ISSN 1027-2119

THE JOURNAL OF NOAMI

VOLUME 37 NUMBERS 1&2

THE JOURNAL OF NOAMI

VOLUME 37 NUMBERS 1 & 2

NATIONAL OCEANOGRAPHIC AND MARITIME INSTITUTE (NOAMI)
DHAKA, BANGLADESH

THE JOURNAL OF NOAMI

EDITORIAL BOARD

NATIONAL OCEANOGRAPHIC AND MARITIME INSTITUTE (NOAMI)

MHK Terminal (2nd Floor), 110 KN Islam Avenue, Banglamotor, Dhaka, Bangladesh

Mob.: +8801913630710 (WhatsApp), **Email:** noamibd@gmail.com, journal@noami.org.bd

Web.: https://www.noami.org.bd

ACKNOWLEDGEMENT

The publication of this journal is funded by the Ministry of Science and Technology

Government of the People's Republic of Bangladesh

BOARD OF GOVERNORS OF NOAMI
(2022-2023)

*The Journal of NOAMI, **37**(1-2):103-121*

IDENTIFYING THREATS AND REDUCTION MEASURES OF EMERGING PLASTIC POLLUTION IN THE CORAL-BEARING ST. MARTIN'S ISLAND, BANGLADESH

Md. Simul Bhuyan[1*], Sayeed Mahmood Belal Haider[1], Mohan Kumar Das[2], Istiak Ahamed Mojumder[3], Monika Das[4] and Md. Tarikul Islam[1]

ABSTRACT

St. Martin's Island is ecologically sensitive in Bangladesh. This coral island is being polluted by plastics gradually. Plastics are dumped along the coast and on the ocean floor, where they eventually settle. Over the last 60 years, global plastic production has exploded, and it is now widely regarded as a severe peril to the marine ecosystem. Despite the prevalence of plastic pollution, quantitative assessments of the worldwide availability and mass of floating litter are still lacking. Plastic pollution is known to impact a large number of marine species. As a result, a more thorough examination of these substances' ecological risks has become a major area of research. In addition to entanglement and consumption of trash by large animals, planktonic and invertebrate species collect microplastics (MPs) and transmit them along food chains. Dietary loss of nutritive value, physical harm, disease exposure, and alien species translocation are all negative outcomes. Plastics also include chemical additives that efficiently absorb a variety of environmental pollutants, making them a possible exposure source to these substances after ingestion. Although intricate toxicological consequences are being more widely recognized, the fate and effect of MPs in the marine ecosystem are yet unknown. Plastic pollution is on the rise as a result of anthropogenic activity. To protect this unique island from the threat of plastic pollution, necessary steps should be taken.

Keywords: Plastics, Threats, Effects, Organisms, Measures, St. Martin’s Island

INTRODUCTION

Plastic pollution on Islands is a great concern worldwide (Bhuyan, 2022; Al Nahian *et al.,* 2022a,b; Bhuyan *et al.,* 2021). St. Martin's Island, popularly known as a coral island, plastic waste has wreaked havoc on the environment (Figure 1a-1j) (Bhuyan *et al.,* 2021). The underwater of Island is also occupied by plastics (Figure 2a-2f). In 1999, the Bangladeshi government designated this island as an ECA, preventing any activity that could affect the island's water, air, or soil. No one, however, is following the rules. It is one of the most visited tourist attractions in the country. From November through March, tens of thousands of visitors visit the island. Daily, roughly 4,000 tourists stay overnight on the 8 km^2 Island, in addition to the 10,000 permanent residents. Thousands of tourists pollute the water on the

Corresponding author email: simulbhuyan@gmail.com

[1]Bangladesh Oceanographic Research Institute, Cox’s Bazar-4730, Bangladesh

[2]National Oceanographic And Maritime Institute, Dhaka-1205, Bangladesh

[3]Department of Zoology, University of Chittagong, Chittagong, Bangladesh

[4]Department of Fisheries, Matshya Bhaban, Dhaka, Bangladesh

island by discarding plastic bags, bottles, straws, glasses, cans, cigarette butts, and other debris. They throw chip packets after feeding birds in ships (Al Nahian *et al.,* 2022a,b). After docking at the St. Martin's jetty, tourists and ship officials discharge contaminants into the ocean. Fishing nets and other fishing nets that fall into the water are also discarded by fishermen (Bhuyan, 2022).

Floating plastics break down into smaller particles as a result of light from the sun and waves, but they are never completely degradable; rather, these tiny plastics breakdown into micro-, meso-, and macro-plastics, acting as a sponge for aquatic toxins like pesticides. The MPs subsequently enter the stomach of the marine organism, producing indigestion and stomach bloating, which leads to death. Fish ingest MPs because they consider them to be food. According to a study, MPs have been found in birds and fish (Bhuyan, 2022).

