2023

Seagrass Meadows – Forests under the Sea

Seagrass Extent
Little Narragansett Bay and the Coastal Salt Ponds

NARRAGANSETT BAY ESTUARY PROGRAM

Science Update:
Seagrass Extent in the Little Narragansett Bay and the Coastal Salt Ponds Between 2009-2021.

Narragansett Bay Estuary Program

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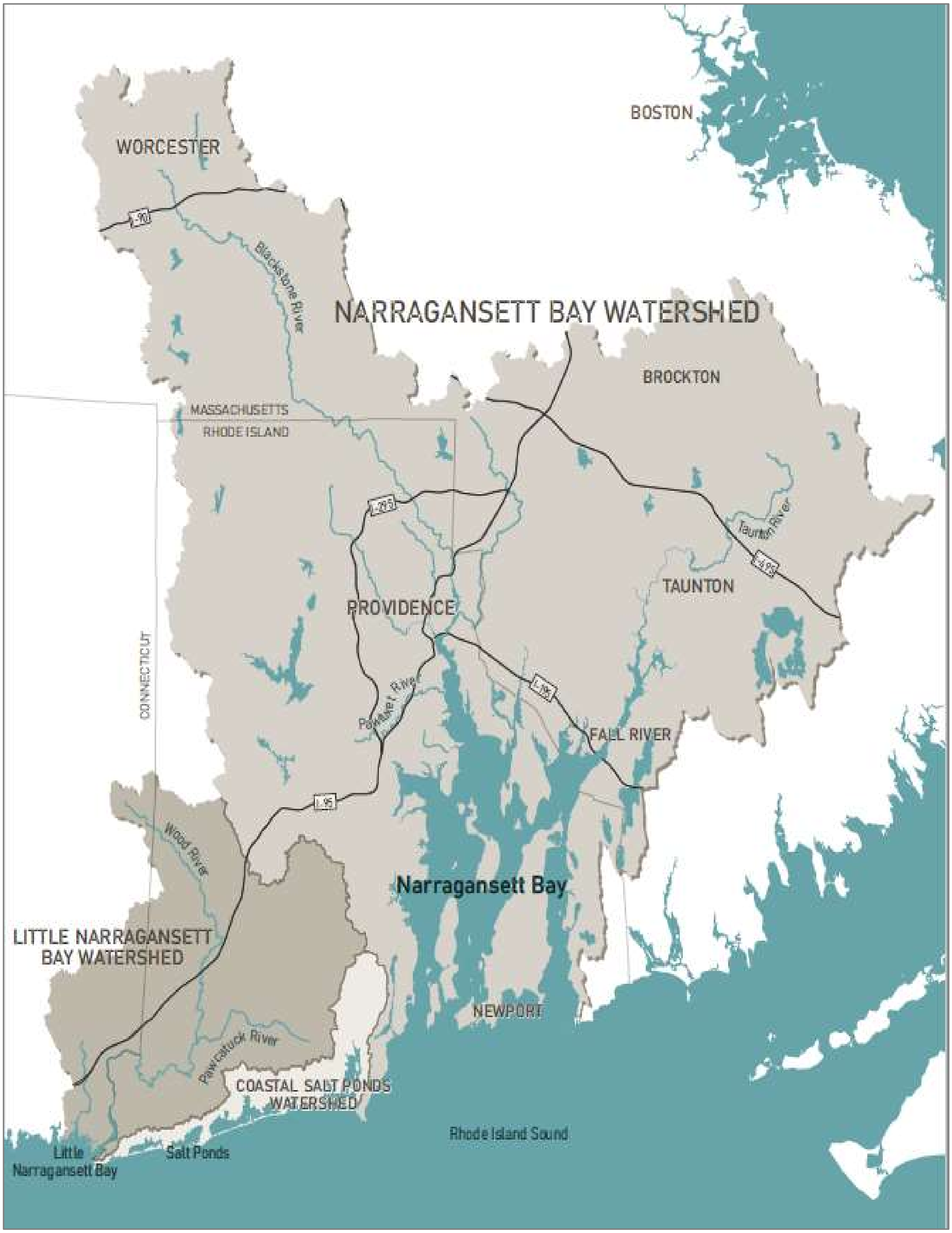
NARRAGANSETT BAY ESTUARY PROGRAM AND ITS STUDY AREAS

