3-23-2016

Monitoring Macroalgae in the Great Bay Estuary for 2014

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A Final Report to

The Piscataqua Region Estuaries Partnership

submitted by

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March 23, 2016

This report was funded by a grant from the Piscataqua Region Estuaries Partnership, as authorized by the U.S. Environmental Protection Agency pursuant to Section 320 of the Clean Water Act, and in part, by NOAA's Office for Coastal Management under the Coastal Zone Management Act in conjunction with the NH Department of Environmental Services Coastal Program.

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Cite as:

Burdick, D.M., A.C. Mathieson, C.R. Peter and S. Nick. 2016. Monitoring Macroalgae in the Great Bay Estuary for 2014. Final Report. The Piscataqua Region Estuaries Partnership. 19 pp.

Executive Summary

Four more intertidal fixed transect sites were added to the long-term macroalgal monitoring array, resulting in a total of eight sites for the Great Bay Estuary. Monitoring results from 2014 show high levels of cover of nuisance green and red algae (*Ulva* and *Gracilaria*, respectively) at all sites except near the mouth of the Estuary. Seasonal sampling of algal cover confirmed earlier work that showed mid-summer accumulations of green algae (primarily *Ulva lactuca*) were largely replaced in late summer and fall by red algae (two species of *Graciliaria*, one native and the other introduced). A determination of whether intertidal macroalgal populations are increasing over time will require a longer time series and would likely benefit from historical analysis of earlier collections of intertidal macroalgae. To this end, a method for analysis of historical photographs was developed.

Monitoring Macroalgae in the Great Bay Estuary for 2014

Introduction

Tracking changes in macroalgae, or seaweed populations of the Great Bay Estuary is important for our understanding of how changes in the environmental conditions affect the structure, function and biodiversity of the Estuary. Monitoring of eelgrass, one of the critical habitats in the Estuary, has shown significant declines over the past fifteen years (Beem and Short 2009, Short 2014) that has concerned resources managers and the public (Trowbridge 2006). Human population growth and climate change can influence nutrient loads and cycling and sediment loads and resuspension as well as the suitability of various estuarine habitats for supporting the growth of macroalgae. Fluctuations in environmental conditions can favor different species at different times, creating opportunities for non-native invasive species to establish populations in the Estuary. Mats of macroalgae can also smother other benthic species and intercept the sunlight needed for eelgrass to grow, altering the habitat structure and food web of the Bay.

Standardized, repeatable sampling of macroalgae has occurred in the Estuary from time to time. Macroalgae typically grows in intertidal and shallow subtidal areas, where it can interact with subtidal eelgrass beds. Aerial imagery can be used to estimate macroalgal cover, but has limited success in correctly separating eelgrass from the three main algal types (greens, reds, and browns; Per'ei et al. 2006). Another sampling approach used a sampling grid to randomly select 200 sample sites in the Estuary in 2013. Each site was approached by land (walking) or sea (small vessel with shallow draft) and cover of macroalgae was assessed with a 0.25 m^2 quadrat. More typically, an array of fixed sample points at locations that provide good intertidal exposure and are accessible by vehicle and on foot were sampled using a 0.25m^2 quadrat at set tidal elevations (0.0 m, 0.5 m, etc. above Mean Low Water). The best archived data were collected from intertidal sampling grids at fixed locations as part of graduate student projects conducted under the direction of Arthur Mathieson: in 1978 (Hardwick-Whitman and Mathieson, 1983) and 2008-2010 (Nettleton et al. 2011). Most recently, Cianciola and Burdick (2014) reoccupied several historically assessed sites and used previous project results to develop a modified protocol for macroalgal monitoring.

Project Goals and Objectives

Building on previous work, four new sites were established to complete the long-term fixed station sampling array. The strategy for maintaining eight sites in a variety of estuarine areas and shoreline exposures was that sampling of the entire fixed array would be completed every other year, with three sites sampled in alternate years and two sites sampled every year. Sampling in 2014 would be performed at five sites for cover and biomass on three occasions over the growing season. In addition, we would develop a method for historical analysis of macroalgal cover at fixed sites in the Great Bay Estuary so we can examine historical trends of macroalgae going back to 1978.

Methods

During July of 2014, the research team established a fixed intertidal sampling grid using randomly placed transects at four new monitoring sites chosen in consultation with PREP staff. Each sample site was set up with three transects along a 100 m length of shoreline with points at 1.5 m, 1.0 m, and 0.5 m above MLLW. Elevations were found relative to the low tide line or high tide line (where low tide could not be reached, e.g., Sunset Hill Farm) and stations were marked along transects using a laser level and tape measure. Sites established were all in New Hampshire and included: Sunset Hill Farm in Newington; Hilton Park at Dover Point in Dover; Adams Point in Durham; and Four Tree Island in Portsmouth.

Macroalgae cover data were collected at the four monitoring sites established in July and the Depot Road site that was established in 2013 for three collection periods, July, August/September and October. Visual estimates of percent cover were made by species or genus in a 0.25 m^2 quadrat centered landward of each sampling point on each transect. A photograph was taken and archived for each plot sampled. Species identifications were authenticated by Dr. Arthur Mathieson and nomenclature generally followed Villalard-Bohnsack (2003), with some changes due to advances in taxonomy (e.g., *Enteromorpha intesinalis* renamed to *Ulva intestinalis*) and new invasive species (e.g., *Dasysiphonia japonica*).

During August/September site visits macroalgal biomass samples were collected along with the cover estimates. A 0.0625 m^2 quadrat was placed 2 meters to the right of each sampling point on each transect, as determined when facing the shore. Percentage cover was estimated in the quadrat and a photgraph was taken before collecting all live material in the quadrat and placing in labeled plastic bags. At the lab, biomass samples were cleaned and sorted by species/genus. Plant material was placed in marked foil envelopes and dried at 60°C in a drying oven for five days before weighing to 0.01g.

The research team compiled the field percent cover estimates from all sampling events and the laboratory biomass estimates from the August/September sampling period in an electronic spreadsheet. Data will be reduced to means for elevations within sites and sites for all taxa and by major algal taxa.

Results and Discussion

Choosing Locations

Based on discussions with PREP and GBNERR regarding data needs and resources available, eight sites were chosen as long term monitoring locations for intertidal macroalgae. Each year, five sites are measured: two annual sites and three biennial sites, so that every two years all eights sites are measured, with two sites measured twice and six sites measured once. Sample locations were chosen based on previous sampling efforts in the 1970s (Hardwick-Witman and Mathieson 1983) and 2000s (Nettleton et al. 2011) as well as observations from those studies and personal observations (ACM).

Nettleton et al. (2011) collected biomass and percent cover data for five sites around Great Bay Estuary: Cedar Point in Durham, NH, on Little Bay (CP); Wagon Hill Farm in Durham, NH, west of the public beach (WH); north of Lubberland Creek in Newmarket, NH (LC); off the landing of Depot Road in Greenland, NH at the Great Bay Discovery Center (DR), and off the landing at Sunset Hill Farms in Newington (SHF). In addition, Hardwick-Witman and Mathieson (1983) collected and published macroalgal biomass and percent cover data at intertidal transects north of Lubberland

Creek as well as a site on the lower Oyster River (near Wagon Hill Farm). [This team also collected transect data with photographic records of algae which were not published at Peirce Island (near our Four Tree Island site), Dover Point (near our Hilton Park site), Cedar Point, Adams' Point and Brackett's Point (between our Depot Road and Sunset Hill Farm sites).] Re-occupation and sampling of four of these sites was conducted in 2013 (CP, WH, LC and DR; Figure 1). These stations represented the eastern, western and southern sides of Great Bay as well as the northwestern portion of Little Bay, including the mouth of the Oyster River, a major tributary to the Estuary. To characterize the macroalgae in other important areas of the estuary, we added sites at: Pierce Island, east of the causeway to Four Tree Island, in Portsmouth, NH (4TI); Dover Point on the Piscataqua River north of the Hilton Park boat launch in Dover, NH (HP); and at Adams Point along the north shore of Great Bay across from the Footman Islands (AP) (Table 1, Figure 1).

Table 1. Macroalgae intertidal collection sites for fixed array sampling.

Site Name	**Town**	**Location (lat/long DD)**	**Elevations (m above MLLW)**	**Years Sampled**
Four Tree Island	Portsmouth	43.07536N 070.74701W	0.0, 0.5, 1.0, 1.5, 2.0, 2.5	Even: 2014
Hilton Point	Dover	43.12292N 070.82786W	0.0, 0.5, 1.0, 1.5, 2.0	Even: 2014
Cedar Point	Durham	43.12934N 070.85283W	-0.8, 0.0, 0.5, 1.0, 1.5	Odd: 2013, 2015
Wagon Hill Farm	Durham	43.12457N 070.87260W	0.0, 0.5, 1.0, 1.5	Odd: 2013, 2015
Adams Point	Durham	43.09019N 070.86735W	0.0, 0.5, 1.0, 1.5	All: 2014-15
Lubberland Creek	Newmarket	43.07427N 070.90339W	0.5, 1.0, 1.5	Odd: 2013, 2015
Depot Road	Greenland	43.05611N 070.89682W	0.5, 1.0, 1.5	All: 2013-15
Sunset Hill Farm	Newington	43.05751N 070.83443W	0.75, 1.0, 1.5	Even, 2014

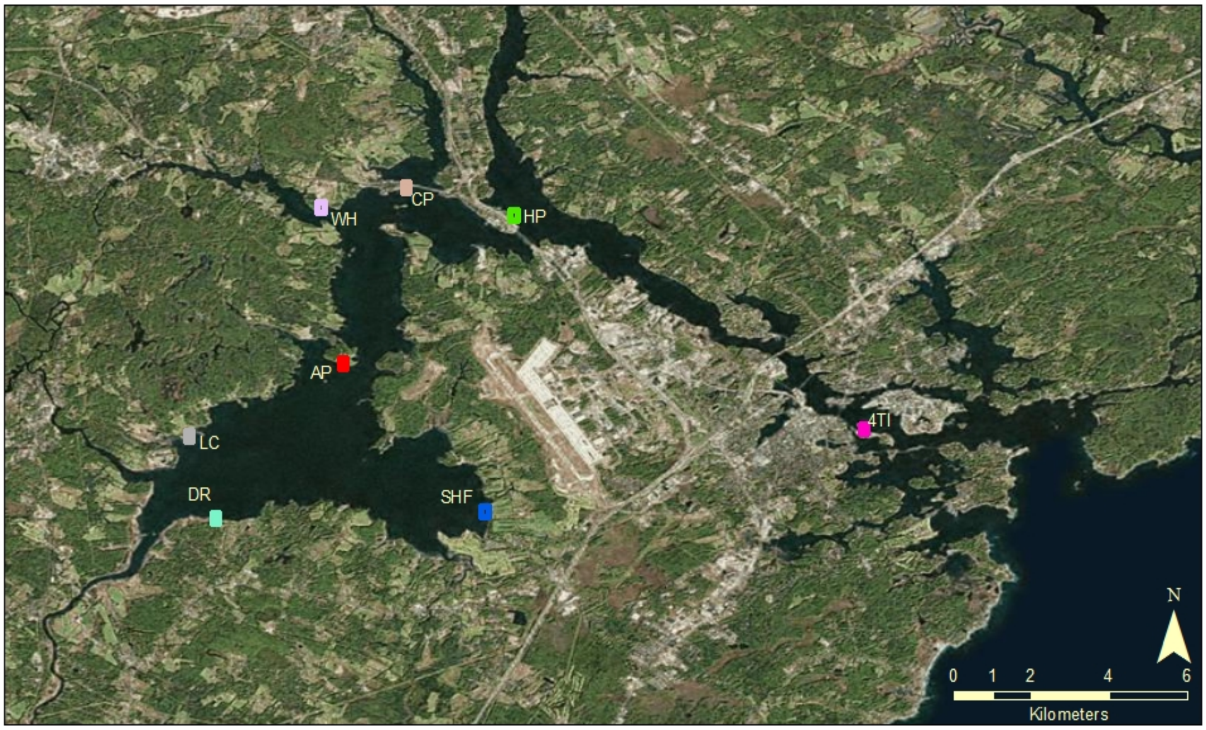

Figure 1. Eight macroalgae intertidal collection sites for fixed array sampling of the Great Bay Estuary.