(a)

(b)

(c)

(d)

(e)

(f)

Figure 1: Plastics in the St. Martin's Island, Bangladesh. (a) Plastics dumping inside the Keya tree (b) Plastic dumping site along the central mosque, Uttar para, St. Martin's Island (c) Dumped plastics beside the road of St. Martin's Bazar (d) Torn plastic bag on the root of Keya tree (e) Plastic materials in the canal connected to the sea (f) Chips packet (Mr. Twist) on the uprooted seaweed (g) Plastics materials on the beach (h) Discarded plastics on the beach (i) Plastics dumping very close to the shore (j) Chips packet (Alooz) on the beach

N.B. Photos (1a-1f) were taken on 16 October 2022 during the UNDP team visit to St. Martin's Island for assessing the proper management of the Island. Photos (1g-1j) were captured by Sharif Sarwar (Freelance Underwater Photographer)

St. Martin's Island is being polluted by plastics. The increasing amount of plastics is a threat to corals, seaweeds, fish, and other marine organisms. In 2022, St. Martin's Island in Cox's Bazar was designated as a marine protected area by the government. Currently, St. Martin's Island is the second-largest marine protected area in the nation. A total of 590 hectares of the island were declared as an ecologically critical area (ECA) in 1999. Though this declaration, the ecosystem of the Island is deteriorating day by day. The present study was conducted to identify the threats from plastics pollution and to provide mitigation measures.

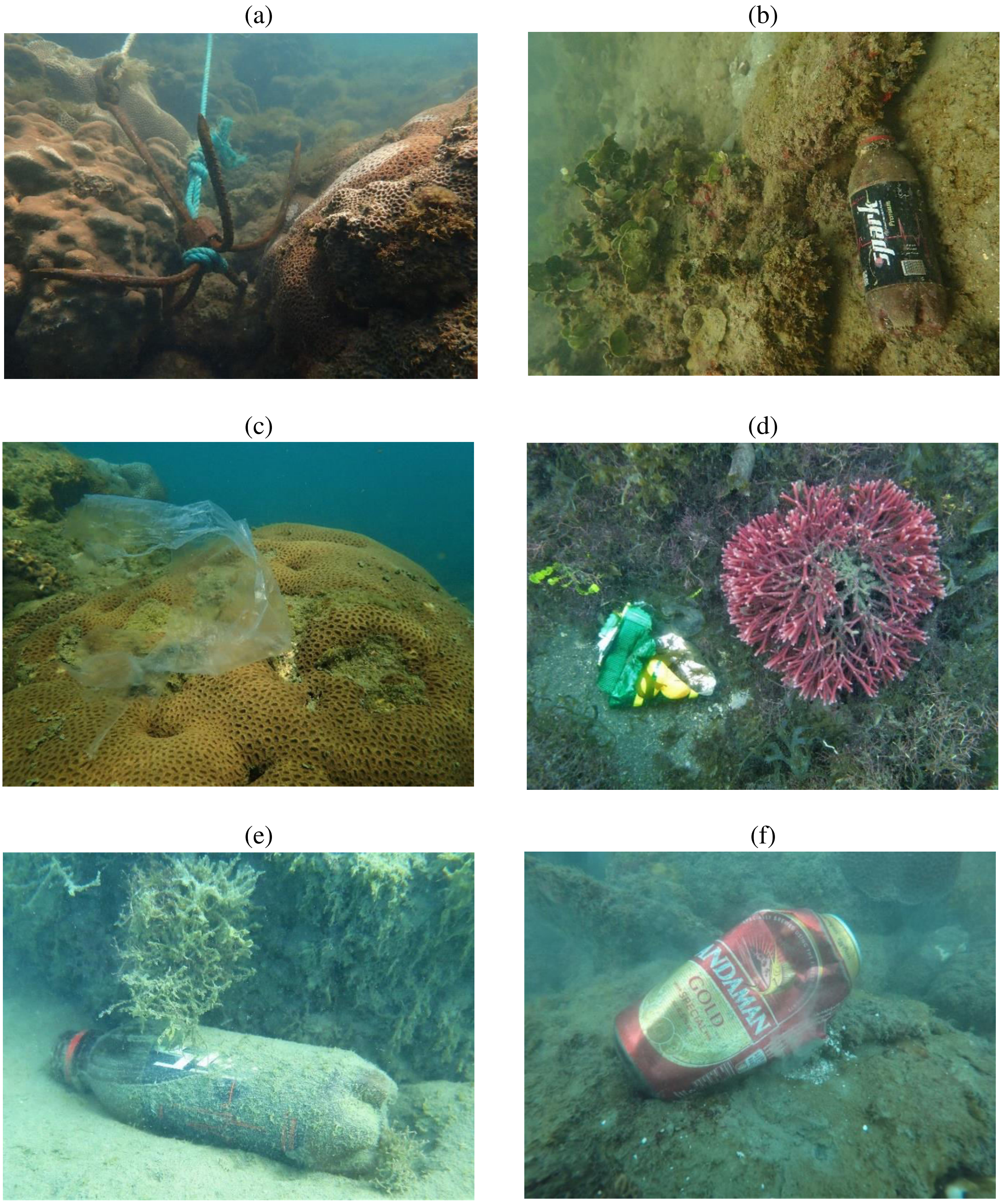

Figure 2: Plastic litter on the seafloor of the Bay of Bengal, Bangladesh [Photo: Sharif Sarwar]. (2a) Anchor attach with Corals (2b) Spark cold drink bottle on seaweed bed (2c) Torn plastic bag on coral (2d) Discarded chips packet on seaweed ecosystem (2e) Spark bottle in coral & seaweed associated ecosystem (2f) Drinking can on the sea bed.