The Narragansett Bay Estuary Program is part of the National Estuary Program, established in 1987 as an amendment to the federal Clean Water Act administered by the U.S. Environmental Protection Agency (EPA). The NBEP uses a voluntary, community-driven approach to enhance the water quality, wildlife, and quality of life in Narragansett Bay, Little Narragansett Bay, Coastal Ponds, and their watersheds in Rhode Island, Massachusetts, and Connecticut. The landscape unites 2 million people across 113 communities in 3 states. It hosts diverse habitats that sustain wildlife and vital economies.



Map of Narragansett Bay Estuary Program Study Areas

PURPOSE

This science update presents the change in seagrass extent from 2009 – 2021 in two of NBEP's study areas – Little Narragansett Bay and the Coastal Salt Ponds. This report is the first time NBEP is presenting seagrass acreage change for the Little Narragansett Bay and the Coastal Salt Ponds. For information on changes in seagrass extent in the Narragansett Bay Watershed, which is an update of the 2017 State of Narragansett Bay and Its Watershed, please see our two page science update included in this download.

The purpose of these documents is to inform our audience on seagrass acreage change in NBEP's study areas and to identify areas for further research. NBEP hopes that this update stimulates discussion among our partners and seagrass experts. The audience for this piece is anyone who is interested in seagrass extent, particularly environmental managers, members of community outreach groups, and the interested public.

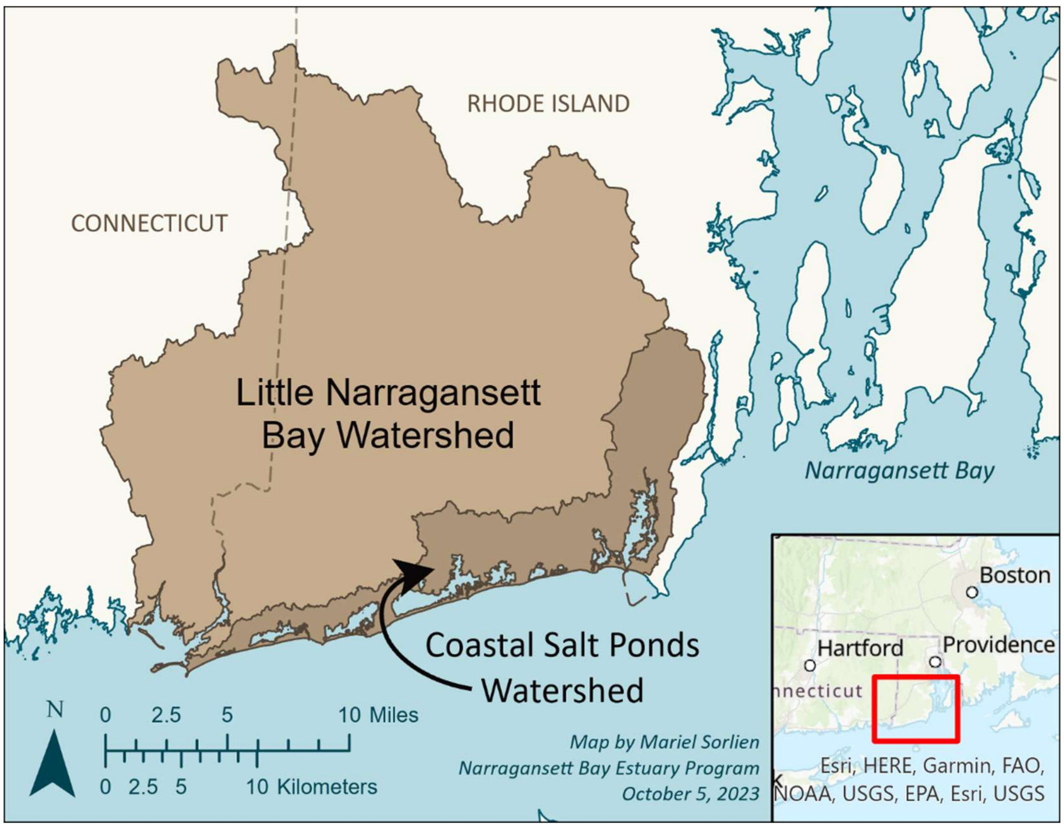


Figure 1. Little Narragansett Bay and Coastal Salt Ponds Watersheds.

