Cockle Cove Salt Marsh
Chatham, MA

Plant and Invertebrate Surveys
August 2005

Investigation Report
MA Office of Coastal Zone Management

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Carlisle, B.K. and J.P. Smith. 2005. Investigation Report : Plant and Invertebrate Surveys, Cockle Cove Salt Marsh, Chatham, MA, August 2005. MA Office of Coastal Zone Management, Boston.

Background

Massachusetts Office of Coastal Zone Management (CZM) offered assistance to the Department of Environmental Protection (DEP), the Town of Chatham (the Town), and the University of Massachusetts' School for Marine Science and Technology (SMAST) in their work on a baseline assessment of the salt marsh system in Cockle Cove and upper Bucks Creek. The assessment is part of a Total Maximum Daily Load (TMDL) process in order to the effects of nitrogen loading from a potential increase in discharge from the Town's wastewater treatment plant

CZM's portion of the assessment was a detailed survey of the plants on the marsh plain and a [semi-quantitative] survey of invertebrates on the creek bank. The methods and results are described in this report. The protocols for plants survey are consistent with those in the US Environmental Protection Agency-approved Cape Cod Salt Marsh Ecological Assessment Project Quality Assurance Project Plan: FINAL June 5, 2000, Massachusetts Coastal Zone Management.

Methods

Twelve transects were established as the basis to survey salt marsh vegetation and creek-bank aquatic macro-invertebrates. The location of the transects was determined according to the following protocol. The Cockle Cove system was segmented into three sections or evaluation areas. In each of the sections, four transects were placed, two on each side of a primary channel, for a total of 12 transects The transect locations were random, determined by generating a random integer between 0 and 100 according to a random number algorithm. The random integer was the percent of the total distance in meters of each evaluation section. Figure 1 shows a map of the Cockle Cove salt marsh site with the layout of the three sections and 12 randomly placed survey transects.

The transects were oriented to run from the bank to the upland edge. Along each transect, $1m^2$ plots were located at 20m intervals, with the first plot at the creek bank, and plots continuing until the end of the transect, generally in the marsh fringe or terrestrial transition border community. If the last plot in the 20m interval scheme fell outside the salt marsh wetland in the upland, the plot location was pulled back along the transect until it fell within the wetland and the new plot location was recorded.

In each plot, every plant (macrophytes) was identified to species and denoted on the field data sheet. For each species within the plot, the overall abundance in the $1m^2$ plot was determined by comparing the visual estimates of the two investigators and then applying a standard cover class value for nine coverage ranges. The standard cover class categories are contained in Appendix A. This cover class was recorded on the field data sheet. Coverage estimates included the following non-macrophyte items, cumulatively classified into the category "other": algae, wrack, dead plant litter, bare ground/mud, and open water.

Figure 1. Study site with evaluation areas, and location of random transects.

At each of the creek-bank 1m^2 plots on the twelve transects, a survey of aquatic macro-invertebrates was conducted according to the following protocol: All visible macro-invertebrates (i.e. crabs, snails, bivalves, amphipods and isopods) were identified to the lowest taxonomic level possible and each individual counted.

The survey was conducted on August 15th, 2005.

Observations and comments

Field work on the survey date (08/15/05) started at 08:00AM just before high tide. A team of two investigators spent an hour circum-navigating the marsh, considering the layout of the randomly generated transects and determining the points of access for the survey. Survey work started about 09:00AM at the upper marsh and the transects were surveyed from landward to seaward, ending about 04:00PM.

The Cockle Cove / Buck's Creek Salt Marsh would be considered to be a typical salt marsh of southern New England. Characterized by large areas of marsh plain intersected by natural sinuous creeks and manmade ditches, the salt marsh was comprised of the typical low marsh, high marsh, and marsh/terrestrial border communities. The site is surrounded on all sides by medium to high density residential development and two lane suburban access roads with little or no shoulder.

