Final Report of the New York State Seagrass Task Force:

Recommendations to the New York State Governor and Legislature

December 2009

EXECUTIVE SUMMARY

New York seagrass beds function as vital habitat and nursery grounds for numerous commercially, recreationally and ecologically important fish and shellfish species. Seagrasses also serve a major role in the nutrient and carbon cycles, provide an important food source for fish and waterfowl, and stabilize bottom sediments. Aside from providing many essential and invaluable ecosystem services, their presence is often used as an indicator of estuarine health and quality.

While historic seagrass acreage in New York has not been documented, historic photography and records indicate that there may have been 200,000 acres in 1930; today, only 21,803 acres remain. Although some loss can be attributed to natural events such as disease, the majority of seagrass loss has been triggered by anthropogenic activities. Several simultaneous impacts have contributed to seagrass declines in New York and throughout the world. These impacts include increased nutrient loadings, decreased water quality and clarity, large phytoplankton blooms, habitat degradation, fishing gear and boating activities, and climate change. Currently, the overall highest threats for seagrass in New York include excess nitrogen (affecting water quality), persistent and sustained algal blooms, and fishing and shellfishing gear impacts.

The New York State Seagrass Task Force, charged with developing recommendations to restore, research, preserve, and manage seagrass, acknowledges the critical need to protect seagrass resources, improve and maintain water quality, manage seagrass resources, monitor the health and extent of seagrass, research seagrass dynamics and impacts, restore seagrass and seagrass habitat, and educate and engage New Yorkers. While it is imperative to ensure water quality conditions suitable for seagrass, addressing water quality issues alone are not enough to protect and restore this species.

A press release was issued in late October 2009 announcing the availability of the draft report as well as an open public comment period continuing through November 2009. Additionally, three public meetings were held throughout New York's Marine District. While this final report outlines several near term and long term actions, the overarching goal and immediate actions are presented below.

Goal: Maintain current New York State seagrass acreage and increase 10% by 2020.

Immediate Actions:

- Create and implement a multi-jurisdictional Seagrass Protection Act or other legislative action such as "Special Management Areas" to give the New York State Department of Environmental Conservation (NYSDEC) and/or other appropriate entity the authority to regulate coastal and marine activities which threaten seagrass beds and seagrass restoration efforts.
- Establish and implement numeric water quality criteria/standards to protect seagrass habitat.

- Control and reduce nutrient, pesticide, and sediment loading to surface and groundwater.
- Protect, enhance and restore coastal and marine properties, habitats (e.g., wetland and shellfish), open space, riparian corridors and natural shorelines to reduce, filter and absorb polluted runoff.
- Develop management and gear restrictions necessary to regulate the use of destructive shellfish harvesting methods such as raking, tonging, and mechanical harvest in seagrass.
- Develop and distribute a triennial New York State Seagrass Status Report Card.
- Implement a general education campaign, which includes producing and distributing brochures and posting of interpretive signage, and a targeted education campaign to distribute pamphlets with boat registrations and fishing and shellfishing licenses/permits, to educate New York State citizens about the importance of seagrass and efforts they can undertake to protect seagrass.

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1. INTRODUCTION

Seagrasses are a unique group of flowering plants that have adapted to living fully submerged in coastal marine waters. Where present, these plants profoundly influence coastal environments, providing numerous critical ecological services. Seagrasses alter water flow, nutrient cycling, and food web structure. They are an important food source and provide critical habitat and nursery grounds for many animals including commercially, recreationally and ecologically important fishery species (e.g., winter flounder, bay scallop, hard clams). They also stabilize sediments and produce large quantities of organic carbon. Because of these important services, seagrasses have been assessed as 25% more valuable than wetlands and three times more valuable than coral reefs to coastal marine waters.[1] However, the health of seagrasses and the associated services they provide are being threatened by a host of anthropogenic influences.[2]

The disappearance of seagrass in our local waters could lead to a substantial decrease in important fish and shellfish species, and ultimately a considerable decrease in economic value of New York's aquatic resources. A publication from National Oceanic and Atmospheric Administration (NOAA), *Fisheries Economics of the US*, estimated that in 2006 alone, commercial harvesting of species that utilize seagrasses amounted to over $1.9 billion dollars worth of sales, $41 million in employment impacts, and $1 billion dollars of earned income. These estimates include the commercial harvesters, seafood processors and dealers, seafood wholesalers and distributors, and retail sectors. While proactive management strategies are being enacted along the Atlantic coast, it is essential that New York develop a similar strategy to preserve this critical marine resource, as it is easier and less costly to preserve and protect seagrass than it is to restore. Once seagrass has been completely lost, it becomes progressively more difficult to bring the ecosystem back, even through the best restoration efforts.[3]

Acknowledging the importance of seagrass and the necessity to protect and restore this valuable natural resource, Chapter 404 of the Laws of 2006, enacted on July 26, 2006, established a New York State Seagrass Task Force chaired by the New York State Department of Environmental Conservation (NYSDEC). Chapter 285 of the Laws of 2008 extended the life of the Task Force one additional year, to January 1, 2010. This Task Force is an assembly of voting and non-voting members who were charged with examining the current state of seagrass abundance and distribution and making recommendations on restoring, researching, preserving, and properly managing this valuable marine resource. This report is intended to serve as a management tool and planning guide for protecting and restoring seagrass habitats; it is a framework for the development of a statewide seagrass management initiative. This report is by no means comprehensive, but will serve as a foundation for future monitoring, restoration and management policies in New York State. The legislation calling for the creation of the Seagrass Task Force can be found in Appendix A.1; members are listed in Appendix A.2.

New York seagrasses received additional attention during the New York State Seagrass Experts Meeting on May 22, 2007 at the New York State Department of Environmental Conservation Bureau of Marine Resources headquarters. The goal of the Seagrass Experts Meeting, through the consultation and involvement of a scientific panel of national and local seagrass experts, was to identify and prioritize information gaps to fill which would allow New York to more effectively protect and restore seagrass habitat. After hearing and discussing presentations on the local environment, estuaries, and stressors, the Expert Panel deliberated for several hours. The result of the Expert Panel deliberations was a table of priority research, monitoring, management and outreach recommendations. This table can be found in Appendix A.3 or in the expert meeting proceeding which are available on the Seagrass Task Force webpage: http://counties.cce.cornell.edu/suffolk/habitat_restoration/seagrassli/conservation/managers/seagrass_taskforce.html. The priority recommendations of the New York State Seagrass Expert Meeting have proven to be a blue print to guide initial efforts of the New York State Seagrass Task Force.

Through funding appropriated under the New York Ocean and Great Lakes Ecosystem Conservation Act, the Task Force was able to fund several recommendations including monitoring recovery of seagrass from physical disturbance, characterizing the interaction of eelgrass and groundwater characteristics, assessing the effects of multiple stressors and groundwater herbicide toxicity on eelgrass, and determining the lethality of groundwater on eelgrass and epiphytic grazers. The Task Force was also able to fund a full-scale eelgrass restoration project in Caumsett State Historic Park and expand public outreach efforts to continue production of the SEAGRASS.LI Newsletter, produced by Cornell Cooperative Extension of Suffolk County, Marine Program (CCE). Another public outreach effort of the Task Force, in cooperation with CCE, was the development of a Seagrass Task Force website. The website relays important information about the Task Force, its initiatives, and meetings. As noted above, the web address to the Seagrass Task Force page is: http://counties.cce.cornell.edu/suffolk/habitat_restoration/seagrassli/conservation/managers/seagrass_taskforce.html . Complete descriptions for each of the funded projects can be found in Appendix A.4, along with the exact monetary values awarded for each individual project.

Additionally, the Task Force's Seagrass Mapping Work Group was able to standardize statewide seagrass inventory survey methods and protocols. For the first time, all three estuary seagrass surveys are scheduled to be conducted in 2009, resulting in consistent, comparable data on a regional scale. Additional information from the Mapping Workgroup can be found in Appendix A.5.

2. WHAT ARE SEAGRASSES?

2.1 Definitions

Seagrass refers to rooted, vascular, flowering marine plants that are submerged in lagoons, bays and other coastal waters. There are two species of seagrass commonly found in New York, *Zostera marina* ("eelgrass") and *Ruppia maritima* ("widgeon grass"). However for the purposes of this document, seagrass will refer exclusively to *Zostera marina*, unless stated otherwise.

Eelgrass, *Zostera marina,* is a marine, vascular flowering plant. Found on the Eastern coast of the United States, it is capable of both sexual reproduction (flowers/seeds) and asexual reproduction (clonal). It is commonly found in depths less than 8 meters (m) and in salinity ranges from 10 to 36 parts per thousand (ppt). *Zostera marina* is mainly a perennial in New York State, with a few exceptions.

Widgeon grass, *Ruppia maritima*, is a marine, vascular flowering plant found in New York waters. It is capable of both sexual reproduction (flowers/seeds) and asexual reproduction (clonal) and is commonly found in depths less than 3 m and in salinity ranges from 8 to 36 ppt. *R. maritima* is an annual in New York state, and is considered a pioneering species.

Submerged Rooted Vascular Plants (SRVP) will refer specifically to seagrasses (as defined above).

SRVP Habitat is the sediment and water column conditions capable of supporting the growth and reproduction of seagrasses. The necessary biological, chemical and physical processes to support seagrass are included in this term.

2.2 Seagrass Biology

Eelgrass, *Zostera marina*, is commonly found along the North Atlantic coastline, ranging from Quebec, Canada, to North Carolina[3]. In New York, *Z. marina* is the dominant seagrass species and inhabits shallow coastal and estuarine waters in depths ranging from less than 1 meter to 8 meters. *Zostera marina* often forms biological and physical assemblages referred to as seagrass meadows. Seagrass meadows are often defined by a visible boundary marking unvegetated and vegetated bottom varying in size from small isolated patches of plants less than a meter (<3 ft) in diameter to continuous meadows covering many acres.

The distribution of *Z. marina* is dependent on several factors including water quality, light availability, nutrients, sediment type, temperature, salinity, and water flow regimes. Since eelgrass requires sunlight to grow, dense beds typically are found in clear, cool waters. However, this is not always true in the South Shore Bays where seagrass can be found in un-clear, nutrient-rich warmer waters. Seagrass health is inextricably linked to water quality; the clearer the water, the deeper seagrass can grow. Activities that impact water quality and clarity, such as dredging and filling activities which may disturb and suspend bottom sediments, or excessive nutrient load from urban, industrial, and agricultural uses which may cause prolonged algal blooms, can severely inhibit the growth of seagrass. While nutrients are beneficial to seagrass, exposure to excessive nutrient concentrations, especially of nitrate, can have sub-lethal to lethal effects on seagrass growth and productivity. Temperature, depth and salinity ranges optimal for eelgrass in New York can be found in Table 1. Wave action and tidal flow can also be important in influencing seagrass distribution; high wave/tidal flow can increase diffusive loss of sediment, nutrients and organic matter.[4,5,6] There is an inverse relationship between water velocity and the ratio of aboveground to belowground biomass in *Z. marina*, suggesting that the plant devotes more energy to anchoring itself in high water flow areas.[7]

Table 1: *Optimal environmental parameters for growth of local seagrass species. Note that there can be deviations from this table, but overall, this is a good representation of the* ***minimum*** *requirements*[8].

Seagrass species	Environmental parameter					
	Salinity (ppt)		Secchi depth m (ft)		Water depth m (ft)	
	Range	Average	Range	Average	Range	Average
Eelgrass	10 - >36	26	0.3 - 2.0 (1.0 - 6.6)	1.0 (3.3)	0.4 - 10 (1.3-33)	1.2 (3.9)
Widgeon Grass	8 - >36	25	0.4 - 2.0 (1.3 - 6.6)	1 (3.3)	0.1-2.5 (0.3 - 6.9)	0.8 (2.6)

The three-dimensional shape of seagrass habitat can be quite variable, ranging from highly mounded, patchy beds several yards wide, to more contiguous, low-relief beds.[9] Leaf canopies formed by seagrasses range in size from a few inches to just less than 1 m tall, *Z. marina* has an average canopy height of .80 m. The structural complexity of seagrass beds varies somewhat because of the growth form of the species present. While leaf density tends to be higher in contiguous beds than in patchy seagrass habitat, belowground root mass is often higher in patchy beds.[9]

Patchy seagrass bed distribution may be a result of new beds sprouting from seed or from existing beds that are fragmented by high wave energy, currents, physical disturbance, or mechanical damage by prop scars.[10] The rate that an area of un-vegetated bottom can re-vegetate may vary on a scale of days to decades, depending on the species, threat of disturbance, and the physical conditions.[9] Patchy seagrass beds need an area of suitable bottom composition twice as big as the combined area of seagrass, and un-vegetated bottom between nearby adjacent patches is often considered a component of patchy seagrass habitat since rhizomes may be present and the beds “move” with sediment erosion and deposition.[9] Patchy habitats provide many ecological functions similar to continuous beds.[11,12] The dynamic nature of seagrass beds has important implications for fisheries habitat; seagrass habitat can change at a scale of hours to decades.[9,13]

Seagrasses are true flowering plants that produce female flowers which are fertilized by pollen released by male flowers into the water column. Seeds are either released individually from the reproductive shoot or the entire reproductive shoot breaks loose and is carried by tidal currents. Light availability has a profound effect on flowering success; when light is decreased, flowering success also decreases.[14,15,16] *Zostera marina* found growing at or near its depth limits in Chesapeake Bay was found to have limited flowering and seed success.[17] Light availability is widely accepted as the primary factor influencing flowering success.

2.3 Seagrass Value, Role and Function

The biogenic structure created by seagrass beds is important in the physical, chemical and biological processes of shallow coastal and estuarine waters. The three-dimensional structure modifies water flow and reduces wave turbulence and storm surge. The root systems of established seagrass meadows also serve to stabilize bay sediments and prevent erosion. As water flows through seagrass beds, the deposition of sediment and organic matter is increased. Seagrasses improve water quality by reducing nutrients in the water column, and are important components in energy and nutrient cycles, and in estuarine and coastal food webs. Seagrasses increase water column oxygen levels through photosynthesis, an important function in areas prone to low O_2 levels during the summer months.[10] The absorption of excess nitrogen and phosphorus by seagrass can reduce the frequency of nuisance algal blooms and resultant anoxic waters when the blooms die off and decay.[10] Eelgrass has been shown to remove contaminants from a system by taking up and binding them in biomass.[18,19,20,21] Seagrass maintains and indicates good water quality.[22,23]

Biologically, seagrass has many functions in coastal habitats. Eelgrass beds rank among the most productive of marine plant habitats.[10] The surface of the leaves provide areas for attachment of various forms of epibiota, which contribute substantially to the total productivity of seagrass beds[10] and are an important food source for fish and invertebrates.[3] Seagrasses in New York's coastal waters provide critical habitat for recreationally and commercially important fish and invertebrate species. Many species of fish and wildlife are directly dependent upon seagrasses for refuge, attachment, nursery, spawning, and foraging as presented in Table 2. Fisheries for a few of these species which rely on seagrass, most notably weakfish and winter flounder, have collapsed in New York.

