

**Results of 2000 Monitoring of Freshwater Mussel Communities of the
Saint Croix National Scenic Riverway, Minnesota and Wisconsin.**

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By

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SUMMARY

In 2000, we repeated freshwater mussel samples at three downstream long-term monitoring sites on the St. Croix River, Minnesota and Wisconsin. These sites included Interstate Parks, Marine2 and Hudson. The purpose was to determine population and community characteristics over time for long-term monitoring. The questions we wanted answered were 1) Has population density changed? 2) Has size or age structure changed? 3) Was there a change in taxa richness? 4) How has community composition changed? 5) Has there been a change in living/dead or sex ratios?

From 1988-2000, mean population densities of total mussels ($\#/m^2$) changed only at Marine2. Densities dropped from 6.26 in 1988 to 2.35 in 1995-96. In 2000, the density was 3.04 and was not significantly different from 1995-96. Mean density of "sensitive" taxa at Marine2 were different between 1988 and 1995-96 (0.81 and 0.22, respectively). The density in 2000 was not different from either year (0.58). "Indifferent" taxa densities changed only at Marine2 and not at Interstate or Hudson. The density in 1988 (5.1) was different than 1995-96 (1.91) and 2000 (2.12). Mean densities among years for "exploitive" taxa were different only at Interstate. The density in 2000 (0.38) was different than the densities in 1988 (0.21) and 1995-96 (0.11). The federally endangered *Q. fragosa*, which was found only at Interstate, had a mean population of $0.02/m^2$ during 2000. Mean densities were not significantly different among all three years. The federally endangered *L. higginsii* was found in quadrat samples at Interstate and Hudson. In 2000, the mean density at Interstate was 0.01 and 0.09 at Hudson. Densities were not significantly different among years at both sites.

For six taxa at Interstate, gradually decreasing young-of-the-year recruitment relative to adults was seen. These taxa included *F. flava*, *L. cardium*, *O. reflexa*, *T. verrucosa* and *T. truncata*. Similarly, *E. dilatata* and *L. fragilis* had decreased recruitment from 1988 to 2000 at Marine2. Increasing recruitment was seen for *L. fragilis* at Interstate, and *Q. p. pustulosa* at Marine2.

Taxa richness may have changed only at Interstate, in spite of larger sample sizes. Richness was 29, 26 and 27 in 1988, 1995-96 and 2000, respectively.

The only obvious change in community composition was the decrease in abundance of *T. donaciformis* at all three monitoring sites. The relative abundance dropped 5.9 percentage points at Interstate, 3.3 at Marine2 and 0.5 at Hudson. Population density also decreased for this species. Mean density differed significantly among years at all sites. At Hudson it dropped from 0.03 to 0.00. At Marine2, it was not found living in quadrat samples during 1995-96 and 2000 but had a density of 0.29 during 1988. At Interstate, it dropped from 1.02, 0.62, and 0.05 during 1988, 1995-96 and 2000, respectively.

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INTRODUCTION

This report briefly summarizes year 2000 results of continuing long-term monitoring of freshwater mussels in the St. Croix River. This monitoring was begun in 1988 when five locations on the St. Croix and Namekagon rivers were sampled (see Heath and Rasmussen, 1990). During 1995 and 1996, four of the five monitoring sites were re-sampled (Doolittle and Heath, 1997; Doolittle, Heath and Rasmussen, 1995). In year 2000, three of the five long-term monitoring locations were re-sampled including Hudson, Marine2 and Interstate. The purpose of this investigation was to repeat the sampling protocols used in 1988 and compare results through time.

METHODS AND MATERIALS

A complete description of monitoring site locations, terminology and sampling methods are included in Heath and Rasmussen, 1990. In summary, at each of the three monitoring sites we took randomly-placed 1m² quadrat samples, counted living and dead unionids, margaritiferids, *Corbicula* and *Dreissena*, measured and aged them, counted both living and dead and determined gravidity status. In addition to quadrat sampling, we randomly collected larger numbers of mussels (relative abundance collections) to complement comparisons of relative abundance and age and total length distributions between years and sites. Finally, special microhabitats were searched for rare species. The dates sampled at each of the 5 study areas are given below.

Interstate: 12-15 June 2000.

Marine 2: 19-20 June 2000.

Hudson: 24-26 July 2000.