Types of Plastics in the Ocean

Synthetic or semi-synthetic organic materials are used to make plastics. Plastic's raw components include natural gas, crude oil, salt, coal, and, cellulose, with petrochemicals accounting for the majority of industrial plastics. "All the plastics in the ocean are immediately covered by a layer of microbes," says Eric Jetler, a microbial ecologist at the Netherlands Royal Institute for Sea Research. In scientific words, it's known as a 'Plasticsphere,' because the chemical released by this slick living layer transforms plastic into delectable food. Because then the plastic smells and tastes like food."

Around 20 different kinds of plastics are used globally, according to European plastic makers' groups. Table 1, representing some of the most commonly used plastics in the world.

Table 1: Plastic materials are identified in wastes (Data source: Plastics Europe, 2017)

Sl. no.	Types of plastics	Usage
1.	High-density Polyethylene (HDPE)	Bags for trash, milk jugs, and shopping bags
2.	Low-density Polyethylene (LDPE)	Plastic film, bags, and food wrap
3.	Polyvinylchloride (PVC)	Covers for the ground and furnishings, bottles, packing, containers, plumbing and sewage pipes
4.	Polyethylene terephthalate (PET)	Bottles and containers for beverages
5.	Polystyrene (PS)	Food containers, egg and meat trays, insulating materials, hot beverage cups, and thermally insulated take-home boxes are all available.
6.	Polypropylene (PP)	yogurt, straws, diapers, wrapping paper, butter tubs, and specialty bags, among other things

On St. Island, many single-use plastics like bottles, straws, cups, and bags, as well as cans, glass bottles, and other waste items, are found, resulting in severe plastic pollution.

Plastic Producing Countries of the World

According to the Earth Day Network of the United States of America (2018), Bangladesh is the tenth-most plastic-polluting country in the world. Every year, Bangladesh dumps about 200,000 tons of plastic into the Bay of Bengal. Every day, 8,500 tons of plastic were used in 1990, compared to 26,000 tons in 2014. Bangladesh will use 50,000 tonnes of plastic per day by 2025 if current trends continue. In 2021, World Population Review reported the plastics-producing countries with their contribution percentage (Figure 3) In recent years, plastic pollution on St. Martin's Island has amplified at a shocking rate, culminating in fatal plastic contamination.

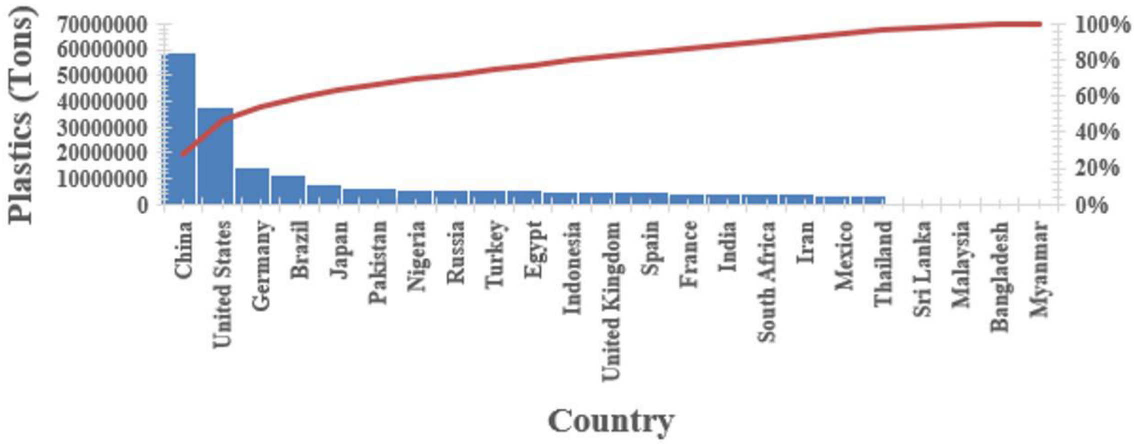

Figure 3: Plastics contributing countries of the world (Data source: World Population Review, 2021)

Adverse Effects of Plastic Pollution

Every year, 9 million tons (MT) of plastics are expected to enter our oceans, with more trash than fish by 2050. A study done by the Ellen MacArthur Foundation, a UK-based organization, yielded such terrible results. According to research by the University of California, global plastics output topped 360 million metric tons (MMT) in 2015, up from 2 MMT in 1950. In 2019, a dead whale was spotted floating off the coast of the Philippines with a 40-kilogram plastic bag in its stomach. According to the Philippines D'Bone Collector's Museum Authority, "the whale carried 16 sacks of rice and a substantial quantity of" shopping bags" in its stomach." Plastic ropes, cups, gloves, nets, and other items were discovered in the stomach of a dead whale on a Scottish beach in 2019. The waste that came out of the stomach weighed a total of 100 kg.

Corals and sea turtles are the island's most abundant biodiversity, both of which are threatened by plastic pollution. Because of the discharge of harmful substances often found in or associated with plastics, also influences biota (Bhuyan, 2022; Bhuyan *et al.,* 2021). The discovery of plastic in fish and large mammals in the Bay of Bengal and other parts of the world is possibly the most concerning. Harmful MPs were recorded in the gastrointestinal tracts of marine Loitta Fish, Sardine Fish, green snails, crabs, and shrimp collected from the Bay of Bengal. When coral reefs come into touch with plastic, the probability of disease transmission upsurges from 4% to 89 percent. MPs have adverse effects on aquatic organisms (Table 2).

