Eastern Shore of Virginia Seaside Special Area Management Plan: Submerged Aquatic Vegetation Restoration Goal & Management Report

May 2014

This project was funded, in whole, by the Virginia Coastal Zone Management Program at the Department of Environmental Quality through Grant #NA11NOS4190122 of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, under the Coastal Zone Management Act of 1972, as amended.

Accomack-Northampton Planning District Commission
23372 Front Street
Accomac, VA 23301

NOAA Grant #NA11NOS4190122
FY 2011, Task 96

This Page Intentionally Left Blank

Eastern Shore of Virginia Seaside Special Area Management Plan: Submerged Aquatic Vegetation Restoration Goal & Management Report

I. Introduction

The Accomack-Northampton Planning District Commission (A-NPDC) coordinated an effort to identify and establish an appropriate restoration goal for submerged aquatic vegetation (SAV) for the Seaside on Virginia's Eastern Shore. Specific consideration was needed and given to the continued development of ongoing and economically important clam and oyster aquaculture, the wild harvest of clams and oysters, and traditional recreational activities while allowing for the development of a viable and potentially commercially productive bay scallop population.

A project team consisting of representatives from the Virginia Marine Resources Commission (VMRC), Virginia Institute of Marine Science (VIMS), and the Virginia Coastal Zone Management Program (VCZMP) met on August 6, 2013 to accomplish the following:

1. Review current spatial data for existing SAV areas,
2. Discuss and identify potential future SAV set-aside areas,
3. Identify knowledge or research needs for understanding bay scallop acreage requirements for SAV, and
4. Identify and recommend options for VMRC policy changes that would specifically support and enhance efforts for restoring SAV and bay scallop populations.

The following report summarizes all project outcomes and is intended to serve as a guide for SAV restoration management on the Seaside that will help maximize environmental quality and economic prosperity while minimizing potential marine-use conflicts.

II. Background

a. Historic Seaside Planning Efforts

In 1990, the VCZMP initiated a Northampton County Special Area Management Plan (SAMP). While much was accomplished, zoning to protect sensitive natural areas was never adopted. In 2002, the VCZMP initiated the Virginia Seaside Heritage Program to restore the coastal habitats of the Seaside of Virginia's Eastern Shore and to promote economic activities such as ecotourism and aquaculture in a sustainable manner. The

Seaside Heritage Program was funded through Section 306/306A of the Coastal Zone Management Act.

As the VCZMP moved beyond habitat restoration, ecotourism and aquaculture into a management plan for the seaside, the Seaside Heritage Program activities were expanded into traditional SAMP activities; i.e. the development of new enforceable policies that would serve to protect the program's investments on the Seaside.

The goals of the Seaside SAMP are to:

1. Map, analyze, and interpret the current status and trends in uses, economic values, and beneficial ecosystem functions associated with state-owned and other habitats in the seaside bays,
2. Re-evaluate these uses in light of current and projected conditions, and
3. Recommend guidelines for the allocation of resources in a manner that optimizes the environmental and socioeconomic benefits derived.

Using existing GIS data, stakeholder and user information, management agency input, and the additional field-collected data, the effectiveness of use allocation patterns such as state oyster grounds are being examined in the context of current stakeholder uses and needs, eelgrass and oyster restoration potential, and current ecological conditions, including bird distribution and uses, and ecotourism and recreational needs. The SAMP is also initiating a consensus building-process that will result in recommendations that encompass planning, regulatory, and other guidelines to increase economic productivity, enhance ecosystem health, and resolve potential conflicts.

The first phase of the SAMP (fiscal year 2008) revealed that as much as 40 percent of currently designated public shellfish grounds are not presently suitable for wild shellfish populations. It also determined that current oyster and SAV restoration sites are a small fraction of the habitats suitable for the re-establishment of these ecologically important and highly productive natural elements.

In February 2011, the Virginia General Assembly passed Senate Joint Resolution 330 which directed VIMS and VMRC to conduct a study on the seaside and “Make recommendations for legislative and regulatory actions required to implement a more flexible and effective management approach toward managing subaqueous bottomland on the seaside of the Eastern Shore.”

Data collected and housed in the Virginia Coastal Geospatial and Educational Mapping System (Coastal GEMS) is being used to inform policy management and

regulatory recommendations and guidelines, as well as provide visual aids for all public input processes. Coastal and marine spatial planning exercises exploring possible resource allocation scenarios are being utilized to support the development of recommendations for statutory, regulatory, or other changes, as needed.

In 2012 and 2013, the current project was undertaken to develop information and make recommendations for coastal and marine spatial planning efforts associated with the Seaside SAMP.

In addition, other states have undertaken similar efforts to establish appropriate SAV restoration goals, such as New York, Massachusetts, North Carolina, and Florida. These efforts have had positive outcomes resulting in adequate acreage to support the development of new industries and sustainability of existing industries.

b. SAV Restoration Efforts and Outcomes in Other States

Nantucket, Massachusetts

Nantucket's largest commercial shellfishery is the harvest of bay scallops. The island hosts one of the last wild-harvest bay scallop fisheries in the nation. In 2012, the Nantucket Shellfish Management Plan was published and serves as the first official management plan for commercially and recreationally harvested shellfish in Nantucket waters. The document was developed by and for local stakeholders with specific attention paid to the biology of the shellfish resources, the interactions within the surrounding ecosystem, the needs and interests of the shellfishing industry, and the cultural and economic attributes of Nantucket.

The Plan established general goals for the local industry including maintaining or improving habitats associated with a healthy shellfish fishery and maintaining or enhancing the populations and health of shellfish of commercial and/or recreational importance in Nantucket waters. The Plan provides a baseline for pertinent local background information and maintains a flexible format that can provide for regular edits and adaptation on an as-needed basis. All background information is then used to makes recommendations, determine adaptation processes, and identify research/information needs that comprise the actions needed to be taken to achieve the Plan's goals. The Plan also establishes an as needed, but no longer than 3-year updating process to allow for new information to be incorporated in an efficient and effective manner.

Recommendations were developed for Habitat Management, Shellfish Resources, Regulations, Management Implementation, Education, Harvest Documentation, Support of the Commercial Fishery, and Adaptation of the Plan. A matrix of recommendations from the Plan is included in **Appendix A**.

North Carolina

In 2007, the North Carolina Department of Environment and Natural Resources Division of Marine Fisheries under the direction of the North Carolina Marine Fisheries Commission with advice from a state Bay Scallop Advisory Committee produced the *North Carolina Bay Scallop Fishery Management Plan*. The planning effort engaged key stakeholders to establish a consensus management plan for the restoration, sustainability, maximization of the social and economic value, and initiate studies of the bay scallop population in North Carolina. The commercial supply of bay scallops in North Carolina has never been able to keep up with increasing demand and the supply is limited to Bogue and Core sounds making it vulnerable to environmental factors such as algal blooms, hurricanes, and predators. The limited areas that bay scallops are available make limitations on harvests very impactful to the local watermen.

