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The Journal of Indian Ocean Studies is a publication of the Society for Indian Ocean Studies (SIOS). Having completed thirty one years of publication, the Journal, published three times a year-in April, August and December, aims at bringing out articles contributed by defence experts, diplomats, eminent scholars and renowned thinkers on the various aspects of the Indian Ocean and the littoral regions of South and Southeast Asia, Africa, the Gulf and Australia. The Editorial Advisory Board Comprising Strategists and former practitioners of foreign affairs and defence as well as distinguished scholars on economy, history, etc. of the region provide regular guidance and advice. The journal has a vast readership among the Parliamentarians, think-tanks, maritime establishments, universities and institutions of excellence in various fields as also individual scholars.

Journal of Indian Ocean Studies
Vol. 32, No. 3
Sep - Dec 2024

Prints Publications Pvt Ltd
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SIOS
ISSN 0972-3080
Vol. 32, No. 3 Sep - Dec 2024

Journal of Indian Ocean Studies

Living and Nonliving Resources of The Indian Ocean

Prints Publications Pvt Ltd

Subscription:

Subscription and orders for the journal should be sent to the Publisher:

Annual Subscription Price:

National (INR) 1500.00 International (US$) 150.00

Online version free with Print Subscription

All remittances must be paid in favor of Prints Publications Pvt Ltd payable at New Delhi.

ELECTRONIC VERSION : This Journal can be accessed at www.printspublications.com

PERIODICITY : This Journal is published three times a year in — **April, August and December**

Published and printed on behalf of Society for Indian Ocean Studies (SIOS)

By Mr. Pranav Gupta, Prints publications Pvt Ltd, New Delhi, India

All business correspondence should be addressed to:

Prints Publications Pvt Ltd
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Darya Ganj, New Delhi-110 002
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Society for Indian Ocean Studies (SIOS)

Society for Indian Ocean Studies, 2, Lado Sarai Institutional Area, New Delhi-110030

Journal of Indian Ocean Studies

Vol. 32, No. 3 **September-December, 2024**

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Editorial

The Indian Ocean, the third largest ocean is the repository of very rich biodiversity as well as vast reserves of hydrocarbons, natural gas and minerals. The underwater domain in this ocean presents a world in itself and is characterised by a unique marine ecosystem which produces seasonal winds and turbulence known as monsoon. Along this Ocean civilisations have flourished since millennia. There are 36 countries on the littoral of this ocean with 11 hinterland states which are habited by appr. 30% of earth's population. The geographical centrality of this body of water and the ease of communication through it because of the largely moderate temperature conditions throughout the year have influenced commentators and strategists to remark from ancient times that whosoever controls the Indian Ocean controls the destiny of the world. No wonder today the global powers have come to realise that the Indian Ocean holds the key to the stability and security of the vast maritime expanse from the west coast of America to the east coast of Africa and therefore they have started treating it as one entity along with the Pacific Ocean-namely the wider Indo-Pacific.

The resources of the Indian Ocean, living or non-living, have been a compelling attraction to the countries of the region as well as outside powers from historical times. The countries around the Ocean were always densely populated and the people living there used the Ocean in multiple ways- fishes and crustaceans for food, corals, pearls etc as precious items and minerals for economic development. The Ocean acted as a convenient and inexpensive avenue for transportation. Today the Indian Ocean is looked upon as a key facilitator for connectivity through its choke points of the Malacca and Sunda Straits, Bab-el-Mandeb and the Hormuz Straits. Thousands of ships pass across the ocean every day carrying goods and energy which supports global trade and economic activity.

Today a host of innovative ways are being explored to use the resources of the Ocean. Modern methods are employed for improving fish collection and processing. New regulatory mechanisms are being introduced to control IUU (Illegal, unreported and unregulated fishing). The BBNJ Treaty (Beyond Borders of National Jurisdiction) enacted recently seeks to regulate activity, with respect to living or non-living resources in the open Seas beyond the Exclusive Economic Zones. A new concept of Blue Economy has emerged which aims at optimising resource utilisation from the seas. In the case of

India, the blue economy already contributes 6% of the country's overall economy. All countries around the Indian Ocean are engaged in expanding the contribution of their Blue Economy to the national development. The rich biodiversity of fauna and flora under the tropical waters of the Indian Ocean is seen to be mind boggling. The island states in the Ocean are getting better placed to protect it as well as benefit from it. Another encouraging development is the increasing attention that the countries like India are paying to Marine Spatial Planning along its long coastline. That should enable a more systematic and effective use of the marine resources. Just as the land-use surveys so also the marine space around the country needs detailed research and analysis. Such planning is however not easily feasible since it involves collection of extensive data, coordination between the various coastal states and the agencies of the government.