RESULTS AND DISCUSSION

TAXA RICHNESS

The cumulative number of taxa collected using methods whose results are representative of the community (i.e. quadrat and relative abundance collection methods) is influenced by the total number of individuals collected. Considering this, taxa richness has not changed much at the three sites among years except for possibly Interstate (Table 1). At Interstate, richness of living individuals has steadily declined since 1988 despite increasing sample sizes.

NUMERICAL RELATIVE ABUNDANCE

Few trends in numerical relative abundance were apparent. At most, three trend points were available and therefore, these "trends" should be interpreted cautiously. More definitive trends can be established using six temporal points.

At all three monitoring sites, only one taxa, *Truncilla donaciformis*, uniformly decreased in abundance (Tables 2-4). This species declined 5.9 percentage points

at Interstate, 3.3 at Marine2 and 0.5 at Hudson. Data from the Hudson site included only two temporal points, unlike Interstate and Marine2, which had three. Therefore, *T. donaciformis* trends at Hudson are less certain. If we include work done in 1996 (Ecological Specialists, Inc. 1997), a declining trend at Hudson, and therefore the entire lower St. Croix River is apparent. The relative abundance at Hudson during 1988 was 0.49%, 0.006% in 1996 and 0.0% in 2000.

POPULATION DENSITY

Arithmetic population densities for the three monitoring sites are given in Tables 5-7. Summaries of tests of significance among all years for the mean of the natural log transformed data for total mussels and taxa subgroups are given in Table 8.

Total mussel population densities at each monitoring site were not significantly different among years except for the years 1988 and 1995-96 at the Marine2 site (Table 8). Between these years, total mussel density dropped from 6.26/m² to 2.35. During 2000 the density was 3.04 and was not different from 1995-96.

Taxa subgroups which include "sensitive", "indifferent" and "exploitive" changed between some years at some locations (for definitions, see Heath & Rasmussen. 1990). Mean density of "sensitive" taxa at Marine2 were different between 1988 and 1995-96 (0.81 and 0.22, respectively). The density in 2000 was not different from either year (0.58).

Indifferent taxa densities changed only at Marine2 and not at Interstate or Hudson. The density in 1988 (5.1) was different than 1995-96 (1.91) and 2000 (2.12).

Mean densities among years for "exploitive" taxa were different only at Interstate. The density in 2000 (0.38) was different than the densities in 1988 (0.21) and 1995-96 (0.11).

The federally endangered *Quadrula fragosa*, which was found only at Interstate, had a mean population of 0.02/m² during 2000. Mean densities were not significantly different among all three years.

The federally endangered *Lampsilis higginsii* was found in quadrat samples at Interstate and Hudson. In 2000, the mean density at Interstate was 0.01/ m² and 0.09/m² at Hudson. Densities were not significantly different among years at both sites.

Mean density of *T. donaciformis* in number/m² differed significantly among years at all sites. At Hudson it dropped from 0.03 to 0.00. At Marine2, it was not found living in quadrat samples during 1995-96 and 2000 but had a density of 0.29 during 1988. At Interstate, it dropped from 1.02, 0.62, and 0.05 during 1988, 1995-96 and 2000, respectively.

POPULATION ESTIMATES OF FEDERALLY ENDANGERED SPECIES

Based on mean arithmetic density estimates for all years combined and monitoring site surface area, we generated population size estimates for each federally endangered species at both Hudson and Interstate. At Hudson, there was a mean of 9224 (95% CI = 4192-14,255) individuals of *L. higgins*. At Interstate there were 4212 *L. higgins* individuals (95% CI = 538-7886) and 8424 (95% CI = 3261-13,587) *Q. fragosa*. Neither of these species has appeared in quadrat samples at Marine2.

LIVING/DEAD AND SEX RATIOS

At Interstate, four taxa had decreasing living/dead ratio trends from 1988. 1995-96 and 2000 (Table 9). These taxa were *Epioblasma triquetra*, *Fusconaia flava*, *Obovaria olivaria*, and *T. donaciformis*. One taxa, *Tritogonia verrucosa* had an increasing trend. There was no apparent three-year trend for all other taxa.

At Marine2, one taxa had a decreasing living/dead ratio trend from 1988. 1995-96 and 2000. This was *T. donaciformis*. There was no apparent three-year trend for all other taxa.

We were only able to calculate sex ratio (# of females/# of males) for six taxa. These taxa were *Ellipsaria lineolata*, *Epioblasma triquetra*, *L. higgins*, *L. siliquoidea*, *L. cardium*, *Ligumia recta*, and *T. verrucosa* (Table 10). Only *E. lineolata* at Interstate showed a three-year declining trend of females relative to males.

