

Draft Report

Aquatic Plant Surveys on Gray's , Phelp's , and Carmans Bays, Lake Minnetonka, Minnesota for 2007 through 2010

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METHODS

At the request of the Minnesota Department of Natural Resources, the US Army Engineer Research and Development Center (ERDC) initiated plant surveys on Gray's, Phelp's, and Carman's Bay in June and September of 2007 to evaluate the plant communities and establish pretreatment data for future aquatic plant management demonstrations on Lake Minnetonka. The surveys were conducted by John Skogerboe, ERDC Eau Galle Aquatic Ecology Laboratory, Spring Valley, WI using a point intercept method (Madsen 1999).

Following herbicide treatments on the bays in 2008, 09, and 10, additional plant surveys were conducted post-treatment in June 2008-10 and in early September 2008-10 to evaluate the effect of herbicide treatments on the target exotic species, Eurasian watermilfoil and curlyleaf pondweed, and non -target native plant species. Herbicide treatments are shown in Table 1. Prior to conducting the first surveys, 50x50 m grids were established for all of the bays using Garmin MapSource Topo mapping software. The grids were downloaded onto GPS (Global Positioning System) equipment accurate to 3-6 m. Samples were collected using a 36-cm wide rake attached to a rope. At each sample point, the rake was thrown from the boat approximately 3 to 6 m and then raised up to the water surface. Each species captured by the rake was then recorded for each sample point. In these surveys, no attempt was made to discern the relative

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abundance of individual plant species; therefore, an individual rake toss that contained dense elodea and very sparse coontail would result in each species being recorded as present.

A summary of the point intercept plant data showing the percent frequency results collected for 2007-10 are presented in Tables 2-4 for Gray's, Phelp's, and Carman's Bays respectively.

Mean native species per point was calculated by dividing the number of native species observed at each point by number of points in the littoral zone (Tables 5-7). Frequency distributions of native species present at each point are depicted in histograms based on the points sampled for each sampling period in each bay (Figures 1-6).

Statistical Analyses

All data have been collected for 2007-2010 and are currently being analyzed. An additional report including statistical analyses and discussion of the data will be provided in the coming months.

References

Madsen, J.D. 1999. Point and line intercept methods for aquatic plant management . APCRP Technical Notes Collection (TN APCRP_M1-02), U.S. Army Engineer Research and Development Center, Vicksburg, MS 16 pp.

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Table 1. Descriptions of bay-wide treatments on Lake Minnetonka, 2008-2010.

Date treated	Bay	Target Plant(s)	Area treated (acres)	Herbicide	Target concentration
2008 May 14	Gray's	Eurasian watermilfoil & Curly-leaf pondweed	160	Triclopyr endothall	0.25 ppm 1.0 ppm
2008 May 13	Carman's	Eurasian watermilfoil & Curly-leaf pondweed	95	Triclopyr endothall	0.25 ppm 1.0 ppm
2008 May 14	Phelp's	Eurasian watermilfoil & Curly-leaf pondweed	150	Triclopyr endothall	0.25 ppm 1.0 ppm
2009 Jun 1	Gray's	Eurasian watermilfoil	123	triclopyr	1.0 ppm
2009 Jun 1	Phelp's	Eurasian watermilfoil	122	triclopyr	1.0 ppm
2010 Apr 19	Gray's	Curly-leaf pondweed	17	endothall	1.0 ppm
2010 Apr 26	Carman's	Eurasian watermilfoil	96	triclopyr	0.75 ppm
2010 Apr 26	Phelp's	Eurasian watermilfoil &	20	Triclopyr	0.75 ppm
2010 Apr 19		Curly-leaf pondweed	71	endothall	1.0 ppm

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Table 2. Summary of point intercept data collected for Gray's Bay (2007-2010).