Site Descriptions

The eight sampling sites are shown in close-up insets of remotely sensed landscape images in Figure 2, with each sampling location along the three transects for each site. Sampling locations were collected using a hand-held Garmin GPS and plotted on the images.

The macroalgal sampling site at Four Tree Island lies east of the causeway between boulder fields on the island and a point on Peirce Island to the east. Access is provided by the adjacent parking lot. The water depth shallows above mean lower low water (MLLW, 0.0 m elevation) into a broad mudflat with coarsening sediments as elevations rise above 0.5 m elevation and flats begin to grade into low marsh of *Spartina alterniflora* at 1.0 m. Low marsh dominated the next two elevation at 1.5 and 2.0 m, and then high marsh dominated by *Spartina patens* (2.5 m) occurred at the uppermost samples.

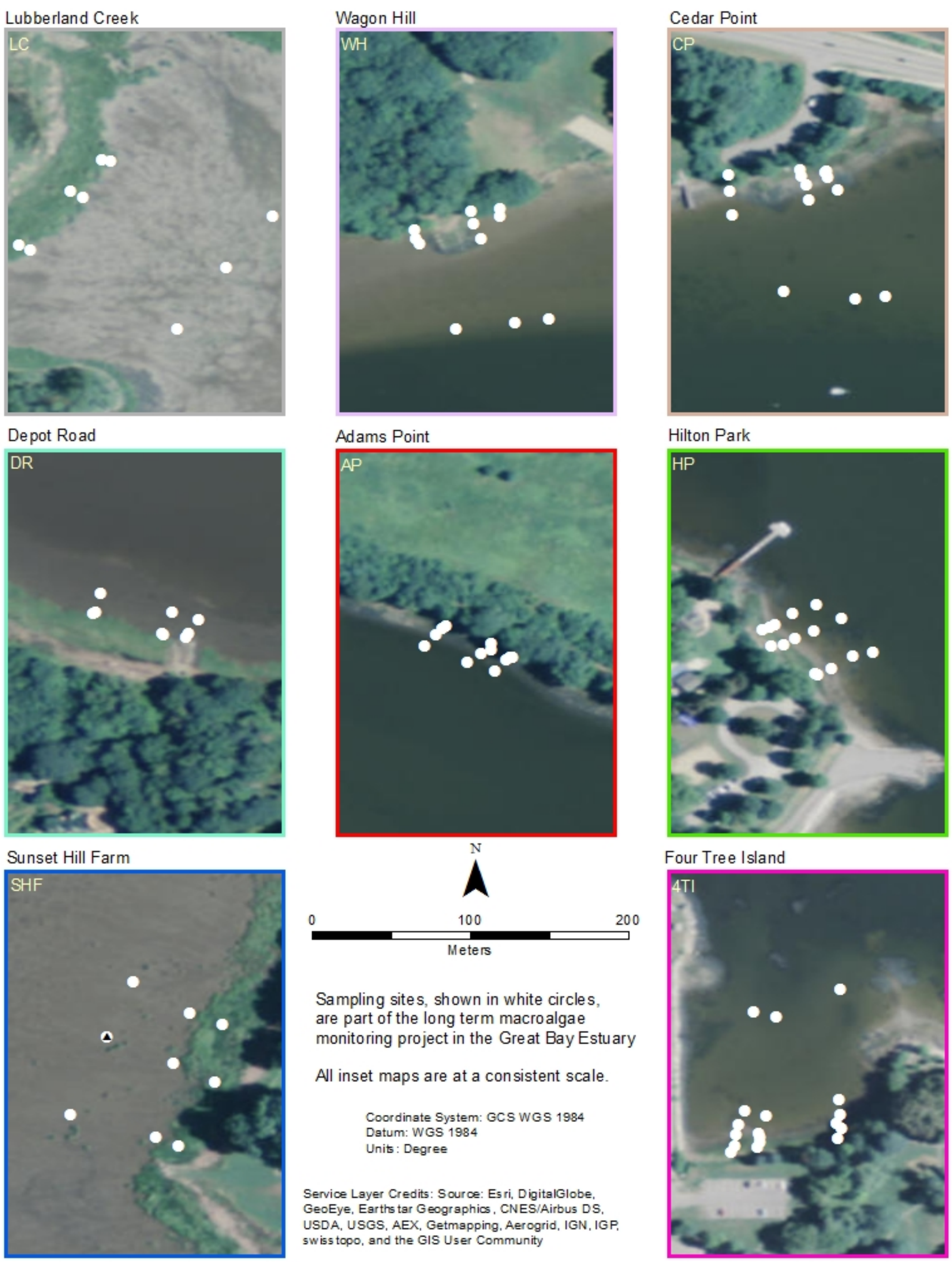

Figure 2. The eight sampling sites for intertidal macroalgae sampling in the Great Bay estuary. Locations were plotted with positions determined by GPS with the exception of one sample site in Sunset Hill Farm (SHF) as indicated by the black triangle. This site will be confirmed in 2016.

The sampling area at Dover Point lies on the northeast side of the point on the Piscataqua River, approximately 200 meters north of the boat launch about 50 meters north of the northernmost portion of Hilton Park and its parking area. The shore is characterized by subtidal boulders (0.0 m) grading into a narrow intertidal mudflat (0.5 and 1.0 m) with scattered rocks before a short step (at 1.5 m) up to low marsh (sampled at 2.0 m). Trees shade out the uppermost portion of a fringing marsh that adjoins vertical rocky outcrop, so samples at 2.5 m elevation were found to be unvegetated.

The transects at Cedar Point lie on the south side with their upper elevations close to the parking lot (southwest corner of the Scammel Bridge), which is above a steep bedrock embankment (access to the shore is provided by stairs). Subtidal mud bottom slopes steeply up to the edge of the intertidal at 0.0 m elevation MLLW and the mudflats continue at 0.5 and 1.0 elevations, where the sediments coarsen as a narrow band of low marsh is approached. The marsh is sampled at 1.5 meters in elevation. A rocky outcrop extends shore-normal between the second and third transects that is colonized by fucoid algae.

The sampling site at Wagon Hill Farm lies just north of the artificial beach created and maintained by the Town of Durham as part of the park. Access to the site from the main lot occurs by heading eastward across several fields to the shore. The transects run across a wide mudflat from intertidal elevations (0.0, 0.5 and 1.0 m MLLW) to a narrow fringing marsh (1.5 m) that is shaded by overhanging trees and shows strong signs of erosion. The third, northernmost, transects runs into a derelict pier characterized as a crib-construction and filled by cobble and larger rock, with fucoid algae attached to some of the exposed rock.

Along the southern shoreline of Adams Point lies the three sampling transects that extend south toward the Footman Islands. Access to the site is provided by state-maintained walking trails and wooden steps constructed along the steep embankment of shale bedrock. Fringing marsh is discontinuous at the site, occurring between coarse shale 'beach'. The edge of the intertidal is characterized by small boulders and rocks (at 0.0 m elevation) that grade up into mudflat interspersed with rocks (0.5 and 1.0 m), often colonized by fucoid algae (primarily *Fucus vesiculosus*). At 1.5 m there can either be a fringing marsh or unconsolidated shale.

Land holdings of The Nature Conservancy (TNC) extend from the middle of Lubberland Creek north through the extensive salt marsh and several points and islands. The sampling location is accessed through a TNC trail that begins on the opposite side of Bay Road from their trail head parking lot. As the trail approaches the shoreline and salt marsh, strike off toward the shore and continue along the shore until a large mowed field extending to the marsh edge is reached. Three transects extend across the marsh into a broad very flat mudflat that extends into the Bay between a point and island. One sample set is collected from the mudflat (0.5 m elevation), another just as the low marsh is reached (1.0 m), and a final set is located in the low marsh (1.5 m). An osprey platform with active nest is located in the adjacent upland field and so sampling should be restricted to mid-July or later to avoid disrupting any fledglings.

The Great Bay National Estuarine Research Reserve (GBNERR) has as its headquarters the Sandy Point Discovery Center located on the southern shore of Great Bay. The transects are located from the GBNERR kayak launch extending westward and accessed by the adjacent parking lot. The mud flats are flat and broad and the 0.0 m elevation could not be accessed by walking across the mudflat (beyond 1 km), and so the three transects began at 0.05 m elevation where the mudflat began to slope upward. The 1.0 elevation was also in mudflat but within 10 meters of a fringing marsh and the 1.5 m elevation was in low marsh at the two western transects and on a rock pile adjacent to the launch for the eastern transect.

On the eastern shore of Great Bay, extensive mudflats grade into fringing salt marsh before the land rises into uplands that were historically farmed. One farm (Sunset Hill) in Newington has been set aside for conservation by the NH Fish and Game. This site has shorelines adjacent to mown fields and knobs of bedrock that show rocky outcrops along the shoreline. The private site is accessed by permission from NH Fish and Game and the first transect has its highest elevation near a derelict crib construction pier. The remaining two shore normal transects are found to the north. Similar to the Lubberland Creek and Depot Road sites, mean low water could not be reached on foot and the lowest elevation was chosen at 0.75 above MLLW, approximately 100 m seaward of the continuous edge of the low marsh (tiny marsh islands were common, but very few extended lower than 0.75 m elevation). The sampling sites at 1.0 m elevation were also in mudflat, but close to the continuous low marsh, where the 1.5 m samples were collected.

Site Establishment

Between May and November of 2013, we collected biomass and percent cover data by seaweed taxon at four sites around Great Bay Estuary: Cedar Point in Durham, N.H.; Wagon Hill Farm in Durham, N.H., west of the public beach; the Nature Conservancy's Lubberland Creek Preserve in Newmarket, N.H.; and the Great Bay Discovery Center off Depot Road in Greenland, N.H. We chose these sites because Nettleton (2011) collected the same types of data for all four of these locations. In addition, Hardwick-Witman and Mathieson (1983) collected macroalgal biomass and percent cover data at Lubberland Creek, and Chock (1983) collected the same types of data at Cedar Point.