The Plan considered management strategies regarding area and seasonal closures, size and trap limits, gear restrictions, and prohibited takes while identifying key research needs to enhance overall management of the population.

Specific recommendations and implementation measures were developed concerning four general categories: insufficient data, environmental concerns, harvest concerns, and stock enhancement.

Recommendations to provide for more sufficient data included establishing a long-term fishery monitoring program including recreational and commercial harvest data and socioeconomic surveys commercial and recreational stakeholders.

To address the need for enhanced understanding of the environmental impacts from bottom-disturbing harvest techniques. Once accomplished, the Plan calls for the establishment of protective buffers and further restrictions on mechanical shellfish harvesting.

To address harvest concerns such as algal blooms, hurricanes, and predators; the Plan proposes considering regulating the harvest of scallops from polluted areas and the prohibition of soaking scallop meats.

Florida

The Florida Bay Scallop population and SAV has experienced a similar decline to other areas along the Atlantic Coast as result of ongoing threats including overpopulation and consequent commercial development and recreation. A management planning effort such as those developed and described above for

Nantucket Bay and North Carolina has not been developed to date. The fishery has historically been managed by a number of federal and state laws and regulations; however, to date the regulatory actions have accomplished little to slow the decline of SAV habitat.

Additionally, restorative measures for SAV have not produced desired results and the South Atlantic Fishery Management Council recently expressed the need to focus on protecting existing SAV areas. THE Council further recommended that additional studies be performed to supplement a comprehensive strategy for addressing the disturbing decline in SAV in the South Atlantic region.

III. Spatial Analysis and Methods

During its meeting on August 6, 2013, the project team reviewed current spatial data for SAV coverage and its location relative to existing Baylor Grounds and areas of bottomland with established private oyster leases. The project team then used this information to discuss and identify potential future SAV set-aside areas.

The following sections describe the project team's findings.

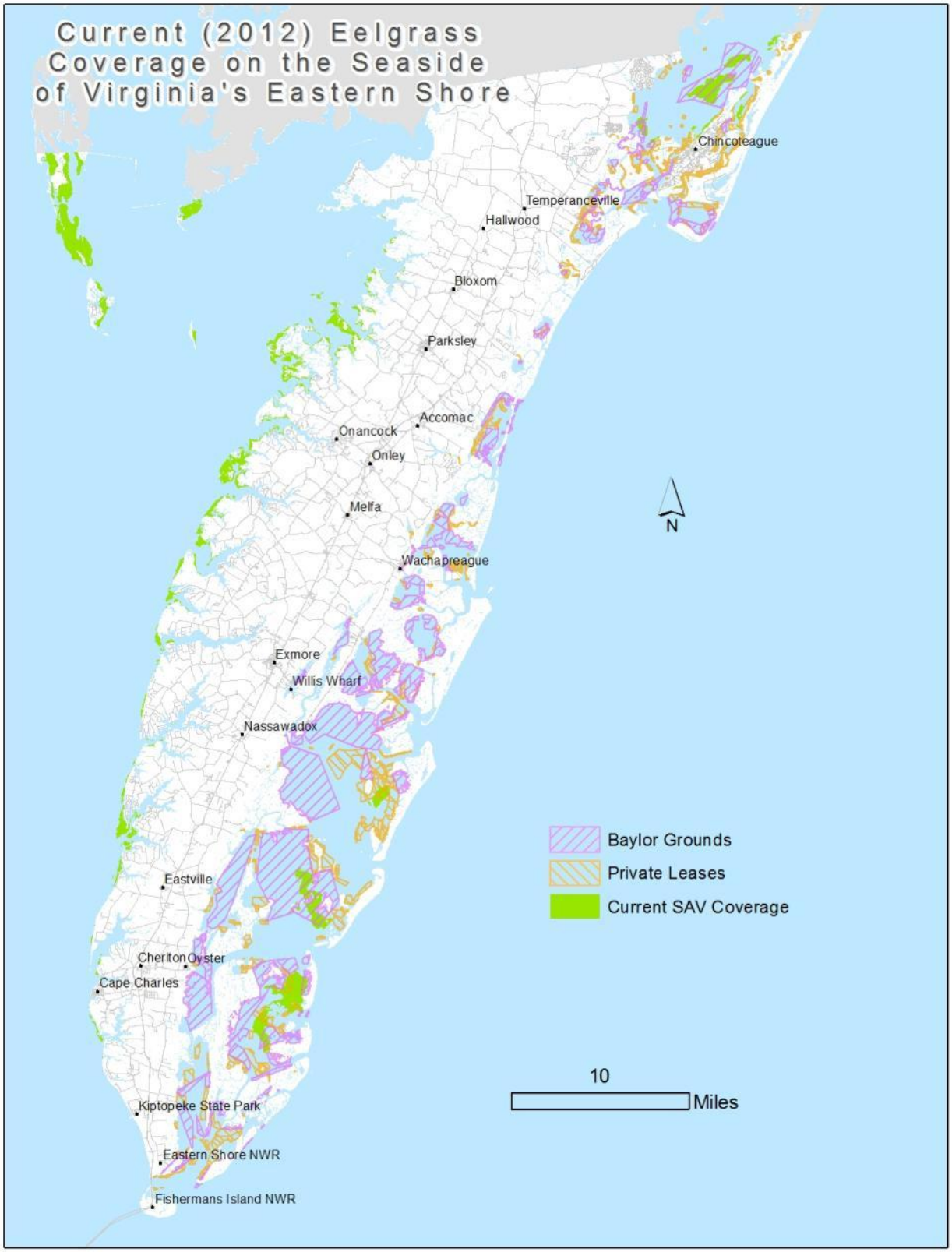
a. Current Situation

The spatial data utilized by the project team showing the current spatial data for SAV coverage and its location relative to Baylor Grounds and private oyster leases is included in Figure 1.

Current SAV coverage exists in concentrated areas on subtidal bottomlands within the back-barrier lagoons on the Seaside. Since SAV restoration is only possible in subtidal areas, the map in Figure 1 was developed by clipping the Baylor Grounds and private oyster lease datasets by water coverage within the Seaside Bays.

SAV preferentially grows in locations that experience a relatively high amount of water temperature change. On the Seaside, these are typically relatively shallow water adjacent to tidal inlets.

