AN ASSESSMENT OF THE ECOLOGICAL IMPORTANCE OF THE SARGASSO SEA TO TUNA AND TUNA-LIKE SPECIES AND ECOLOGICALLY ASSOCIATED SPECIES

Anonymous[1]

SUMMARY

An assessment of the ecological importance of the Sargasso Sea to tuna and tuna-like species and ecologically associated species has resulted in a significant increase in information and understanding of this ecosystem and includes the following: 1) Of the many fish species known to occur in the Sargasso Sea, information on the biology and ecology of 18 pelagic ICCAT species has been presented to date. This includes the principal ICCAT target species, billfishes, smaller tuna species and pelagic sharks. This analysis focused on their habitat use and migration patterns, 2) Six of these ICCAT species are known to reproduce in the Sargasso Sea and a further eight species are presumed to reproduce there based on suitable oceanographic conditions, 3)All of the above species use the area for feeding and a preliminary food web has been proposed incorporating most of the species above, 4)All of the above species use the Sargasso Sea for one or more of their life history phases, 5)A multi-species spawning area of three ICCAT-managed species has been identified in the southern Sargasso Sea and spawning seasonality has been defined, 6) The catches of targeted ICCAT species in the Sargasso Sea were analyzed from 1992-2011. The analysis indicated that the Sargasso Sea was not a significant fishing area for any of the six principal target species as the 20 year average annual catch levels were under 3% of the respective species stock totals, 7)The Sargasso Sea is an important and unique ecosystem for ICCAT species. At the same time, it was acknowledged that there are other ecosystems in the Atlantic ocean that are also important and unique for ICCAT species, and 8) Significant advances were made in the past few years to increase the understanding of the importance of the Sargasso Sea for ICCAT species and it was recommended continuing collecting and reviewing information from the Sargasso Sea.

RÉSUMÉ

L'évaluation de l'importance écologique de la mer des Sargasses pour les thonidés, les espèces apparentées et les espèces apparentées écologiquement a entraîné une augmentation considérable des informations et de la compréhension de cet écosystème, à savoir : 1) En ce qui concerne les nombreuses espèces de poissons dont on connaît la présence dans la mer des Sargasses, des informations sur la biologie et l'écologie de 18 espèces pélagiques de l'ICCAT ont été présentées jusqu'à ce jour. Il s'agit des principales espèces cibles relevant de l'ICCAT, des istiophoridés, des espèces de thonidés mineurs et des requins pélagiques. Cette analyse s'est centrée sur l'utilisation de leur habitat et sur les schémas migratoires, 2) On sait que six de ces espèces relevant de l'ICCAT se reproduisent dans la mer des Sargasses et on présume que huit autres espèces s'y reproduisent si les conditions océanographiques s'y prêtent, 3) Toutes les espèces susmentionnées utilisent la zone pour s'y nourrir et une chaîne alimentaire préliminaire a été proposée, laquelle incorpore la plupart des espèces suscitées, 4) Toutes les espèces susmentionnées utilisent la mer des Sargasses pour l'une des phases de leur cycle vital ou plusieurs phases, 5)On a identifié au Sud de la mer des Sargasses une zone de frai plurispécifique de trois espèces gérées par l'ICCAT et le caractère saisonnier du frai a été défini, 6) Les prises des espèces ciblées de l'ICCAT dans la mer des Sargasses ont été analysées de 1992 à 2011. L'analyse a indiqué que la mer des Sargasses n'était pas une zone de pêche importante pour aucune des six principales espèces cibles étant donné que les niveaux des captures annuelles moyennes au cours de ces 20 ans représentaient moins de 3% du total des stocks d'espèces respectifs, 7) La mer des Sargasses est un écosystème important et unique pour les espèces relevant de l'ICCAT. Dans le même temps, on a reconnu que d'autres écosystèmes de l'océan Atlantique sont également importants et uniques pour les espèces relevant de

[1] Fisheries & Oceans Canada, Biological Station, 531 Brandy Cove Road, St. Andrews NB, E5B 2L9, CANADA. Email address: alex.hanke@dfo-mpo.gc.ca. Telephone: (506) 529-5912.

l'ICCAT et 8) Des progrès considérables ont été accomplis ces dernières années en vue de progresser dans la compréhension de l'importance que revêt la mer des Sargasses pour les espèces relevant de l'ICCAT et il a été recommandé de continuer à recueillir et à examiner les informations émanant de la mer des Sargasses.