Exploration of non-living resources from the sea-bed is relatively new. The Sea-Bed Treaty, signed in 1994 formalized it. But offshore exploration and extraction of oil and natural gas has been going on even before that. The Indian Ocean has emerged as a major source of these vital energy items. The Persian Gulf region is one of the world's largest oil-producing areas. Despite the growing global concern over the fossil fuels as a major contributor to climate change the extraction of oil was maximum last year. At the recently concluded COP 29 it was evident that most countries are still in business of protecting their fossil fuel stocks (many of which are in the oceans) that can lend great value.

Deposits of non-living items such as polymetallic nodules, critical minerals, hydrogen sulphide gas etc are estimated to be abundant in the Indian Ocean. They contain valuable metals like manganese, nickel, cobalt, titanium, zircon, copper, rutile etc. How to extract these would inevitably require international regulation, huge investment in developing underwater domain technology, cooperation in research etc. After all this kind of effort cannot be undertaken by one country alone. In the Indian Ocean a number of western companies are engaged in such projects. Developing countries from the Indian Ocean region are also working in this field. The regional organization like the Indian Ocean Regional Association (IORA) can hopefully contribute to this process.

The subject 'Living and Non-living Resources of the Indian Ocean' impacts India and the region in so many ways that we thought a study in all its multiple facets was imperative and necessary. Hence we decided to devote

this issue of our Journal exclusively to this topic. The response from both experts and scholars has been encouraging.

In the paper titled 'Dual Riches of the Indian Ocean-Biodiversity and Mineral Resources' Dr Pradeep Raja C. has done an integrated assessment of the extraordinary variety of living and non-living resources. He finds the Ocean to be home to a big biological diversity as also a repository to rich deposits of minerals and energy resources. The diversity supports economies of many countries while playing a crucial role in regulating global climate patterns. He calls for a balance between resource utilization and conservation, while addressing geopolitical challenges.

In his article' India's Blue Frontier: Exploring the Indian Ocean's Resources and India's Role in Global Foreign Policy, ' Dr Sriniwas Junuguru emphasises the vital role of the Indian Ocean in India's Blue Economy and as a key route for global trade. He refers to the Deep Ocean Mission of India's Ministry of Earth Sciences, in which the Ministry took up resource inventories for energy, fisheries, and minerals. He calls for a leading role for India in the Indian Ocean, given its strategic position.

Ms Yonne Waweru, in her paper on Biodiversity Beyond National Jurisdiction (BBNJ) has termed this new treaty (agreed to after 15 years of negotiations) which she believes can act as a carbon sink regulating global climate, supporting fisheries and blue economy . According to her the Indian Ocean Regional Association (IORA) is best suited for a variety of reasons for the Indian Ocean wide governance to implement BBNJ and proposes the establishment of an institutional mechanism.

In her article Dr Lekha Ravi has written on seaweed farming in High Seas as a carbon capturing tool and explored its potential and research gaps. By referring to an interesting and promising subject she has described the role that seaweed farming can play by sequestering carbon thus reducing atmospheric CO2 and contributing to mitigating climate change.

In his paper 'Japan's Involvement in Promoting Connectivity and Resilience in Marine Security Island Nations in IOR, ' Dr Emadul Islam writes from Tokyo that Japan wants to enhance marine security in the Bay of Bengal and island nations of the Indian Ocean. Japanese policy tools include regional multilateralism, Official Development Assistance (ODA), and aid to littoral states in equipment and capacity building. He has made policy recommendations in this regard.