Some observations from the investigators included:

- ✓ At low tide, there is considerable freshwater flow in the creek channel network.
- ✓ There are some large panne areas in the lower marsh (the seaward end) that do not appear in the 2001 ortho imagery and could indicate recent trajectory toward marsh surface degradation.
- ✓ There are some stands of Phragmites australis—the largest being in the marsh "finger" on the east side. Transects 7 and 8 picked up only the edges of this large stand, so that the total abundance reported in the Results section is likely an under-representation (but statistically valid).
- ✓ There was a distinct, extremely strong odor of sulfur in this same area. Both investigators who regularly spend significant time conducting similar field work in Massachusetts salt marshes noted that this was particularly strong (offensive) and definitely not the characteristic "low tide" odor.
- ✓ Wildlife observations in the marsh and its buffer included a snapping turtle (and a turtle carcass), bullfrogs, shorebirds (least sandpiper, semi-palmated plover, semi-palmated sandpiper), black-backed gull, herring gull, least and common terns, and numerous songbirds and neo-tropical migrants.
- ✓ We were approached by numerous residents (and visitors) asking about our work. There was a definite sense of concern and appreciation for baseline study.

Results

The survey consisted of 12 transects and 39 total plots. 33 different species of plants were surveyed in the study plots. *Spartina alterniflora* (both tall and short forms) was the dominant species (17.3 % and 8.6% respectively), followed by the high marsh turf grasses, *Distichlis spicata* (8.4%) and *Spartina patens* (7.7%). Also in the top ten percent were the brackish *Typha angustifolia* (6.9%) and the invasive *Phragmites australis* (1.8%). The species list, total and percent total abundance values are listed in Table 1. The complete list of species and abundances by transect in included on Appendix B.

This site has a particularly high level of plant diversity for a salt marsh system which can be attributed to large numbers of brackish and terrestrial border species. Much of the marsh perimeter seems to be the interface for local water table, creating fresher edges where species like *Typha angustifolia*, *Scirpus pungens*, *Scirpus robustus*, and *Spartina cynosuroides* hold their niches. In addition, there are areas on the upper marsh plain behind the former dike (landward section including transects 1-4) where marsh elevation is obviously higher and supports salt marsh terrestrial border species like

Solidago sempirvirens, *Agropyron pungens*, *Panicum virgatum*, and *Festuca rubra*. No floating algal mats occurred in the survey plots, although a couple small mats were seen on the marsh plain and would not be considered to be of concern.

Table 1. Complete plant species list with total and percent cover abundances.

Genus species	Total Cover	Percent Cover
Spartina alterniflora	716	17.30
Spartina alterniflora (short form)	356	8.60
Distichlis spicata	346	8.36
Spartina patens	319	7.71
Typha angustifolia	286	6.91
Juncus gerardii	262	6.33
Solidago sempirvirens	232	5.61
Iva frutescens	125	3.02
Phragmites australis	76	1.84
Scirpus pungens	75	1.81
Agropyron pungens	61	1.47
Scirpus robustus	55	1.33
Toxicodendron radicans	44	1.06
Panicum virgatum	42	1.01
Agalinis maritime	29	0.70
Salicornia europaea	18	0.43
Suaeda linearis	18	0.43
Ilex verticilatta	15	0.36
Festuca rubra	14	0.34
Spartina cynosuroides	13	0.31
Parthenocissus quinquefolia	7	0.17
Rosa palustris	7	0.17
Atriplex patula	6	0.14
Galium tinctorium	4	0.10
Pluchea purpurascens	4	0.10
Althaea officinalis	3	0.07
Aster sp.	3	0.07
Calystegia sepium	3	0.07
Glaux maritima	3	0.07
Leersia oryzoides	3	0.07
Myrica gale	3	0.07
Plantago maritima	3	0.07
Limonium nashii	1	0.02
Polygonum punctatum	1	0.02
Other (bare ground, dead plant, water)	985	23.80

Only four taxa of macro-invertebrates were surveyed in the 12 study plots. The most common was the marsh snail, *Melampus bidentatus* (73.1%), with the ribbed mussel, *Geukensia demissa* (24.4%), essentially comprising the rest of the invertebrate

community. Several individual isopods and fiddler crabs (either *Uca pugilator* or *Uca pugnax*) were surveyed. It is important to note that the survey was on the marsh surface and vegetation only and did not include substrate removal. There was significant evidence of *Uca* burrows, but the presence of crabs in each burrow was not part of the scope of work and was not determined. The taxa list, total and percent total abundance values are listed in Table 2. The complete list of species and abundances by transect in included on Appendix C.