RESUMEN

Una evaluación de la importancia ecológica del mar de los Sargazos para los túnidos y especies afines y especies ecológicamente asociadas ha generado un importante incremento en la información y comprensión de este ecosistema, lo que incluye lo siguiente: 1) de las muchas especies de peces que se sabe que están presentes en el mar de los Sargazos, hasta la fecha se ha presentado información sobre la biología y ecología de 18 especies pelágicas de ICCAT. Esto incluye las principales especies objetivo de ICCAT; peces de pico y especies de túnidos más pequeños, así como tiburones pelágicos. Este análisis se centró en su utilización del hábitat y en sus patrones de migración, 2) se sabe que seis de estas especies ICCAT se reproducen en el mar de los Sargazos y se supone que otras ocho especies ICCAT se reproducen allí cuando se dan las condiciones oceanográficas adecuadas, 3) todas estas especies utilizan la zona para alimentarse y se ha propuesto una cadena alimentaria preliminar que incorpora la mayor parte de las especies consideradas, 4) todas estas especies utilizan el mar de los Sargazos durante uno o más fases de su ciclo vital, 5) se ha identificado una zona de reproducción de varias especies para tres especies gestionadas por ICCAT en la parte meridional del mar de los Sargazos y se ha definido la estacionalidad del desove, 6) se han analizado las capturas de especies objetivo de ICCAT en el mar de los Sargazos para el periodo 1992-2011. El análisis indicó que el mar de los Sargazos no es una zona de pesca importante para ninguna de las seis especies objetivo principales ya que los niveles medios de captura anual de estos veinte años se situaron por debajo del 3% de los totales de los stock de la especie respectiva, 7) el mar de los Sargazos es un ecosistema importante y único para las especies de ICCAT. Al mismo tiempo, se reconoció que existen otros ecosistemas en el océano Atlántico que también son importantes y únicos para las especies ICCAT y 8) se han realizado avances significativos en los últimos años en lo que concierne al incremento del conocimiento de la importancia del mar de los Sargazos para las especies de ICCAT y se recomienda que se siga recabando y revisando la información sobre el mar de los Sargazos.

KEYWORDS

Sargassum, Resolution 12-12, Ecosystem, ICCAT Fisheries

1. Introduction

In 2005, ICCAT passed Resolution 05-11 on pelagic *Sargassum* requesting Contracting Parties and others to provide to the SCRS information and data on activities that impact pelagic *Sargassum* in the Convention area on the high seas, directly or indirectly, with particular emphasis on the Sargasso Sea. As a result, the SCRS was asked to examine available and accessible information and data on the status of pelagic *Sargassum* and its ecological importance to tuna and tuna-like species. In 2006, the Sub-Committee on Ecosystems noted in this regard that there was no information on the matter.

Then in 2012, ICCAT passed Resolution 12-12 which requested that the SCRS examine the available data and information concerning the Sargasso Sea and its ecological importance to tuna and tuna-like species and ecologically associated species. What follows is a summary of the information provided to the Sub-Committee on Ecosystems from 2013 to 2015.

2. Background

The published literature on the Sargasso Sea indicates that it is a distinctive area of open ocean situated within the North Atlantic Subtropical Gyre, bounded on all sides by major ocean currents. The area of particular interest is between 22°-38°N, 76°-43°W centered upon 30°N - 60°W. It covers an area of about 4 million km2 and is essentially the western basin of the wider Sargasso Sea. The oceanography of the area is such that its enclosing currents trap and retain materials (both biological and non-biological) within the central gyre. This simplistic picture is complicated by a variety of mesoscale oceanographic features (eg. frontal phenomena), but essentially it is the long residence times of material within the gyre that is of great importance here as it is largely responsible for containing the world's only self-sustaining community of holopelagic algae, dominated by *Sargassum natans* and *S. fluitans* (SAFMC 2002) which form mats and host a wide spectrum of communities, including 10 endemic species.

