ActaPesca
Acta de Pesca de Recursos Aquáticos
Acta Fisheries and Aquatic Resources

PELAGIC *Sargassum* spp. BLOOMS AS AN AGENT OF MARINE LITTER TRANSPORT ALONG THE AMAZON CONTINENTAL SHELF

Florações de *Sargassum* spp. pelágicas como um agente de transporte de lixo marinho ao longo da plataforma continental amazônica

Floraciones de *Sargassum* spp. pelágicas como agente de transporte de desechos marinos a lo largo de la plataforma continental amazónica

Flavio de Almeida Alves-Júnior [1]* Déborah E. Galvão Martins [1] Alex Garcia C. de Macedo Klautau [2] Ana Patrícia Cordeiro Barros [3] & Israel Hidenburgo Aniceto Cintra [1]

[1] Socio-Environmental and Water Resources Institute, Federal Rural University of Amazon, Belém, Brazil.
[2] Chico Mendes Institute to Biodiversity Conservation National Center for Research and Conservation of Marine Biodiversity in Northern Brazil, Belém, Brazil.
[3] Socio-Environmental and Water Resources Institute, Federal Rural University of Amazon, Belém, Brazil
*Corresponding Author: Alves-Júnior, F.A. E-mail: bioflavio@hotmail.com

ABSTRACT

In this brief observation, we report on the transport of marine litter, originated from the fishing activities, promoted by the patches of seaweed (*Sargassum* spp.) in the Great Amazon Reef System (GARS) region, on the northern Brazilian continental shelf. This report highlights the environmental impacts of algal clumps and macroplastics and how these actions can harm fishing activities and the native biodiversity in the region.

Keywords: macroplastics, *Sargassum natans*, *Sargassum fluitans*, Northern Brazil, fishing impacts, Amazon Reef System.

RESUMO

Nesta breve observação, relatamos o transporte de lixo marinho, originado das atividades pesqueiras, promovido pelas manchas de algas marinhas (*Sargassum* spp.) na região do Grande Sistema de Recifes Amazônicos (GSRA), na plataforma continental do norte do Brasil. Esse relato destaca os impactos ambientais dos aglomerados de algas e macroplásticos e como essas ações podem prejudicar as atividades de pesca e a biodiversidade nativa na região.

Palavras-Chaves: macroplásticos, *Sargassum natans*, *Sargassum fluitans*, Norte do Brasil, impactos da pesca, Sistema de Recifes Amazônicos.

RESUMEN

En esta breve observación, informamos sobre el transporte de desechos marinos, procedentes de actividades pesqueras, promovido por parches de algas (*Sargassum* spp.) en la región del Sistema Arrecifal de la Gran Amazonia (GSRA), en la plataforma continental del norte de Brasil. Este informe destaca los impactos ambientales de los cúmulos de algas y macroplásticos y cómo estas acciones pueden poner en peligro las actividades pesqueras y la biodiversidad nativa de la región.

Palabras clave: macroplásticos, *Sargassum natans*, *Sargassum fluitans*, Norte de Brasil, impactos de la pesca, Sistema Arrecifal Amazónico.

ActaPesca 12(2), 2024
URL www.actapescanews.com
ISSN 2357-8068
DOI 10.46732/actafish

Note: Onboard Observation
Submitted: Aug 30, 2024 / Sep 06, 2024
Published: 14 Sep 2024
DOI: 10.46732/actafish.2024.12.2.121-126

SARGASSUM spp. AS A TRANSPORT AGENT OF MARINE LITTER

Currently, marine environments are suffering severe impacts from anthropogenic activities, including eutrophication of coastal zones, climate change and global warming, ocean acidification, oil spills, fishing activities, and marine litter. These impacts are causing significant negative effects on ocean health (Craveiro et al., 2022; Alves-Júnior et al., 2024). Among the main problems occurring in western Atlantic are the algae blooms promoted by the pelagic species, such as *Sargassum fluitans* (Børgesen) Børgesen, 1914 and *S. natans* (Linnaeus) Gaillon, 1828. In addition, marine litter discarded by fishing activities, which has been receiving increasing attention from researchers in the northern region of Brazil, is linked to the impacts of these activities in the region, such as the deposition of tons of algae on beaches (e.g. Atalaia beach, in the state of Pará), high fishing rates, difficulties in fishing regulation, and the deposit of plastic materials in marine areas.