POPULATION LENGTH AND AGE STRUCTURES

We used the first quartile (Q₁) of the length distribution as a measure of relative recruitment. The first quartile is that length below which the lowest 25% of the lengths lie. In a year of good young-of-the-year recruitment, the Q₁ should be small because of the large proportion of small individuals; in a year of low recruitment, on the other hand, the Q₁ should be larger because of the small proportion of small individuals.

Some taxa at some locations had a three-year Q₁ trend (Table 11). At Interstate, *F. flava*, *L. cardium*, *Obliquaria reflexa*, *T. verrucosa* and *Truncilla truncata* had increasingly greater Q₁ from 1988 to 2000. Q₁ increased for *Elliptio dilatata* and *Leptodea fragilis* at Marine2. These suggest gradually decreasing relative young-of-the-year recruitment. Decreasing Q₁ were seen for *L. fragilis* at Interstate, and *Q. p. pustulosa* at Marine2 suggesting increasing young-of-the-year recruitment relative to adults.

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Table 1. Living and Dead Taxa Richness, 1988-2000. (n) = number of individuals.

Site	1988		1995-96		2000	
	Live	Dead	Live	Dead	Live	Dead
Hudson	29 (1448)	35 (1211)	NA	NA	27 (996)	30 (897)
Marine2	25 (620)	29 (270)	24 (390)	28 (76)	23 (475)	28 (199)
Interstate	29 (1857)	30 (1122)	26 (2403)	26 (1095)	27 (2942)	27 (2026)

Table 2. Interstate Monitoring Site 1988 - 2000 Numerical % Relative Abundances.

TAXA	1988	1996	2000	3 Yr Trend
<i>Quadrula fragosa</i>	0.1678	0.1665	0.102	Decreasing
<i>Truncilla donaciformis</i>	6.1521	3.8702	0.2711	Decreasing
<i>Lampsilis cardium</i>	0.783	0.7907	1.2877	Increasing
<i>Leptodea fragilis</i>	0.783	1.3317	1.457	Increasing
<i>Cyclonaias tuberculata</i>	1.4541	1.4981	1.9999	Increasing
<i>Tritogonia verrucosa</i>	1.7338	1.7478	1.9315	Increasing
<i>Obovaria olivaria</i>	1.7897	1.9559	2.4737	Increasing
<i>Actinonaias ligamentina carinata</i>	2.0694	3.3292	3.3548	Increasing
<i>Lasmigona complanata complanata</i>		0.0832	0.2711	Increasing
<i>Lampsilis siliquoidea</i>	0	0.0416		no trend
<i>Simpsonaias ambigua</i>	0			no trend
<i>Anodonta grandis form corpulenta</i>	0.0559	0.0832	0.0339	no trend
<i>Anodonta imbecillis</i>	0.0559			no trend
<i>Potamilus ohioensis</i>	0.0559			no trend
<i>Ligumia recta</i>	0.1119	0.2497	0.1694	no trend
<i>Lampsilis higginsii</i>	0.1678		0.0678	no trend
<i>Lasmigona costata</i>	0.1678	0.2497	0.1694	no trend
<i>Strophitus undulatus undulatus</i>	0.2796	0.2081	0.3728	no trend
<i>Amblema plicata plicata</i>	1.2304	0.541	1.6266	no trend
<i>Alasmidonta marginata</i>	1.2864	0.6242	0.9488	no trend
<i>Potamilus alatus</i>	1.3423	0.9988	1.3216	no trend
<i>Ellipsaria lineolata</i>	1.3982	1.3317	1.8638	no trend
<i>Obliquaria reflexa</i>	2.4049	1.0404	1.9315	no trend
<i>Pleurobema coccineum</i>	2.7964	2.6633	3.4226	no trend
<i>Quadrula metanevra</i>	2.9642	2.2056	2.2026	no trend
<i>Epioblasma triquetra</i>	3.8031	4.6192	3.2870	no trend
<i>Fusconaia flava</i>	4.0268	3.7453	3.9309	no trend
<i>Elliptio dilatata</i>	5.0336	2.5385	2.7787	no trend
<i>Quadrula pustulosa pustulosa</i>	6.5436	6.8664	6.5063	no trend
<i>Truncilla truncata</i>	51.3423	57.2201	56.1843	no trend
<i>Cumberlandia monodonta</i>			0.0339	no trend

Table 3. Marine2 Monitoring Site 1988 - 2000 Numerical % Relative Abundances.

