Efforts to Enhance Protection of the Sargasso Sea

TAMMY M. TROTT[1]*, SHEILA A. MCKENNA[2], JOANNA M. PITT[1], ARLO HEMPHILL[3], FREDERICK W. MING[1], PHILIPPE ROUJA[4], KRISTINA M. GJERDE[5], BILLY CAUSEY[6] and SYLVIA A. EARLE[2]
[1]*Department of Environmental Protection, PO Box CR52, Crawl CRBX, Bermuda. *ttrott@gov.bm .*
[2]*SEAlliance / Mission Blue, 2470 Mariner Square Loop, Alameda, California 94501, USA.*
[3]*Center for Ocean Solutions, 99 Pacific St. Suite. 155A, Monterey, California 93940 USA.*
[4]*Department of Conservation Services, PO Box FL588, Flatts FLBX, Bermuda.*
[5]*IUCN Global Marine and Polar Programme, IUCN Conservation Centre, Rue Mauverney 28, Gland 1196, Switzerland.*
[6]*NOAA Southeast Office of National Marine Sanctuaries, 33 East Quay Rd, Key West, Florida 33043 USA.*

ABSTRACT

The Sargasso Sea is a distinctive area of open ocean situated within the North Atlantic Subtropical Gyre, bounded on all sides by major ocean currents. Named for the floating *Sargassum* seaweed, it contains the world's only self-sustaining community of holopelagic algae, dominated by *Sargassum natans* and *S. fluitans*. The ecology and life-history patterns of many oceanic species are adapted to the unique habitats provided by the *Sargassum*. The Sargasso Sea is a critical spawning site, migratory route and feeding ground for commercially important pelagic fishes such as dolphinfish (*Coryphaena hippurus*), jacks (family Carangidae) and various tuna species, as well as a number of other threatened and endangered species. Many of these species are critical to the commercial fisheries, sport fisheries and eco-tourism industries of Gulf and Caribbean communities. Direct threats to the Sargasso Sea are unsustainable and destructive fishing practices and commercial collection of *Sargassum* weed for use as fertilizer, cattle feed and biofuel. Indirect threats include vessel traffic and pollution from ship discharges, tar and plastics. Recognizing the importance of this area and the need to protect it, the Government of Bermuda with international partners is leading an international initiative to explore ways to enhance protection of the Sargasso Sea. Most of the Sargasso Sea is in the high seas, and only a small portion is under national jurisdiction, within the Exclusive Economic Zone of Bermuda. International cooperation and action within the framework of the United Nations Convention on the Law of the Sea are thus essential.

KEY WORDS: Sargasso Sea, high seas conservation, marine protected areas, *Sargassum*

Esfuerzos para Realzar la Protección del Mar del Sargasso

PALABRAS CLAVE: Mar del Sargasso, protección, áreas marinas protegidas, *Sarrgassum*

Efforts pour Augmenter la Protection de la Mer des Sargasses

MOTS CLÉS: Mer des Sargasses, protection, aires marines protégées, *Sargassum*

INTRODUCTION

The Sargasso Sea is a distinctive area of open ocean situated within the North Atlantic Subtropical Gyre, bounded on all sides by the clockwise flow of major ocean currents. The Gulf Stream and North Atlantic Drift form the western and northern boundaries, while the Canary Current forms the eastern boundary and the North Equatorial Current and Antilles Current form the southern boundary (Figure 1). As these currents vary, the precise location of the Sargasso Sea is also variable, but it is most commonly situated in the area between latitude 25° and 32° north and longitude 35° and 70° west (Ryther 1956, Butler et al. 1983, Coston-Clements et al. 1991).

Named for the floating *Sargassum* seaweed, the Sargasso Sea is home to the world's only self-sustaining community of holopelagic algae. The floating algal mats are dominated by *Sargassum natans* and *S. fluitans*, which have no benthic stage, but other species of *Sargassum* which are primarily benthic, *S. filipendula*, *S. hystrix*, *S. platycarpum*, *S. polycertium*, and *S. pteropleuron*, are also occasionally present (South Atlantic Fishery Management Council (SAFMC) 2002). The *Sargassum* mats provide a rare form of structure in the open ocean, and the ecology and life-history patterns of many oceanic species are adapted to the unique habitats provided by this cornerstone species (Hemphill 2005).

Although other drift algal habitats do exist, diversity in the Sargasso Sea is greater for two reasons. First, research has shown that both density and diversity of associated organisms is linked to the greater area and thickness achieved by the *Sargassum* mats (Moser et al. 1998, Casazza and Ross 2008). Secondly, diversity is enhanced because some of the *Sargassum* originates in the Gulf of Mexico, working its way up to the Sargasso Sea via the Gulf Stream (Gower and King 2008) and collecting additional organisms along the way (Stoner and Greening 1984).