Figure 1


Current (2012) Eelgrass Coverage on the Seaside of Virginia's Eastern Shore
Chincoteague
Temperanceville
Hallwood
Bloxom
Parksley
Accomac
Onancock
Onley
Melfa
Wachapreague
Exmore
Willis Wharf
Nassawadox
Eastville
Cheriton
Oyster
Cape Charles
Kiptopeke State Park
Eastern Shore NWR
Fishermans Island NWR
N
Baylor Grounds
Private Leases
Current SAV Coverage
10
Miles

SAV currently exists over unassigned bottomlands, private leases, and Baylor Grounds. Recent SAV restoration efforts adjacent to locations with existing SAV coverage have shown that some locations are more ideally suited for targeted SAV restoration than others.

b. Future Areas Suitable for SAV Restoration

After determining the areas with greater concentrations of SAV coverage, the project team attempted to identify by consensus the areas with the greatest potential concentration of acreage suitable for SAV restoration. For this process, the project team considered the following criteria for identifying priority areas suitable for SAV restoration:

- Proximity to concentration of existing and thriving SAV beds;
- Amount of suitable SAV locations within areas that had minimum acreage held in private oyster leases; and
- Amount of suitable SAV locations within areas that have abundance of acreage of Baylor Grounds or unassigned bottomlands.

The project team determined that two general areas, Spidercrab Bay and South Bay, more appropriately met these criteria (see **Figure 2**).

The project team then utilized GIS to determine the exact amount of potential acreage suitable for expansion of SAV and the breakdown of acreage established as Baylor Grounds, private oyster leases, and unassigned bottomland. **Table 1** summarizes the outcomes of this assessment.

The assessment in Table 1 indicates that in 2012 there were 7,174 acres of SAV coverage on the Seaside. 4,190 Acres, or 58%, of all SAV coverage on the Seaside exists within Spidercrab Bay and South Bay. This was one factor for the project team's decision to identify these two bays as the most suitable area for SAV restoration activities. In addition to the 4,190 acres currently in Spidercrab Bay and South Bay, the project team identified an additional 7,712 acres suitable for SAV growth.

On the entire Seaside, the project team identified a maximum of 14,886 acres that currently have SAV or are suitable for SAV growth. 11,902, or 80%, of the areas suitable for SAV growth on the Seaside exist within Spidercrab Bay and South Bay.

There are currently 8,216 acres of current and potential SAV growth areas, which constitutes 16.3% of the entire Seaside. These 8,216 acres within Baylor are currently

Figure 2

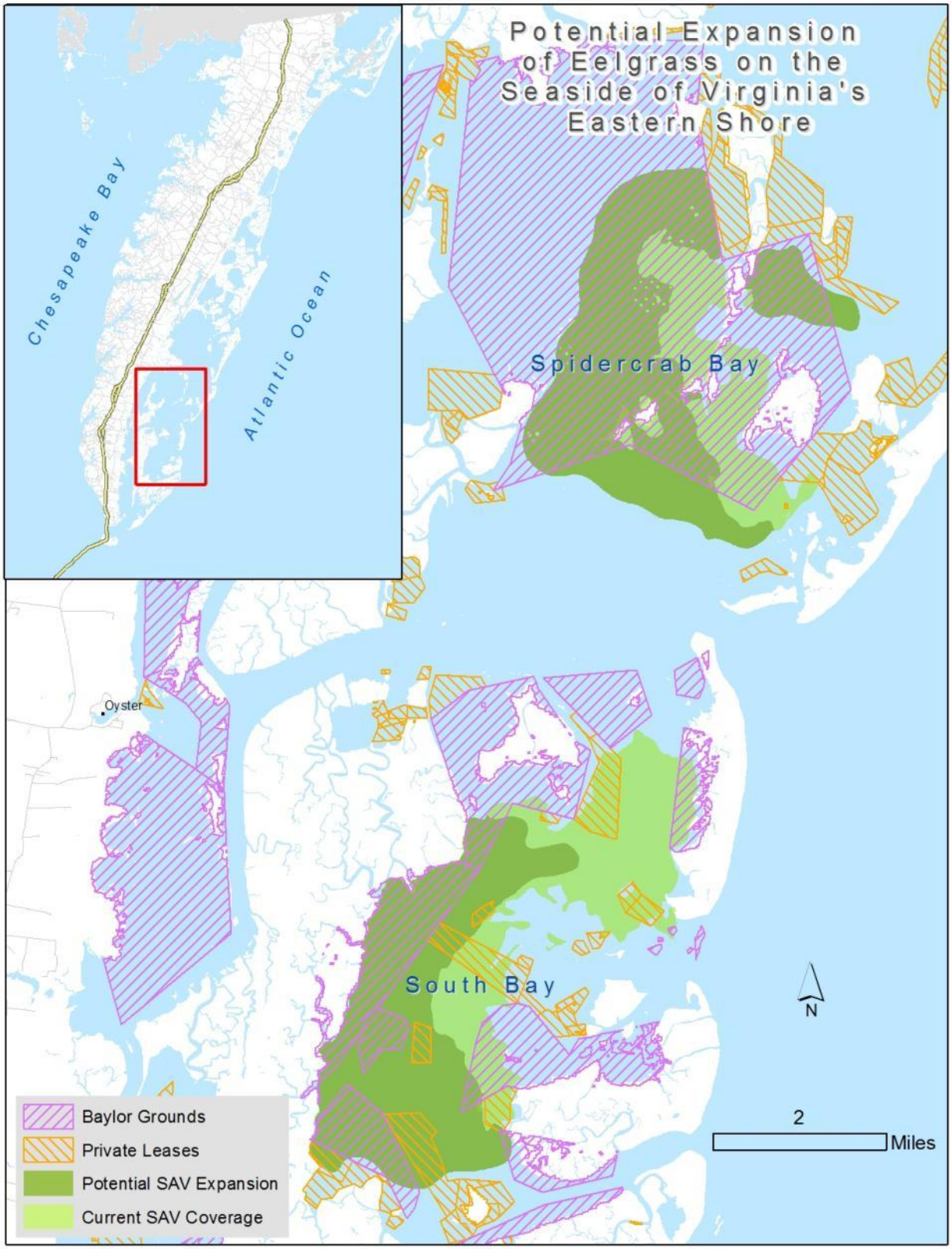

Potential Expansion of Eelgrass on the Seaside of Virginia's Eastern Shore
Chesapeake Bay
Atlantic Ocean
Spidercrab Bay
Oyster
South Bay
N
2
Miles
Baylor Grounds
Private Leases
Potential SAV Expansion
Current SAV Coverage