Table 2: Effects of plastics on aquatic biota (Modified from Bhuyan et al. 2021) (PE stand for Polyethylene; PS stand for Polystyrene; PP stand for Polypropylene; PVC stand for Polyvinylchloride; PLA stand for Biodegradable plastic; AC stand for Acrylic; PES stand for Polyester)

Classes	Species	Exposure time (hrs)	MPs		Effects[b]	References
			Type (size µm)[a]	Tested Concentration		
Annelida	*Arenicola marina*	744	PE, PVC (1.4-707)	0.2-20 g of MPs/Kg of wet sediment	↑ Rate of metabolism	Green *et al.,* 2016
		336	PE, PS (<100)	110 MPs/g of sediment	↑ EC ↑ Amount of protein	Van Cauwenberghe *et al.,* 2015
		672	PS (400-1300)	100 g/L	↓ Consumption of food	Besseling *et al.,* 2013
		240	PVC (250)	n.s	↑ Stress from oxidation	Browne *et al.,* 2013
		48, 672	PVC (130)	5-50g of MPs Kg^{-1} of sediment	↓ Stores of energy ↓ Consumption of food ↑ The phagocytic process ↑ Inflammation reaction ↓ Lipid stores ↑ Retention of MPs	Wright *et al.,* 2013a
Echinodermata	*Paracentrotus lividus*	48	PS (6)	10^3-10^5 MPs/ml	↓ Rate of fertilization ↓ Growth ↑ Aberrant larval growth	Martinez-Gomez *et al.,* 2017
			PE (>0-80)	0,005-5 g of MPs/L	↑Aberrant larval growth	
	Lytechinus variegatus	24	PE	200 ml of MPs/L	↑Abnormal growth of larvae	Nobre *et al.,* 2015
	Paracentrotus lividus	6-48	PS (0.04-0.05)	1-50 µg/ml	↑ Accumulation of MPs ↑ Malformations ↑ Damage to the cell membrane ↑ *Cas8* ↑ Stress from oxidation ↑ *Abcb1* gene	Della Torre *et al.,* 2014
	Tripneustes gratilla	120	PE (10-45)	300 MPs/ml	↓ Growth ↓ Development rate	Kaposi *et al.,* 2014
Rotifera	*Brachionus koreanus*	288	PS (0.05-6)	0.1 – 20 µg/ml	↓ Fecundity ↓ Lifespan	Jeong *et al.,* 2016
Mollusca	*Crassostrea gigas*	1440	PS (2-6)	0.023 mg/L	↑ Microalgae consumption ↑ Utilization of the sorbent ↑ Costs of upkeep ↓ Oocyte number ↓ Sperm velocity	Sussarellu *et al.,* 2016
	Mytilus edulis	336	PE, PS (<100)	110 MPs/ml	↑ EC	Van Cauwenberghe *et al.,* 2015
		3-96	PE (0-80)	2.5 g/L	↑ Accumulation of MPs ↑ Granulocytoma development ↓ LMS ↓ Lysosomal stability	von Moos *et al.,* 2012
		8	PS (0.03)	0.1-0.3 g/L	↓ Filtering operations	Wegner *et al.,* 2012

	Mytilus galloprovincialis	24	PE (1-50)	1.5×10^7 MPs/L	↓ Haemolymph and gills contain PK and SD ↑ PK and SD in the gastric gland and mantle ↓ *ID* in the haemolymph ↑ *ID* in the mantle ↓ PGRP in the gastrointestinal tract and hemolymph ↑ TLR in the mantle and gastrointestinal tract ↑ The mantle and stomach glands contain myticin A ↓ The gills contain myticin A ↑ The mantle, gills, and hemoglobin contain myticin B ↓ *Myticin B* in the mantle ↑ The gills, hemoglobin, and mantle all contain myticin B ↑ p53 in the mantle, gills, digestive gland, and hemolymph ↑ FADD in the gastrointestinal tract and mantle	Détrée and Gallardo-Escárate, 2017
		0.5-4	PS (0.05)	1-50 µg/L	↓ LMS ↓ The phagocytic process ↑ Lysozyme production ↑ ROS ↑ ZERO production ↑ Apoptotic mechanisms ↓ Cytotoxicity of MMP	Canesi *et al.,* 2015
		168	PE, PS (<100)	20 g/L	↓ Granulocytes ↓ LMS ↑ DNA rifts in hemoglobin ↑ Nuclear atypicalities ↓ Activities for AChE, Se-D-GPx, and CAT	Avio *et al.,* 2015a
	Scrobicularia plana	336	PS (20)	1 mg/L	↑ Activities involving SOD, CAT, GPx, and GST ↑ SOD activity ↓ CAT activity ↑ GPx activity 3 days after exposure ↓ After the remaining time, GPx activity ↓ GST ↓ AChE activity ↑ LPO levels	Ribeiro *et al.,* 2017
Crustacea	*Palaemonetes pugio*	3h	PE, PS, PP (30-165)	50 000 MPs/L	↑ Mortality	Gray and Weinstein 2017
	Gammarus fossarum	24	AC (Acrylic glass) (32-250)	10-100000 MPs/ individual	↓ Rationality of assimilation ↓ Increased wet weight	Straub *et al.,* 2017
			PES (32-250)		↓ Increased wet weight	
		24	PS (0,1)	0,001-10 mg/L	↓ Speed of swimming	Blarer and Burkhardt-Holm, 2016