There is a rich community of small invertebrates at home amongst the *Sargassum* mats, with more than 145 invertebrate species having been recorded in association with *Sargassum* (Morris and Mogelberg 1973, Butler et al. 1983, Coston-Clements et al. 1991, Sterrer 1992, Calder

1995, SAFMC 2002). Many of these species are highly adapted, having evolved coloration and appendages that resemble the *Sargasssum* and give them the additional advantage of camouflage among the floating seaweed (Sterrer 1992). There are ten species endemic to the Sargasso Sea, including the Sargassum snail, *Litiopa melanostoma*, slug, *Scyllaea pelagica*, crab, *Planes minutus*, shrimp, *Latreutes fucorum*, and anemone *Anemonia sargassensis*, (Coston-Clements et al. 1991, SAFMC 2002). The rest of the *Sargassum* invertebrate community is comprised of a variety of gastropod and nudibranch molluscs, portunid, caprellid, amphipod and picnogonid crustaceans, serpulid and nereid polychaetes, flatworms, bryozoans and hydroids, providing a broad representation from a wide range of taxa (Fine 1970, Butler et al. 1983, Coston-Clements et al. 1991, Sterrer 1992, Calder 1995, SAFMC 2002).

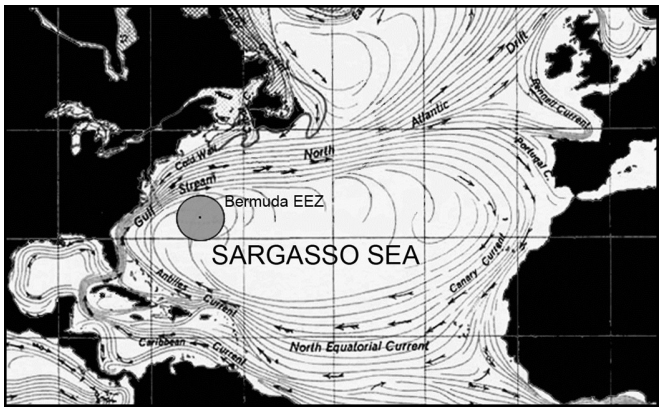

Figure 1. The central Atlantic Ocean, showing the currents that form the North Atlantic Subtropical Gyre, also known as the Sargasso Sea, with the location of Bermuda and the extent of Bermuda's Exclusive Economic Zone depicted. (Adapted from United States Army Service Forces 1943.)

Sargassum also provides habitat for over 100 species of finfish, including the endemic Sargassum angler fish, *Histrio histrio*, and Sargassum pipefish, *Syngnathus pelagicus* (Dooley 1972, Bortone 1977, Fedoryako 1980, Coston-Clements *et al*. 1991, SAFMC 2002, Casazza and Ross 2008). A range of ecological functions, including protection, feeding opportunity, cleaning, shade, structural affinity, visual reference, tactile stimulation, historical accident, passive drift, and use as a spawning substrate, have been attributed to this association by a variety of authors (references in SAFMC 2002).

The *Sargassum* provides shelter for an assemblage of juvenile and other small fishes that feeds on the associated plankton and invertebrate community and, in turn, serves as forage for larger, commercially and recreationally important species (Dooley 1972, Coston-Clements *et al*. 1991, SAFMC 2002). The former include juvenile swordfish, *Xiphius gladius*, juvenile and subadult jacks, Carangidae, juvenile and subadult dophin fishes, Coryphaenidae, along with filefishes and triggerfishes, Balistidae, and driftfishes, Stromateidae (Coston-Clements et al. 1991, SAFMC 2002, Casazza and Ross 2008). The latter include large predatory species such jacks, *Caranx spp*., amberjacks, *Seriola spp*., Rainbow runner, *Elagatis bipinnulata*, dolphins, *Coryphaenus spp*., barracudas, Sphyraenidae, various mackerels, wahoo and tunas, Scombridae, and billfishes, Istiophoridae, (Gibbs and Collette, 1959, Stephens 1965, Dooley 1972, Fedoryako 1980, Manooch and Hogarth 1983, Manooch and Mason 1984, Manooch et al. 1984, Manooch *et al*. 1985, Carr, 1986, Coston-Clements et al. 1991, SAFMC 2002, Casazza and Ross 2008). Data have also shown that Bluefin tuna, *Thunnus thynnus*, tagged throughout the Atlantic pass through the Sargasso Sea during their migrations (Block *et al*. 2001).

In addition, adults of some oceanic pelagic fishes, most notably the flyingfishes, Exocoetidae, use *Sargassum* as a spawning susbtrate (Dooley 1972, Sterrer 1992). They, in turn, are a major component of the diet of the large oceanic fishes, such as dolphin, wahoo and tunas, on which pelagic fisheries are based (Manooch and Hogarth 1983, Manooch and Mason 1984, Manooch et al. 1984, Manooch et al. 1985). Other key fish species known to spawn in the Sargasso Sea include white marlin, *Tetrapturus albidus*, and blue marlin, *Makaira nigricans*, (SAFMC 2002, Luckhurst et al. 2006).