Table 1
SAV Coverage on the Seaside of Virginia's Eastern Shore

Spidercrab Bay and South Bay

	*Total Baylor (acres)	*Total POL (acres)	Current Eelgrass Coverage			Total Current SAV (acres)	Potential Expansion of Eelgrass			Total Potential SAV (acres)	Current + Potential TOTAL (acres)
			Baylor (acres)	Private Lease (acres)	Unassigned Bottom (acres)		Baylor (acres)	Private Lease (acres)	Unassigned Bottom (acres)		
Spidercrab Bay	10045	2446	1350	9	194	1553	3158	0	770	3928	5481
South Bay	4683	1867	372	471	1794	2637	1556	391	1837	3784	6421
Total	14728	4313	1722	480	1988	**4190**	4714	391	2607	**7712**	11902

Entire Seaside

	Acreage	% of Open Water
Open Water	153176	100%
*Private Leases	17386	11.4%
*Baylor	50256	32.8%
Unassigned Bottom	85534	55.8%
Current SAV	7174	4.7%
Current + Potential SAV	14886	9.7%

Baylor & Private Oyster Leases were clipped by water coverage within the seaside bays:

- *557 acres of Seaside private leases not included because they are covered my marsh and*
- *11305 acres of Seaside Baylor not included because they are covered by marsh or in the Atlantic*

Note: 14886/153176 = 9.7% max (current + potential) SAV in seaside waters

	Acreage	% of SAV in Baylor
Current SAV in Baylor	3502	7.0%
Potential SAV in Baylor	4714	9.4%
Total Current + Potential	8216	16.3%

	Acreage	% of SAV in POL
Current SAV in POL	796	4.6%
Potential SAV in POL	391	2.2%
Total Current + Potential	1187	6.8%

	Acreage	% SAV Coverage of Total Seaside
SAV Coverage (2007)	3,863	2.5%
SAV Coverage (2012)	7,174	4.7%

not suitable for oyster growth and could be used in a manner that is more beneficial in terms of water quality and habitat, such as SAV restoration.

Finally, private oyster leases exist on 17386 acres, or 11.4%, of open water on the Seaside. Within the 17,386 acres of private oyster lease areas, only 1,187 acres, or 6.8% are currently in or are suitable for SAV growth. This means that over 93% of open water acreage on the Seaside is not suitable for and therefore could not be impacted by SAV restoration activities.

c. Knowledge and Research Needs

The project team identified several items that would further refine the assessment of potential SAV growth areas on the Seaside, these are listed as follows:

- Sediment distribution data – considering SAV and Bay Scallops preferentially grow in specific sediment types, it was recommended that a comprehensive dataset be developed for the bottomlands of the entire Seaside;
- Water temperature data – considering SAV and Bay Scallops preferentially grow in specific water temperatures, it was recommended that a more comprehensive dataset be developed for water temperature conditions within the water bodies of the Seaside; and
- Bathymetric data – a comprehensive high resolution bathymetric survey of all Seaside water bodies was recommended in order to enhance the selection and prioritization of SAV restoration areas.

Appendix A

Matrix of Recommendations from *Nantucket Shellfish Management Plan – March, 2012*

		Objective	Recommendation #	Recommendation	Implementing Agencies/Groups	Priority	Evaluation Criteria
Habitat Management	Goal 1	Objective 1	Recommendation 1	Conduct and/or support research to better understand the hydrodynamics within Nantucket and Madaket Harbors and the impacts of water circulation on shellfish habitat and population dynamics. This research should include a study to determine the impacts of raising the jetties. With better information on water circulation and its impacts, options for improving circulation could be considered and implemented as appropriate.	• Nantucket Research Collaborative* • Department of Marine and Coastal Resources or the Town • Outside experts as appropriate • Harbor Plan Implementation Committee		
			Recommendation 2	Support research activities, regulatory management changes, public education initiatives, capital improvements, and related fund-raising activities aimed at reducing nutrient inputs from anthropogenic sources, both in Nantucket waters and in Nantucket Sound. Nantucket is currently addressing nutrient reduction from anthropogenic sources through a variety of activities, including reviewing the Massachusetts Estuaries Report project and implementing the Best Management Practices guide developed by the Article 68 Work Group. Additionally, the Harbor Pan Implementation Committee, in conjunction with the Town, is currently developing an educational initiative called the "Nantucket Blue Pages" that was recommended as part of the Harbor Plan. Nantucket is supporting a water quality testing effort to assess the effectiveness of activities to reduce nutrient input into local waters. Researchers are looking into the possibility of using barriers of natural materials (e.g., woodchips) to remove	• Nantucket Research Collaborative* • Board of Selectmen • Board of Health • Marine and Coastal Resources Department or the Town • Conservation Commission • Harbor Plan Implementation Committee • Maria Mitchell Association • University of Massachusetts Boston Nantucket Field Station • Harbor and Shellfish Advisory Board • Nantucket Shellfish Association • Outside experts as appropriate		

				nitrogen from groundwater. A federal No Discharge Area for Nantucket Sound is under development. Stakeholders should support these types of activities by lending their expertise; raising awareness of important information, events and developments, such as meetings or the dissemination of publications; and helping to secure financial resources.			
			Recommendation 3	Conduct and/or support research to better understand the links between shellfish habitats, population dynamics, and anthropogenic activities that introduce chemicals into Nantucket waters. Examples of activities of interest include: the application of fertilizers, herbicides, and pesticides on upland areas (including details about the chemicals being used, the quantities being applied, and the associated impacts); the use of septic systems; the discharge of grey water from vessels (and the related No Discharge Area designation); the discharge of petroleum hydrocarbon, and boat maintenance activities such as boat washing and bottom painting.	• Nantucket Research Collaborative* • Board of Selectmen • Board of Health • Mosquito Working Group • Marine and Coastal Resources Department or the Town • Conservation Commission • Nantucket Land Council • Maria Mitchell Association • University of Massachusetts Boston Nantucket Field Station • Boat yards and marinas • Outside experts as appropriate		
			Recommendation 4	Develop a better understanding of the sources and impacts of HABs on shellfish and their habitat. Support or conduct research to address identifying and tracking potentially harmful blooms in local waters.	• Nantucket Research Collaborative* • The Marine and Coastal Resources Department • Nantucket Land Council • Nantucket Biodiversity Initiative • Maria Mitchell Association • University of Massachusetts Boston Nantucket Field Station • Outside experts as appropriate		

			Recommendation 5	Conduct and/or support studies to investigate the role that environmental changes may have in altering shellfish populations on Nantucket, including sea level rise, ocean acidification, and climate change. As part of this, continue, and where appropriate, enhance efforts to record water temperature, changes in pH, and details about when the Harbors freeze over.	• Nantucket Research Collaborative* • Marine and Coastal Resources Department or the Town • Maria Mitchell Association • Outside experts as appropriate		
			Recommendation 6	Explore options to reduce the financial cost and temporal delay currently associated with obtaining water quality results. Include a review of on-Island options for "in house" local analysis.	• Nantucket Research Collaborative* • Marine and Coastal Resources Department or the Town • Massachusetts DEP • US EPA • Outside experts as appropriate		
		Objective 2	Recommendation 1	Beginning with historical data compiled and maintained by the Massachusetts DEP, encourage continued monitoring of the extent and health of eelgrass in Nantucket waters, and explore the relationships between eelgrass beds and other aquatic vegetation such as epiphytic growth, which can influence eelgrass health. To the extent possible, connect with regional eelgrass mapping exercises.	• Nantucket Research Collaborative* • Marine and Coastal Resources Department or the Town • Massachusetts DEP • US EPA • Outside experts as appropriate		