Hyalella azteca	240, 1008	PE (10-27)	0-100000 MPs/ml	↑ Death ↓ Succession ↓ Development	Au *et al.,* 2015
		PP (20-75)	0-90 MPs/ml	↑ Mortality ↓ Growth ↓ Weight	
Artemia franciscana					Gambardella *et al.,* 2017
	48			↑ Pace of swimming ↓ AChE activity ↑ PChE and CAT activities	Cui *et al.,* 2017
Daphnia galeata	120	PS (0.05)	5 mg/L	↑ Death ↓ Replica Strange growth	
Daphnia magna	24,504	PS (0.1-2)	0.1-1 mg/L	↓ Rate of eating	Rist *et al.,* 2017
	24	PS (0.052)	0.075-0.15 g/L	↑Death	Mattsson *et al.,* 2017
	48	PS (0,2)	1-30 mg/L	↑ Inactivation	Kim *et al.,* 2017
	24,48	AC (Acrylic resin) (0.086-0.125)	0.01-1000 mg/L	↑ Inactivation	Booth *et al.,* 2016
	48	PES (62-1400)	12.5-100 mg/L	↑ Death	Jemec *et al.,* 2016
	6,24	PS (0.09-0.1)	10 µg/ml	↑ Retention of MPs ↑ Pressure ↓ Eating rate ↓ Existence rate	Nasser and Lynch, 2016
	0.008 - 504	PE (1-5)	10^2-$3x10^4$ MPs/L	↑ Death ↓ Eating ↓ Development	Ogonowski *et al.,* 2016
	96	PE (1-100)	12.5-400 mg/L	↑ Inactivation	Rehse *et al.,* 2016
	504	PS (0.07)	0.22-103 mg/L	↓ Reproduction ↓ Body size ↑ Death	Besseling *et al.,* 2014
Amphibalanus amphitrite	48	PS (0.1)	0.001-10 mg/L	↓ Swim rapidity ↑ AChE, PChE and CAT activities	Gambardella *et al.,* 2017
	96	PE, PS, PP, PVC, PES	0.10 and 0.50 m^2/L	↑ Death ↓ Reimbursement	Li *et al.,* 2016
Paracyclopina nana	24	PS (0.05-6)	0.1-20 µg/mL	↑ Intracellular ROS level ↑ Extracellular signal-regulated kinase and p38 phosphorylation ↑ GR, GPx, GST and SOD activities	Jeong *et al.,* 2017
Parvocalanus crassirostris	144, 576	PES (5-10)	10000-80000 MPs/mL	↓ Egg production ↓ Population size ↑ *H3*	Heinder *et al.,* 2017
Carcinus maenas	1-24	PS (8)	10^6-10^7 MPs/L	↓ Hemolymph Na ions ↑ Hemolymph Ca ions ↑ O_2 consumption	Watts *et al.,* 2016
Nephrops norvegicus	5760 (feeding test)	PP (3000-5000)	5 MPs/feeding	↓ Eating rate ↓ Body mass ↓ Metabolic rate	Welden and Cowie, 2016
Calanus helgolandicus	24, 216	PS (20)	65-75 MPs/ml	↓ Predatory behavior ↓ production of offspring ↓ Endurance	Cole *et al.,* 2015

					Energy exhaustion	
	Tigriopus japonicus	2 generation test	PS (0.05-0.5)	0.125-25 µg/ml	↑ Death ↓ Endurance ↓ Fertility	Lee *et al.,* 2013
	Centropages typicus	24	PS (0.4-3.8)	$40x10^3$-$1x10^6$ MPs/ml	↓ Absorption rates	Cole *et al.,* 2013
Fish	*Dicentrarchus labrax*	864	PE (10-45)	10^4-10^5 MPs/g of diet	↑ Death ↑ CYP P450	Mazurais *et al.,* 2015
		2160	PVC (300)	1 g/kg of diet	↑ Structural alterations of the DI ↓ Serosa, muscularis mucose, and submucosa/mucosa have regular structures. Rodlet cells are found in the gut mucosa	Peda *et al.,* 2016
	Pomatoschistus microps	0.002 (predatory test)	PE (450-500)	100 MPs/L	↓Predatory actions ↓Ruthless effectiveness	de Sá *et al.,* 2015
		96	PE (1-5)	0.184 mg/L	↓ AChE activity	Luis *et al.,* 2015
		96	PE (1-5)	0.184 mg/L	↓ AChE activity	Oliveira *et al.,* 2013
		96	PE (1-5)	0.184 mg/L	↓ AChE activity	Oliveira *et al.,* 2012
	Sparus Aurata	720 (40-150)	PVC (40-150)	100-500 mg of MPs/Kg of individual	↑ ASP and CK activities ↑ Albumin and globulin ↓ Glucose ↑ Peroxidase activity and skin mucus IgM ↑ Phagocytic capacity ↓ *prdx5* and *hsp90* ↑ *prdx1, prdx3*, and *ucp1*	Espinosa *et al.,* 2017