In his article, Dr Jayan draws attention to the issue of maritime debris in the Indian Ocean, which is extremely harmful to the people, economy, and wildlife. He has also written about the menace of plastic waste, which enters the Indian Ocean in huge quantities every year. While various campaigns to eradicate this problem are taken up at the national level, the author also calls for efforts at the international level.

In an interesting paper Dr M.P. Itambu writes about the legacy embedded within the assets of the Indian Ocean and Tanzania which share a long antiquity, especially during the ancient maritime trade systems. Interregional trade networks existed from 1000 to 1500 AD which stimulated vastly socio-economic activities of coastal communities in eastern Africa. According to the author, historic contacts have left legacies in terms of language, crops, animal domestication, trade, architecture etc . Indian origin is also traced in several cross-cultural traditions in culinary practices, sports, music etc.in the region.

In his article Captain Vertul Dixit has described Indian Ocean as a treasure of enormous wealth. He gives a detailed list of minerals available in the Indian Ocean bed. Stating that India got the right to explore polymetallic nodules from seabed in the central Indian Ocean basin in 2002 from the International Seabed Authority he illustrates a schematic image of a ship engaged in mining. He further mentions that the coastal area provides anchoring ground to ships and several related activities. He discusses the availability and exploitability of various resources in the Indian Ocean, primarily oil and gas reserves, minerals and ocean fauna.

The richness of the Indian Ocean in terms of living and non-living resources places a responsibility on the littoral countries as well as outside powers to protect and explore them only for sustainable utilisation. International agreements wherever possible will be necessary for the regulation and implementation lest the invaluable resources available in the ocean will be severely damaged if not exhausted forever.

Happy Reading

Sudhir T. Devare
Editor-in-Chief
20th December, 2024

Journal of Indian Ocean Studies, Vol. 32, No. 3, September–December 2024, 347-356

Crossing the Rubicon: Addressing the Issue of Maritime Debris in Indian Ocean*

*P. A. Jayan

Introduction

The marine litter constitute one of the key concerns and issues facing the seafaring countries around the world. In the maritime eco system, the living and nonliving assets of any ocean occupies a significant role. Maritime litters or debris is extremely harmful to the marine environment. It affects the marine ecosystem, people and economy of a nation. In addition, it contributes to the impact to marine wildlife. Marine debris has been documented by Gall and Thompson[1] to influence more than 700 species, from coastal vegetation, to plankton, invertebrates, fish, cetaceans, sea turtles and seabirds. When it comes to the Indian Ocean, it is rich in natural resources. The 95 per cent of India's trade by volume and 68 per cent of trade by value come via the Indian Ocean. The presence of 13 major ports and over 200 minor ports provide avenues for exports of Indian goods to world. Maritime litters are global issue. The reason related to there is no proper waste disposal or recycling. Moreover, the key solution lies in the proper waste management at the source. The origin of marine pollution mainly emanates from land-based pollution. Still, the

**The phrase/idiom "Crossing the Rubicon" has been used figuratively in English since the early 1600s. It is used to describe a decision that cannot be reversed. The idiom also purports to make a final decision or pass a point of no return. It comes from the story of Julius Caesar crossing the Rubicon River in 49 BC, which started the Roman Civil War.*

***Dr. P. A. Jayan is in a faculty member in the School of Maritime Management, Indian Maritime University, Kochi.*

1 Marine Debris Program, Why is Marine Debris a Problem? Office of Response and Restoration, National Oceanic and Atmospheric Administration, available at https://marinedebris.noaa.gov/discover-marine-debris/why-marine-debris-problem#:~:text=Marine%20debris%20can%20cause%20a,cetaceans%2C%20sea%20turtles%20and%20seabirds. Accessed on 21st October 2024.

DOI : https://doi.org/10.32381/JIOS.2024.32.03.6

ocean- based pollution, which is primarily the major concern for living and non-living assets of ocean. Key issues facing the Indian Ocean related to a range of challenges in the form of plastic pollution, climate change, coastal development, overfishing, coral reef degradation and deep-sea mining. Is marine debris preventable? The answer is loud and clear and main underlying argument in this paper-- marine debris is preventable. It is everyone's problem.

