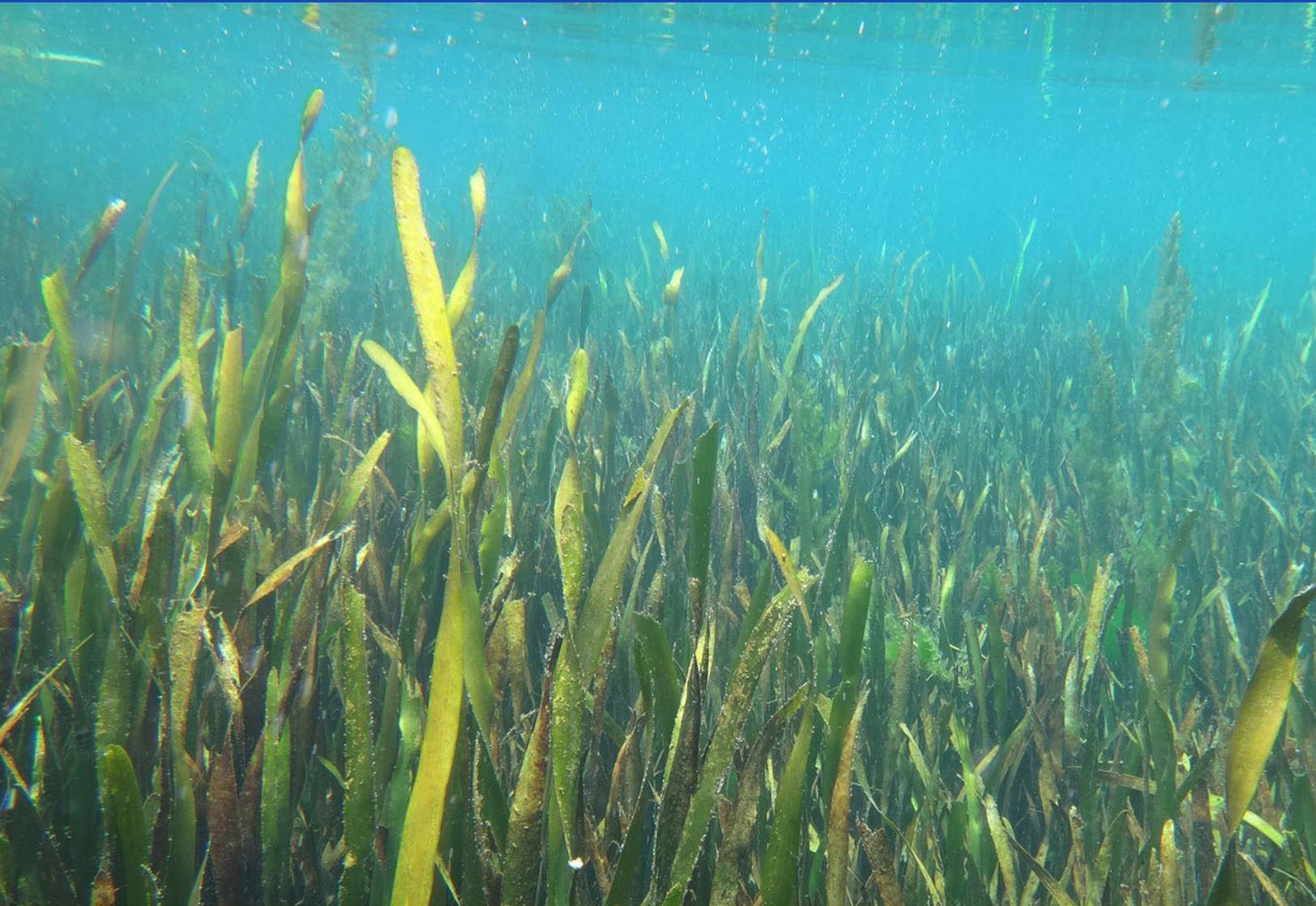




Atlantic States Marine Fisheries Commission
Habitat Management Series #15
Spring 2018



Submerged Aquatic Vegetation Policy: A Review of Past Accomplishments and Emerging Research and Management Issues

Vision: Sustainably Managing Atlantic Coastal Fisheries



Submerged Aquatic Vegetation Policy: **A Review of Past Accomplishments and Emerging Research and Management Issues**

prepared by
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Approved by the ISFMP Policy Board
February 8, 2018



