2012 Eelgrass Survey for Eastern Long Island Sound, Connecticut and New York

U.S. Fish and Wildlife Service - 2013

Cover Photo: Mumford Cove, Groton, Connecticut.

2012 Eelgrass Survey for Eastern Long Island Sound, Connecticut and New York

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Table of Contents

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Introduction

Since eelgrass beds are vital habitats for marine and estuarine biota, there is interest in documenting their status and trends. The U.S. Fish and Wildlife Service's National Wetlands Inventory Program (NWI) has conducted eelgrass inventories for the eastern end of Long Island Sound since 2002. These inventories were initiated because the State of Connecticut's Office of Long Island Sound Programs wanted to know the status of eelgrass beds in 2001 and how they change over time. Since then, four surveys have been conducted: in 2002, 2006, 2009, and most recently in 2012 (Tiner et al. 2003, 2007, 2010).

The U.S. Environmental Protection Agency through the Long Island Sound Study provided funding to update these surveys. This report outlines survey methods, summarizes the 2012 results, and compares the findings with the 2009 survey.

Study Area

The project area encompasses the eastern end of Long Island Sound, including Fishers Island and the North Fork of Long Island (Figure 1). It includes all coastal embayments and nearshore waters (i.e., to a depth of –15 feet at mean low water) bordering the Sound from Clinton Harbor (CT) in the west to the Rhode Island border in the east and including Fishers Island and the North Shore of Long Island from Southold to Orient Point and Plum Island (NY). The study area includes the tidal zone of 18 sub-basins in Connecticut: Little Narragansett Bay, Stonington Harbor, Quiambog Cove, Mystic Harbor, Palmer-West Cove, Mumford Cove, Paquonock River, New London Harbor, Goshen Cove, Jordan Cove, Niantic Bay, Rocky Neck State Park, Old Lyme Shores, Connecticut River, Willard Bay, Westbrook Harbor, Duck Island Roads, and Clinton Harbor, and two areas in New York: Fishers Island and a portion of the North Shore of Long Island.

Figure 1. Location of eelgrass survey study area, with coastal sub-basins identified.
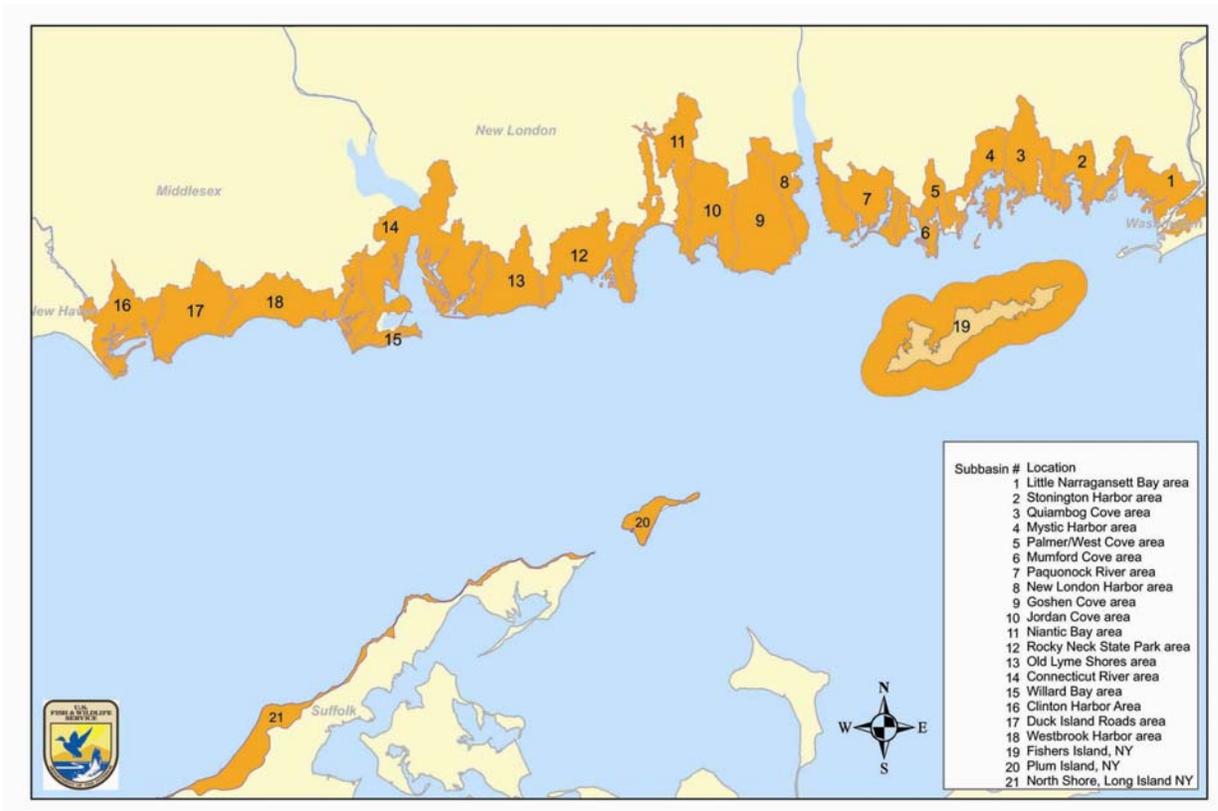
Methods

Acquisition of Aerial Photography

The National Oceanic and Atmospheric Administration's Coastal Change Analysis Program developed aerial photography specifications for mapping submerged aquatic beds in coastal regions (Dobson et al. 1995). June is the recommended flying time for submersed rooted vascular plants in the Northeast. The imagery for this project was 1:20,000 true-color aerial photography captured during low tide on August 7, 2012. Earlier photo acquisition was not possible due to unfavorable weather conditions.