			Recommendation 2	Undertake a review of practices that may directly damage eelgrass beds (e.g., moorings, scallop dredges, propeller damage, excess nutrient inputs from upland sources) to determine the short and long-term nature and significance of the impacts and explore methods to minimize those impacts. As part of this, look at options to modify dredging activity throughout the season (e.g., starting with a 40 pound limit at the beginning of the season, and reducing weight as the season progressed; changing the design of the dredge to reduce impacts to eelgrass; etc.). Also, specifically evaluate the progress of modifying moorings in Nantucket Harbor to minimize damage to surrounding eelgrass beds. Also evaluate the effects of alternative technologies, such as placing floats on mooring chains, replacing chains with flexible bungee-style rope, or placing multiple boats on one chain anchored between two mushroom moorings. Once the effects and capabilities of these technologies are understood, work to implement appropriate mooring strategies to reduce impacts on eelgrass. Additionally, explore the option of charging an extra fee for people who do not upgrade to more environmentally sensitive mooring technologies and for dedicating those funds to mitigation of damaged resources.	• Nantucket Research Collaborative* • Nantucket Land Council • Marine and Coastal Resources Department or the Town • Great Harbor Yacht Club • Nantucket Land Council • Conservation Commission • SHAB		
			Recommendation 3	Develop and implement a cost-effective strategy to protect/restore eelgrass in locations of significance to shellfish resources –both within and outside Nantucket and Madaket Harbors. This strategy should take into consideration options such as propagating eelgrass, re-seeding areas, and removing stressors (e.g., moorings, excess nutrients)	• Marine and Coastal Resources Department or the Town* • Nantucket Land Council • Maria Mitchell Association • SHAB		

			to existing and potential eelgrass habitats.			
		Recommendation 4	Until a new strategy to protect eelgrass is in place, enforce existing mooring regulations and ensure that moorings are not located in productive shellfish beds. This will require a substantial reduction in the number of permits.	• Marine and Coastal Resources Department or the Town* • SHAB		
		Recommendation 5	Support research to better understand the relationship between eelgrass health and density and shading from various algae blooms, physical effects on eelgrass growth from overlying macroalgae (for example, observations suggest that Gracilaria sp. is covering eelgrass and causing it to lay flat during the spring, but it may also serve as a settlement substrate for bay scallops), and effects to eelgrass from nuisance epiphytes growing directly on eelgrass.	• Nantucket Research Collaborative* • Marine and Coastal Resources Department or the Town • Massachusetts DEP • Outside experts as appropriate • Nantucket Land Council		
		Recommendation 6	Conduct research to better understand changes in sediment within the Harbors since the most recent data were gathered.	• Nantucket Research Collaborative* • Marine and Coastal Resources Department or the Town • Maria Mitchell Association • UMass Boston Nantucket Field Station • Outside experts as appropriate		
	Objective 3	Recommendation 1	Catalog, map, and ground-truth information about the dominant habitat types (relative to shellfish survival) throughout Nantucket waters. If adequate funding for these activities cannot be secured, explore alternative, less-costly options for obtaining habitat information. Use this information as baseline data and as a basis for prioritizing and protecting shellfish habitat and promoting an awareness of the need for managing habitat as a	• Nantucket Research Collaborative* • Marine and Coastal Resources Department or the Town • SHAB • UMass Boston Nantucket Field Station • Maria Mitchell Association		

				means to manage the shellfishery.			
			Recommendation 2	Work with the Department of Public Works to institute a shell recycling program where most, if not all, shells are returned to the Harbors for pH buffering and settlement substrate purposes (potentially with assistance from fishermen). Ensure that the deposition of shells does not harm existing habitat features (such as eelgrass beds) or create new habitat dominated by predators. Adhere to DMF's Shellfish Planting Guidelines for placing shells in the water: "Oyster, quahog and softshell clam shell used as cultch shall be aged on land for a minimum of one year. Shell from other species of bivalves such as surf clam, ocean quahog, scallops and mussels may be used without limitations. All issues regarding approved shell cultch must be addressed by Marine Fisheries prior to placement into coastal waters" (Hickey, et al., 2012). Conduct research and monitoring activities to understand the impacts of, and to identify the most appropriate locations for returning the shells.	• Marine and Coastal Resources Department or the Town* • Department of Public Works • Massachusetts Division of Marine Fisheries • Nantucket Shellfish Association		
			Recommendation 3	Continue to monitor dissolved oxygen in benthic areas of the Harbors, and expand monitoring to include monitoring of sediment acidity.	• Maria Mitchell Association* • The Marine and Coastal Resources Department or the Town • Conservation Commission		

			Recommendation 4	Continue existing monitoring of spat settlement throughout the waters of Nantucket by way of spat collection and enumeration.	• Marine and Coastal Resources Department or the Town* • Maria Mitchell Association		
			Recommendation 5	Conduct collaborative annual surveys of juvenile shellfish stocks to assess the areas of spatfall to aid in management decision-making.	• The Marine and Coastal Resources Department* • Maria Mitchell Association • Harbor and Shellfish Advisory Board • Nantucket Shellfish Association • UMass Boston Nantucket Field Station		
		Objective 4	Recommendation 1	Conduct and/or support studies to determine the impacts of recreational and commercial shellfish harvesting on the sustainability of the resource and the habitat.	• Nantucket Research Collaborative* • Marine and Coastal Resources Department or the Town • Nantucket Shellfish Association • Commercial fishermen • SHAB • Outside experts as appropriate		
			Recommendation 2	Monitor and assess the overall intensity of shellfish harvest practices and manage activities within specific harvest areas to minimize the risk of detrimental impacts from excessive harvest practices.	• Nantucket Research Collaborative* • The Marine and Coastal Resources Department • Nantucket Shellfish Association • SHAB		
Shellfish Propagation	Goal 1	Objective 1	Recommendation 1	Develop and implement a strategy to track the effectiveness of propagation activities in terms of supplementing the commercial and recreational harvests. As part of this, identify locations best suited for larval release (e.g. areas with larval retention),examine the timing of larval release in terms of survival, and conduct post-set release and associated monitoring for survivability.	• Marine and Coastal Resources Department or the Town* • Nantucket Shellfish Association • Commercial fishermen • UMass Boston Nantucket Field Station • Outside experts as appropriate		