The 2014 macroalgal monitoring team established sampling locations at each of the four new sites (4TI, HP, AP, and SHF). The individuals who assisted us in the field included undergraduate students at the University of New Hampshire and staff from the UNH Jackson Estuarine Laboratory. We selected a section of shoreline roughly 100 meters in length, and then placed a center transect roughly in the middle. Using distances selected from a table of random numbers between 10 and 50 meters, we established outer transects on either side of the center transects, orienting the sampling transects perpendicular to the shoreline. We marked points at 0.0 meters, +0.5 meters, +1.0 meters, +1.5 meters and up through the intertidal, relative to mean low water (MLLW) on each transect. Four Tree Island and Hilton Park had six sites per transect (up to 2.5 meters), Adams Point had five (up to 2.0 meters) and Sunset Hill Farm had only three, with the first point at 0.75 m above MLLW due the extensive, flat mudflats.

To determine the elevation of MLLW at each site, we estimated the time at which low tide was expected to occur (NOAA Tide Tables). We also adjusted the heights of the low tides using the following tidal correction factors: 70% for Hilton Park, and 75% for Sunset Hill Farm. We confirmed the time of low tide with field observations. The research team then measured the elevation of the land at the edge of the low water level relative to a laser level positioned on shore using a laser receiver. Because the receiver was too distant to detect the laser beam emitted from the tripod at MLLW at the Sunset Hill Farm site, we used a top-down approach to estimate elevation instead. We used the water elevation at mean high water (MHW) for a sample date with a similar predicted tide and marked sampling locations relative to the baseline using the laser level and receiver to find the chosen elevations. The extensive mudflats at the Lubberland Creek and Depot Road sites prevented the establishment of sampling points at MLLW at these sites. In the fall of 2013, we generated the latitude and longitude positions of each of the sampling points shown in Figure 2 using a Garmin Etrex 20 GPS unit.

Macroalgae Cover

Cover ranged up to 100% for macroalgae, with *Gracilaria*, (a genus of red algae comprised mainly of one native and one invasive species) averaging 9.4% cover and *Ulva* (a genus of diverse tubular and foliose green algae, but dominated by *U. lactuca*, sea lettuce) averaging 8.7% cover. Raw cover data is available in tabular form in Appendix A. When categorized by major color types (red, green and brown) and compared across sites, the brown algae (primarily long-lived fucoids) dominated Four Tree Island (Figure 3). Cover at Hilton Park, Adams Point and Depot Road all had a mix of reds, greens and browns, with reds increasing up estuary, from Four Tree Island (almost no cover) to Sunset Hill Farm (25% cover).

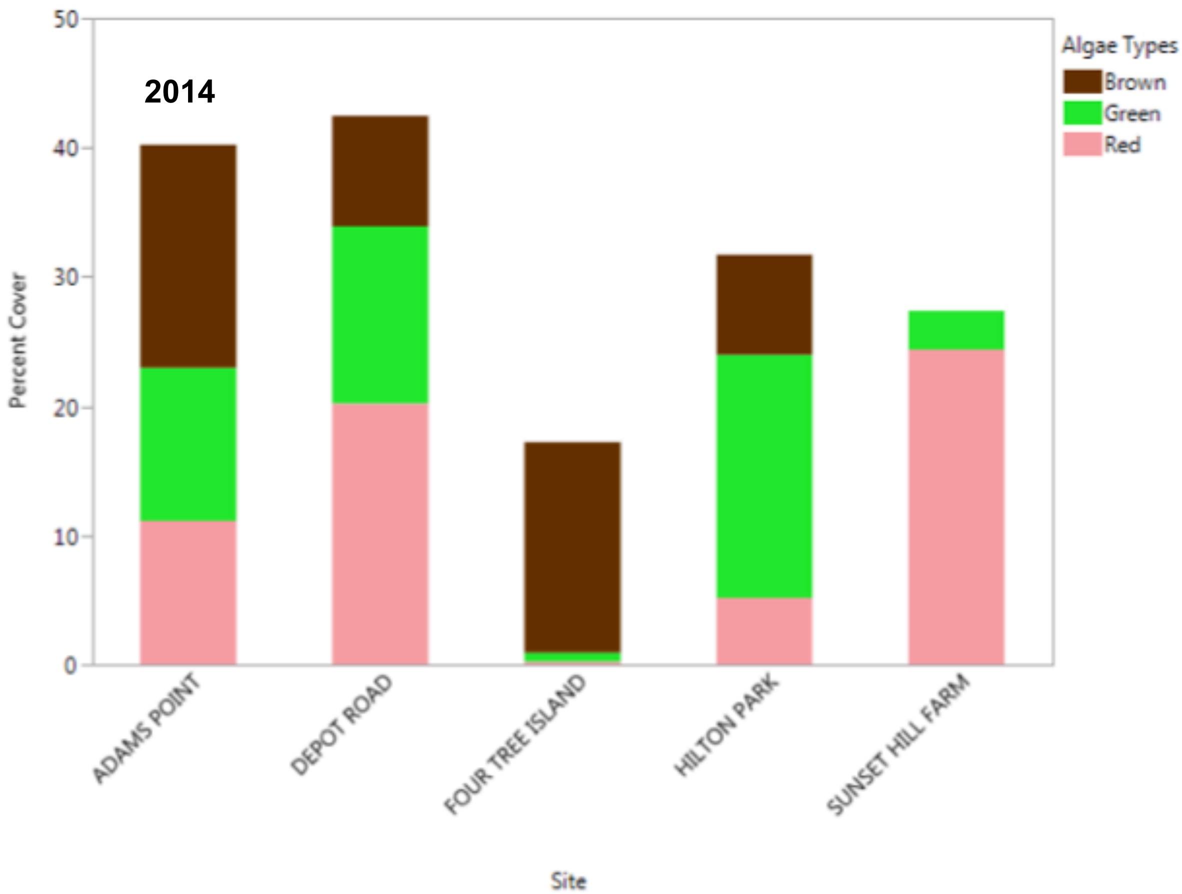

Figure 3. Cover of macroalgae averaged over sampling depths and three seasonal collection periods at the five sites sampled in 2014.

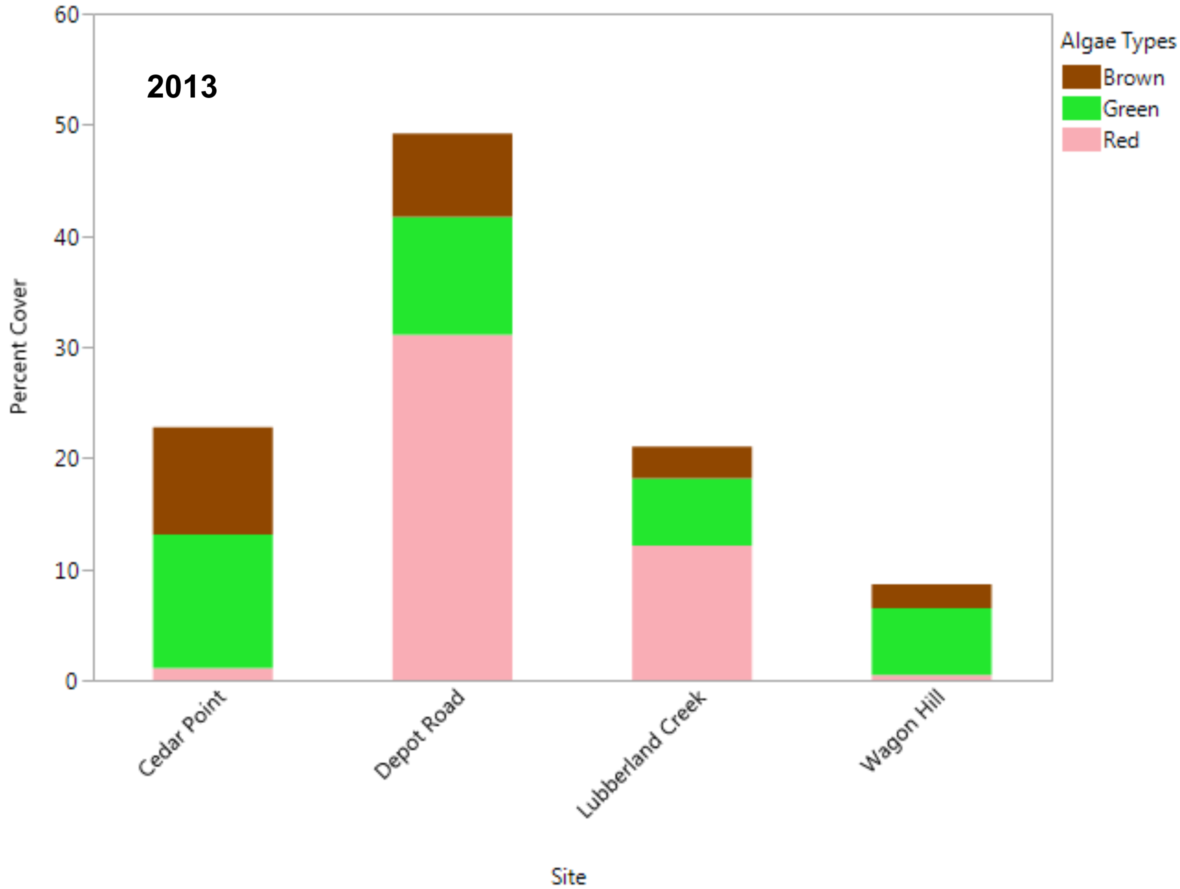

Figure 4. Cover of macroalgae in 2013, averaged over sampling depths and four seasonal collection periods at the four sites sampled by Cianciola and Burdick (2014).

The general pattern of intertidal seaweeds by major color groups and position in the estuary was similar in 2013 to 2014 (Figures 3 and 4). As was found in 2014, macroalgae sampled in 2013 and averaged over all depths and collection seasons showed greens and browns dominated sites in Little Bay (CP and WH in 2013 were similar to HP in 2014) and reds were important in Great Bay proper (DR and LC in 2013 were similar to DR and SHF in 2014).

When the data are presented showing cover by elevation for each of the three collection periods, some general patterns emerge (Figure 5). Cover appears to have become greater in late summer and fall, especially fueled by increases in the red alga *Gracilaria vermiculophylla*. An increase in algae at the Great Bay sites was found by Nettleton in the fall, and Cianciola and Burdick (2014) found late season increases in *Gracilaria* at the expense of the green *Ulva*. In July, green algae dominated the lower elevations of 0.0 and 0.5 m above MLLW except at Four Tree Island (a site dominated by brown algae). By October, most of these lower elevation sites became dominated by *Graciliaria*. At 1.5 m elevation, many sites had graded into salt marsh and *Gracilaria* became uncommon. Under the canopy of marsh grasses, browns and greens became the most important algae with respect to cover (Figure 5).