A report of the Atlantic States Marine Fisheries Commission pursuant to
U.S. Fish & Wildlife Service Grant No. F12AF00200

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Executive Summary

Submerged aquatic vegetation (SAV) comprise some of the most productive ecosystems in the world. SAV is significantly important to many Atlantic States Marine Fisheries Commission (Commission) managed fish species, and afforded different degrees of protection up and down the coast. In 1997, the Commission's Habitat Committee developed a policy to communicate the need for conservation of coastal SAV resources, and highlight state and Commission-based activities for implementation of a coastal SAV conservation and enhancement program. The Commission encouraged implementation of this policy by state, federal, local, and cooperative programs which influence and regulate fish habitat and activities impacting fish habitat; specifically SAV.

In 2017, twenty years after the original policy was released, the Habitat Committee re-evaluated its recommendations and importance. Upon review, it was determined that the policy is still relevant, and arguably more important now than ever.

The Habitat Committee has left the goals largely unchanged from the 1997 version. The primary goal is to preserve, conserve, and restore SAV where possible, in order to achieve a net gain in distribution and abundance along the Atlantic coast and tidal tributaries, and to prevent any further losses of SAV in individual states by encouraging the following:

1. Protect existing SAV beds from further losses due to degradation of water quality, physical destruction to the plants, or disruption to the local benthic environment;
2. Continue to promote state or regional water and habitat quality objectives that will result in restoration of SAV through natural re-vegetation;
3. Continue to promote, develop, attain, and update as needed, state SAV restoration goals in terms of acreage, abundance, and species diversity, considering historical distribution records and estimates of potential habitat.
4. Continue to promote SAV protection at local, state and federal levels and when unavoidable impacts to SAV occur from permitted coastal alterations or other unintended actions, agencies should implement compensatory mitigation for the functional and temporal impacts.

There are six key components to achieving the goal of this policy: 1) Assessment of historical, current and potential distribution and abundance of SAV; 2) Protection of existing SAV; 3) SAV Restoration and Enhancement; 4) Public Education and Involvement; 5) Research; and 6) Implementation.

The background information, policies and recommended actions have been updated based on emerging issues and new information released over the last 20 years. A summary of SAV initiatives taken by the Commission's state and federal partners is also included in this updated policy.

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Acknowledgements

The Habitat Committee would like to acknowledge all of the partners and staff who took the ASMFC 1997 SAV Policy to heart and implemented it. In particular, we thank the early pioneers in North Carolina and Virginia – Bob Noffsinger, Wilson Laney, John Stanton, and John Gallegos of the U.S. Fish and Wildlife Service; Dean Carpenter of the Albemarle Pamlico National Estuary Program (APNEP); Anne Deaton of the North Carolina Division of Marine Fisheries (NC DMF); and Don Field of the National Ocean Service, NOAA for their organization and regular mapping efforts. Also thanks to Rob Allen and Keith Johnston of the North Carolina Department of Transportation’s Photogrammetry section. Their team’s collaboration with APNEP and NC DMF during the project’s second cycle (2012-2014) translated into great gains in efficiency during aerial image acquisition.

For their assistance with providing, reviewing, and/or updating information in this document (in some cases multiple times), we thank Soren Dahl, Kathryn Ford, Kate Frew, and others that we might have forgotten to mention.

Additionally, we would like to extend our gratitude to Bob Orth of the Virginia Institute of Marine Science for his May 2, 2017 presentation to the Habitat Committee on SAV in the Chesapeake Bay. The presentation and subsequent discussion helped guide the direction of this update to the SAV Policy.

PUBLICATION CITATION

Havel, L.N. and ASMFC Habitat Committee. 2018. Submerged Aquatic Vegetation Policy. ASMFC Habitat Management Series No. 15, Arlington, VA. 13pp plus appendix.

Preface

The Atlantic States Marine Fisheries Commission (Commission) was formed in 1942 as a means to conserve and enhance interjurisdictional fisheries of the Atlantic coast. The Commission and its 15 member states and associated jurisdictions which also serve on the Commission's Interstate Fisheries Management Policy Board (District of Columbia, NOAA Fisheries, Potomac River Fisheries Commission, and U.S. Fish and Wildlife Service) recognize that marine fisheries cannot be adequately managed without due consideration for marine fish habitat; however, the Commission does not have the capability to regulate marine fish habitat or activities other than fishing that may cause adverse impacts. Under these circumstances, the Commission recognizes that it is imperative to collaborate with the state and federal agencies that hold such authority, and equip them with the recommendations and guidance necessary to help provide for the conservation of healthy marine fish habitat.