TAXA	1988	1996	2000	3 Yr Trend
<i>Epioblasma triquetra</i>	0.1692	0	0	Decreasing
<i>Alasmidonta marginata</i>	0.6768	0.5128	0.4211	Decreasing
<i>Truncilla donaciformis</i>	3.5533	0.2564	0.2105	Decreasing
<i>Lasmigona costata</i>	0	0	0.4211	Increasing
<i>Obovaria olivaria</i>	0	0.2564	0.6316	Increasing
<i>Tritogonia verrucosa</i>	4.3993	7.6923	8.8421	Increasing
<i>Elliptio dilatata</i>	12.0135	14.6154	17.8947	Increasing
<i>Lampsilis higginsi</i>	0	0	0.2105	Increasing
<i>Actinonaias ligamentina carinata</i>	4.9069	6.9231	4.2105	No trend
<i>Cyclonaias tuberculata</i>	0.1692	0.2564	0	No trend
<i>Ellipsaria lineolata</i>	0.1692	0.2564	0	No trend
<i>Potamilus ohioensis</i>	0.1692	0.2564	0.2105	No trend
<i>Anodonta grandis form corpulenta</i>	0.3384	0.7692	0.4211	No trend
<i>Ligumia recta</i>	0.3384	0.5128	0.2105	No trend
<i>Obliquaria reflexa</i>	0.6768	0.2564	1.0526	No trend
<i>Lasmigona complanata complanata</i>	1.0152	1.2821	0.4211	No trend
<i>Pleurobema coccineum</i>	1.0152	0.2564	2.7368	No trend
<i>Lampsilis cardium</i>	1.3536	2.8205	0.6316	No trend
<i>Quadrula metanevra</i>	2.0305	1.0256	2.1053	No trend
<i>Strophitus undulatus undulatus</i>	3.2149	1.2821	1.4737	No trend
<i>Quadrula pustulosa pustulosa</i>	3.5533	3.3333	4.2105	No trend
<i>Potamilus alatus</i>	4.5685	9.2308	6.3158	No trend
<i>Amblyma plicata plicata</i>	5.9222	15.8974	5.8947	No trend
<i>Leptodea fragilis</i>	9.9831	11.0256	9.4737	No trend
<i>Truncilla truncata</i>	12.6904	3.8462	13.2632	No trend
<i>Cumberlandia monodonta</i>	0	0.2564	0	No trend
<i>Fusconaia flava</i>	27.0728	17.1795	18.7368	No trend

Table 4. Hudson Monitoring Site 1988, 2000 Numerical % Relative Abundances.

TAXA	1988	2000
<i>Cyclonaias tuberculata</i>	0.3494	0
<i>Truncilla donaciformis</i>	0.4892	0
<i>Anodonta grandis form corpulenta</i>	1.3976	0.8008
<i>Alasmidonta marginata</i>	0	0.1001
<i>Lasmigona costata</i>	0	0.1001
<i>Actinonaias ligamentina carinata</i>	0.2096	0.6006
<i>Lasmigona complanata complanata</i>	0.0699	0
<i>Simpsonaias ambigua</i>	0.0699	0
<i>Magnonaias nervosa</i>	0.1398	0.2002
<i>Ligumia recta</i>	0.2096	0.1001
<i>Anodonta imbecillis/s</i>	0.3494	0.2002
<i>Corbicula fluminea</i>	0.4193	0.4004
<i>Lampsilis siliquoidea</i>	0.559	0.7007
<i>Lampsilis cardium</i>	0.559	1.6016
<i>Quadrula quadrula</i>	0.6289	0.6006
<i>Tritogonia verrucosa</i>	0.6289	0.2002
<i>Ellipsaria lineolata</i>	0.6988	1.2012
<i>Leptodea fragilis</i>	0.7687	0.4004
<i>Strophitus undulatus undulatus</i>	0.9085	0.5005
<i>Lampsilis higginsii</i>	1.188	1.3013
<i>Potamilus alatus</i>	1.2579	2.8028
<i>Quadrula metanevra</i>	1.3277	0.8008
<i>Quadrula pustulosa pustulosa</i>	3.9832	4.7047
<i>Truncilla truncata</i>	4.8218	1.9019
<i>Pleurobema sintoxia</i>	5.0314	5.4054
<i>Fusconaia flava</i>	11.3208	14.3143
<i>Obliquaria reflexa</i>	11.4605	10.6106
<i>Elliptio dilatata</i>	13.9762	10.2102
<i>Amblema plicata plicata</i>	37.1768	39.8398
<i>Arcidens confragosus</i>	0	0.1001
<i>Dreissena polymorpha</i>	0	0.3003

Table 5. Interstate arithmetic population density, 2000 (n= 150).