Eelgrass Database Construction

Aerial photographs were scanned to create digital images for interpretation. Digital imagery was interpreted on-screen to delineate eelgrass beds and create a digital database of these beds. Three categories of aquatic beds were initially identified: 1) eelgrass beds, 2) areas where eelgrass beds were suspected to exist, and 3) areas that had aquatic vegetation but not eelgrass. Given the lack of field verification (see next subsection), data collected from the previous survey was consulted to provide some insight for the present survey. If an eelgrass bed did not appear on the 2009 survey (i.e., was field verified as not eelgrass in 2009), the bed was not included in the 2012 survey. If, however, a new bed was located on the 2012 imagery, it was mapped as "undetermined aquatic vegetation." In some cases, very small beds that were identified during the field work for the prior survey were retained for the 2012 survey (i.e., mapped as points and buffered to yield a polygon of 0.1-acre in size).

Bed density was determined using spectral signatures in the current imagery with three categories recognized: high, medium, and low (Figure 2). The results of earlier surveys (including their field observations) were used to help identify these signatures.

In preparing a layer that highlights eelgrass changes, three categories were identified: loss, gain, and no change. Differences in image quality between 2012 and 2009 and lack of field verification created some challenges for image analysts. When delineating a loss or gain, image analysts focused on what was visible on the imagery. The configuration of some pre-existing beds was revised accordingly but whether the change was marked as a gain, loss, or no change was left to the interpreter.

Field Work

Since this project was an add-on to the 2009 survey using some remaining funds, time and budget did not allow for extensive field work. Also the occurrence of Hurricane Sandy was a factor in reducing field effort. Due largely to the late season acquisition of the imagery and unfavorable weather conditions, only one day of field work was conducted on October 2, 2012 prior to Hurricane Sandy. A total of 13 points were inspected. Given the likely effects of the hurricane on aquatic vegetation and on bed

sediments, field work was suspended as agency efforts focused on other issues. Due to the lack of field verification, questionable beds were simply identified as undetermined submerged aquatic vegetation.

Geospatial Data

While printable maps were not prepared for this project, two geospatial data layers were prepared for display via an online mapper. One layer shows the mapped beds and the other shows the changes in the beds from 2009 to 2012.
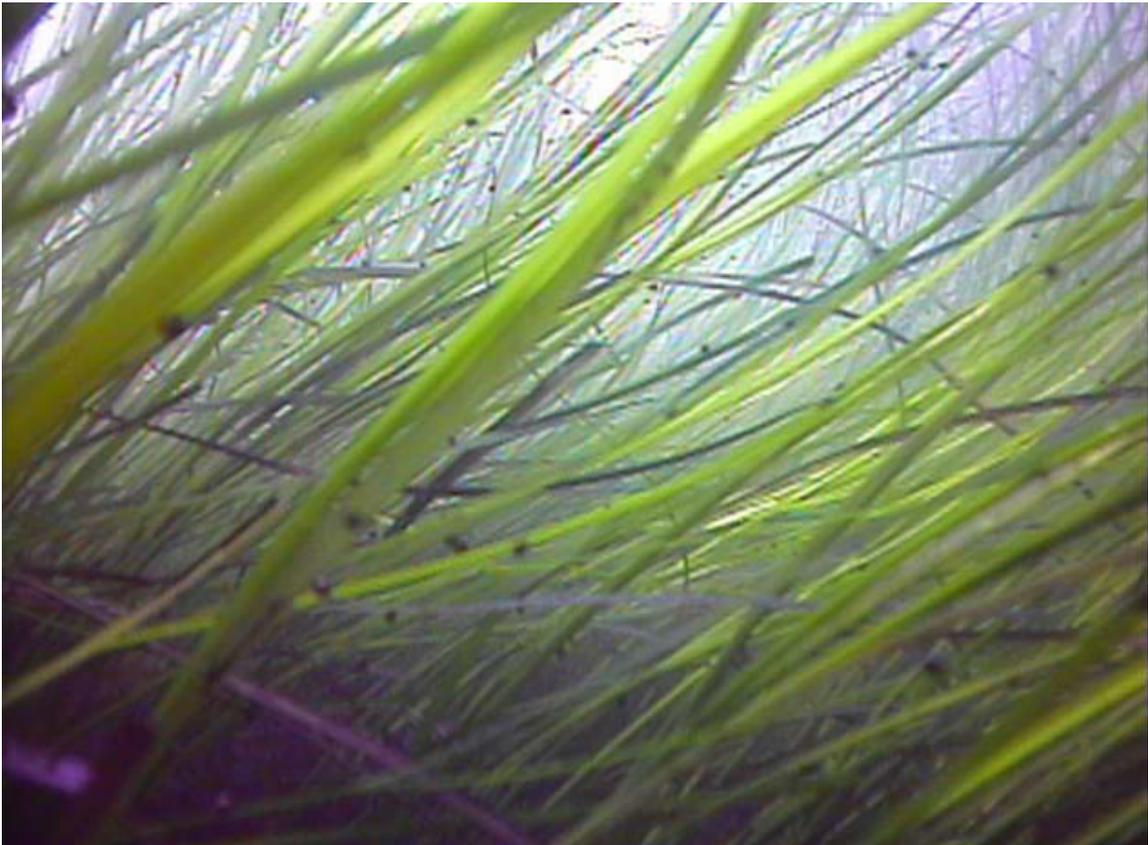