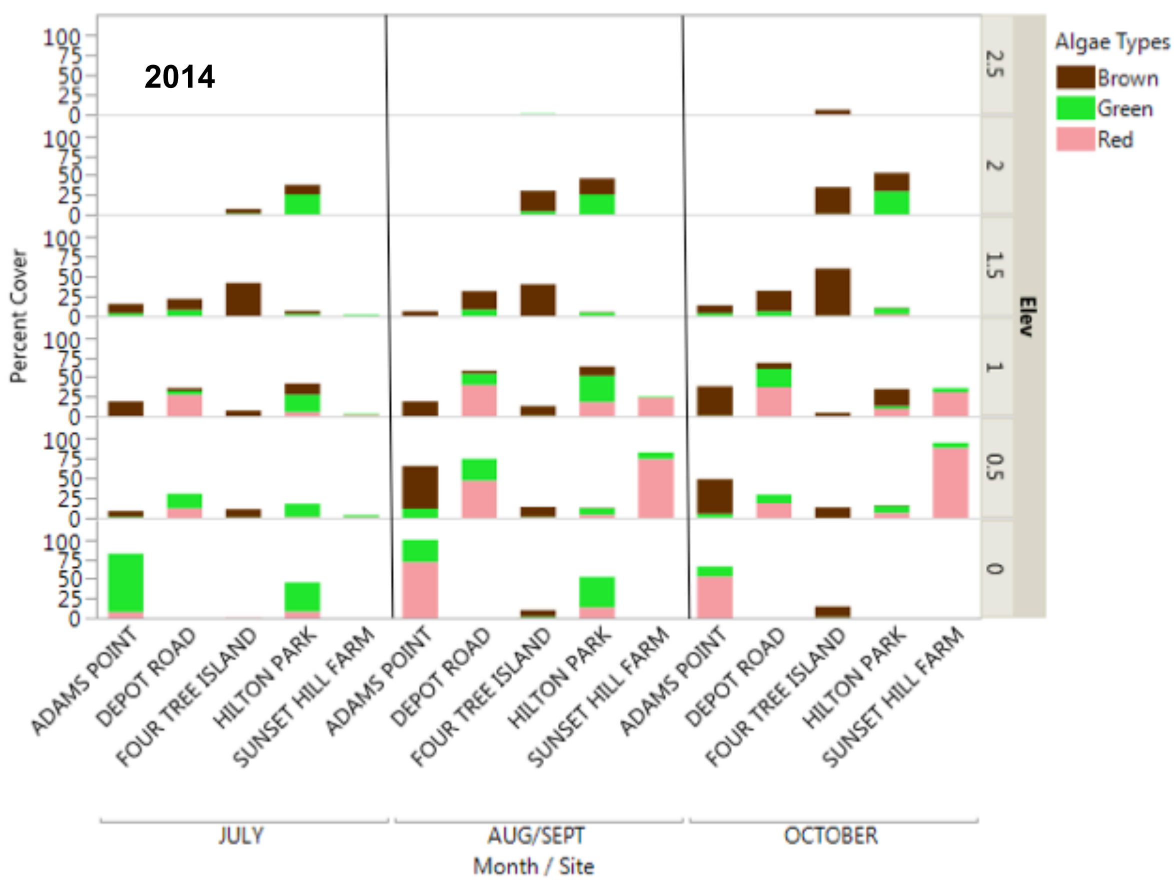

Figure 5. Cover of marcoalgae at five sites sampled during three periods and shown for each elevation, averaged over the three transects. Lowest sample elevation at Sunset Hill Farms was actually 0.75 m (not 0.5 m) above MLLW.

Plant cover in salt marsh is shown in Figure 6 as low marsh, dominated by *Spartina alterniflora* (smooth cordgrass). Some cover of low marsh plants was found at 1.0 m elevation above MLLW, but by 1.5 m all sites but Hilton Park showed substantial cover (15 to 40%). At 2.0 m elevation, the sites in Great Bay graded into shoreline covered with wrack (drift material) or upland vegetation, but Four Tree Island and Hilton Park showed significant marsh cover (40 to 50%). Four Tree Island was the only site with appreciable high marsh, which was dominated by *S. patens* (salt hay) and mixed with a variety of other high marsh plants.

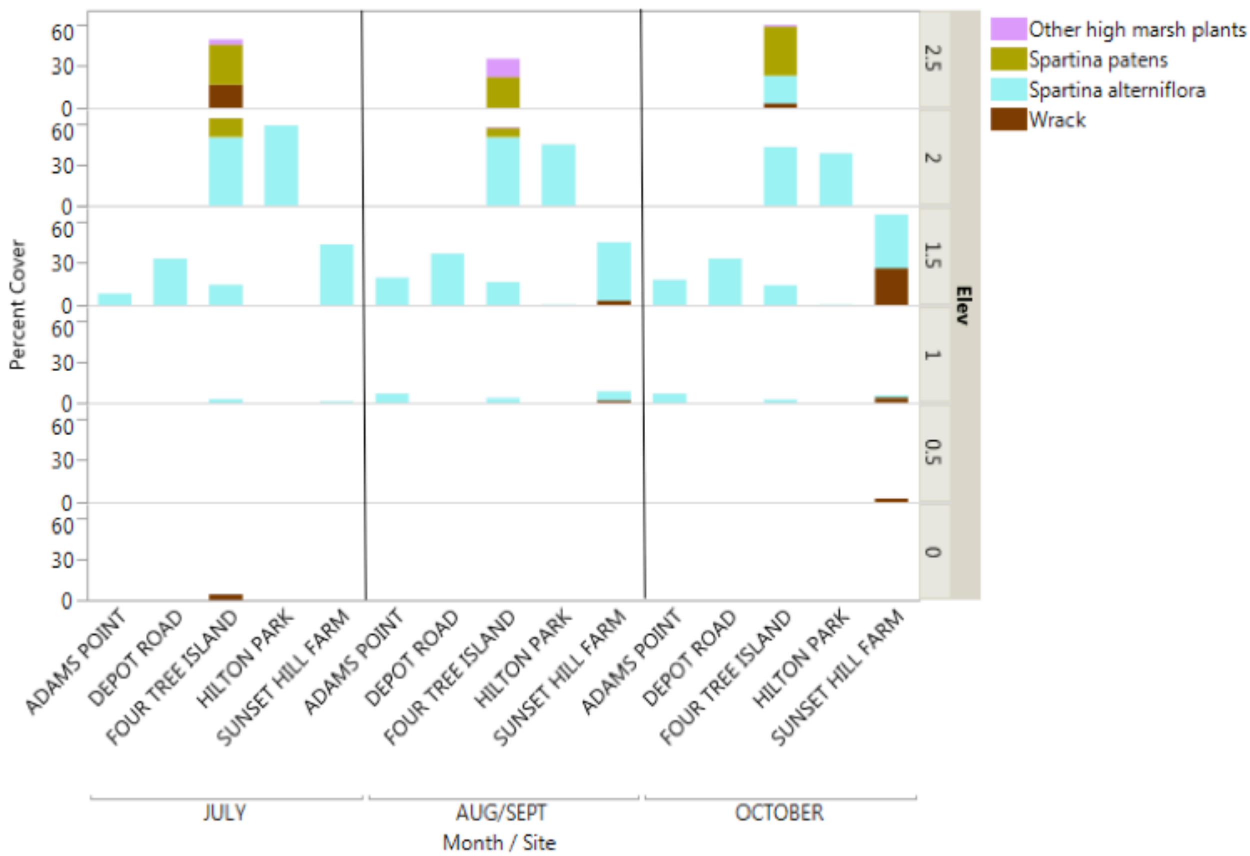

Figure 6. Cover of vascular plants and wrack (drift material) at the five sites sampled during three periods and shown for each elevation, averaged over the three transects. Lowest sample elevation at Sunset Hill Farms was actually 0.75 m (not 0.5 m) above MLLW.

Paired Cover and Biomass

Following the collection protocol, a 0.0625 m² quadrat was placed two meters from each sampling site and after estimation of cover and photographing the plot, all algae within the plot was collected and processed to determine biomass. We added significant numbers of data points for four taxa of algae: *Ulva* (green), *Gracilaria* (red) and the two species of brown fucoid algae: *Ascophyllum nodosum* and *Fucus vesiculosus*. The 2013 data were combined with our new data collected in 2014 to generate correlations (Figure 7). Although the correlation coefficients (r = 0.73 to 0.88) indicate fairly good correspondence, there is still quite a bit of variability in the data. It appears that there are some outliers (greater weight than expected for the amount of cover) for the 2013 data and these will be examined for possible removal. The cover-biomass relationships can be developed into associations and used to create a regression so that algal cover data can be used to estimate algal biomass at our collection sites.

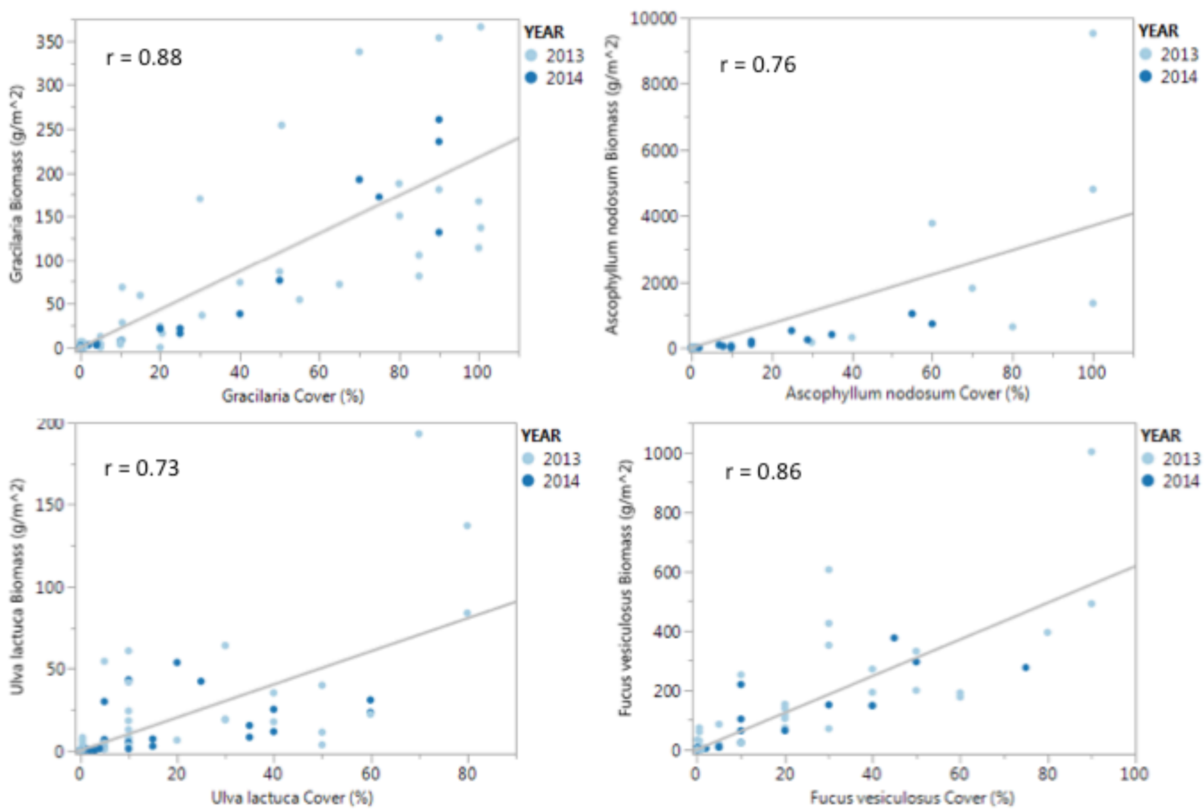

Figure 7. Correlations of percentage visual cover and biomass from the 0.0625 m² quadrats in 2013 and 2014.