Indian Ocean: An Overview

The sea, as a theatre of exploration, fascinated humanity from time immemorial. The Indian Ocean covers some 27 per cent of the maritime space of the world. It is the third largest ocean in the world and covers 14 per cent of the total globe [2]

With over 7,500 kilometers of coastline, 14,500 kilometers of navigable waterways, and 212 active ports (12 government-owned and 200 immediate and minor ports), India relies heavily on the Indian Ocean for commercial and noncommercial shipping, energy importation, trade, tourism, and fishing.[3] The Indian Ocean holds 16.8% of the world's proven oil reserves and 27.9% of proven natural gas reserves.[4] The dependence on fossil fuels is endangering the Indian Ocean.

The Indian Ocean is the third largest ocean covering 70,560,000 km^2 and corresponding to 19.8% of the earth's water surface, when the marginal seas are included.[5] As the resident naval power in the Indian Ocean, India plays a significant role.[6] The Indian Navy identifies the entire Indian Ocean—from the eastern coast of Africa to the Andaman Sea—as its area of priority, underpinning its role as a first responder as well as a net provider of security for its friends and partners in the region.

2 Michael Pearson, 2003, The Indian Ocean, (London: Routledge) P.14.

3 "Annual Report 2021–22," Government of India, Ministry of Ports, Shipping & Waterways, October 13, 2022. https://shipmin.gov.in/sites/default/files/Annual%20Report%202021-22%20%28ENGLISH%29.pdf.

4 British Petroleum (2017). *BP Statistical Review of World Energy 2017.* [online] pp.12-34. Available at: https://calculators.io/statistical-review-of-world-energy/.

5 Eakins, B.W. and Sharman, G.F. (2007) Volumes of the World's Oceans from ETOPO2v2. American Geophysical Union, Fall Meeting 2007.

6 See also, Darshana M. Baruah, Nitya Labh, and Jessica Greely 'Mapping the Indian Ocean Region' June 15, 2023. The Paper is available at https://carnegieendowment.org/research/2023/06/mapping-the-indian-ocean-region?lang=en. Accessed on 7th November 2024.

What is Marine Debris or Maritime Litters? How to Address the Issue of Marine Debris/Marine Litters?

Marine ecosystems[7] are characterised by the biological community of organisms that they are associated with and their physical environment. Marine debris is defined as any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned in the marine environment or the great lakes.[8] Anything human-made and solid can become marine debris once lost or littered in these aquatic environments. Our trash has been found in every corner of our ocean, from the most remote shorelines, to ice in the Arctic, and even the deepest parts of the sea floor.

Marine debris is defined as "any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned into the marine environment or

7 Marine ecosystems are the largest aquatic ecosystems on Earth and it consists of plenty of salt. Here are some examples of living and nonliving things found in the ocean:
Living things:
- Fish (e.g. sharks, clownfish, tuna)
- Crustaceans (e.g. crabs, lobsters, shrimp)
- Mollusks (e.g. clams, oysters, squid)
- Corals
- Seaweed and other marine algae
- Plankton (microscopic organisms such as phytoplankton and zooplankton)
- Marine mammals (e.g. whales, dolphins, seals)
Nonliving things:
- Water
- Sand and rocks on the seafloor
- Driftwood and other submerged plant matter
- Dissolved salts and minerals in the water
- Hydrothermal vents and volcanic features on the ocean floor
- Ocean currents and waves
- Sunlight that penetrates the water
The living things in the ocean include a diverse array of plants, animals, and microscopic organisms that play important roles in the marine ecosystem. The nonliving components provide the physical environment and resources that support this rich biodiversity.

8 Marine Debris Program, Why is Marine Debris a Problem? Office of Response and Restoration, National Oceanic and Atmospheric Administration, available at https://marinedebris.noaa.gov/discover-marine-debris/why-marine-debris-problem#:~:text=Marine%20debris%20can%20cause%20a,cetaceans%2C%20sea%20turtles%20and%20seabirds. Accessed on 21st October 2024.

Great Lakes."[9] Major marine debris events caused by natural disasters, such as the 2017 hurricanes Harvey, Irma and Maria and 2018 typhoon Yutu, continue to bring national and international attention to the marine debris issue.