Percent frequency results: Gray's Bay	Jun 07	Jun 08	Jun 09	Jun 10	Sep 07	Sep 08	Sep 09	Sep 10
Exotic submersed macrophytes (%)								
Eurasian watermilfoil (<i>Myriophyllum spicatum</i>)	86	50	37	45	86	54	1	57
Curly-leaf pondweed (<i>Potamogeton crispus</i>)	20	5	23	0	3	0	1	0
Native submersed macrophytes (%)								
water marigold (<i>Bidens beckii</i>)	1	1	6	7	1	2	6	10
coontail (<i>Ceratophyllum demersum</i>)	38	45	48	49	40	56	50	32
elodea (<i>Elodea canadensis</i>)	8	15	8	21	9	19	12	20
slender naiad (<i>Najas flexilis</i>)	5	21	33	24	2	35	31	34
big-leaf pondweed (<i>Potamogeton amplifolius</i>)	27	18	24	12	28	16	24	9
Illinois pondweed (<i>Potamogeton illinoensis</i>)	3	1	8	5	3	4	8	5
white-stem pondweed (<i>Potamogeton praelongus</i>)	7	1	2	0	8	0	2	2
small pondweed (<i>Potamogeton pusillus</i>)	10	2	0	0	5	2	0	0
clasping-leaf pondweed (<i>Potamogeton richardsonii</i>)	62	51	33	48	60	45	29	51
fern pondweed (<i>Potamogeton robbinsii</i>)	24	16	8	6	23	17	8	3
flat-stem pondweed (<i>Potamogeton zosteriformis</i>)	54	12	2	0	51	6	2	0
white water crowfoot (<i>Ranunculus longirostris</i>)	3	2	2	7	1	0	0	0
sago pondweed (<i>Stuckenia pectinata</i>)	19	13	14	25	21	16	14	34
wild celery (<i>Vallisneria americana</i>)	5	6	14	21	5	17	23	28
water star-grass (<i>Zosterella dubia</i>)	1	2	2	13	1	13	3	20
Native floating-leaf macrophytes (%)								
spatterdock (<i>Nuphar advena</i>)	4	4	3	4	5	4	2	1
fragrant water-lily (<i>Nymphaea odorata</i>)	7	6	6	8	7	7	3	5
Submersed macro-algae (%)								
Chara	13	3	14	39	8	11	12	27
Number of sample sites	258	262	274	262	258	264	274	261
Number of sample sites in littoral zone (depth ≤ 15 ft)	216	218	233	225	216	238	233	222
Percent points in littoral zone	84	83	85	86	84	90	85	83
Mean number of species per point (littoral zone)	4.0	3.2	2.9	3.4	3.8	3.2	2.3	3.4
Mean number of native species per point (littoral zone)	2.9	2.4	2.3	2.9	2.9	2.7	2.3	2.8
Number of plant species	20	20	20	19	20	18	20	18
Number of native plant species	18	18	18	17	18	17	18	17

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Table 3. Summary of point intercept data collected for Phelp's Bay (2007-2010).

Percent frequency results: Phelp's Bay								
	Jun 07	Jun 08	Jun 09	Jun 10	Sep 07	Sep 08	Sep 09	Sep 10
Exotic submersed macrophytes (%)								
Eurasian watermilfoil (<i>Myriophyllum spicatum</i>)	65	60	29	50	67	69	20	51
Curly-leaf pondweed (<i>Potamogeton crispus</i>)	36	1	40	0	5	7	3	0
Native submersed macrophytes (%)								
water marigold (<i>Bidens beckii</i>)	7	2	11	11	8	4	13	14
coontail (<i>Ceratophyllum demersum</i>)	52	56	46	54	55	69	53	47
elodea (<i>Elodea canadensis</i>)	1	3	9	22	2	5	6	19
northern milfoil (<i>Myriophyllum sibiricum</i>)	5	5	4	1	8	11	1	1
slender naiad (<i>Najas flexilis</i>)	13	8	23	33	10	21	26	33
big-leaf pondweed (<i>Potamogeton amplifolius</i>)	18	15	11	3	23	6	11	4
Illinois pondweed (<i>Potamogeton illinoensis</i>)	16	8	4	7	17	11	4	12
floating-leaf pondweed (<i>Potamogeton natans</i>)	1	1	2	3	1	1	3	2
white-stem pondweed (<i>Potamogeton praelongus</i>)	2	3	4	5	3	7	4	3
small pondweed (<i>Potamogeton pusillus</i>)	4	2	0	0	0	7	0	0
clasping-leaf pondweed (<i>Potamogeton richardsonii</i>)	27	23	23	14	29	24	23	20
fern pondweed (<i>Potamogeton robbinsii</i>)	3	3	2	1	3	1	2	0
flat-stem pondweed (<i>Potamogeton zosteriformis</i>)	37	10	3	1	40	17	4	2
white water crowfoot (<i>Ranunculus longirostris</i>)	5	5	16	24	1	0	5	6
grassy arrowhead (<i>Sagittaria graminea</i>)	<1	0	0	0	1	1	0	0
softstem bulrush (<i>Scirpus validus</i>) Submersed ?	1	1	1	3	1	1	1	3
sago pondweed (<i>Stuckenia pectinata</i>)	15	5	15	4	17	10	12	8
great bladderwort (<i>Utricularia vulgaris</i>)	2	2	6	4	2	2	7	19
wild celery (<i>Vallisneria americana</i>)	8	12	9	24	9	25	19	28
water star-grass (<i>Zosterella dubia</i>)	5	5	8	13	7	27	8	18
Native floating-leaf macrophytes (%)								
spatterdock (<i>Nuphar advena</i>)	7	5	8	5	7	5	3	6
fragrant water-lily (<i>Nymphaea odorata</i>)	19	18	12	12	21	22	10	10
Submersed macro-algae (%)								
Chara	3	1	11	18	2	2	8	6
Summary Statistics								
Number of sample sites	365	363	355	337	365	360	336	372
Number of sample sites in littoral zone (depth ≤ 15 ft)	257	255	252	229	257	255	235	237
Percent points in littoral zone	70	70	71	68	70	71	70	71
Mean number of species per point (littoral zone)	3.5	3.2	3.1	3.1	3.1	3.4	2.5	3.1
Mean number of native species per point (littoral zone)	2.5	2.2	2.3	2.6	2.7	2.7	2.2	2.6
Number of plant species	25	24	24	23	24	24	25	22
Number of native plant species	23	22	22	22	22	22	23	21