Table 2. Complete invertebrate taxa list with total and percent cover abundances.

Taxa	Total abundance	Percent Abundance
Melampus bidentus	510	73.07
Geukensia demissa	169	24.21
Uka sp	7	1.00
Unknown isopod	12	1.72

If there is serious concern regarding potential effects of increased nitrogen to the macro-invertebrate communities, we would recommend a more detailed survey be conducted and include substrate (sediment) samples from the creek bank and the creek bottom, along with water column samples during flood (mid-tide) conditions.

In an effort to examine the effects of two landscape patterns—the landward - seaward gradients and the creek bank - upland gradient—on the data, discriminate analyses were conducted. Multi-variate software (Primer, version 5.2.9) was used to run standard routines. Bray-Curtis similarity matrices were created for the plant data using the plots as the sample and then using transects as the sample. Using the Bray-Curtis similarity coefficients, a graphical representation of the results was generated. These multi-dimensional scaling (MDS) graphs show the similarities between samples plotted as the distance between points, so that the more similar two sample points are, the closer they will be together (and the more different the farther apart).

Figure 2 shows the MDS graph for the plant plots, with different symbols for the location of the plots: either low marsh (at the creek bank), high marsh (on the marsh platform or plain), or fringe (at the marsh/terrestrial border). Clearly there is more separation of the three groups (or communities) than shared area (note that two samples have been designated as outliers). This analysis demonstrates reasonable discrimination between the three marsh community types on a gradient from creek bank to upland edge.

In Figure 3 the MDS graph for the plant data using the transects as samples is shown. Here the value markers are shown for position on the marsh gradient from seaward to

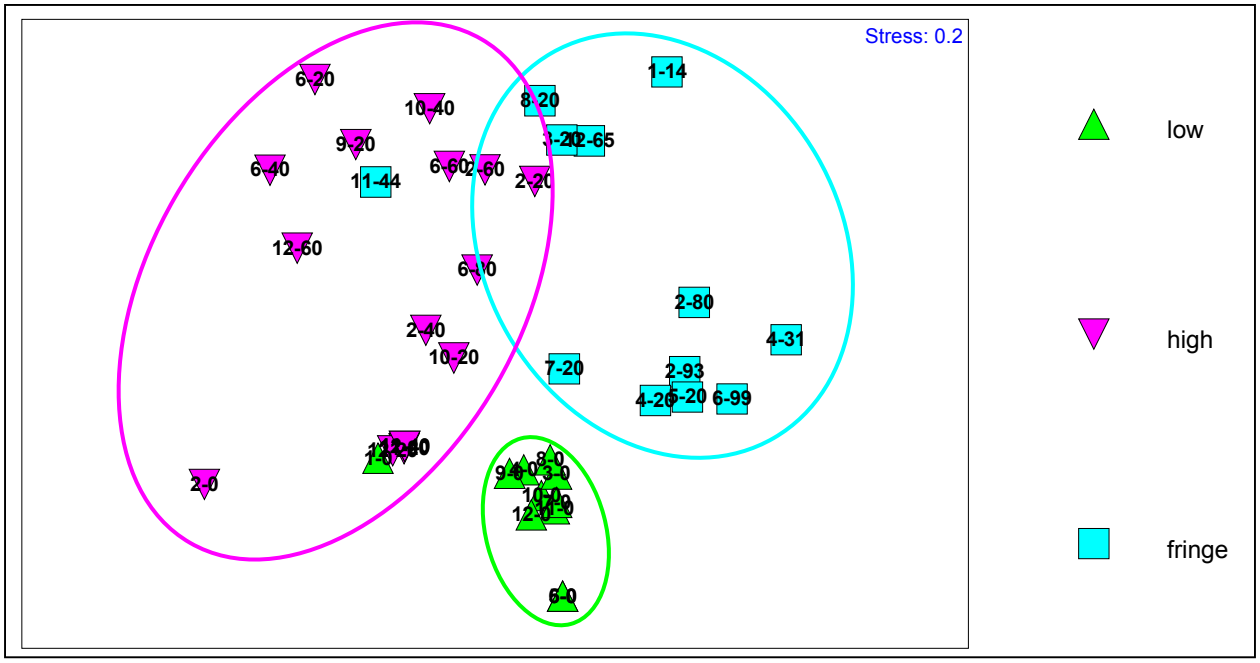


Figure 2. MDS graph of plant plots.