It is quite interesting to know that what constitutes the marine debris—huge amounts of plastics, metals, rubber, paper, textiles, derelict fishing gear, derelict vessels, and other lost or discarded items enter the marine environment every day. Anything man-made – such as fishing gear, plastic bags, beverage bottles, balloons, food wrappers, and even vessels – can become marine debris through dumping, improper waste management, litter that is blown or washed out to sea through storm drains, and extreme natural events which can transport both small and large items into the ocean.[10] This makes marine debris one of the most widespread pollution problems facing the world's ocean and waterways. Some of the most common and harmful types of marine debris include plastic, such as cigarette butts, plastic bags, and food wrappers, and derelict fishing gear. Marine debris can also range greatly in size from the smallest plastic pieces, called microplastics, that can be too small to be seen with the human eye, to huge abandoned and derelict vessels, construction debris, and household appliances that can damage sensitive habitats. Although some of these items may eventually break down, others are made to last a long time. Once they are in the environment, these items may never fully go away.

A study by Borrelle et al., estimated that in 2016, as much as 23 million metric tons of plastic waste entered aquatic ecosystems from land around the world.

What qualifies as a marine ecosystem? Although there is some disagreement[11], several types of marine ecosystems are largely agreed on: estuaries, salt marshes, mangrove forests, coral reefs, the open ocean, and the deep-sea ocean.

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9 See, 33 U.S.C. 1951 et seq., as amended by in 2012 by Title VI of Public Law 112-213 and 2018 by Public Law 115-265. Available at https://www.fws.gov/testimony/marine-debris-impacts-ecosystems-and-species#:~:text=Marine%20debris%20can%20injure%20or,threaten%20human%20health%20and%20safety. Accessed on 14th November 2024. Source: Marine Debris: Impacts on Ecosystems and Species, U.S Fish & Wildlife Service

10 Ibid.

11 National Geographic Education, Marine Ecosystems, available at https://education.nationalgeographic.org/resource/marine-ecosystems/. Accessed on 23th October 2024.

Like all oceans, the Indian Ocean absorbs excess heat – 80-90% – from the earth's surface.[12] It is also bordered by the South Asian landmass to the north. Consequently, heat accumulated in the northern part of the ocean and heat absorbed from the atmosphere due to global warming triggers severe climate change impacts such as marine heatwaves, sea-level rise, ice melting in Antarctica, and ocean acidification. These extreme changes have far-reaching impacts on marine biodiversity, including coral bleaching and the decimation of marine species.[13] There is also potential for extreme weather conditions like flooding in low-lying areas, as has been evident in South Africa in recent years.

The easternmost part of the Indian Ocean, termed a global hotspot for marine biodiversity, is inhabited by the highest population of marine species in the world, including sharks, dugongs, whales, and sea turtles. The ocean's seamounts and hydrothermal vents also provide conducive conditions for marine life to thrive.[14] Further, its clear waters are populated by huge tuna fish schools whose main source of food is the smaller fish, exemplifying the diversity of marine animals.

Marine litter includes all synthetic materials that are discarded or abandoned in the marine environment, which is sourced to the sea through riverine systems. It is estimated that 0.6 million metric tons of plastic waste enter the Indian Ocean each year through various land-based (littering, dumping, tourism, recreation, surface run-off) and sea-based (fishing, aquaculture, shipping, coastal dumping, oil and gas exploration) activities.[15] The marine litter accumulated in the Indian Ocean forms a â€œgarbage patchâ€ and also acts as a transboundary source. Marine litter negatively affects the environment, ecology, public health, climate, and economy. It is

12 Karen Nkatha, '15 Indian Ocean Facts in 2023: Its Importance and The Threats It Faces'. 15 May 2023. Available at https://www.greenpeace.org/africa/en/blogs/53514/15-indian-ocean-facts-in-2023-its-importance-and-the-threats-it-faces/#:~:text=Threats%20to%20the%20Indian%20Ocean,reef%20degradation%2C%20and%20coastal%20development. Accessed on 23th October 2024.

