



**Nearshore *Sargassum* Management:
Policy Analysis and Agency Gaps
Assessment**

Nearshore *Sargassum* Management: Policy Analysis and Agency Gaps Assessment

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Dear Readers,

The designation of *Sargassum* as Essential Fish Habitat and its consideration as a Harmful Algal Bloom complicate and limit its mitigation and management. Through the development of this document, we aimed to identify areas where NOAA should improve its internal coordination among line offices. Through the careful review of mandates, which have overlapping and sometimes conflicting jurisdictions, we have identified key gaps in *Sargassum* policy that would benefit from intra-agency discussion and coordination.

NOAA recognizes and appreciates the internal challenges outlined in this paper. We are actively working to reconcile gap 1 *“Due to overlapping jurisdictions and designations, addressing Sargassum requires navigating complex legal frameworks for coastal managers,”* by beginning the process of coordinating research into the ecological impacts of *Sargassum* in the coastal zone. This work will aim to inform the interpretation and enforcement of The Magnuson Stevens Act and the Endangered Species Act by building a basis of scientific knowledge that can inform ecologically sound removal of *Sargassum* mats before they become a hazard and economic burden on communities.

We are also working to actively reconcile gap 2 *“There is no formal intra-agency (within NOAA) or interagency group to respond in the event of a large-scale Sargassum event”* by planning a *Sargassum* workshop in fiscal year (FY) 2025. This session will bring together representatives and key players from across NOAA to codify a NOAA-wide response plan to a large-scale inundation event. This meeting will be coordinated by NOAA’s Southeast and Caribbean Regional Team (SECART), which is focused on facilitating collaborations across NOAA to improve the services provided to this region.

As co-chairs of the Interagency Working Group on the Harmful Algal Bloom and Hypoxia Research and Control Act (IWG-HABHRCA), NOAA and the Environmental Protection Agency (EPA) initiated a cross-agency sub-working group on *Sargassum* to increase interagency coordination and collaboration with respect to *Sargassum* management, information sharing, and research.

Sincerely,

A handwritten signature in black ink that reads "Katharine Egan". The signature is written in a cursive, flowing style.

Katharine Egan
Regional Coordinator, NOAA
Southeast and Caribbean Regional
Team (SECART)

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Executive Summary

Since 2011, the increased frequency and severity of *Sargassum* Inundation Events (SIEs) in the South Atlantic, Caribbean, and Gulf of Mexico regions of the United States have created a variety of challenges for coastal communities, wildlife managers, and commercial fisheries. *Sargassum* falls under the jurisdiction and management of several federal and state agencies due to its increasingly wide-spread distribution. In August 2022, the U.S. Virgin Island's (USVI) water supply was contaminated with an influx of *Sargassum*, leading to a potable water shortage. The Federal Emergency Management Agency (FEMA) declared a federal emergency and NOAA deployed scientific support staff. This prompted an agency-wide movement within NOAA to better understand how roles of individual offices apply to *Sargassum*. NOAA's Southeast and Caribbean Regional Team (SECART) and NOAA's National Centers for Coastal Ocean Science (NCCOS) have taken initiative in documenting this Policy Analysis and Agency Gaps Assessment to provide an overview of different management and regulatory jurisdictions surrounding *Sargassum*. This effort was executed in partnership with the Cooperative Institute of Marine and Atmospheric Research (CIMAS), NOAA National Marine Fisheries Service (NMFS), NOAA National Ocean Service (NOS), NOAA Oceanic and Atmospheric Research (OAR), and the Gulf of Mexico Regional Collaboration Team.

The purpose of this document is to identify NOAA's policy gaps in *Sargassum* management within the United States, its territories, and freely associated states. The authors do not intend to provide a position on behalf of NOAA on how to manage *Sargassum*, but rather aim to provide consolidated reference material for management and expedited policy development. In part I, we provide a brief overview of *Sargassum* ecology, distribution, and onshore impacts. In part II, we review the various U.S. legal designations of *Sargassum*. In part III, we describe existing efforts within NOAA related to *Sargassum*. Finally, in part IV, we identify gaps within the existing legal and agency framework that should be considered within NOAA. We find that it is unclear when and how *Sargassum* transitions from being nearshore habitat to a harmful hazard, and that this ambiguity will require a nuanced approach to response, mitigation, and clean-up efforts.

I. *Sargassum* background

Ecology

Sargassum is a genus of holopelagic free-floating, brown, macroalgal seaweed that consists of over 300 species found worldwide (Hardouin et al., 2014). In this report, *Sargassum* references two species of holopelagic *Sargassum*, *S. natans* and *S. fluitans* (Gower & King, 2011; Doyle & Franks, 2015; Wang et al., 2019). *Sargassum* has floating “berries” called pneumatocysts that allow transport by marine currents (Godinez-Ortega et al., 2020). When pneumatocysts lose buoyancy, *Sargassum* sinks to the seafloor, providing carbon to the deep-sea (Baker et al., 2017). *Sargassum* “blooms”, or large accumulations of the macroalgae, can grow to be a few centimeters (cm) to meters (m) in length, often in “swaths” or “patches” extending for thousands of miles within the Sargasso Sea (Wang et al., 2019). *Sargassum* provides food, protection, and breeding grounds for hundreds of species that permanently reside within it (Smith & Salmon, 2009; Witherington et al., 2012). It is an important habitat for many ecologically and commercially important species such as billfish, sea turtles, wahoo, tuna, and dolphin (South Atlantic Fishery Management Council, SAFMC, 2021). There are various endemic, threatened, and endangered species that are supported by *Sargassum* habitat (SAFMC, 2021). It has also been documented as nursery grounds for many juvenile species off the U.S. Southeast coast (Casazza & Ross, 2008; Smith & Salmon, 2009). These include plane-head fish, blue runner, gray triggerfish, pipefish, sergeant major, amberjack, and the iconic sargassumfish (Wells & Rooker, 2004). Additionally, fish communities that reside within *Sargassum* have been found to be more diverse than communities residing in the surrounding water (Vandendriessche et al., 2007).

Distribution

Sargassum blooms have continually occurred each year, peaking May to July (University of South Florida, USF, 2023). Many variables determine abundance each year, such as sea surface temperature, nutrient inputs, wind patterns, and ocean currents (Johns et al., 2020). *Sargassum* is most associated with the Sargasso Sea, a sea without land boundaries located in the west-central portion of the North Atlantic, which is defined by currents circulating the North Atlantic Gyre, the Gulf Stream, and the Antilles Current (Johns et al., 2020; Sapsford, 2022). *Sargassum* is an essential part of this pelagic ecosystem; the Sargasso Sea is recognized as an Ecologically or Biologically Significant Marine Area (EBSMA) by the Convention on Biological Diversity (CBD) (Secretariat of the Convention on Biological Diversity 2014). However, *Sargassum* is also abundant in the Gulf of Mexico and found in the Caribbean Sea (Gower & King, 2011; Wang et al., 2018). More recently (2011), a second aggregation has developed called the Great Atlantic Sargassum Belt extending from West Africa to the Caribbean Sea and the Gulf of Mexico (Hu et al., 2016; Wang et al., 2018). There are numerous theories as to how this formed, namely 1) the combination of excess Amazon River discharge and wind blowing from the Sahara Desert, 2) the drastic shift south in westerly winds of the 2009-2010 North Atlantic Oscillation (NAO), and 3) increasing sea surface temperatures that lead to large blooms of *Sargassum* (Sissini et al., 2017; Oviatt et al., 2019; Wang et al., 2019; Johns et al., 2020).

Coastal impacts

Recent expansions in *Sargassum* distribution can be accompanied by negative effects for nearshore environments (Hu et al., 2016; Trianes et al., 2023). *Sargassum* has become a nuisance for beach users and a disturbance for coastal ecosystems (Trianes et al., 2023). SIEs occur when large amounts of

Sargassum are “beached” on shorelines. These inundation events are hard to predict, leaving coastal communities unprepared (USF, 2023). In March 2023, numerous media outlets featured the story of a massive “blob” headed towards Florida, warning audiences of an expected *Sargassum* disaster. Fortunately, the 2023 *Sargassum* season did not reach predicted biomass levels on Florida coasts. For the Caribbean, however, FEMA declared a federal emergency in August 2022 when the St. Croix water supply was plagued by *Sargassum*, leading to a water contamination and shortage on the island (NOAA OR&R, 2022). Similarly, in 2021 an SIE clogged the water filtration system of a power plant in Puerto Rico resulting in the loss of electricity to 100,000 people according to LUMA Energy (The Weekly Journal, 2021).

SIEs negatively impact human use of coastal areas by severely impacting fisheries and reducing tourism. SIEs have been associated with localized episodes of hypoxia, ocean acidification, and reducing light penetrance in shallow coastal ecosystems resulting in both seagrass and coral mortality (van Tussenbroek et al., 2017; Hernández et al., 2022). Large blooms disrupt recreational and commercial fisheries by reducing access to fishing areas and navigation, causing marine life mortality, and clogging fishing gear (Oxenford et al. 2019; UN Environment Programme, UNEP, 2021). Onshore, SIEs affect the way sea turtles nest on beaches, causing them to shift from natal nesting sites and thereby the journey of hatchlings into the ocean (Mauer et al., 2021). Heavy metals accumulate in *Sargassum*, and when *Sargassum* decays these metals become toxins on the beach (Resiere et al., 2018). After 48 hours of washing onshore, the decomposition process starts and toxic gasses (hydrogen sulfide and ammonia) are released (Resiere et al., 2018). The effects of high exposure to these toxins can develop into pulmonary, neurological, and cardiovascular lesions in humans (Resiere et al., 2018). Lower levels of exposure cause allergy-like symptoms (itchy-watery eyes, nausea, headaches, and rashes). Recent studies show that *Sargassum* cleanup workers face a high exposure risk of hydrogen sulfide emissions (Rodríguez-Martínez et al., 2024). At the very least, decomposition of large *Sargassum* accumulations on the shore is accompanied by a foul odor (UNEP, 2021) that can affect tourism and local recreation. Notably, clean-ups for *Sargassum* can be costly: in Florida’s Miami-Dade County, the annual cost to remove *Sargassum* is over \$3.9 million (CBS News, 2023). Some countries impacted by SIEs have taken federal measures to address beaching events. For example, the Mexican government has an annual budget appropriation of \$302 million Pesos (~\$15 million USD) for removal in the tourist-heavy state of Quintana Roo (Rosellón-Druker et al., 2022). In summation, *Sargassum* blooms in coastal areas can negatively impact infrastructure, ecosystem health, fisheries, tourism, and human health, while being costly to clean-up.