Figure 2. Eelgrass bed – high density.

Results

Online Maps and Geospatial Data

Two data layers were prepared for presenting the results of this survey: (1) the location of eelgrass beds and other submerged aquatic vegetation that could include eelgrass but was not field verified and (2) changes in the eelgrass from 2009-2012. These layers can be uploaded and viewed on the NWI+ web mapper, an online mapping tool posted at: http://aswm.org/wetland-science/wetlands-one-stop-mapping.[1] When you access the site, scroll down the list of topics at the bottom of the page to "NWI+ Mapper", then click on that topic and you'll be directed to the "NWI+ Web Mapper" page. To open the mapper, click on "NWI+ Web Mapper" in the first line of text. The mapper will take a little time to load but you'll soon see a map of the U.S. with several red boxes. Zoom into Connecticut (see Appendix for an overview of the mapper and tips on using it); click on the "Map Contents" to view the potentially available NWI+ data layers. You will need to add the eelgrass layers to this list; be sure to check off the marked box so that no data are showing on the map (i.e., you will only see the base map). To obtain the eelgrass layers (status and trends) simply click on the "Search" icon (the magnifying glass) on the tool bar above the map, then click on the ESRI online tab (middle tab) and type "Long Island Sound eelgrass" in the space provided, then click on the magnifying glass to the right of the line. This will produce a list of data sets related to eelgrass. Scroll down the list and choose "Long Island Sound 2012 Eelgrass Bed Density and SAV" for the location of the 2012 beds and "Long Island Sound 2012 Eelgrass Trends" to view the changes between 2009 and 2012. To add them to the NWI+ web mapper, simply click on the word "Add" just to the right of the layer name. The data can be viewed on aerial imagery or a variety of maps via the mapper.

When the status layer is visible (turned on), the distribution of the eelgrass beds will be shown by density - high (red), medium (orange) and low (tan) and the other beds (undetermined SAV) in green (Figure 3). When the trends layer is open, areas of gain will be shown in green, areas of loss in red, and areas of eelgrass beds that did not change in brown (Figure 4).

The eelgrass geospatial data will posted for downloading on CTDEEP's website: http://www.ct.gov/deep/cwp/view.asp?a=2698&q=322898&deepNav_GID=1707.