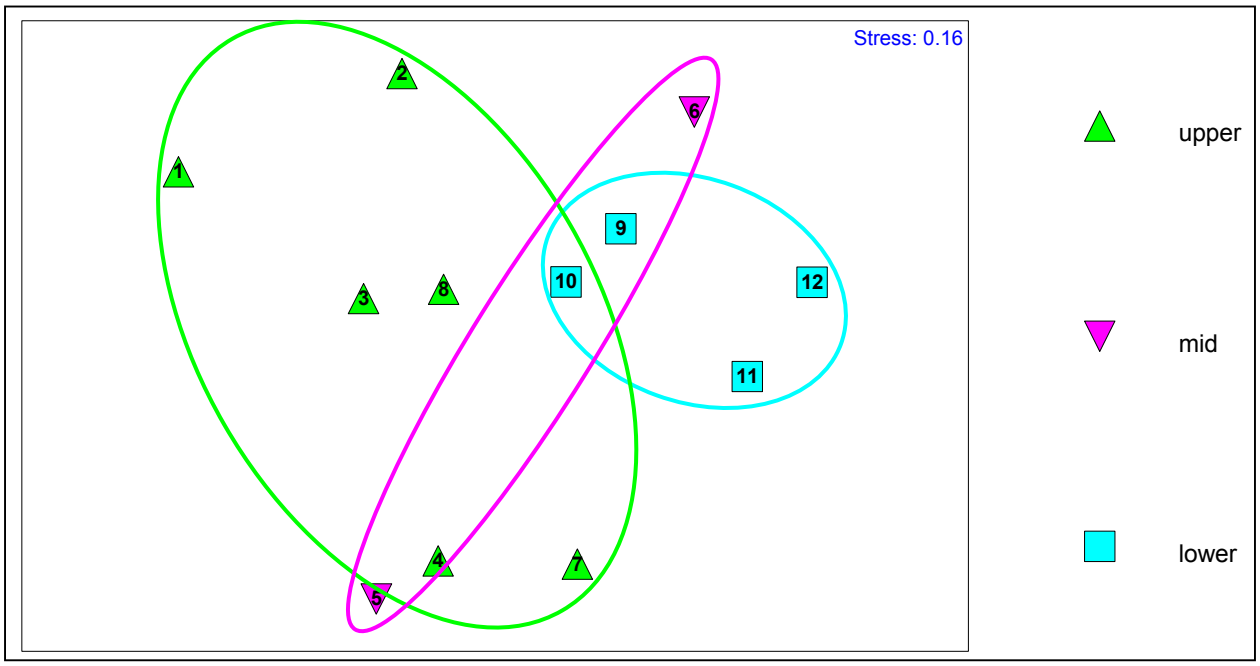


Figure 3. MDS graph of plant transects.

landward: either lower (for transects located in the seaward portion of the marsh), mid (for transects in middle of the marsh), and upper (for transects in the upper or landward portions). Here too, we do see separation between the upper and lower transects (excepting transect 10), but the analysis cannot discriminate mid-marsh located

transects however, with transect 5 having more similarity to the upper marsh transects and transect 6 to the lower.

For the invertebrates, since survey samples were only conducted at the creek-bank and not out onto the marsh plain, the discrimination would only be for marsh location on the seaward-landward gradient. Figure 4 shows the MDS graph for the invertebrate data using transect location as the discriminatory variable. Here, again, we see reasonable separation, with the exception of a lower marsh outlier (transect 9).