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Table 4. Summary of point intercept data collected for Carman's Bay (2007-2010)

Percent frequency results: Carman's Bay							
	Jun 07	Jun 08	Jun 10	Sep 07	Sep 08	Sep 09	Sep 10
Exotic submersed macrophytes (%)							
Eurasian watermilfoil (<i>Myriophyllum spicatum</i>)	58	59	74	60	72	77	70
Curly-leaf pondweed (<i>Potamogeton crispus</i>)	28	4	3	4	0	0	0
Native submersed macrophytes (%)							
water marigold (<i>Bidens beckii</i>)	4	1	8	4	10	8	13
coontail (<i>Ceratophyllum demersum</i>)	42	39	38	40	35	32	47
elodea (<i>Elodea canadensis</i>)	3	3	10	5	6	6	6
Northern milfoil (<i>Myriophyllum sibiricum</i>)	7	2	8	8	7	6	2
slender naiad (<i>Najas flexilis</i>)	12	3	22	10	24	18	21
big-leaf pondweed (<i>Potamogeton amplifolius</i>)	9	3	11	9	1	1	11
Illinois pondweed (<i>Potamogeton illinoensis</i>)	3	3	12	4	15	12	16
white-stem pondweed (<i>Potamogeton praelongus</i>)	2	1	3	2	4	3	2
small pondweed (<i>Potamogeton pusillus</i>)	2	1	0	1	1	1	0
clasping-leaf pondweed (<i>Potamogeton richardsonii</i>)	24	15	10	25	28	22	12
flat-stem pondweed (<i>Potamogeton zosteriformis</i>)	24	15	16	21	4	3	6
white water crowfoot (<i>Ranunculus longirostris</i>)	2	2	5	0	0	0	1
sago pondweed (<i>Stuckenia pectinata</i>)	17	10	10	20	16	13	5
great bladderwort (<i>Utricularia vulgaris</i>)	2	1	1	2	1	1	11
wild celery (<i>Vallisneria americana</i>)	4	5	16	6	23	16	23
water star-grass (<i>Zosterella dubia</i>)	7	5	19	7	26	20	21
Native floating-leaf macrophytes (%)							
fragrant water-lily (<i>Nymphaea odorata</i>)	10	13	12	10	14	11	14
Submersed macro-algae (%)							
Chara	7	6	12	6	14	11	15
Summary Statistics							
Number of sample sites	305	304	291	305	301	315	302
Number of sample sites in littoral zone (depth ≤ 15 ft)	181	175	172	181	170	212	179
Percent points in littoral zone	59	58	59	59	56	67	59
Mean number of species per point (littoral zone)	2.6	2.1	2.9	2.3	3.1	2.6	3.0
Mean number of native species per point (littoral zone)	1.8	1.3	2.2	1.7	2.3	1.9	2.3
Number of plant species	20	21	21	19	20	18	20
Number of native plant species	18	19	19	17	19	17	19

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Table 5. Mean native species per point (± 1 SE) for each sampling period (June, September) on Gray's Bay (2007-2010).

