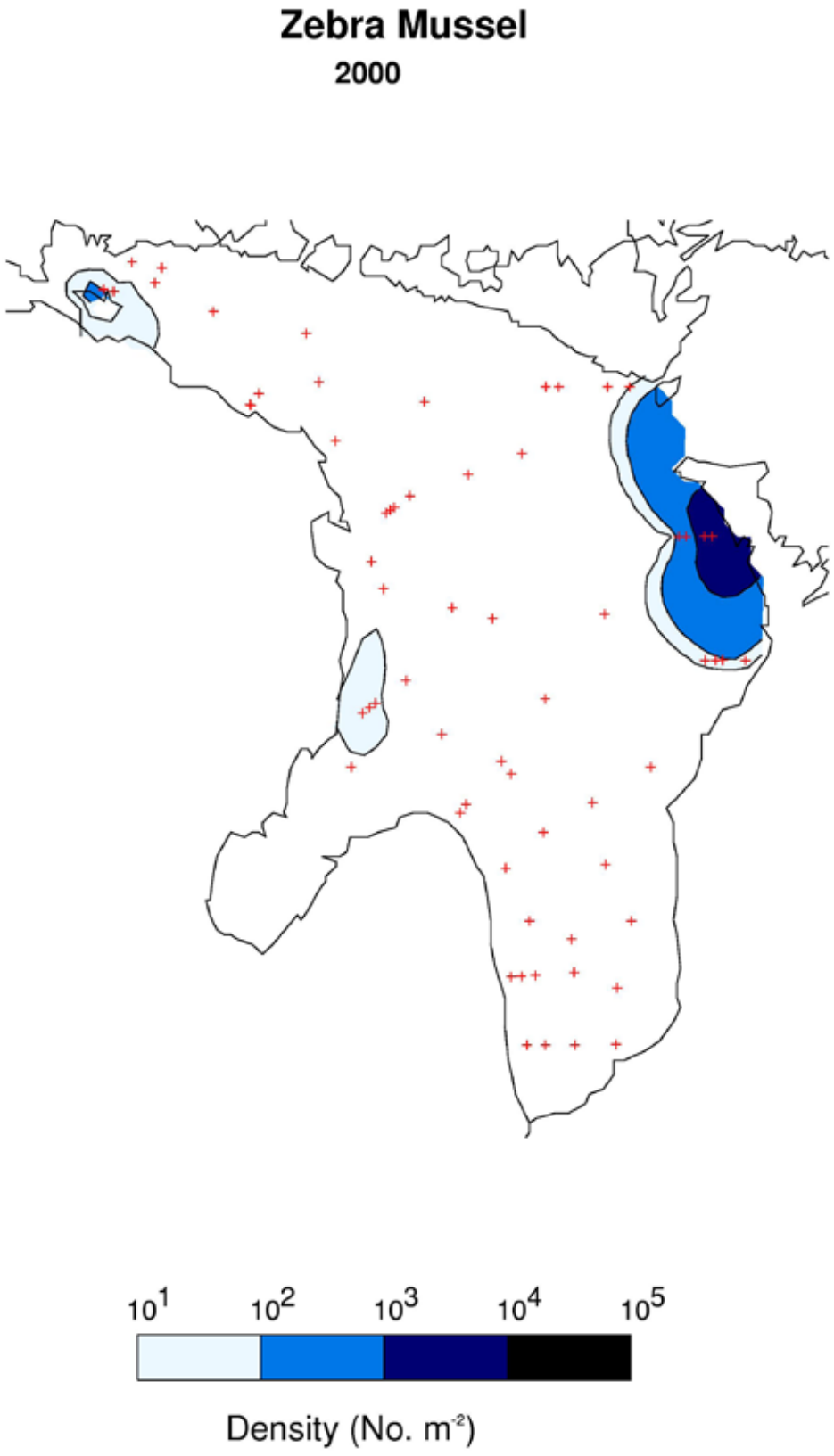

Figure 8a. Density (no.m^{-2} x10^{3}) of *Dreissena polymorpha* (zebra mussel) found in the main basin of Lake Huron in 2000. Small crosses denote locations of sampling sites.