13 Ibid.

14 Ibid.

15 Robin, R. S., Karthik, R., Nithin, A., & Purvaja, R. (2023). Removal of Marine Litter and Its Impact Along the Coast of India. *Records of the Zoological Survey of India*, *123*(1S), 67–86. https://doi.org/10.26515/rzsi/v123/i1S/2023/172453. Also available at https://recordsofzsi.com/index.php/zsoi/article/view/172453. Accessed on 13th November 2024.

well known that the emergence of marine litter, especially plastic, has been a global problem for the past two decades and that its cost to society and the marine environment is enormous and irreversible. At the national level, various campaigns[16] (Swachha Sagar Abhiyan, Suchitwa Sagaram, Swachch Sagar, and Surakshit Sagar) are conducted to overcome the marine litter pollution along Indian coast. Swachch Sagar Surakshit Sagar (1500 tonnes of litter removed from 75 beaches) and Puneet Sagar Abhiyan (100 tonnes of plastics removed, out of which about 60 tonnes of plastics were recycled) are some of the initiatives in India. Community action is successful in the removal of marine litter, as seen at Vengurla (a landfill converted to Swachh Bharat Waste Park) and Versova (5 million Kg of plastic removed), Maharashtra.

Most marine litter is composed of plastic items (e.g. Galgani et al., 2015) and comes from both land-based and maritime sources (Law, 2017). Once in the marine environment, the fate of plastics can be diverse but items of neutral and positive buoyancy are driven by winds and currents to concentrate in particular areas of the oceans, the so-called 'garbage patches' (Van Sebille et al., 2020). Garbage patches have been identified in all mid-ocean gyres with the ones in the Pacific exhibiting the highest litter densities recorded (reviewed in Ryan, 2013).

The United Nations signed a resolution in March 2019 to fight ocean plastic waste by revolutionising the production, use, recycling and discarding of plastics (UNEP, 2019). Innovative solutions are being developed to tackle plastic pollution (Dijkstra et al., 2020; Schmaltz et al., 2020), and oceanographic models have highlighted where actions should be prioritised (Sherman and Van Sebille, 2016). However, even if changes are implemented rapidly and effectively, it is likely plastics will continue to pollute aquatic environments for many years due to their long-life spans and their current ubiquity in all environments (Lebreton et al., 2019). Further, there is currently a mismatch between the amount of plastics estimated to be released in the marine environment (19–23 million metric tonnes; Borrelle et al., 2020) and the low estimated amount of floating plastics at sea (0.09–0.27 million metric tonnes; Eriksen et al., 2014; Van Sebille et al., 2015). As acknowledged by Borrelle et al., (2020), the complex interactions in the coastal environments make it difficult to predict accurately the litter inputs into the oceans. Empirical

16 Ibid.

data are therefore needed to refine the estimates of plastics going to sea (e.g. Ryan et al., 2020), but also of plastics floating at sea and in the water column to help resolve the conundrum of the 'missing plastics.'

Tackling the marine litter issues should not be confined only to the recycling and waste reduction. Identify the limitations of existing solutions, filling up the critical gaps, the challenges of developing new and innovative solutions. New methods of prevent, monitor and clean (PMC) is the need of the hour in addressing the issue of marine litters.

Why Indian Ocean Matters?

The Indian Ocean is the world's 3rd-largest ocean. Its maritime trade routes manage almost 70% of the world's container traffic.[17]

Importance for India:

1. Trade Route: 80% of India's external trade and 90% of the energy trade happens through it.
2. Prominence of the Indo-Pacific in Geopolitics: The global power axis has shifted away from the Pacific-Atlantic to the Indo-Pacific in India's neighbourhood now.
3. Civilizational Importance: It carried India's cultural and civilisational imprint across its shores and created a vast sphere of India's civilisational influence.

The Indian Ocean offers a livelihood to millions of people. Alone for Kerala, it is estimated that in 2017 there were 240,000 people earning a livelihood from marine fishing.[18] Sri Lanka reported 250, 000 active fishers and another 100,000 support personnel[19], Pakistan reported 194,400 people, in Mauritius

17 "Ram Madhav, "India, Making Waves in the Indian Ocean" published in "Indian Express" on 10th February 2024.

18 Government of Kerala, Directorate of Fisheries (2022) Fisheries Handbook 2019. https://fisheries.kerala.gov.in/sites/default/files/2019-06/Handbook%20for%20web%20Publishing-compressed.pdf.