Historical analysis

Photographs from Hardwick-Whitman and Nettleton were obtained and compiled with those from 2013 and 2014 to create a complete data record from 1978 to the present. Photos from 1978 were taken with a camera using slide film (Kodak Ektachrome). Each slide was projected and photographed using a digital camera and uploaded and organized on an external hard drive. Each photograph can be brought into IPhoto and overlain by a seven by seven line grid, producing 49 intersections. Percentage cover can be visually estimated in steps of 10% for the entire image and then the number of intersections hitting each species is counted, providing two measures of cover. A pilot project by Molly McGovern examined data from one site over the historical period and shared the results as a poster at the UNH Undergraduate Research Conference held in April 2015 (Appendix C).

Summary and Conclusions

The establishment of four additional intertidal fixed array sites (Four Tree Island, Hilton Park, Adams Point and Sunset Hill Farm) completed the spatial design of the long-term macroalgal monitoring plan for the Great Bay Estuary. Monitoring results from 2014 show high levels of cover of nuisance green and red algae (*Ulva* and *Gracilaria*, respectively) at all sites except near the mouth of the Estuary. Biomass collections in 2014 increased sample size and strengthened our ability to predict biomass from cover data. Seasonal sampling of algal cover confirmed earlier work that showed mid-summer accumulations of green algae (primarily *Ulva lactuca*) were largely replaced by red algae (two species of *Graciliaria*, one native and the other introduced) in late summer and fall. Further, intertidal macroalgal populations appear to be increasing over time, but developing a statistically significant pattern of increase will require a longer time series and would likely benefit from historical analysis of earlier collections of intertidal macroalgae. To this end, a method for analysis of historical photographs was developed and a quality assurance project plan for sampling was finalized.

Acknowledgements

The authors thank Mark Kotowski and Molly McGovern, undergraduate students at UNH, for assistance in the field and laboratory. We also thank Kalle Matso, Rachel Rouillard and Jean Brochi for support of the project. Financial support was obtained through the Piscataqua Region Estuaries Project. This project was funded, in part, by NOAA's Office for Coastal Management under the Coastal Zone Management Act in conjunction with the NH Department of Environmental Services Coastal Program.

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Appendices

Appendix A: Data Tables: Cover and biomass

Appendix B: List of photographic images by site and date

Appendix C: Poster for UNH Undergraduate Research Conference (April 2015)

DATE	YEAR	MONTH	SITE	REP	ELEVATION (M)	PLOT SIZE (M^2)	Ulva Blade	Ulva Tube	Ulva prolifera	Gracilaria	Heterosiphonia japonica	Polysiphonia	Neosiphonia	Other Red algae	Ascophyllum nodosum	A.n. var. scorpioides	Fucus vesiculosus	F.v. var spiralis	Kelp	Vaucherria	Blacktar algae	Spartina alterniflora	S. Patens	Limonium sp.	Atriplex patula	Juncus gerardii	Salicornia depressa	Puccinellia maritima	Plantago maritima	Ruppia maritima	Wrack
7/28/14	2014	JULY	FOUR TREE ISLAND	A	0.0	0.25	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
7/28/14	2014	JULY	FOUR TREE ISLAND	A	0.5	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/28/14	2014	JULY	FOUR TREE ISLAND	A	1.0	0.25	0	0	0	0	0	0	0	0	0	0	0	7	0	0	2	0	0	0	0	0	0	0	0	0	0
7/28/14	2014	JULY	FOUR TREE ISLAND	A	1.5	0.25	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	30	0	0	0	0	0	0	0	0	0
7/28/14	2014	JULY	FOUR TREE ISLAND	A	2.0	0.25	0	0	0	0	0	0	0	0	0	0	0	5	0	2	0	60	0	0	0	0	0	0	0	0	0
7/28/14	2014	JULY	FOUR TREE ISLAND	A	2.5	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	5	1	0	0	0	0	0	0
7/28/14	2014	JULY	FOUR TREE ISLAND	B	0.0	0.25	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/28/14	2014	JULY	FOUR TREE ISLAND	B	0.5	0.25	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
7/28/14	2014	JULY	FOUR TREE ISLAND	B	1.0	0.25	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
7/28/14	2014	JULY	FOUR TREE ISLAND	B	1.5	0.25	0	0	0	0	0	0	0	0	40	0	0	10	0	0	1	2	0	0	0	0	0	0	0	0	0
7/28/14	2014	JULY	FOUR TREE ISLAND	B	2.0	0.25	0	0	0	0	0	0	0	0	0	1	0	3	0	0	0	50	25	0	0	0	0	0	0	0	0
7/28/14	2014	JULY	FOUR TREE ISLAND	B	2.5	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	1
7/28/14	2014	JULY	FOUR TREE ISLAND	C	0.0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/28/14	2014	JULY	FOUR TREE ISLAND	C	0.5	0.25	2	0	0	0	0	0	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0
7/28/14	2014	JULY	FOUR TREE ISLAND	C	1.0	0.25	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	8	0	0	0	0	0	0	0	0	0
7/28/14	2014	JULY	FOUR TREE ISLAND	C	1.5	0.25	0	0	0	0	0	0	0	0	0	67	0	6	0	0	0	12	0	0	0	0	0	0	0	0	0
7/28/14	2014	JULY	FOUR TREE ISLAND	C	2.0	0.25	0	0	1	0	0	0	0	0	0	3	0	5	0	2	0	40	16	0	0	0	0	0	0	0	0
7/28/14	2014	JULY	FOUR TREE ISLAND	C	2.5	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	5	0	0	0	0	50
7/28/14	2014	JULY	HILTON PARK	A	0.0	0.25	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/28/14	2014	JULY	HILTON PARK	A	0.5	0.25	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/28/14	2014	JULY	HILTON PARK	A	1.0	0.25	8	3	0	8	0	0	0	0	0	0	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/28/14	2014	JULY	HILTON PARK	A	1.5	0.25	0	3	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/28/14	2014	JULY	HILTON PARK	A	2.0	0.25	0	0	50	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0	0	0	0	0	0	0	0
7/28/14	2014	JULY	HILTON PARK	B	0.0	0.25	70	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/28/14	2014	JULY	HILTON PARK	B	0.5	0.25	40	2	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/28/14	2014	JULY	HILTON PARK	B	1.0	0.25	40	0	0	6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/28/14	2014	JULY	HILTON PARK	B	1.5	0.25	1	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0
7/28/14	2014	JULY	HILTON PARK	B	2.0	0.25	0	0	25	0	0	0	0	0	5	0	0	8	0	0	0	60	0	0	0	0	0	0	0	0	0
7/28/14	2014	JULY	HILTON PARK	C	0.0	0.25	40	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/28/14	2014	JULY	HILTON PARK	C	0.5	0.25	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/28/14	2014	JULY	HILTON PARK	C	1.0	0.25	15	1	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/28/14	2014	JULY	HILTON PARK	C	1.5	0.25	5	0	0	2	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0
7/28/14	2014	JULY	HILTON PARK	C	2.0	0.25	0	0	2	0	0	0	0	0	0	21	0	2	0	0	0	75	0	0	0	0	0	0	0	0	0
8/1/14	2014	AUGUST	ADAMS POINT	A	0.0	0.25	60	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/1/14	2014	AUGUST	ADAMS POINT	A	0.5	0.25	1	0	0	0	0	0	0	0	2	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/1/14	2014	AUGUST	ADAMS POINT	A	1.0	0.25	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/1/14	2014	AUGUST	ADAMS POINT	A	1.5	0.25	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0
8/1/14	2014	AUGUST	ADAMS POINT	B	0.0	0.25	80	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/1/14	2014	AUGUST	ADAMS POINT	B	0.5	0.25	1	0	0	0	0	0	0	0	3	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/1/14	2014	AUGUST	ADAMS POINT	B	1.0	0.25	0	0	0	0	0	0	0	0	30	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/1/14	2014	AUGUST	ADAMS POINT	B	1.5	0.25	2	5	0	0	0	0	0	0	2	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/1/14	2014	AUGUST	ADAMS POINT	C	0.0	0.25	80	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/1/14	2014	AUGUST	ADAMS POINT	C	0.5	0.25	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/1/14	2014	AUGUST	ADAMS POINT	C	1.0	0.25	0	0.5	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/1/14	2014	AUGUST	ADAMS POINT	C	1.5	0.25	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0
8/5/14	2014	AUGUST	SUNSET HILL FARM	A	0.75	0.25	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/5/14	2014	AUGUST	SUNSET HILL FARM	A	1.0	0.25	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
8/5/14	2014	AUGUST	SUNSET HILL FARM	A	1.5	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	95	0	0	0	0	0	0	0	0	0
8/5/14	2014	AUGUST	SUNSET HILL FARM	B	0.75	0.25	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/5/14	2014	AUGUST	SUNSET HILL FARM	B	1.0	0.25	2	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
8/5/14	2014	AUGUST	SUNSET HILL FARM	B	1.5	0.25	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/5/14	2014	AUGUST	SUNSET HILL FARM	C	0.75	0.25	4	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/5/14	2014	AUGUST	SUNSET HILL FARM	C	1.0	0.25	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/5/14	2014	AUGUST	SUNSET HILL FARM	C	1.5	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	0	0	0	0	0	0	0	0
8/6/14	2014	AUGUST	DEPOT ROAD	A	0.5	0.25	50	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/6/14	2014	AUGUST	DEPOT ROAD	A	1	0.25	4	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/6/14	2014	AUGUST	DEPOT ROAD	A	1.5	0.25	1	0	0	0	0	0	0	0	6	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/6/14	2014	AUGUST	DEPOT ROAD	B	0.5	0.25	1	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/6/14	2014	AUGUST	DEPOT ROAD	B	1	0.25	2	0	0	1	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/6/14	2014	AUGUST	DEPOT ROAD	B	1.5	0.25	6	3	0	0	0	0	0	0	0	0	10	0	0	0	0	60	0	0	0	0	0	0	0	0	0
8/6/14	2014	AUGUST	DEPOT ROAD	C	0.5	0.25	4	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/6/14	2014	AUGUST	DEPOT ROAD	C	1	0.25	10	0	0	80	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/6/14	2014	AUGUST	DEPOT ROAD	C	1.5	0.25	4	10	0	0	0	0	0	0	0	0	1	0	0	0	0	40	0	0	0	0	0	0	0	0	0
8/26/14	2014	AUGUST	DEPOT ROAD	A	0.5	0.25	18	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/26/14	2014	AUGUST	DEPOT ROAD	A	1.0	0.25	22	0	0	10	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/26/14	2014	AUGUST	DEPOT ROAD	A	1.5	0.25	0	0	0	0	0	0	0	0	8	0	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/26/14	2014	AUGUST	DEPOT ROAD	B	0.5	0.25	50	0	0	45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/26/14	2014	AUGUST	DEPOT ROAD	B	1.0	0.25	2	0	0	40	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/26/14	2014	AUGUST	DEPOT ROAD	B	1.5	0.25	8	2	0	0	0	0	0	0	0	0	15	0	0	0	0	60	0	0	0	0	0	0	0	0	0
8/26/14	2014	AUGUST	DEPOT ROAD	C	0.5	0.25	15	0	0	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/26/14	2014	AUGUST	DEPOT ROAD	C	1.0	0.25	20	0	0	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/26/14	2014	AUGUST	DEPOT ROAD	C	1.5	0.25	6	10	0	0	0	0	0	0	0	0	5	0	0	0	0	50	0	0	0	0	0	0	0	0	0
8/28/14	2014	AUGUST	FOUR TREE ISLAND	A	0.0	0.25	1	0	0	0	2	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0
8/28/14	2014	AUGUST	FOUR TREE ISLAND	A	0.5	0.25	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/28/14	2014	AUGUST	FOUR TREE ISLAND	A	1.0	0.25	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/28/14	2014	AUGUST	FOUR TREE ISLAND	A	1.5	0.25	0	0	0	0	0	0	0	0	3	0	2	0	0	0	0	30	0	0	0	0	0	0	0	0	0
8/28/14	2014	AUGUST	FOUR TREE ISLAND	A	2.0	0.25	0	0	0	0	0	0	0	0	0	3	20	0	0	2	0	65	0	0	0	0	2	0	0	0	0