Mean native species per point				Mean native species per point			
<i>Jun 07</i>	<i>Jun 08</i>	<i>Jun 09</i>	<i>Jun 10</i>	<i>Sep 07</i>	<i>Sep 08</i>	<i>Sep 09</i>	<i>Sep 10</i>
2.77 ± 0.11	2.26 ± 0.10	2.30 ± 0.12	2.91 ± 0.13	2.84 ± 0.11	2.68 ± 0.11	2.23 ± 0.13	2.82 ± 0.13
n=217				n=217			

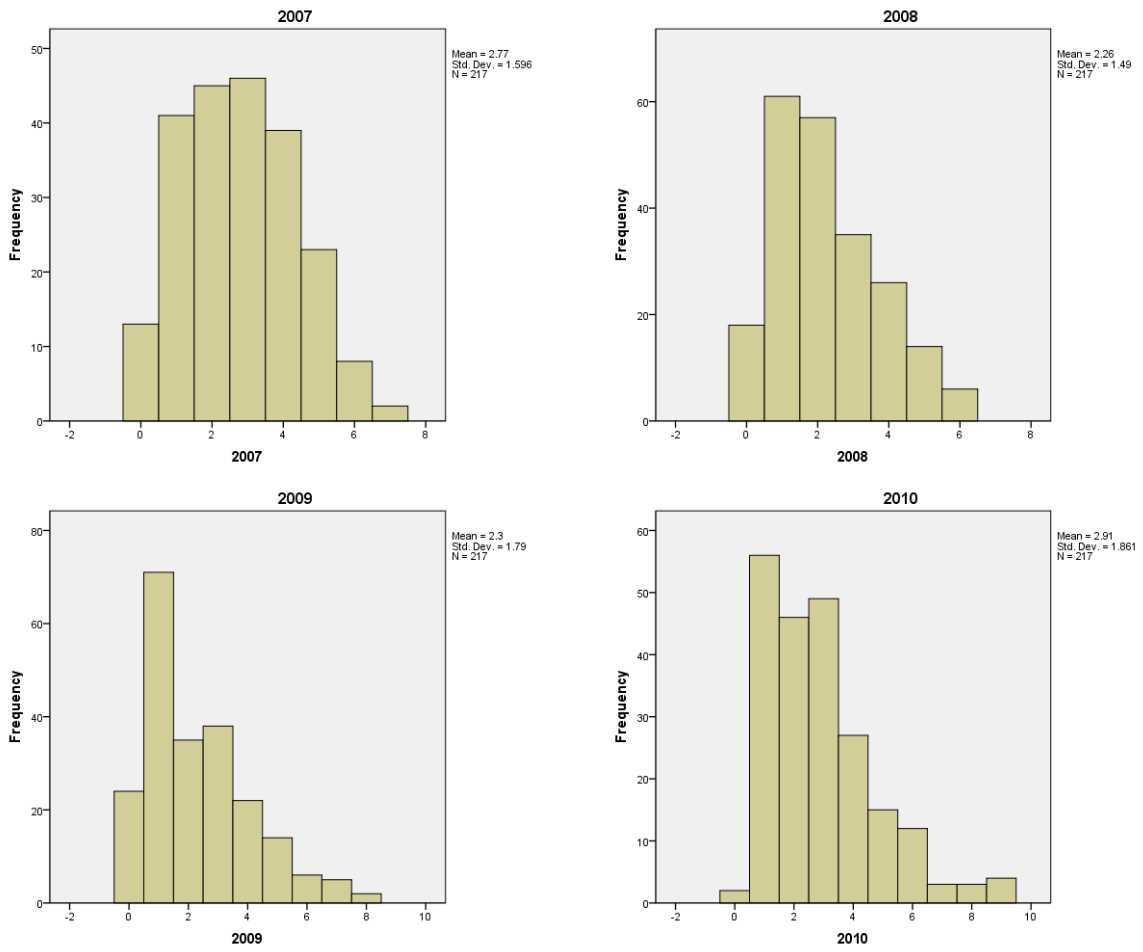


Figure 1. Frequency distribution of native species present at sample points in Gray's Bay during the June sampling period for 2007-2010 (n=217).