Sargassum serves as a nursery ground and juvenile habitat for at least four threatened and endangered turtle species (Carr and Mylen 1980, Carr 1987, Schwartz 1988, Manzella and Williams 1991). On the sea bed, there are seamounts with hundreds of endemic species, and within the deep water column there is evidence for enhanced diversity.

Most of the Sargasso Sea is on the high seas and only a small portion is under national jurisdiction (i.e. the Exclusive Economic Zone of Bermuda). Direct threats to the Sargasso Sea include commercial collection of *Sargassum* weed and impacts associated with fishing (Hemphill 2005, SAFMC 2002, Pauly and Watson 2005). Indirect threats include vessel traffic and pollution from ship discharges, tar (Burns and Teal 1973, Wade and Quinn 1975, Butler 1983, SAFMC 2002) and plastics (Carpenter and Smith 1972, Law *et al.* 2010).

The ICCAT Commission first recognized the importance to study the ecological importance of the Sargasso Sea in 2005 [Rec. 05-11] and requested the SCRS that an update of the progress made in this study be provided in 2015 [Rec 12-12].

Groups concerned with the study and conservation of the Sargasso Sea initially organized themselves as the Sargasso Sea Alliance (SSA) in 2011. The work conducted by the SSA culminated in 2012, when SSA proposed the Sargasso Sea to be recognized as an Ecologically or Biologically Significant Area (EBSA) at the Convention on Biological Diversity, a United Nations body.

In 2014, "The Sargasso Sea Commission was established pursuant to the Hamilton Declaration on Collaboration for the Conservation of the Sargasso Sea, signed on 11 March 2014, by the governments of the Azores, Bermuda, Monaco, UK and US."[2] The Sargasso Sea Commission (SSC) has a stewardship and review role and no management responsibility.

3. ICCAT Species within the Sargasso Sea

Many species managed by ICCAT are found in the Sargasso Sea, however only a subset of 18 different ICCAT fish species with distributions that include the Sargasso Sea have been considered to date. These have been divided into broad ecological groupings, they are:

- Group 1 (Principal tuna species): yellowfin tuna, albacore tuna, bigeye tuna, bluefin tuna and skipjack tuna.
- Group 2 (Swordfish and billfishes): swordfish, blue marlin, white marlin and sailfish.
- Group 3 (Small tunas): wahoo, blackfin tuna, Atlantic black skipjack tuna (Little Tunny) and dolphinfish.
- Group 4 (Sharks): shortfin mako, blue shark, porbeagle, bigeye thresher and basking shark.

[2] http://www.sargassoalliance.org/about-the-alliance

Their dependence on the Sargasso Sea for at least part of their life cycle was demonstrated (Lockhurst. 2014, Luckhurst. 2016 (*in press*) and the feeding ecology and diet of 15 of these fish predators was used to construct a preliminary food web (Lockhurst. 2015b) illustrating the interdependencies within this system. The dependence of fisheries on this habitat for their catch was investigated by a simple analysis of the Task I and II data (Lockhurst. 2015a, Lockhurst. 2016 (*in press*)).

4. Dependence on Habitat

Published work on the ecology and life-history patterns of oceanic species indicated that many are adapted to the unique habitats provided by *Sargassum*. The Sargasso Sea is a feeding ground for commercially important pelagic fishes such as swordfish bluefin tuna, yellowfin tuna, albacore tuna, white marlin, blue marlin, wahoo, dolphinfish and jacks (family Carangidae) (Casazza and Ross 2008, CostonClements *et al*. 1991, Dooley 1972, Fedoryako 1980, Gibbs and Collette 1959, Manooch and Hogarth 1983, Manooch and Mason 1983, Manooch *et al.* 1984, SAFMC 2002). It is also a migratory route for bluefin tuna (Block *et al*. 2001, Block et al. 2005), leatherback (James *et al* 2005) and loggerhead turtles (Bolten 2003, Mansfield *et al.* 2009) and a spawning site for white marlin (Arocha *et al.* 2005, 2007), blue marlin (Luckhurst et al. 2006, SAFMC 2002) and albacore tuna (Le Gall 1974, Nishikawa *et al.* 1985).For those species not described above, preliminary information and data was provided on distribution, fishery landings, migration and movement patterns, reproduction, age and growth, food and feeding habits and ecology in relation to oceanographic parameters, primarily water temperature. This information identified *Sargassum* as essential fish habitat through its role in supporting feeding habits of tunas and other pelagic predators. Notably, flying fishes are an important prey species in the diet of tunas and billfishes and they are largely dependent on *Sargassum* mats as spawning habitat. Thus, the Sargasso Sea plays a role in sustaining a trophic web involving highly migratory, pelagic species in the northwest Atlantic.