Submerged aquatic vegetation (SAV) comprise some of the most productive ecosystems in the world (Orth et al. 2006a). SAV is significantly important to many Commission managed fish species, and afforded different degrees of protection up and down the coast. In 1997, the Commission's Habitat Committee developed a policy (ASMFC 1997) to communicate the need for conservation of coastal SAV resources, and highlight state and Commission-based activities for implementation of a coastal SAV conservation and enhancement program. This policy was modeled after a similar policy prepared by the Chesapeake Bay Program (Chesapeake Executive Council 1989), and background information relied heavily on the Commission's publication *Atlantic Coastal Submerged Aquatic Vegetation: a Review of its Ecological Role, Anthropogenic Impacts, State Regulation, and Value to Atlantic Coastal Fisheries* (Stephan and Bigford 1997). The intent of the original policy was not to hold marine fisheries agencies accountable for the suggested state activities, but rather to efficiently communicate the goals of the policy to the agencies or organizations that can best carry out the prescribed activities, and encourage the participation of these agencies in achieving policy goals.

In 2017, 20 years after the original policy was released, the Habitat Committee re-evaluated its recommendations and importance. Upon review, it was determined that the policy is still relevant, and arguably more important now than ever due to new or intensifying threats that could reduce water quality or damage beds, such as aquaculture and coastal development (Short et al. 2011, Lefcheck et al. 2017). Our objective is to provide updates to the scientific research and management issues, including emerging issues over the past 20 years. The goals of the original policy are still valid, but have been revised to meet the needs of the 21st century.

Introduction

BACKGROUND

Submerged aquatic vegetation or SAV systems, which include both true seagrasses in saline regions and freshwater angiosperms that have colonized lower salinity regions of estuaries, are among the most productive ecosystems in the world (Orth et al. 2006a). They perform a number of irreplaceable ecological functions, which range from chemical cycling and physical modification of the water column and sediments, to providing food and shelter for commercial, recreational, as well as ecologically important organisms, and are especially critical for juvenile development of many fish and invertebrate species (Thayer et al. 1997, Heck et al. 2003, Ralph et al. 2013). Due in part to their status as a nursery habitat, SAV is also a key linkage among not only other marine ecosystems, but terrestrial ones as well (Heck et al. 2008). All ASMFC managed species utilize SAV for refuge, attachment, spawning, food, or prey location for at least part of their life cycle, with the possible exception of Jonah crab and Northern shrimp (data from Kritzer et al. 2016).

The Commission established a policy on SAV in 1997 because of the important role SAV plays in the habitat of Commission-managed species. Both marine and freshwater SAV is covered by the policy because some managed species utilize both during their ontogenetic development. Both natural events and human activities (including climate change) can threaten local and regional SAV health and abundance, and result in impacts to fisheries. SAV loss has been reported worldwide (Orth et al. 2006a, Waycott et al. 2009) and in most Atlantic coastal states (see 'SAV Efforts by Atlantic Coast States and Federal Partners since the Policy was Released' on page 3). Some reasons for the decline, including water quality degradation, are pervasive threats along the coast. Certain regions have a fraction of historic SAV coverage. For example, the Chesapeake Bay saw declines in all species in all areas of the bay in the early 1970s (Orth and Moore 1983, Orth et al. 2002a). In 1993, researchers identified the main influencers on SAV abundance and distribution: water clarity, suspended sediments, nitrogen, phosphorus, and chlorophyll a (Dennison et al. 1993). Since then, managers have been using these indicators for specific water quality targets. They also have a goal of restoring a total of 75,000 acres of SAV in the Chesapeake Bay by 2025 (Orth et al. 2017). Conservation measures have also slowed, and in some cases reversed, SAV decline in other locations, including parts of Florida (SAFMC 2014).

The Commission encouraged implementation of the original policy by state, federal, local, and cooperative programs which influence and regulate fish habitat and activities impacting fish habitat; specifically SAV. The development of the original policy was overseen by the Commission's Habitat Committee, with scientific guidance from experts in the field of SAV ecology. This version of the SAV policy was updated by distributing the 1997 policy to SAV and habitat experts and incorporating their changes. The final draft was approved by the Habitat Committee January 16, 2018 and by the Policy Board February 8, 2018.