A number of species that have been recognized as being threatened or endangered also have very strong ties to the Sargasso Sea. Catadromous American and European eels, *Anguilla rostrata and A. anguilla,* migrate to the Sargasso Sea to spawn (Kleckner et al. 1983). The larvae of both species develop in the Sargasso Sea and migrate along the Gulf Stream back to their respective freshwater habitats in North America and Europe, where they metamorphose into adults. Populations of both of these species are in decline, with the latter considered to be critically endangered and at risk of global extinction by the International Union for the Conservation of Nature (IUCN), a so-called "red-listed species". Research shows a potential link between the status of these populations and changes in the oceanic conditions of the Sargasso Sea (Friedland et al. 2007).

Green turtles (*Chelonia mydas*), hawksbill turtles (*Eretmochelys imbricata*), loggerhead turtles (*Caretta caretta*) and Kemp's ridley turtles (*Lepidochelys kempii*) turtles, all listed as threatened or endangered species, are known to utilise *Sargassum* as a nursery habitat (Carr and Meylan 1980, Carr 1987, Schwartz 1988, Manzella and Williams 1991). Hatchlings of green and loggerhead turtles swim hundreds of miles to the Sargasso Sea, where the few that survive this journey hide in the *Sargassum* to feed and grow in relative safety (Carr and Meylan 1980, Carr 1987, Schwartz 1988). A fifth turtle species, the Leatherback (*Dermochelys coriacea*) passes through the Sargasso Sea during its migrations (James et al. 2005).

Humpback whales, *Megaptera novaeangliae*, also pass through the Sargasso Sea during their annual migrations (Martin et al. 1984, Stone et al. 1987).

In addition, 23 species of seabirds have been observed foraging in association with *Sargassum*, with bird density being much greater in areas with *Sargassum* than in areas without (Haney 1986). In particular, the majority of white-tailed tropic birds (*Phaethon lepturus*), masked boobies (*Sula dactylatra*) and bridled terns (*Sterna anaethetus*) recorded were observed in the vicinity of *Sargassum* patches (Haney 1986). The *Sargassum* mats are dense enough that some birds, notably bridled and sooty terns (*Chlidonias niger*), actually roost upon them (Haney 1986).

Sargassum, once it sinks, also provides a food source for deepwater and benthic communities below (Schoener and Rowe, 1970, Butler et al. 1983). However, the benthic communities on the seabed below the Sargasso Sea are not well investigated, and their importance is generally not well understood. An exception to this is the area known as the Corner Rise Seamount Complex (Vinnichenko 1997). Explorations of these seamounts during 2005 found areas of rich deepwater coral habitat, as well as areas exhibiting extensive damage caused by bottom trawling that occurred between 1976 and 1996 and showing little evidence of recovery (Waller et al. 2007). The Corner Rise seamounts are now closed to bottom fishing by the Northwest Atlantic Fishery Commission.

Many of the species that depend on the Sargasso Sea are critical to the commercial fisheries and sport fisheries of communities in the wider Caribbean and Gulf of Mexico. In Bermuda, pelagic species like wahoo and yellowfin tuna, which feed in the Sargasso Sea, dominate the local commercial fishery and make up over one third of total annual landings, generating the equivalent of approximately US$1 million in sales per annum. In addition, these species together with marlin, which spawn in the Sargasso Sea, are the base of a tournament-based sport fishery that attracts sportfishing vessels from the U.S. east coast and some of the northeastern Caribbean islands, bringing critical foreign exchange into the island. In other Caribbean jurisdictions, wahoo, dolphinfish and amberjack, all highly dependent on the Sargasso Sea, are important components of the commercial fishery, and virtually every country in the region has some form of sport fishery that focuses on these species and the similarly-dependent marlin. The importance of the Sargasso Sea to the fisheries-related economies of the wider Caribbean region cannot be over emphasized.

In addition, some of the charismatic threatened and endangered species that depend on the Sargasso Sea play an important role in eco-tourism industries throughout the wider Caribbean region. The annual migration of humpback whales past Bermuda and through the Sargasso Sea provides opportunities for local whale watching eco-tours (Stone et al. 1987). Humpback whales are also the basis of whale watching eco-tours around the Caribbean, and it has been estimated that whale watching in Antigua and Barbuda, Dominica, Dominican Republic, Grenada, Guadeloupe, St. Kitts and Nevis, St. Lucia, and St. Vincent and the Grenadines is worth over $22 million annually across the region (O'Connor et al. 2009). Turtles are another group of species that draw eco-tourists to the Caribbean, and the four species of turtle that utilize the Sargasso Sea as a nursery area and as part of their migration routes support turtle watching eco-tourism in Antigua, Costa Rica, Dominica, Grenada, Nicaragua, St. Lucia, St. Vincent and the Grenadines, Trinidad and Tobago and the gulf and southeastern states of the United States, including Puerto Rico. Birdwatching is also a popular eco-tourism pursuit throughout the Caribbean, and although the role of migratory seabirds in drawing tourists to the region has not been quantified, the seabird species that utilize the Sargasso Sea contribute to the diversity of birdlife found in the region.