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[1] Note that links to internet sites may change over time, so if this link is not working, use a search engine to access the Association of State Wetland Managers "Wetlands One-Stop Mapping" site.
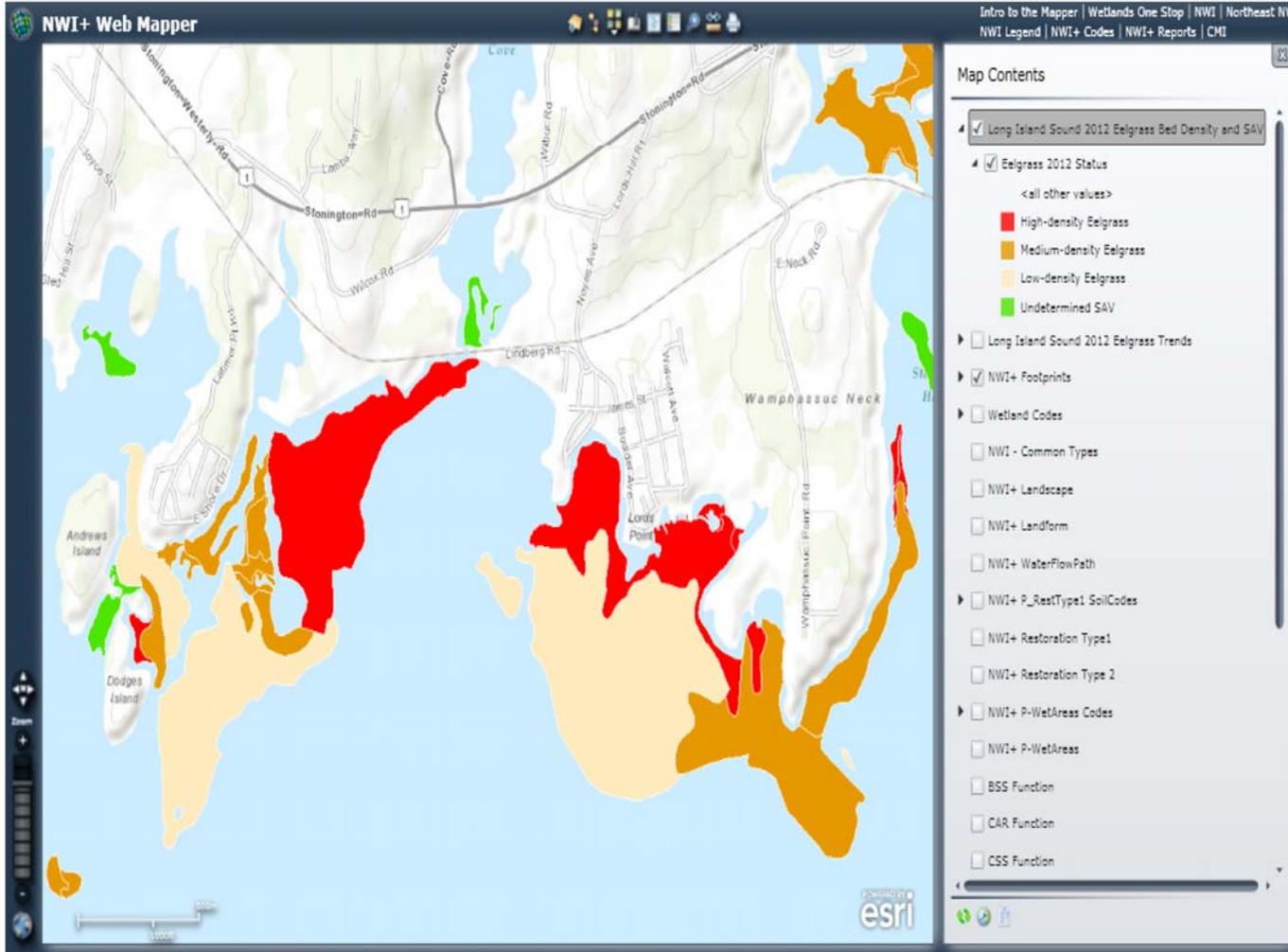
Figure 3. Example of eelgrass status map from the NWI+ web mapper. "Print screen" was used to obtain this image.
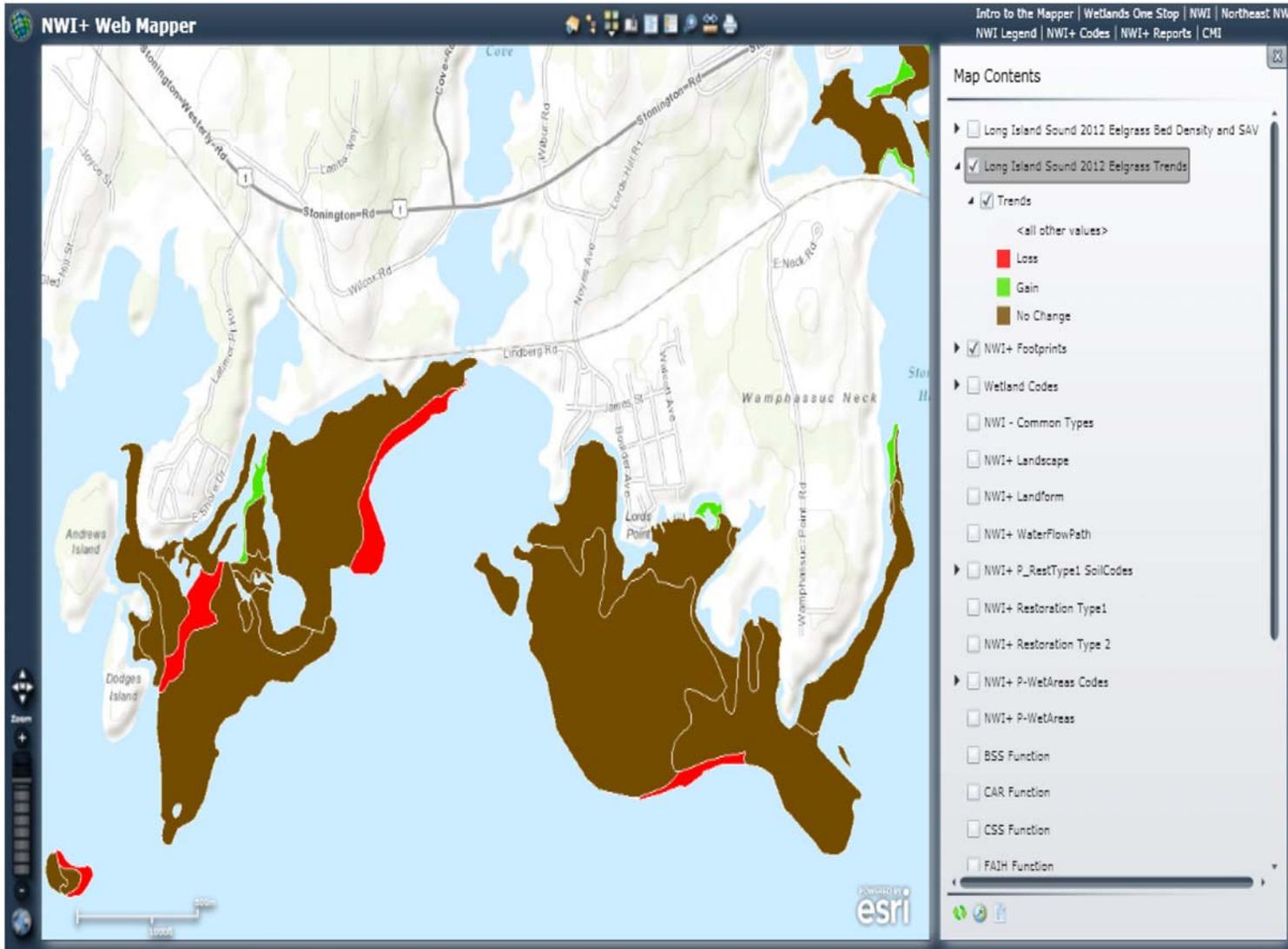
Figure 4. Example of eelgrass change map from the NWI+ web mapper.