(a) **(b)**

Figure 4: Coral bleaching in St. Martin's Island, Bangladesh (Photo: Sharif Sarwar)

Several times in July 2020, tons of waste, mostly plastics, were detected drifting about the Cox's Bazar coastline for inexplicable reasons. Hundreds of volunteers assisted in the collection of 20 dead and 500 injured olive ridley turtles, as well as several snakes and other marine creatures ensnared in plastic garbage. Every year, St. Martin's shrinks rather than growing as it should geologically. Plastic pollution has increased, cyclones have occurred, and coral damage has occurred. We have no idea what will happen to the population of St.

Martin if it vanishes. The fact that so many sea turtles are dying suggests that something is wrong. Coral is bleaching at an alarming rate as pollution levels rise (Figure 4).

Plastics Pollution Reduction History in Bangladesh

Bangladesh was the foremost nation to enact legislation prohibiting the usage of plastic bags. In Bangladesh, ESDO was the first group to ban plastic bags. In 1990, it took the initiative to write articles on the dangers of plastic contamination in national newspapers to bring attention to the issue and raise public consciousness about its seriousness.

In 1993, the Ministry of Environment and Forests judged the anti-plastic pollution campaign and proposed a ban on the manufacture and use of polythene bags, but the proposal was rejected by the parliament. In 1997, ESDO raised up its voice once more, launching a "Plastic Bag-Free Day." In 1999, the MOEF launched the Sustainable Environment Management Program to devise a strategy to eliminate polythene shopping bags through public awareness campaigns. Before reaching a final decision, approved members of the program urged doing a thorough investigation into the production, promotion, and use of polythene shopping bags, as well as considering the socioeconomic implications.

The Ministry then used public awareness campaigns to encourage consumers to quit using polyethylene bags, announcing that the production and use of polyethylene shopping bags in Bangladesh would cease on January 1, 2002. The law governing section 1 of the Bangladesh Environment Conservation Act was updated in 2002. Rule 6ka of Clause-5 under Section-9 made it illegal to manufacture and use plastic shopping bags. The penalty and punishment will be determined by rule 6ka.

- For manufacturing, import, and marketing: ten years in prison with hard labor, or a fine of one million taka, or both.
- To sell, display for selling, stock, distribute, convey, or usage for business reasons: 6 months in solitary confinement or a fine of 10,000 taka, or both.

In 2018, Transparency International Bangladesh advocated for stricter enforcement of the law to prevent unlawful production, advertising, and the use of plastic to decrease pollution.

The Ministry of Environment and Forests launched the National 3R Waste Management Strategy to reduce waste and potentially reduce plastic materials related wastes by boosting the recycling and reuse of cast-off plastic. Reduce, reuse, and recycle, or the 3R policy can effectively reduce plastic pollution. The Bangladeshi government, on the other hand, continues to try to enact the law by setting up mobile courts several times a year in different marketplaces.

Laws to Reduce Plastic Pollution

Marine pollution is addressed under the Bangladesh Environment Protection Act 1995 and the Marine Pollution Ordinance 1989. Bangladesh was the primary state to enact legislation prohibiting the usage of plastic bags. In Bangladesh, ESDO was the first group to ban plastic bags. Furthermore, by 2025, governments must prevent and drastically reduce plastic pollution, according to SDG 14.1. Sadly, despite all of the agreements and action plans, massive volumes of plastic, both MPs and bigger debris continue to enter the ocean every year. Different stakeholders aim to reduce marine pollution (Table 3).

Table 3: Participation of important government agencies in marine environmental protection (Source: Karim, 2014)

Name of organizations	Role
Ministry of Shipping	Execution of all IMO Conventions
Department of Shipping	Liaison with the International Maritime Organization and other global organizations
Mercantile Marine Department	Ships' inspections
Government Shipping Office	Enforcing the Merchant Shipping Ordinance of 1893, as well as all other applicable legislation
Marine Academy	Ships' registering, investigation, and accreditation
Seamen's Training School	Marine officers, engineers, and seamen are all trained and certified
Port Authorities	Port management and development, pollution prevention in the port area
Coast Guard	1. Patrolling in Bangladesh's marine area 2. Detection of activities that pollute the environment in Bangladesh's marine zones and implementation of actions to stop them 3. Execution of any warrants or any other order handed down by a judge or other expert regarding any ship that has sailed within Bangladeshi territorial waters.
Bangladesh Navy	Safeguarding the nation's territorial sea, contiguous zone, exclusive economic zone, and continental shelf, as well as its jurisdiction over those areas

Department of Environment	Environment protection and management as a whole. Execution of The Environmental Protection Act of 1995

Recommendation to Reduce Plastic Pollution

Coral reefs serve as storm buffers, which are essential for the island's safety and survival. Waves break up in the coral reefs before reaching the coast, causing less damage to the island. Without these natural barriers, the beaches on St. Martin's Island could wash away, resulting in a significant decline in tourism and economic calamity.