Seagrasses provide a source of attachment and/or protection for the two largest shell fisheries in New York, the bay scallop (*Argopectin irradians*)[24] and hard clam (*Mercenaria mercenaria*). Tautog (*Tautoga onitis*) and other fish lay their eggs on the surface of eelgrass leaves, and juvenile and larval stage starfish, snails, mussels, and other creatures attach themselves to eelgrass leaves. Short et al. (2001) demonstrated that juvenile and adolescent lobsters utilize eelgrass beds for burrowing and overwintering, and that overall lobsters prefer seagrass habitat to bare mud. There is also substantial evidence that blue crabs (*Callinectes sapidus*) rely heavily on seagrass habitat for food, refuge and reproduction.[26,27]

Table 2: *A list of commercially, recreationally and ecologically important species found in NY and how each species utilizes seagrass beds (NYSDEC, 2008).*

SPECIES	**SEAGRASS FUNCTION**					**STOCK STATUS** (V= viable; R=recovering; C=concern; O=overfished; U=unknown)
	Refuge	*Spawning*	*Nursery*	*Foraging*	*Corridor*	
Atlantic Menhaden			x		x	C/R
Atlantic Needlefish				x		U
Atlantic Tomcod			x			U
Atlantic Seahorse	x	x	x	x		C
Bay Anchovy			x	x		U
Blackfish	x		x	x	x	C/O
Black Sea Bass	x				x	U
Bluefish			x	x		V
Cunner	x		x	x	x	U
Fluke				x	x	R
Menidia	x			x	x	U
Mummichog	x	x	x	x		U
Northern Kingfish				x		U
Northern Pipefish	x	x	x	x		U
Northern Puffer	x	x	x	x	x	U
Oyster Toadfish	x	x	x	x		U
Pollock			x			C
Rainwater Killifish	x	x	x	x		U
Scup	x				x	U
Sheepshead Minnow	x					U
Smooth Dogfish				x		C
Stickleback - 3, 4, 9 Spine, Black	x	x	x	x		U

Striped Bass				x		V
White Perch				x		U
Winter Flounder	x	x	x	x	x	O
American Eel	x		x	x		C
Sand Eels				x		U
Clearnose Skate				x		U
Little Skate				x		U
Winter Skate				x		U
Loligo Squid		x			x	V
Grass Shrimps	x	x	x	x		V
Sand Shrimp	x	x	x	x		U
Bay Scallop	x	x	x	x		C
Hard Clam	x	x	x	x		C
Knobbed Whelk		x	x	?		C
Blue Crab			x	x		C
Green Crab	x	x	x	x		U
Hermit Crab - 1 of 35 species	x	x	x	x		U
Horseshoe Crab				x		C
Lady Crab	x					U
Rock Crab	x			x		U
Spider Crab - 2 species	x	x	x	x		U
Diamondback Terrapin	x					U
Green Sea Turtle	x		x	x	x	C (Threatened)
Kemps Ridley Sea Turtle	x		x	x	x	C (Endangered)
Loggerhead Sea Turtle	x		x	x	x	C (Threatened)

2.4 Restoring Seagrass

While preserving and protecting existing eelgrass habitat is a more environmentally sound and less costly management approach, restoration is also an important step to bring seagrass back to areas that once supported populations. Successful restoration is dependent upon the environmental conditions of a restoration site, specifically water quality. Improvement of water quality is one of the most important preconditions that will increase the chances of preservation and restoration. After seagrass is lost from an area, habitat conditions and parameters change; increased turbidity, lowered organism diversity, and increased water flow may result. Once seagrass is removed, the water quality requirements for recovery and restoration of an area might actually be greater than those required for already established seagrass beds. This presents a problem for restoration, since returning the water quality to a level greater than the environment experienced before seagrass was lost takes considerable effort and time.

Zostera marina restoration efforts started with simple transplantation into areas formerly supporting eelgrass; however, because of the changes in the environment, this did not always work. These original restoration failures lead to the creation of elaborate scientific tools and methods for eelgrass restoration. There are now site selection models designed to quantitatively identify areas for potential restoration based on water quality, sediment characteristics, physical conditions, etc. Planting methods have also evolved over the years to accommodate different environments and conditions. Using rock anchors, free-planting into sand, TERFS (Transplanting Eelgrass Remotely with Frame Systems) [28], seeding by hand or bags, and machine plantings are just some of the techniques restoration ecologists have utilized. Test plots, or small patches are often planted and monitored to determine whether the site will sustain seagrass. If these plots work, the planting/seeding is expanded and larger areas will be planted.

CCE has spearheaded restoration efforts in Long Island Sound, Peconic Bay, the South Shore Bays, and mostly recently in Jamaica Bay. CCE has created a Peconic Estuary Eelgrass Restoration Site Suitability Index Model to determine suitability of sites for restoration in the Peconic Bays. This Geographic Information System (GIS) model was developed using water quality and eelgrass bed monitoring data and years of field experience. Using environmental parameters such as water depth, total phosphate, water temperature, total nitrogen, and light levels, locations are identified where eelgrass restoration has the highest potential for success. Proposed restoration sites are typically within 100m of an historic eelgrass bed, and farther than 15m from hardened shoreline. Once areas meeting these criteria are identified, they are further analyzed based on parameters such as proximity to shellfish growing areas, sediment chemistry, macroalgae abundance, and wind exposure and are then assigned scores which determine restoration feasibility potential. The model is further explained and sample results are available for viewing at: www.seagrassli.org under “Restoration.”

3. SEAGRASS IN NEW YORK

3.1 Long Island Sound

Distribution

Seagrass in Long Island Sound is limited to the shallow margins of the Sound; on the New York side only 236 acres (95.5 hectares) of seagrass coverage remain (2006 LIS report). Historically, seagrass in the shallow regions (1-4 meters depth) of Long Island Sound was in high abundance until the 1930's when seagrass wasting disease, caused by the slime mold *Labyrinthula zosterae,* destroyed populations. Currently less than 1% of historic acreage remains; and 98% of New York's LIS seagrass is found around Fishers Island. Although most of the eelgrass found in LIS is in waters less than 3m depth, there is eelgrass growing at depths of 8m around Fishers Island.

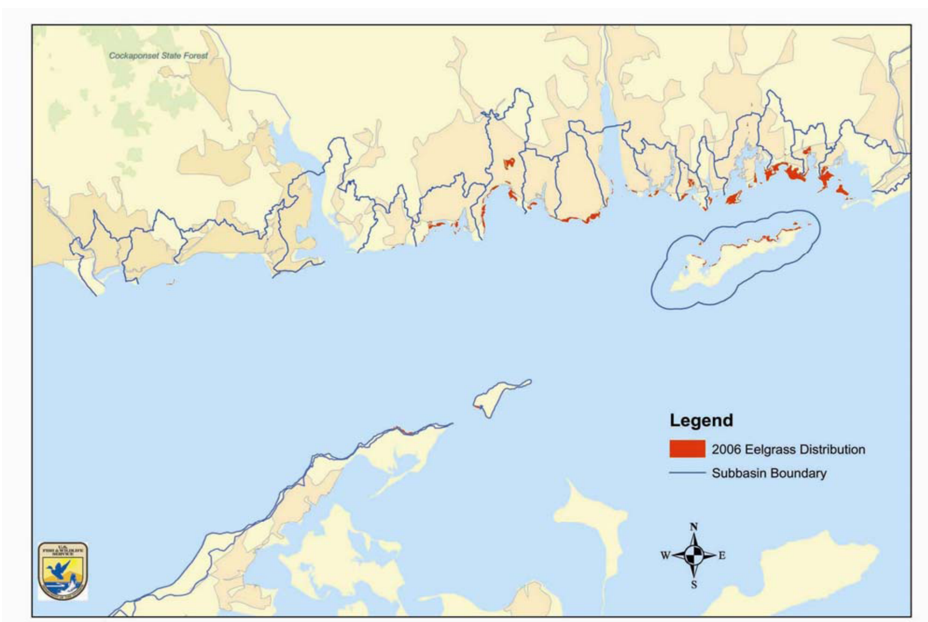


Figure 1: *Seagrass Distribution Map for Long Island Sound (USFWS, 2006)*

Monitoring and Mapping

Long Island Sound eelgrass is mapped in both New York and Connecticut waters. The US Fish and Wildlife Service conducted aerial surveys of the entire region in 2002, 2006, and 2009; a field component was involved as well. In 2004, CCE, funded in part by the Long Island Sound Study created six monitoring stations at Mulford Point, near Orient Point to monitor the eelgrass beds in this region. The Connecticut Department of Environmental Protection, on behalf of the Long Island Sound Study, conducts a Long Island Sound Water Quality Monitoring Program, where surface and bottom waters are monitored at 284 stations. Testing parameters include water temperature, salinity, dissolved nitrogen, particulate nitrogen, and dissolved oxygen. Monitoring began in 1991. On the New York side Suffolk

County Department of Health Services (SCDHS) implements an extensive water quality monitoring since 1976. Their stations monitor temperature, salinity/conductivity, irradiance, turbidity, dissolved oxygen, suspended solids, nutrient levels, herbicides/pesticides and fertilizers, and volatile organic compounds. Biological parameters include levels/presence of Coliform bacteria, chlorophyll A, and the Brown Tide species, *Aureococcus anophagefferens.* NYSDEC also conducts water quality monitoring in Long Island Sound waters through their Shellfish Sanitation Program. A few smaller groups actively engage in water quality monitoring, such as Friends of the Bay, Coalition to Save Hempstead Harbor, and some townships have enacted localized water quality monitoring programs.

Restoration

Long Island Sound has several areas undergoing seagrass restoration. The goal of restoration is to increase the amount of eelgrass in LIS while expanding and diversifying the geographic distribution of this species in the face of multiple stressors. To date, this work has initially been very successful. Numerous planting sites have been identified and several new eelgrass meadows, resulting in a net increase in both geographic range and acreage, have been created on Long Island's North Shore. With support from the National Fish and Wildlife Foundation, CCE has identified the following areas of restoration: St. Thomas Point, East Marion, Southold Town, NY; Terry's Point, Orient, NY; Old Field, NY; Caumsett Point, Huntington, NY; Great Gull Island, Plum Island and Horton's Point, Southold Town, NY; and Huntington/Northport Bay, NY. The *Long Island Sound Restoration Project I* focused on St. Thomas Point, East Marion in Southold where CCE first began test transplants using eelgrass shoots in 2003. The primary planting method included anchoring shoots under existing rocks until they become rooted in the coarse sediments. The transplanting continued until 2007 when large-scale planting efforts ceased and the newly created meadow was monitored for survival, reproduction and stability. The *Long Island Sound Eelgrass Restoration Project II* was initiated in 2007 and utilizes similar techniques as previous efforts to expand ongoing efforts and locate additional planting sites. The *Long Island Sound Eelgrass Restoration Project III* was initiated in 2008 and involves plantings in the eastern reaches of Long Island Sound including Great Gull Island, Plum Island and several points along the North Fork Sound front. More information on CCE's restoration efforts in Long Island Sound can be found online at: www.seagrassli.org under "Restoration."

3.2 Peconic Estuary

Distribution

Historically, seagrass was found in shallow waters from the westernmost Flanders Bay to eastern Gardiner's Bay, however the existing eelgrass is now limited to the eastern part of the Peconic Estuary, mainly east of Shelter Island (the only exception is Bullhead Bay, which is considered an annual population of eelgrass). The estimated seagrass coverage in the 1930's was approximately 8,720 acres (CCE). An analysis of 2000 aerials by the Peconic Estuary Program estimated 1,552 acres, an 80% decrease from the 1930's.

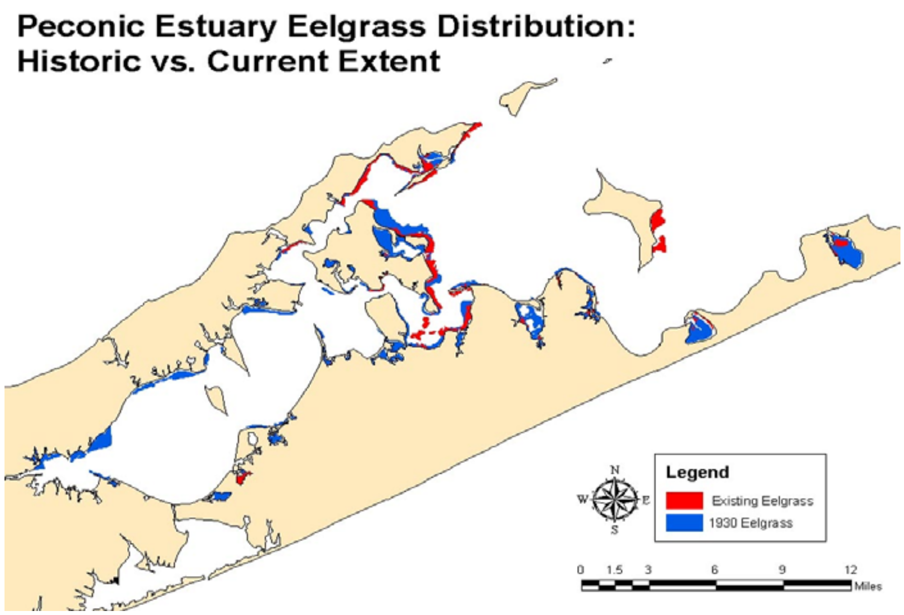
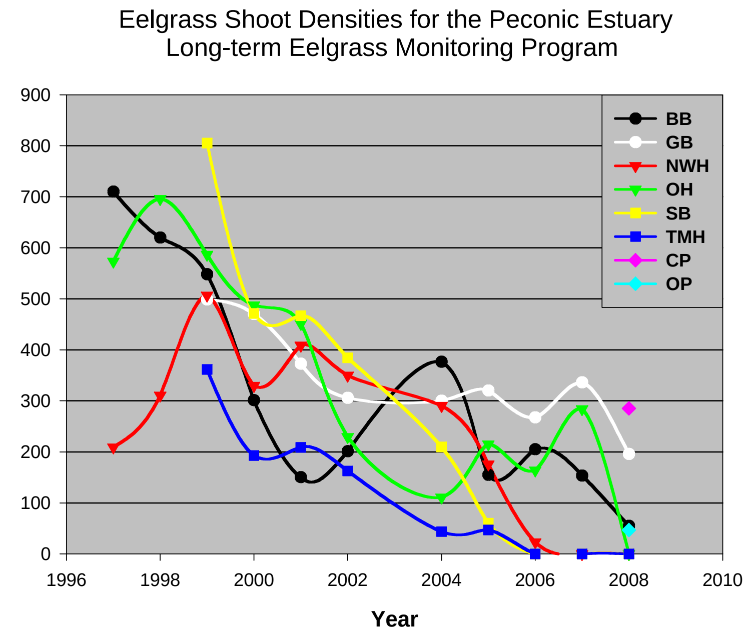


Figure 2: *Seagrass Distribution Map for the Peconic Estuary (USFWS, 2003)*

Monitoring and Mapping

While seagrasses have been mapped several times in the Peconic Estuary, only one complete quantitative mapping was conducted by Tiner et al. (2003) which used 2000 aerial surveys to estimate seagrass acreage. Since 1997, the Peconic Estuary Program has provided funding to CCE to conduct an extensive Peconic Estuary Program Eelgrass Long-Term Monitoring Program. Eight sites, each with numerous monitoring stations, are monitored annually. Parameters such as water quality, water temperature, shoot density, macroalgal cover and biodiversity of organisms are monitored at these eight sites, and examined for trends. The data collected from this program has shown a dramatic decrease in eelgrass density from 1997-2006 (Figure 3)**.** SCDHS conducts the Peconic Estuary Program Long Term Water Quality Monitoring Program, whereby 38 surface water quality stations are monitored monthly. NYSDEC Shellfish Sanitation Program also conducts water quality monitoring in all Peconic Shellfish Growing Areas.