Unfortunately, despite their remote location, the Sargasso Sea and the rich array of organisms found within it are not immune to the anthropogenic impacts that have plagued the coastal oceans. An analysis of human impacts on marine ecosystems by Halpern and co-workers (2008) determined that the Sargasso Sea has sustained moderate to high impacts over time. Direct threats to *Sargassum*, the Sargasso Sea and its inhabitants are unsustainable and destructive fishing practices and commercial collection of *Sargassum* seaweed for use as fertilizer, cattle feed and biofuel (SAFMC 2002, Markels 2009).

There are also various indirect threats associated with ship traffic and exogenous contaminants. The Sargasso Sea has a high volume of maritime traffic and there is a risk that harmful substances may be discharged in the area by transiting ships (SAFMC 2002). In addition to the obvious potential for oil and other chemical contamination, there is also the possibility that exotic, and potentially harmful, organisms may be introduced to the area via ballast water discharges (SAFMC 2002). The encircling currents that concentrate the *Sargassum* within the Sargasso Sea also serve to concentrate pollutants and floating debris. Exogenous oil and tar balls from distant extraction and processing facilities or accidents have historically been recorded in the area (Burns and Teal 1973, Butler 1983, SAFMC 2002), however, following the recent Deep Horizon oil spill in the Gulf of Mexico, the extent of threats associated with present and potential future oil and dispersant contaminant is unknown. Plastic particles floating in the Sargasso Sea were reported as early as 1972 (Carpenter and Smith 1972), and today the North Atlantic gyre has a patch of floating debris similar in scale and extent to the more famous North Pacific garbage patch (Law et al. 2010). Finally, the impact of the many submarine cables that pass over the seabed beneath the Sargasso Sea is unclear.

Bermuda's marine environment has strong linkages with the Sargasso Sea and our pelagic fisheries depend on

it. Indeed, given the migratory nature of many of the animals that depend on the Sargasso Sea, the coastal marine environments and fisheries of many jurisdictions around the wider Atlantic basin are likely to have stronger linkages to this area, sometimes called 'the cradle of life in the Atlantic', than might at first be realized. Recognizing the importance of the Sargasso Sea and the existing and potential threats to this unique ecosystem must, in turn, lead to recognition of the need to protect it.

APPROACHES TO PROTECTION

There are some existing measures that aim to protect *Sargassum*, if not the Sargasso Sea itself. Within United States waters, the South Atlantic Fisheries Management Council (SAFMC), the federal body responsible for protecting ocean fish and their habitat from North Carolina to Florida, declared *Sargassum* as "Essential Fish Habitat" under the Magnuson-Stevens Fishery Conservation and Management Act. Since 2004, a management plan has been in place that restricts harvest of *Sargassum* in waters under its jurisdiction to a nominal 5,000 lbs (approximately 2,267 kg) per year. In addition, the International Commission for the Conservation of Atlantic Tunas (ICCAT), the regional fisheries management body for the wider Atlantic Ocean, passed a resolution in 2005 recognizing the role of pelagic *Sargassum* in supporting a diverse assemblage of organisms that includes the tunas and tuna-like species under its mandate. The resolution requires that parties report any activities that may impact *Sargassum*, directly or indirectly and with particular emphasis in the Sargasso Sea, and resolves that the Standing Committee on Research and Statistics should conduct an assessment of the status of *Sargassum* and its ecological importance (05-11 MISC). However, the impact of these measures is limited.

Most of the Sargasso Sea is in the high seas, and only a small portion is under national jurisdiction, within the Exclusive Economic Zone of Bermuda. Although the high seas encompass 64% of the world's oceans, at present there is no international legal mechanism for designating marine protected areas outside of national jurisdictions. National, multi-lateral or sectoral actions and declarations are only binding on those parties signed on to them, and the issue of compliance on the part of non-signatory parties compromises the ability of such initiatives to realize conservation goals on the high seas.

Several major international conservation organizations, in particular the International Union for the Conservation of Nature (IUCN), have been examining the possibility of protection for areas of the high seas for some time, and a key workshop was held in Vilm, Germany, in 2001 (Gjerde 2001). In 2002, the World Summit on Sustainable Development in Johannesburg, South Africa, set goals regarding the establishment of representative networks of marine protected areas, with a target date of 2012. Further developments during the Vth IUCN World Parks Congress in Durban, South Africa, 2003 (Laffoley et al. 2008), led to the establishment of the IUCN's High Seas MPAs Task Force under the World Commission on Protected Areas (WCPA).

In 2006, at the VIIIth Conference of Parties to the CBD (COP8), the Parties called for development of a set of scientific criteria for identifying ecologically or biologically significant areas (EBSAs) in need of protection in open ocean waters and deep sea habitats (Decision VIII/24, para. 44(b)). The need for such criteria was also recognized by the UN informal working group convened to address marine conservation issues beyond the bounds of national jurisdiction (Kohona and Lijnzaad 2010). A set of seven criteria for marine areas in need of protection were developed at an expert workshop convened by the Government of Portugal in October, 2007, and these criteria were adopted at the IXth Conference of Parties to the CBD (COP9) in 2008 (Decision IX/20, Annex I) (summarized in Table 1).