Initially, elements of the ecology of 18 ICCAT species known to occur in the Sargasso Sea were summarized in **Table 1**. This preliminary evaluation of the existing data highlighted the fact that each species uses the Sargasso Sea for one or more aspects of its life history. **Table 2** demonstrates that landings of the main ICCAT target species from this area are a small fraction of what is landed in the respective management zones. A more thorough treatment of the available data (Lockhurst. 2016 (*in press*)) demonstrated that the presence of the Subtropical Convergence Zone in the southern Sargasso Sea is an important feature associated with spawning of swordfish albacore tuna and white marlin.

A review of a recent bluefin tuna tagging presentation (SCRS/P/2015/010) provided more evidence that both eastern and western stocks use the Sargasso Sea. Evidence from unpublished work indicates that while in the Sargasso Sea these fish are making deep dives consistent with feeding on meso-pelagic fish and other organisms.

5. Role in Food Web

The analysis of stable isotopes of nitrogen in tissue samples as well as stomach content analyses, collected from the Sargasso Sea and adjacent areas, were used to estimate the trophic position (TP) for each of the species listed above with the exception of bigeye thresher shark and basking shark. A preliminary pelagic food web of the Sargasso Sea was proposed (Lockhurst. 2015b). All of these species were found to have TP values equal to or greater than 4.0 with the exception of skipjack tuna (3.8). Large swordfish were the top-ranked predator (TP = 5.1) followed by white marlin (4.9). Small swordfish and two other species - blue marlin and bigeye tuna - follow with the same TP (4.8). Large ommastrephid squid have a TP of 4.7 ranking them at a similar trophic level to other large fish predators. Squids were shown to be an important element of this food web in the role of both predator and prey but their importance as prey is still to be understood.

The data revealed the uniqueness of the Sargasso Sea as the link between the *Sargassum* as an important reproductive habitat for flying fishes and the significance of flying fishes as a principal prey group for tunas and billfishes but these relationships were not quantified.

6. Contribution to catch

The ICCAT database (CATDIS) provided catch data for a 20 year period (1992-2011) for the principal tuna species namely, yellowfin tuna, albacore tuna, bigeye tuna, bluefin tuna and skipjack tuna as well as swordfish (Lockhurst. 2015a). Catch in the Sargasso Sea was compiled for a total of eleven ICCAT 5x5 degree reporting

squares (25° N to 40° N latitude) that overlapped the Sargasso Sea Alliance (SSA) study area. This analysis was subsequently expanded in Lockhurst. 2016 (*in press*) to include 4 additional squares between 20° N and 25° N latitude. All of these squares are exclusively in international waters with the exception of Bermuda's EEZ and the EEZ of several islands bordering on the southwest corner of the Sargasso Sea.

Relatively low catch levels were reported in the 1990s for almost all of the above species but there was a generally increasing catch trend during the last decade of the analysis. The results indicate that the Sargasso Sea (SSA Area) was not a significant fishing area for any of the six principle target species presented here as the 20 year average annual catch levels for the reference period within the Sargasso Sea were less than 3% of the respective stock totals. Among the five principal tuna species, the reported catch of skipjack tuna in the area was insignificant. **Table 2** indicates the individual catch values for 2011.

A second catch analysis from 20° N to 30° N latitude reviewed landings of white marlin, swordfish and albacore in their spawning grounds in the southern Sargasso Sea. Historically, the 5x5 squares between 20° N to 25° N latitude, where the spawning occurred, contained a significant fraction of the total catch in the Sargasso Sea but recently this has declined to near zero.

When interpreting catch data, the SCRS noted that the low catches reported from the Sargasso Sea may be due, in part, to the use of fixed reporting squares that do not capture the spatial dynamics of the fishery. It is known that, for example, Japanese fishermen fish along the subtropical convergence zone in the Sargasso Sea and that the fishing areas may shift in response to the location of this zone, moving the catch in and out of the study area.

