THE OCEAN FOUNDATION

Sargassum Factsheet - Scientific Information
as of December 20, 2019

General Information

- Sargassum is a genus containing about 150 different species of brown algae which are generally attached to rocks along temperate coasts or as pelagic (free-floating) algae in the open ocean
    - Specifically, sargassum is defined as a holopelagi, meaning algae that not only floats freely around the ocean but also reproduces vegetatively
    - Some can reach several meters in length
- Reproduces asexually through fragmentation
    - Fragmentation is a form of asexual reproduction where the parent splits into fragments and each develops into a fully-formed adult identical to their parents
    - Also known as being totipotent
- In the Caribbean, there are two common types of Sargassum found
    - *Sargassum fluitans* and *Sargassum natans*
        - *S. natans* and *S. fluitans* are considered the only holopelagic macroalgae
        - These are the only two species of **pelagic** Sargassum, which are found in the Gulf of Mexico, throughout the Caribbean, and in the Sargasso Sea
            - This is based on morphological differences, not genetic
- Sargassum has many leafy structures, branches, and round, berry-like structures, called pneumatocysts, that are filled with mostly oxygen aiding in the buoyancy of the plant, allowing it to float on the surface
- Sargassum acts as a floating 'island' that provides food and refuge to a plethora of species including the Sargassum fish, who live their whole lives on Sargassum 'islands'
    - Sargassum accumulates in areas of converging surface currents with downwelling and low winds
- When Sargassum loses its buoyancy after about a year, it sinks to the seafloor and provides energy to ocean life on the seafloor
- *Sargassum* is a keystone species that support relatively high levels of biodiversity that is facing a lot of challenges due to anthropogenic pressures
    - In the US, scientists and lawmakers understand the importance of this habitat and in 2003 ban the commercial harvest of Sargassum within US waters
    - Sargassum has been designated as Essential Fish Habitat which affords it some special protections
- Sargassum can survive a wide range of temperatures and salinity
- It forms "islands" that can be acres across and several feet deep

Benefits of Sargassum

- Supporting marine life
    - Sargassum supports a high level of biodiversity and is required to maintain the health and resilience of entire ecosystems
    - Sargassum acts as an oasis in an otherwise desolate environment

    - Sargassum contributes an estimated 60% of the total primary production in the upper 1m of the water column
    - Pelagic sargassum supports micro and macro-epiphytes, fungi, more than 100 species of invertebrates, over 100 species of fish, and 4 species of turtles
        - Some of the species that are dependent on sargassum have evolved special shapes and colorations that are advantageous for living on the rafts
        - Serves as a primary habitat, temporary refuge, foraging grounds, and/or nursery grounds
        - There are several species are endemic to Sargassum and spend their whole lives aboard the rafts
            - Sargassum frogfish
            - Sargassum pipefish
            - And multiple species of shrimp
    - With all the prey available on Sargassum mats, apex predators like marlin, tuna, and sharks are attracted to the mats
    - The egg and larval stages of fish, some crustaceans, and juvenile sea turtles are particularly dependent upon the pelagic sargassum habitat for survival
        - Sargassum is a vital temporary habitat for the juvenile stage of many species of sea turtles and eels, including many that are endangered or threatened
    - Many species including tuna, white marlin, porbeagle shark, dolphinfish and many species of birds migrate through the Sargasso Sea and depend on it for food and shelter
    - Turtles use sargassum mats as nurseries for their hatchlings, which provides them with food and shelter
    - The sargassum community is critical for feeding for some western North Atlantic seabirds
    - Sargassum is a ‘magnet’ to a wide variety of fauna due to it being pelagic
        - Clinging fauna like crabs
        - Free swimming species like filefish
        - Hydroids
    - Sargassum is important in the reproduction cycles of many commercially important fish such as mahi-mahi, jacks, and amberjacks
    - There are a plethora of benthic mobile species, like crabs, shrimp, snails, and worms that are also found on the rafts
- Not harmful to humans
- Can help nourish beaches if in small amounts
- Sargassum is edible
- Onshore it is a food source for many coastal marine and bird species
- In non-excessive quantities, Sargassum helps beach ecosystems
    - It prevents erosion by absorbing wave energy and deposits sediments and nutrients onto beaches

    - Collects wind-blown sand and when it washes back ashore, restores beaches, and acts as a short-term help to reduce wave and wind erosion
- Biofuel
- Possible medical and pharmaceutical uses