An initiative to highlight areas of the high seas that merit further conservation was then launched at the 2008 IUCN World Conservation Congress in Barcelona, through a collaboration of IUCN, WCPA and the Marine Conservation Biology Institute (MCBI). As part of this initiative, the brochure *High Seas Gems: Hidden Treasures of Our Blue Earth* was released (available at www.mcbi.org), highlighting ten high seas areas of particular significance, including the Sargasso Sea. Subsequently, a brief was submitted (by authors SM and AH) during the CBD's Scientific Experts Workshop in Ottawa, Canada, in 2009, illustrating how the Sargasso Sea fulfills the criteria for uniqueness as defined under CBD decision IX/20. This information is presented, along with other illustrations, in the Global Ocean Biodiversity Initiative's *Working towards high seas conservation* (available at www.gobi.org). The Sargasso Sea has also been nominated as a "hope spot" as part of Mission Blue, a multi-year global initiative founded by the Sylvia Earle Alliance (SEAlliance), together with TED (Technology, Entertainment and Design), the National Geographic Society and the Waitt Foundation. The initiative brings together many partners committed to inspiring people to act to restore the ocean's health and productivity by reducing the impact of fishing and creating marine protected areas based around the "hope spots".

Within this wider context, the Government of Bermuda with international partners is leading an international initiative to explore ways to enhance protection of the Sargasso Sea. The partnership, known as the Sargasso Sea Alliance, is presently comprised of the Bermuda Government Departments of Environmental Protection and Conservation Services, Mission Blue / SEAlliance, IUCN, WCPA, the Center for Ocean Solutions at Stanford University, the National Marine Sanctuaries Program of the National Oceanic and Atmospheric Administration (NOAA), and the Marine Conservation Biology Institute (MCBI) (Table 2). However, it is anticipated that addition-

al partners will join the alliance as the initiative gains momentum. A workshop made up of leading scientists and other experts was convened in Bermuda in February 2010 to explore possible approaches to protection and the opportunity for international cooperation.

Some progress has recently been made in the protection of high seas areas. Contracting parties to the OSPAR Convention (1992), a regional agreement under which fifteen European countries together with the European Union co-operate to protect the North East Atlantic, have agreed to establish six Marine Protected Areas in the wider North East Atlantic in areas beyond national jurisdiction. These areas are described in OSPAR (2010), and were adopted by the Ministers at the OSPAR Commission meeting in September 2010 (OSPAR news, September 24, 2010).

Several proponents of high seas conservation have suggested the Regional Seas Conventions as suitable instruments through which to achieve protection of areas beyond the bounds of national jurisdiction. However, the Sargasso Sea does not fall under any of the existing United Nations Environment Programme (UNEP) regional seas Conventions. With no models to work from, it is anticipated that the route to protection may require a combination of several sectoral and multi-lateral actions, using the United Nations Convention on the Law of the Sea (UNCLOS) as a framework.

A number of international regulatory and management bodies have mandates that are relevant to conservation of the high seas in the Atlantic (Table 3). The CBD, through its call on Parties and competent international organizations to identify and protect areas that meet its criteria for ecologically or biologically significant areas, serves as the scientific framework for collective action to protect the Sargasso Sea.

The International Maritime Organisation (IMO), a Special Agency of the UN, has responsibility for the safety and control of maritime traffic. It is also responsible for the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) and the International Convention for the Control and Management of Ships' Ballast Water and Sediments. The Marine Environmental Protection Committee of the IMO may designate 'Special Areas' and 'Particularly Sensitive Sea Areas' (PSSAs) that are subject to special protective measures. Members may present a case for areas that satisfy ecological criteria that include uniqueness, dependency, representativeness, diversity, productivity, naturalness, integrity and vulnerability. As vessel traffic, pollution from ship discharges, and the potential for introduction of exotic organisms via ballast water have been identified as threats to the Sargasso Sea, there may be actions within the remit of the IMO that will serve to reduce these threats and provide a degree of enhanced protection for the area.

Table 1. Summary of Site Criteria for "Ecologically or Biologically Significant Areas" (EBSAs) from CBD COP9 Decision 20, Annex I.

Criteria	Definition
Uniqueness or rarity	Area contains (i) unique, rare or endemic species, populations or communities; and / or (ii) unique, rare or distinct habitats or ecosystems; and / or (iii) unique or unusual geomorphological or oceanographic features
Importance for key life history stages	Areas that are required for a population to survive and thrive
Importance for species / habitats at risk	Area containing habitat required for the survival and recovery of endangered, threatened or declining species, or area with significant assemblages of such species
Vulnerability	Areas that contain a relatively high proportion of sensitive habitats, biotopes or species that are functionally fragile (highly susceptible to degradation or depletion by human activity or by natural events) or with slow recovery
Biological productivity	Area containing species, populations or communities with comparatively higher natural biological productivity
Biological diversity	Area contains comparatively higher diversity of ecosystems, habitats, communities, or species, or has higher genetic diversity.
Naturalness	Area with a comparatively higher degree of naturalness as a result of the lack of, or low level of, human-induced disturbance or degradation

Table 2. List of partner organizations forming the Sargasso Sea Alliance.