7. Future Direction

The SCRS recognized that the information provided to date represented substantial progress toward informing the Commission on the ecological importance of the Sargasso Sea for tuna and tuna-like species but also offered the following items to direct future work:

1. Clarify the reasons for the low catch of ICCAT species within the Sargasso Sea (e.g. whether this is due to the selected reporting squares, whether the *Sargassum* creates difficulties for fishing, low fishing effort etc.).

2. Assess seasonal trends in landings from the Sargasso Sea.

3. Use available PSAT tagging data to attempt to determine residence time of species within the Sargasso Sea.

4. Compare the landings from the Sargasso Sea area relative to the relevant stock area.

5. Determine if available data supports the assumption that the Sargasso Sea is a relatively productive area.

6. Determine if there are indicators that can be derived from the Sargasso Sea ecosystem that are responsive to fluctuations in recruitment of ICCAT species.

7. Estimate biomass of target species from length-frequency data derived from the Sargasso Sea.

8. Examine CPUE trends of species in selected reporting squares versus areas outside of these squares.

9. Investigate the dependence of ICCAT target and by-catch species (eg. marine turtles) on *Sargassum*.

10. Investigate changes that may have occurred in the oceanography of the region for the presented time series of catches.

11. Determine the annual level of fishing effort (number of hooks deployed) in the Sargasso Sea.

12. Determine the annual spatial extent of *Sargassum* in relation to the spatial extent of ICCAT fisheries.

References

Arocha, F., Bárrios, A., Silva, J., Lee, D.W. 2005, Preliminary observations on gonad development, sexual maturity and fecundity estimates of white marlin (*Tetrapturus albidus*) from the western central Atlantic.

Collect. Vol. Sci. Pap. ICCAT, 58(5): 1567-1573. Arocha, F., Bárrios, A. and Lee, D.W. 2007, Spatial-temporal distribution, sex ratio at size and gonad index of white marlin (*Tetrapturus albidus*) and longbill spearfish (*Tetrapturus pfluegeri*) in the western central Atlantic during the period of 2002-2005. Collect. Vol. Sci. Pap. ICCAT, 60(5): 1746-1756.

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

Block, B.A., Teo, S.L.H., Walli, A., Boustany, A., Stokesbury, M.J.W., Farwell, C.J., Weng, K.C., Dewar, H. and Williams, T.D. 2005, Electronic tagging and population structure of Atlantic bluefin tuna. Nature 434: 1121-1127.

Bolten, A.B. 2003, Active Swimmers - Passive Drifters: The Oceanic Juvenile Stage of Loggerheads in the Atlantic System p. 63-78 In: Bolten, A.B., Witherington, B.E. Eds., Loggerhead Sea Turtles. Smithsonian Books, Washington, DC, 319 pp.

Boustany A., 2015. Canadian Pop-up Tagging. SCRS/P/2015/010.

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

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

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

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

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

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

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

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.

Gibbs, R.M., Jr. and Collette, B.B. 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.

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

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

Le Gall, J.Y. 1974, Exposé synoptique des données biologiques sur le germon *Thunnus alalunga* (Bonaterre, 1788) de l‟Océan Atlantique. Synopsis FAO sur les pêches, 109: 70 p.

Luckhurst, B.E., Prince, E.D., Llopiz, J.K., Snodgrass, D. and Brothers, E.B. 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.

Luckhurst, B.E., 2014. Inventory and Ecology of Fish Species of Interest to ICCAT in the Sargasso Sea. Col. Vol. Sci. Pap. 71(1): 440-459.

Luckhurst, B.E., 2015a. Analysis of ICCAT reported catches of tunas and swordfish in the Sargasso Sea (1992-2011). Col. Vol. Sci. Pap. 71(6): 2900-2912.

Luckhurst, B.E., 2015b. A preliminary food web of the pelagic environment of the Sargasso Sea with a focus on the fish species of interest to ICCAT. Col. Vol. Sci. Pap. 71(6): 2913-2932.

Luckhurst, B.E., Arocha, F., 2016. *In press*. SCRS/2015/111. Evidence of Spawning In the Southern Sargasso Sea of Fish Species Managed by ICCAT - Albacore Tuna, Swordfish and White Marlin.