Despite the negative impacts, upon landing on beaches and coastal areas, *Sargassum* has potential to help mitigate beach erosion and provide nutrients to dune and coastal habitats (Innocenti et al., 2018). Many commercial uses to repurpose beached *Sargassum*, including applications as soil fertilizer and bio-fuel, are currently being explored (Kumari et al., 2013; Innocenti et al., 2018; Lopez-Sosa et al., 2020).

II. Policy and management of *Sargassum* in the United States, territories, and freely associated states

This section highlights current jurisdictions, mandates, and collaborations that apply to *Sargassum*. While some of these do not explicitly apply to *Sargassum*, it is imperative to highlight how they impact the way *Sargassum* is managed.

Magnuson-Stevens Fishery Conservation and Management Act 1976

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) was established to manage U.S fisheries through federal management plans. The Fishery Management Plans (FMPs) include annual catch limits, harvest rules, gear restrictions, temporal restrictions, Essential Fish Habitat (EFH) designations, and other management options that undergo public comment before final rule is implemented. The five main objectives of the MSA are to 1) prevent overfishing, 2) rebuild overfished stocks, 3) increase economic and social benefits, 4) ensure sustainable and safe food supply, and 5) protect EFH for managed species. The MSA created eight regional fishery management councils (16 USC 1801 MSA §2). Each regional fishery council is responsible for developing FMPs.

- Essential Fish Habitat: The MSA requires fishery management councils and NOAA NMFS to designate EFH(s) for species managed through FMPs. An EFH is defined as waters and substrate necessary for fish spawning, breeding, feeding, and growth (16 U.S.C. § 1802 (10); 50 C.F.R. 600.10). Additionally, the Councils and NMFS designate subsets of EFH for prioritization purposes, which are called Habitat Areas of Particular Concern (EFH-HAPC) (16 U.S.C. 1853 Sec. 303(a)(7)). These are designated based on ecological importance, susceptibility to human impacts, stress from development, probability of human degradation, and rarity of habitat. It is important to note that EFH designations for pelagic *Sargassum* within FMPs do not prohibit harvest of *Sargassum*; it simply triggers EFH NMFS consultations if an agency action may “adversely affect” EFH. (16 U.S.C 1855 Sec 305(b)).
- *Sargassum* FMP: In 2002, the SAFMC developed an FMP for pelagic *Sargassum* (68 FR 57375; SAFMC, 2003). The FMP allowed for the EFH designation of *S. fluitans* and *S. natans*, as the area when located within the top 10 m of the water column in the South Atlantic Exclusive Economic Zone (EEZ) (76 FR 82183). This protects the two species from excessive commercial harvest and stems from scientific support that shows surface waters of up to 10 m as the optimal depth range for *Sargassum* growth and reproduction. In Amendment 1, EFH-HAPC for *Sargassum* are the Point off Cape Hatteras, North Carolina and the Charleston Bump, South Carolina (Crabtree 2011). The most recent amendment, Amendment 2 (Crabtree 2011), established the following criteria for *Sargassum*:
 - Prohibited harvest within 100 mi of shore between the Virginia/NC border and NC/SC border.
 - Harvest allowed beyond 100 mi and between the Virginia/NC border and NC/SC border from November - June.
 - Annual catch limit (ACL) 5,000 lbs wet weight per year is considered equivalent to the optimal yield for *Sargassum*. Harvest is prohibited once the quota is met during allowable months.
 - Prohibited to harvest south of the NC/SC border extending to Dry Tortugas in the Florida Keys.

- Nets used to harvest must be 4-inch stretch mesh or larger, fitted to frame no larger than 4x6 feet.
- Above criteria apply to all waters within the U.S. EEZ to the landward most influence of the tide from NC to Dry Tortugas in the Florida Keys (Crabtree 2011).

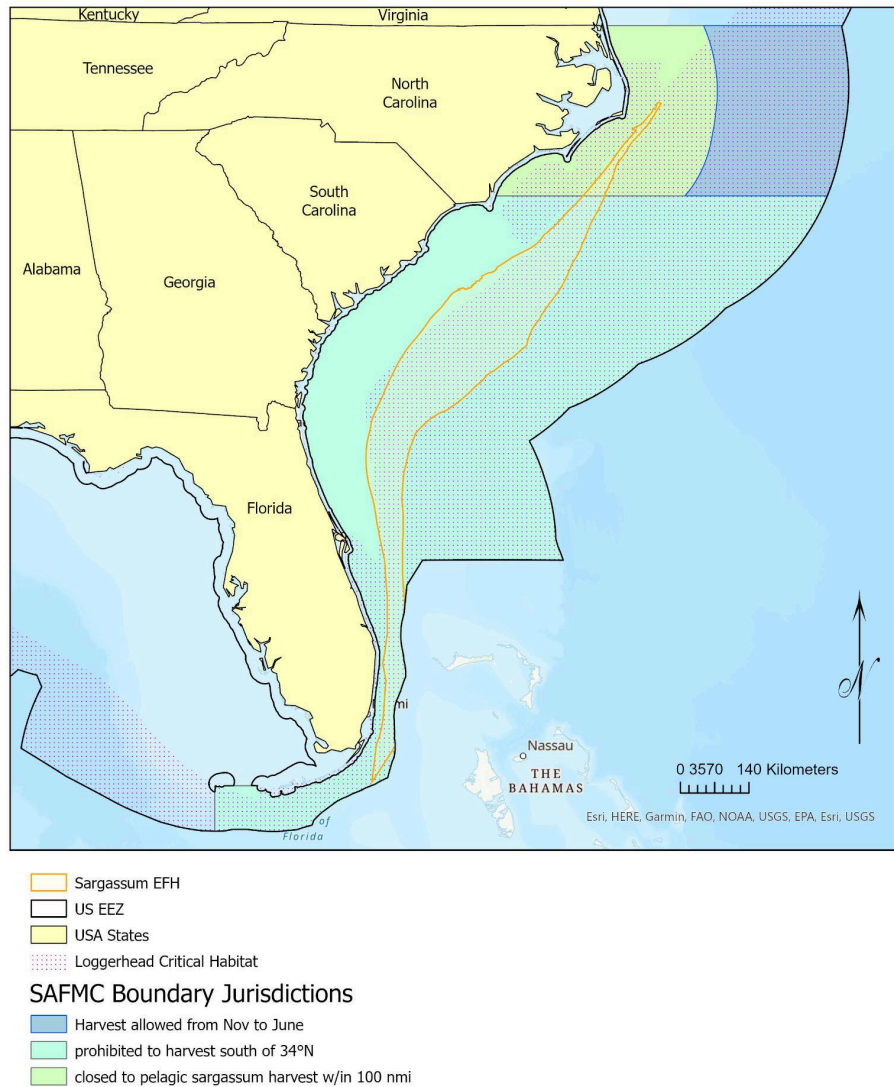


Figure 1: Sargassum Fisheries Regulations within the South Atlantic (adapted from Vital, 2024).

- *Sargassum* as EFH in Southeast Atlantic: *Sargassum* is listed as an EFH for many SAFMC managed species including greater amberjack, lesser amberjack, banded rudderfish, almaco jack, dolphin, wahoo, and coastal migratory pelagic species (SAFMC 2021; 76 FR 82183). The SAFMC also designated *Sargassum* as an EFH-HAPC for coastal migratory fish species from the Gulf Stream shoreward. This requires agencies to consult with NMFS if an agency action may “adversely affect” the EFH by impacting the quality or quantity of the EFH (16 U.S.C. 1855 § 305; 104-297(b)(2)).

- *Sargassum* as EFH in the U.S. Caribbean: The U.S. Caribbean territories have fishery jurisdictions through the Caribbean Fishery Management Council (CFMC) that manage and regulate *Sargassum* related activities. Although initially region-focused, the CFMC has shifted from a Caribbean-wide management plan to implement three island-based plans in 2022 (Puerto Rico, St. Thomas and St. John, and St. Croix) to better manage each island’s resources. Through this new approach, the Council aims to provide higher stakeholder engagement, manage stocks targeted in federal waters of each island, account for differences between fishing sectors (commercial and recreational), and consider social and cultural attributes of each island. *Sargassum* is included as an EFH for various species managed from the mean high water line to the outer boundary of the U.S. EEZ (Table 1). *Sargassum* is listed as an EFH under the Puerto Rico FMP for gray triggerfish, great barracuda, and for newly managed pelagic species such as dolphin and wahoo (CFMC, 2020 a; 87 FR 56204) and for dolphin and wahoo in the St. Croix and St. Thomas and St. John FMPs (CFMC, 2022 b,c; 87 FR 56204) (Table 1).
- *Sargassum* as EFH in the Gulf of Mexico: *Sargassum* is described as drifting algae, one of 12 habitat types listed by the Gulf of Mexico Fisheries Management Council (GMFMC, GMFC 2016, 2022). It is specifically mentioned in descriptions of king mackerel, greater amberjack, almaco jack, banded rudderfish, and gray triggerfish habitats (GMFC, 2016).