Figure 3 (right): *This figure shows the decline in eelgrass density in the Peconic Estuary since 1997, when the eelgrass monitoring program began. BB= Bullhead Bay, Southampton; GB= Gardiners Bay/Hay Beach, Shelter Island; NWH= Northwest Harbor, East Hampton; OH= Orient Harbor, Southold; SB= Southold Bay, Southold; and, TMH= Three Mile Harbor, East Hampton; CP= Cedar Point, East Hampton; OP= Orient Point, Southold. Source: CCE*



Restoration

CEE spearheads eelgrass restoration efforts in the Peconic Estuary system. Although water quality in this region is relatively good when compared to other estuarine systems, eelgrass acreage continues to decline steadily based on the results of CCE's long-term monitoring (above). Since natural recovery has not taken place to-date in most areas, proactive restoration has been identified as a potential means of overcoming this problem. Despite repeated attempts at many different sites and using a number of techniques, long-term success of eelgrass restoration in the inner Peconic Estuary has not been achieved. However, current work focusing on the eastern reaches of the Peconic Estuary, including Gardiner's Bay offers more hope as recent plantings here show signs of success that, to date, have not been observed previously in other parts of the estuary. Early on, a Peconic Estuary Eelgrass Restoration Site Suitability Index Model was developed by CCE to determine the most suitable sites for restoration. Based on this work, suitable sites appear to be limited to the waters east of Shelter Island given issues with water clarity, temperature and sediment conditions. With funding from Suffolk County current work focuses on sites in Gardiner's Bay including a large-scale restoration project off the southeast shore of Plum Island. It is expected that this work will lead to a net increase in eelgrass acreage in the estuary in the coming years. More information on past and current restoration efforts in the Peconic Estuary System can be found online at: www.seagrassli.org under "Restoration."

3.3 South Shore Estuary

Distribution

The South Shore Estuary Reserve (SSER) covers approximately 108,000 acres including Hempstead Bay, South Oyster Bay, Great South Bay, Moriches Bay and Shinnecock Bay. Based on aerial surveys in 2002, approximately 20,015 acres of the SSER currently supports seagrass, and 99% of seagrass is found at a depth less than 2m. In 2002, NOAA Coastal Services Center regional aerial photography survey found 14,744 acres of seagrass beds in the Great South Bay study area alone.

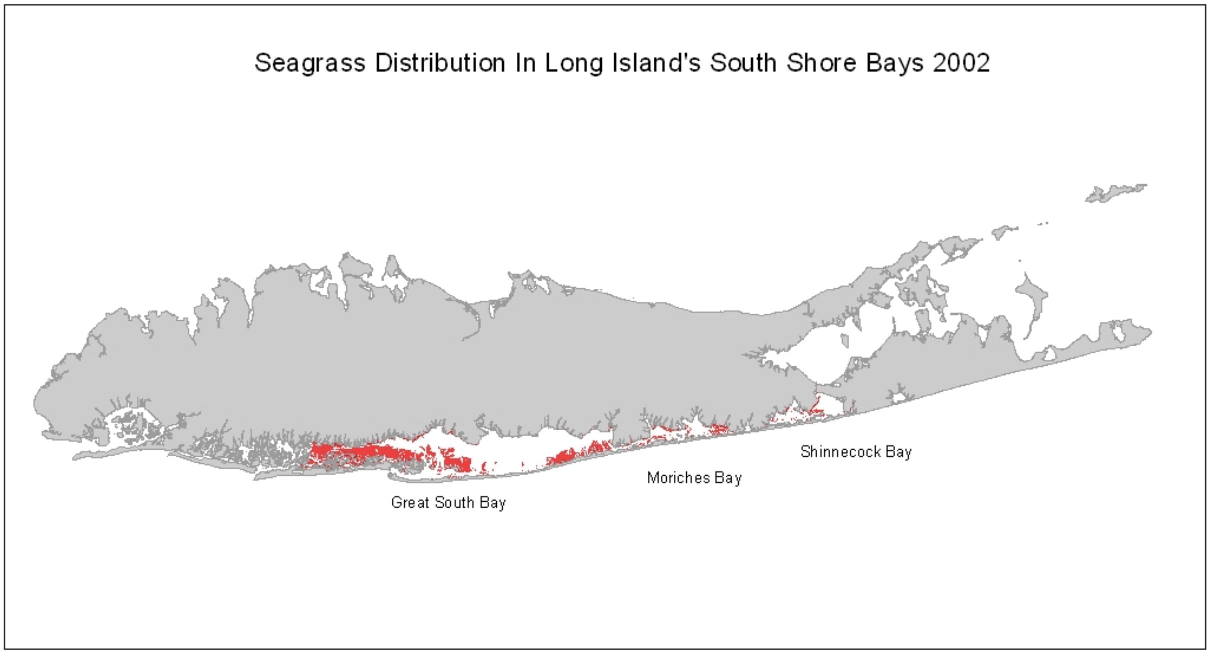


Figure 4: *Seagrass Distribution Map for the South Shore Estuary Reserve (NYSDOS/NOAA, 2002)*

Monitoring and Mapping

Aerial survey mapping of SSER benthic habitat, including seagrass distribution, was conducted in 2002 in a cooperative effort between New York State Department of State (NYSDOS) and NOAA Coastal Services Center; groundtruthing was completed in 2003. In 2007, the National Park Service initiated a spatial survey of seagrass resources within the boundaries of the Fire Island National Seashore, which will be repeated in 2009. Surveys of seagrass resources in Shinnecock and Quantauk Bays were conducted in 2004 and Great South Bay in 2005 by researchers at Stony Brook University's School of Marine and Atmospheric Sciences. In addition, the National Park Service initiated a bi-annual water quality monitoring program within the boundaries of Fire Island National Seashore. This program uses a probability-based systematic survey design of tessellated hexagons that encompasses the entire submerged boundary of the park. The systematic survey of water column measurements occurs weekly during a four-week summer index period. In addition to this spatial survey, one station is established for continuous monitoring throughout the index period. The parameters measured include dissolved oxygen, turbidity, chlorophyll *a*, salinity, temperature and attenuation of Photosynthetically Available

Radiation (PAR). The NYSDEC also conducts water quality monitoring in all three estuaries through their Shellfish Sanitation Program.

Restoration

In an effort to bring eelgrass back to areas of the South Shore Estuary, CCE created the *South Shore Estuary Eelgrass and Bay Scallop Planning Project* in 2005, a cooperative project between the CCE eelgrass restoration team and the aquaculture team. The project's aim was to determine the best restoration methods for this area, assess seed yield from existing seagrass beds, perform test plots in areas of Shinnecock, Tiana, Quantuck and Moriches Bays, and look at the bay scallops' response to eelgrass test-plots. This program aims to restore both eelgrass and bay scallops simultaneously in areas of the SSER. Following the successful completion of this project in 2009, CCE, in cooperation with the Southampton Town Trustees and with funding from the Suffolk County initiated a 5-acre restoration project in Shinnecock Bay that is expected to lead to a net increase in eelgrass in this region. More information on restoration efforts in the South Shore Estuary Reserve can be found online at: www.seagrassli.org under "Restoration."

Table 3: *This table details seagrass acreage in New York estuaries; comparisons are made to other Atlantic states.*

State	SEAGRASS		Source
	acres	hectares	
New York (total)	**21,803**	**8823.6**	
LIS (NY waters)	236	95.5	USFWS, 2006
Peconic Estuary System	1,552	628.1	USFWS, 2003
South Shore Estuary Reserve	20,015	8100	2002 NYSDOS, NOAA aerial survey, NPS spatial seagrass survey
Florida	2,658,290	1,075,772	Sargent et al. (1995)
North Carolina	200,000	80,937	Field et al. 1988 and Orth et al. 1990

Chesapeake (VA and MD)	59,300	23,998	Funderburk et al. (1991)

3.4 Regulations and Management

Various levels of government may have jurisdiction and/or regulatory authority over activities which threaten seagrass health and extent including, public recreation structures, dredging and dredged material placement, storm-water management, water quality, and fishery harvesting techniques. Currently there are no federal or New York State regulations that are exclusively dedicated to protecting seagrass. There are regulations in place that indirectly and insufficiently protect seagrass.

Federal Law

Magnuson-Stevens Fishery Conservation & Management Act- Requires that essential fish habitat is protected and conserved when possible. This applies directly to New York's seagrass beds since many fish utilize seagrass as habitat and refuge. The winter flounder fishery management plan includes seagrass beds as habitat of particular concern. These requirements are designed to manage the fish species and not their habitats.

Clean Water Act- Places regulations on pollution, discharge and other threats to water quality. Many water quality issues can be addressed under the umbrella of the Clean Water Act. While NY State has water quality standards, there are no resource-based water quality or nitrogen criteria specifically designed to protect seagrass habitats.

New York State Law and Regulations

New York State does not currently have any regulations or laws specifically protecting seagrass, however many laws, mandates and regulations apply to areas where seagrass may be found. These regulations either indirectly or directly affect seagrass beds, but do not adequately protect seagrass or seagrass habitat.

Environmental Conservation Law (ECL):

- *6NYCRR Part 49: Shellfish Management*- Gives NYSDEC authority to develop regulations on manner and method of taking and gear restrictions for harvest of hard clams, soft clams, razor clams, oysters and scallops.
- *ECL Article 13* restricts the use of mechanical harvest on public or unleased underwater land except for the taking of certain species defined in law. Both the ECL and 6NYCRR are

generally resources based and should be amended to afford protection of seagrass habitat that may be impacted by shellfish harvesting activities.

- *ECL Article 25 & 6NYCRR Part 661: Tidal Wetlands Land Use Regulations*- Gives NYSDEC jurisdiction over tidal wetlands up to 6 feet below Mean Low Water (MLW), which includes some, but not all of the seagrass habitats in NY. It does not give the DEC authority to restrict activities that may negatively affect seagrasses.

- *6NYCRR Part 46: Public Use of State-Owned Tidal Wetlands* – This regulation protects tidal wetlands, requiring permits for use and outlines public-use criteria, however this is exclusive of seagrass.

- *ECL Article 15 & 6NYCRR Part 608: Protection of Waters, Article 15*- Provides authority for docking rules and regulations, water quality, and disturbance of tidal wetlands by filling water with materials. Seagrass is not mentioned in this act.

- *6NYCRR Part 617: State Environmental Quality Review (SEQR)*- Process requires that any project or activity proposed by the state or other local government agency undergo an environmental impact assessment to identify and mitigate the significant environmental impacts of proposed projects.

New York State Coastal Management Program Policies require the protection of habitats that support commercially and recreationally important species (see Table 2) and habitats that are essential to the survival of a large portion of a fish or wildlife population.

New York State Navigation Law requires that boaters maintain three feet of depth (low water mark) when navigating shallow areas. This helps reduce boat-induced damage in seagrass habitats, but is not a habitat based management tool.

Local Municipal Regulations

Municipalities have adopted and implemented more stringent rules and regulations protecting seagrasses and their habitat. See Appendix A.6 for local regulations in the Peconic Estuary watershed which directly and indirectly pertain to protecting seagrass and seagrass habitat.

Local Management

In June 2009 the Peconic Estuary Program adopted the “Eelgrass Management Plan for the Peconic Estuary.” This innovative plan details specific management objectives, actions and action steps to help protect and restore this valuable resource within the Peconic Estuary. With losses attributed to several collective multiple stresses, the Peconic Estuary Program calls on government, residents, stakeholders and industry to make and undertake educated and sustainable choices and practices to ensure that Peconic eelgrass can once again flourish. This Plan can be accessed at: www.peconicestuary.org.

4. SEAGRASS THREATS

A NY seagrass threats assessment completed by the Task Force, helped focus the Task Force on developing specific management actions. This threats analysis can be found in Appendix A.7 or online at: http://counties.cce.cornell.edu/suffolk/habitat_restoration/seagrassli/conservation/managers/seagrass_taskforce.html.

4.1 Water Quality

Water quality is one of the most important environmental parameters affecting seagrass. Eelgrass is an indicator species that requires good water quality and clarity to support photosynthesis. Water quality can be reduced in a number of ways: turbidity, high nutrients, toxins or chemicals, etc. The following threats all affect water quality and therefore are considered a threat to seagrass.

Excess Nitrogen and Water Quality Degradation

As the coastal population in New York increases, so does the level of nutrients being transported to the coastal waters. Anthropogenic sources include atmospheric deposition (derived from the burning of fossil fuels); sewage treatment (both centralized publicly and privately owned facilities and on-site disposal systems); fertilizer use (on landscaping, agricultural operations and golf courses); storm-water (resulting in enriched bottom sediments). The fate and effects of nitrogen in the near-shore marine environment has also been impacted by ecological changes, such as decreases in beneficial filter feeder populations and increases in noxious macroalgae.

The majority of seagrass loss is now considered to result from large-scale nutrient enrichment (causing enhanced epiphytic and phytoplanktonic growth) and sedimentation, which results in reduced water transparency and light penetration.[30,31,32,33,34] Decreased water clarity due to dissolved organic matter, suspended particulate matter, detritus, or algae that is suspended in the water column has a major effect on seagrass distribution. In addition to light attenuation in the water column, sedimentation and algal growth on the surface of grass blades (heavy amounts of epiphytes) reduce light reaching the surface of leaves.[22] Because algal growth is directly related to dissolved nutrient concentrations, heavy epiphyte loads are often the result of excessive nutrients in the water column.