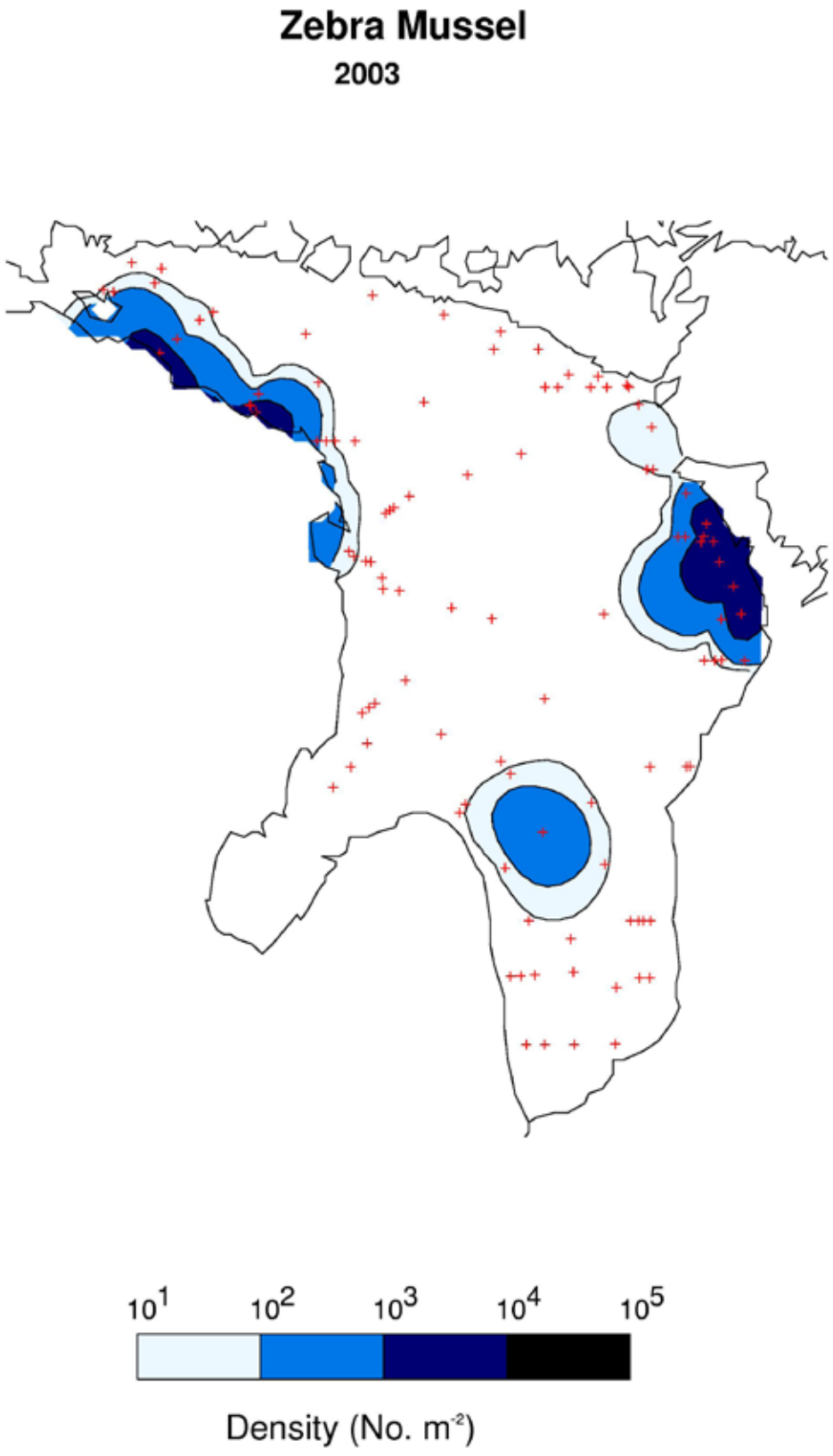

Figure 8b. Density (no.m^{-2} x10^{3}) of *Dreissena polymorpha* (zebra mussel) found in the main basin of Lake Huron in 2003. Small crosses denote locations of sampling sites.