DATE	YEAR	MONTH	SITE	REP	ELEVATION (M)	PLOT SIZE (M^2)	Ulva Blade	Ulva Tube	Ulva prolifera	Gracilaria	Heterosiphonia japonica	Polysiphonia	Neosiphonia	Other Red algae	Ascophyllum nodosum	A.n. var. scorpioides	Fucus vesiculosus	F.v. var spiralis	Kelp	Vaucherria	Blacktar algae	Spartina alterniflora	S. Patens	Limonium sp.	Atriplex patula	Juncus gerardii	Salicornia depressa	Puccinellia maritima	Plantago maritima	Ruppia maritima	Wrack
8/28/14	2014	AUGUST	FOUR TREE ISLAND	A	2.5	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	10	1	1	1	0	0	0	0
8/28/14	2014	AUGUST	FOUR TREE ISLAND	B	0.0	0.25	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/28/14	2014	AUGUST	FOUR TREE ISLAND	B	0.5	0.25	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/28/14	2014	AUGUST	FOUR TREE ISLAND	B	1.0	0.25	1	0	0	0	0	0	0	0	20	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/28/14	2014	AUGUST	FOUR TREE ISLAND	B	1.5	0.25	0	0	0	0	0	0	0	0	0	20	20	0	0	0	0	5	0	0	0	0	0	0	0	0	0
8/28/14	2014	AUGUST	FOUR TREE ISLAND	B	2.0	0.25	0	0	0	0	0	0	0	0	0	10	5	0	0	0	0	50	20	0	0	0	0	0	0	0	0
8/28/14	2014	AUGUST	FOUR TREE ISLAND	B	2.5	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0
8/28/14	2014	AUGUST	FOUR TREE ISLAND	C	0.0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/28/14	2014	AUGUST	FOUR TREE ISLAND	C	0.5	0.25	3	0	0	0	1	0	0	0	0	0	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/28/14	2014	AUGUST	FOUR TREE ISLAND	C	1.0	0.25	1	0	0	0	0	0	0	0	0	0	8	0	0	0	0	10	0	0	0	0	0	0	0	0	0
8/28/14	2014	AUGUST	FOUR TREE ISLAND	C	1.5	0.25	0	0	0	0	0	0	0	0	0	55	20	0	0	0	0	15	0	0	0	0	0	0	0	0	0
8/28/14	2014	AUGUST	FOUR TREE ISLAND	C	2.0	0.25	0	0	0	0	0	0	0	0	3	30	0	8	0	11	0	35	0	0	0	0	0	0	0	0	0
8/28/14	2014	AUGUST	FOUR TREE ISLAND	C	2.5	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	25	0	0	0	0	0
9/5/14	2014	AUGUST	HILTON PARK	A	0.0	0.25	2	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/5/14	2014	AUGUST	HILTON PARK	A	0.5	0.25	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/5/14	2014	AUGUST	HILTON PARK	A	1.0	0.25	5	1	0	0	0	0	0	0	8	0	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/5/14	2014	AUGUST	HILTON PARK	A	1.5	0.25	5	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/5/14	2014	AUGUST	HILTON PARK	A	2.0	0.25	0	55	0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	0	0	0	0	0	0	0	0
9/5/14	2014	AUGUST	HILTON PARK	B	0.0	0.25	85	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/5/14	2014	AUGUST	HILTON PARK	B	0.5	0.25	20	1	0	10	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/5/14	2014	AUGUST	HILTON PARK	B	1.0	0.25	50	0	0	30	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/5/14	2014	AUGUST	HILTON PARK	B	1.5	0.25	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
9/5/14	2014	AUGUST	HILTON PARK	B	2.0	0.25	0	20	0	0	0	0	0	0	0	20	10	0	0	0	0	45	0	0	0	0	0	0	0	0	0
9/5/14	2014	AUGUST	HILTON PARK	C	0.0	0.25	30	0	0	25	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/5/14	2014	AUGUST	HILTON PARK	C	0.5	0.25	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/5/14	2014	AUGUST	HILTON PARK	C	1.0	0.25	45	0	0	20	5	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/5/14	2014	AUGUST	HILTON PARK	C	1.5	0.25	1	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/5/14	2014	AUGUST	HILTON PARK	C	2.0	0.25	2	0	0	0	0	0	0	0	0	30	1	0	0	0	0	55	0	0	0	0	0	0	0	0	0
9/10/14	2014	SEPTEMBER	SUNSET HILL FARM	A	0.75	0.25	8	0	0	88	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/10/14	2014	SEPTEMBER	SUNSET HILL FARM	A	1.0	0.25	1	0	0	20	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0
9/10/14	2014	SEPTEMBER	SUNSET HILL FARM	A	1.5	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	80	0	0	0	0	0	0	0	0	10
9/10/14	2014	SEPTEMBER	SUNSET HILL FARM	B	0.75	0.25	10	0	0	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/10/14	2014	SEPTEMBER	SUNSET HILL FARM	B	1.0	0.25	1	1	0	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
9/10/14	2014	SEPTEMBER	SUNSET HILL FARM	B	1.5	0.25	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0
9/10/14	2014	SEPTEMBER	SUNSET HILL FARM	C	0.75	0.25	3	2	0	70	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/10/14	2014	SEPTEMBER	SUNSET HILL FARM	C	1.0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/10/14	2014	SEPTEMBER	SUNSET HILL FARM	C	1.5	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0	0	0	0	0	0	0	0
9/19/14	2014	SEPTEMBER	ADAMS POINT	A	0.0	0.25	45	0	0	50	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/19/14	2014	SEPTEMBER	ADAMS POINT	A	0.5	0.25	5	0	0	0	0	0	0	0	0	0	45	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/19/14	2014	SEPTEMBER	ADAMS POINT	A	1.0	0.25	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/19/14	2014	SEPTEMBER	ADAMS POINT	A	1.5	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0
9/19/14	2014	SEPTEMBER	ADAMS POINT	B	0.0	0.25	10	0	0	80	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/19/14	2014	SEPTEMBER	ADAMS POINT	B	0.5	0.25	10	0	0	0	0	0	0	0	15	0	45	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/19/14	2014	SEPTEMBER	ADAMS POINT	B	1.0	0.25	0	0	0	0	0	0	0	0	40	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/19/14	2014	SEPTEMBER	ADAMS POINT	B	1.5	0.25	0	0	0	0	0	0	0	0	10	0	10	0	0	0	0	20	0	0	0	0	0	0	0	0	0
9/19/14	2014	SEPTEMBER	ADAMS POINT	C	0.0	0.25	30	0	0	67	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/19/14	2014	SEPTEMBER	ADAMS POINT	C	0.5	0.25	15	5	0	0	0	0	0	0	15	0	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/19/14	2014	SEPTEMBER	ADAMS POINT	C	1.0	0.25	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	20	0	0	0	0	0	0	0	0	0
9/19/14	2014	SEPTEMBER	ADAMS POINT	C	1.5	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0
10/10/14	2014	OCTOBER	ADAMS POINT	A	0.0	0.25	15	0	0	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/10/14	2014	OCTOBER	ADAMS POINT	A	0.5	0.25	3	0	0	0	0	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/10/14	2014	OCTOBER	ADAMS POINT	A	1.0	0.25	1	0	0	0	0	0	0	0	3	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/10/14	2014	OCTOBER	ADAMS POINT	A	1.5	0.25	0.5	0	0	0	0	0	0	0	2	0	1	0	0	0	0	30	0	0	0	0	0	0	0	0	0
10/10/14	2014	OCTOBER	ADAMS POINT	B	0.0	0.25	7	0	0	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/10/14	2014	OCTOBER	ADAMS POINT	B	0.5	0.25	5	0	0	0	0	0	0	0	0	0	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/10/14	2014	OCTOBER	ADAMS POINT	B	1.0	0.25	1	0	0	0	0	0	0	0	90	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/10/14	2014	OCTOBER	ADAMS POINT	B	1.5	0.25	2	0	0	0	0	0	0	0	8	0	17	0	0	10	0	10	0	0	0	0	0	0	0	0	0
10/10/14	2014	OCTOBER	ADAMS POINT	C	0.0	0.25	17	0	0	83	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/10/14	2014	OCTOBER	ADAMS POINT	C	0.5	0.25	5	0	0	3	0	0	0	0	15	0	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/10/14	2014	OCTOBER	ADAMS POINT	C	1.0	0.25	1	0	0	0	0	0	0	0	7	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0
10/10/14	2014	OCTOBER	ADAMS POINT	C	1.5	0.25	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0
10/10/14	2014	OCTOBER	DEPOT ROAD	A	0.5	0.25	30	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/10/14	2014	OCTOBER	DEPOT ROAD	A	1.0	0.25	15	0	0	10	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/10/14	2014	OCTOBER	DEPOT ROAD	A	1.5	0.25	0	0	0	0	0	0	0	0	20	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/10/14	2014	OCTOBER	DEPOT ROAD	B	0.5	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/10/14	2014	OCTOBER	DEPOT ROAD	B	1.0	0.25	15	0	0	45	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/10/14	2014	OCTOBER	DEPOT ROAD	B	1.5	0.25	10	5	0	0	0	0	0	0	5	0	20	0	0	0	0	45	0	0	0	0	0	0	0	0	0
10/10/14	2014	OCTOBER	DEPOT ROAD	C	0.5	0.25	2	0	0	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/10/14	2014	OCTOBER	DEPOT ROAD	C	1.0	0.25	40	0	0	57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/10/14	2014	OCTOBER	DEPOT ROAD	C	1.5	0.25	2	0	0	0	0	0	0	0	0	0	7	0	0	3	0	55	0	0	0	0	0	0	0	0	0
10/15/14	2014	OCTOBER	HILTON PARK	A	0.5	0.25	2	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/15/14	2014	OCTOBER	HILTON PARK	A	1.0	0.25	1	1	0	0	0	1	0	0	60	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/15/14	2014	OCTOBER	HILTON PARK	A	1.5	0.25	5	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/15/14	2014	OCTOBER	HILTON PARK	A	2.0	0.25	18	0	0	1	0	0	0	0	0	0	0	0	0	50	0	30	0	0	0	0	0	0	0	0	0
10/15/14	2014	OCTOBER	HILTON PARK	B	0.5	0.25	18	3	0	13	0	0	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/15/14	2014	OCTOBER	HILTON PARK	B	1.0	0.25	4	0	0	20	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/15/14	2014	OCTOBER	HILTON PARK	B	1.5	0.25	6	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0