DEFINITION OF SUBMERGED AQUATIC VEGETATION

SAV refers to rooted, vascular, flowering plants that, except for some flowering structures, live and grow below the water surface. Because of their requirements for sufficient sunlight, seagrasses are found in shallow coastal areas of all Atlantic coastal states, with the exception of Georgia and South Carolina, where freshwater inflow, high turbidity and tidal amplitude combine to inhibit their growth. SAV growth is seasonal, and during winter months, leaf blades may not be present. Therefore SAV habitat may be characterized by the presence of rhizomes, roots, leaves, or reproductive structures. Mapping and surveying during the active growing season enhances the ability to identify SAV habitat.

There are at least 13 species of seagrasses common in US waters to which this definition of SAV and these policies may apply. In the New England and northern Mid-Atlantic regions, eelgrass (*Zostera marina*) dominates, with two other species also occurring – widgeon grass (*Ruppia maritima*) and, from North Carolina southward, Cuban shoalgrass (*Halodule wrightii*). South towards Florida, turtlegrass (*Thalassia testudinum*) and manatee grass (*Syringodium filiforme*) become dominant along with Cuban shoalgrass and several species of Halophila. One species of Halophila, Johnson's seagrass (*H. johnsonii*), was listed as threatened in 1998. Its critical habitat was designated in 2000, and in 2002 the National Oceanic and Atmospheric Administration (NOAA) published a recovery plan for the species. Widgeon grass (*Ruppia maritima*) which can tolerate both fresh and saltwater, has the broadest range of all species (Orth 1997).

Approximately 20 – 30 species of freshwater macrophytes may be found in the tidal freshwater and low salinity areas of the estuaries of the eastern United States. These lower salinity communities can be quite diverse, with as many as 10 species co-occurring at a single location. Wild celery (*Vallisneria americana*), redhead grass (*Potamogeton perfoliatus*), sago pondweed (*P. pectinatus*), horned pondweed (*Zannichellia palustris*), common elodea (*Elodea canadensis*), coontail (*Ceratophyllum demersum*), and southern naiad (*Najas quadalupensis*) are a few of the native species that will dominate these areas while two non-native (invasive) species, milfoil (*Myriophyllum spicatum*) and hydrilla (*Hydrilla verticillata*), will also be found in many areas.

This update and the original policy acknowledge that there will be situations where it may be appropriate to undertake control measures for invasive species. However, where native species have been eliminated and invasive species are of functional value it may be more appropriate to protect the invasive species from development activities (e.g. see Ramus et al. 2017). These situations should be evaluated on a case-by-case basis.

SAV EFFORTS BY ATLANTIC COAST STATES AND FEDERAL PARTNERS SINCE THE POLICY WAS RELEASED

In 2017, the Habitat Program Coordinator sent out a survey asking each partner a series of questions based on the goals and components of the original policy statement (results in Figure 1).

Of the eleven states that have marine seagrass within their borders and responded to the survey, seven of the eleven have implemented a resource assessment and monitoring strategy to quantitatively evaluate SAV distribution and abundance. One state is currently in the process of developing an assessment. Ten states have put measures in place to limit

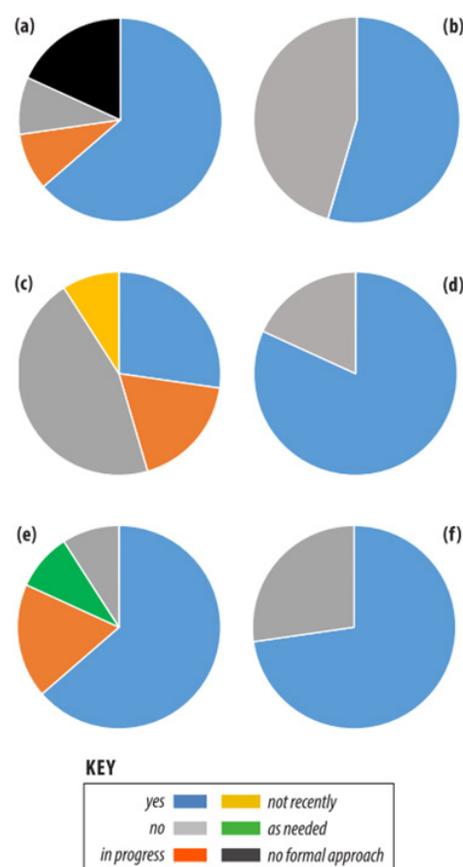


Figure 1. State responses to the following questions: (a) Has your state implemented an SAV resource management assessment and monitoring strategy? (b) Has your state set restoration goals? (c) Has your state reviewed the effectiveness of their assessment and monitoring programs? (d) Has your state identified reasons for loss and/or addressed the need for SAV improvement? (e) Has your state identified areas for protection or restoration? (f) Does your state follow specific Best Management Practices?