Partner	Type of Organisation
Department of Environmental Protection	Government of Bermuda
Department of Conservation Services	Government of Bermuda
Mission Blue / Sylvia Earle Alliance	Non-Governmental Organisation
International Union for the Conservation of Nature (IUCN)	Multi-lateral Conservation Organisation
Center for Ocean Solutions, Stanford University	Academic
NOAA National Marine Sanctuaries Program	United States Government Agency
Marine Conservation Biology Institute (MCBI)	Non-Governmental Organisation

Table 3. International regulatory and management bodies with mandates relevant to high seas conservation in the Western Atlantic Ocean.

Type of Legal Entity	Legal Entity, Mandate and Parties
UN Special Agency	**International Maritime Organisation (IMO)** Responsible for maritime traffic control and safety and the following conventions: International Convention for the Prevention of Pollution from Ships (MARPOL); International Convention for the Control and Management of Ships' Ballast Water and Sediments. May designate 'Special Areas' and 'Particularly Sensitive Sea Areas' (PSSAs).
UN convention	**Convention on the Law of the Sea (UNCLOS)** The globally recognized regime governing all uses of the oceans and their resources. 161 parties.
UN convention	**Convention on Biological Diversity (CBD)** International treaty concerning the conservation of biodiversity, the sustainable use of the components of biodiversity and the equitable sharing of benefits derived from use of genetic resources. 192 states plus the European Union are parties.
Autonomous international body	**International Seabed Authority (ISA)** Originally established under UNCLOS. Assesses and regulates deep seabed resources and their extraction.
Regional management body	**International Commission for the Conservation of Atlantic Tunas (ICCAT)** Responsible for management of fisheries for tunas and tuna-like species in the Atlantic. 47 contracting parties.
Regional management body	**Northwest Atlantic Fisheries Organisation (NAFO)** Responsible for management of fisheries in the Northwest Atlantic not covered by other agreements. 12 members.

With 47 contracting parties that utilize the fisheries resources of the wider Atlantic Ocean and an existing resolution recognizing the importance of *Sargassum*, ICCAT has a role to play in the regulation of fishing practices that have been identified as a threat to the Sargasso Sea and in conserving this critical fish habitat.

Other bodies whose regulations may be brought into play include the International Seabed Authority (ISA) and the Northwest Atlantic Fisheries Organisation (NAFO).

DISCUSSION

While efforts by the Sargasso Sea Alliance to enhance protection of the Sargasso Sea are still in the early stages, the following next steps have been provisionally identified:

i) Promote global recognition of the significance of the Sargasso Sea as a unique and valuable ecosystem;
ii) Promote the adoption of measures to protect the Sargasso Sea consistent with international law;
iii) Invite those countries adjacent to the Sargasso Sea, and those that would benefit from its conservation, to co-operate in the development of regional and international initiatives;
iv) Invite support from the global community of states, territories and relevant organizations to join in the protection of the Sargasso Sea;
v) Invite the local and international scientific community and civil society to assist in efforts to study and protect the Sargasso Sea.

In addition, any plan for protection will necessarily need to incorporate a strategy for the enforcement of protective measures.

Of the 13 Regional Seas Conventions under UNEP, the Wider Caribbean Region, covered by the Cartagena Convention, is nearest to the Sargasso Sea. Engagement of the Parties to the Cartagena Convention in efforts to enhance protection of the Sargasso Sea will be an important step in gaining support for this initiative.

Finally, it is hoped that efforts to enhance protection of the Sargasso Sea will contribute to models that will facilitate the development of other high seas marine protected areas.

ACKNOWLEDGEMENTS

The authors would like to thank all those that have contributed to the initiative thus far, including the JM Kaplan Foundation, the Waitt Foundation and a number of individual donors, along with the various international organisations that laid the groundwork that makes this initiative possible.

LITERATURE CITED

Block, B.A., H. Dewar, S.B. Blackwell, T.D. Williams, E.D. Prince, C.J. Farwell, A. Boustany, S.L.H. Teo, A. Seitz, A. Walli, and D. Fudge. 2001. Migratory movements, depth preferences, and thermal biology of Atlantic bluefin tuna. *Science* **293**:1310-1314.

Burns, K.A. and J.M. Teal. 1973. Hydrocarbons in the pelagic Sargassum community. *Deep-Sea Research* **20**:207-211.

Butler, J.N., B.F. Morris, J. Cadwallader and A.W. Stoner. 1983. *Studies of* Sargassum *and the* Sargassum *Community*. BBS Special Publication No. 22, Bermuda Biological Station for Research / Bermuda Institute of Ocean Sciences, Bermuda.

Calder, D.R. 1995. Hydroid assemblages on holopelagic *Sargassum* from the Sargasso Sea at Bermuda. *Bulletin of Marine Science* **56**(2):537-546.