Plastic pollution is largely to blame for the destruction (bleached coral) of coral on St. Martin's Island. To safeguard the island of St. Martin from plastic pollution, the following steps should be implemented.

- Plastics use should be prohibited on the island.
- Reduce, reuse, and recycle can effectively reduce plastic pollution.
- Tourist activists are regularly monitored, and their activities and how they destroy the maritime environment are broadcast on television (TV) on the ship.
- Tourists are being educated about ecology and biodiversity through the distribution of pamphlets and banners.
- To raise awareness, the media (e.g., television, radio, newspapers, etc.) can be a useful instrument.
- The entire island, including tourist ships, should be placed under CCTV surveillance, with regular punishment (e.g., monetary restitution) implemented.
- Instead of discharging the plastic items into the sea after arriving on St. Martin Island, the ship's authority must collect them in a safe location. If a ship discharges waste into the ocean, it must be penalized with a large sum of money as restitution.
- There must be a lot of portable dustbins and baskets on the beach. Reusable items, such as reusable metal straws and reusable shopping bags, are highly suggested because they are considerably more durable and stronger than plastic bags.
- Use multimedia presentations to inform tourists about their activities (what they may and cannot do).
- Restaurants on the island can use environmentally friendly materials such as jute, paper, and hay. Plastic can be replaced with decomposable cups, bags, straws, sugar cane and bamboo plates, wooden cutlery, and food containers.
- Make use of the given and taken policies. Plastic materials will be given away if someone (only locals) donates them. To implement an award-based plastic collection campaign to inspire the public not to litter with plastic debris.

- A conservation fund might be established by levying a tax on all visitors to the island. An independent committee may be in charge of the fund. To promote ecotourism throughout the island, and to prohibit the use, sale, importation, and manufacture of single-use plastic goods.

CONCLUSION

Plastic contamination in the marine ecosystem is increasingly acknowledged as a serious concern with a worldwide reach and negative consequences ranging from the microscopic level to physiological effectiveness and organism health to ecosystem service loss. Because plastics have such a long life in marine environments, damage to marine organisms would persist for decades even if the manufacture and dumping of plastics were to abruptly cease. In this regard, serious actions must be implemented at both the nationwide and worldwide levels to solve the situation. Further study is needed to better realize the mechanisms that influence the occurrence of MPs in marine species, as well as the regulation of biological consequences. Novel systematic data should help to sustain conservation management input, give stronger proof for political authorities in charge of normative norms, and build the foundation for educational initiatives. Increased public awareness of the environment MPs should spur technical invention to lessen the use and ingestion of plastics, lessen their environmental impact, and encourage a new strategy for stranded material collection and reuse. So now is the time to protect this one-of-a-kind coral reef from the looming plastic disaster.

ACKNOWLEDGMENTS

The Editor and the anonymous reviewers have received praise from the writers for their helpful criticism throughout the review process. Their comments help to improve the paper's quality substantially. The authors also express heartfelt thanks to United Nations Development Programme (UNDP) for a research visit to St. Martin’s Island.

REFERENCES

Al Nahian, S., Rakib, M. R. J., Kumar, R., Haider, S. M. B., Sharma, P., & Idris, A. M. (2022a). Distribution, characteristics, and risk assessments analysis of microplastics in shore sediments and surface water of Moheshkhali channel of Bay of Bengal, Bangladesh. Science of The Total Environment, 158892.

Al Nahian, S., Rakib, M. R. J., Haider, S. M. B., Kumar, R., Walker, T. R., Khandaker, M. U., & Idris, A. M. (2022b). Baseline marine litter abundance and distribution on Saint Martin Island, Bay of Bengal, Bangladesh. Marine Pollution Bulletin, 183, 114091.

Au, S. Y., Bruce, T. F., Bridges, W. C., & Klaine, S. J. (2015). Responses of Hyalella azteca to acute and chronic microplastic exposures. *Environmental toxicology and chemistry*, *34*(11), 2564-2572.

Avio, C. G., Gorbi, S., & Regoli, F. (2015a). Experimental development of a new protocol for extraction and characterization of microplastics in fish tissues: first observations in commercial species from Adriatic Sea. *Marine environmental research*, *111*, 18-26.

Besseling, E., Wang, B., Lürling, M., & Koelmans, A. A. (2014). Nanoplastic affects growth of S. obliquus and reproduction of D. magna. *Environmental science & technology*, *48*(20), 12336-12343.

Besseling, E., Wegner, A., Foekema, E. M., Van Den Heuvel-Greve, M. J., & Koelmans, A. A. (2013). Effects of microplastic on fitness and PCB bioaccumulation by the lugworm Arenicola marina (L.). *Environmental science & technology*, *47*(1), 593-600.

Bhuyan, M. (2022). Effects of Microplastics on Fish and in Human Health. Frontiers in Environmental Science, 250.

Bhuyan, M. S., Venkatramanan, S., Selvam, S., Szabo, S., Hossain, M. M., Rashed-Un-Nabi, M., ... & Islam, M. S. (2021). Plastics in marine ecosystem: a review of their sources and pollution conduits. Regional Studies in Marine Science, 41, 101539.