permanent and irreversible direct and indirect impacts to SAV and their habitats. Evaluation of the effectiveness of these measures has been mixed along the coast. Three states have carried out an evaluation and five have not. Two states have evaluations in development, and one state has conducted an evaluation in the past, but is not currently doing so. Fifty-five percent of states have set restoration goals, whereas 45% have not. Most (81%), however, have identified the key reasons for SAV loss in their state. Seven states have identified suitable areas for protection and restoration, and two are in the process of doing so. One state has not, and one identifies areas as needed. All states either incorporate SAV education in their outreach or citizen science programs, either directly or via other entities (such as National Estuarine Research Reserves). Most states have also supported SAV research and follow specific Best Management Practices (10 and 8 states, respectively).

Most of the federal partners do not have regulatory authority pertaining to SAV, but do serve in an advisory role and can designate specific SAV areas as protected. More than half have developed technical guidance or SAV standards, and promote Best Management Practices. While they have not implemented the Commission's SAV Policy, most have implemented other, similar policies to protect SAV.

Policy Statement

GOAL

The Habitat Committee found that the original goals are still relevant today, and have left them largely unchanged from the 1997 version. The primary goal is to preserve, conserve, and restore SAV where possible, in order to achieve a net gain in distribution and abundance along the Atlantic coast and tidal tributaries, and to prevent any further losses of SAV in individual states by encouraging the following:

1. Protect existing SAV beds from further losses due to degradation of water quality, physical destruction to the plants, or disruption to the local benthic environment;
2. Continue to promote state or regional water and habitat quality objectives that will result in restoration of SAV through natural re-vegetation;
3. Continue to promote, develop, attain, and update as needed, state SAV restoration goals in terms of acreage, abundance, and species diversity, considering historical distribution records and estimates of potential habitat.
4. Continue to promote SAV protection at local, state and federal levels and when unavoidable impacts to SAV occur from permitted coastal alterations or other unintended actions, agencies should implement compensatory mitigation for the functional and temporal impacts.
5. There are six key components to achieving the goal of this policy: 1) Assessment of historical, current and potential distribution and abundance of SAV; 2) Protection of existing SAV; 3) SAV Restoration and Enhancement; 4) Public Education and Involvement; 5) Research; and 6) Implementation.

I. ASSESSING THE RESOURCE

Determining current status and identifying trends in health and abundance are key factors in management of SAV resources. In an effort to develop consistent monitoring techniques among regions, SAV mapping protocols have been identified by NOAA's Coastal Change Analysis Program (C-CAP, Dobson et.al. 1995), and updated in 2001 (NOAA 2001).

Policy: At a minimum, each member state should ensure the implementation of an SAV resource assessment and monitoring program which will provide a continuing quantitative evaluation of SAV distribution and abundance and the supporting environmental parameters. The optimal coast-wide situation would be a monitoring system which would establish consistent monitoring techniques among regions so that the data are comparable. For example, SeagrassNet is used at several locations along the Atlantic coast and other areas worldwide to assess trends in health of discrete SAV beds using comparable techniques. In addition to evaluating distribution and abundance, monitoring should also evaluate trends in the overall health of existing SAV beds.

Action: *ASMFC* — Support (financially, politically, or through the sharing of resources and information) and promote states to adopt an SAV mapping and monitoring plan. Assessment and data collection should have relevant metrics and scales to inform specific management questions and goals (Bernstein et al. 2011, Neckles et al. 2012, Roca et al. 2016). When possible, promote universal metrics for monitoring along the coast to allow for inter-state comparisons.