TAXON	Live #/m ²	Std Dev	Coef. Of Var.
<i>Actinonaias ligamentina carinata</i>	0.66	1.21	1.83
<i>Alasmidonta marginata</i>	0.19	0.47	2.50
<i>Amblema plicata plicata</i>	0.32	0.68	2.11
<i>Anodonta grandis form corpulenta</i>	0.01	0.08	12.25
<i>Cumberlandia monodonta</i>	0.01	0.08	12.25
<i>Cyclonaias tuberculata</i>	0.39	0.84	2.14
<i>Ellipsaria lineolata</i>	0.37	0.74	2.01
<i>Elliptio dilatata</i>	0.55	1.28	2.38
<i>Epioblasma triquetra</i>	0.65	0.98	1.51
<i>Fusconaia flava</i>	0.77	1.31	1.69
<i>Lampsilis cardium</i>	0.25	0.51	2.00
<i>Lampsilis higginsii</i>	0.01	0.12	8.63
<i>Lasmigona complanata complanata</i>	0.05	0.23	4.23
<i>Lasmigona costata</i>	0.03	0.18	5.40
<i>Leptodea fragilis</i>	0.29	0.74	2.60
<i>Ligumia recta</i>	0.03	0.18	5.40
<i>Obliquaria reflexa</i>	0.38	0.77	2.01
<i>Obovaria olivaria</i>	0.49	0.98	2.02
<i>Pleurobema coccineum</i>	0.67	1.12	1.66
<i>Potamilus alatus</i>	0.26	0.50	1.91
<i>Quadrula fragosa</i>	0.02	0.14	7.02
<i>Quadrula metanevra</i>	0.43	0.86	1.99
<i>Quadrula pustulosa pustulosa</i>	1.28	1.55	1.21
<i>Strophitus undulatus undulatus</i>	0.07	0.29	3.90
<i>Tritogonia verrucosa</i>	0.38	0.90	2.37
<i>Truncilla donaciformis</i>	0.05	0.23	4.23
<i>Truncilla truncata</i>	11.05	13.14	1.19
Total Mussels	19.67	18.42	0.94

Table 6. Marine2 arithmetic population density, 2000 (n= 50).

TAXON	Live #/m ²	Std Dev	Coef. Of Var.
<i>Actinonaias ligamentina carinata</i>	0.26	0.53	2.03
<i>Alasmidonta marginata</i>	0.04	0.20	4.95
<i>Amblema plicata plicata</i>	0.30	0.97	2.65
<i>Anodonta grandis form corpulenta</i>	0.00	0.00	.
<i>Ellipsaria lineolata</i>	0.00	0.00	.
<i>Elliptio dilatata</i>	0.46	0.81	1.96
<i>Epioblasma triquetra</i>	0.00	0.00	.
<i>Fusconaia ebena</i>	0.00	0.00	.
<i>Fusconaia flava</i>	0.54	1.03	1.92
<i>Lampsilis higginsii</i>	0.00	0.00	.
<i>Lampsilis cardium</i>	0.04	0.20	4.95
<i>Lasmigona complanata complanata</i>	0.04	0.20	4.95
<i>Lasmigona costata</i>	0.02	0.14	7.07
<i>Leptodea fragilis</i>	0.24	0.48	1.98
<i>Ligumia recta</i>	0.00	0.00	.
<i>Obliquaria reflexa</i>	0.04	0.20	4.95
<i>Obovaria olivaria</i>	0.02	0.14	7.07
<i>Pleurobema coccineum</i>	0.06	0.24	4.00
<i>Potamilus alatus</i>	0.18	0.43	2.64
<i>Quadrula metanevra</i>	0.08	0.27	3.43
<i>Quadrula pustulosa pustulosa</i>	0.10	0.30	3.03
<i>Simpsonaias ambigua</i>	0.00	0.00	.
<i>Strophitus undulatus undulatus</i>	0.08	0.27	3.43
<i>Tritogonia verrucosa</i>	0.18	0.48	2.68
<i>Truncilla donaciformis</i>	0.00	0.00	.
<i>Truncilla truncata</i>	0.36	0.60	1.66
Total Mussels	3.04	3.77	1.24

Table 7. Hudson arithmetic population density, 2000 (n= 152).