Table 1: Fishery Management Plans (FMP) of the South Atlantic, United States Caribbean, boundaries, and Essential Fish Habitat (EFH) designations that list *Sargassum*.

Region	FMPs	Boundary (nautical mi offshore)	<i>Sargassum</i> substrate as EFH
Southeast Atlantic	Coastal Migratory Pelagic, coral and live bottom habitat, dolphin and wahoo, golden crab, <i>Sargassum</i> , shrimp, snapper grouper complex.	3 - 200	Greater amberjack, lesser amberjack, banded rudderfish, almaco jack, dolphin, wahoo, and coastal migratory pelagic species
Gulf of Mexico	None list <i>Sargassum</i> .	State water boundary - 200	King mackerel, greater amberjack, almaco jack, banded rudderfish, and grey triggerfish
Puerto Rico	Spiny lobster, queen conch, 63 species of fish, all species of corals, sea urchins, and sea cucumbers.	9 - 200	Gray triggerfish, little tunny, blackfin tuna, king mackerel, cero mackerel, wahoo, dolphin, barracuda, tripletail
St. Thomas and St. John	Spiny lobster, queen conch, 47 species of fish, and all species of corals, sea urchins, and sea cucumbers.	3 - 200	Dolphin and wahoo
St. Croix	Spiny lobster, queen conch, 43 species of fish, and all species of corals, sea urchins, and sea cucumbers.	3 - 200	Dolphin and wahoo

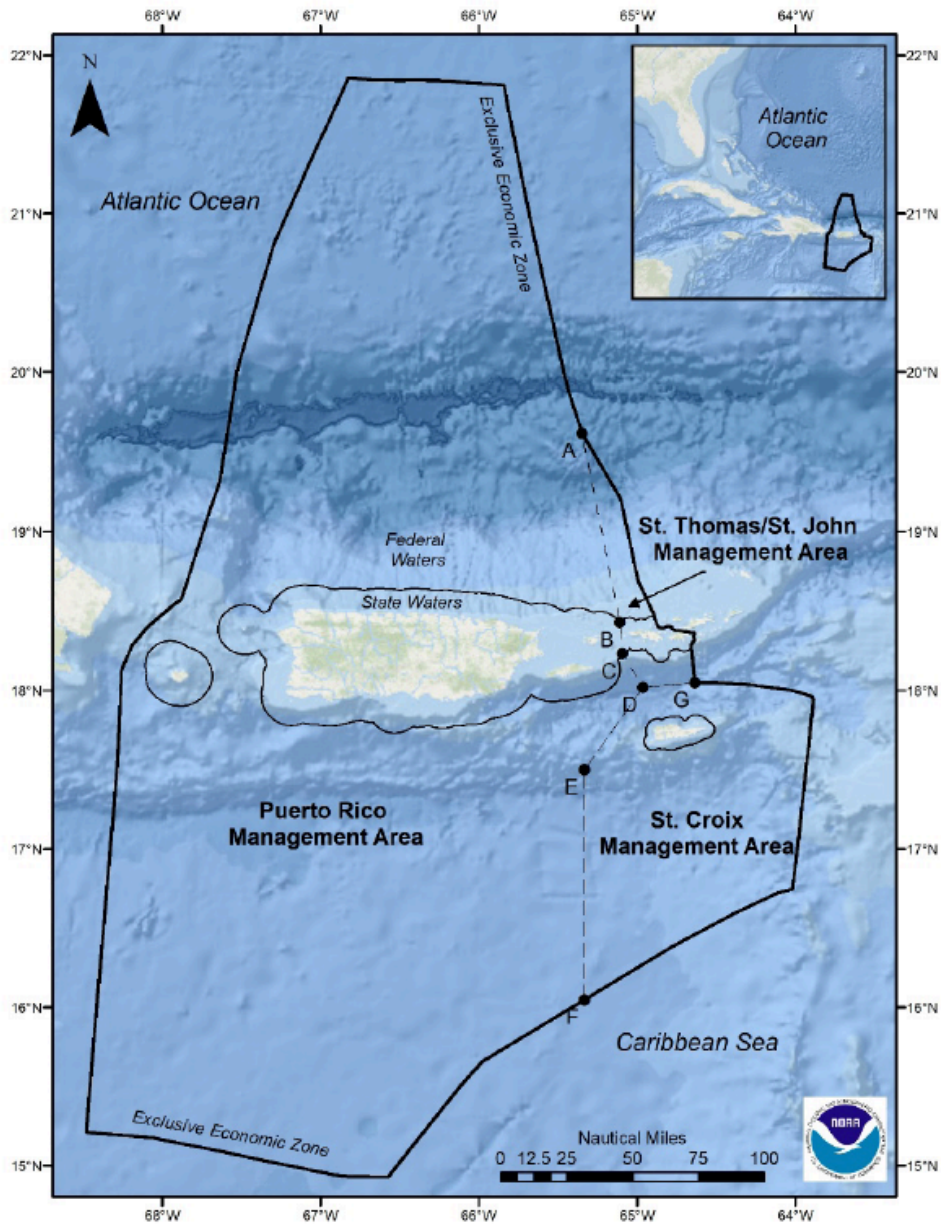


Figure 2: U.S. Caribbean Exclusive Economic Zone (EEZ) map showing areas in which Fishery Management Plans (FMPs) and Essential Fish Habitat (EFH) designations are applicable (NOAA, 2021).

Endangered Species Act 1973

The Endangered Species Act (ESA) provides protection for species that are endangered or threatened throughout areas they occupy and extends protection to their habitats (ESA Section 2 & Section 3). NOAA NMFS and the U.S. Fish and Wildlife Service (USFWS) implement and ensure ESA goals are met (SAFMC, 2021). NMFS focuses primarily on the marine environment, while the USFWS is responsible for freshwater and terrestrial species.

- Critical Habitat: Critical habitat is defined under section 3(5)(a) of the ESA as specific areas occupied by species at the time that it is listed and areas that contain physical or biological features essential to the conservation of endangered or threatened species and which may require special management considerations. It also includes specific areas outside the geographic area occupied by the species at the time it is listed that are essential to the conservation of the species (16 USC §1531(5)(a)). ESA Section 7 requires consultation by NMFS or USFWS to ensure federal actions authorized will not jeopardize the continued existence of listed species or adversely modify designated critical habitats (16 USC §1533(a)(2)). Activities that would be considered a threat to the listed species are those that destruct or adversely modify a critical habitat or that “appreciably diminish the value of critical habitat for both the survival and recovery” (50 CFR § 402.02). The designation of critical habitat protects the area by ensuring that federal activities do not destroy or adversely modify the area designated as critical habitat.
 - *Sargassum* is listed as an essential feature of critical habitat for the endangered loggerhead sea turtle (*Carretta carretta*, see Table 2) and is proposed for green sea turtles (*Chelonia mydas*) by NMFS (88 FR 46572). For the loggerhead sea turtle, the Distinct Population Segment (DPS) within the Northwest Atlantic Ocean (defined as north of the equator, south of 60 N.latitude, and west of 40 W.longitude) includes areas containing nearshore reproductive habitat, wintering area, breeding areas, migratory corridors, essential features, and *Sargassum* habitat (79 FR 39856, 2014). The critical habitat designation is split in two different units for the Gulf of Mexico and the Atlantic Ocean distributions of *Sargassum* due to migratory patterns of loggerheads. In the Atlantic DPS, *Sargassum* habitat extends from 10 m of depth to the outer boundary of the EEZ starting at waters south of 40° N. The Western Gulf of Mexico unit covers the eastern edge of the Loop Current, again from the 10 m depth contour to the outer boundary of the EEZ. These areas contain restrictions to harvest and activities in the area should consider impact to critical habitats. *Sargassum* provides important foraging and roosting habitat for many coastal dependent shore and water birds such as for Piping Plovers (*Charadrius melodus*) and Rufa Red Knot (*Calidris canutus rufa*) especially once it reaches the intertidal zone. In addition, *Sargassum* can serve as habitat for post-hatchling sea turtles that get washed back on the shore with *Sargassum*. Removal of *Sargassum* may be detrimental to all these species of birds. Any federal action to collect *Sargassum* on the shoreline/beach would require a Section 7 consultation with the USFWS.
 - NMFS and USFWS share jurisdiction overseeing sea turtle conservation; with NMFS focusing on the marine environment and USFWS focusing on land. The terrestrial critical habitat designations from USFWS are nesting beaches in the states of North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi, and are detailed in Table 2 (79 FR 39756). Of these regions, *Sargassum* landings have predominantly been recorded in Florida.

Table 2: Critical habitat for the Northwest Atlantic (NWA) Distinct Population Segment (DPS) of loggerhead sea turtles (70 FR 39856; 79 FR 39756).

Critical Habitat (Marine) NMFS (79 FR 39856)	Critical Habitat (Terrestrial) USFWS (79 FR 39756)
<ul style="list-style-type: none"> ● Northwest Atlantic Ocean DPS region containing: Nearshore reproductive habitat (nearshore reproductive areas, the areas extend directly from the mean high water (MHW) line datum at each end of the area seaward 1.6 km), winter area, breeding areas, constricted migratory corridors, and/or <i>Sargassum</i> habitat. ● <i>Sargassum</i> Habitat NWA: Extends starting from 10 m of depth from shore to the EEZ starting at waters south of 40° N. ● <i>Sargassum</i> Habitat Gulf of Mexico: Extends starting from 10 m of depth from shore to the EEZ starting at waters south of 40° N. 	<ul style="list-style-type: none"> ● North Carolina: Brunswick, Carteret, New Hanover, Onslow, and Pender Counties. ● South Carolina: Beaufort, Charleston, Colleton, and Georgetown Counties. ● Georgia: Camden, Chatham, Liberty, and McIntosh Counties. ● Florida: Bay, Brevard, Broward, Charlotte, Collier, Duval, Escambia, Flagler, Franklin, Gulf, Indian River, Lee, Manatee, Martin, Monroe, Palm Beach, Sarasota, St. Johns, St. Lucie, and Volusia Counties. ● Alabama: Baldwin County. ● Mississippi: Jackson County.