Research has shown that elevated nitrogen concentrations not only affect seagrass through light reduction, but also may be toxic to eelgrass. In laboratory experiments, long-term exposure of eelgrass to enriched nitrate concentrations was lethal at enrichment levels ranging from 3.5 – 35 µM per day in the water column.[35] In another experiment with eelgrass, nitrogen enrichment (10 µM of nitrate in the water column per day for 14 weeks) significantly lowered shoot production compared to control plants without nitrogen enrichment (<2 µM of nitrate in the water column).[36] The ambient water nitrate concentrations of Long Island Sound, Peconic Estuary and South Shore Estuary range from 1-5µM year round, with locally higher concentrations near sewage outfalls, in areas experiencing high run-off, or areas experiencing nutrient rich submarine groundwater discharge. While concentrations of bio-available phosphorus and silica probably play an important role in the ecology of the South Shore Estuaries, Peconic Bay and Long Island Sound, through their influence on the types of phytoplankton that occur there, it is presumed that nitrogen is the key nutrient-related water quality parameter with respect to seagrass management.

Development/Imperviousness

Land development along the shoreline may indirectly affect seagrasses by increasing erosion and polluted run-off. Increases in population will create a larger demand on estuary systems recreationally, commercially and industrially. Communities which rely on onsite disposal systems, such as septic systems, rather than sewage treatment plants, may increase the amount of nutrients released to estuaries, especially in areas of high and rising groundwater tables. Impervious surfaces, such as roads and sidewalks inhibit the ability of rainwater and stormwater to infiltrate back into the ground, leading to increased volumes of polluted nonpoint source and stormwater runoff.

Pore Water Sulfide Toxicity

Pore water chemistry affects the rhizomes of seagrasses, which must continually pump oxygen into the sediments to counteract the effects of sulfide toxicity.[37,38] In general, sediments in New York's marine waters range from sandy to muddy, with percent of organic matter ranging from 1-13%, resulting in drastically different pore water chemistries. Seagrass is most often found in sandy sediments where the oxygenated sediment layer extends deeper. However, if high organic matter is present, the amount of respiration occurring in the sediments increases, depleting pore water oxygen levels. Sulfate reduction begins to occur to compensate and releases sulfide as a product. Researchers at Stony Brook University have shown that there seems to be compounding effects of shading (caused by algal blooms) and pore water sulfide, leading to seagrass death at sulfide concentrations around 300µM. Sulfide surveys in Great South Bay, in areas with and without seagrass, have shown naturally occurring levels between 0 and 500µM, with an average bay-wide concentration of around 60µM. It is important to remember that sulfide is a natural product and is important for maintaining a healthy, balanced ecosystem. Seagrass subject to high sulfide levels alone may experience sublethal effects.

Toxic Chemicals

Herbicides are the primary toxic chemical known to have negative impacts to seagrasses.[39] While submarine groundwater discharge is common along the coasts of Long Island, especially along the North Fork, occurrence of herbicides in upwelled groundwater around seagrass beds is not well documented.

Groundwater monitoring has shown that high nitrate levels occur in some regions along with contamination of herbicides, pesticides and fertilizer used for agricultural purposes. Currently research is being conducted to evaluate the effects of groundwater discharge containing herbicides on eelgrass. Specifically, investigations into the impact of the herbicide Diuron on eelgrass have demonstrated that at environmentally realistic concentrations, Diuron has a measurable impact on photosynthesis. In addition, experiments have demonstrated that the impacts of this herbicide increase with other stresses such as reducing light levels or increasing temperatures.

4.2 Physical Disturbance

The following threats are categorized under physical disturbance as they result in a direct removal of the plant or part of a plant, or destruction of seagrass beds.

Fishing and Shellfishing Gear and Aquaculture

Several bottom-disturbing fishing gears have the potential to destroy or damage seagrass. The Atlantic States Marine Fisheries Council (ASMFC) seagrass policy [40] urges development of technical guidelines and standards to objectively determine fishing gear impacts and develop standard mitigation strategies, in cooperation with National Marine Fisheries Service (NMFS) and US Fish and Wildlife Service. Damage from fishing gear varies in severity. Shearing or cutting of leaves, flowers, or seeds, and uprooting of plants without major disruption of the sediment, are most often caused by dragging or snagging of gear, such as long haul seines or bottom trawls. [41] High turbidity from use of bottom-disturbing fishing gear can reduce water clarity, affecting seagrass growth, productivity, and in some cases, survival. Qualitatively, damage to eelgrass meadows caused from unspecified dredges used to harvest shellfish was surpassed only by damage associated with propellers. [10] The NYSDEC has assessed the impacts of fishing gear in New York in an updated version of the original tables created and submitted by the NYSDEC to ASMFC for its seagrass policy; see Tables 5.A and 5.B for specific impacts of each gear type.

Aquaculture operations that utilize floating racks and bottom culture techniques can shade seagrass, if placed in shallow areas where seagrass occurs. Impacts of aquaculture on seagrass habitats in New York are unknown at this time, but as the extent of private aquaculture projects accelerates, it will be increasingly important to establish monitoring projects to assess impacts from aquaculture such as shading and nutrient enrichment. Mechanical harvest of cultivated shellfish occurs on privately controlled underwater lands in deep waters that are outside of seagrass beds and typically a good distance away from them.

Table 5.A: Impacts of shellfishing gear and activity on New York seagrasses. (Source: NYSDEC, 2008)

GEAR TYPE	FISHERY	POTENTIAL GEAR IMPACT	POTENTIAL SEAGRASS IMPACT	AREA OF USE W/ SEAGRASS	SEAGRASS PROTECTION	THREAT TO SEAGRASS
Shellfish						
Churning	soft clam, razor clam/hard clam	propeller wash	roots, leaf, turbidity, burial	All areas (some local gov't. restrict churning in seagrasses in Town waters)	area restrictions (Southampton Town waters); prohibited in state waters for razor clams & hard clams	high
Rakes & Tongs	hard clam, oyster	rake tines	Root damage, leaf shear	all waters	none	moderate
Dredge	scallop	leading edge	roots, leaf, turbidity	all waters	area & seasonal restrictions	moderate
Dredge	mussel	leading edge	roots, leaf, turbidity	Peconics, LIS east of Herod Pt., Atlantic Ocean east of Shinnecock	area restrictions	moderate but low use
Dredge	oysters	leading edge	roots, leaf, turbidity	privately held areas, waters under sail	area restrictions	low to moderate
Treading	hard clams	bottom disturbance	leaf, roots	all waters	none	low
Dredge	whelks	leading edge	roots, leaf, turbidity	all waters	none (no method restrictions)	low
Pots	whelks	pot placement, hauling	leaf, burial	all waters	none	low
Aquacultur e	Numerous (hard clams, oysters, etc.)	placement of cages and dock structures	shading and smothering	town waters	none	low
Hydraulic dredge	hard clam	leading edge, water jet	Root damage, leaf shear, turbidity	limited to privately held areas (deep waters)	area restrictions	activity poses a high threat, but low threat due to minimal use
Hydraulic dredge	surf clam	leading edge, water jet	Root damage, leaf shear, turbidity	none (deep waters)	area restrictions and deeper water use	activity poses a high threat, but low threat due to area gear restrictions confined to deeper waters

Table 5.B: Impacts of fishing gear and activity on New York seagrasses. (Source: NYSDEC, 2008)

GEAR TYPE	FISHERY	POTENTIAL GEAR IMPACT	POTENTIAL SEAGRASS IMPACT	AREA OF USE W/ SEAGRASS	SEAGRASS PROTECTION	THREAT TO SEAGRASS
Finfish, Lobster, Crabs						
Dredge	crab	leading edge, teeth	roots, leaf, turbidity	central and eastern GSB, Peconics	area (deeper waters) & seasonal restrictions (winter)	moderate to high
Pots	crab	pot placement, hauling	leaf, burial	Great South Bay	none	moderate
Pound and Fyke nets	finfish	net placement, hauling, poles	leaf, burial	Peconics, GSB	none, limited areas of use	low to moderate
Trawls	finfish	bottom drag	leaf, roots, turbidity	Eastern LIS, eastern Peconics	area restriction and deeper water use	low; high for Fishers Island
Combing	eels	possible bottom drag	leaf	shallow waters	none	low
Purse seine	finfish (menhaden)	possible bottom drag	leaf, turbidity	none	area restrictions (shallow waters)	low
Pots	finfish/eel	pot placement, hauling	leaf, burial	shallow waters	none	low
Pots	lobster	pot placement, hauling	leaf, burial	Fishers Island and Gardiners Bay	none	low
Gill nets	baitfish, finfish, Horseshoe crab	bottom drag	leaf	all waters	seasonal and area restrictions	low
Rod and reel	finfish	retrieval of hooks or lures	leaf shear and root damage	all waters	none	low

Maintenance Navigational Channel Dredging

In New York, maintenance dredging occurs during the winter, which reduces the threat to seagrass since it is not growing as quickly as in the spring and summer months. Permitting processes also reduce the likelihood that projects will interfere with seagrass beds. However, the creation of new navigational channels and inlets, as well as the maintenance of existing channels could result in the removal or destruction of seagrass beds by changing the bottom depth, sediment characteristics, and water clarity if not adhering to the respective permit conditions. The creation of new channels may remove existing seagrass beds, and prevent or discourage future growth or establishment of seagrass.[39,42] Direct destruction of seagrass habitat during the dredging process is an issue when high levels of suspended solids reduce light availability. [43] The increased water depth in dredged channels limits light penetration to the bottom, limiting the ability of seagrass to colonize the area. In addition, dredged channels tend to refill with finer sediments[44,45] that are easily resuspended by currents or boat wakes. The resulting chronic elevated turbidity and sedimentation can reduce light penetration to levels that reduce or eliminate productivity of adjacent grass beds and make colonization of un-vegetated areas difficult.[44] Turbidity from dredging of fine sediments, such as mud bottom, is usually more severe and persistent than dredging of coarse sand bottom. Seagrass habitat can be altered or destroyed if dredged material is placed directly on existing seagrass. Potential seagrass habitat can also be eliminated if un-vegetated soft bottom is filled and converted to an upland placement island, or dredged to an excessive water depth. Re-suspension and dispersion events caused by wind-generated waves are primarily responsible for the propagation of dredge-related turbidity over space and time. However, both navigational and environmental dredging may increase tidal flushing and circulation and actually improve water quality conditions for seagrass. This hypothesis should be studied further on a case by case basis.

Hardened Shoreline

Shoreline hardening structures, such as bulkheads and docking facilities, may impact seagrass by increasing the impact of wave energy and reflecting the wave back to deeper water, which in certain conditions may scour soft-bottom habitats where seagrass may grow.[39] Numerous studies of soft-bottom habitats indicate urban structures may affect or change the biological, chemical and physical parameters of the benthos.[46,47] In addition to increasing bottom scour on soft bottom habitats, hardened shoreline prevent dead algae and debris from washing ashore to decompose.[46] This increases the amount of organic matter being deposited in the water column and could lead to organic matter build-up in the sediments. But, it should also be noted that in quiescent areas, seagrass has been seen growing in front of bulkheads. There is also concern that, as sea level rises, hardened shorelines may prevent the migration of seagrass into newly inundated shallow areas. The potential or witnessed migration of seagrass beds in response to sea level rise must be further assessed.

Recreational Boating

Physical impacts such as propeller (prop) scarring, vessel wakes, scouring and mooring scars from inappropriate or irresponsible boating practices may be contributing to seagrass loss in areas frequented by recreational and commercial boaters.[9,30,40] Propeller scarring of seagrass occurs when vessels travel through water that is shallower than the draft of the boat; boaters would prefer to avoid situations like "running aground" as it can cause extensive damage to boats. Boat props cut plant leaves, roots, and stems, and create narrow trenches through the sediment. The damaged area is referred to as a "prop scar."[30] A "blow hole" may also be excavated where boaters attempt to rapidly power off the shallow bottom.[48] Mechanical disturbance to sediments damages plant rhizomes, which reduces plant abundance and cover for extensive periods of time, sometimes for many years.

An increase in boating impacts may be a consequence of reduced water clarity and quality, which prevents boaters from determining depths in certain areas. The South Shore Estuary is particularly susceptible to boating damage, as the reoccurrence of heavy phytoplankton blooms make visually determining the depth at any given spot virtually impossible. In the Chesapeake Bay, prop scarring was identified as an increasing problem in some areas due to a reduction in water clarity and an increase in boaters.[39] The increase in prop scars is associated with an increase in human population (increased nutrient loading leading to algal blooms), as well as an increasing amount of boating activity.[30,49] Recovery of seagrass can take anywhere from 18 months to 10 years, depending on the seagrass species, extent of damage, and local conditions, or in some cases, the habitat may never recover.[40,50] Once initial impacts are made, seagrass damage can expand beyond the initial footprint of the prop scar due to physical scouring by tidal currents, storms, or biological disturbance such as crab and skate burrowing.[51,52] Better channel markings and increased boater education could limit the disturbance of seagrass habitats.

Mooring field scars have also been identified as a threat to seagrass since traditional mooring designs rely on mooring buoys attached to lengths of chain which, it turn, are attached to a large weight. As winds and tides changes, moored boats move in different directions and the chain sweeps the bottom, effectively clearing the sediment of aboveground biomass. This results in "halos" around moorings where seagrass is not able to grow due to constant disturbance. There are other mooring technologies that have a more secure and smaller diameter embedment into the bottom material. Chains can be eliminated and replaced with other materials, some of which employ sub-mooring balls, which have had large success at eliminating the "halo" effect around moorings.

Marinas and Docks

Construction of marinas and docks can deplete seagrass habitat by introducing suspended sediment during construction and reducing light availability (as docks shade bottom). However, most large marina and dock constructions or repairs would likely occur during the winter boating offseason months as not to conflict with the height of boating season; when eelgrass growth and potential impacts to eelgrass is minimized. Burdick and Short (1999) measured the effects of dock height and orientation on seagrass growth in Waquoit Bay, Massachusetts. They concluded that fixed docks, if possible, are better than floating docks and that dock height should be at least 3m above the bottom in areas where the tidal range is less than 1m in order to optimize light penetration around docks. They also suggested that docks should be narrow in a north-south orientation where possible to promote seagrass growth and survival.

Energy Cables and Pipelines

Placement of infrastructure, such as bridge supports and fiber optic cables, on submerged lands can impact seagrasses and seagrass habitat. Bridge construction and replacement have resulted in seagrass loss in several areas of Florida.[54] Impacts to seagrass can be minimized by use of directional drilling technology. This method involves drilling a small tunnel under the seafloor instead of dredging a trench from the seafloor surface in order to install cables and pipelines.