WHAT IS SEAGRASS?

Seagrasses are aquatic vascular flowering plants that stabilize sediments and provide vital habitat and nursery grounds for fish and shellfish. Two types of seagrasses are found in the region: eelgrass (*Zostera marina*) and widgeongrass (*Ruppia maritima*). Eelgrass is a predominantly estuarine species, while widgeongrass thrives in lower salinity waters (Kantrud 1994). Eelgrass is taller than widgeongrass, and the two species have been observed intermixing within seagrass beds in the Coastal Salt Ponds (this study).

Because seagrasses require abundant light, they are restricted to shallow areas with clear water. The slope of the substrate and the amount of light that can penetrate the water determine the greatest distance that seagrasses can grow from shore (Dennison and Alberte 1985, Mann 2000). In temperate zones, seagrasses flower between 50°F and 70°F (10 and 20°C). They live in areas with low nutrient input, as high nutrient levels tend to favor nuisance macroalgae, phytoplankton, and epiphytic growth that shade seagrasses and reduce their growth (Mann 2000). Seagrasses are generally considered perennial plants, but in the shallowest areas (less than approximately 3 feet [1 meter] depth) stressors during the summer (thermal stress and desiccation) and ice scour in the winter favors a seed-driven annual form. The annual form is comprised entirely of flowering shoots and lacks both the vegetive shoots and long rhizomes found in the perennial form (Keddy and Patriguin 1978).

Figure 2. Seagrass meadows in Little Narragansett Bay from the 2021 RI Eelgrass Taskforce Seagrass Survey. Still image captured from underwater video captured by Bryan Oakley (Eastern Connecticut State University).

WHY SEAGRASS MATTERS?

Seagrass beds are highly productive and help to create complex habitats for a variety of other species that live in, on, or above the seabed. Seagrass beds also help to maintain the physical, chemical, and biological integrity of the ecosystem (e.g., Thayer et al. 1975, Collette and Klein-MacPhee 2002, Liu and Nepf 2016). In southern New England, seagrass beds provide nursery grounds, refuge, and feeding grounds for many commercially important and iconic organisms, such as bay scallops, flounder, striped bass, tautog, and seahorses (e.g., Heck et al. 1989). Additionally, seagrasses bind and stabilize sediment by slowing water currents and causing sediment to drop out of the water column (Liu and Nepf 2016). This provides food for animals that feed on the bottom and creates clearer water, increasing the amount of light reaching the seagrass blades (Orth 1977).

The productivity of seagrass beds makes them potentially valuable candidates for long-term carbon storage to mitigate the impacts of climate change (known as blue carbon). Seagrasses store or sequester carbon through both primary production and accumulation in the sediment (Lavery et al. 2013, Greiner et al. 2013). Data on organic carbon content of living seagrasses and sedimentary accumulation in seagrass meadows worldwide show a significant amount of storage capacity—roughly 4.6 to 9.3 billion tons (4.2 to 8.4 petagrams) of carbon (Fourqurean et al. 2012). The amount of organic carbon stored per unit area of seagrass is similar to that of forests worldwide (Fourqurean et al. 2012). Protection and conservation of seagrass beds enhances global and regional resilience to climate change.

Since the 1930s, seagrass extent has steadily declined because of nutrient enrichment and physical disturbances (e.g., dredging, removal through boating or other activities, and storms), as well as by a seagrass disease outbreak in the 1930s that caused extensive losses along the Atlantic coast (Costa 1988, Short et al. 1993, Doherty 1995, Kopp et al. 1995).

The ecological and societal value of seagrasses makes it critical to adequately monitor trends in the extent and condition of seagrass beds. Seagrasses are considered “coastal canaries” because the loss of seagrass often indicates ecosystem degradation and loss of ecosystem services, which can result in habitat regime shifts (Orth et al. 2006, Costello and Kenworthy 2011).