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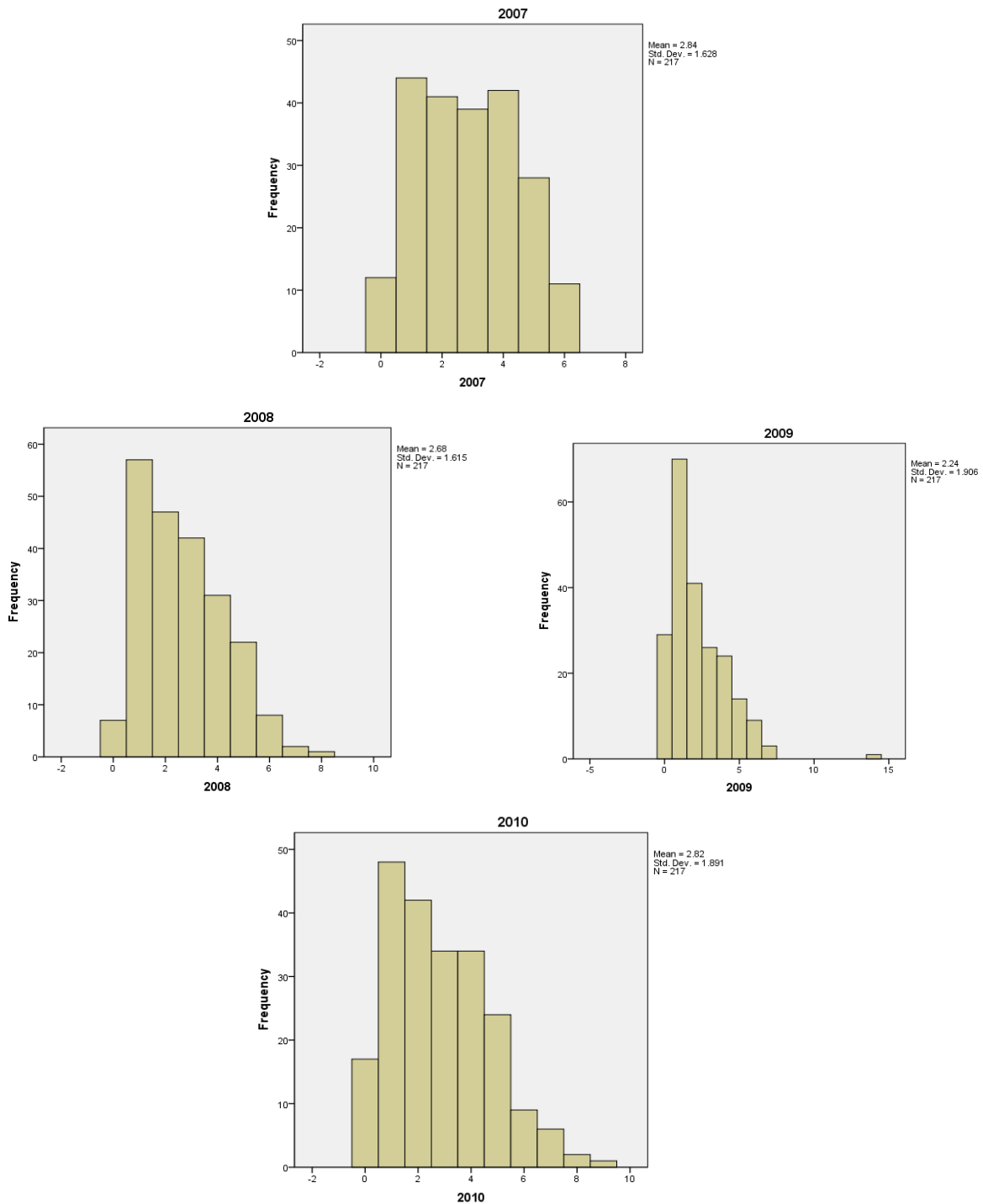


Figure 2. Frequency distribution of native species present at sample points in Gray's Bay during the September sampling period for 2007-2010 (n=217).

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Table 6. Mean native species per point (± 1 SE) for each sampling period (June, September) on Phelps's Bay (2007-2010).

Mean native species per point				Mean native species per point			
<i>Jun 07</i>	<i>Jun 08</i>	<i>Jun 09</i>	<i>Jun 10</i>	<i>Sep 07</i>	<i>Sep 08</i>	<i>Sep 09</i>	<i>Sep 10</i>
2.63 ± 0.14	2.07 ± 0.11	2.35 ± 0.13	2.65 ± 0.12	2.73 ± 0.14	2.64 ± 0.12	2.24 ± 0.13	2.64 ± 0.15
n=229				n=234			