Drawbacks of Excessive Sargassum

- Huge 'rafts' of the seaweed smother other seagrasses and coral reefs
    - Prevent fishermen from leaving the shore
        - Tangles their motors, engines, nets, and lines
    - Less flying fish
    - Mahi-Mahi are caught earlier in development, potentially causing future problems in the species
    - The turtles cannot nest on the beaches because the Sargassum itself prevents them or the clean-up of the Sargassum
- Deters tourists and prevents swimmers and small boats from accessing the ocean
    - Unsightly
- If not removed in time, it can produce H2S (hydrogen sulfide), which can have major detrimental effects on coastal ecosystems
- Smells terrible as it decomposes/decays
- Removal is very expensive and can damage beaches
- Invasive species can hitch a ride
- When decomposing in water, it can promote harmful blooms of bacteria and other microbes
- When machinery used to remove it, can compact sand, remove sand and nutrients from beaches which promotes beach erosion
- Sargassum that washed ashore and covers beaches is detrimental to the survival of some species of turtles because it blocks female sea turtles from coming ashore to lay eggs
    - Even the ones that do make it ashore, their nests are often destroyed by bulldozers that are cleaning up the Sargassum

History and Evolution of Sargassum

- Sargassum is difficult to track so the origins and drift patterns of pelagic Sargassum have always been uncertain
- Documented descriptions of Sargassum mats were described by early sailors including Christopher Columbus in 1492
- Sargassum has a long, unbroken evolutionary history
    - Evidenced by the many species that have unique adaptations to survive on the floating habitat
    - Including the highly specialized sargassum fish
- Sargassum is threatened by many anthropogenic pressures
    - Oil spills
    - Harvesting
    - Shipping traffic

    - Climate change
- Barbados formed a working group on sargassum to address research, commercial, and educational uses

Uses for Sargassum

- Harvesting sargassum could be an effective solution
    - Some commercial uses of sargassum are being explored
        - A natural fertilizer
        - Plant tonic
        - Biofuel
- Sargassum contains alginic acid, which can be used as a thickener and emulsifier in food
- Sargassum contains cellulose and hemicellulose, which are raw materials in paper
    - Sarganico
        - Makes notebooks and paper that can be used for packaging and/or crafts
    - Cup and menu holders for restaurants being produced
- Sargassum generates ethanol, a main compound in biofuel
- Sargassum also makes an excellent fertilizer
    - Natural fertilizer instead of chemicals
        - Claimed to be better than what is available in stores
    - Improves crop productivity by improving resilience and resistance to harsh environmental conditions and pests
    - Can be used as raw material for liquid fertilizers and fertilizer amendments as well as compost
    - Most practical of seaweeds to be used in crop production
    - Algas Organics, the Caribbean's first indigenous agriculture biotechnology company, makes a "Total Plant Tonic"
- Cosmetic and skincare products
- Cocktail drinks
    - Pineapple gift
    - Sargassum is rich in iodine, bromine, mineral salts, and vitamins that benefit the absorption of fats
- Bricks for house construction
    - A similar process to making adobe bricks
    - Can reduce the cost of building a house by up to 50%
- Sargassum can be harvested and fed to livestock
    - Rich in carbohydrates and amino-acids can be used as a replacement for livestock feed
    - More sustainable and climate-smart feed option
- Humans can also eat it
    - You can boil, fry, steam or dry it
- The presence of flavonoids, tannins, terpenoids, and saponins shows that sargassum can be used for medical purposes
    - It's a part of Chinese medicine that dates back as far as the 8th century

    - It acts as an anti-inflammatory, antioxidant, neuroprotective, antimicrobial, antitumor, antiviral, and more
- Limiting factors
    - Availability of extraction
    - Consistency
    - Transportation costs from the sea/shore

Predictions

- Some studies say that warming waters are causing bigger and bigger blooms stretching from Brazil to Africa
    - Sargassum reproduces/grows faster in higher temperatures and cannot survive in cold temperatures
    - Global warming -> warmer oceans = more bloom
- The increase in the presence of sargassum is caused by coastal eutrophication (excessive loading of the water with nutrients)
    - Pollution = nutrient-rich waters act as fertilizer
        - From things like agriculture run-off, sewage, etc.
- More storms help it disperse farther

Images

Image of *Sargassum natans*, a common type of sargassum found in the Caribbean, Wikipedia