4.3 Biological Impacts

This section involves native or nonnative species that affect seagrasses directly or the environmental factors necessary to support seagrass.

Algal Blooms

Algal blooms increase light attenuation, reducing the photosynthetic processes of seagrass. When sufficient light is not available seagrass begins to suffer, thus, a persistent bloom is capable of killing seagrass in a single season. Beyond the direct impact of lowered light levels, large blooms of phytoplankton will uptake available water column nutrients and prevent its availability to seagrass. The inevitable die-off of algal blooms may deplete oxygen levels in the water causing hypoxic or anoxic conditions.[55] This will directly impact the redox chemistry of the sediments and allow toxic levels of sulfide in the pore water to penetrate the roots of the seagrass.

Harmful algal blooms (HABs) have been more prevalent over the past 20 years in New York waters and their persistence can threaten and harm seagrass[56], sometimes for months at a time. New York has two distinct harmful algal blooms that threaten the health of seagrass: *Aureococcus anophagefferens*, commonly referred to as Brown Tide and *Cochlodinium polykrikoides* (Red Tide). *Aureococcus* first appeared in New York waters in 1985 when a bloom occurred in the Peconic Estuary. Brown tide blooms when water temperature rises in late spring/early summer and water column nutrients are plentiful. It generally dies off in the summer as water temperatures rise above 24 degrees Celsius. In recent years, brown tide blooms have worsened in duration and intensity. The summer of 2008 marked the worst bloom in history for the South Shore Estuary, with *Aureococcus* blooming in May and continuing until October.

The other harmful algal species, *Cochlodinium*, was first recorded in New York[57] in West Neck Bay (Peconic Estuary) during the fall of 2002, however it was not formally identified until 2004 when a bloom occurred in Flanders Bay, Peconic Bay and Shinnecock Bay during early fall. Although no reports of fish kills occurred in New York waters as a result of *Cochlodinium*, the dinoflagellate has been the cause of fish die-offs in Asian waters, Canada, and the Gulf of California. The level of impact from red tide on seagrass is unknown, but persistent blooms could lead to light limitation and other stresses.

Bioturbation and Grazing

Skates, crabs, mute swans, and various other bottom-feeding animals can disturb seagrass roots or completely uproot plants, and slow or prevent seagrass recovery. The frequency and duration of bioturbation disturbances and their potential role in altering or maintaining the spatial heterogeneity of seagrass beds have yet to be evaluated in New York waters. Spider crabs have been observed uprooting small isolated patches of eelgrass in the Peconic Estuary and have negatively impacted restoration efforts there. Knob whelks, searching for food in eelgrass beds, have uprooted plants and present a problem for newly restored beds in the Peconic Estuary. Some restoration efforts in New England utilize bioturbation fences or exclosure fencing to prevent uprooting by crabs. Unnatural, fragmented patches, caused by boats, fishing gear, etc. may be worsened by bioturbation. Bioturbation may be beneficial in some cases as oxygen is introduced into the sediment and may reduce pore water sulfide levels. It is only when the bioturbators directly and excessively remove seagrass that it becomes a threat to seagrass beds.

Disease

Seagrass wasting disease is a natural event that occurs in New York. Stressed seagrass may be more susceptible to wasting disease. Wasting disease can negatively affect seagrasses and therefore may indirectly cause reductions in bay scallops, fisheries resources, and migratory waterfowl populations. It was suspected, but never proven, that the slime mold protist, *Labryinthula,* was the cause of the wasting disease event that devastated eelgrass populations throughout the North Atlantic between 1930 and 1933, dramatically disrupting estuarine systems.[58] Higher water temperatures apparently stressed the seagrasses, making them more susceptible to *Labryinthula*. Healthy eelgrass beds were generally reestablished by the 1960s. More recently, similar large-scale die-offs of eelgrass from Nova Scotia to Connecticut have been attributed to *Labryinthula.*[59] Eelgrass infected with *Labryinthula* was also found near Beaufort, North Carolina in the 1980's.[59] Submerged aquatic vegetation is less susceptible to infection by the pathogen in low salinity waters.[59] Although the current infections have not caused catastrophic declines in eelgrass populations such as those that occurred in the 1930s, the disease is a potential indirect threat to coastal fisheries.

Invasive Species

Little is known about the impact exotic species have on seagrasses in New York. One species of concern is the ascidian *Didemnium*. The recent arrival of this species in Peconic and the South Shore Estuaries may have negative effects on seagrass. *Didemnium* forms dense mats that smother the sediment surface, and may smother present eelgrass, as has been observed in Great South Bay (GSB). Potential negative impacts of this and other invasive species must be examined further.

Loss of Filter Feeders

Large historic populations of filter feeders such as clams, oysters and bay scallops no longer exist in New York waters. A lack of filter feeders, which cleanse and filter our bays, may contribute to decreased water quality. At one point in time hard clams were capable of filtering GSB waters in less than a week, however at current decreased population levels it would take up to 5-6 months for filter feeders to filter GSB. In addition to the filtering services, shellfish are often important bioturbators in seagrass beds, introducing oxygen into the root and rhizome system and preventing levels of hydrogen sulfide from reaching toxic conditions.

Lack of Genetic Diversity

Seagrasses typically exhibit low effective population sizes and large clonal spreads with relatively low genotypic diversity, which make them particularly susceptible to genetic degradation under poor environmental conditions.[60] This lack of genetic diversity threatens seagrass in multiple ways. Genetic diversity allows seagrass plants to survive varying environmental pressures and stresses, providing adaptability in a changing environment. However, seagrass beds on Long Island are no longer as genetically diverse as they once were. Years of disease, increasing temperatures, harmful algal blooms, and other stressors have reduced the seagrass beds' genetic diversity. Strategies to manage seagrasses must look beyond environmental and ecological stressors and factor in genetic diversity. Using a single genotype as donor material in restoration transplanting may actually negatively impact the fitness of the population by decreasing the overall genetic diversity.[60] Conversely, using donor genotypes that are not locally adapted could also lead to increased mortality and lower the fitness of local populations.[61]

4.4 Global Concerns

The following environmental threats have both local and global implications. It is expected that these threats may become more prevalent in the future. These issues are not beyond our control, and we can adaptively respond to their threat to seagrass.

Storm damage

Storm surges and wind/wave action may physically remove seagrass and/or increase water column turbidity. Storm damage is exacerbated when natural storm barriers and displacers, such as wetlands, salt marshes and other types of natural shoreline are removed or replaced by hardened shoreline or structures. These hardened structures do not absorb the force of waves and storm surges as natural habitat would, but rather deflect wave energy back into the estuary. This could lead to increased scouring and physical removal of seagrass. Ice during the winter months can also scour and remove seagrass in shallow embayments.

Sea Level Rise/Climate Change

Rising sea levels may result in deeper water in some coastal environments. Less light is able to penetrate deeper waters down to bay bottom seagrass habitat, especially if those waters suffer from turbidity and nutrient issues and algal blooms. Hardened shoreline, likely to increase as sea level rises, may prevent the landward migration of existing seagrass beds, and decrease the availability of suitable habitat. Climate change may result in increases in water temperature. Seagrasses are very sensitive even to the slightest increases in temperature. Thus, there could be significant implications on seagrass health and restoration success. Recent reports have indicated that a lack of genetic diversity in seagrass beds may play a role in the inability of seagrass to adapt to climate change, specifically increasing water temperatures. [62,63]

4.5 Threat Ranking

Each estuary and their respective watersheds are distinct and diverse in geology, environmental characteristics, development patterns, and current or potential threats and stresses to seagrass; consequently, the Task Force ranked the aforementioned threats for three estuarine systems. Table 4 groups the known threats into four larger threat categories: water quality, physical disturbance, biological impacts, and global concerns. The Task Force assigned rankings using monitoring data and reports, direct field observations and documentation, restoration effort results, personal observations, and available research. “High” rankings reflect significantly severe and abundant impacts; “moderate” rankings reflect impacts less significant in scope and scale, and individually, slightly more tolerable to seagrass; “low” rankings reflect limited impact; and, “unknown” rankings reflect insufficient evidence or unavailability of research to determine level of threat. Threat ranking rationale can be found in Appendix A.8.

Although each individual threat may not be fatal to seagrass, the combination of multiple threats and stressors (e.g., simultaneous water quality issues, fishing gear impacts and presence of toxic chemicals) can prove devastating. Healthy seagrass beds are able to withstand some level of natural and anthropogenic disturbance and are able to recover. Stressed seagrass habitats can weaken seagrass plant structures, leaving them susceptible and vulnerable to other environmental stressors.

Table 4: *Current threats are ranked for each of the three estuaries*

	THREAT	ESTUARINE SYSTEM Peconic Estuary	Long Island Sound	LI South Shore Estuary
Water Quality	**Excess Nitrogen**	High (western)/ Low (eastern)	High	High
	Development/Imperviousness	Mod	Mod	Mod/High
	Pore water Sulfide Toxicity (reduced redox)	Mod	Unknown	Unknown
	Toxic Chemicals (herbicides/pesticides, oil spills)	Potential (agriculture)	Unknown	Unknown
Physical Disturbance	**Fishing and Shellfishing Gear/ Aquaculture** (see Table 5)	Mod/High	Low	Mod/High
	Navigational Dredging	Low	Low	Low
	Hardened Shorelines	Mod/High	Low	Mod/High
	Recreational Boating (prop scars, anchors/moorings)	Mod	Low	High (west of the Robert Moses Causeway (RMC)) Mod (East of RMC)
	Marinas and Docks (shading)	Low	Low	Mod
	Energy Cables/Pipelines	Low	Low	Low
Biological Impacts	**Harmful Algal Blooms** (light limitation)	High	Low	High
	Bioturbation/Grazing	Mod	Low	Low
	Disease	Unknown	Unknown	Unknown
	Invasive Species (codium, tunicates)	Unknown	Unknown	Unknown
	Loss of Filter Feeders	Unknown	Unknown	Unknown

	Lack of Genetic Diversity	Unknown	Unknown	Unknown
Global Concerns	**Storm Damage** (overwash, breaches, wave action)	Mod	Mod	Mod
	Climate Change (temperature)	Mod	Low	Low/Mod
	Sea Level Rise (inability to migrate- hardened shoreline)	Low/Mod	Low	Mod

Currently, the overall highest threats for seagrass in New York include excess nitrogen (affecting water quality), persistent and sustained algal blooms, and fishing and shellfishing gear impacts. Highest threats differ for each individual estuarine system:

• Long Island Sound seagrass is most threatened by excess nitrogen.

• Peconic Estuary seagrass is most affected by fishing and shellfishing gear and boating activities, which likely are exacerbated by already weakened and stressed seagrass beds. Elevated nitrogen levels in the western estuary also prove to be a limiting factor.

• Long Island's South Shore Estuary is most threatened by harmful algal blooms that reduce the light availability, and excess nitrogen (water quality) in the water column.

Current threats to seagrass may increase or decrease in severity, and new, different threats and stressors may emerge as the landscape of the land and water changes. The emerging threats differ for each estuary:

• Long Island Sound seagrass is most susceptible to climate change, particularly rising water temperatures in shallow water areas and embayments.

• Peconic Estuary seagrass is at risk from potential increases in hardened shoreline and construction of private docks. Sea level rise and increasing development pressures may spark increased hardening. Peconic seagrass is also susceptible to increased water temperatures brought about by climate change.

• The South Shore Estuary, the shallowest area where seagrasses are found, is susceptible to sea level rise, and increased water temperatures from climate change. The proliferation of docks and hardened shorelines in response to sea level rise will decrease seagrass coverage further by preventing migration and shading seagrass habitat.

5. RECOMMENDATIONS:

The recommendations of the New York State Seagrass Task Force are designed to:

- Ensure Protection of New York State Seagrass Resources
- Improve and Maintain Water Quality
- Manage New York State Seagrass Resources
- Monitor the Health and Extent of New York State Seagrass
- Research Seagrass Dynamics and Impacts
- Restore Seagrass and Seagrass Habitat
- Educate and Engage New Yorkers

Acknowledging that there are limited resources available for these efforts, the Task Force has assigned time-sensitive categories to the recommendations.

- *Immediate Actions*: Highest priority actions that must be taken now.
- *Near Term Actions*: Actions that must be taken in the near future.
- *Long Term Actions*: Actions which build upon the immediate and near term actions.

In spite of the assigned sequencing of the following actions, these recommendations are all essential steps to take in order to effectively protect, restore and manage seagrass.

Goal: Maintain current seagrass acreage and increase 10% by 2020.

Ensure Protection of New York State Seagrass Resources

- Create and implement a multi-jurisdictional Seagrass Protection Act or other legislative action such as "Special Management Areas" to give the New York State Department of Environmental Conservation (NYSDEC) and/or other appropriate entity the authority to regulate coastal and marine activities which threaten seagrass beds and seagrass restoration efforts.
  Immediate Action (Responsible Entity: New York State Legislature, NYSDEC, Municipalities)

- Incorporate protection of seagrass into State Environmental Quality Review (SEQR) through updated guidance.
  Near Term Action (Responsible Entity: NYSDEC)

- Address seagrass protection and restoration in development of Local Waterfront Revitalization Programs and Harbor Management plans, where appropriate.
  Long Term Action (Responsible Entity: NYSDOS, Municipalities)

- Implement an invasive species management plan to limit negative effects on seagrass.
  Long Term Action (Responsible Entity: New York State Invasive Species Council)

- Evaluate the best regulatory mechanism to protect seagrass and seagrass habitat in the Hudson River.
  Long Term Action (Responsible Entity: NYSDEC)

Improve and Maintain Water Quality

- Establish and implement numeric water quality criteria/standards to protect seagrass habitat.
  Immediate Action (Responsible Entity: NYSDEC)

- Control and reduce nutrient, pesticide, and sediment loading to surface and groundwater. This includes:
  - Developing and implementing total maximum daily loads (TMDLs).
  - Implementing NYSDEC Phase II stormwater regulations.
  - Sewering high-density coastal residential areas where onsite disposal systems are failing due to high groundwater levels.
  - Implementing nitrogen removal at sewage treatment plants (STPs).
  - Reducing atmospheric nitrogen loads.
  - Implementing fertilizer management on agricultural and non agricultural lands.