		Recommendation 2	Continue current propagation efforts such as the larval release program and, based on the results of the study of propagation effectiveness, consider pursuing opportunities to expand propagation activities, including expansion to different species (i.e., oysters).	• Marine and Coastal Resources Department or the Town* • Nantucket Shellfish Association • Commercial Fishermen		
	Objective 2	Recommendation 1	Develop seed management protocols for transplanting seed. Outline criteria for establishing seed sanctuaries and for determining compensation to volunteers who assist with seed management. Review the effects of the protocols and adapt as appropriate.	• Marine and Coastal Resources Department or the Town* • Harbor and Shellfish Advisory Board		
		Recommendation 2	Develop and/or support studies to evaluate the efficacy of seed management activities. Adjust seed programs to improve on efficacy.	• Nantucket Research Collaborative* • Marine and Coastal Resources Department or the Town		
		Recommendation 3	Better understand effects of wind-driven strandings on the bay scallop population. Topics of interest include survivability of seed returned to the water and the effects upon the seed population (i.e. what percent of seed is stranded).	• Nantucket Research Collaborative* • Marine and Coastal Resources Department or the Town • Maria Mitchell Association • Outside experts as appropriate		
	Objective 3	Recommendation 1	Continue to develop spawning sanctuaries, through the use of spawning cages, to increase larval supply, and monitor their impacts. As part of this, focus on utilizing areas with high larval retention and evaluate manipulating water flow for larval retention.	• Marine and Coastal Resources Department or the Town* • Harbor and Shellfish Advisory Board • UMass Boston Nantucket Field Station		
		Recommendation 2	Institute new steps, and continue existing efforts, such as placing spat bags strategically around the Harbors, to identify spawning events and monitor spat levels in the Harbors.	• The Marine and Coastal Resources Department or the Town* • Maria Mitchell Association • Harbor and Shellfish Advisory Board		

		Recommendation 3	Continue the larval release strategy at various locations throughout Nantucket waters and evaluate the effectiveness of the program in terms of localized recruitment of spat. Also investigate whether or not the timing of the releases impacts their effectiveness at enhancing local populations.	• The Marine and Coastal Resources Department* • Nantucket Shellfish Association		
Goal 2	Objective 1	Recommendation 1	Measure and monitor predator abundance in local waters (in part through a survey of by-catch) and measure impacts on shellfish resources during the various stages of life for each species. Understand the impacts of native versus non-native predators and implement a predator management protocol as appropriate, perhaps based on the identification of an "over-abundance" (which would need to be defined) of predators in the ecosystem. As part of the protocol, conduct research to understand the impacts of predator removal – both on the harvested resources and on the biological communities in the Harbors. Specifically look at the impacts of the mud blister worm (Polydora).	• Nantucket Research Collaborative* • Marine and Coastal Resources Department or the Town • Shellfishermen • Outside experts as appropriate		
Goal 3	Objective 1	Recommendation 1	Conduct and/or support current and future research to better understand the spawning cycle of scallops, and specifically the spawning cycle of nub scallops.	• Nantucket Research Collaborative* • Marine and Coastal Resources Department or the Town • Maria Mitchell Association • University of Massachusetts • Massachusetts Division of Marine Fisheries • Massachusetts bay scallop fishing communities • Outside experts as appropriate		

			Recommendation 2	Better understand and define the biological traits of and stressors to bay scallops, quahogs, conch, oysters, soft shelled clams, and other harvested shellfish. Use that knowledge to make informed management decisions. Specific topics of interest include (1) the relationship between spat recruitment and post-set spat survival as it relates to the overall abundance of shellfish, and (2) the genetic variability among harvested shellfish.	• Nantucket Research Collaborative* • Marine and Coastal Resources Department or the Town • Maria Mitchell Association • Outside experts as appropriate		
Regulations	Goal 1	Objective 1	Recommendation 1	Monitor the population characteristics of important shellfish resources across the Island, assessing recruitment into the fishery and the standing stock available for harvest, in order to provide information for management decisions. This monitoring could lead to the development of a predictive population model for Nantucket shellfish. This monitoring could be done in a collaborative manner by working with local fishermen.	• Nantucket Research Collaborative* • Marine and Coastal Resources Department or the Town • Harbor and Shellfish Advisory Board • NSA • Maria Mitchell Association		
			Recommendation 2	Continue to limit the size and mechanics (power hoisting) of dredges and enforce existing restrictions such as the 40 pound limit on the weight of the dredge.	• Board of Selectmen* • Marine and Coastal Resources Department or the Town • Harbor and Shellfish Advisory Board • NSA		
			Recommendation 3	Work with other Massachusetts-based shellfishing communities and DMF to identify and conduct research designed to evaluate the definition of a legally harvestable bay scallop. As part of this, consider research to inform the potential use of a thickness gauge to measure harvestable bay scallops.	• Nantucket Research Collaborative* • Marine and Coastal Resources Department or the Town • Board of Selectmen • Harbor and Shellfish Advisory Board • NSA		

		Recommendation 4	Increase oversight of recreational shellfishermen and enforcement of recreational regulations more widely. This includes expanding enforcement efforts during the summer, obtaining data on recreational catches throughout the shellfishing seasons, and enforcing the regulation requiring people to wear the pins which prove they have purchased licenses.	• Marine and Coastal Resources Department or the Town*		
Goal 2	Objective 1	Recommendation 1	Implement the steps needed to institute the adaptive management section of this Plan. As a first step, the Town should establish a Shellfish Management Plan Implementation Committee. This Committee should be responsible for developing specific rules about adaptation, including the timing of meetings, whether or not a "traffic light" approach to management is logical/feasible (see Appendix F), etc.	• Board of Selectmen* • Marine and Coastal Resources Department or the Town • Harbor and Shellfish Advisory Board • NSA		
Goal 3	Objective 1	Recommendation 1	Develop alternative commercial and recreational permit fee structures to generate more direct, indirect, and induced revenue for Nantucket. Investigate opportunities for changes to permit fees from time to time. Any direct revenues should be put toward propagation activities. Follow-up studies should be conducted to determine the economic impacts of the new fees.	• Marine and Coastal Resources Department or the Town* • Board of Selectmen • Harbor and Shellfish Advisory Board • NSA		