Extent of Eelgrass and Other Submerged Vegetation

A total of 240 eelgrass beds accounting for 2,061 acres were inventoried, while another 80 beds of undetermined submerged aquatic vegetation totaling approximately 584 acres were also mapped (Tables 4 and 5, respectively; Figure 5). Seven sub-basins had over 100 acres of eelgrass beds: Fishers Island (402.8 acres), Quiambog Cove (388.2), Little Narragansett Bay (327.1), Niantic Bay (243.8), Mystic Harbor (164.8), Goshen Cove (121.2), and Rocky Neck State Park (104.8). Figure 5 shows the location of eelgrass and undetermined submerged aquatic beds in the study area as of August 7, 2012.

Figure 5. General distribution of eelgrass and undetermined submerged aquatic vegetation (SAV) for eastern Long Island Sound in 2012. Note that the SAV represent areas that may support eelgrass to some degree but since they were not field checked they could not be designated as eelgrass.
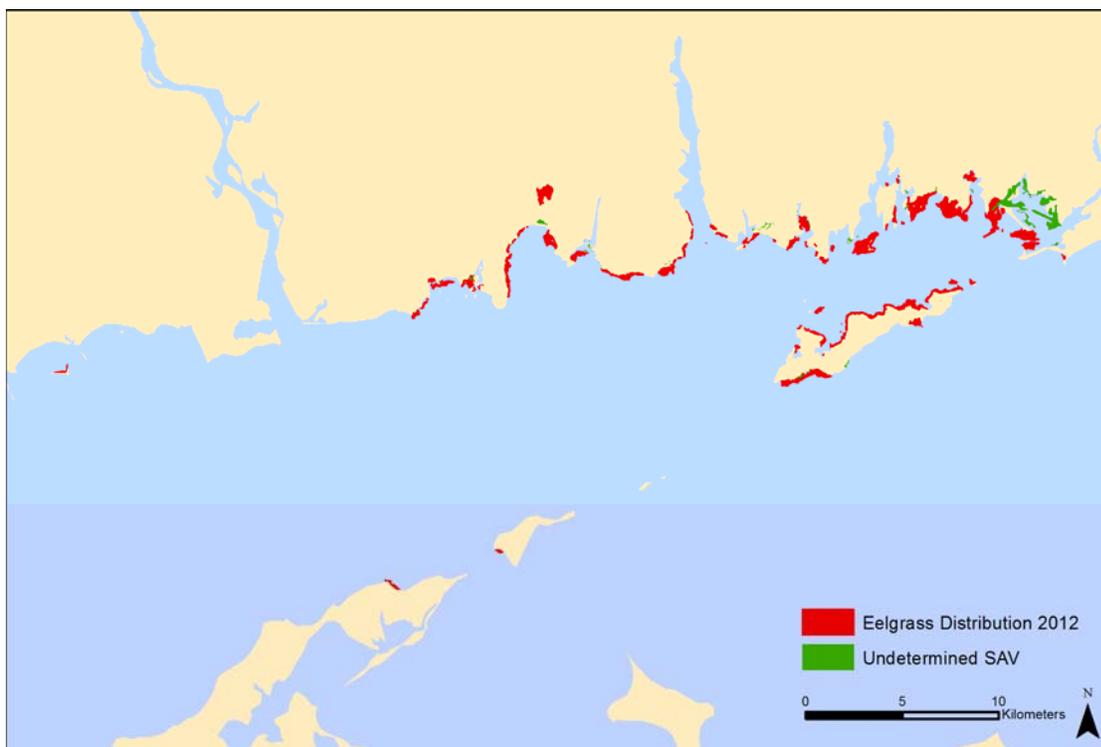
Table 4. Eelgrass beds in eastern Long Island Sound in 2012. Sites are in Connecticut, except where noted otherwise.