  Immediate Action (Responsible Entity: USEPA, New York State, County, Municipalities, STPs, Private property owners)

- Ban or restrict coastal watershed use of pesticides and herbicides proven to be toxic to seagrass and species dependent on seagrass resources.
  Long Term Action (Responsible Entity: USEPA, New York State)

- Protect, enhance and restore coastal and marine properties, habitats (e.g., wetland and shellfish), open space, riparian corridors and natural shorelines to reduce, filter and absorb polluted runoff. ***Immediate Action (Responsible Entity: Federal, New York State, County, Municipalities, Estuary Programs, Non-profits, Private property owners)***

Manage New York State Seagrass Resources

- Develop and implement estuary-specific seagrass management plans using the Peconic Estuary Program's "Eelgrass Management Plan for the Peconic Estuary" as a model. The seagrass management plans must set quantitative estuary-specific acreage goals and targets.
  Near Term Action (Responsible Entity: Estuary Programs)

- Implement Seagrass Management Areas to manage activities near and within seagrass beds.
  Long Term Action (Responsible Entity: New York State, Municipalities)

- Reduce physical disturbance of seagrass beds from hardened shorelines, navigational dredging, boating and fishing activities. This includes:
  - Developing management and gear restrictions necessary to regulate the use of destructive shellfish harvesting methods such as raking, tonging, and mechanical harvest in seagrass.
    Immediate Action (Responsible Entity: Federal, NYSDEC, Municipalities)

  - Encouraging and promoting natural shorelines through education, permit guidance, and standard activity permits.
    Near Term Action (Responsible Entity: New York State, NYSDEC, New York Sea Grant , Municipalities, Estuary Programs, Non-profits)

  - Implementing a dredging strategy for routinely maintained navigational channels near/abutting seagrass beds through permit guidance (e.g., reduction in light levels and sediment settlement).
    Long Term Action (Responsible Entity: Federal, New York State, County, Municipalities)

  - Increasing navigational channel markings to prevent boats from running aground in seagrasses and damage caused by personal watercraft.
    Long Term Action (Responsible Entity: Coast Guard)

- Undertake a coastal spatial planning effort to map activities in relation to seagrass beds to support compatible uses.
  Long Term Action (Responsible Entity: Municipalities)

- Convene a Seagrass Working Group 1-2 times a year to oversee implementation of Task Force recommendations.
  Near Term Action (Responsible Entity: NYSDEC)

Monitor the Health and Extent of New York State Seagrasses

- Develop and distribute a triennial New York State Seagrass Status Report Card.
  Immediate Action (Responsible Entity: New York State)

- Conduct uniform triennial mapping of seagrass and implement a sentinel seagrass bed monitoring program in all three estuaries: Long Island Sound, Peconic Estuary, and South Shore Estuary.
  Near Term Action (Responsible Entity: Estuary Programs)

Research Seagrass Dynamics and Impacts

- Create comprehensive eelgrass restoration site suitability index models for each estuary to identify candidate restoration sites; confirm and test through in-field restoration test plots.
  Near Term Action (Responsible Entity: Estuary Programs)

- Conduct research to determine the effects of multiple stressors on seagrass, determine the genetic diversity of seagrasses in and between estuarine systems, and determine the causes of exacerbated wasting disease or other potential diseases affecting seagrasses.
  Long Term Action (Responsible Entity: Federal, New York State, New York Sea Grant, Academia)

- Identify pesticides and herbicides and the concentrations at which they are toxic or sublethal to seagrass and seagrass habitat.
  Long Term Action (Responsible Entity: Federal, New York State, Academia)

- Investigate the ability of seagrasses to migrate in response to climate change and sea level rise, and their carbon dioxide uptake potential in light of climate change.
  Near Term Action (Responsible Entity: Federal, New York State, New York Sea Grant, Academia)

Restore Seagrass and Seagrass Habitat

- Promote natural recovery through the site selection model and use propagation facilities to aid in human induced restoration initiatives.
  Long Term Action (Responsible Entity: New York State, Municipalities, Estuary Programs, Non-profits, Cornell Cooperative Extension of Suffolk County,)

Educate and Engage New Yorkers

- Implement a general education campaign, which includes producing and distributing brochures and posting of interpretive signage, and a targeted education campaign to distribute pamphlets with boat registrations and fishing and shellfishing licenses/permits, to educate New York State citizens about the importance of seagrass and efforts they can undertake to protect seagrass. ***Immediate Action (Responsible Entity: New York State, New York State Parks, Municipalities, Estuary Programs, New York Sea Grant, Industry, Non-profits)***

- Hold regular workshops for municipal officials and targeted audiences on the biological, ecological, social, and economic importance of seagrass and threat to seagrass health. *Long Term Action (Responsible Entity: New York State, Municipalities, Estuary Programs, New York Sea Grant, Non-profits)*

6. CONCLUSION

New York State seagrasses are declining at an alarming rate and continue to be threatened by increased nutrient loadings, decreased water quality and clarity, large phytoplankton blooms, habitat degradation, fishing gear and boating activities, and climate change. Collectively, these multiple impacts are stressing seagrass to the point it can no longer survive. Because seagrasses provide so many ecosystem services to coastal and marine environments (most notably quality habitat and nursery grounds), a decrease in seagrass means a decrease in fish and shellfish, a decrease in water quality, and disrupted nutrient cycles and food webs. The biologic, ecologic and economic implications are profound.

The New York State Seagrass Task Force warns that current efforts to protect, restore, and manage seagrass are not enough. New regulations are imperative to effectively protect seagrass, efforts to improve coastal and marine water quality are necessary, new and additional resources are essential to manage, monitor, research and restore seagrasses, and efforts to educate and engage New Yorkers in the process to restore seagrass and seagrass habitat is crucial.

The Seagrass Task Force has investigated many of the hypothesized impacts to seagrass, most notably impacts of groundwater characteristics on seagrass. Additional resources and investigations are needed. The recommendations in this report are intended to serve as a blueprint for programs and efforts to protect and restore New York seagrasses. All levels of government, estuary programs, industry, academia, environmental groups, and citizens are urged to use this report to guide future endeavors. Comprehensive, collaborative initiatives are necessary to restore this irreplaceable habitat.

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Appendix A.1: New York State Seagrass Task Force Legislation

NEW YORK STATE SENATE INTRODUCER'S MEMORANDUM IN SUPPORT submitted in accordance with Senate Rule VI. Sec 1

BILL NUMBER: S8052

SPONSOR: JOHNSON

TITLE OF BILL:
An act to establish a seagrass research, monitoring and restoration task force and providing for its powers and duties; and providing for the repeal of such provisions upon expiration thereof

PURPOSE:
To establish a task force that will examine and make recommendations on means of restoring, preserving and properly managing seagrass.

SUMMARY OF PROVISIONS:
Section one establishes a seagrass research, monitoring and restoration task force. The Task force will consist of five voting members and ten non-voting members. Sections two, three and four provide for the organization of the task force by establishing that the chairperson will be the commissioner of environmental conservation or his or her designee and requires that any vacancies on the task force be filled in the manner provided by the initial appointment. Sections five, six and seven authorize the task force to hold public hearings and meetings to enable it to accomplish its duties; and requires that every state agency, local agency and public corporation having jurisdiction over areas of native seagrass habitat or over programs relating to the purposes and goals of this act offer full cooperation and assistance to the task force in carrying out the provisions of this act. Defines "native seagrass," as native underwater plants found in Long Island bays and estuaries including, but not limited to, eelgrass and widgeon grass.

JUSTIFICATION:
Long Island seagrass populations were severely decimated by wasting disease in the 1930s and again by a massive brown tide event in the 1980s. Despite the absence of these events in some areas like the Peconic Bays and Long Island Sound over the past 20 years, local seagrasses have not recovered. The intent of this legislation is to set up a task force to develop recommendations for regulations to improve seagrass protection, restoration, research and monitoring. This task force will establish the necessary framework for reducing the impact of direct and indirect threats and restoring and properly managing seagrass into the future. Direct impacts include physical damage from boat groundings, incompatible fishing practices, docks and bulkheads, and other potentially destructive activities. Indirect impacts include water quality effects from nutrients, sedimentation and toxic contaminants. Effective regulations for seagrass protection and restoration will depend greatly on the State's ability to understand the severity of these impacts. This task force will identify and assess severity of indirect and direct threats, develop restoration goals, recommend short-term and long-term research and monitoring and propose public outreach and education tools. Seagrass, which is designated as Essential Fish Habitat and a Habitat Area of Particular Concern for many of New York State's recreationally and commercially important marine species, is a vital component to successful and lasting restoration of Long Island finfish, shellfish, crustacean, and waterfowl populations, which has far reaching benefits for improved quality of life and economic growth opportunities for present and future generations on Long Island.

LEGISLATIVE HISTORY:
New bill.

FISCAL IMPLICATIONS:
Minimal.

EFFECTIVE DATE:
This act shall take effect immediately and be deemed repealed January 1, 2009.

LAWS OF NEW YORK, 2006
CHAPTER 404

AN ACT to establish a seagrass research, monitoring and restoration task force and providing for its powers and duties; and providing for the repeal of such provisions upon expiration thereof

Became a law July 26, 2006, with the approval of the Governor.
Passed by a majority vote, three-fifths being present.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. Seagrass research, monitoring and restoration task force.
There is hereby established, within the department of environmental conservation a seagrass research, monitoring and restoration task force("task force") which shall consist of five voting members and ten non-voting members who shall be appointed as follows:
(a)the commissioner of environmental conservation or his or her designee;
(b)the commissioner of parks, recreation and historic preservation or his or her designee;
(c)the secretary of state or his or her designee;
(d)one member upon the recommendation of the temporary president of the senate;
(e)one member upon the recommendation of the speaker of the assembly;
(f)ten non-voting members to be selected by the department of environmental conservation representing: recreational anglers, town marine law enforcement, estuary programs, the commercial fishing industry, recreational boaters, the director of New York sea grant, local government officials, the marine resources advisory council, New York businesses and advocates for the environment.

§ 2. Task force members shall receive no compensation for their services but shall be reimbursed for actual and necessary expenses incurred in the performance of their duties.

§ 3. The chairperson of the task force shall be the commissioner of environmental conservation or his or her designee. The task force shall meet no less than four times and at other times at the call of the chairperson.

§ 4. Any vacancies on the task force shall be filled in the manner provided for in the initial appointment.

§ 5. The task force shall be authorized to hold public hearings and meetings to enable it to accomplish its duties.

§ 6. Every state agency, local agency and public corporation having jurisdiction over areas of native seagrass habitat or over programs relating to the purposes and goals of this act shall, to the fullest extent practicable, offer full cooperation and assistance to the task force in carrying out the provisions of this act.

§ 7. As used in this act, "native seagrass" shall mean native underwater plants found in Long Island bays and estuaries including, but not limited to, eelgrass (zostera marina) and widgeon grass (ruppia maritima); "native seagrass meadows" shall mean those habitats in estuarine waters vegetated with one or more species of native seagrass.

§ 8. No later than December 31, 2008, the task force shall transmit to the governor, the temporary president of the senate and the speaker of the assembly a report containing recommendations on how to accomplish the following:
(a) Recommendations on elements of a seagrass management plan including, but not limited to, regulatory and/or statutory alterations
required to preserve, restore, protect and map the native seagrass population on Long Island.

(b) Recommendations on means of preserving and restoring seagrass and native seagrass meadows that will bring about a lasting restoration of finfish, shellfish, crustaceans, and waterfowl, that is compatible with an improved quality of life and economic growth for the future of the region. Such proposals shall also include any recommendations for monitoring, additional research, and public education to ensure the success of the effort.

§ 9. This act shall take effect immediately and shall expire and be deemed repealed January 1, 2009.

The Legislature of the STATE OF NEW YORK **ss:**
Pursuant to the authority vested in us by section 70-b of the Public Officers Law, we hereby jointly certify that this slip copy of this session law was printed under our direction and, in accordance with such section, is entitled to be read into evidence.

JOSEPHL. BRUNO
Temporary President of the Senate

SHELON SILVER
Speaker of the Assembly

APPENDIX A.2 New York State Seagrass Task Force Members

<u>Voting Members:</u>

Designee of Environmental Conservation Commissioner
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Designee of Parks, Recreation and Historic Preservation Commissioner
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Designee of the Secretary of State
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Greg Capobianco (alternate)
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Representative of the Temporary President of the Senate
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Dean and Director
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Marine Resources Advisory Council
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Living Marine Resources Institute
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New York Marine Trades Assn.
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csqueri@aol.com

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Citizen's Campaign for the Environment
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Maureen Dolan Murphy (alternate)
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APPENDIX A.3

New York State Seagrass Experts Meeting Table of Research and Monitoring Recommendations

<u>Expert Panel Participants</u>

Paul Carlson, Florida Fish and Wildlife Conservation Commission
Bradley Peterson, Stony Brook University
William Dennison, University of Maryland
Kenneth Heck, Jr., University of South Alabama
Mark Fonseca, NOAA National Ocean Service
Chris Pickerell, Cornell Cooperative Extension
A. Coolidge Churchill, Adelphi University
Fred Short, University of New Hampshire

Ranked Order	Group Priority	ID#	Category	Action	Task	Time	Cost (w/out overhead)
1	High	1	Management	Establish a working group for coordination, and info dissemination	Define seagrass habitat, monitoring schemes, scale, indicatiors, leveraging efforts, take lead role in synthesis	Immediate and regular meetings	10% total budget
2	High	2	Management	Synthesis of existing data, merge the datasets, IM coordinator	Follow up on May 2007 mtg, produce a report, getting GIS data layers	By end of 2007	$80K
3	High	5	Monitoring	Monitoring physical conditions of the seagrass beds	Light/Temperature loggers in grass beds, use carefully chosen spatial scale. And more frequent (or continous) light sampling.	Need high resolution in Summer, quarterly thereafter.	$20-30K
4	High	16	Management	Public education / perception	Reduce impacts to seagrasses through changes in resource use and vessel operations - potentially through waste management and regulation. Outreach with signs at boat ramps, etc.	Follow synthesis	$25K - $50K
5	High	3	Monitoring	New mapping of seagrass, with standardization, metadata implementation, timely reporting. Include analysis of historical aerial photos where usable to determine where seagrass existed at different times in the past. Spatial patterns of loss give clues to causes of loss- deep edge losses = light stress.	Best technique to be determined by working group (i.e., aerial photography, hyperspectral satelite data, acoustic surveys on sentiel areas). May be advantageous to do LIS, PE, SSER in same years. Develop a universal metric for defining seagrass habitat	Starting now, do every 2-3 years	$150/sq mile total (photo= 1/3 of cost; interpretation = 2/3). Groudtruthing of remote data necessary.
6	High	6	Monitoring	Monitor seagrass beds themselves; as examples SeagrassNet, Seagrass Watch. Frequency and design to be determined by working group. Options include fixed transects, spatially -distributed random points, fixed points.	Visual assessment for density and cover, do not count individual shoots. To be decided by working group, geared toward question being asked	Ongoing quarterly	10-15 FTE days per quarter
7	High	13	Research	Need to look at multiple stressors together (e.g., light and sulfide, root penetrability of hard substrates)	E.g., manipulate organic matter in common garden experiment? Feed information inot any modeling from the synthesis section	Years 2-3	$100K
8	High	9	Research	Is there a biological disturbance inhibiting persistaence, restoration, recolonization? Bioturbation, crabs, swans, lugworms, whelks, etc.	Use exlusion cages 1 ft deep and above the grass to test with and without planting	Immediate	$85K
9	Phase 1 = high Phase 2 = Low to High	8	Monitoring	Identify sources of light attentuation	Light attenuation parsing to guide whe to focus on. Phase 1 = regression model (color, TSS, Chl a), Gallegos model. Use secchi and WQ data. Phase 2 would be using thise and other factors to do your restoration selection	Part of Synthesis	0 Phase 2 = $130K