Image of sargassum floating in the water, Wikipedia

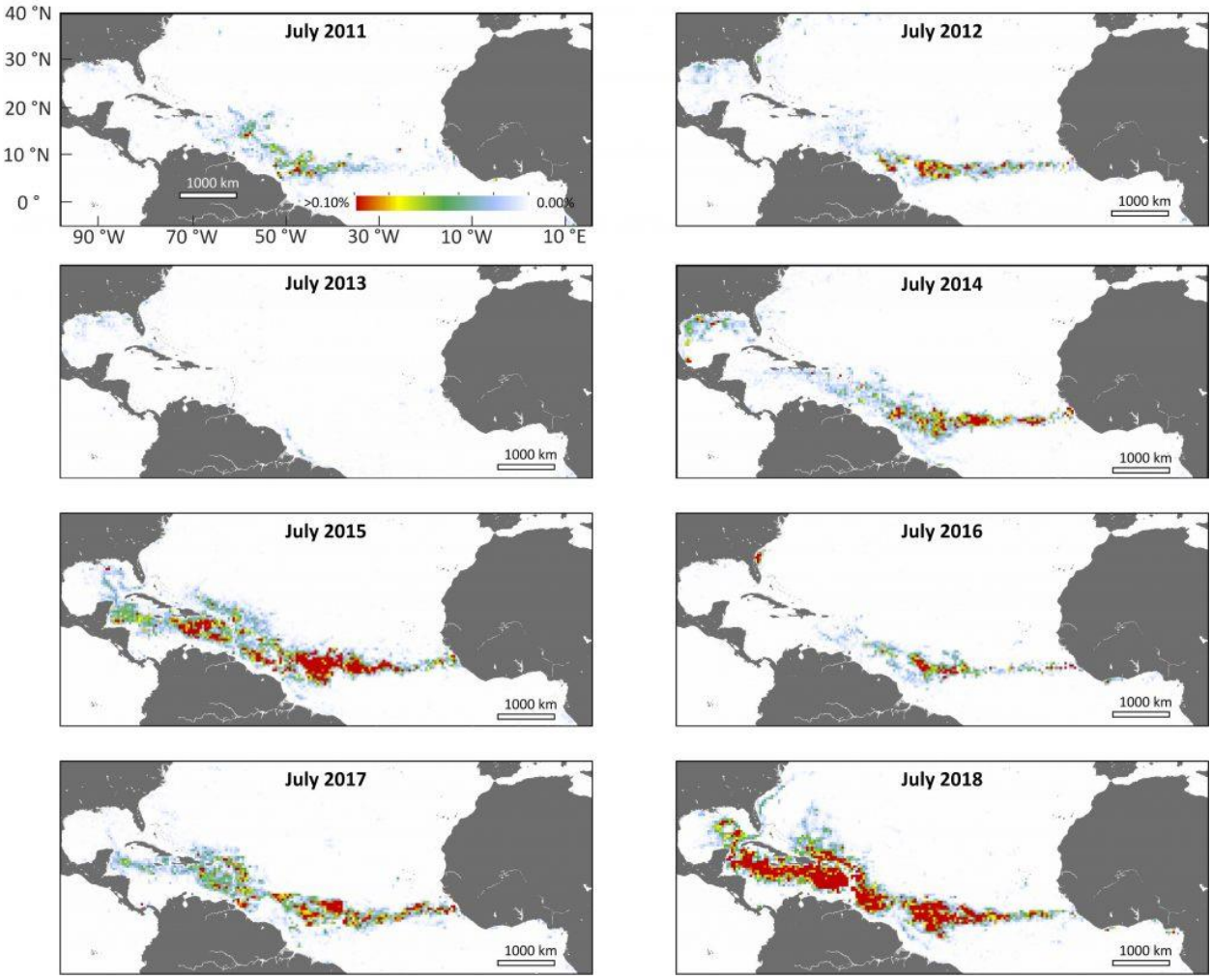