Sub-basin	Acres of High Density (number)	Acres of Medium Density (number)	Acres of Low Density (number)	Total Acres (number)
Little Narragansett Bay	109.0 (9)	188.1 (11)	30.0 (4)	327.1 (24)
Stonington Harbor	2.4 (2)	55.0 (9)	0.3 (1)	57.7 (12)
Quiambog Cove	108.4 (6)	99.9 (16)	179.9 (5)	388.2 (27)
Mystic Harbor	11.1 (3)	129.8 (6)	23.9 (4)	164.8 (13)
Palmer-West Cove	0	14.5 (1)	8.5 (1)	23.0 (2)
Mumford Cove	2.9 (3)	72.6 (10)	15.5 (3)	91.0 (16)
Paquonock River	9.0 (2)	16.2 (9)	0	25.2 (11)
New London Harbor	12.9 (9)	28.8 (5)	0	41.7 (14)
Goshen Cove	0	82.4 (14)	38.8 (1)	121.2 (15)
Jordan Cove	6.5 (3)	32.4 (7)	5.1 (1)	44.0 (11)
Niantic Bay	41.0 (5)	137.5 (16)	65.1 (4)	243.6 (25)
Rocky Neck State Park	4.0 (2)	16.7 (17)	84.1 (16)	104.8 (35)
Duck Island Roads	0	5.6 (1)	2.1 (1)	7.7 (2)
Fishers Island, NY	218.7 (9)	137.9 (11)	46.2 (3)	402.8 (23)
North Shore, NY	4.2 (4)	6.6 (5)	0	10.8 (9)
Plum Island, NY	0	7.5 (1)	0	7.5 (1)
Total	530.1 (57)	1,031.5 (139)	499.5 (44)	2,061.1 (240)

Note: *In earlier surveys, a 2.1-acre low density eelgrass bed was mapped for the Connecticut River Area in Long Island Sound just off the mouth of the Connecticut River because it was identified by field personnel. In the 2012 imagery, this bed was not detected and it is not included in this survey. Given that this bed was never observed on any of the imagery (2002, 2006, 2009 or 2012), it is also not reported in this survey as a loss.*

Table 5. Other submerged aquatic beds in eastern Long Island Sound in 2012. These beds are not likely to be eelgrass but were mapped since their vegetation could not be verified given issues with field work. Sites are in Connecticut, except where noted otherwise.

Sub-basin	Acres of High Density (number)	Acres of Medium Density (number)	Acres of Low Density (number)	Total Acres (number)
Little Narragansett Bay	54.0 (7)	63.5 (7)	352.0 (6)	469.5 (20)
Stonington Harbor	0	0.4 (1)	3.9 (1)	4.3 (2)
Quiambog Cove	0	7.5 (3)	3.4 (1)	10.9 (4)
Mystic Harbor	0	1.6 (1)	1.2 (1)	2.8 (2)
Palmer-West Cove	0	9.4 (1)	0	9.4 (1)
Mumford Cove	0	7.8 (5)	0.3 (1)	8.1 (6)
Paquonock River	2.4 (1)	15.0 (11)	0.1 (2)	17.5 (14)
New London Harbor	0	0.1 (1)	0	0.1 (1)
Goshen Cove	0	1.4 (5)	1.0 (1)	2.4 (6)
Jordan Cove	0	11.1 (14)	0	11.1 (14)
Niantic Bay	0	10.1 (2)	12.2 (3)	22.3 (5)
Rocky Neck State Park	0	7.6 (1)	1.0 (1)	8.6 (2)
Duck Island Roads	0	0	0	0
Fishers Island, NY	6.9 (1)	9.9 (1)	0.1 (1)	16.9 (3)
North Shore, NY	0	0	0	0
Plum Island, NY	0	0	0	0
Total	63.3 (9)	145.4 (53)	375.2 (18)	583.9 (80)

Comparison with Earlier Surveys

When comparing 2012 findings with 2009 survey results, we detected a gain of 83 acres (Table 6). The sub-basins with the largest increases in eelgrass area were Fishers Island and Niantic Bay, whereas Quiambog Cove and Little Narragansett Bay appeared to experience the most losses. The lack of field surveys to verify the presence of eelgrass in submerged vegetation stands led us to designate an additional 584 acres as undetermined aquatic beds. These beds are likely to be algal beds since they were not observed in earlier surveys, but they could contain eelgrass to some degree.

Table 6. Differences in eelgrass survey results from 2002 to 2012. + indicate gains and – losses.

Sub-basin	2002-2006 Acreage Change	2006-2009 Acreage Change	2009-2012 Acreage Change
Little Narragansett Bay	-2.8	+60.0	-15.9
Stonington Harbor	+28.0	-15.1	+2.0
Quiambog Cove	+70.7	-20.6	-19.1
Mystic Harbor	+61.9	+20.9	+3.1
Palmer-West Cove	+0.1	-12.2	+0.3
Mumford Cove	-11.0	+7.0	+8.9
Paquonock River	-2.9	-3.1	+1.1
New London Harbor	+3.9	-0.9	+8.2
Goshen Cove	-4.9	-27.7	-3.2
Jordan Cove	-6.5	+1.7	+5.6
Niantic Bay	+130.2	-57.0	+31.7
Rocky Neck State Park	+7.7	-7.7	+2.1
Connecticut River Area	-0-	+2.1	**
Duck Island Roads	+5.3	-0-	+1.3
Fishers Island, NY	+7.8	+22.5*	+56.9
North Shore, NY	+9.2	-14.4	+0.3
Plum Island, NY	+9.5	-1.9	-0.1
Total	+306.2	-46.4*	+83.2

*Two large beds totaling 122.1 acres on the south side of Fishers Island could be seen on the 2009 imagery while they were not visible on 2006 imagery due to environmental conditions. Field inspections in 2006 had located robust beds in this area and recorded their occurrence as points since the beds could not be accurately delineated on the imagery. Consequently, for the 2009 report, this acreage was not treated as a gain because robust beds were noted in this area in 2006 and their boundaries could not be established.
**Not assessed due to lack of field review; could not be verified on imagery as either a loss or gain, since site was only recorded in past through field observation.