METHODS

The methods used in this report are similar to the Seagrass Chapter of the *Status of Narragansett Bay and Its Watershed* (NBEP 2017). The acreage reported in this update stem from Rhode Island Eelgrass Taskforce’s Tier 1 aerial photography monitoring in 2009, 2012, 2016, and 2021. Data and methods are available here (NBEP’s data hub) and here (RI CRMC’s eelgrass mapper).

LITTLE NARRAGANSETT BAY

Little Narragansett Bay is a 3,072-acre bay in the southwest corner of Rhode Island (Figure 3). The watershed is fed by the Wood and Pawcatuck Rivers, and a portion of the watershed is in eastern Connecticut near Stonington (Figure 1). The major city in the watershed is Westerly. In 2021, Little Narragansett Bay had 117 acres of seagrass covering approximately 4 percent of the bay (Table 1). The current dataset reports only eelgrass for the area, no widgeongrass.

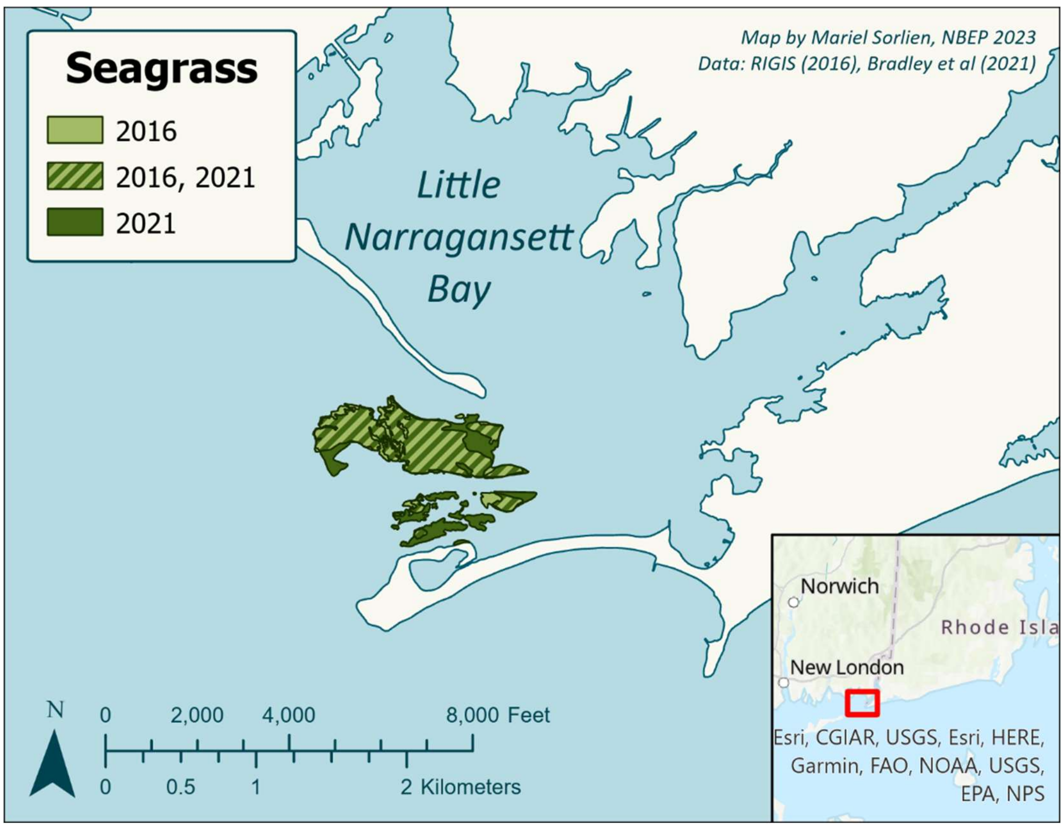


Figure 3. Seagrass extent in Little Narragansett Bay. 2016 acreage is light green, 2021 in dark green. Areas where seagrasses remained between aerial surveys is striped light and dark green.