Harmful Algal Blooms and Hypoxia Research and Control Act 1998

The severity of Harmful Algal Blooms (HABs) in the U.S. prompted Congress to authorize and implement the Harmful Algal Blooms and Hypoxia Research and Control Act (HABHRCA). HABHRCA created a mandate and financial support for NOAA to monitor, assess, predict, and respond to HABs. A HAB occurs when phytoplankton or macroalgae reach concentrations “resulting in nuisance conditions or harmful impacts on marine and aquatic ecosystems, coastal communities, and human health through the production of toxic compounds or other biological, chemical, and physical impacts” (§4008, HABHRCA, Amended 2017). Rafts of *Sargassum* can be considered a HAB when there are negative implications for surrounding environments (Anderson et al., 2019). NOAA considers *Sargassum* a HAB when large accumulations along the shoreline have negative impacts as delineated in part I.

Coastal Zone Management Act 1972

The National Coastal Zone Management Program comprehensively addresses the nation’s coastal issues through a voluntary partnership between the federal government and coastal and Great Lakes states and territories. Authorized by the Coastal Zone Management Act of 1972 (CZMA), the program provides the basis for protecting, restoring, and responsibly developing our nation’s diverse coastal communities and resources. While state and territorial partners must follow basic requirements, the program also gives them the flexibility to design individual programs that best address their coastal challenges. By leveraging both federal and state expertise and resources, the program strengthens the capabilities of each to address coastal issues.

Under the CZMA, NOAA provides financial and technical assistance to U.S. states and territories impacted by *Sargassum*, enhancing their capability to take mitigation actions and manage impacts. Since coastal impacts of *Sargassum* occur in state and territorial waters and shoreline areas, the partnership with NOAA under the CZMA is key to ensuring states and territories have resources, policies, and capabilities to address the impacts.

The Robert T. Stafford Disaster Relief and Emergency Assistance Act 1988

The Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) provides a means of federal assistance to local and state governments to alleviate suffering and damage from disasters. Under the Stafford Act, FEMA responded to the USVI SIE in 2022.

Other U.S. Agencies involved in *Sargassum* management

This section is not intended to be a comprehensive list of U.S. government agencies that are or may be engaged in activities involving *Sargassum*. The agencies that have been included are those considered by the authors to have key statutory authorities that are the most relevant to the purpose of this document.

- U.S. Army Corps of Engineers (USACE): In U.S. States and U.S. Caribbean territories, any *Sargassum* mitigation structures deployed within navigable waters up to the mean high water mark require permitted approval by the USACE through Section 10 of the Rivers and Harbors Act of 1899. The party of interest would need an “Individual Permit” or “General Permit” from USACE. While there is no USACE Nationwide Permit (NWP) or specific procedures that involve the removal of *Sargassum*, two of the available permits may be modified for *Sargassum* purposes. These are 1) Nationwide Permit 20, Response Operations for Oil or Hazardous Substances and 2) Nationwide Permit 38, Cleanup of Hazardous and Toxic Waste. Land removal of *Sargassum* may also require a USACE permit through Section 404 of the Clean Water Act if the activity or structure is within waters of the U.S. up to the high tide line and if they result in discharge of fill material. Some manual removal activities (rakes, wheelbarrows or handheld nets) on the beach do not require a permit.
- Environmental Protection Agency (EPA): Some private entities have expressed an interest in transporting *Sargassum* to the deep sea as a means of disposal, as well as carbon sequestration. Naturally, *Sargassum* connects surface and benthic production (Baker et al., 2017). However, once *Sargassum* has beached and begun decomposition, the impacts of reintroduction on the deep-sea environment are unknown. The dumping of *Sargassum* poses a great risk to deep-sea communities and is considered unlawful without a permit under the Marine Protection Research and Sanctuaries Act (MPRSA), also known as the Ocean Dumping Act, that considers *Sargassum* a “non-dredged material”. However the EPA can provide a permit to put *Sargassum* back in the ocean under Section 1412 of the MPRSA. Additionally, the Resource Conservation and Recovery Act (RCRA) outlines a framework for a national system of solid waste management in the U.S. Non-hazardous solid waste, including cellulosic material, is regulated under Subtitle D of RCRA. Regulations established under Subtitle D ban open dumping of waste and set minimum federal criteria for the operation of municipal waste and industrial waste landfills, including design criteria, location restrictions, financial assurance, corrective action (clean-up), and closure requirement. States play a lead role in implementing these regulations and may set more stringent requirements. In absence of an approved state program, the federal requirements must be met by waste facilities. Furthermore, the Federal Water Pollution Control Act (Clean Water Act or CWA), requires water quality standards for all Waters of the United States, including coastal waters. When the designated uses, including recreation and aquatic life, under those standards are impaired, these waters should be listed and plans developed to restore the uses. SIEs have the potential to cause or contribute to the cause of impairment of recreational

and aquatic life uses in coastal waters and such restoration plans under the CWA may be required.

- Federal Emergency Management Agency (FEMA): While FEMA does not have an official management capacity for *Sargassum*, they may be called to facilitate emergency responses to SIEs. For example, on July 22, 2022, several FEMA management teams reached out to NOAA for subject matter expertise to assist with an SIE that threatened the only seawater desalination and water treatment plant on the island of St. Croix, USVI. On July 24th the USVI Governor issued an Emergency Declaration as the impairment in potable water supply threatened public safety. In response to this unprecedented event, President Biden issued an Emergency Declaration under the Stafford Act. NOAA assisted with the effort by bringing together expertise from across the agency, including staff from the Atlantic Oceanographic and Meteorological Laboratory (AOML) and the Caribbean, Gulf of Mexico, Atlantic OceanWatch Node of the NOAA CoastWatch program (a.k.a. “CoastWatch”, housed within the National Environmental Satellite, Data, and Information Service (NESDIS) Center for Satellite Applications and Research (STAR) with regional and thematic Node partners across NMFS, NOS, NWS, and OAR), NCCOS, Office of Response and Restoration (OR&R), the Disaster Preparedness Program (DPP), and the Emergency Response Division (ERD). The situation was resolved by August 11, 2022 (NOAA, USVI 2022 Sargassum Event After-Action Report).
- Other parties involved in the U.S. Caribbean: In the USVI, removal of *Sargassum* from beaches requires permission based on non-mechanized or mechanized methods of removal and environmental considerations. Interested parties consult with the USVI Department of Planning and Natural Resources (DPNR). Additionally, DPNR works closely with USFWS for consultations. The Department of Natural and Environmental Resources (DNER) of Puerto Rico is the primary agent that manages removal of *Sargassum* from nearshore waters and beaches. In 2015, the DNER published a protocol for *Sargassum* management. Subsequently, the CFMC provided a template of this protocol to be utilized by its Member States (CFMC, 2016). In 2023, the DNER published a revised and expanded version of the protocol, which includes specific management and monitoring strategies for Puerto Rico (DNER, 2023). Recently, there has been an effort to clarify the legal regime for *Sargassum* management in Puerto Rico in order to improve the governmental, private, and civil responses to Sargassum events (León-Pérez et al., 2024).

Notes on international efforts

The Sargasso Sea lies primarily in the high seas, in areas beyond national jurisdiction (Sapsford, 2022). The Sargasso Sea Alliance was formed to bring interested governments together to manage and conserve the area. In March 2014, the governments of the Azores, Bermuda, Monaco, the United Kingdom, and the U.S. signed the Hamilton Declaration. It has subsequently also been signed by Canada, the British Virgin Islands, the Bahamas, the Cayman Islands, and the Dominican Republic. This document is a non-binding political statement establishing the Sargasso Sea Commission (SSC) to “facilitate voluntary collaboration toward the conservation of the Sargasso Sea” (Hamilton Declaration, 2014). The Declaration also established the Sargasso Sea as an “Area of Collaboration,” with the exclusion of Bermuda's EEZ. The SSC exercises a stewardship role for the Sargasso Sea by keeping its health, productivity, and resilience under continual review. Its current work program includes two main

projects: the Sargasso Sea Project, funded by the Global Environment Facility, and the SARGADOM project, funded by the French Facility for Global Environment.

The Cartagena Convention is a regional legal agreement for the protection and development of the marine environment of the Wider Caribbean Region (WCR). The United States is a Party to the Convention and its Protocols. The *Sargassum* working group under the Convention's Protocol on Specially Protected Areas and Wildlife has started to survey all Parties to the Convention about how *Sargassum* affects management practices for threatened and endangered species, marine protected areas, and coastal areas. Taking into account the findings of the survey and additional consultations, the working group will update and prioritize an action plan on *Sargassum* inundation for the Cartagena Convention. NOAA participates in the *Sargassum* working group and will participate in the development and implementation of the action plan.

The International Committee for the Conservation of Atlantic Tuna (ICCAT) recognizes the importance of *Sargassum* and the Sargasso Sea as habitat for highly migratory species (e.g., tunas, billfishes), and has incorporated this into management approaches (Luckhurst, 2015).

III. NOAA's role and capabilities

NOAA's Southeast and Caribbean Regional Team (SECART) is one of eight regional collaboration teams focused on coordinating and facilitating collaborations across NOAA's line offices and partners to improve services provided to communities within the region. In 2023, reports of a *Sargassum* "blob" that was expected to wash up on beaches in U.S. states and territories made headlines. In response, SECART initiated a series of meetings to bring together NOAA personnel with expertise in *Sargassum* monitoring, response, and research. From this series of meetings came a number of actions including 1) creating an inventory of the NOAA offices, programs, and points-of-contact (POCs) that cover *Sargassum*, and 2) developing a series of products to further the coordination among the offices, programs, and POCs.