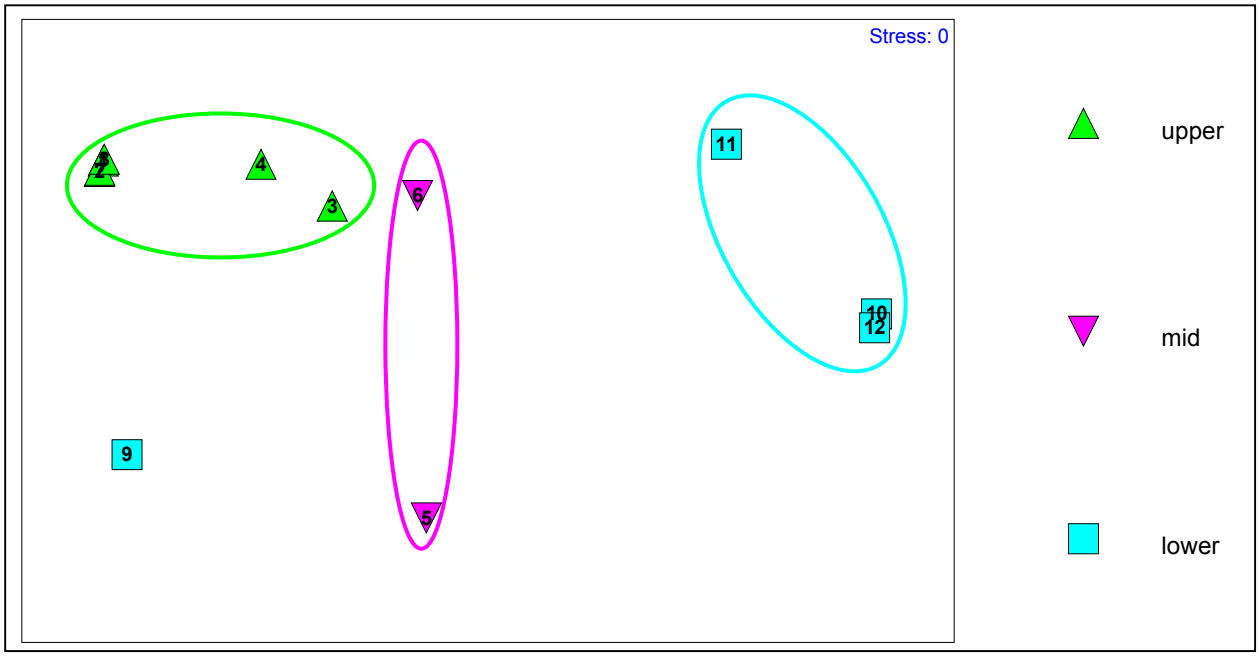


Figure 4. MDS graph of invertebrate transects.

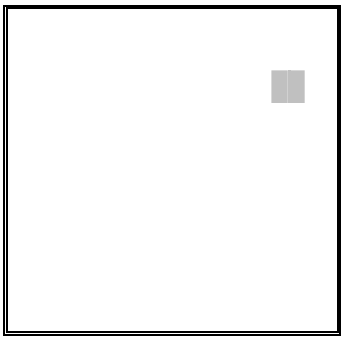
The practical application of this multi-variate analysis would be to see over time, with the effects of added nitrogen to the system, if the plant and invertebrate assemblages for plots and transects shifted. If the communities became more homogenous, say due to loss if species diversity and shift to greater abundance of *Spartina alterniflora*, *Phragmites australis*, or *Typha sp.*, we would see less separation both in terms of the creek bank - upland gradient as well as the seaward - landward gradient

In conclusion, we would not consider the site—in its current state—to be a degraded system. The plant data from our survey indicates a typical salt marsh system. Higher elevations on the upper (landward area) marsh plain and freshwater table seeps at the perimeters give the system a high number and moderate abundance of plant species. We would mention that there are two dynamics we'd recommend watching for: (1) the spread of the large *Phragmites* stand in the eastern "finger" and (2) the rate and extent of short-form *Spartina alterniflora* and unvegetated marsh pannes. We would recommend long-term monitoring (surveying) of the plant communities at a frequency of every 2-3 years.