19 Fishing Industry in Sri Lanka (2019) https://www.watchinglanka.com/fishing-inustry-in-sri-lanka/

22,000 people worked in the fishing sector[20], and in the Maldives, the fishing sector accounts for 11% of employment. It is known that parts of the Indian Ocean suffer from significant plastic pollution[21], however, much of the

20 Fisheries Sector in Mauritius. (2022). https://blueconomy.govmu.org/Pages/Fisheries.aspx

21 Thiemann, T. (2023) Microplastic in the Marine Environment of the Indian Ocean. *Journal of Environmental Protection*, 14, 297-359. The article states that Microplastics (MPs) are defined as small plastic particles of 5 mm or less in size [1] , with mesoplastics making up the category of next larger-sized plastics (5 mm - 25 mm). Microplastics are categorized as primary MPs (plastic particles that have been synthesized in this small size to fulfill a certain purpose such as abrasives) and as secondary MPs (particles stemming from the fragmentation of larger plastic pieces). MPs can be made of a variety of polymeric materials such as Polythene (PE), Polypropylene (PP), Polystyrene (PS), Polyamide (PA), and Polyalkylene Terephthalate (PPT and PET), among others. For a detailed analysis, the best estimates see 82 - 358 trillion plastic particles weighing 1.1 - 4.9 million tons in the marine environment [See, Eriksen, M., Cowger, W., Erdle, L.M., Coffin, S., Villarrubia-Gómez, P., Moore C.J., Carpenter, E.J., Day, R.H., Thiel, M. and Wilcox, C. (2023) A Growing Plastic Smog, Now Estimated to Be over 170 Trillion Plastic Particles Afloat in the World's Oceans—Urgent Solutions Required. PLOS ONE, 18, e0281596.
https://doi.org/10.1371/journal.pone.0281596] . MPs are not only found on the water surface [See, Cincinelli, A., Martellini, T., Guerranti, C., Scopetani, D. and Giarrizzo, T. (2019) A Potpourri of Microplastics in the Sea Surface and Water Column of the Mediterranean Sea. TrAC Trends in Analytical Chemistry, 110, 321-326.
https://doi.org/10.1016/j.trac.2018.10.026], but rather the majority of MPs are located along the water column [See also, Cincinelli, A., Martellini, T., Guerranti, C., Scopetani, D. and Giarrizzo, T. (2019) A Potpourri of Microplastics in the Sea Surface and Water Column of the Mediterranean Sea. *TrAC Trends in Analytical Chemistry,* 110, 321-326.
https://doi.org/10.1016/j.trac.2018.10.026] [See for details, Liu, K., Zhang, F., Song, Z., Zong, C., Wei, N. and Li, D. (2019) A Novel Method Enabling the Accurate Quantification of Microplastics in the Water Column of Deep Ocean. *Marine Pollution Bulletin,* 146, 462-465.
https://doi.org/10.1016/j.marpolbul.2019.07.008], the ocean floor [See, Kane, I.A., Clare, M.A., Miramontes, E., Wogelius, R., Rothwell, J.J., Garreau, P. and Pohl, F. (2020) Seafloor Microplastic Hotspots Controlled by Deep-Sea Circulation. Science, 368, 1140-1145.
https://doi.org/10.1126/science.aba5899] , and in the ocean sediments [See, Martin, C., Young, C.A., Valluzzi, L. and Duarte, C. (2022) Ocean Sediments as the Global Sink for Marine Micro- and Mesoplastics. *Limnology and Oceanography Letters,* 7, 235-243.
https://doi.org/10.1002/lol2.10257] . In addition, anthropogenic activity on and near the oceans contributes to the influx of MP. These activities include fishing [See, Wright, L.S., Napper, I.E. and Thompson, R.C. (2021) Potential Microplastic Release from Beached Fishing Gear in Great Britain's Region of Highest Fishing Litter Density. *Marine Pollution Bulletin,* 173, Article ID: 113115.
https://doi.org/10.1016/j.marpolbul.2021.113115] [See, Dowarah, K. and Devipriya, S.P. (2019) Microplastic Prevalence in the Beaches of Puducherry, India and Its Correlation with Fishing and Tourism/Recreational Activities. *Marine Pollution Bulletin,* 148, 123-133.
https://doi.org/10.1016/j.marpolbul.2019.07.066] and shipping [See, Tamburri, M.N., Soon, Z.Y., Scianni, C., pstad, C.L., Oxtoby, N.S., Doran, S. and Drake, L.S. (2022) Understanding the Potential Release of Microplastics from Coatings Used on Commercial Ships. *Frontiers in Marine Science,* 9, Article 1074654.

systematic research on MP (Micro Plastic) abundance in different regions of the Indian Ocean stems only from the last five years.