One product included developing a new section on *Sargassum* for the [Guide to Integrated NOAA Disaster Resilience in the Southeast and Caribbean](#) ("the Guide"). The Guide is designed to enhance coordination of NOAA's diverse expertise, services, and resources when preparing for, responding to, or recovering from a natural or anthropogenic emergency that involves a threat or damage to human health or life, to property, or to the environment. In addition, the Guide is intended to help raise awareness of NOAA roles and responsibilities and promote coordination during these events with NOAA partners. The *Sargassum* section includes contact information on NOAA line offices involved in the preparation, response, and recovery to *Sargassum* disaster events.

An additional product that came out of these meetings included SECART and NCCOS taking the initiative to prepare this Policy Analysis and Agency Gaps Assessment paper in an effort to provide an overview of different management and regulatory jurisdictions surrounding *Sargassum*. Below is a summary of the main NOAA roles related to *Sargassum* and the NOAA line and program offices that are involved in several aspects of *Sargassum* management (see also Table 3).

Tracking and Monitoring

- [Sargassum Inundation Risk \(SIR\) maps](#): NOAA's Atlantic Oceanographic and Meteorology Laboratory (AOML), the NOAA NESDIS CoastWatch, and USF partnered to create the [Sargassum Inundation Risk \(SIR\) product](#) (Figure 3). AOML and CoastWatch, in partnership with the University of South Florida, apply satellite-based sensors with the capability of detecting *Sargassum* and use these results to improve the value of the SIR maps (Putman et al., 2023). They aim to identify how *Sargassum* extends over the Caribbean, Gulf of Mexico, and South Florida in real time, and to improve inundation risk assessment through monitoring winds, ocean currents, and waves. Additionally, in cooperation with NESDIS CoastWatch, AOML developed a citizen science [form](#) for beach users to report *Sargassum*. NOAA's Integrated Ocean Observation System (IOOS) works closely with these partners to improve tools used for forecasting. IOOS contains real-time imaging and works across 11 regional associations.

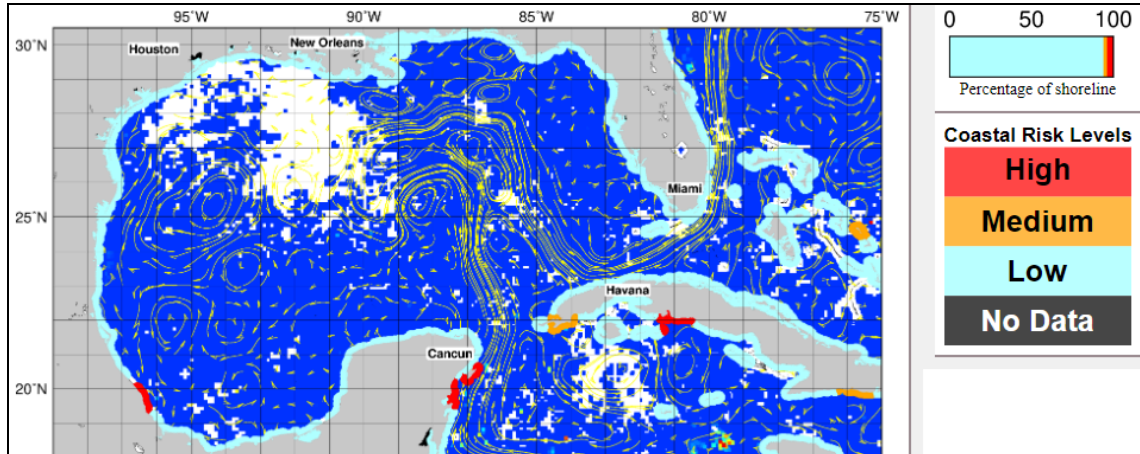


Figure 3: Satellite-based *Sargassum* Watch System (SaWS) in the Gulf of Mexico developed by University of South Florida, NASA, and NOAA partners.

- [Caribbean *Sargassum* Tracker](#): In the U.S. Caribbean, the Caribbean Coastal Ocean Observing System (CARICOOS) is the regional association for IOOS that is responsible for coastal and ocean observations in Puerto Rico and the USVI. CARICOOS uses remote sensing technologies to track *Sargassum* in the U.S. Caribbean. The information produced is available for stakeholders to utilize in management of marine resources, food security, ecosystem health, and economic interests. The website shows real time *Sargassum* distributions in coastal areas of the U.S. Caribbean.

Scientific Research

NCCOS, within NOS, is charged with researching solutions to address issues affecting coastal waters. Using both internal and external expertise, NCCOS has capabilities to assess ecological and socioeconomic impacts of *Sargassum* inundations. Under the authority provided by HABHRCA, NCCOS also provides federal funding support to extramural partners to conduct scientific research on HABs. NCCOS currently leads the implementation of the HAB Interagency Working Group (IWG) that coordinates the activities of the federal agencies working on HAB related issues. The Interagency Working Group for HABHRCA occurs on a bi-monthly basis and the Ad Hoc *Sargassum* group meets on a monthly basis to highlight new developments in *Sargassum* research and share resources.

Fisheries Management

NMFS is charged with overseeing fisheries issues backed by sound science and an ecosystem-based management approach. These are applicable for *Sargassum* through FMP/EFH designations and through ESA designated critical habitats for listed species. In addition to the overview in Section 2 of MSA and ESA, which NMFS is the regulatory agency for, outlined in an [FAQ](#) from the NMFS Southeast Regional Office.

Event Response and Coordination

OR&R, within NOS, contains the Emergency Response Division (ERD) that should be contacted when significant coastal weather events have occurred and when there is risk of oil or hazardous materials being released in coastal or inland waterways. In 2023, OR&R put together the [Oil Spills & Pelagic *Sargassum* Report](#). This reference, intended for oil spill response planners and scientists, builds upon

work within NOAA at the intersection of *Sargassum* ecology and oil spill response. The Office for Coastal Management (OCM), also within NOS, works with coastal states and territories in the development and implementation of their coastal zone management plans to support the management of coastal resources. As such, OCM could provide guidance in updating plans to incorporate protocols for SIE response. In addition, NCCOS administers the HAB Event Response Program, which provides short term immediate funding or other forms of support to resource managers and researchers during the response to HAB events for collecting data that could be used to better understand the dynamics and impacts of HAB events.

Table 3: NOAA efforts related to *Sargassum*

Effort	Category	NOAA Line Office and Program Offices	<i>Sargassum</i> effort
Research	Social	NOS:NCCOS	Impacts of <i>Sargassum</i> in the Caribbean.
Research	Chemical	NOS:NCCOS	Detecting and analyzing chemical contaminants in <i>Sargassum</i> from Puerto Rico, USVI, and FL.
Research	Ecological/Habitat value	NOS:NCCOS, OAR:AOML	University of Southern Mississippi and USF work on evaluating <i>Sargassum</i> 's role as a fish nursery in the Gulf of Mexico. Research aimed at understanding ecological impacts of inundations through NOAA line offices. Research underway to improve assessment of inundation risk. Habitat sensitivity to beached <i>Sargassum</i> is also being investigated.
Research	Monitoring/Forecasting	OAR:AOML, NESDIS:CoastWatch, NOS: IOOS-CARICOOS	Projects to quantify <i>Sargassum</i> biomass, hypoxia and acidification levels in reef and nearshore mangrove environments.
Research	Modeling	NOS:OR&R, IOOS, NESDIS:STAR	Satellite imagery efforts to forecast <i>Sargassum</i> Inundation Events (SIEs) with some satellite data obtained through CoastWatch.
Response and Coordination	Disaster Support	NOS:OR&R NESDIS:OSPO	Primarily for oil and hazardous materials with support from NESDIS Marine Pollution satellite products
Response and Coordination	Interagency Coordination	NOS:NCCOS (leads IWG-HABHRCA)	Interagency working group that shares updates on <i>Sargassum</i> efforts between EPA, NASA, and FEMA
Response and Coordination	State/Local Partner Coordination	NOAA SECART	Coordinate across NOAA when needed.
Response and Coordination	HAB Research/Response	NOS:NCCOS	Immediate support to help manage events and advance the understanding of HABs as they occur.
Communications and Outreach	Guidance Material	NOS:IOOS OAR:AOML NESDIS:CoastWatch	Develop guidance on <i>Sargassum</i> FAQ and publish educational resources

IV. Gaps in U.S. *Sargassum* policy

In the open ocean, *Sargassum* is not an imminent threat to coastal communities or aquatic ecosystems. Rather, it functions as EFH, acting as a nursery and supporting a highly productive ecosystem (Witherington et al., 2012). Complexity within current policy begins once *Sargassum* approaches coastal and inshore environments, potentially transitioning to a HAB and producing undesirable effects (van Tussenbroek et al., 2017). As *Sargassum* moves closer to shore, it loses its EFH attributes (those necessary to fish for spawning, feeding, breeding, or growth to maturity). This distinction is key to management within the current legislative framework: at what point does *Sargassum* cease to be EFH and transition to a HAB? Stemming from this overarching question, there are several considerations NOAA should account for when making policy decisions and management plans.