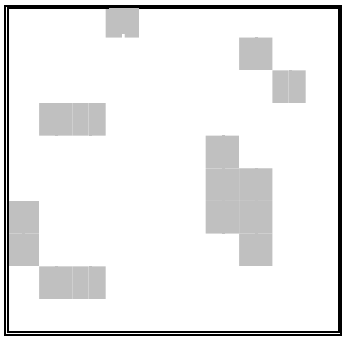
Appendix A:
Standard Cover Classes and Midpoints
For Salt Marsh Plant Survey

Salt Marsh Vegetation Survey
Standard Cover Classes and Midpoints for Estimating Abundance

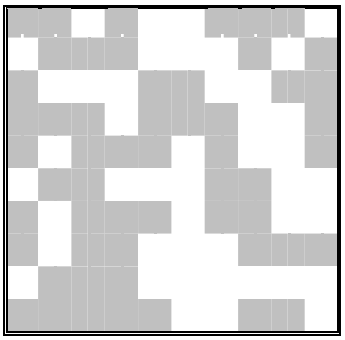
One method for obtaining abundance values for vegetation surveys is to estimate the percent of a plot occupied by the target plant. To assess percent cover, one estimates the area of the plot frame ($1m^2$) that is covered by all of the leaves, branches, and stems of the target species. Visual estimates may vary from one person to another. This variability can be significantly reduced by using standard cover classes and midpoint abundance values. The following figures illustrate 9 standard cover classes to use. For each plot, first identify and list the species present, then for each species determine which figure best describes its cover. Record the midpoint value on the data sheet.