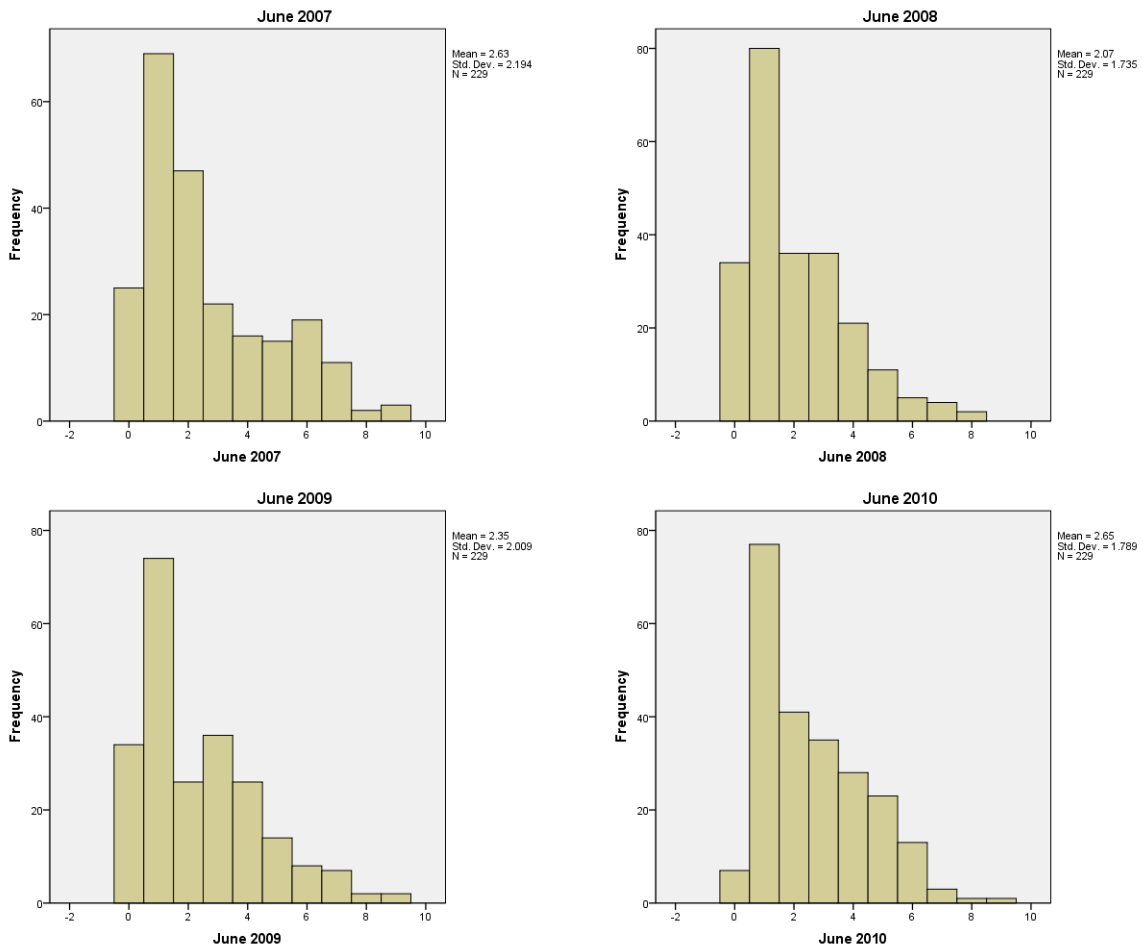


Figure 3. Frequency distribution of native species present at sample points in Phelps's Bay during the June sampling period for 2007-2010 (n=229).

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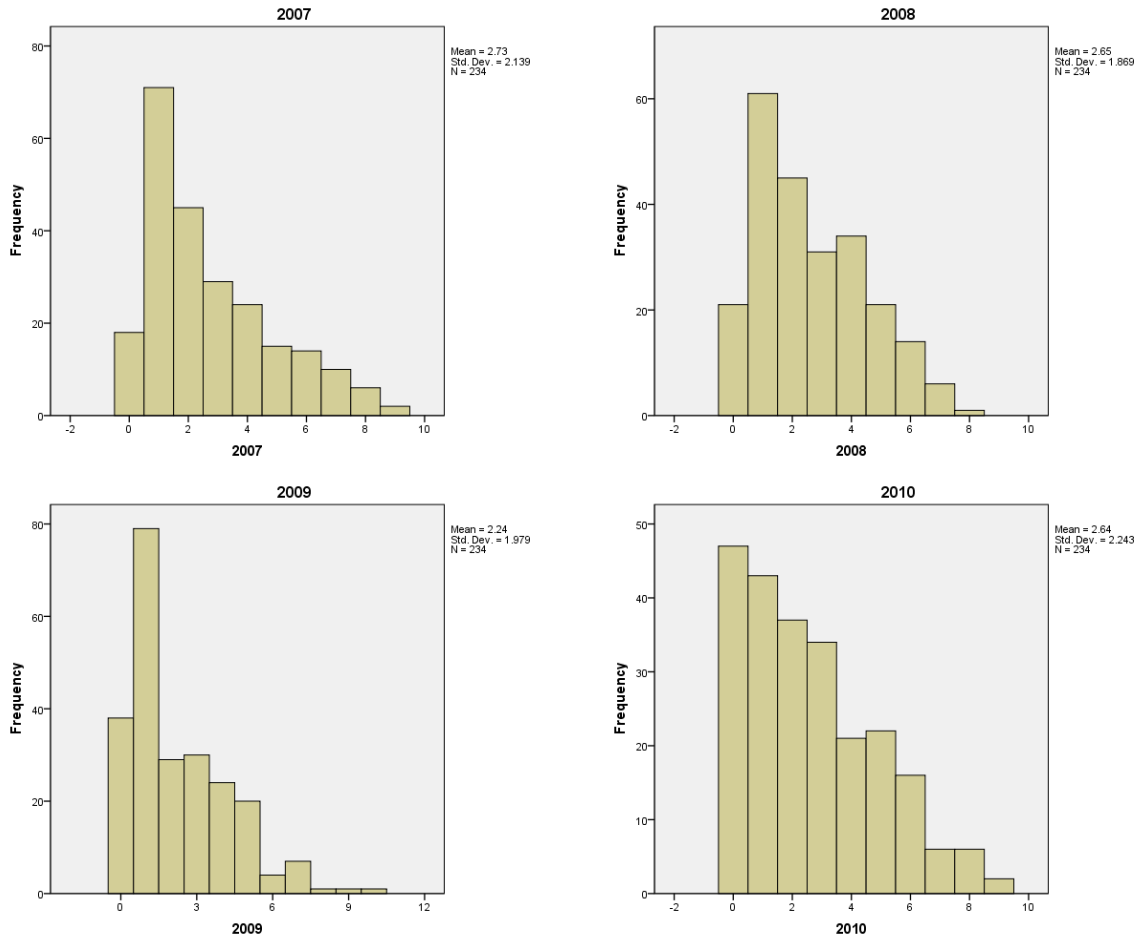