10	**Medium to High**	**4**	**Monitoring**	Need bathymetry of SSER first, then PE, then LIS. If light limitation is one of the principal causes of seagrass mortality, bathymetry data will tell you where recovery is possible given incremental improvements in water clarity	10 cm resolution, focusing in the shallow water(e.g., < 3 m in SSER). Weak green laser (3 cm accuracy) RTK (3-D GPS) unit (DOT may have)	**Once**	**Weak green laser (lidar) $1K/sq km. Look to NOAA/ACOE for pro bono**
11	**Medium to High**	**18**	**Research**	Restoration strategy including integration of landscape ecology into planning	Site selection, technique, etc. spatial modeling to predict potential recovery	**Follows synthesis**	**90K**
12	**??? Priority depends on synthesis**	**7**	**Research**	Is GW having a negative effect on seagrass? As a transport pathway for N and pesticides. Includes sewage/septic as affecting N (high nitrate 10uM threshold) - direct toxicity and increased phytoplankton	A) Look at SCDHS data first B) literature search about effects. C) Bioassays of chemicals - are they killing the seagrass or community (grazers)	**TBD**	**0 for A and B; C = $60k**
13	**Low to High**	**17**	**Research**	Nitrogen budget needed for PE (mainly) and SSER to determine what the potential controlling sources may be … integrate with synthesis work	Points to potential management jurisdictions and actions	**Follows synthesis**	**$25K**
14	**Medium**	**15**	**Research**	Epiphytic -grazer interactions - are changes in abundance or absence of grazers influencing current distribution or restoration	Indications of limitation to colonization and bed maintenance. This is examining how these grazers may facilitate survival of seagrass esp in areas where there are potentially high epiphyte loads that would reduce light availability to the plants.	**1-3 years**	**$50K**
15	**Low to High**	**12**	**Research**	Impact of shellfishing (damage) and connection (positive feedback) between seagrass and shellfish	BPBL as a control and set up other test areas, soft vs hard bottom differences; also consider recreational impacts. - i.e. all local gear types with manipulative planting experiments	**Years 2-3**	**$120K**
16	**Medium**	**14**	**Research**	What is the genetic diversity of seagrasses in the various estuarine systems (SSER, PE, LIS)?	Populations genetic analysis - initial screening with appropriate scale of sampling	**Years 2-3**	**$70K**
17	**Low to Medium**	**11**	**Research**	Determine effects of physical disturbance of seagrass bed areas, including dredging, hardening, boating	BPBL could be used as a control for some disturbances, and set up other test areas	**build out of information synthesis**	**$25K - $100K**
18	**Low**	**10**	**Monitoring**	Characterize biota in seagrass beds	How have impacts to the bays influenced the function and secondary production of seagrass beds? This is about how animals USE seagrass beds and conversely, the larger community value of seagrass beds in your area	**Year 3**	**$50K**

APPENDIX A.4 *Seagrass Taskforce Funded Projects and Accomplishments*

Monitoring

Monitoring the Natural Recovery of a Storm-damaged Eelgrass Meadow in Peconic Estuary ($21,892)
This project will determine the mechanisms which allow natural eelgrass meadows to recover from physical disturbance. Better understanding of the process of re-vegetation will help to explain local meadow persistence and could further refine eelgrass restoration methods in the region.

Eelgrass Groundwater Interaction Study ($58,772)
This project will identify and characterize the contribution of groundwater seepage at three different locations and collect samples of the seepage for analysis. In addition, it will monitor and document the survival of planted eelgrass in permanent plots through photo documentation and direct counts.

NYS Seagrass Mapping Workgroup and Protocol
A collaborative workshop was organized to standardize and adopt state-wide protocols and recommendations for acquiring and interpreting digital aerial imagery, as well as digitizing and groundtruthing delineated eelgrass beds.

Research

Experimental Evaluation of Groundwater on Zostera marina and Associated Epiphytic Grazer Mortality in Peconic Bay, New York ($67,472)
The primary objectives of this research study are to experimentally determine the lethality of groundwater on *Zostera marina* or associated epiphytic grazers (i.e. amphipods, isopods and gastropods), to assess the impact of groundwater on *Zostera* growth morphometrics and productivity in the field and to determine whether known herbicides and pesticides that damage seagrass are present in Peconic Bay groundwater.

Experimental Assessment of Multiple Stressors on Groundwater Herbicide Toxicity for Eelgrass ($105,223)
This research project will experimentally determine the lethality and sub-lethal effects of measured Peconic Bay groundwater concentrations of Diuron on *Zostera marina* survival and assess the impact of lower light availability and increased water temperature on these lethal and sub-lethal effects.

Restoration

Caumsett Eelgrass Restoration Project ($35,663)
This restoration project is to undertake large-scale planting of eelgrass at Caumsett State Historic Park. Planting involves using existing rocks to hold down groups of plants until they can root into the adjacent sediment. All of the methods proposed have been tested at this site and others like it over the last several years. Monitoring involves SCUBA observations of plant survival and relative health at fixed intervals relative to changes in water temperature.

Outreach

SEAGRASS.LI Newsletter Publication ($22,220)
This outreach project was to continue the production, publication and distribution of the SEAGRASS.LI newsletter by Cornell Cooperative Extension which will prepare timely articles covering local issues relating to seagrass on Long Island.

Investigation of alternative mooring technology
A presentation of "chainless," less destructive, mooring technology was given to the Seagrass Taskforce and a field demonstration will soon be initiated within the seagrass beds of a local marina.

APPENDIX A.5
Task Force Mapping Workgroup Recommendations

Meeting Highlights
Mapping New York's Seagrasses
March 4, 2008

A. Current State:

	Peconic Bays	**Long Island Sound**	**South Shore**	**Narragansett Bay**
Responsible Entity	PEP -> CCE	LISS -> USFWS	NYSDOS ->NOAA CSC	NBNERR ->URI EDC
Last Survey	2000	2006	2002	2006
Mapping Frequency				
Desired	2 years	4 years	2 years	
Actual	9 years	4 years	6 years	10 years
Methods	C-CAP; 1:14000 True Color DOQQ	C-CAP; 1:20000 True Color DOQQ	C-CAP	C-CAP; 1:12000 True Color Ortho
Entities				
Aerials	PEP contracted out	USFWS contracted out	DOS Contracted w/ Sewall	J. W. Sewall Co.
Interpretations	USFWS	USFWS	NOAA CSC/Photoscience	URI EDC
Groundtruthing	CCE and Peconic BayKeeper	USFWS	NOAA CSC	URI/ NB NERR
Next Survey?	2008/2009	2009	2008	?

B. Recommendations, Conclusions, Issues and Action Items:

General Mapping:

- Ideally, plan for complete mapping every 2 years
- Mapping vs Trends Analysis
- Map SAV only or macroalgae too?

Aerial Timing/Frequency:

- Aerials should reflect peak biomass (Peconics & LIS- June/July; SSER- May)
- Ideally, aerials should be taken same time, every mapping effort
- More important that LIS and Peconic efforts match up- similarity of beds
- Technology- digital is the way to go
- *NYSDOS to roll Peconics into NOAA/Photo Science MOA for 2008 season – aerials and interpretation only? (Action Item)*
- *Historical photosets: ID what historic sets exist (to be used for intermediate analyses)- Seagrass Task Force (Action Item)*

Digitizing:

- Heads-up digitizing best method
- Good bathy data needed
- Minimize # of photo interpreters
- Standardized classification system (continuous, patchy, discontinuous)
- Standardized minimum mapping unit
- What about beds not detectable on aerials? Mapping vs trends analysis.
- *South Shore bathy data issues need to be resolved- Seagrass Task Force (Action Item)*

Groundtruthing:

- Should be conducted same season as aerials (2 month turn around)
- Peconic to duplicate LIS groundtruthing methods
- Use of acoustic?
- Distance b/w video transects?

C. Action Items:

1. NYSDOS to investigate feasibility of adding Peconics to NOAA/Photo Science MOA for 2008 season – aerials and interpretation only. PEP to provide info on coverage area for quote.
2. Seagrass Task Force to identify and inventory all historical photosets- to support intermediate analyses.
3. Seagrass Task Force to resolve South Shore bathy data issues.

D. Attendees:

Name	Affiliation	Phone	Email
Laura Stephenson	NYSDEC/PEP	631.444.0871	lbstephe@gw.dec.state.ny.us
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Jim Gilmore	NYSDEC	631.444.0430	jjgilmor@gw.dec.state.ny.us

Agenda
Mapping New York's Seagrasses

Tuesday March 4th, 2008 1pm-4:30pm
NYSDEC, Bureau of Marine Resources
East Setauket, NY

1:00pm **Introductions**

1:15pm **Where are we Now?**
Brief presentation/discussion of estuary efforts. Topics may include but are not limited to: last completed survey and results; survey frequencies; methodology used for aerials, aerial interpretation and groundtruthing; who actually does the work; when the next survey will likely occur.
- Peconic Estuary
- Long Island Sound
- South Shore Estuary
- Narragansett Bay

2:45pm **Where should we go? And how do we get there?**
- Discussion of different techniques, methodologies, timing, frequency, etc.
- Appropriateness/applicability of non-SAV photosets for intermediate analyses?
- What really is the best route?
- How can efforts be coordinated b/w estuaries to ensure consistency?

4:00pm **Conclusions and Next Steps**

APPENDIX A.6

Local Regulations Affecting Seagrass in the Peconic Estuary

TABLE I. LOCAL MANAGEMENT AFFECTING EELGRASS

Responsible Entity	Chapter in Code	Section/Article	Direct/ Indirect Impact	Details
Town of Southold	**219** -Shellfish and other Marine Resources	219-20: Vegetation removal prohibited	**D/I**	• No wetland vegetation of any kind can be removed or soil placed thereon during shellfishing activities
		219-16: Culling shellfish and restoration of underwater lands	**I**	• Bottom must be returned to previous state upon taking of shellfish
	275 (formally 97) - Wetlands and Shoreline	275-2: Definitions	**I**	• Basically same as DEC wetlands regs. , but up to 5ft depth @mlw; 100 ft from wetland boundary
		275-11: Construction and Operation standards	**D**	• Dredging in or close to **seagrass** is prohibited • Whether or not **seagrasses (including eelgrass and widgeon grass**) will be damaged or prevented from growth is considered before permitting dock placement
			I	• Use of lumber treated with CCA, creosote, penta products or homemade wood preservatives prohibited • No new bulkheads in creeks and bays unless low-sill • No new jetties or groins unless results in a total net decrease in the subject area
	Mooring and Anchoring Draft Chapter 34 (new chapter) Dec 11,2006	34-15: Moorings in Designated Mooring Areas created by the Town 34-14 (A,C): Mooring Assignments: General rules for Town waters	**D**	• In designating mooring areas, the Town Board shall ensure town mooring areas avoid **eelgrass** beds. • Boatyard, Marina, Yacht club, and riparian moorings only allowed based on considerations including locations of seagrass meadows.

TABLE II. LOCAL MANAGEMENT AFFECTING EELGRASS cont'd				
Responsible Entity	**Chapter in Code**	**Section/Article**	**Direct/ Indirect Impact**	**Details**
Town of Easthampton	**255**- Zoning	**255-1-20**: Definitions	**I**	• "Lands lying within or beneath tidal waters shall also be deemed to be "tidal wetlands," regardless of the type or amount of vegetation growing thereon or the absence of the same." • All underwater lands are included in wetland definition, no max depth
		255-5-50: Special Permit Uses: Specific standards and safeguards	**I**	• "No permit shall issue for any structure which would unduly interfere with…marine life or habitat or which would destroy other than minimal practicable areas of existing wetland vegetation…
			D	• Dock permit issuance will consider "whether the dock will result in the destruction of beds of **eelgrass** or shellfish."
			I	• Use of wood treated with CCA, ACQ, or creosote will be allowed for coastal structures "unless it can be shown that no reasonable alternative material will serve the purpose"
			I	• No new docks unless floating and seasonally removed; coastal erosion structures only permitted if "imminent, rapid or sudden loss of the property, or a substantial portion thereof, to erosion caused by rain, current, wind, wave or storm tidal action", and structures shall be minimum necessary.
		255-4-20: Natural resources special permit; regulations	**I**	• Like DEC wetland regs, but w/in 150ft of wetland boundary

TABLE II. LOCAL MANAGEMENT AFFECTING EELGRASS cont'd				
Responsible Entity	**Chapter in Code**	**Section/Article**	**Direct/ Indirect Impact**	**Details**
Town of Southampton	Shellfish Permits and Regulation Article II (not in Town Code)	Section 8E. Soft Clams	**D**	• "Churning over or through submerged **eelgrass** beds is strictly prohibited" Regulated by bay constables
	278 - Shellfish	278-8 ,9: Escallops and Hard Clams	**I**	• Scallops and crabs may be harvested with a dredge only if same as DEC requirements for scallops • No plant life (or hard clams) may be removed by mechanical means
	330 - Zoning	330-40: Tidal Wetland Regulations	**I**	• Bulkheading prohibited unless in Waterfront Business District or to protect the natural environment from erosion, silting etc.
	111-Beaches, Parks and Waterways	111-28: Removal of Beach Grass	**?**	• "No person shall remove, impair, damage or destroy any beach grasses or wetlands vegetation of any kind nor place spoil thereon in any other area of the Town of Southampton without prior written approval by the Director of Natural Resources of the Town of Southampton and the Board of Trustees."
	325-Wetlands	325-3: Definitions	**I**	• Tidal wetland definition includes "All lands lying in the area inundated by tidal action and/or peak lunar tides", "all estuaries", "littoral zones", though no depth limit specified • Same regulated activities as DEC except **200ft** from wetland boundary
Town of Riverhead	**47**-Bays and Creeks	47-21: Docks, basins and ramps	**D**	• The potential for destruction of **eelgrass** or shellfish beds is considered by the Conservation Advisory Counsel before issuing a dock permit
			I	• No commercial copper quat (ACQ), pentachlorophenol, or creosote treated wood may be used for shoreline structures. CCA can only be used for pilings.
		Article II- Shellfish	**I**	• Same as Southampton Town regs