Recommendations for Future Surveys

The use of helicopter surveys to verify beds may be worth investigating. Helicopters can cover much ground in a short period and timing could be tailored to the best conditions for eelgrass bed observation (low tide) and for accessing sites where boat access requires costly travel time.

Capturing video images via conventional aircraft or unmanned aerial vehicles (UAVs) is possible low-cost option for verifying beds and/or acquiring basic data. The latter are being used for research studies at Virginia Tech. Perhaps this would be worth exploring in a pilot study.

A final option to improve the results is to conduct a pilot study to evaluate the advantages that larger scale imagery would offer in terms of detecting beds and estimating their density. Acquisition of larger scale photos (1:12,000) or high-resolution digital imagery would allow an interesting comparison with current techniques.

This survey identified nearly 600 acres of other submerged aquatic vegetation (SAV) that was not reported during earlier surveys. This may be due to differences in the quality of the imagery (e.g., timing of acquisition or water clarity) or simply to a difference in interpretation of a photo signature. These sites may or may not contain eelgrass. Since the sites were not field checked they were included in the inventory as "undetermined SAV" rather than omit them from the survey. Future inventories should include field work to check these areas to determine if eelgrass is present or not and if present, assess the density of the beds.

Summary

The 2012 survey located 240 eelgrass beds in eastern Long Island Sound totaling 2,061 acres. An additional 80 beds of undetermined submerged aquatic vegetation totaling approximately 584 acres were also identified. Seven sub-basins had over 100 acres of eelgrass beds: Fishers Island, Quiambog Cove, Little Narragansett Bay, Niantic Bay, Mystic Harbor, Goshen Cove, and Rocky Neck State Park. Compared with the 2009, eelgrass in this portion of Long Island Sound increased by 83 acres. The largest gains occurred in the Fishers Island and Niantic Bay sub-basins (+57 and +32 acres, respectively). Quiambog Cove and Little Narragansett Bay sub-basins experience the most losses (-19 and -15 acres, respectively). The results of this survey can be viewed via an online mapper – the NWI+ web mapper – following instructions given in the Results section.

Acknowledgments

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APPENDIX. An Introduction to the NWI+ Web Mapper

An Introduction to the NWI+ Web Mapper
(November 25, 2013)

Introduction

The NWI+ web mapper is an online mapping tool that allows users to display a collection of special National Wetlands Inventory (NWI) project wetland data on different types of base maps. The mapper is an ESRI product while the wetlands data are produced by the U.S. Fish and Wildlife Service and its cooperators. The mapper was developed by Virginia Tech's Conservation Management Institute (CMI, Blacksburg, VA) to make available special project data that it was mainly producing for the Northeast Region of the U.S. Fish and Wildlife Service, NWI Program. Besides showing wetland types classified according to the Cowardin et al. (1979) classification system which is the Service's standard classification, the data include hydrogeomorphic classification as recommended by the Federal Geographic Data Committee (LLWW descriptors – landscape position, landform, water flow path, and waterbody type) and a preliminary assessment of wetland functions at the landscape-level (up to 11 functions), while for some projects, the location and type of potential wetland restoration sites and potential wetland areas (e.g., undeveloped hydric soils that were not mapped as NWI wetlands due to a lack of a recognizable wetland photo-signature) may be displayed.

Format of the Mapper

The mapper will open to a map of the United States with project areas outlined in red. Above the map is a tool bar that includes several icons from left to right (each icon is described in the next section): "Browse", "Remove Layer", "Choose Basemap", "Show NWI+ Bookmarks", "Map Contents", "Show Legend", "Search", "Measure", and "Print". To the right of these icons is a list of topics that will take you to various websites such as the Service's NWI (national website), Region 5's NWI website, and Virginia Tech's CMI website.

What the Icons Do

"Browse" – allows you to add other geospatial data to the mapper. For example you could add other base maps and imagery from a pre-chosen list or add geospatial data from a website.

"Remove Layer" – remove a layer that you've added.

"Choose Basemap" – select the type of basemap you'd like to display the data on – maps or imagery.

"Show NWI+ Bookmarks" – provides a list of the project names where NWI+ data are available.

"Map Contents" – perhaps the most important icon – clicking on this will produce a table of contents on the right side of the map. Boxes are located to the left of each data layer. Two boxes are marked as default ("NWI+ Footprints" shows the project areas while the "NWI+ Landscape" shows wetlands classified by landscape position). To view other data layers, click off the "NWI+ Landscape" checkmark, then click on the box of the topic of interest. A summary of each of the NWI+ data layers is in the next section.

"Show Legend" – displays a series of legends related to the layers in map contents.