Management Implementation	Goal 1	Objective 1	Recommendation 1	Ensure stable funding for sufficient staffing of all management activities including research, water quality testing and analysis, propagation, enforcement and the use of interns and seasonal employees (estimated to cost at least $150,000). Funding sources should include money for salaries and equipment out of the general fund, money for propagation from fines, and additional income from grants, gifts, and the sale of licenses. One hundred percent of license fees must be used for propagation efforts. Consider various budget scenarios for expanded propagation activities, and the hiring of a second biologist.	• Marine and Coastal Resources Department or the Town* • Board of Selectmen		
		Objective 2	Recommendation 1	All personnel involved in management of shellfish resources and enforcement of shellfish regulations should attend periodic joint-training sessions (facilitated by fishermen and managers together) to ensure consistency of enforcement. These sessions should be open to commercial and recreational shellfishermen in the interest of improving compliance and communication between managers and the regulated community. Continue to include attendance in a training session as part of the penalty for harvesting seed scallops.	• Harbor and Shellfish Advisory Board* • Marine and Coastal Resources Department or the Town • Board of Selectmen • NSA • Commercial fishermen		
			Recommendation 2	Work with other fishing communities in Massachusetts to identify and make recommendations to DMF in areas where changes might benefit Nantucket shellfisheries, such as with the size of a legally harvestable bay scallop. Prepare and make widely available clear guidance on identifying harvestable scallops.	• Marine and Coastal Resources Department or the Town* • Board of Selectmen • Harbor and Shellfish Advisory Board • NSA • Fishermen • Other fishing communities in Massachusetts • Outside experts as appropriate		

		Recommendation 3	Work with the Harbor Plan Implementation Committee to develop the data clearinghouse for Harbors-related topics, including information pertaining to shellfish. Include the resources listed in this Management Plan, and ensure the availability of information pertaining to previous research on Nantucket shellfish.	• Shellfish Management Plan Implementation Committee* • Marine and Coastal Resources Department or the Town • Board of Selectmen • Harbor and Shellfish Advisory Board • NSA • Maria Mitchell Association • UMass Boston Nantucket Field Station		
		Recommendation 4	Nantucket's research entities, along with the Town and fishermen, should work together to further develop and implement the coordinated Research Plan associated with this Shellfish Management Plan, identifying priority research sites, data needs, and a standardized method for data collection, recording and reporting. This research coordination should be overseen by a group of local and outside experts with knowledge of research issues contained in the Research Plan. For purposes of this Plan, that group is referred to as the "Nantucket Research Collaborative."	• Nantucket Research Collaborative* • Marine and Coastal Resources Department or the Town • Maria Mitchell Association • University of Massachusetts Boston Nantucket Field Station • Department of Health • School for Marine Science and Technology • Massachusetts DEP • Other experts as needed		
	Objective 3	Recommendation 1	Continue to develop and implement an action plan to increase available space and use of space for aquaculture in Town waters. The action plan should address qualifications of bidders; a requirement for a business plan, and; management standards. The action plan should also ensure that shellfishing activities are not impaired as a result of aquaculture, and stress the participation of fishermen in hearings pertaining to aquaculture decisions.	• Marine and Coastal Resources Department or the Town* • Board of Selectmen • Harbor and Shellfish Advisory Board • NSA		

			Recommendation 2	Continue to work with DMF to identify and consider (1) potential aquaculture locations outside of the agency's usual physical siting requirements and (2) approval of a block of sites in advance of the DMF's issuance of a license to an individual.	• Marine and Coastal Resources Department or the Town* • Board of Selectmen • MA Division of Marine Fisheries • Harbor and Shellfish Advisory Board • NSA		
		Objective 4	Recommendation 1	Identify and make publically available areas for recreational fishing. Recreational fishing already dominates those shallow areas of the Harbors most easily accessible to recreational fishermen. Those areas should be officially identified and set aside for recreational fishing, though commercial fishing should not be excluded from those areas.	• Marine and Coastal Resources Department or the Town* • Board of Selectmen • Harbor and Shellfish Advisory Board • NSA		
Education	Goal 1	Objective 1	Recommendation 1	Design and implement a study to assess the economic impact of recreational and commercial shellfishing to Nantucket. This study should address topics such as employment rates (including jobs both directly and indirectly impacted by shellfishing), wages, impacts to other sectors of the economy, cash-flow through the Island economy, and economic trends related to shellfishing.	• Nantucket Research Collaborative* • Marine and Coastal Resources Department or the Town • Harbor and Shellfish Advisory Board • NSA • Outside experts as needed • Nantucket Planning and Economic Development Commission		

			Recommendation 2	Develop and implement a public outreach strategy to highlight the significance of shellfishing both from a cultural and an economic perspective. This may include components such as a series of articles in local newspapers and magazines; a mail campaign; outreach activities at fairs and festivals; recruitment of recreational shellfishers for the NSA; a "meet the fishermen" event; the development and distribution of the Blue Pages book; and an informational display that can be moved from venue to venue (appearing in such places as the library, town hall, ferry terminals, the airport, etc). This strategy should be developed in a way that fosters collaboration with other existing outreach plans so as to not duplicate efforts or send mixed messages to audiences.	• Shellfish Management Plan Implementation Committee* • Marine and Coastal Resources Department or the Town • Harbor and Shellfish Advisory Board • NSA		
			Recommendation 3	Develop an oral history of commercial and recreational shellfishermen and those associated with the industry as part of the historical records of the Island.	• Nantucket Historical Society* • NSA • SHAB		

	Objective 2	Recommendation 1	Develop and implement an outreach strategy to educate the public about how land and water-based activities can affect shellfish habitat. The outreach strategy should consider opportunities to coordinate with existing education efforts such as those identified in the Harbors Plan. This outreach strategy should make every effort to reach landowners, boaters, yacht clubs and their members, students, Maritime Festival audiences, and others, as appropriate. Additionally, electronic communication methods, including social network tools, should be explored. Examples of possible topics include fertilizer applications and their impact on shellfish habitat, and the dangers of dropping anchor in a shellfish bed.	• Shellfish Management Plan Implementation Committee* • Marine and Coastal Resources Department or the Town • Harbor and Shellfish Advisory Board • NSA • Harbor Plan Implementation Committee • Marine Science Teacher(s) • Egan Maritime Institute • reMain Nantucket • Nantucket Health Department • Nantucket Department of Public Works • Others as appropriate		
		Recommendation 2	Support the Harbor Plan Implementation Committee's work to develop and circulate a Blue Book modeled after those found in many communities on Cape Cod and Martha's Vineyard. Assist with content development and distribution.	• Shellfish Management Plan Implementation Committee * • Harbor Plan Implementation Committee • Marine and Coastal Resources Department or the Town • Harbor and Shellfish Advisory Board • NSA		