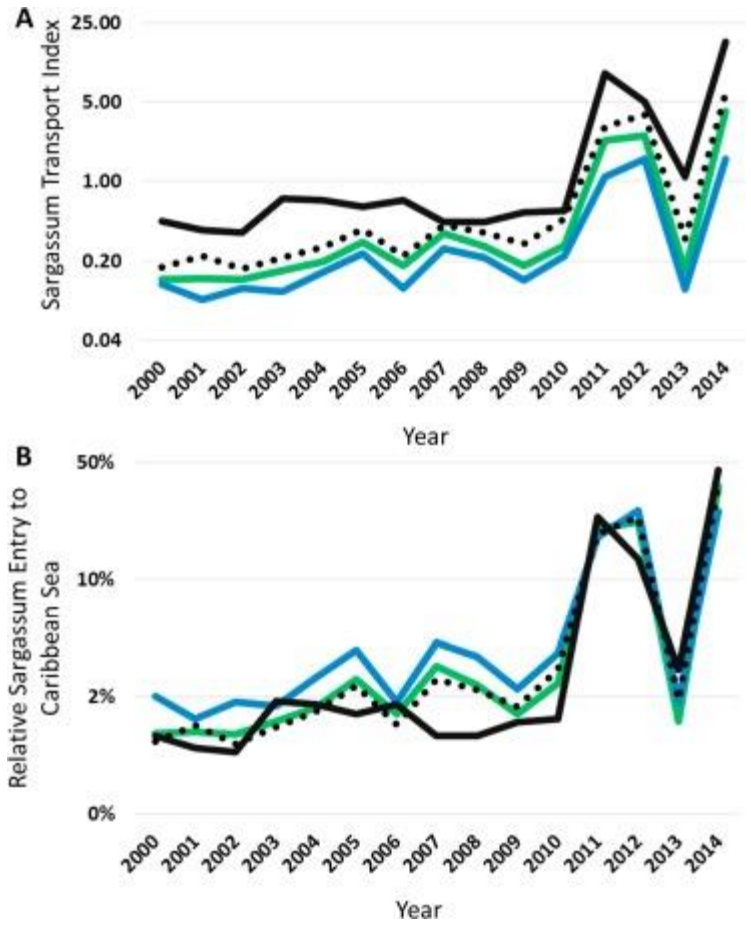
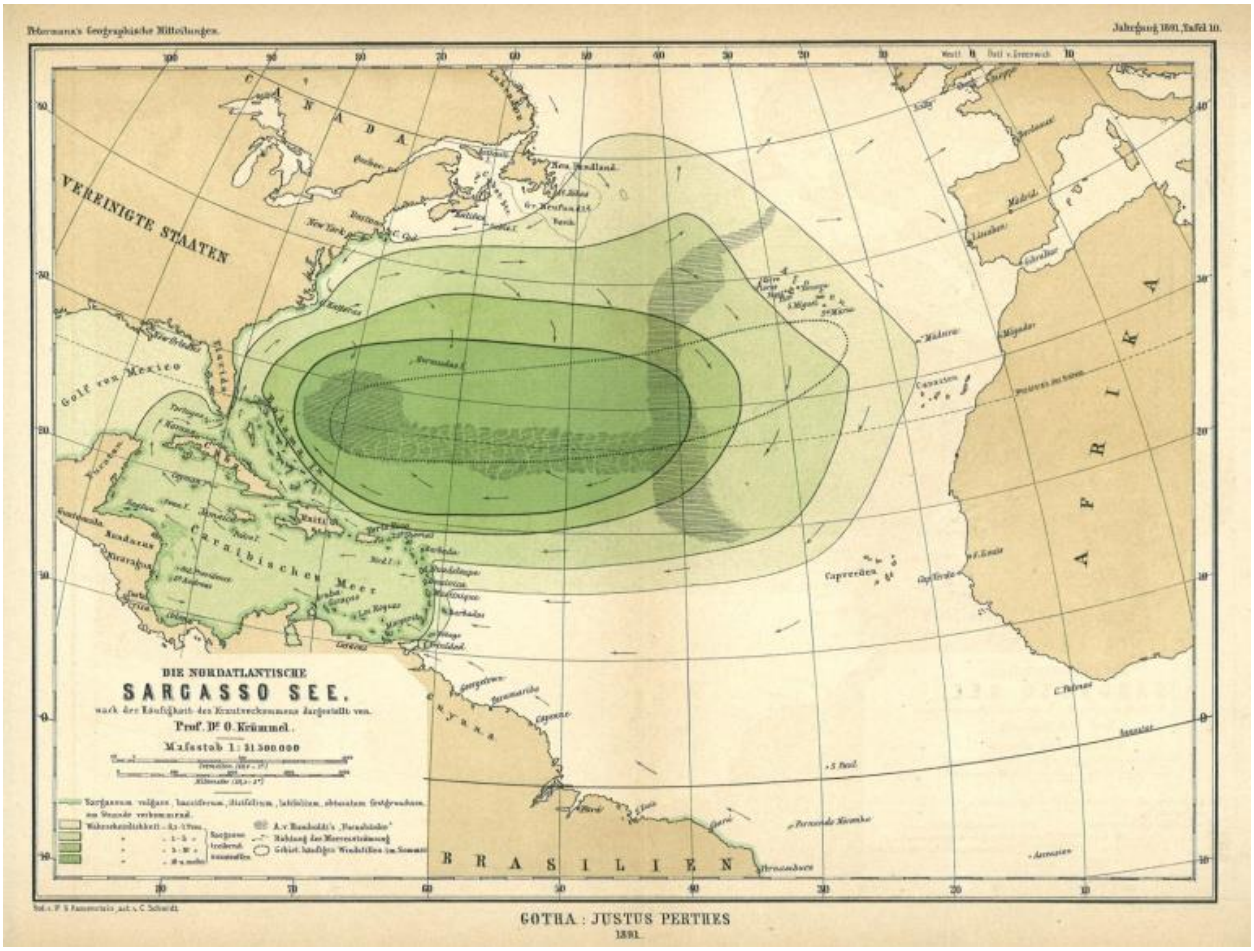