1. Due to overlapping jurisdictions and designations, addressing *Sargassum* requires navigating complex legal frameworks for coastal managers

Federal consultations are required for actions that may adversely impact EFH, designated critical habitat, or associated Endangered Species (ESA, Section 7(a); 16 U.S.C. 1535, MSA § 305; 104-297(b)(2), see Table 4). These rules vary regionally in state and federal waters. For example, in the USVI, the CFMC has identified *Sargassum* as EFH for selected species, which may require an EFH consultation for federal agencies with NOAA when conducting removal activities. For *Sargassum* removal in Florida, the take of sea turtles is prohibited under Section 9 of the ESA. Habitat modification during removal can be a form of take in the EEZ: acquisition of an incidental take permit is recommended due to the listed species and not the critical habitat. Both examples may require USACE consultation. The USACE is the federal regulator in permitting work done in navigable waters that may cause navigational hazards, such as booms, to collect *Sargassum*. USACE's area of jurisdiction extends to the high tide line, requiring permitting for onshore removal. NOAA must be contacted if the USACE decides consultation is needed. These jurisdictions make swift response to an SIE in state and federal waters difficult. The multiple legal designations of *Sargassum* circle back to the question: how can we address *Sargassum* when it is both EFH and a HAB? NOAA should build a basis of scientific knowledge on *Sargassum*, including its ecology, observation and monitoring requirements, and associated environmental factors in order to inform these policy questions.

In recent years, SIEs have been approached with varying management practices. Other countries in the Caribbean deploy barriers or boom devices to contain *Sargassum* from reaching the shore. However, implications for the environment, habitat, and endangered species from these nearshore clean-up methods are unknown and require further research. One question that arises once *Sargassum* approaches the shore: what is the scientific and ecological basis for prohibiting harvest of a large SIE that is within 100 mi from shore and approaching commercially valuable fisheries and/or coastal communities? NOAA has valuable partnerships with universities to conduct funded research. NOAA should engage in research with partners to study the benefits or disadvantages of using *Sargassum* barriers and other methods of deterrence and removal.

Moreover, state and territory approaches vary with different resources available for clean-ups. Approaches to clean-ups are site specific and can become both costly and a health concern for the public. Once *Sargassum* is beached on shore, impacted states have primary jurisdiction managing *Sargassum* clean-ups. Scientific support is available from various NOAA offices and other federal

agencies, though consulting with the agencies is not required. USFWS may work with local municipalities to manage clean-up on beaches. NOAA should explore how to help streamline onshore cleanup. This includes developing efficient onshore clean-up methods/protocols while taking into account impacts on coastal ecology. The assessment of SIEs impacts to human health on both the public and workers involved in clean-up efforts is another aspect that should be addressed by local, state/territory, and federal public health agencies.

Several Caribbean agencies have developed best management practices, documents and methods to guide efficient removal of *Sargassum* from nearshore environments. For example, the Caribbean Regional Fisheries Mechanism, an intergovernmental organization with its mission being “to promote and facilitate the responsible utilization of the region's fisheries and other aquatic resources for the economic and social benefits of the current and future population of the region”, has created a model protocol for the management of *Sargassum* aggregations (CRFM, 2016). There are policies on *Sargassum* management that establish regulatory frameworks to serve conservation efforts in the Greater Antilles region and Mexican Caribbean (Rossignol, 2022). There are additionally consolidated best practices for management and response in the Dutch Caribbean (Dutch Caribbean Nature Alliance, 2019). These methods generally consider both nearshore and offshore management of *Sargassum* and take into account impacts on threatened species such as loggerhead hatchlings.

There is currently no analogous document that stakeholders (states, municipalities, property owners) in U.S. states and territories can reference when navigating the multiple legal jurisdictions for SIEs. León-Pérez et al. (2024) recently published a paper aimed at clarifying the *Sargassum* legal framework in Puerto Rico, concluding barriers to effective mitigation include a lack of information and clarity in permitting processes. NOAA has various resources across the agency's entire website relating to *Sargassum* facts and NOAA's efforts. However, NOAA should explore developing a clear protocol, standard operating procedure, or best practices document to aid coordination. This will help coastal managers respond to beaching events in compliance with the varied designations related to *Sargassum*.

Additionally, NOAA is not the only federal agency addressing *Sargassum*. The USFWS as well as state/territory and local agencies all hold different approaches and resources that cause confusion in addressing SIEs among stakeholders and managers alike.

Table 4: The different legal policies and mandates directly applied to *Sargassum*.

Policy/ Mandate	Action/Description	NOAA's Role	Agency Involved
MSA, <i>Sargassum</i> as EFH	Listed as SAFMC managed species and EFH in the South Atlantic, Gulf of Mexico, and U.S. Caribbean.	Oversee establishment of the EFH through research and scientific support. Evaluate the impacts of federal activities on EFH. Work with Regional FMCs on developing management plans.	NOAA:NMFS:Regional FMCs
MSA, FMP for <i>Sargassum</i>	Prohibits harvest of <i>Sargassum</i> year round, except for beyond the 100 mi and between Virginia/NC border and NC/SC border.	Work with SAFMCs on developing management plans.	NOAA: NMFS:SAFMC
ESA, Critical Habitat	Establishes critical habitat for loggerhead sea turtles in Northwest Atlantic DPS and Gulf of Mexico that contain reproductive habitat, winter area, breeding areas, migratory corridors, and <i>Sargassum</i> habitat. <i>Sargassum</i> can also serve as habitat for Piping Plovers and Rufa Red Knot when <i>Sargassum</i> is washed up on the shoreline.	Implement and provide scientific support for ESA consultations regarding the species or its designated critical habitat.	NOAA: NMFS, USFWS
HABHRCA	Funds research to develop prevention, control, and mitigation of HABS	Develop research for monitoring	NOAA:NCCOS, NESDIS, OAR:AOML
The Clean Water Act Section 404 The Rivers and Harbors Act Section 10	Structures associated with <i>Sargassum</i> control (including but not limited to booms or barriers) and some onshore removal equipment within coastal USACE jurisdiction may require permits.	Not applicable	USACE
MPRSA	Permits are required for the transportation of material for dumping in ocean water.	Not applicable	EPA
RCRA	Regulations affecting disposal or combustion of non-hazardous waste need to be considered and recommendations offered.	Not applicable	EPA

2. There is no formal intra-agency (within NOAA) or interagency group to respond in the event of a large-scale SIE

The lack of formal coordination from the U.S. government ultimately affects coastal communities. There is a broad understanding on different jurisdictions of *Sargassum*; however, there needs to be more information on how these can be interpreted in the event of a disaster or large-scale inundation event with a clear outline of how different agencies should respond to an SIE. Within NOAA, several offices and programs have the authority to respond or assist with *Sargassum* inundation. NOAA should establish a clear point-of-contact through which response activities can be routed. Although OR&R is designated to respond to the release of “hazardous materials”, it is unclear if this extends to SIEs. Moreover, the U.S. government lacks communication among different efforts aiming to address SIEs. While many discussions are held via interagency working groups, NOAA should develop a proactive plan for SIE response specifically. Although many government actions regarding these events are on a case-by-case basis, this leaves agencies ill-prepared for handling an SIE that becomes a disaster. Furthermore, NOAA should consider a cohesive data management plan to ensure that any NOAA-collected data applied to management decisions is preserved in the event of a large-scale *Sargassum* event. This data management plan must be in accordance with NAO 212-15, providing for publicly available data, and include clearly defined roles, responsibilities, and timelines for long term preservation and access to event-specific data collections.

It should be noted that although coordination may be effective once the disaster has occurred, NOAA should proactively designate a “task force” or similar entity that immediately helps facilitate communication and then sustain coordination. As the co-chair of the IWG-HABHRCA, NOAA should encourage cross-agency coordination on *Sargassum* management.

Conclusion

Federal regulatory frameworks have been primarily developed to protect and conserve *Sargassum*, but many such regulations may no longer be in the best interest of natural resource conservation as SIE events continue to arise each year. Additionally, the regulatory framework surrounding *Sargassum* is often questioned during SIEs due to the varying regulations that apply to *Sargassum* based on its geographic location. NOAA should establish clear guidelines for addressing harmful *Sargassum* Inundation Events. Such guidelines would take into account FMPs, state/territory and local authorities, critical habitat designations, socioeconomic impacts, best management practices, and relevant research to coordinate response in a large-scale inundation event. As noted in the foreword, NOAA acknowledges these issues and is in the process of reconciling the gaps listed in this document.

References

- Anderson, C.R., Berdalet, E., Kudela, R.M., Cusack, C.K., Silke, J., O'Rourke, E., Dugan, D., McCammon, M., Newton, J.A., Moore, S.K., Paige, K., Ruberg, S., Morrison, J.R., Kirkpatrick, B., Hubbard, K., & Morell, J. (2019) Scaling up from regional case studies to a global harmful algal bloom observing system. *Frontiers in Marine Science*, 6. <https://doi.org/10.3389/fmars.2019.00250>
- Baker, P., Minzlaff, U., Schoenle, A., Schwabe, E., Hohlfeld, M., Jeuck, A., Brenke, N., Prausse, D., Rothernbeck, M., Brix, S., Frutos, I., Jörger, K.M., Neusser, T.P., Koppelman, R., Devey, C., Brandt, A., & Arndt, H. (2017) Potential contribution of surface-dwelling *Sargassum* algae to deep-sea ecosystems in the southern North Atlantic. *Deep Sea Research Part II: Topical Studies in Oceanography*, 148, 21–34. <https://doi.org/10.1016/j.dsr2.2017.10.002>
- Casazza, T. L., & Ross, S.W. (2008) Fishes associated with pelagic *Sargassum* and open water lacking *Sargassum* in the Gulf Stream off North Carolina. <http://fishbull.noaa.gov/1064/casazza.pdf>
- CBS News. (2023) Massive clumps of seaweed from a giant blob are washing up on Florida beaches. 01 May 2023. <https://www.cbsnews.com/news/florida-beaches-seaweed-sargassum-clumps-giant-blob/>
- Crabtree, Roy E. (2011) Comprehensive ecosystem-based amendment 2 for the South Atlantic region : amendment 7 to the fishery management plan for coral, coral reefs, and live/hard bottom habitats of the South Atlantic region; amendment 23 to the fishery management plan for the snapper grouper fishery of the South Atlantic region; amendment 21 to the fishery management plan for the coastal migratory pelagic resources in the Atlantic and Gulf of Mexico; amendment 1 to the fishery management plan for the pelagic *Sargassum* habitat of the South Atlantic Region. <https://doi.org/10.25923/yfyg-p416>
- CRFM (2016) Model Protocol for the Management of Extreme Accumulations of *Sargassum* on the Coasts of CRFM Member States. *Technical & Advisory Document*, 2016/5.
- Dutch Caribbean Nature Alliance (2019) Prevention and clean-up of *Sargassum* in the Dutch Caribbean. Bonaire, Dutch Caribbean, Dutch Caribbean Nature Alliance. <http://dx.doi.org/10.25607/OBP-796>
- Doyle, E. & Franks, J. (2015) *Sargassum* Fact Sheet. Gulf and Caribbean Fisheries Institute. <https://www.gcfi.org/wp-content/uploads/2017/02/GCFISargassumFactSheet.pdf>
- Endangered Species Act. Section 2; Findings, Purposes, and Policy. 16 U.S.C. §§ 1531-1544.
- Endangered Species Act. Section 3 Definition. Critical Habitat (5)(a). 16 USC §1531(5)(a).
- Endangered Species Act. Section 7. Interagency Cooperation. Consultations 16 USC §1533(a)(2))