Table 1. Total seagrass extent (acres) based on the Long Island Sound Study (2002, 2006, 2009, 2012, 2017) and RI Eelgrass Taskforce (2012, 2016, 2021) aerial photography surveys. The bay is 3,072 acres.

	Total Acreage							
	Long Island Sound Study[1]					RI Eelgrass Taskforce[2]		
	2002	**2006**	**2009**	**2012**	**2017**	**2012**	**2016**	**2021**
Little Narragansett Bay	286	283	343	327				
*Rhode Island waters**	*111*	*94*	*154*	*168*	*93*	*201*	*96*	*117*
TOTAL	**286**	**283**	**343**	**327**		**201**	**96**	**117**

[1]Acreage is based on Long Island Sound Study's Tier 1 aerial photography surveys (Bradley & Paton 2017) Acreage listed as "Little Narragansett Bay" is the total acreage assigned by Long Island Sound Study based on their boundaries for Little Narragansett Bay. The acreage listed as "Rhode Island waters" is the total acreage found in the Rhode Island's portion of Little Narragansett Bay.
[2]Acreage determined by the RI Eelgrass Taskforce is assumed to be in Rhode Island waters

CHANGES IN SEAGRASS EXTENT

The Long Island Sound Study data shows that total seagrass acreage increased to 2009, then began to decline. The most acreage in Rhode Island waters was observed in 2012 followed by a dramatic decline of over 50% in 2017.

The RI Eelgrass Taskforce data also shows a decline since 2012, with over a 50% loss between 2012 and 2016. Since 2016, seagrass has recovered somewhat to 117 acres (an increase of 22%).

COASTAL SALT PONDS

The Coastal Salt Ponds are a 35,800-acre watershed on the southern shore of Rhode Island. Collectively, the Ponds have 5,568 acres of estuarine water. They present a unique ecosystem of coastal lagoons with reduced water flow from the Atlantic Ocean (Figure 1). This creates unique hydrology and ecology for each pond (see this story map on the Ponds). In 2021, they collectively had 282 acres of seagrass, representing about 5 % of the Ponds. Ninigret Pond has the most seagrass with 166 acres while Green Hill Pond has the least with 3 acres (Figure 4).

The Ponds contain mostly eelgrass (265 acres), with pockets of eelgrass mixed with widgeongrass, particularly in Ninigret Pond (13 acres). The survey of Green Hill Pond in 2021 found only widgeongrass (3 acres); however, eelgrass has been observed in the system in recent years (personal observation, E. Schneider, RI DMF).