Carpenter, E.J. and K. L. Smith. 1972. Plastics on the Sargasso Sea Surface. *Science* **175**:1240-1241.

Carr, A. 1987. Perspective on the pelagic stage of sea turtle development. *Conservation Biology* **1**(2):103-121.

Carr, A. and A. B. Meylan. 1980. Evidence of passive migration of green turtle hatchlings in *Sargassum*. Copeia 1980(2): 366-368.

Casazza, T.L. and S.W. Ross. 2008. Fishes associated with pelagic *Sargassum* and open water lacking *Sargassum* in the Gulf Stream off North Carolina. *Fishery Bulletin* **106**(4):348-363.

Conover, J.T. and J.M. Sieburth. 1964. Effect of *Sargassum* distribution on its epibiota and antibacterial activity. *Botanica Marina* **6**:147-157

Coston-Clements, L., L.R. Settle, D.E. Hoss, and F.A. Cross. 1991. Utilization of the Sargassum habitat by marine inverterates and vertebrates - a review. NOAA Technical Memorandum. NMFS-SEFSC-296. 30 pp.

Dooley, J.K. 1972. Fishes associated with the pelagic *Sargassum* complex, with a discussion of the *Sargassum* community. *Contributions to Marine Science* **16**:1-32.

Fedoryako, B.I. 1980. The ichthyofauna of the surface waters of the Sargasso Sea southwest of Bermuda. *Journal of Ichthyology* **20**(4):1 -9.

Fine, M.L. 1970. Faunal variations on pelagic Sargassum. *Marine Biology* **7**: 112-122.

Friedland, K.D., M.J. Miller and B. Knights. 2007. Oceanic changes in the Sargasso Sea and declines in recruitment of the European eel. *ICES Journal of Marine Science* **64**:519–530.

Gibbs, R.M., Jr. and B.B. Collette. 1959. On the identification, distributions, and biology of the dolphins, *Coryphaena hippurus* and *C. equisetis*. *Bulletin of Marine Science of the Gulf and Caribbean* **9**: 117-152.

Gjerde, K.M. 2001. Participant's report on the expert workshop on managing risks to biodiversity and the environment on the high seas, including tools such as marine protected areas: scientific and legal aspects. *The International Journal of Marine and Coastal Law* **16** (3): 515-528.

Global Ocean Biodiversity Initiative. *Working towards high seas conservation*. Available at: http://www.gobi.org

Gower, J. and S. King. 2008. Satellite Images Show the Movement of Floating *Sargassum* in the Gulf of Mexico and Atlantic Ocean. Available from Nature Proceedings http://hdl.handle.net/10101/npre.2008.1894.1

Haney, J.C. 1986. Seabird Patchiness in tropical ocean waters: The influence of Sargassum "reefs". *The Auk* **103**:141-151.

Halpern, B.S., S. Walbridge, K.A. Selkoe, C.V. Kappel, F. Micheli, C. D'Agrosa, J.F. Bruno, K.S. Casey, C. Ebert, H.E. Fox, R. Fujita, D. Heinemann, H.S. Lenihan, E.M.P. Madin, M.T. Perry, E.R. Selig, M. Spalding, R. Steneck, and R. Watson. 2008. A Global Map of Human Impact on Marine Ecosystems. *Science* **319**:948-952.

Hemphill, A.H. 2005. Conservation on the High Seas - drift algae habitat as an open ocean cornerstone. *High Seas Marine Protected Areas. Parks* **15**(3):48-56.

James, M.C., R.A. Myers, and C.A. Ottensmeyer. 2005. Behaviour of leatherback sea turtles, *Dermochelys coriacea*, during the migratory cycle. *Proceedings of the Royal Society* **272**:1547-1555.

Kleckner, R.C., J.D. McCleave, and G.S. Wippelhauser. 1983. Spawning of American eel, *Anguilla rostrata*, relative to thermal fronts in the Sargasso Sea. *Environmental Biology of Fishes* **9**(3-4):289-293.

Kohona, P.T.B. and L. Lijnzaad. 2010 Co-Chairpersons Recommendations of the Ad Hoc Open-ended Informal Working Group to study issues relating to the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction. UN Document A/65/68, 17 March, 2010.

Laffoley, D., K. Gjerde, and L. Wood. 2008. Progress with Marine Protected Areas since Durban, and future directions. *Parks* **17**(2):13-22.

Law, K.L., S. Morét-Ferguson, N.A. Maximenko, G. Proskurowski, E.E. Peacock, J. Hafner, and C.M. Reddy. 2010. Plastic Accumulation in the North Atlantic Subtropical Gyre. *Science* **329**:1185-1188.

Luckhurst, B.E., E.D. Prince, J.K. Llopiz, D. Snodgrass and E.B. Brothers. 2006. Evidence of blue marlin (*Makaira nigricans*) spawning in Bermuda waters and elevated mercury levels in large specimens. *Bulletin of Marine Science* **79**:691-704.