States — *ASMFC* members should encourage their appropriate state agencies or departments to implement regular statewide or regional SAV monitoring programs which will identify changes in SAV health and abundance cumulatively on a coast-wide basis if they are not already doing so (see 'SAV Efforts by Atlantic Coast States and Federal Partners since the Policy was Released' on page 3 for more information). Surveys should minimally be on a five year basis, and preferably annually, for areas considered to be especially at risk of severe declines from anthropogenic activities, disease, or other factors. Aerial images captured from a plane allow for standard comparability across regions, if resources allow. A good map provides spatial extent and rough approximations of density. However, aerial-based assessment results can vary considerably based on image quality, SAV bed plant densities, visual signature interpretation and extent of surface level verification. Above ground biomass (e.g. shoot density and canopy height) from sentinel beds can allow for a closer look at plant health and bed dynamics.

II. PROTECTION OF EXISTING SUBMERGED AQUATIC VEGETATION

A concerted effort should be made to protect those areas where SAV currently exists since it is problematic to successfully restore or mitigate SAV losses. Impacts which result in losses of SAV such as direct alterations to a vegetated area or indirect actions within a watershed should be minimized. Primary causes of SAV loss include navigational dredging, filling, and reduced water clarity due to runoff from development and agriculture. Shading from docks, propeller dredging from boating, and bottom disturbing fishing gear also contribute to SAV loss (e.g. Orth et al. 2002b).

While there have been numerous documented restoration successes, there have been just as many or more failures. Therefore protection and conservation are much more assured and cost effective approaches to the preservation of SAV. Because SAV requirements for growth and survival are stringent, controlling the type, extent, intensity, and duration of impacts to SAV will further other efforts to restore and protect coastal fish habitat.

Since the original policy was released SAV has been facing emerging issues including a boom in the installation of new boat mooring areas and significant increases in shellfish aquaculture in shallow coastal waters, both of which can conflict with the conservation of SAV. This is especially true for shellfish aquaculture. Aquaculture has the potential for conflicts that requires careful ocean planning, and siting should not occur in current or adjacent to seagrass beds. Climate change is also expected to have an effect on SAV distribution and abundance as water temperature, salinity, and water depth change.

Policy: Member states and federal partners should use existing regulatory, proprietary, and resource management programs, and in addition, develop new programs, to limit permanent and irreversible, direct, and indirect impacts to SAV and their habitats.

Action: *ASMFC, States, and Federal Partners* — Review and evaluate the effectiveness of existing administrative procedures, regulatory, proprietary, and resource management programs to protect existing SAV and their habitats. This includes: fishing impacts; aquaculture; dredging; water quality standards; dock placement; marina expansion and vessel impacts such as elevated wakes, suspended sediments, placement and maintenance of moorings, direct impacts from hulls, propellers, and personal watercraft; runoff from development and agriculture; and compensatory mitigation.

ASMFC — Support and promote the development of water quality standards by the Environmental Protection Agency and member states that can be implemented to protect SAV habitat (i.e. light attenuation, total suspended solids, chlorophyll a, dissolved inorganic nitrogen, dissolved inorganic phosphorus, critical life period).

In partnership with NOAA Fisheries and U.S. Fish and Wildlife Service, develop technical guidelines and standards to objectively evaluate fishing gear, propeller scarring, dredging, coastal construction, and bottom fishing impacting, and develop standard mitigation strategies.

States — ASMFC members should propose improvements necessary in state regulation and management including conditions pertaining to harvesting shellfish or finfish in SAV beds by use of mechanical means and the placement and operations of aquaculture activities to protect existing SAV beds.

Encourage state agencies or departments with jurisdiction over construction activities to propose improvements necessary in state regulation and management of SAV habitats based on the standards developed in the above actions.

III. RESTORATION OF SUBMERGED AQUATIC VEGETATION

In addition to protecting existing SAV habitat, restoration of former habitat should improve the likelihood of achieving an overall net gain. In cases where monitoring assessments show SAV is in decline due to poor environmental quality, sufficient environmental quality standards must be attained before restoration can occur. Planning will induce maximum restoration program effectiveness. Even with adequate environmental quality, SAV restoration is challenging due to predators, human impacts, and the risk of newly planted shoots to uproot easily. Good planning and use of scientifically-based restoration protocols will help ensure success where environmental conditions warrant. Examples of tools and protocols include habitat suitability models (Vaudrey et al. 2013), site-specific planning and testing (Leschen et al. 2010), and restoration strategies (Orth et al. 2006b, van Katwijk et al. 2016). To be successful, water quality conditions that historically and currently support

Policy: ASMFC and member states should promote and support public education and stewardship programs that will increase the public's knowledge of SAV, its importance as fish habitat, and commitment to SAV conservation.