DATE	YEAR	MONTH	SITE	REP	ELEVATION (M)	PLOT SIZE (M^2)	Ulva Blade	Ulva Tube	Ulva prolifera	Gracilaria	Heterosiphonia japonica	Polysiphonia	Neosiphonia	Other Red algae	Ascophyllum nodosum	A.n. var. scorpioides	Fucus vesiculosus	F.v. var spiralis	Kelp	Vaucherria	Blacktar algae	Spartina alterniflora	S. Patens	Limonium sp.	Atriplex patula	Juncus gerardii	Salicornia depressa	Puccinnellia maritima	Plantago maritima	Ruppia maritima	Wrack
10/15/14	2014	OCTOBER	HILTON PARK	B	2.0	0.25	0	12	0	0	0	0	0	0	30	0	3	0	0	3	0	40	0	0	0	0	0	0	0	0	0
10/15/14	2014	OCTOBER	HILTON PARK	C	0.5	0.25	2	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/15/14	2014	OCTOBER	HILTON PARK	C	1.0	0.25	4	1	0	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/15/14	2014	OCTOBER	HILTON PARK	C	1.5	0.25	1	2	0	4	0	0	1	0	1	0	1	0	0	4	0	0	0	0	0	0	0	0	0	0	0
10/15/14	2014	OCTOBER	HILTON PARK	C	2.0	0.25	0	5	0	0	0	0	0	0	28	0	8	0	0	0	0	45	0	0	0	0	0	0	0	0	0
10/15/14	2014	OCTOBER	SUNSET HILL FARM	A	0.75	0.25	10	0	0	80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
10/15/14	2014	OCTOBER	SUNSET HILL FARM	A	1.0	0.25	1	0	0	85	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	5
10/15/14	2014	OCTOBER	SUNSET HILL FARM	A	1.5	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	0	0	0	0	0	0	0	0	0
10/15/14	2014	OCTOBER	SUNSET HILL FARM	B	0.75	0.25	3	0	0	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/15/14	2014	OCTOBER	SUNSET HILL FARM	B	1.0	0.25	9	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
10/15/14	2014	OCTOBER	SUNSET HILL FARM	B	1.5	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	80
10/15/14	2014	OCTOBER	SUNSET HILL FARM	C	0.75	0.25	5	0	0	94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10/15/14	2014	OCTOBER	SUNSET HILL FARM	C	1.0	0.25	8	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
10/15/14	2014	OCTOBER	SUNSET HILL FARM	C	1.5	0.25	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0	0	0	0	0	0	0	0
11/4/14	2014	NOVEMBER	FOUR TREE ISLAND	A	0.0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/4/14	2014	NOVEMBER	FOUR TREE ISLAND	A	0.5	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/4/14	2014	NOVEMBER	FOUR TREE ISLAND	A	1.0	0.25	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/4/14	2014	NOVEMBER	FOUR TREE ISLAND	A	1.5	0.25	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	35	0	0	0	0	0	0	0	0	0
11/4/14	2014	NOVEMBER	FOUR TREE ISLAND	A	2.0	0.25	0	0	0	0	0	0	0	0	1	0	15	0	0	0	0	77	0	0	0	0	0	0	0	0	0
11/4/14	2014	NOVEMBER	FOUR TREE ISLAND	A	2.5	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	80	4	0	0	0	0	0	0	0
11/4/14	2014	NOVEMBER	FOUR TREE ISLAND	B	0.0	0.25	0	1	0	0	0	3	0	0	0	0	0	0	40	0	0	0	0	0	0	0	0	0	0	0	0
11/4/14	2014	NOVEMBER	FOUR TREE ISLAND	B	0.5	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/4/14	2014	NOVEMBER	FOUR TREE ISLAND	B	1.0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/4/14	2014	NOVEMBER	FOUR TREE ISLAND	B	1.5	0.25	0	1	0	0	0	1	0	0	48	0	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/4/14	2014	NOVEMBER	FOUR TREE ISLAND	B	2.0	0.25	0	0	0	0	0	0	0	0	35	0	18	0	0	0	0	2	0	0	0	0	0	0	0	0	0
11/4/14	2014	NOVEMBER	FOUR TREE ISLAND	B	2.5	0.25	0	0	0	0	0	0	0	0	10	0	3	0	0	0	0	60	20	0	0	0	0	0	0	0	0
11/4/14	2014	NOVEMBER	FOUR TREE ISLAND	C	0.0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/4/14	2014	NOVEMBER	FOUR TREE ISLAND	C	0.5	0.25	0	0	0	0	0	0	0	0	0	0	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11/4/14	2014	NOVEMBER	FOUR TREE ISLAND	C	1.0	0.25	0	0	0	0	0	1	0	0	5	0	1	0	0	0	0	7	0	0	0	0	0	0	0	0	0
11/4/14	2014	NOVEMBER	FOUR TREE ISLAND	C	1.5	0.25	1	0	0	0	0	0	0	0	56	0	30	0	0	0	0	8	0	0	0	0	0	0	0	0	0
11/4/14	2014	NOVEMBER	FOUR TREE ISLAND	C	2.0	0.25	0	3	0	0	0	0	0	0	25	0	8	0	0	0	0	50	0	0	0	0	0	0	0	0	0
11/4/14	2014	NOVEMBER	FOUR TREE ISLAND	C	2.5	0.25	0	0	0	0	0	0	0	0	2	0	3	0	0	0	0	0	5	0	0	0	0	0	0	0	10