Macroalgae blooms are becoming a problem in Atlantic regions, especially in northern Brazil and the Caribbean Sea, where their high density affects fishing activities and ship traffic. These macroalgae also facilitate the active transport of species, called “raft drifting” (e.g. sponges, corals, bryozoans, molluscs, echinoderms, crustaceans and fish) (see Figure 1 for example), beyond their respective biogeographical limits, creating a pathway for the introduction of invasive species into different ecosystems (Niermann, 1986; Moreira & Alfonso, 2013; Wang et al., 2019).

Figure 1. Clump of *Sargassum* spp. (collected *in situ*) acting in the transport of marine fauna (raft drifting) along the Atlantic Ocean. Highlighting the swimming crab *Achelous* sp. De Haan, 1833 being transported associated with the clump of algae.

On July 28th, 2023, during the commercial fishing operations of the red snapper *Lutjanus purpureus* (Poey, 1866), we observed a large clump of macroalgae of approximately 38,919 km^2 (Figure 2). This fishery is performed along the Amapá continental shelf areas (04°N, 0° S; 50°, 46° W), covering the depths between 70 and 100 m, in areas associated with the Great Amazon Reef System (GARS). In this area, we also observed several adjacent clumps, approximately 2 km in size, containing plastic materials such as plastic bottles, fuel jerry cans, bottle caps, styrofoam, ropes and fragments of nets (Figure 3). The majority of these materials are related to fishing activities, possibly originating in the northeastern region of Brazil (covering coastal zones between the states of Ceará and Maranhão), as well as materials discarded in the red snapper fishing areas. Large clumps of

pelagic algae occurring in fishing areas have negative impacts due to their heavy densification, which may cause boats to become entangled with the algae on the propellers, nets (including trawl nets), hooks, longline and winches.

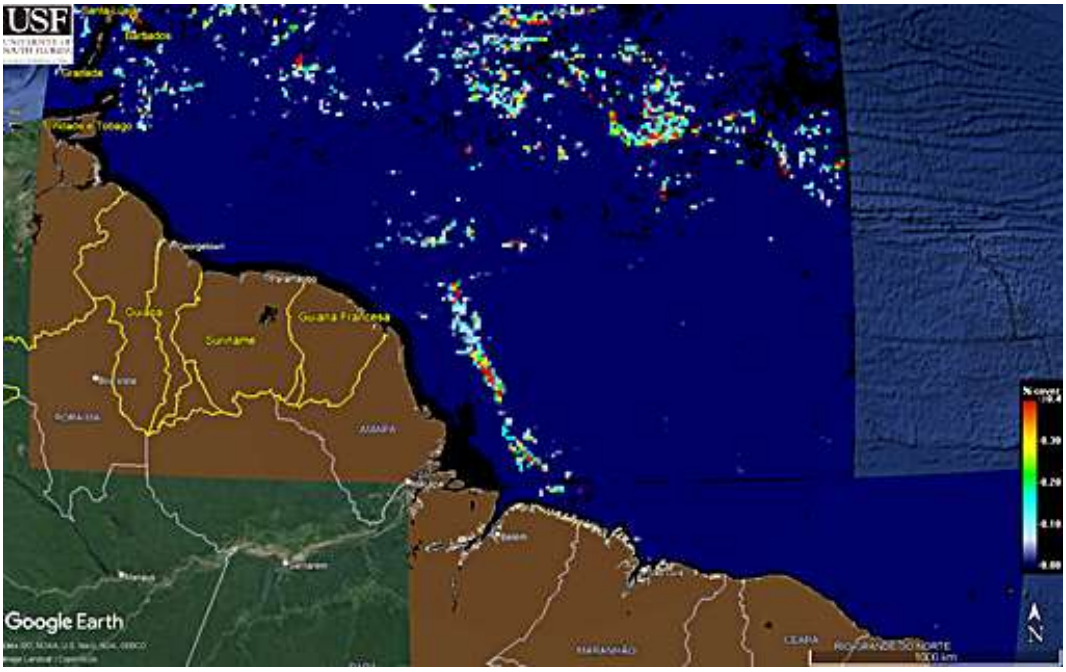

Figure 2. Map of the Amazon Continental Shelf (ACS), showing the large masses of floating algae (*Sargassum* spp.), between the states of Pará and Amapá. Scale = Red points (high densities) and Blue points (low densities). Source: Hu et al. (2023); USF - University of South Florida (2024).