Mansfield, K.L., Saba, V.S., Keinath, J. and Musick, J.A. 2009, Satellite telemetry reveals a dichotomy in migration strategies among juvenile loggerhead sea turtles in the northwest Atlantic. Marine Biology. 156: 2555-2570.

Manooch, C.S., III and Hogarth, W.T. 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 Mason, D.L. 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, Mason, D.L. and Nelson, R.S. 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.

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

Nishikawa, Y., Honma, M., Ueyanagi, S. and Kikawa, S. 1985, Average distribution of larvae of oceanic species of scombroid fishes, 1956-1981. Far Seas Fish. Res. Lab. 12, 99 pp.

Pauly, D. and Watson, R. 2005, Background and interpretation of the „Marine Trophic Index‟ as a measure of biodiversity. Philosophical Transactions of the Royal Society B 2005 360: 415-423.

Paul, D., Watson, R. and Alder, J. 2005, Global trends in world fisheries: Impacts on marine ecosystems and food security. Philosophical Transactions of the Royal Society B 2005 360: 5-12.

Sargasso Sea Commission 2014. Hamilton declaration on collaboration for the conservation of the Sargasso Sea Hamilton, Bermuda 11 March, 2014. Sargasso Sea Commission, Bermuda. 7 p.

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 (SAFMC). 2002, Fishery Management Plan for Pelagic Sargassum Habitat of the South Atlantic Region. South Carolina. 183 pp.

Wade, T.L. and Quinn, J.G. 1975, Hydrocarbons in the Sargasso Sea surface microlayer. Marine Pollution Bulletin 6(4): 54-57. Surname of first author, name or initial(s), Surname of other others, name or initials. Year of publication. Title of paper. Journal of publication Vol. (No.): pages.

Neilson, J. and S. Campana. 2008. A validated description of age and growth of western Atlantic bluefin tuna (*Thunnus thynnus*). Can. J. Fish. Aquat. Sci. 65: 1523-1527.

Table 1. Preliminary assessment of the ecological importance of the Sargasso Sea to tunas and tuna-like species and to ecologically associated species (SCRS/2014/132). Reproduction: Yes - direct evidence of spawning in area; Presumed - based on suitable oceanographic conditions and Unknown. Migration: seasonal residence or passes through area during annual movements or migrations. Feeding: Uses area for foraging. Life History Cycle: Uses area in one or more phases (larvae, juveniles, adults) of its life history cycle.

Species	Reproduction	Migration	Feeding	Life history cycle
Bluefin tuna	Unknown	Yes	Yes	Yes
Yellowfin tuna	Presumed	Yes	Yes	Yes
Albacore tuna	Yes1	Yes	Yes	Yes
Bigeye tuna	Presumed	Yes	Yes	Yes
Skipjack tuna	Presumed	Yes	Probably	Yes
Swordfish	Yes1	Yes	Yes	Yes
Blue marlin	Yes	Yes	Yes	Yes
White marlin	Yes1	Yes	Yes	Yes
Sailfish	Unknown	Probably	Probably	Probably
Wahoo	Yes	Yes	Yes	Yes
Blackfin tuna	Presumed	Yes	Yes	Yes
Atl. Black skipjack tuna	Presumed	Yes	Yes	Yes
Dolphinfish	Presumed	Yes	Yes	Yes
Blue shark	Presumed	Yes	Yes	Yes
Shortfin mako	Presumed	Yes	Yes	Yes
Porbeagle shark	Yes	Yes	Yes	Yes
Bigeye thresher shark	Unknown	Yes	Probably	Probably
Basking shark	Unknown	Yes	Probably	Unknown

1 Updated information from Luckhurst 2016 (*in press*).

Table 2. Catch in the Sargasso Sea and Atlantic by relevant stock for six principal target species for reference year 2011 (Luckhurst. 2015a). All catch statistics were based on Task I and II data aggregated by 5x5 squares.

Species	Sargasso Sea Catch (t)	Atlantic Catch by Stock (t)	% of total Stock Catch
W. Bluefin tuna	4	1986	0.21
Yellowfin tuna	165	19408	0.85
Albacore tuna	348	19995	1.74
Bigeye tuna	23	77795	0.03
Skipjack tuna	0.1	39324	0.0
Swordfish	790	12836	6.2