TAXON	Live #/m ²	Std Dev	Coef. Of Var.
<i>Actinonaias ligamentina carinata</i>	0.04	0.20	4.95
<i>Alasmidonta marginata</i>	0.01	0.08	12.33
<i>Amblema plicata plicata</i>	2.62	3.22	1.23
<i>Anodonta grandis form corpulenta</i>	0.05	0.25	4.79
<i>Anodonta imbecillis</i>	0.01	0.11	8.69
<i>Arcidens confragosus</i>	0.01	0.08	12.33
<i>Corbucula fluminea</i>	0.03	0.16	6.10
<i>Dreissena polymorpha</i>	0.02	0.14	7.07
<i>Ellipsaria lineolata</i>	0.08	0.32	4.00
<i>Elliptio dilatata</i>	0.67	2.02	3.00
<i>Fusconaia ebena</i>	0.00	0.00	.
<i>Fusconaia flava</i>	0.94	1.62	1.72
<i>Lampsilis cardium</i>	0.11	0.37	3.48
<i>Lampsilis higginsii</i>	0.09	0.30	3.55
<i>Lampsilis siliquoidea</i>	0.05	0.21	4.57
<i>Lasmigona complanata complanata</i>	0.00	0.00	.
<i>Lasmigona costata</i>	0.01	0.08	12.33
<i>Leptodea fragilis</i>	0.03	0.16	6.10
<i>Ligumia recta</i>	0.01	0.08	12.33
<i>Magnonaias nervosa</i>	0.01	0.11	8.69
<i>Obliquaria reflexa</i>	0.70	1.26	1.80
<i>Pleurobema coccineum</i>	0.36	0.66	1.84
<i>Potamilus alatus</i>	0.18	0.45	2.45
<i>Quadrula metanevra</i>	0.05	0.22	4.26
<i>Quadrula pustulosa pustulosa</i>	0.31	0.67	2.18
<i>Quadrula quadrula</i>	0.04	0.20	4.95
<i>Strophitus undulatus undulatus</i>	0.03	0.18	5.44
<i>Tritogonia verrucosa</i>	0.01	0.11	8.69
<i>Truncilla donaciformis</i>	0.00	0.00	.
<i>Truncilla truncata</i>	0.13	0.35	2.81
Total Mussels	6.57	6.63	1.01

Table 8. Results of tests of significance among years (1988, 1995-96, 2000) for n-log transformed total mussel mean population density. Years with the same letter are not significantly different, NA= not applicable.

		Year	1988	1995-96	2000
Monitoring site	Interstate	Total mussel	A	A	A
		Sensitive	A	A	A
		Indifferent	A	A	A
		Exploitive	B	B	A
	Marine2	Total mussel	A	B	B
		Sensitive	A	B	AB
		Indifferent	A	B	B
		Exploitive	A	A	A
	Hudson	Total mussel	A	NA	A
		Sensitive	A	NA	A
		Indifferent	A	NA	A
		Exploitive	A	NA	A

Table 9. Living/Dead ratios, Interstate, Marine2 and Hudson Monitoring Sites, 1988-2000.