Figure 3. Observation of a large clump of algae (~2 km) in the state of Amapá, carrying marine litter from fishing activities between the northeastern and northern regions of Brazil.

Large masses of pelagic *Sargassum* spp. act as a denser substrate than seawater, forming a solid conglomerate that facilitates the active transport of solid materials, such as macroplastics, collected by this dense mass floating in the water column. The presence of plastic materials associated with the clumps of algae may create new microhabitats for the attachment and transport of marine fauna, potentially introducing species to new regions. This fact has been observed in studies by Davenport (1992), Sano et al. (2003), Rech et al. (2016), Tutman et al. (2017), Mantelatto et al. (2020), Haram et al. (2021) and Soares et al. (2023), which reported that marine litter and fishing waste, such as glass and plastic bottles, nets, ropes, buoys, cages, tyres and wood from boats may work as vectors for introducing exotic species, mostly small invertebrates. The same case is herein reported, with the presence of Brazilian alien species *Balanus trigonus* Darwin, 1854 adhered to a plastic bottle (Figure 4A) and the cosmopolitan goose barnacle *Lepas (Lepas) anatifera* Linnaeus, 1758 floating in the water column associated with styrofoam (Figure 4B). This species is widely observed around the world associated with invertebrates and vertebrates (epibiosis) (Alves-Júnior et al., 2022), as well as associated with marine litter, tar balls, boat hulls and other consolidated materials (Bérgamo et al., 2023; Mello et al., 2023).

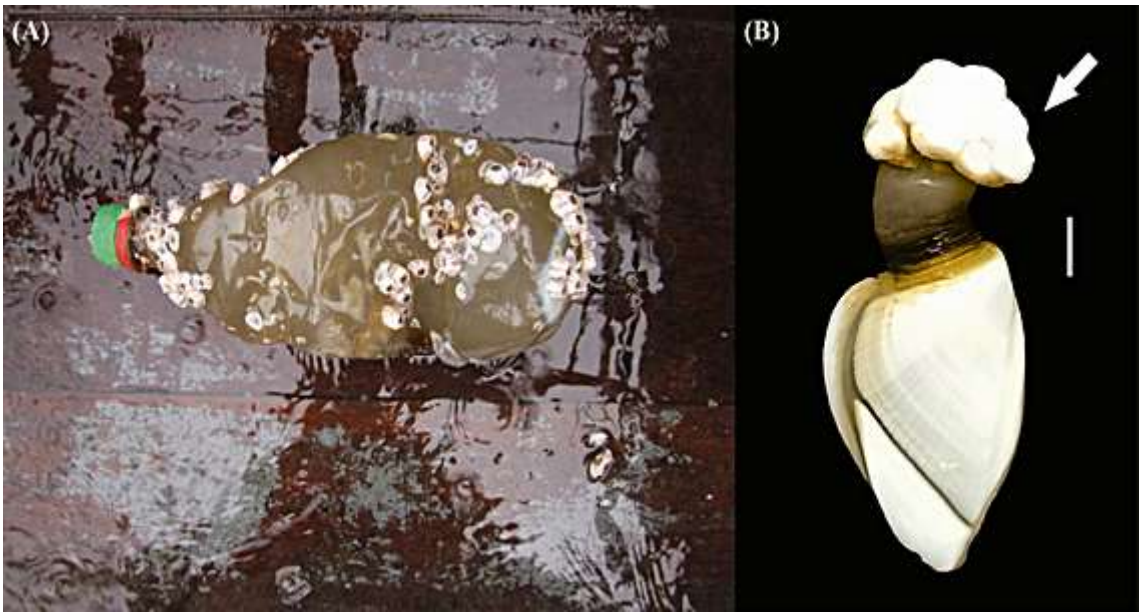

Figure 4. (A) The invasive barnacle species *Balanus trigonus* Darwin, 1854 observed adhered on the plastic bottle. (B) The goose barnacle *Lepas (Lepas) anatifera* Linnaeus, 1758 growing adhered to pieces of styrofoam. Both species were collected *in situ* (among the clumps of algae) in areas of commercial red snapper fishing operations.