DATE	YEAR	MONTH	SITE	TRANSECT	ELEVATION (m)	PLOT SIZE (m^2)	Ulva Blade Cover (%)	Ulva Blade Biomass (g)	Ulva Tube Cover (%)	Ulva Tube Biomass (g)	Gracilaria Cover (%)	Gracilaria Biomass (g)	Ascophyllum nodosum Cover (%)	Ascophyllum nodosum Biomass (g)	Fucus vesiculosus Cover (%)	Fucus vesiculosus Biomass (g)
8/26/14	2014	AUG/SEPT	DEPOT ROAD	A	0.5	0.0625	60	1.454	0	0.000	0	0.075	0	0.00	0	0.00
8/26/14	2014	AUG/SEPT	DEPOT ROAD	A	1.0	0.0625	10	0.065	0	0.000	2	0.180	10	0.00	0	0.36
8/26/14	2014	AUG/SEPT	DEPOT ROAD	A	1.5	0.0625	0	0.021	1	0.017	4	0.268	2	0.18	0	0.35
8/26/14	2014	AUG/SEPT	DEPOT ROAD	B	0.5	0.0625	35	0.958	0	0.000	0	0.019	0	0.00	0	0.00
8/26/14	2014	AUG/SEPT	DEPOT ROAD	B	1.0	0.0625	40	1.572	0	0.003	50	4.780	0	0.00	0	0.00
8/26/14	2014	AUG/SEPT	DEPOT ROAD	B	1.5	0.0625	5	0.364	0	0.000	0	0.000	0	0.00	0	0.05
8/26/14	2014	AUG/SEPT	DEPOT ROAD	C	0.5	0.0625	0	0.000	0	0.000	0	0.000	0	0.00	0	0.00
8/26/14	2014	AUG/SEPT	DEPOT ROAD	C	1.0	0.0625	5	1.870	0	0.002	90	16.287	0	0.00	0	0.00
8/26/14	2014	AUG/SEPT	DEPOT ROAD	C	1.5	0.0625	1	0.084	5	0.010	1	0.000	0	0.00	10	3.95
8/28/14	2014	AUG/SEPT	FOUR TREE ISLAND	A	0.0	0.0625	0	0.000	0	0.000	0	0.000	0	0.00	0	0.00
8/28/14	2014	AUG/SEPT	FOUR TREE ISLAND	A	0.5	0.0625	0	0.000	0	0.000	0	0.000	0	0.00	0	0.00
8/28/14	2014	AUG/SEPT	FOUR TREE ISLAND	A	1.0	0.0625	0	0.000	0	0.000	0	0.000	0	0.00	0	0.00
8/28/14	2014	AUG/SEPT	FOUR TREE ISLAND	A	1.5	0.0625	1	0.024	1	0.001	0	0.000	0	0.00	2	0.24
8/28/14	2014	AUG/SEPT	FOUR TREE ISLAND	A	2.0	0.0625	0	0.000	0	0.000	0	0.000	15	7.24	10	13.67
8/28/14	2014	AUG/SEPT	FOUR TREE ISLAND	A	2.5	0.0625	0	0.000	0	0.000	0	0.000	0	0.00	0	0.00
8/28/14	2014	AUG/SEPT	FOUR TREE ISLAND	B	0.0	0.0625	0	0.000	0	0.000	0	0.000	0	0.00	0	0.00
8/28/14	2014	AUG/SEPT	FOUR TREE ISLAND	B	0.5	0.0625	0	0.000	0	0.000	0	0.000	0	0.00	0	0.00
8/28/14	2014	AUG/SEPT	FOUR TREE ISLAND	B	1.0	0.0625	0	0.000	0	0.000	0	0.000	29	15.05	20	3.95
8/28/14	2014	AUG/SEPT	FOUR TREE ISLAND	B	1.5	0.0625	0	0.000	0	0.000	0	0.000	0	0.83	45	23.45
8/28/14	2014	AUG/SEPT	FOUR TREE ISLAND	B	2.0	0.0625	0	0.000	0	0.000	0	0.000	7	5.43	5	0.67
8/28/14	2014	AUG/SEPT	FOUR TREE ISLAND	B	2.5	0.0625	0	0.000	0	0.000	0	0.000	0	0.00	0	0.00
8/28/14	2014	AUG/SEPT	FOUR TREE ISLAND	C	0.0	0.0625	0	0.000	0	0.000	0	0.000	0	0.00	0	0.00
8/28/14	2014	AUG/SEPT	FOUR TREE ISLAND	C	0.5	0.0625	0	0.000	0	0.000	0	0.000	0	0.00	0	0.00
8/28/14	2014	AUG/SEPT	FOUR TREE ISLAND	C	1.0	0.0625	0	0.000	0	0.000	0	0.000	8	2.88	30	9.37
8/28/14	2014	AUG/SEPT	FOUR TREE ISLAND	C	1.5	0.0625	0	0.000	0	0.000	0	0.000	10	2.90	50	18.42
8/28/14	2014	AUG/SEPT	FOUR TREE ISLAND	C	2.0	0.0625	0	0.000	0	0.000	0	0.000	25	32.47	20	3.92
8/28/14	2014	AUG/SEPT	FOUR TREE ISLAND	C	2.5	0.0625	0	0.000	0	0.000	0	0.000	0	0.00	0	0.00
9/5/14	2014	AUG/SEPT	HILTON PARK	A	0.0	0.0625	0	0.000	1	0.004	1	0.010	0	0.00	0	0.00
9/5/14	2014	AUG/SEPT	HILTON PARK	A	0.5	0.0625	0	0.000	0	0.000	0	0.000	0	0.00	0	0.00
9/5/14	2014	AUG/SEPT	HILTON PARK	A	1.0	0.0625	0	0.000	1	0.009	1	0.010	0	0.00	0	0.00
9/5/14	2014	AUG/SEPT	HILTON PARK	A	1.5	0.0625	2	0.024	0	0.000	25	0.996	1	0.56	0	0.00
9/5/14	2014	AUG/SEPT	HILTON PARK	A	2.0	0.0625	0	0.000	35	0.007	0	0.000	0	0.00	0	0.00
9/5/14	2014	AUG/SEPT	HILTON PARK	B	0.0	0.0625	15	0.445	2	0.005	10	0.450	0	0.00	0	0.00
9/5/14	2014	AUG/SEPT	HILTON PARK	B	0.5	0.0625	5	0.067	0	0.000	0	0.000	0	0.00	1	0.08
9/5/14	2014	AUG/SEPT	HILTON PARK	B	1.0	0.0625	35	0.511	0	0.000	25	1.356	2	0.47	0	0.00
9/5/14	2014	AUG/SEPT	HILTON PARK	B	1.5	0.0625	15	0.164	0	0.000	0	0.000	0	0.00	0	0.00
9/5/14	2014	AUG/SEPT	HILTON PARK	B	2.0	0.0625	5	0.005	0	0.000	0	0.000	15	12.55	10	6.39
9/5/14	2014	AUG/SEPT	HILTON PARK	C	0.0	0.0625	3	0.001	1	0.000	0	0.000	0	0.00	0	0.00
9/5/14	2014	AUG/SEPT	HILTON PARK	C	0.5	0.0625	1	0.003	0	0.000	1	0.022	0	0.00	0	0.00
9/5/14	2014	AUG/SEPT	HILTON PARK	C	1.0	0.0625	40	0.723	0	0.000	2	0.116	0	0.00	0	0.00
9/5/14	2014	AUG/SEPT	HILTON PARK	C	1.5	0.0625	1	0.022	0	0.000	0	0.000	0	0.00	0	0.00
9/5/14	2014	AUG/SEPT	HILTON PARK	C	2.0	0.0625	0	0.000	5	0.001	0	0.000	0	0.00	0	0.00
9/10/14	2014	AUG/SEPT	SUNSET HILL FARM	A	0.75	0.0625	0	0.000	0	0.000	0	0.000	0	0.00	0	0.00
9/10/14	2014	AUG/SEPT	SUNSET HILL FARM	A	1.00	0.0625	4	0.074	0	0.000	0	0.000	0	0.00	0	0.00
9/10/14	2014	AUG/SEPT	SUNSET HILL FARM	A	1.50	0.0625	0	0.000	0	0.000	0	0.000	0	0.00	0	0.00
9/10/14	2014	AUG/SEPT	SUNSET HILL FARM	B	0.75	0.0625	0	0.007	0	0.001	90	8.227	0	0.00	0	0.00
9/10/14	2014	AUG/SEPT	SUNSET HILL FARM	B	1.00	0.0625	2	0.021	0	0.000	40	2.401	0	0.00	0	0.00
9/10/14	2014	AUG/SEPT	SUNSET HILL FARM	B	1.50	0.0625	0	0.000	0	0.000	0	0.000	0	0.00	0	0.00
9/10/14	2014	AUG/SEPT	SUNSET HILL FARM	C	0.75	0.0625	0	0.000	0	0.019	20	1.336	0	0.00	0	0.00
9/10/14	2014	AUG/SEPT	SUNSET HILL FARM	C	1.00	0.0625	0	0.000	0	0.000	0	0.000	0	0.00	0	0.00
9/10/14	2014	AUG/SEPT	SUNSET HILL FARM	C	1.50	0.0625	0	0.000	0	0.000	0	0.000	0	0.00	0	0.00
9/15/14	2014	AUG/SEPT	ADAMS POINT	A	0.0	0.0625	25	2.637	0	0.000	70	12.002	0	0.00	0	0.00
9/15/14	2014	AUG/SEPT	ADAMS POINT	A	0.5	0.0625	10	0.313	0	0.000	0	0.000	0	0.00	75	17.19
9/15/14	2014	AUG/SEPT	ADAMS POINT	A	1.0	0.0625	0	0.004	0	0.000	0	0.000	0	0.00	5	0.55
9/15/14	2014	AUG/SEPT	ADAMS POINT	A	1.5	0.0625	0	0.000	0	0.000	0	0.000	0	0.00	0	0.00
9/15/14	2014	AUG/SEPT	ADAMS POINT	B	0.0	0.0625	10	2.694	0	0.000	90	14.701	0	0.00	0	0.00
9/15/14	2014	AUG/SEPT	ADAMS POINT	B	0.5	0.0625	5	0.422	0	0.000	0	0.000	35	24.99	40	9.20
9/15/14	2014	AUG/SEPT	ADAMS POINT	B	1.0	0.0625	0	0.000	0	0.000	0	0.000	0	0.00	10	1.44
9/15/14	2014	AUG/SEPT	ADAMS POINT	B	1.5	0.0625	0	0.000	0	0.000	0	0.000	60	45.59	0	0.00
9/15/14	2014	AUG/SEPT	ADAMS POINT	C	0.0	0.0625	20	3.353	0	0.000	75	10.746	0	0.00	0	0.00
9/15/14	2014	AUG/SEPT	ADAMS POINT	C	0.5	0.0625	60	1.928	1	0.004	4	0.174	0	0.00	5	0.45
9/15/14	2014	AUG/SEPT	ADAMS POINT	C	1.0	0.0625	0	0.000	0	0.000	0	0.000	55	64.63	0	0.00
9/15/14	2014	AUG/SEPT	ADAMS POINT	C	1.5	0.0625	0	0.000	0	0.000	0	0.000	0	0.00	0	0.00

Appendix B

Adam's Point:
September 2014
October 2014

Four Tree Island:
July 2014
August 2014
November 2014

Hilton Point:
July 2014
September 2014
October 2014

Depot Road (Great Bay Discovery Center; Sandy Point):
August 2014
October 2014

Sunset Hill Farm:
September 2014
October 2014

Looking Back to Plan Ahead: Macroalgal Trends in the Great Bay Estuary 1978-2014

University of New Hampshire

Molly R. McGovern advised by David M. Burdick

Jackson Estuarine Laboratory, Department of Natural Resources and the Environment

PREP Piscataqua Region Estuaries Partnership

Background

❖ **Issue:** Over the past 30 years, scientists studying the Great Bay Estuary have observed ecosystem shifts from valued eelgrass habitat to nuisance macroalgae as nutrient inputs to the Estuary have grown due to increasing population, wastewater, and impervious surfaces in the watershed (Cianciola and Burdick, 2014).

❖ **Past studies:** Sporadic surveys from 1978 to 2014 at different sites around the Great Bay have shown an increasing trend of nuisance algae (i.e. Ulva lactuca and Gracilaria spp.) Photographs of macroalgal cover framed within 0.25 m2 quadrats were taken at four different elevations at several sites including Cedar Point and Wagon Hill Farm in Little Bay and Depot Road, Lubberland Creek, Sandy Point, and Sunset Hill Farm in Great Bay over three different time periods (1978, 2008-2009, and 2013-2014). Average abundance for each species of macroalgae was determined at each site using two different approaches: percent cover and point intercept converted to percent cover.

❖ **This study:** Funded by the Piscataqua Region Estuaries Partnership, a new analysis of the photographs from all three sampling periods was performed using both analysis methods.

Methods

❖ Data Organization:

- Organization and consistent labeling of digital photographs taken in 2008-2011 by Jeremy Nettleton and in 2013-2014 by Elisabeth Cianciola on the program iPhoto.
- Ecktachrome slide photographs taken by Morgan Hardwick-Whitman in 1978 were projected on a screen, and a digital camera on a tripod was used to take pictures of each projection to allow download into iPhoto for analysis.
- All photographs were cropped to the inside edge of the .25 m^2 quadrat to create a generally uniform size photo in iPhoto.

Site photo, Lubberland Creek, Sep. 2009 (Jeremy Nettleton)

Cropped photo of quadrat, Lubberland Creek, Nov. 2013 (Elisabeth Cianciola)

Projection of Ecktachrome slide photo, Cedar Point, Sep. 1978 (Morgan Hardwick-Whitman)

❖ Analysis:

- **Percent-cover** of each macroalgae species was estimated within each quadrat
- **Point-intercept:** The "straighten" tool in iPhoto was used to overlay the photo with a 49-point grid. Macroalgal species intercepted by each point was recorded; percent-cover was generated by dividing the number of points for each species by 49 and multiplying by 100.
- Data was recorded in Microsoft Excel for three sites: Cedar Point, Lubberland Creek, Wagon Hill Farm at three different time periods: 1978, 2008-2009, and 2013-2014. Data was then analyzed in JMP to produce means and statistical results

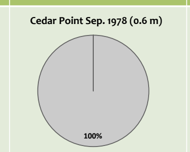
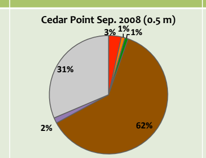
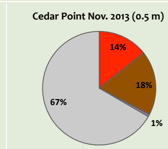
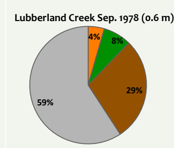
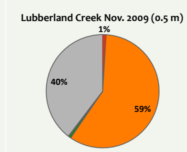
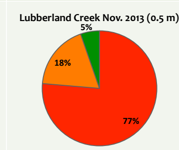
49-point grid in iPhoto used to determine point-intercept of macroalgae species. Wagon Hill, Sep. 2009 (Jeremy Nettleton)

Three study sites at Great Bay, NH (map from Google Earth)

Objectives

1. Does macroalgae species cover change *within* sites over time?
2. Does macroalgae species cover change *between* sites over time?
3. Do estimates of algal cover differ between the two analyses (percent cover and point intercept)?

Results

Analysis	1978	2008-2009	2013-2014	Cover type
% Cover				GRAC ULBL ULTU SPGR Brown Other Bare/wrack
Point-intercept				GRAC ULBL ULTU SPGR Brown Other Bare/wrack

Cover types:

❖ Nuisance algae**:**
- **GRAC:** *Gracillaria vermiculophylla*
- **ULBL:** *Ulva lactuca*
- **ULTU:** *Ulva filamentis*

(Nettleton, et. al, 2014).

❖ Aquatic rooted plants:
- **SPGR:** *Spartina* grasses (i.e. *Spartina alterniflora* and *Spartina patens*

❖ **Brown** algae
- *Ascophyllum nodosum*
- *Fucus vesiculosus*

❖ Other:
- *Chondrus crispus*
- *Dasysiphonia japonica*
- *Suaeda maritima*

Discussion:

❖ Visual increase of nuisance algae at Lubberland Creek and Cedar Point (from generation of pie charts).

❖ Statistical analysis currently underway to show trends and significance

References:

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Acknowledgments:

This project was funded the Piscataqua Region Estuaries Partnership. Thanks to phycologist Arthur Mathieson for help identifying species and to Chris Peter for help with Excel and JMP analysis.