Endangered Species Act. Section 7. Definitions. Action 50 CFR § 402.02

Essential Fish Habitat Final Rule. Definition. 50. C.F.R. 600.10.

Federal Register. (2023) Department of Commerce. Endangered and Threatened Wildlife and Plants: Proposed Rule To Designate Marine Critical Habitat for Six Distinct Population Segments of Green Sea Turtles. 88 FR 46572.
<https://www.govinfo.gov/content/pkg/FR-2023-07-19/pdf/2023-14109.pdf>

Fish and Wildlife Service, Interior. (2014) Endangered and Threatened Species: Critical Habitat for the Northwest Atlantic Ocean Loggerhead Sea Turtle Distinct Population Segment (DPS) and Determination Regarding Critical Habitat for the North Pacific Ocean Loggerhead DPS. NOAA NMFS. 79 FR 39856.

Fish and Wildlife Service, Interior. (2014) Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Northwest Atlantic Ocean Distinct Population Segment of the Loggerhead Sea Turtle; Correction. 2014. Fish and Wildlife Service, Interior. 79 FR 39756.

Fisheries of the Caribbean, Gulf of Mexico, and Atlantic (2003) Pelagic *Sargassum* Habitat of the South Region. Rule by NOAA. 68 FR 57375.

Fisheries of the Caribbean, Gulf of Mexico, and Atlantic (2011) Comprehensive Ecosystem-Based Amendment 2 for the Atlantic Region. Essential Fish Habitat. 76 FR 82183.

Godínez-Ortega, J. L., Cuatlán-Cortés, J. V., López-Bautista, J. M., & van Tussenbroek, B. I. (2021) A natural history of floating *Sargassum* species (Sargasso) from Mexico. In, Hufnagel, L. (Ed.) Natural History and Ecology of Mexico and Central America, 59-94.

Gower, J. & King, S. (2019) Seaweed, seaweed everywhere. *Science*, 365, (6448), 27.
<https://doi.org/10.1126/science.aay0989>

Gulf of Mexico Fisheries Council (2016) Final Report 5-Year Review of Essential Fish Habitat Requirements.
https://gulfcouncil.org/wp-content/uploads/EFH-5-Year-Review-plus-App-A-and-B_Final_12-2016.pdf

Gulf of Mexico Fisheries Council (2022) Generic Amendment 5 to the Shrimp, Reef fish, Coastal Migratory Pelagics, Spiny Lobster, Coral, and Red Drum Fishery Management Plans of the Gulf of Mexico. https://gulfcouncil.org/wp-content/uploads/P-5-Draft_EFH_Generic_EA_1_14.pdf

Harmful Algal Bloom and Hypoxia Research and Control Act. 1998. 33 USC Ch. 53 Title 33. Sec. 4008

Hamilton Declaration. 2014. The Sargasso Sea Commission. 2014.

Hardouin, K., Bedoux, G., Burlot, A.S., Nyvall-Collen, P., & Bourgoignon, N. (2014) Enzymatic Recovery of Metabolites from Seaweeds: Potential Applications In, Jacquot, J. & Gada, P. (Ed.),

Advances in Botanical Research, 279-320. Academic Press.
<https://doi.org/10.1016/B978-0-12-408062-1.00010-X>

- Hernández, W. J., Morell, J. M., & Armstrong, R. A. (2022) Using high-resolution satellite imagery to assess the impact of Sargassum inundation on coastal areas. *Remote Sensing Letters*, 13(1), 24-34.
- Hu, C., Murch, B., Barnes, B.B., Wang, M., Marechal, J.P, Franks, J., Johnson, B., Lapoint, B., Goodwin, D.S., Schell, J.M., & Siuda A.N.S. (2016) *Sargassum* Watch Warns of Incoming Seaweed. *Eos*. 97, 10-15. <https://doi.org/10.1029/2016EO058355>
- Innocenti, R. A., Feagin, R. A., & Huff, T. P. (2018) The role of *Sargassum* macroalgal wrack in reducing coastal erosion. *Estuarine, Coastal and Shelf Science*, 214, 82-88.
<https://doi.org/10.1016/j.ecss.2018.09.021>
- Johns, E. M., Lumpkin, R., Putman, N. F., Smith, R. H., Muller-Karger, F. E., Rueda-Roa, D. T., Chuanmin, H., Wang, M., Brooks, M.T., Gramer, L.J., & Werner, F. E. (2020) The establishment of a pelagic *Sargassum* population in the tropical Atlantic: Biological consequences of a basin-scale long distance dispersal event. *Progress in Oceanography*, 182, 102269.
<https://doi.org/10.1016/j.pocean.2020.102269>
- Kumari, R., Kaur, I., & Bhatnagar, A. K. (2013) Enhancing soil health and productivity of *Lycopersicon esculentum* Mill. using *Sargassum johnstonii* Setchell & Gardner as a soil conditioner and fertilizer. *Journal of applied phycology*, 25, 1225-1235.
<https://doi.org/10.1007/s10811-012-9933-y>
- León-Pérez M., McLaughlin R., Gibeaut J., Carrubba L., Colón-Rivera R., & Esteves R. (2024) First steps towards untangling the sargassum legal regime in Puerto Rico. *Marine Policy*, 165, 106202. <https://doi.org/10.1016/j.marpol.2024.106202>.
- López-Sosa, L. B., Alvarado-Flores, J. J., Corral-Huacuz, J. C., Aguilera-Mandujano, A., Rodríguez-Martínez, R. E., Guevara-Martínez, S. J., Alcaraz-Vera, J., Guevara-Martínez, S.J., Zarate-Medina, J., Avalos-Rodríguez, M.L., & Morales-Máximo, M. (2020) A prospective study of the exploitation of pelagic *Sargassum* spp. as a solid biofuel energy source. *Applied Sciences*, 10(23), 8706. <https://www.mdpi.com/2076-3417/10/23/8706>
- Luckhurst, B.E. (2015) A preliminary food web of the pelagic environment of the Sargasso Sea with a focus on the fish species of interest to ICCAT. *Collect. Vol. Sci. Pap. ICCAT*, 71(6), 2913-2932.
- Magnuson-Stevens Fishery Conservation and Management Act, as amended 2007 (P.L. 109-479). Findings, Purposes, and Policy. 16 U.S.C. 1801 MSA § 2.
- Magnuson-Stevens Fishery Conservation and Management Act, as amended 2007 (P.L. 109-479). Fish Habitat. 16 U.S.C. 1855, MSA § 305; 104-297(b)(2)).

- Magnuson-Stevens Fishery Conservation and Management Act, as amended 2007 (P.L. 109-479).
Definitions. 16 U.S.C. § 1802 (10).
- Magnuson-Stevens Fishery Conservation and Management Act, as amended 2007 (P.L. 109-479).
Secretary and Councils identify EFH. 16 U.S.C. 1853 Sec. 303(a)(7).
- Magnuson-Stevens Fishery Conservation and Management Act, as amended 2007 (P.L. 109-479).
Federal agency consultations required in EFH. 16 U.S.C 1855 Sec. 305(b).
- Maurer, A.S., Stapleton, S.P., Layman, C.A., & Reiskind, M.O.B. (2021) The Atlantic *Sargassum* invasion impedes beach access for nesting sea turtles. *Climate Change Ecology*, 2, 100034.
<https://doi.org/10.1016/j.ecochg.2021.100034>
- NOAA OR&R. (2022) OR&R Supporting Response to *Sargassum* in St. Croix, U.S. Virgin Islands.
NOAA USVI 2022 *Sargassum* Event. After-Action Report/ Improvement Plan.
- Oviatt, C.A., Huizenga, K., Rogers, C.S., & Miller, W. J. (2019) What nutrient sources support anomalous growth and the recent *Sargassum* mass stranding on Caribbean beaches? A review. *Marine Pollution Bulletin*, 145, 517-525.
- Oxenford, H.A., Johnson, D., Cox, S.A., & Franks, J. (2019) Report on the Relationships Between *Sargassum* Events, Oceanic Variables, and Dolphinfish and Flying Fish Fisheries. University of the West Indies, submitted to the Food and Agriculture Organization of the United Nations (FAO) 32.
- Putman, N., Beyea, R.T, Iporac, L.A.R, Triñanes, J., Ackerman, E.G., Olascoaga, M.J., Appendini, C.M., Arriaga, J., Collado-Vides, L., Lumpkin, R., Ch. Hu, & Goni, G. (2023) Improving satellite monitoring of coastal inundations of pelagic *Sargassum* algae with wind and citizen science data. *Aquatic Botany*, 188(103672) <https://doi.org/10.1016/j.aquabot.2023.103672>.
- Resiere, D., Valentino, R., Nevière, R., Banydeen, R., Gueye, P., Florentin, J., Cabie, A., Lebrun, T., Megarbane, B., Guerrier, G., & Mehdaoui, H. (2018) *Sargassum* seaweed on Caribbean islands: an international public health concern. *The Lancet*, 392(10165), 2691.
[https://doi.org/10.106/S0140-6736\(18\)32777-6](https://doi.org/10.106/S0140-6736(18)32777-6)
- Rodríguez-Martínez R.E., Gómez Reali M.Á., Torres-Conde E.G., (2024) Bates M.N. (2024) Temporal and spatial variation in hydrogen sulfide (H₂S) emissions during holopelagic *Sargassum* spp. decomposition on beaches. *Environmental Research*, 247(118235).
<https://doi.org/10.1016/j.envres.2024.118235>.
- Rosellón-Druker, J., Calixto-Pérez, E., Escobar-Briones, E., González-Cano, J., Masiá-Nebot, L., & Córdova-Tapia, F. (2022) A review of a decade of local projects, studies and initiatives of atypical influxes of pelagic *Sargassum* on Mexican Caribbean coasts. *Phycology*, 2(3), 254-279.
<https://doi.org/10.3390/phycolgy2030014>
- Rossignol, L.J. (2022) *Sargassum* Systems: A Comparative Analysis of Policy Responses to the New