Action: *ASMFC, States, and Federal Partners* — ASMFC in coordination with member States, federal agencies, and non-profits will promote and support the improvement of policy maker and public understanding of the value, habitat requirements, status, significant threats, cumulative human impacts, and trends in abundance of SAV. States should include this information in their aquatic education programs.

States — ASMFC members should encourage their appropriate state agency or department to promote the involvement of citizen's groups in activities such as groundtruthing of remotely sensed and mapped SAV locations; water quality monitoring programs; reporting of impacts, especially cumulative impacts such as dock and pier expansions; losses or perturbations; and SAV restoration and protection activities. One way to aid in increasing awareness would be to share area maps online (preferably not requiring ArcGIS user capabilities).

V. SCIENTIFIC RESEARCH

Through scientific research, we will improve our knowledge and understanding of SAV to ensure that efforts to protect and restore the resource will be effective. Further information on growth, physiology, reproduction, genetics, life cycles, disease, transplanting (successes and failures), environmental requirements, and anthropogenic impacts is needed to protect and restore SAV.

Policy: ASMFC and member states should promote and support those research projects which will improve our knowledge of SAV and its benefits as fish habitat.

Action: *ASMFC, States, and Federal Partners* — On a coast wide basis, support research financially, politically, and through data and results sharing in the following areas:

1. The relationship between SAV and the environmental quality of fish habitat and the relative importance of SAV to other, high quality habitat types. This should include the development of specific habitat functions of SAV (e.g. spawning, feeding, growth, refuge), taking into consideration the benefits to managed fish species across their ranges.
2. Improving methodologies for SAV transplanting and restoration techniques, and determine the ecological functioning of transplanted vs. naturally vegetated areas.
3. Improving our understanding of the relationships between SAV and managed fish species, including fishery production patterns associated with different landscape or bed forms and sizes within the context of location within the system, as well as the influence of human disturbance and consequences of altering seagrass landscapes vis-à-vis fragmentation and isolation.
4. The specific physical requirements for SAV survival, on a regional basis, as well as the effects of eutrophication, sediment loading, indirect (pesticides) and direct (herbicides) impacts to epiphyte grazers, disease, physical disturbance, climate change (e.g., respiratory stress from increased temperatures), and natural perturbations on growth and survival of SAV. Efforts should be made to identify the primary threat(s) to SAV health in each locale. This will help identify potential sites for SAV restoration.

5. The effects of reduced genetic diversity and difference in physiology (e.g. annual vs. perennial, below-ground biomass) on the ability of seagrass populations to survive habitat alterations. Research should also identify regional differences in SAV requirements.
6. The potential effect of climate change on SAV, including range expansion and contraction, temperature tolerance, susceptibility to disease, etc.

VI. POLICY IMPLEMENTATION

Habitat Program

This policy was distributed to all Commissioners and other interested persons for use in promoting local and regional protection of SAV. The Commission's federal partners, including the U.S. Fish and Wildlife Service and NOAA Fisheries, were encouraged to adopt and implement this policy. Other federal agencies, such as the U.S. Army Corps of Engineers and the Environmental Protection Agency, were briefed on the policy, and encouraged to adopt it as well.

The Commission will continue to progress in its commitment to facilitate communication among local, state, and federal fishery and habitat managers, as well as assist marine fisheries agencies in transmitting this updated policy to habitat protection agencies (Appendix I).

Fishery Management Planning

Under the Atlantic Coastal Fisheries Cooperative Management Act, the Commission may require that states implement certain facets of fishery management plans, termed "compliance criteria." The following is a list of compliance criteria which the Commission will continue to consider for adoption in fishery management plans (FMP) for species with demonstrated reliance on SAV habitat (Laney 1997):

1. Preparation of an annual status report by each state and federal partner on implementation of each aspect of the policy.
2. Transmission of the policy by each state and federal partner to all agencies with habitat regulatory and management authority or organizations which can have a significant positive or negative impact on SAV.
3. Preparation of state plans to identify fishing gear and practices employed by any state regulated fishery which may negatively impact SAV; and development and implementation of strategies to eliminate negative impacts identified pursuant to Section II where appropriate to achieve SAV objectives.

In addition, the policy should continue to be incorporated by reference into FMPs for species with demonstrated reliance on SAV habitat. These FMPs should include background information on the importance of SAVs, and recommendations which parallel the prescribed activities of the policy.

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