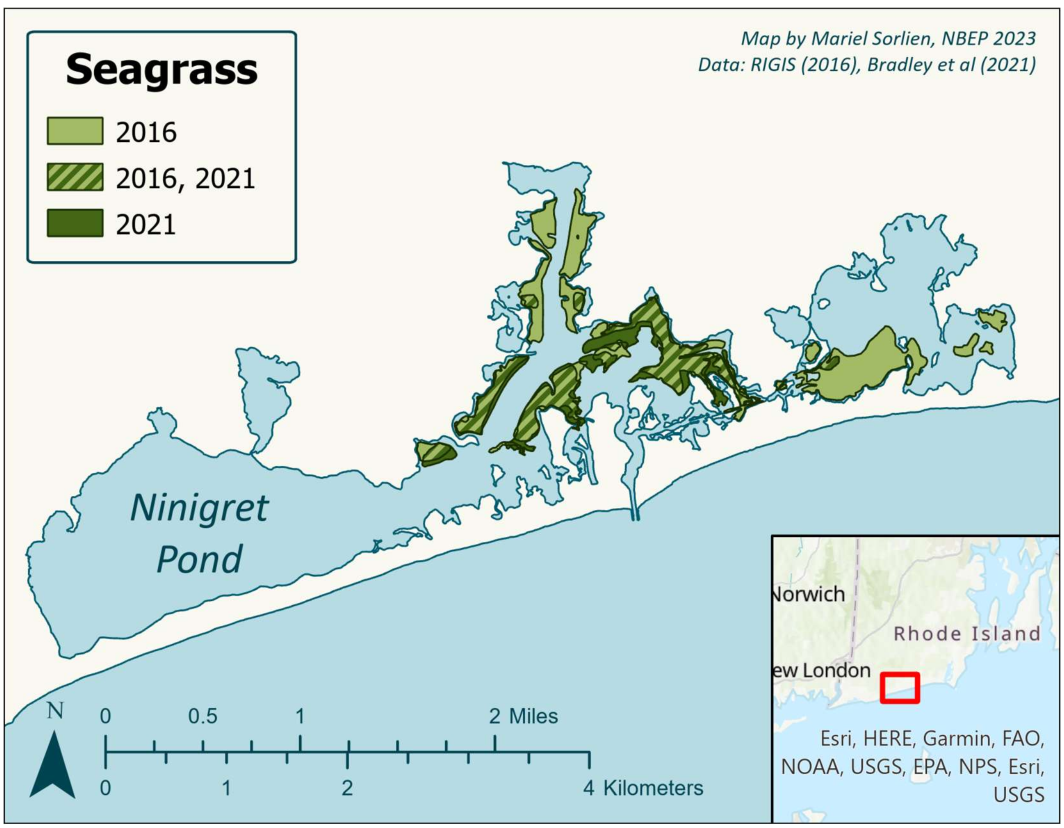


Figure 4. Seagrass extent in Ninigret and Green Hill (on right) Ponds. 2016 acreage is light green, 2021 in dark green. Areas where seagrasses remained between aerial surveys is striped light and dark green.

Table 2. Total seagrass extent (acres) based on the RI Eelgrass Taskforce aerial photographs. The Ponds collectively have 5,568 acres of estuarine water and are listed west to east in the table.

	Total Acreage			
	2009	**2012**	**2016**	**2021**
Coastal Salt Ponds				
Maschaug	0	0	0	0
Little Maschaug Pond	0	0	0	0
Winnapaug Pond	0	0	0	0
Quonochontaug Pond	93	71	34	51
Ninigret Pond	203	193	201	166
Green Hill Pond	138	91	88	3
Trustom Pond	0	0	0	0
Cards Pond	0	0	0	0
Potter's Pond	75	67	67	38
Point Judith Pond	94	101	53	24
TOTAL	**603**	**523**	**442**	**286**

CHANGES SEAGRASS EXTENT

Since 2009, seagrass extent has declined in the coastal ponds by 53%, with the largest loss in Green Hill Pond (138 acres in 2009 to only 3 acres in 2021).

Widgeongrass acreage seems to be stable or potentially replacing eelgrass. In Ninigret Pond, 16 acres of eelgrass and widgeongrass were observed in 2012. That number declined to 10 acres in 2016 and is currently 13 acres. However, Green Hill Pond has been steadily losing seagrass. In 2012, 87 acres of eelgrass and widgeongrass mix were observed. The acreage mix declined to 73 acres in 2016, and now the 3 acres observed in 2021 are all widgeongrass. Observing changes in the mixed beds in the future, with anticipated warming waters, will be necessary.

WHAT DOES THIS MEAN?

Aerial photography highlights the interannual variability of seagrass extent throughout the region. Detailed monitoring (such as Tier 2 and Tier 3 monitoring protocols [Raposa and Bradley 2009]) is needed to assess if changes in seagrass extent are due to external factors or interannual variability that is expected in a healthy bed. Despite these challenges, the region is beginning to collect enough aerial survey data to make some general conclusions about the state of seagrass extent. Looking at both Long Island Sound Study and RI Eelgrass Task Force shows that Little Narragansett Bay is showing a general decline in seagrass extent. According to Bradley and Paton (2017), much of the seagrass in Little Narragansett Bay appears to be moving west towards North Stonington Harbor and New London. In the Coastal Salt Ponds, seagrass extent has been declining steadily through the surveys.

The overall declines are likely due to two factors: nutrient enrichment and water temperature. In the past, degradation of water quality due to nutrient enrichment appears to have been the main cause of seagrass loss (Costa 1988, Valiela et al. 1992, Hauxwell et al. 2003). Increased phytoplankton productivity, epiphyte growth, and turbidity are often invoked as the reasons for light limitation leading to seagrass decline (Kemp et al. 1983, Duarte 1995, Taylor et al. 1999, Pryor et al. 2007, Chintala et al. 2015). Water quality degradation may be caused by increased development in these areas. Little Narragansett Bay witnessed an increase of over 700 acres of developed land while the Coastal Ponds had an increase of over 650 acres of developed land from 2001 to 2016 (NBEP 2021).