Caribbean Seaweed Crisis. *Wm. & Mary Env't L. & Pol'y Rev.*, 47, 517.

Sapsford, F. (2022) Sargasso Sea Commission. National Oceanic and Atmospheric Administration – Ocean Exploration. <https://oceanexplorer.noaa.gov/facts/high-seas-governance.html>

Secretariat of the Convention on Biological Diversity (2014) Ecologically or Biologically Significant Marine Areas (EBSAs): Special places in the world's oceans. Volume 2: Wider Caribbean and Western Mid-Atlantic Region.

Sissini, M.N., de Barros Barreto, M.B.B., Széchy, M.T.M., De Lucena, M.B., Oliveira, M.C., Gower, J., Liu, G., de Oliveira Bastos, E., Milstein, D., Gusmão, F. & Martinelli-Filho, J.E. (2017) The floating *Sargassum* (Phaeophyceae) of the South Atlantic Ocean—likely scenarios. *Phycologia*, 56(3), 321-328.

Smith, M.M. & Salmon, M. (2009) A comparison between the habitat choices made by hatchling and juvenile green turtles (*Chelonia mydas*) and loggerheads (*Caretta caretta*). *Marine Turtle Newsletter* 126:9–13.

South Atlantic Fishery Management Council (2003) Second Revised Final: Fishery Management Plan for Pelagic *Sargassum* Habitat of the South Atlantic Region. SAFMC.

South Atlantic Fishery Management Council and National Marine Fishery Service (2021) EFH Users Guide- Fishery Ecosystem Plan II. SAFMC.

The Weekly Journal (2021) PREPA: Sargassum 'Event' Took Unit 1 of Aguirre Powerplant Out of Operation. https://www.theweeklyjournal.com/business/prepa-sargassum-event-took-unit-1-of-aguirre-powerplant-out-of-operation/article_68bae5f0-1f8f-11ec-90b2-3fdb0aa76e5.html

Trinanes, J., Putman, N. F., Goni, G., Hu, C., & Wang, M. (2023) Monitoring pelagic *Sargassum* inundation potential for coastal communities. *Journal of operational oceanography*, 16(1), 48-59. <https://doi.org/10.1080/1755876X.2021.1902682>

United Nations Environment Programme- Caribbean Environment Programme (2021) Sargassum White Paper – Turning the crisis into an opportunity. Ninth Meeting of the Scientific and Technical Advisory Committee (STAC) to the Protocol Concerning Specially Protected Areas and Wildlife (SPA) in the Wider Caribbean Region. Kingston, Jamaica.

University of South Florida Optical Oceanography Laboratory (2023) Satellite-based *Sargassum* Watch System. <https://optics.marine.usf.edu/projects/SaWS.html>

U.S. Fish and Wildlife Service, Interior. Proposed Rule: Endangered and Threatened Wildlife and Plants; Regulations for Designating Critical Habitat. 16 USC §1533(a)(3)(A). 50 CFR Part 17.

Vandendriessche, S., Messiaen, M., O'Flynn, S., Vincx, M., & Degraer, S. (2007) Hiding and feeding in floating seaweed: floating seaweed clumps as possible refuges or feeding grounds for fishes.

Estuarine, Coastal and Shelf Science, 71(3-4), 691-703.
<https://doi.org/10.1016/j.ecss.2006.09.017>

Vital, V. (2024) Analysis of *Sargassum* policy and management in the U.S. Southeast Atlantic and Caribbean Region. Internship Report. University of Miami, Rosenstiel School of Marine, Atmospheric, and Earth Science.

Van Tussenbroek, B. I., Arana, H. A. H., Rodríguez-Martínez, R. E., Espinoza-Avalos, J., Canizales-Flores, H. M., González-Godoy, C. E., Guadalupe Barba-Santos, M., Vega-Zepeda, A., & Collado-Vides, L. (2017) Severe impacts of brown tides caused by *Sargassum* spp. on near-shore Caribbean seagrass communities. *Marine pollution bulletin*, 122(1-2), 272-281.
<https://doi.org/10.1016/j.marpolbul.2017.06.057>

Wang, M., & Hu, C. (2018) On the continuity of quantifying floating algae of the Central West Atlantic between MODIS and VIIRS. *International Journal of Remote Sensing*, 39(12), 3852-3869.
<https://doi.org/10.1080/01431161.2018.1447161>

Wang, M., Hu, C., Barnes, B. B., Mitchum, G., Lapointe, B., & Montoya, J.P. (2019) The great Atlantic *Sargassum* belt. *Science*, 365(6448), 83-87. DOI: [10.1126/science.aaw7912](https://doi.org/10.1126/science.aaw7912)

Wells, R.J., & Rooker, J.R. (2004) Spatial and temporal patterns of habitat use by fishes associated with *Sargassum* mats in the northwestern Gulf of Mexico. *Bulletin of Marine Science*, 74(1), 81-99.

Weaver, J., Zengel, S., Doelling, P., Fravel, H., & Michel, J. (2023) Oil Spills and Pelagic *Sargassum* - Planning and Response Considerations. NOAA OR&R. 2023.

Witherington, B., Hiram, S., & Hardy, R. (2012) Young sea turtles of the pelagic *Sargassum*-dominated drift community: habitat use, population density, and threats. *Marine Ecology Progress Series*, 463, 1-22. <https://doi.org/10.3354/meps09970>

Appendix: List of Acronyms

AOML Atlantic Oceanographic and Meteorological Laboratory
ACL Annual Catch Limit
CARICOOS Caribbean Coastal Ocean Observing System
CBD Convention on Biological Diversity
CIMAS Cooperative Institute of Marine and Atmospheric Research
CFMC Caribbean Fishery Management Council
CFR Code of Federal Regulations
CRFMC Caribbean Regional Fisheries Management Council
CS Caribbean Sea
CWA Clean Water Act
CZMA Coastal Zone Management Act
DNER Puerto Rico Department of Natural and Environmental Resources
DPP Disaster Preparedness Program
DPNR U.S. Virgin Islands Department of Planning and Natural Resources
DPS Distinct Population Segment
EBSMA Ecologically or Biologically Significant Marine Area
EEZ Exclusive Economic Zone
EFH Essential Fish Habitat
EPA Environmental Protection Agency
ERD Emergency Response Division
ESA Endangered Species Act
FEMA Federal Emergency Management Agency
FL Florida
FMP Fishery Management Plan
FR Federal Register
FY Fiscal Year
GOM Gulf of Mexico
GMFC Gulf of Mexico Fisheries Council
HAB Harmful Algal Bloom
HABHRCA Harmful Algal Blooms and Hypoxia Research and Control Act
HAPC Habitat Areas of Particular Concern
ICCAT International Committee for the Conservation of Atlantic Tuna
IOOS Integrated Ocean Observation System
IWG International Working Group
MHW Mean High Water
MPRSA Marine Protection Research and Sanctuaries Act
MSA Magnuson-Stevens Fishery Conservation and Management Act
NAO North Atlantic Oscillation
NASA National Aeronautics and Space Administration
NC North Carolina
NCCOS National Centers for Coastal Ocean Science
NESDIS National Environmental Satellite, Data, and Information Service
NMFS National Marine Fisheries Service

N/A Not applicable
NAW Northwest Atlantic
NAO NOAA Administrative Order
NOAA National Oceanic and Atmospheric Administration
NOS National Ocean Service
NWP Nationwide Permit
NWS National Weather Service
OAR Oceanic and Atmospheric Research
OCM Office for Coastal Management
OR&R Office of Response and Restoration
OSPO Office of Satellite and Product Operations
POC Point-of-contact
RCRA Resource Conservation and Recovery Act
SAFMC South Atlantic Fishery Management Council
SaWS Sargassum Watch System
SC South Carolina
SECART NOAA Southeast and Caribbean Regional Team
SIE Sargassum Inundation Event
SIR Sargassum Inundation Report
SSC Sargasso Sea Commission
STAR Center for Satellite Applications and Research
UN United Nations
UNEP United Nations Environment Programme
U.S. United States
USACE United States Army Corps of Engineers
USC United States Code
USF University of South Florida
USFWS United States Fish and Wildlife Service
USVI United States Virgin Islands
WCR Wider Caribbean Region