Image showing the increase in quantity of sargassum during the annual bloom over the past decade, Candace Oviatt
(https://www.sciencedirect.com/science/article/abs/pii/S0025326X19304953#bb0180)

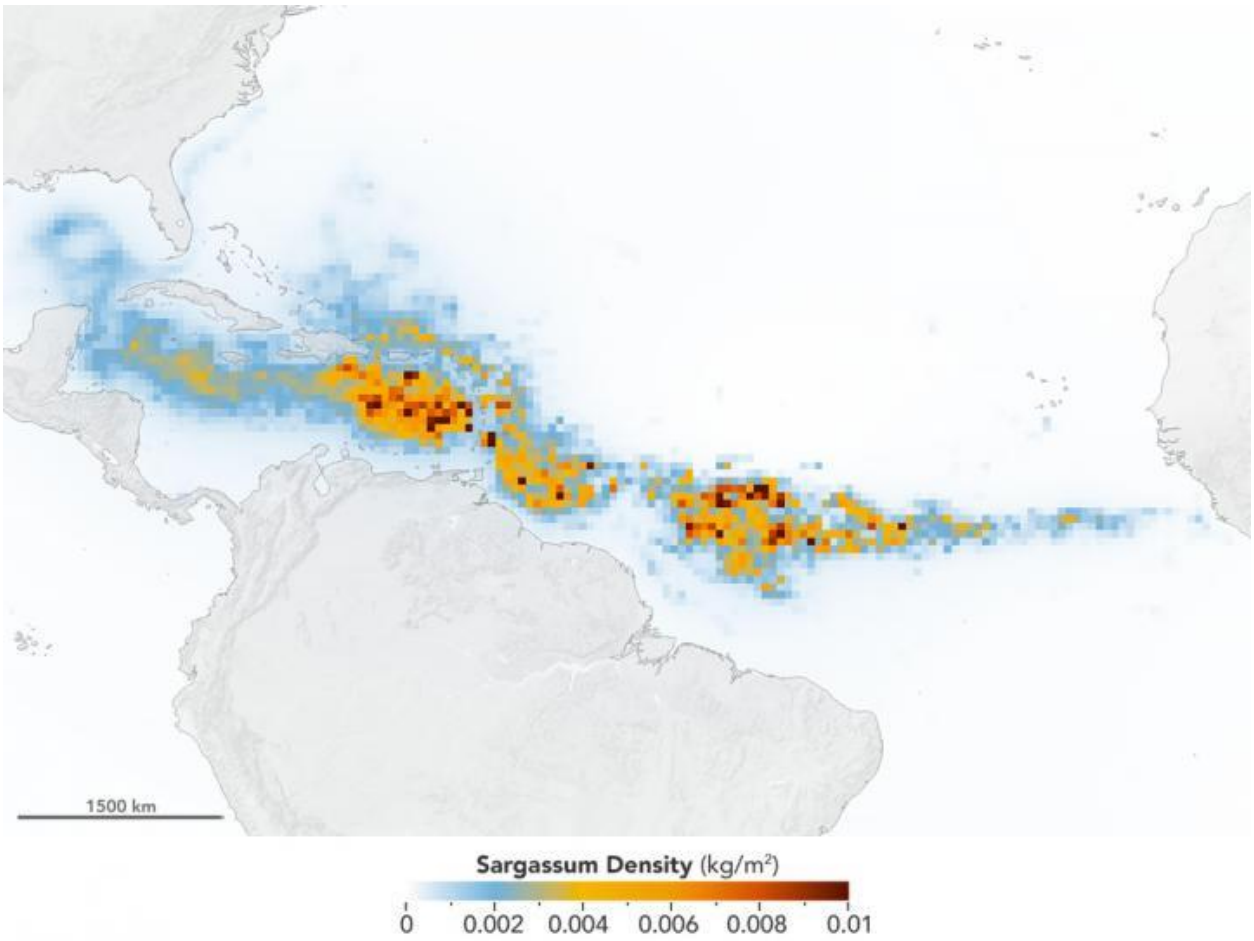


Graph showing the increase in sargassum entry to the Caribbean Sea, Candace Oviatt (https://www.sciencedirect.com/science/article/abs/pii/S0025326X19304953#bb0180)

Map from the week of 23 July 2019 showing the amount of sargassum that washed up on beaches, Mexico News Daily



A historical map from 1891 defining the Sargasso Sea, ship logs recorded a mass of “seagrass” sometimes so thick it would prevent the ship from moving, Blue Ocean Network



Scientists used NASA's Moderate Resolution Imaging Spectroradiometer (MODIS) on Terra and Aqua satellites to discover the Great Atlantic Sargassum Belt (GASB), which started in 2011. It has occurred every year since, except 2013, and often stretches from the west coast of Africa to the Gulf of Mexico. Credit: NASA/Earth Observatory. Data provided by Mengqiu Wang and Chuanmin Hu, USF College of Marine Science

Sources:

1. https://pdfs.semanticscholar.org/688a/906fbcbf050909c86dc02934d68e147aeef3.pdf
2. https://botany.natur.cuni.cz/algo/soubory/algologie/2019/nature12860.pdf
3. https://www.bbc.com/news/world-latin-america-45044513
4. https://www.britannica.com/science/Sargassum
5. https://oceanexplorer.noaa.gov/facts/sargassum.html
6. https://www.sciencedirect.com/science/article/pii/S0025326X19304953#bb0180
7. https://mexiconewsdaily.com/news/excessive-amounts-of-sargassum-at-29-locations/
8. https://blueocean.net/sargassum-smothering-caribbean-beaches/
9. https://www.eurekalert.org/pub_releases/2019-07/nsfc-nsf070819.php
10. https://www.villapalmarcancun.com/blog/destination/practical-and-creative-uses-of-sargassum-seaweed-in-the-caribbean