Figure 4. Frequency distribution of native species present at sample points in Phelps' Bay during the September sampling period for 2007-2010 (n=234).

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Table 7. Mean native species per point (± 1 SE) for each sampling period (June, September) on Carman's Bay (2007-2010).

Mean native species per point			Mean native species per point			
<i>Jun 07</i>	<i>Jun 08</i>	<i>Jun 10</i>	<i>Sep 07</i>	<i>Sep 08</i>	<i>Sep 09</i>	<i>Sep 10</i>
1.70 ± 0.15	1.33 ± 0.11	2.16 ± 0.17	1.75 ± 0.16	2.13 ± 0.17	2.14 ± 0.17	2.29 ± 0.18
n=172			n=165			

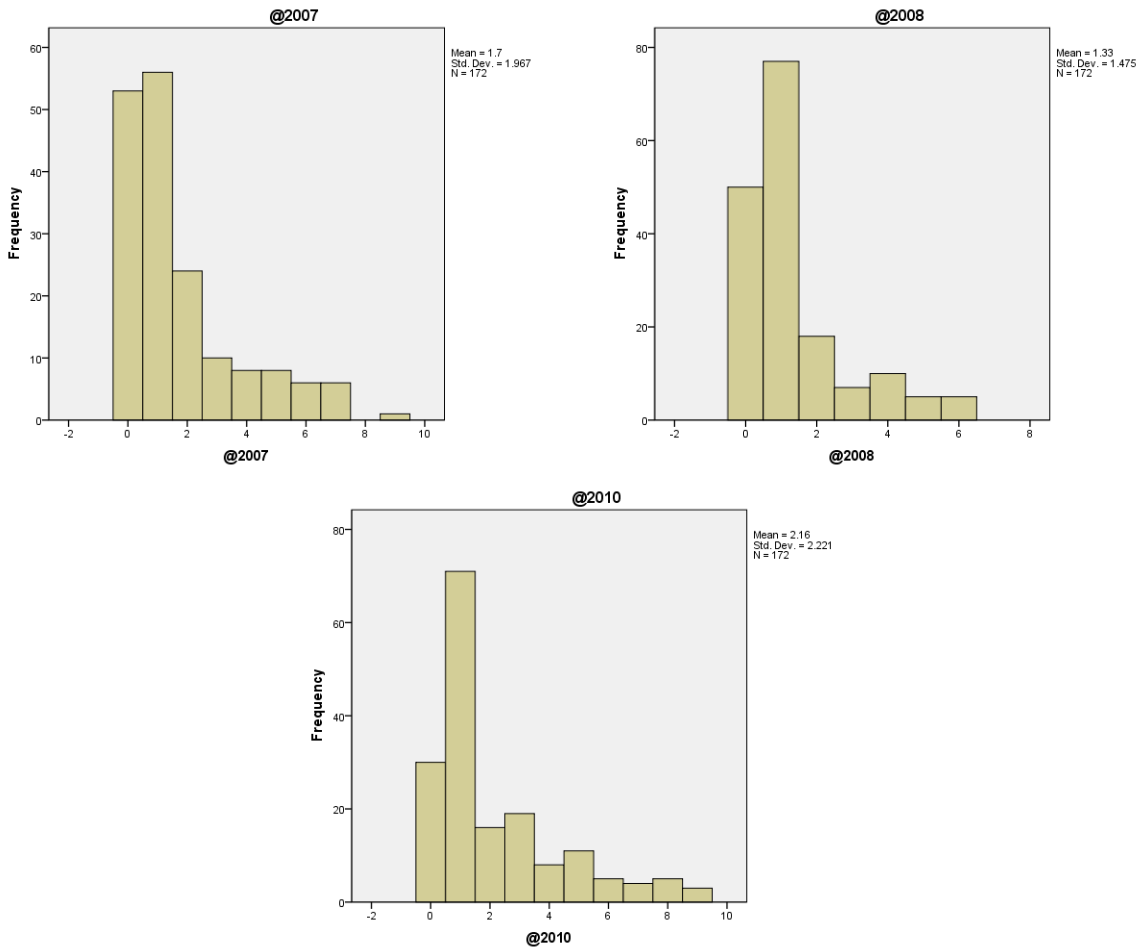


Figure 5. Frequency distribution of native species present at sample points in Carman's Bay during the June sampling period for 2007-2010 (n=172).

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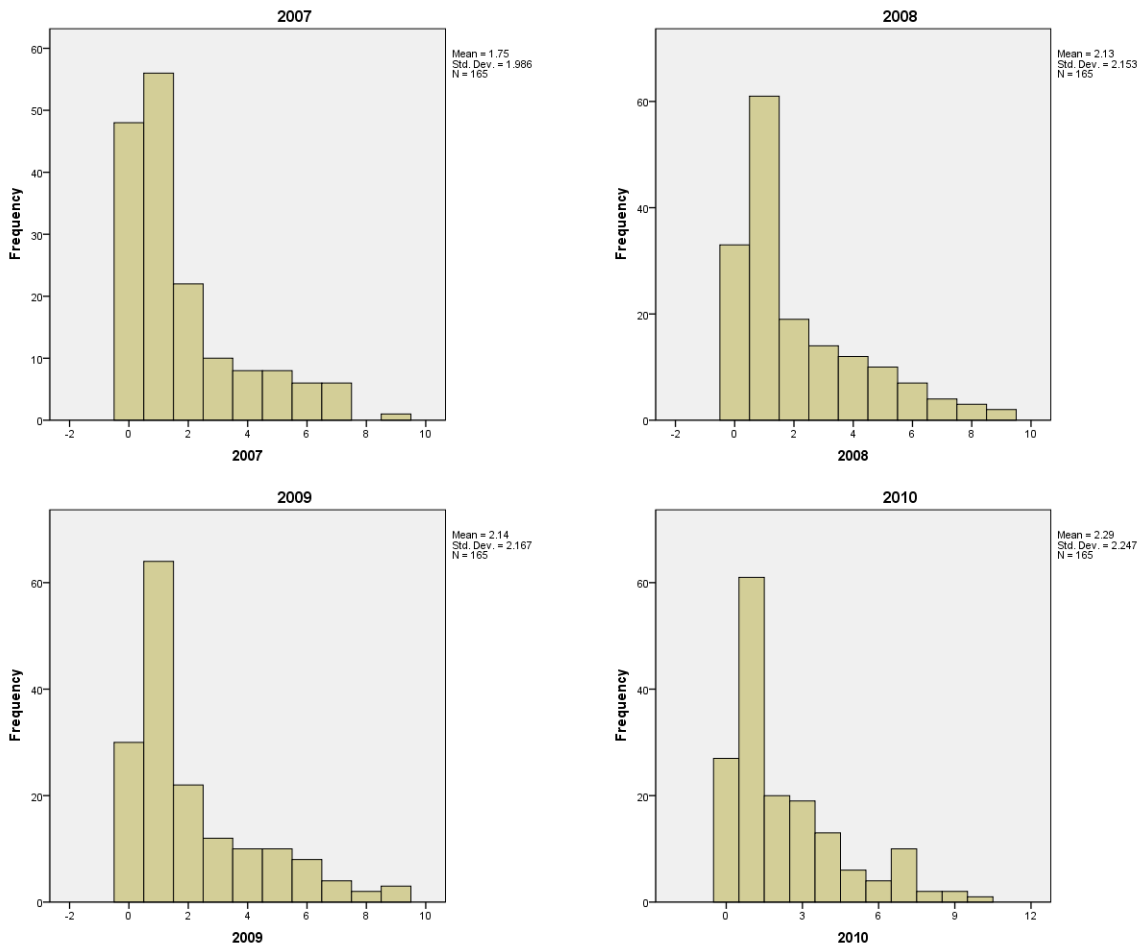


Figure 6. Frequency distribution of native species present at sample points in Carman's Bay during the September sampling period for 2007-2010 (n=165).