According to Széchy et al. (2012) and Suida et al. (2024), large floating patches of *Sargassum* spp. were first observed in the Amazon continental shelf (ACS) in 2011, at that time of unknown origin. Since then, successive deposits on the coast were observed between 2014 and 2018; additionally, in 2022 and 2023, the beaches of the Caribbean and Florida (USA) reported record levels of macroalgae deposition in their coastal zones, probably from the Amazon shelf. These large clumps of algae occurs floating along the ACS under the influence of the North Brazilian Current (see Figure 2) and are eventually deposited in coastal zones from the states of Ceará to Amapá; small clusters of floating algae are concentrated in surface recirculation areas within the ACS, before being transported to the Caribbean Sea, the Gulf of Mexico and the southeastern United States.

In conclusion, the large influx of algae present in the northern region of Brazil has been generating negative impacts on fishing activities between the states of Pará and Amapá, due to the entanglement of boats and fishing nets, cages, hooks, ropes, and trap buoys. Additionally, the transport of marine litter associated with algae blooms increases the environmental impacts along the coastal zones, e.g. with the large seasonal deposit on beaches in the northeastern region of Pará. In the GARS area, the large presence of marine litter (micro- and macroplastics) may favor the deposition of plastic on the

seafloor, which is composed of coral, sponges and rhodolith banks, increasing the likelihood of ingestion or use by the native fauna, as well as the risk of introducing invasive species to the northern region of Brazil.

ACKNOWLEDGEMENTS

The authors would like to thank the National Center for Research and Conservation of Northern Marine Biodiversity (Cepnor) for the support and availability of material.

REFERENCES

Alves-Júnior, F.A., Martins, D.E.G., Silva, K.C.A., Klautau, A.G.C.M. & Cintra, I. H.A. (2022). Barnacles as epibionts in crustaceans from the Great Amazon Reef System (GARS) Northern of Brazil: New Records and New Host Associations. *Thalassas: An International Journal of Marine Sciences*, 38: 1371-1378. DOI: https://doi.org/10.1007/s41208-022-00480-y

Alves-Júnior, F.A., Martins, D.E.G., Cordeiro, A.P.B., Klautau, A.G.C.M. & Cintra, I.H.A. (2024). Rope to the sea: observation of the fishing rope acting as artificial substrata to fixation of coral *Astrangia solitaria* (Le Sueur, 1817) collected in the Great Amazon Reef System (GARS). *Environmental Smoke*, 7: 1-6. DOI: https://doi.org/10.32435/envsmoke-2024-0006

Bérgamo, D.B., Craveiro, N., Magalhães, K.M., Yogui, G.T., Soares, M.O., Zanardi-Lamardo, E., Rojas, L.A.V., Lima, M.C.S. & Rosa-Filho, J.S. (2023). Tar balls as a floating substrate for long-distance species dispersal. *Marine Pollution Bulletin*, 196: 115654. DOI: https://doi.org/10.1016/j.marpolbul.2023.115654

Craveiro, N., Alves, R.V.A., Silva, J.M., Vasconcelos, E., Alves-Júnior, F.A. & Rosa Filho, J.S. (2021). Immediate effects of the 2019 oil spill on the macrobenthic fauna associated with macroalgae on the tropical coast of Brazil. *Marine Pollution Bulletin*, 165: 112107. DOI: https://doi.org/10.1016/j.marpolbul.2021.112107

Davenport, J. (1992). Observations on the ecology, behavior, swimming mechanism and energetics of the neustonic grapsid crab, *P. minutus*. *Journal of the Marine Biological Association of the United Kingdom*, 72: 611-620. DOI: https://doi.org/10.1017/S0025315400059385

Haram, L.E., Carlton, J.T., Centurioni, L., Crowley, M., Hafner, J., Maximenko, N., Clarke, Murray, C.C., Shcherbina, A.Y., Hormann, V., Wright, C. & Ruiz, G.M. (2021). Emergence of a neopelagic community through the establishment of coastal species on the high seas. *Nature Communications*, 12: 6885. DOI: https://doi.org/10.1038/s41467-021-27188-6