Warming waters can affect the spread of seagrass diseases, stress the plants, and influence how they reproduce. As waters warm, diseases such as wasting disease may spread more quickly. A combination of other climate impacts and anthropogenic factors can also exacerbate wasting disease outbreaks (Short et al. 1993, Doherty 1995). To date, wasting disease has not been observed since the early 1930s, even though temperature is warming in the region (Fulweiler et al. 2015). In addition to disease threats, warmer water temperatures can both stress plants, modifying plant growth, reproduction, and overall health, and at times exceed the maximum temperature plants can tolerate (Kaldy 2014, Hammer et al. 2018).

Widgeongrass occupies approximately 16 acres of seagrass extent in the Coastal Ponds. While widgeongrass can exist in the same beds as eelgrass, it can tolerate fresher and warmer waters than eelgrass (Kantrud 1994) and withstand higher nutrient regimes (Burkholder et al. 1994). Therefore, the prevalence of widgeongrass points to sources of groundwater influx to the Ponds. As waters warm in the ponds, it is possible that widgeongrass extent will increase. In fact, widgeongrass was found to bounce back quicker in Chesapeake Bay after a heat-induced eelgrass die-off (Moore et al. 2014). We should train a critical eye on the Coastal Ponds during the next aerial survey to see any changes to the extent of widgeongrass, particularly in Green Hill Pond which lost all its eelgrass between 2016 and 2021.

In the temperate zone, seagrasses can reproduce in two ways: by extending new shoots and rhizomes, or through seed propagation. Warming waters may promote seed propagation instead of rhizome and shoot growth, particularly at high temperatures near or above 77 to 86°F (25 to 30°C) (Phillips et al. 1983, Short and Neckles 1999, Bintz et al. 2003). While seed germination can promote expansion of seagrass beds into new areas, if conditions are such that seed germination is restricted or a seed bank cannot be established (Harwell and Orth 2002), then seagrass may suffer and decline. Many interacting factors will influence the future status of seagrass, with temperature an important factor. Estuarine water temperatures have risen approximately 3.6°F (2°C) over the last 50 years (NBEP 2017), and if the trend continues water temperatures will reach a tipping point where the current strains of seagrasses may not be able to reproduce or persist.

Recently, NBEP has been involved in conversations with regional partners from Long Island Sound and Massachusetts to discuss seagrass restoration in New England (including Long Island Sound) and what methods would be used. Efforts are now underway to create inter-state collaborations, share monitoring data, and investigate the best places for seagrass restoration. These collaborations will also explore techniques that have shown success, such as seeding rather than shoot transplanting, and update existing suitability models. Understanding how eelgrass and widgeongrass will individually and collectively (as a mixed bed) respond to climate and anthropogenic changes is vital to successful preservation and restoration. As these efforts produce results, NBEP will include them in future updates.

AREAS FOR FURTHER STUDY

This section describes new topics of interest or questions stemming from this land use update. These topics could be addressed by future work of the NBEP staff, partners, or others who are interested.

- To better understand the changes in seagrass extent and composition, we must first increase capacity to do comprehensive monitoring, including Tier 1 aerial surveys, and update Tier 2 and 3 methodologies (Raposa and Bradley 2009).
- Strengthen regional partnerships to understand how best to preserve and restore seagrass beds.
- Identify areas in the region that are better suited for seagrass restoration and the approaches, including the source material and planting/seeding techniques, that should be used.
- Identify areas where increased water temperatures in shallow embayments may impact the extent and overall health of seagrass beds and explore climate

change adaptation strategies to minimize or mitigate these impacts (e.g., Nadeau et al. 2024).

- What is the life history of widgeongrass and what ecosystem services does the habitat provide?
- Evaluate experimental restoration approaches aimed to increase genetic and species diversity, including the potential for mixed sources and multiple species?

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