Manooch, C.S., III and W.T. Hogarth. 1983. Stomach contents and giant trematodes from wahoo, *Acanthocybium solandri*, collected along the south Atlantic and Gulf coasts of the United States. *Bulletin of Marine Science* **33**:227-238.

Manooch, C.S., III and D.L. Mason. 1983. Comparative food of yellowfin tuna, *Thunnus albacares*, and blackfin tuna, *Thunnus atlanticus*, (Pisces: Scombridae) from the southeastern and Gulf of Mexico coasts of the United States. *Brimleyana* **9**:33-52.

Manooch, C.S., III, D.L. Mason, and R.S. Nelson. 1984. Food and gastrointestinal parasites of dolphin *Coryphaena hippurus* collected along the southeastern and Gulf coasts of the United States. *Bulletin of the Japanese Society of Scientific Fisheries* **50**:1511-1525.

Manooch, C.S., III, D.L. Mason, and R.S. Nelson. 1985. Food of little tunny *Euthynnus alletteratus* collected along the southeastern and Gulf coasts of the United States. *Bulletin of the Japanese Society of Scientific Fisheries* **51**:1207-1218.

Manzella, S. and J. Williams. 1991. Juvenile head-started Kemp's ridleys found in floating grass mats. *Marine Turtle Newsletter* **52**:5-6.

Marine Conservation Biology Institute. *High Seas Gems: Hidden Treasures of Our Blue Earth*. Available at: http://www.mcbi.org/what/hsbooklet.htm.

Markels Jr., M. 2009. Method of production of biofuel from the surface of the open ocean. United States Patent 7479167. Available at: http://www.freepatentsonline.com/7479167.html.

Martin, A.R., S.K. Katona, D. Mattila, D. Hembree, and T.D. Waters. 1984. Migration of Humpback Whales Between the Caribbean and Iceland. *Journal of Mammalogy* **65**:330-333.

Morris, B.F. and D.D. Mogelberg. 1973. Identification manual to the pelagic Sargassum fauna. Bermuda Biological Station Special Publication 11. 63 pp.

Moser, M.L., P.J. Auster, and J.B. Bichy. 1998. Effects of mat morphology on large Sargassum-associated fishes: observations from a remotely operated vehicle (ROV) and free-floating video camcorders. *Environmental Biology of Fishes* **51**(4):391-398.

O'Connor, S., R. Campbell, H. Cortez, and T. Knowles. 2009. *Whale Watching Worldwide: tourism numbers, expenditures and expanding economic benefit.* A special report from the International Fund for Animal Welfare, Yarmouth MA, USA, prepared by Economists at Large.

OSPAR, 2010. Quality Status Report 2010. OSPAR Commission, London, England. 176 pp.

OSPAR news. 24 September, 2010. Available at: http://www.ospar.org/content/news_detail.asp?menu=00600725000000_000013_000000

Ryther, J.M. 1956. The Sargasso Sea. *Scientific American* **194**(1):98-104.

Schoener, A. and G.T. Rowe. 1970. Pelagic Sargassum and its presence among the deep-sea benthos. *Deep-Sea Research* **17**:923-925.

Schwartz, F.J. 1988. Aggregations of young hatchling loggerhead sea turtles in the sargassum off North Carolina. *Marine Turtle Newsletter* **42**:9-10.

South Atlantic Fishery Management Council. 2002. Fishery Management Plan for Pelagic *Sargassum* Habitat of the South Atlantic Region. South Carolina. 183 pp.

South Atlantic Fishery Management Council. 2003. Fishery Management Plan for the Dolphin and Wahoo Fishery of the Atlantic. South Carolina. 309 pp.

Sterrer, W. 1992. *Bermuda's Marine Life*. Island Press, Bermuda.

Stevenson, J.J. 1910. Special Articles: The Sargasso Sea. *Science* **32** (832):841-843.

Stone, G.S., S.K. Katona, and E.B. Tucker. 1987. History, Migration and Present Status of Humpback Whales, *Megaptera novaeangliae*, at Bermuda. *Biological Conservation* **42**:122-145.

Stoner, A.W., and H.S. Greening. 1984. Geographic variation in the macrofaunal associates of pelagic *Sargassum* and some biogeographic implications. *Marine Ecology Progress Series* **20**:185-192.

United States Army Service Forces. 1943. "Ocean Currents and Sea Ice" from Atlas of World Maps, Army Specialized Training Division, Army Service Forces Manual M-101. Available at: http://upload.wikimedia.org/wikipedia/commons/e/ef Ocean_currents_1943_%28borderless%29.png

Vinnichenko VI 1997. Russian Investigations and Deep Water Fishery on the Corner Rising Seamount in Subarea 6. *NAFO Scientific Country Studies* **30**:41–49 (East Sargasso sea).

Waller, R., L. Watling, P.J. Auster, and T. Shank. 2007. Anthropogenic impacts on the Corner Rise Seamounts, NW Atlantic Ocean. Journal of the *Marine Biological Association of the United Kingdom* **87**: 1075-1076