"Search" – allows you to zoom into a particular address by clicking on "Place" and then typing the address in the box, or to search the web to find geospatial data to add to the mapper. For example, NWI data for the entire country can be added by clicking on "The Web" then typing in "national wetlands inventory" then click on the magnifying glass on the right… the FWS wetlands web mapping service will be listed, then simply click on "Add" and the FWS NWI data will be added to the mapper for this session. The NWI data will be the first layer on the list and all its contents (data layers) will be active. The first NWI layer is "Wetlands Data" that will show the location/type of wetlands and deepwater habitats for the entire country, but you'll need to zoom in to see the data. The default at the national level will show the status of the NWI; I'd suggest clicking off all the other NWI data layers until you are interested in viewing them. Throughout this mapper, the first box checked will take precedence over others checked. In other words, that data will overlie other data that are checked, so you'll have to uncheck the boxes for data layers that are not of interest…that will remove them from view.

"Measure" – allows you to measure length and area on the map (use the freehand polygon to draw an irregularly shaped polygon).

"Print" – allows you to prepare a map of the data in view and either send it to your printer or to produce a pdf image for storing on your computer. You can also use the "Print Screen" key on your keyboard to do the same. This will allow you to print the legend alongside of the map just as the image you are viewing.

The NWI+ Data Layers

Some of the following layers have legends showing the variety of categories within the layer. To view the legend simply click on the name of the layer, and then on the word "legend" that will appear. A colored coded legend will then come into view.

"NWI+ Footprints" – shows project areas where NWI+ data are available.

"Wetland Codes" – places dots on the wetlands so that user can click on the dot to get the wetland classification by NWI type and by LLWW type.

"NWI Types" – shows mapped wetlands and deepwater habitats by Cowardin et al. types (color-coded types – legend can be viewed by clicking on "NWI Types" then on "Legend").

"NWI+ Landscape" – shows mapped wetlands classified by landscape position (color-coded types – view legend as described above)

"NWI+ Landform" – shows mapped wetlands classified by landform (color-coded types – view legend as described above)

"NWI+ WaterFlowPath" - shows mapped wetlands classified by water flow path (color-coded types – view legend as described above)

"NWI+ Rest Type 1 Soil Codes" – should be viewed with "NWI+ Restoration Type1" – shows dots that when clicked on identify the soil type for this former wetland site (hydric soil but not wetland today??).

"NWI+ Restoration Type1" – shows former wetlands (based on hydric soils data) that have been developed but are in a land use that may be suitable for restoration; many are drained hydric soils that are now in agricultural use. A legend lists the major types of these former wetlands (color-coded to type).

"NWI+ Restoration Type2" – shows existing wetlands that have been altered in some way that has affected their natural functions. A legend indicates the nature of the restoration type. To view their classification and the nature of the alteration, check the box for "Wetland Codes" and then on the dot in the wetland of interest. The alterations include ditched (d), diking/impoundment (h), excavation (x) and farmed wetlands (f). Many are partly drained wetlands, while others are ponds created by excavating former vegetated wetlands or diking vegetated wetlands to create open water habitat and altering the hydrology of remaining marshes and swamps.

"NWI+ P-WetArea Codes" – should be viewed with "NWI+ P-WetAreas" – shows dots that when clicked on identify the soil type for these hydric soil areas that may support wetlands.

"NWI+ P-WetAreas" – shows hydric soil areas (mapped by USDA Natural Resources Conservation Service) that are in "natural vegetation" but lacked an identifiable wetland photo-signature and were not mapped as wetlands by the NWI; given that they have not been developed it is quite possible that they may support wetlands to some degree.

"_____ Function" shows wetlands predicted to perform specific functions at significant levels (e.g., high or moderate): "BSS" (bank and shoreline stabilization, "CAR" (carbon sequestration, "CSS" (coastal storm surge detention), "FAIH" (fish and aquatic invertebrate habitat), NT (nutrient transformation), OWH (other wildlife habitat), SM (streamflow maintenance), SR (sediment and other particulate retention), SWD (surface water detention – for freshwater wetlands only), UWPC (uncommon or highly diverse wetland plant communities – based on NWI codes only), and WBIRD (waterfowl and waterbird habitat).

Adding Other Data Layers to the Web Mapper

To increase the functionality of the NWI+ Web Mapper, you can add other GIS data to the mapper. For this use the "Search" tool (magnifying glass) on the tool bar at the top of the mapper. Before using this tool, you may want to check off any marked box (NWI+ data layer) that can be seen when viewing "Map Contents." By doing this only the base map or image will be visible on the mapper (i.e., all the NWI+ data layers are turned off). To obtain another GIS data layers simply click on the "Search" tool (the magnifying glass) on the tool bar above the map, then click on the ESRI online tab (middle tab) and type the name of a layer you wish to view in the space provided (e.g., NHD data, NWI wetlands, Presence of hydric soils), then click on the magnifying glass to the right of the line. This will produce a list of data sets related to that topic. Scroll down the list and choose the one you are interested in, then add it to the NWI+ web mapper by simply clicking on the word "Add" just to the right of the layer name. The layer will appear in the Map Contents window at the top of the list (i.e., when "Map Contents" is open), but the data may not be visible because of scale-dependency. Zoom in as necessary to view the data. A scale bar on the bottom of the map identifies the relative scale (linear dimensions). To view the legend, double-click on the name of the layer in "Map Contents" and on any other name that opens up below the layer name. To remove the layer, use the "Remove" icon on the toolbar.