	Objective 3	Recommendation 1	Provide information on "best fishing practices" for recreational fishermen, including tips on how to identify legally harvestable scallops, where to access the water, how to be safe while harvesting, and how to minimize impacts on the habitat. Improve outreach to let people know that recreational permits are required to harvest shellfish. Use the outreach opportunity as a way to improve community awareness of the issues facing the shellfisheries. Include information about how the money raised by license sales helps the fishery and the Island's economy.	• Harbor and Shellfish Advisory Board* • Marine and Coastal Resources Department or the Town • NSA • Maria Mitchell Association and Aquarium • DMF		
		Recommendation 2	Improve access for recreational fishermen when feasible. Ensure that these new access points do not lead to illegal parking, blocking of traffic, culling on private property, and other similar issues.	• Marine and Coastal Resources Department or the Town* • Harbor and Shellfish Advisory Board • NSA • Planning Office		
		Recommendation 3	Gather contact information from people when they purchase their recreational shellfish permits. Use that information to communicate with recreational fishermen about upcoming events; management changes; opportunities to provide input on shellfish management; opportunities to participate in surveys about recreational shellfishing; and other important issues/opportunities.	• Marine and Coastal Resources Department or the Town* • NSA		
	Objective 4	Recommendation 1	Investigate other Fishery Cooperative Research Programs in the region with the intention of developing and implementing a program on Nantucket that will allow local fishermen to be involved in research and stock assessment efforts.	• NSA* • Harbor and Shellfish Advisory Board • Marine and Coastal Resources Department or the Town • BOS		

			Recommendation 2	Identify a select group of fishermen to assist with research by documenting bycatch details such as the percentage of seed and the types and abundance of predators.	• Nantucket Research Collaborative* • Marine and Coastal Resources Department or the Town • Board of Selectmen • Harbor and Shellfish Advisory Board • Nantucket Shellfish Association • Commercial fishermen		
Harvest Documentation	Goal 1	Objective 1	Recommendation 1	Continue to utilize records from shanties to help monitor and verify commercial landings. Additionally, continue to utilize records from shanties for enforcement of limits.	• Marine and Coastal Resources Department or the Town* • DMF		
			Recommendation 2	Implement a means to track the general locations where shellfish were harvested –both recreationally and commercially. The new trip-level reporting to DMF includes records of the growing areas fished and captures information about effort. Recreational fishing records should be designed to collect information similar to that reported for commercial harvests. While methods to track recreational fishing are imperfect, they could be augmented to also obtain information about where recreational fishermen fish. These commercial and recreational data should be analyzed jointly to understand where the fishing is greatest from year to year, and what significance that might have for management.	• Marine and Coastal Resources Department or the Town* • Commercial fishermen • DMF		

Support of the Commercial Fishery	Goal 1	Objective 1	Recommendation 1	Develop marketing strategies, such as branding the Nantucket bay scallop and/or controlling the rate at which scallops reach the market, to optimize the price of the Nantucket bay scallop. As part of this, continue to develop the concept of using a sticker to identify boxes of scallops as coming from Nantucket. Also consider developing quality standards (such as a freshness standard) that would be universally agreed upon and promoted by all who handle Nantucket bay scallops. Work with USDA to see if their marketing programs are applicable to the Nantucket bay scallop fishery. Link with ecotourism opportunities on Nantucket.	• NSA* • Harbor and Shellfish Advisory Board • Commercial fishermen • Wholesalers • Outside experts as appropriate		
			Recommendation 2	Consider establishing a co-op for marketing purposes. As part of the development of this co-op, consider making participation optional, and look to other co-ops for examples of good strategies. Appendix H provides some guidelines and resources for developing this cooperative.	• NSA* • Harbor and Shellfish Advisory Board • Commercial fishermen		
			Recommendation 3	Develop marketing strategies that will enhance the value of Nantucket shellfish bi-products (e.g. shells as a buffering source for restoration projects, viscera as a protein source, guts as bait or food, gonads as food).	• NSA* • Harbor and Shellfish Advisory Board • Fishermen • Wholesalers • Shuckers • Outside experts as appropriate		
			Recommendation 4	Review options for timed fishing closures to ensure the quality and consistency of product reaching the market.	• NSA* • Harbor and Shellfish Advisory Board • Board of Selectmen • Fishermen • Marine and Coastal Resources Department or the Town		

		Recommendation 5	Explore the apparent correlation between the price of scallops and number of buyers. Determine whether or not the number of buyers impacts the price they are willing to pay.	• Nantucket Research Collaborative* • Harbor and Shellfish Advisory Board • NSA • Outside experts as appropriate		
	Objective 2	Recommendation 1	In conjunction with the Harbor Plan Implementation Committee, consider opportunities to improve shore-side access and facilities through the expansion of existing access points and/or the creation of new access points. Ensure that these new access points do not result in the unreported taking of additional shellfish.	• Marine and Coastal Resources Department or the Town* • Nantucket Land Bank • Harbor and Shellfish Advisory Board • Planning and Economic Development Commission • Conservation Commission • Roads and Right of Way Committee		
	Objective 3	Recommendation 1	Continue to enhance and implement a mentoring program to assist new entries into the fishery. As part of the enhancement, develop a check-list of topics for the teaching captain to cover with the apprentice. The checklist would include topics such as how to identify a legal bay scallop (to be taught by a Warden or shellfish biologist), how to cull a catch, a review of the regulations, and general etiquette at sea. Continue to allow the reduction of the 40-day limit to allow for shorter apprenticeships if fishermen demonstrate the appropriate knowledge and skills needed to operate safely. These shorter apprenticeships would require the approval of SHAB.	• Harbor and Shellfish Advisory Board*		

Adaptation of the Plan	Goal 1	Objective 1	Recommendation 1	Bring together a group of people (a "Shellfish Management Plan Implementation Committee") responsible for overseeing the implementation, and adaptation of this Plan. This group should meet regularly and should include representatives from multiple stakeholder groups including recreational fishermen, commercial fishermen, scientists, and managers. Off-Island expertise should be included as appropriate. This group should work closely with not-for-profit entities to help raise funds for management plan research and implementation activities, identify common data reporting/gathering techniques, prioritize research projects, and address other research-related issues.	• Board of Selectmen* • Marine and Coastal Resources Department or the Town • Harbor and Shellfish Advisory Board • NSA • Nantucket Land Council • UMass Boston Nantucket Filed Station • Maria Mitchell Association • Conservation Commission		
			Recommendation 2	Establish a system whereby a review of coordinated threshold criteria (e.g. number of weather-related fishing days lost, seed density, stock assessments, etc.) or a valid concern raised by a citizen would initiate a public process, through SHAB, to address the issue(s) – including possible management actions.	• Nantucket Research Collaborative* • Harbor Plan Implementation Committee • Marine and Coastal Resources Department or the Town • Harbor and Shellfish Advisory Board • NSA • Outside experts as appropriate		
			Recommendation 3	Review and revise the Shellfish Management Plan every three years.	• Shellfish Management Plan Implementation Committee • Marine and Coastal Resources Department or the Town • Harbor and Shellfish Advisory Board • NSA		