Hu, H., Zhang, S., Barnes, B.B., Xie, Y., Wang, M., Cannizzaro, J.P., English, D.C. (2023). Mapping and quantifying pelagic *Sargassum* in the Atlantic Ocean using multi-band medium-resolution satellite data and deep learning. *Remote Sensing of Environment*, 289: 113515. DOI: https://doi.org/10.1016/j.rse.2023.113515

Mello, L.C., Nascimento, A.P., Lopes, B.D., Lima, A.D.F., Bezerra, L.E.A., Mendes, L.F., Bastos, L.M., Nossol, A.B.S., Martins, M.M., Martins, L.L. & Cavalcante, R.M. Tarballs on the Brazilian coast in late 2022 sustain *Lepas anatifera* Linnaeus, 1758 (Crustacea: Cirripedia): Occurrence and risk of petroleum hydrocarbon ingestion. (2023). *Science of the Total Environment*, 894: 164981. DOI: https://doi.org/10.1016/j.scitotenv.2023.164981.

Mantelatto, M.C., Póvoa, A.A., Skinner, L.F., Araújo, F.V. & Creed, J.C. (2020). Marine litter and wood debris as habitat and vector for the range expansion of invasive corals (*Tubastraea* spp.). *Marine Pollution Bulletin*, 160: 111659. DOI: https://doi.org/10.1016/j.marpolbul.2020.111659

Moreira, A. & Alfonso, G. (2013). Inusual arribazón de *Sargassum fluitans* (Børgesen) Børgesen en la costa centro-sur de Cuba. *Revista de Investigacion Marina*, 33: 17-20.

Niermann, U. (1986). Distribution of *Sargassum natans* and some of its epibionts in the Sargasso Sea. *Helgoländer Meeresuntersuchungen*, 40(4): 343-353. DOI: https://doi.org/10.1007/BF01983817

Rech, S., Borrell, Y. & García-Vazquez, E. (2016). Marine litter as a vector for non-native species: What we need to know. *Marine Pollution Bulletin*, 113, 40-43. DOI: http://dx.doi.org/10.1016/j.marpolbul.2016.08.032

Sano, M., Omori, M. & Taniguchi, K. (2003). Predator-prey systems of drifting seaweed communities off the Tohoku coast, northern Japan, as determined by feeding habit analysis of phytal animals. *Fisheries Science*, 69: 260-268. DOI: https://doi.org/10.1046/j.1444-2906.2003.00616.x

Suida, A.N.S., Blanguné, A., Dibner, S., Velarque, M., Boudouresque, C.-F., Connan, S., Goodwin, D.S., Stiger-Pouvreau, V., Viard, F., Rousseau, F., Michotey, V., Schell, J.M., Changeaux, T., Aurelle, D. & Thibaut, T. (2024). Morphological and molecular characters differentiate common morphotypes of Atlantic holopelagic *Sargassum*. *Phycology*, 4: 256-275. DOI: https://doi.org/10.3390/phycology4020014

Széchy, M.T.M., Guedes, P.M., Baeta-Neves, M.H. & Oliveira, E.N. Verification of *Sargassum natans* (Linnaeus) Gaillon (Heterokontophyta: Phaeophyceae) from the Sargasso Sea off the coast of Brazil, western Atlantic Ocean. *Check List*, 8(4): 638-641, 2012. DOI: https://doi.org/10.15560/8.4.638

Soares, M.O., Garcia, T.M., Giarrizzo, T., Martinelli Filho, J.E., Tavares, T.C.L., Ziveri, P., Smith, T.B., Bejarano, S. & Teixeira, C.E.P. (2023). Marine debris provide long-distance pathways for spreading invasive corals. *Science of the Total Environment*, 900: 165637. DOI: https://doi.org/10.1016/j.scitotenv.2023.165637

Tutmana, P., Kapiris, K., Kirinčićc, M. & Pallaoro, A. (2017). Floating marine litter as a raft for drifting voyages for *Planes minutus* (Crustacea: Decapoda: Grapsidae) and *Liocarcinus navigator* (Crustacea: Decapoda: Polybiidae). *Marine Pollution Bulletin*, 120(1–2): 217-221, 2017. DOI: https://doi.org/10.1016/j.marpolbul.2017.04.063

USF - University of South Florida (Optical Oceanography Laboratory of College of Marine Science) (2024). Accessed on: https://optics.marine.usf.edu/projects/saws.html

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: https://doi.org/10.1126/science.aaw7912