TAXON	Interstate			Marine2			Hudson	
	1988	1996	2000	1988	1995	2000	1988	2000
<i>A. g. form corpulenta</i>	1.00		0.50	1.00		0.00	2.00	1.60
<i>A. imbecillis</i>								
<i>A. l. carinata</i>	1.23	2.22	1.41	0.80	5.00	0.72	0.06	0.13
<i>A. marginata</i>	2.88		4.00	1.00	0.00	2.00	0.00	
<i>A. p. plicata</i>	1.83	0.76	2.09	1.50	11.00	7.50	1.31	2.71
<i>C. fluminea</i>							0.05	0.25
<i>C. tuberculata</i>	4.33	12.00	7.38				0.33	
<i>E. dilatata</i>	2.25	0.67	0.85	0.87	2.71	1.05	0.40	0.37
<i>E. lineolata</i>	8.33	2.29	6.88			0.00	0.43	1.71
<i>E. triquetra</i>	4.00	2.18	1.08			0.00		
<i>F. ebena</i>						0.00		
<i>F. flava</i>	2.77	1.96	1.73	1.32	1.48	0.52	0.59	1.93
<i>L. c. complanata</i>			2.00	2.00	.	.	0.00	0.00
<i>L. cardium</i>	0.70	4.75	2.71	1.00	.	0.18	0.43	0.80
<i>L. costata</i>		3.00	0.83	0.00	0.00	1.00	0.00	0.13
<i>L. fragilis</i>	1.27	32.00	3.91	2.00	4.50	1.20	0.43	0.44
<i>L. higginsii</i>						0.00	0.04	0.59
<i>L. recta</i>	0.40	1.00	0.31	2.00		0.00	0.06	0.08
<i>L. siliquoidea</i>	0.00			0.00			0.09	0.19
<i>M. nervosa</i>								0.67
<i>O. olivaria</i>	1.60	1.47	1.30	0.00	.	.	0.00	
<i>O. reflexa</i>	3.58	0.89	1.33	0.80	.	2.00	1.04	2.30
<i>P. alatus</i>	2.00	6.00	3.90	2.00	.	1.80	4.50	2.00
<i>P. ohioensis</i>				1.00	.		0.00	
<i>P. sintoxia</i>	2.38	2.37	3.48	0.67	0.33	0.75	0.56	1.29
<i>Q. fragosa</i>	0.43	1.00	0.75					
<i>Q. metanevra</i>	5.30	5.30	2.83	6.00	1.00	4.00	1.25	4.00
<i>Q. p. pustulosa</i>	4.03	1.60	1.75	1.20	0.78	0.28	0.34	2.14
<i>Q. quadrula</i>							1.25	1.20
<i>S. ambigua</i>	0.00			0.00		0.00		
<i>S. u. undulatus</i>	1.00	5.00	1.57	2.00	.	4.00	0.67	5.00
<i>T. donaciformis</i>	1.62	0.84	0.06	0.48	0.00	0.00	0.02	0.00
<i>T. parvus</i>					0.00		0.00	
<i>T. truncata</i>	1.37	2.79	1.43	0.85	0.00	0.50	0.28	0.28
<i>T. verrucosa</i>	3.10	3.82	4.38		5.00	9.00	2.00	0.67
All Taxa	1.7	2.19	1.46	1.15	1.69	0.77	0.42	1.11

Table 10. Female/male sex ratios, 1988-2000, Interstate, Marine2 and Hudson study areas.

Taxon	Interstate			Marine2			Hudson	
	1988	1995-96	2000	1988	1995-96	2000	1988	2000
<i>E. lineolata</i>	2.14	1.07	0.96				1.20	1.00
<i>E. triquetra</i>	0.74	1.88	0.24	0.00				
<i>L. higginsii</i>	0.50					0.00	1.00	1.17
<i>L. siliquoidea</i>	0.50						0.00	1.17
<i>L. cardium</i>	0.60	0.33	0.63	0.40	1.00	0.00	1.00	0.50
<i>L. recta</i>	0.00	0.20	0.00	0.00			0.00	0.00
<i>T. verrucosa</i>	0.90	1.69	1.20	0.83	1.50	0.95	4.00	0.00

Table 11. First quartile of Length Distribution (mm) for taxa with n > 30.

Taxon	Interstate			Marine2			Hudson	
	1988	1995-96	2000	1988	1995-96	2000	1988	2000
<i>A. l. carinata</i>	54	30	63					
<i>A. plicata</i>	66	35	57	103	110	93	42	56
<i>C. tuberculata</i>	50	50	49					
<i>E. lineolata</i>	40	48	45					
<i>E. dilatata</i>	15	66	47	71	95	99	94	87
<i>E. triquetra</i>	19	16	34					
<i>F. flava</i>	35	36	45	35	51	49	37	40
<i>L. cardium</i>	40	41	62					
<i>L. fragilis</i>	46	28	16	58	73	86		
<i>O. reflexa</i>	32	37	41				37	38
<i>O. olivaria</i>	47	50	43					
<i>P. sintoxia</i>	45	40	55				42	44
<i>P. alatus</i>	64	72	59	116	131	127		
<i>Q. metanevra</i>	64	42	67					
<i>Q. pustulosa</i>	47	38	42	71	58	55	52	53
<i>T. verrucosa</i>	51	71	85					
<i>T. donaciformis</i>	20	23	18					
<i>T. truncata</i>	28	34	39					