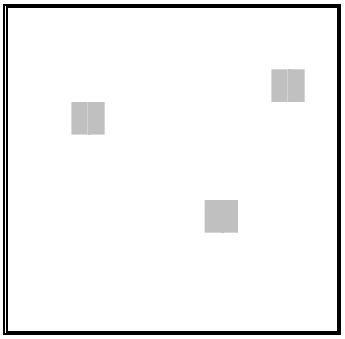
(Trace to 1%)
Use 1%



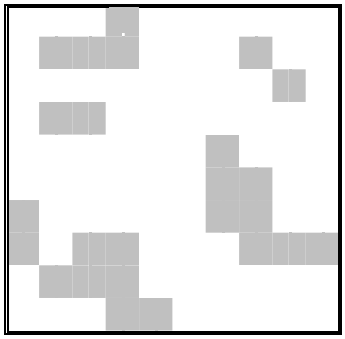
(11% to 19%)
Use midpoint 15%



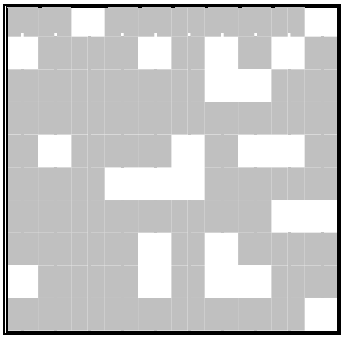
(46% to 64%)
Use midpoint 55%



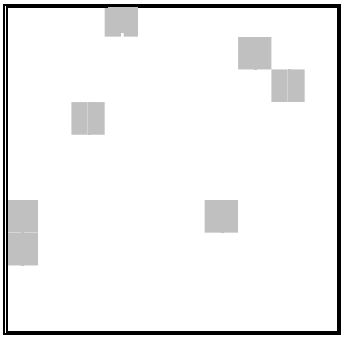
(2% to 4%)
Use midpoint 3%



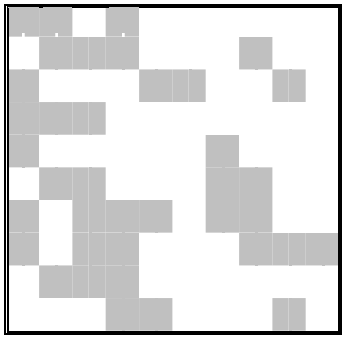
(20% to 30%)
Use midpoint 25%



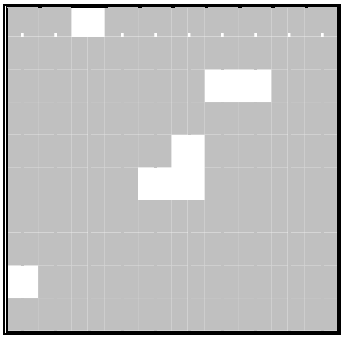
(65% to 87%)
Use midpoint 76%



(5% to 10%)
Use midpoint 7%



(31% to 45%)
Use midpoint 38%



(88% to 100%)
Use midpoint 94%

Appendix B:
Plant data: abundance values by transect

	Transects												Variability	
Genus species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**SD**	**SE**
Agalinis maritima	0	0	0	0	0	0	0	0	1	3	0	25	7.17	2.07
Agropyron pungens	0	0	3	0	0	0	0	0	0	0	3	55	15.76	4.55
Althaea officinalis	0	0	0	0	3	0	0	0	0	0	0	0	0.87	0.25
Aster sp.	0	0	0	0	0	0	0	0	0	0	0	3	0.87	0.25
Atriplex patula	0	3	0	0	0	0	0	0	3	0	0	0	1.17	0.34
Calystegia sepium	1	0	1	0	0	0	0	0	0	0	0	1	0.45	0.13
Distichlis spicata	0	85	3	0	0	228	0	7	3	10	7	3	67.05	19.36
Festuca rubra	0	3	0	0	0	0	0	7	3	1	0	0	2.17	0.63
Galium tinctorium	0	3	0	1	0	0	0	0	0	0	0	0	0.89	0.26
Glaux maritima	0	0	0	0	0	0	0	0	0	3	0	0	0.87	0.25
Ilex verticilatta	0	15	0	0	0	0	0	0	0	0	0	0	4.33	1.25
Iva frutescens	0	1	0	0	0	38	0	15	15	1	55	0	18.14	5.24
Juncus gerardii	0	3	0	0	0	83	0	0	76	38	7	55	32.29	9.32
Leersia oryzoides	0	0	0	3	0	0	0	0	0	0	0	0	0.87	0.25
Limonium nashii	0	0	0	0	0	0	0	0	0	0	0	1	0.29	0.08
Myrica gale	0	0	0	3	0	0	0	0	0	0	0	0	0.87	0.25
Other	22	129	30	95	45	95	110	40	40	68	156	155	48.18	13.91
Panicum virgatum	3	0	38	0	0	0	0	1	0	0	0	0	10.90	3.15
Parthenocissus quinquefolia	0	0	0	0	0	0	0	0	0	0	0	7	2.02	0.58
Phragmites australis	0	7	0	0	0	7	55	7	0	0	0	0	15.64	4.51
Plantago maritime	0	0	0	0	0	0	0	0	0	0	0	3	0.87	0.25
Pluchea purpurascens	0	3	0	0	0	0	1	0	0	0	0	0	0.89	0.26
Polygonum punctatum	0	1	0	0	0	0	0	0	0	0	0	0	0.29	0.08
Rosa palustris	7	0	0	0	0	0	0	0	0	0	0	0	2.02	0.58
Salicornia europaea	1	0	0	3	0	1	0	0	4	4	1	4	1.73	0.50
Scirpus pungens	25	33	7	0	0	0	0	7	0	3	0	0	11.09	3.20
Scirpus robustus	0	0	0	0	0	55	0	0	0	0	0	0	15.88	4.58
Solidago sempirvirens	25	80	38	0	0	19	0	25	7	25	0	13	22.99	6.64
Spartina alterniflora	0	0	76	55	94	94	55	76	38	76	76	76	32.09	9.26
Spartina alterniflora (short)	76	22	0	0	0	0	1	0	0	15	110	132	48.10	13.88
Spartina cynosuroides	7	0	0	0	0	0	0	0	0	0	3	3	2.19	0.63
Spartina patens	3	169	6	25	0	0	7	32	38	39	0	0	47.47	13.70
Suaeda linearis	0	0	0	0	0	0	0	0	3	0	15	0	4.34	1.25
Toxicodendron radicans	25	0	0	3	1	0	0	15	0	0	0	0	7.97	2.30
Typha angustifolia	0	93	0	131	55	7	0	0	0	0	0	0	44.79	12.93

Appendix C:
Invertebrate data: abundance values by transect

	Transects												Variability	
Taxa	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**SD**	**SE**
Melampus bidentus	28	67	76	118	22	152	2	3	39	0	3	0	50.84	14.68
Geukensia demissa	0	0	5	4	9	48	0	0	0	14	57	32	20.26	5.85
Uka sp	0	0	0	0	7	0	0	0	0	0	0	0	2.02	0.58
Unknown isopod	0	0	0	0	5	0	0	0	7	0	0	0	2.37	0.69