11. http://akumaldiveshop.com/sargassum-the-what-where-and-why-of-this-seaweed/
12. https://oceanservice.noaa.gov/facts/sargassosea.html
13. https://repository.library.noaa.gov/view/noaa/9151
14. https://www.ajol.info/index.php/ajb/article/view/117605
15. https://www.nature.com/articles/nature12860
16. https://bioone.org/journals/the-wilson-journal-of-ornithology/volume-124/issue-1/11-067.1/Foraging-over-Sargassum-by-Western-North-Atlantic-Seabirds/10.1676/11-067.1.short
17. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3931196/
18. http://www.cardi.org/wp-content/uploads/downloads/2015/11/Sargassum-Seaweed-and-its-use-in-crop-and-livestock-production-CARDI-Policy-Brief.pdf
19. https://science.sciencemag.org/content/365/6448/83
20. https://www.algasorganics.com/
21. https://www.sciencedirect.com/science/article/pii/S2352938516300441#f0025
22. https://www.sciencedirect.com/science/article/pii/S0079661118300259#f0035
23. https://www.sciencedirect.com/science/article/pii/S0025326X17305374#f0015
24. https://www.sciencedirect.com/science/article/pii/S0025326X19304953#bb0180
25. https://link.springer.com/article/10.1007/s10811-017-1218-z
26. https://science.sciencemag.org/content/365/6448/83.abstract
27. https://digital.library.txstate.edu/handle/10877/8143
28. https://eos.org/articles/satellite-data-reveal-growth-and-decline-of-sargassum
29. https://www.sciencenewsforstudents.org/article/record-seaweed-belt-spanned-africa-gulf-mexico
30. https://www.npr.org/2019/07/11/740871359/mexicos-beaches-are-being-overwhelmed-by-sargassum-seaweed-from-the-atlantic
31. https://www.marine.usf.edu/news-and-events/scientists-discover-the-biggest-seaweed-bloom-in-the-world/
32. https://www.livescience.com/65873-record-breaking-sargassum-bloom.html
33. http://www.algaebase.org/search/species/detail/?species_id=826&distro=y#distro