Conclusion

The issue of marine debris is largely global in nature. Since the concept, maritime itself crossing national boundaries, the issue should be addressed at international level. To protect and preserve the marine environment and the framework for ocean governance, the key international law and treaties include United Nations Convention on the Law of the Sea (UNCLOS), the United Nations Framework Convention on Climate Change (UNFCCC), Convention on International Trade in Endangered Species (CITES), Convention on Biological Diversity (CBD), Convention on Migratory Species (CMS), and the Agreement on the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks. The role of individual nations, community initiatives and human level efforts are extremely needed to address the marine litters issue in an intended way with result-oriented and outcome-based approaches. Reduce carbon emissions, make the ports sulphur-free areas, keep the ocean plastic free are few solutions to address the

https://doi.org/10.3389/fmars.2022.1074654] [See also, Jaini, M. and Namboothri, N. (2023) Boat Paint and Epoxy Fragments—Leading Contributors of Microplastic Pollution in Surface Waters of a Protected Andaman Bay. Chemosphere, 312, Article ID: 137183.
https://doi.org/10.1016/j.chemosphere.2022.137183] operations, and recreational activities [See, Dowarah, K. and Devipriya, S.P. (2019) Microplastic Prevalence in the Beaches of Puducherry, India and Its Correlation with Fishing and Tourism/Recreational Activities. *Marine Pollution Bulletin,* 148, 123-133.
https://doi.org/10.1016/j.marpolbul.2019.07.066]. In all world's oceans, MP has been found. This includes the Arctic [See, Bergmann, M., Collard, F., Fabres, J., Gabrielsen, G.W., Provencher, J.F., Rochman, C.M., van Sebille, E. and Tekman, M.B. (2022) *Plastic Pollution in the Arctic. Nature Reviews Earth & Environment,* 3, 323-337.
https://doi.org/10.1038/s43017-022-00279-8
[See, Ross, P.S., Chastain, S., Vassilenko, E., Eyemadifari, A., Zimmermann, S., Quesnel, S.A., Eert, J., Solomon, E., Patankar, S., Posackar, A.M. and Williams, B. (2021) Pervasive Distribution of Polyester Fibres in the Arctic Ocean Is Driven by Atlantic Inputs. Nature Communications, 12, Article No. 106.
https://doi.org/10.1038/s41467-020-20347-1] and Antarctic waters [See, Waller, C.L., Griffiths, H.J., Waluda, C.M., Thorpe, S.E., Loaiza, I., Moreno, B., Paccheres, C.O. and Hughes, K.A. (2017) Microplastics in the Antarctic Marine System: An Emerging Area of Research. *Science of the Total Environment,* 598, 220-227.
https://doi.org/10.1016/j.scitotenv.2017.03.283] [Kelly, A., Lannuzel, D., Rodemann, T., Meiners, K.M. and Auman, H.J. (2020) Microplastic Contamination in East Antarctic Sea Ice. Marine Pollution Bulletin, 154, Article ID: 111130. https://doi.org/10.1016/j.marpolbul.2020.111130] .

ocean pollution and its subsequent impact on living and non living resources of ocean. Educate oneself about the issue, advocating and spreading the awareness of marine debris, minimize direct threats to coral reefs are really mattered in the pollution free marine eco system. Natural debris (seaweeds, terrestrial vegetation) also needs to be concerned. Citizens can participate in coastal clean-up activities to remove litter from the coastal and beach areas in India. Some of the measures can be adopted to arrest the problem of marine debris such as adopting the sustainable practices, implementing the polluter pays principle, eco-labelling of beaches, trash booms in urban rivers, ensuring healthy oceans, and promoting a sustainable blue economy.