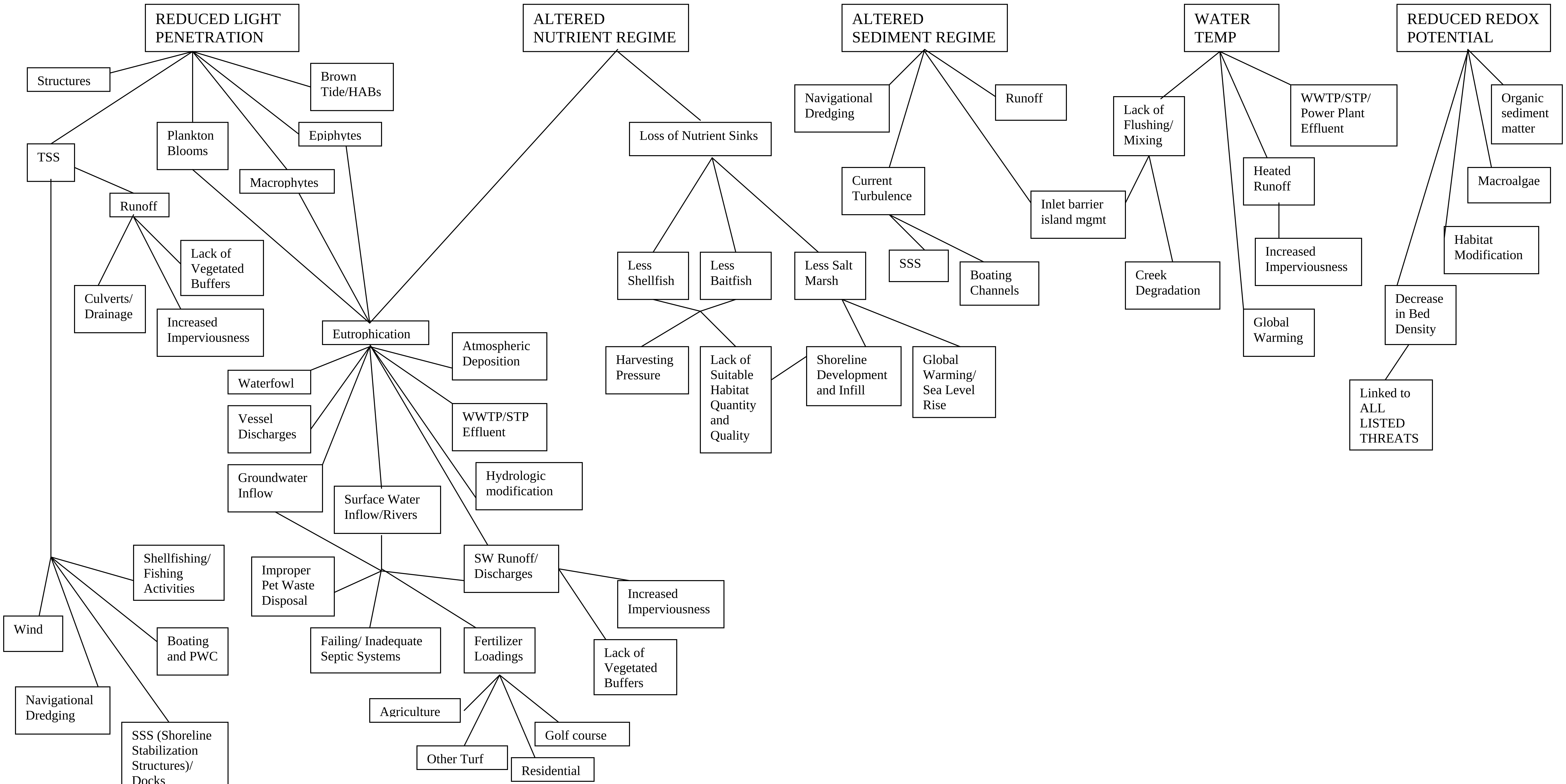
TABLE II. LOCAL MANAGEMENT AFFECTING EELGRASS cont'd				
Responsible Entity	**Chapter in Code**	**Section/Article**	**Direct/ Indirect Impact**	**Details**
Town of Riverhead cont'd	**107**-Tidal and Freshwater Wetlands	107-3,4 –Definitions and Regulations	**I**	• Littoral zone (up to 6ft at mlw) included in tidal wetlands definition. • Same wetland regs. as DEC except **150ft** from wetland boundary.
Town of Shelter Island	**129**-Wetlands	129-3: General guidelines to activities within regulated area.	**I**	• "The depositing or removal of the natural products of wetlands during recreational or commercial fishing, shellfishing or aquaculture is allowed so long as there is no undue disturbance of the wetlands."
			I	• No new bulkheads will be allowed unless property is in imminent peril of destruction from erosion and that other measures are not viable.
		129-8: Definitions	**I**	• Wetlands def. includes "all lands generally covered or intermittently covered with, or which border on, tidal waters, or lands lying beneath tidal water such as…littoral zones", though no depth mentioned. • Same regulated activities as DEC; **100ft** from wetland boundary
	108-Shellfish	108-5: Regulations	**I**	• No churning for soft clams • Same scallop, hard clam regs. as DEC

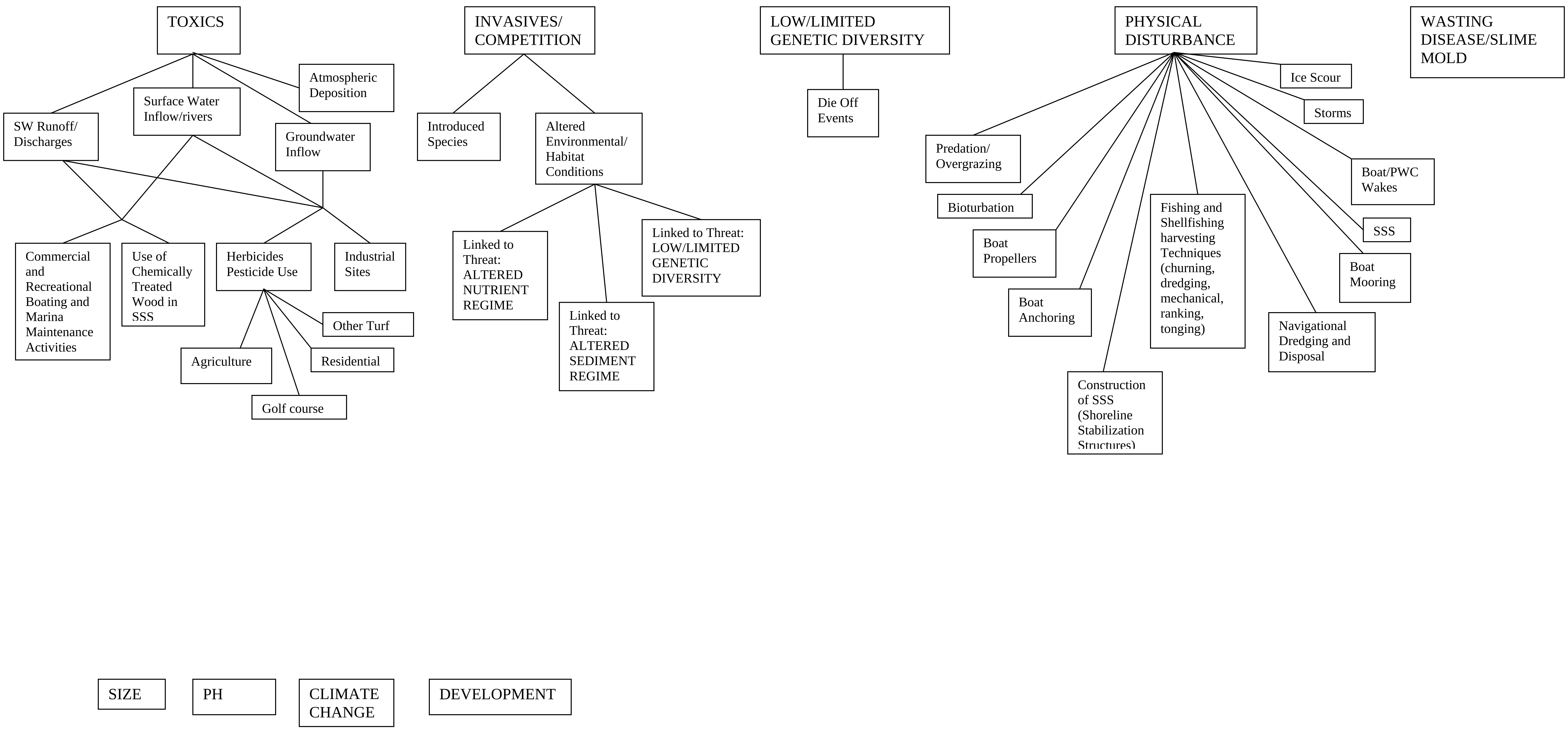
APPENDIX A.7

New York State Seagrass Task Force Seagrass Threats Assessment

NYS Seagrass Task Force Eelgrass Threats Assessment

Modified from "Peconic Estuary Eelgrass Threats Assessment" (Stephenson, NYSDEC/PEP)




TOXICS
Atmospheric Deposition
Surface Water Inflow/rivers
SW Runoff/ Discharges
Groundwater Inflow
Commercial and Recreational Boating and Marina Maintenance Activities
Use of Chemically Treated Wood in SSS
Herbicides Pesticide Use
Industrial Sites
Other Turf
Agriculture
Residential
Golf course
INVASIVES/ COMPETITION
Introduced Species
Altered Environmental/ Habitat Conditions
Linked to Threat: ALTERED NUTRIENT REGIME
Linked to Threat: ALTERED SEDIMENT REGIME
Linked to Threat: LOW/LIMITED GENETIC DIVERSITY
LOW/LIMITED GENETIC DIVERSITY
Die Off Events
PHYSICAL DISTURBANCE
Ice Scour
Storms
Predation/ Overgrazing
Bioturbation
Boat/PWC Wakes
SSS
Boat Propellers
Boat Anchoring
Fishing and Shellfishing harvesting Techniques (churning, dredging, mechanical, ranking, tonging)
Boat Mooring
Navigational Dredging and Disposal
Construction of SSS (Shoreline Stabilization Structures)
WASTING DISEASE/SLIME MOLD
SIZE
PH
CLIMATE CHANGE
DEVELOPMENT

APPENDIX A.8

Threat Ranking Rationale

THREATS		ESTUARY RANKING	RATIONALE
Water Quality	Excess Nitrogen	Peconic: High (western); Low (eastern)	Western: DO issues, high surface/groundwater N levels. Eastern: Adequate flushing, low N in surface waters.
		LIS: High	High nearshore nutrients, low western flushing.
		South Shore: High	Excess nitrogen levels detected.
	Development/ Imperviousness	Peconic: Mod	Currently less developed, but higher potential.
		LIS: Mod	Lack of potential development.
		South Shore: Mod/High	Higher development .
	Pore Water Sulfide Toxicity	Peconic: Mod	Currently being researched.
		LIS: Unknown	Information currently does not exist.
		South Shore: Unknown	
	Toxic Chemicals	Peconic: Potential	Data herbicides, significant groundwater discharge.
		LIS: Unknown	Information currently does not exist.
		South Shore: Unknown	
Physical Disturbance	Fishing and Shellfishing Gear/Aquaculture	Peconic: Mod/High	Amount of fishing, gear used, target species.
		LIS: Low	Eelgrass in deeper waters not affected by gear.
		South Shore: Mod/High	Amount of fishing, gear used, target species.
	Navigational Dredging	Peconic: Low	Dredging occurs in winter outside seagrass growth period, permit reviews/regulations factor in potential eelgrass affects.
		LIS: Low	
		South Shore: Low	
	Hardened Shorelines	Peconic: Mod/High	Significant potential for additional hardening.
		LIS: Low	Hardening not present near seagrass (Fisher's Island).
		South Shore: Mod/High	Significant hardening.
	Recreational Boating	Peconic: Mod	Level of boating near seagrass beds, prop scarring.
		LIS: Low	Seagrass found at depths not affected by boating.
		South Shore: High (west); Mod (eastern)	Western: High boat traffic, shallow waters, prop scarring Eastern: Less boating , seagrass in deeper waters.
	Marinas and Docks	Peconic: Low	Current permit review process does not allow construction of marinas and docks in significant coastal fish and wildlife habitats.
		LIS: Low	
		South Shore: Mod	
	Energy Cables/Pipeline	Peconic: Low	Directional drilling technology eliminates need to disturb significant bottom area.
		LIS: Low	
		South Shore: Low	
Biological Impacts	Harmful Algal Blooms	Peconic: High	Past significant destructive blooms.
		LIS: Low	Seagrass not present where blooms may appear.
		South Shore: High	Past significant destructive blooms.
	Bioturbation/ Grazing	Peconic: Mod	Significantly impacts restoration efforts.
		LIS: Low	Less restoration attempts, bioturbation effects not significant on established beds.
		South Shore: Low	
	Disease	Peconic: Unknown	Information currently does not exist. Wasting disease is always present, but it is not known what triggers destructive outbreaks.
		LIS: Unknown	
		South Shore: Unknown	
	Invasive Species	Peconic: Unknown	Information currently does not exist. Invasives may not necessarily displace seagrass, but may affect restoration efforts.
		LIS: Unknown	
		South Shore: Unknown	
	Loss of Filter Feeders	Peconic: Unknown	Information currently does not exist. Filter feeder role in nutrient cycling and may affect severity and persistence of harmful algal blooms.
		LIS: Unknown	
		South Shore: Unknown	
	Lack of Genetic Diversity	Peconic: Unknown	Information currently does not exist. Research currently underway in the Peconics and plans exist to expand to all estuaries.
		LIS: Unknown	
		South Shore: Unknown	
Global Concerns	Storm Damage	Peconic: Mod	Current, wave action and scouring from coastal storms can affect even healthy seagrass beds. Task Force funding research to monitor response and re-growth.
		LIS: Mod	
		South Shore: Mod	
	Climate Change	Peconic: Mod	Shallow water seagrass affected by rising water temperatures.
		LIS: Low	Seagrass below thermocline and not significantly affected.
		South Shore: Low/Mod	Shallow water seagrass affected by rising water temperatures.
	Sea Level Rise	Peconic: Low/Mod	Threat of shoreline hardening may limit seagrass migration
		LIS: Low	Less shoreline hardening around Fisher's Island.
		South Shore: Mod	Current shoreline hardening may limit seagrass migration.