Blarer, P., & Burkhardt-Holm, P. (2016). Microplastics affect assimilation efficiency in the freshwater amphipod Gammarus fossarum. *Environmental science and pollution research*, *23*(23), 23522-23532.

Booth, A. M., Hansen, B. H., Frenzel, M., Johnsen, H., & Altin, D. (2016). Uptake and toxicity of methylmethacrylate-based nanoplastic particles in aquatic organisms. *Environmental toxicology and chemistry*, *35*(7), 1641-1649.

Browne, M. A., Niven, S. J., Galloway, T. S., Rowland, S. J., & Thompson, R. C. (2013). Microplastic moves pollutants and additives to worms, reducing functions linked to health and biodiversity. *Current biology*, *23*(23), 2388-2392.

Canesi, L., Ciacci, C., Bergami, E., Monopoli, M. P., Dawson, K. A., Papa, S., & Corsi, I. (2015). Evidence for immunomodulation and apoptotic processes induced by cationic polystyrene nanoparticles in the hemocytes of the marine bivalve Mytilus. *Marine environmental research*, *111*, 34-40.

Cole, M., Lindeque, P., Fileman, E., Halsband, C., & Galloway, T. S. (2015). The impact of polystyrene microplastics on feeding, function and fecundity in the marine copepod Calanus helgolandicus. *Environmental science & technology*, *49*(2), 1130-1137.

Cole, M., Lindeque, P., Fileman, E., Halsband, C., Goodhead, R., Moger, J., & Galloway, T. S. (2013). Microplastic ingestion by zooplankton. *Environmental science & technology*, *47*(12), 6646-6655.

Cui, R., Kim, S. W., & An, Y. J. (2017). Polystyrene nanoplastics inhibit reproduction and induce abnormal embryonic development in the freshwater crustacean Daphnia galeata. *Scientific reports*, *7*(1), 1-10.

de Sá, L. C., Luís, L. G., & Guilhermino, L. (2015). Effects of microplastics on juveniles of the common goby (Pomatoschistus microps): confusion with prey, reduction of the predatory performance and efficiency, and possible influence of developmental conditions. *Environmental pollution*, *196*, 359-362.

Della Torre, C., Bergami, E., Salvati, A., Faleri, C., Cirino, P., Dawson, K. A., & Corsi, I. (2014). Accumulation and embryotoxicity of polystyrene nanoparticles at early stage of development of sea urchin embryos Paracentrotus lividus. *Environmental science & technology*, *48*(20), 12302-12311.

Détrée, C., & Gallardo-Escárate, C. (2017). Polyethylene microbeads induce transcriptional responses with tissue-dependent patterns in the mussel Mytilus galloprovincialis. *Journal of Molluscan Studies*, *83*(2), 220-225.

Espinosa, C., Cuesta, A., & Esteban, M. Á. (2017). Effects of dietary polyvinylchloride microparticles on general health, immune status and expression of several genes related to stress in gilthead seabream (Sparus aurata L.). *Fish & shellfish immunology*, *68*, 251-259.

Gambardella, C., Morgana, S., Ferrando, S., Bramini, M., Piazza, V., Costa, E., ... & Faimali, M. (2017). Effects of polystyrene microbeads in marine planktonic crustaceans. *Ecotoxicology and environmental safety*, *145*, 250-257.

Gambardella, C., Morgana, S., Ferrando, S., Bramini, M., Piazza, V., Costa, E., ... & Faimali, M. (2017). Effects of polystyrene microbeads in marine planktonic crustaceans. *Ecotoxicology and environmental safety*, *145*, 250-257.

Gray, A. D., & Weinstein, J. E. (2017). Size-and shape-dependent effects of microplastic particles on adult daggerblade grass shrimp (Palaemonetes pugio). *Environmental toxicology and chemistry*, *36*(11), 3074-3080.

Green, D. S. (2016). Effects of microplastics on European flat oysters, Ostrea edulis and their associated benthic communities. *Environmental pollution*, *216*, 95-103.

Heindler, F. M., Alajmi, F., Huerlimann, R., Zeng, C., Newman, S. J., Vamvounis, G., & van Herwerden, L. (2017). Toxic effects of polyethylene terephthalate microparticles and Di (2-ethylhexyl) phthalate on the calanoid copepod, Parvocalanus crassirostris. *Ecotoxicology and environmental safety*, *141*, 298-305.

Jemec, A., Horvat, P., Kunej, U., Bele, M., & Kržan, A. (2016). Uptake and effects of microplastic textile fibers on freshwater crustacean Daphnia magna. *Environmental Pollution*, *219*, 201-209.

Jeong, C. B., Kang, H. M., Lee, M. C., Kim, D. H., Han, J., Hwang, D. S., & Lee, J. S. (2017). Adverse effects of microplastics and oxidative stress-induced MAPK/Nrf2 pathway-mediated defense mechanisms in the marine copepod Paracyclopina nana. *Scientific reports*, *7*(1), 1-11.

Jeong, C. B., Won, E. J., Kang, H. M., Lee, M. C., Hwang, D. S., Hwang, U. K., & Lee, J. S. (2016). Microplastic size-dependent toxicity, oxidative stress induction, and p-JNK and p-p38 activation in the monogonont rotifer (Brachionus koreanus). *Environmental science & technology*, *50*(16), 8849-8857.

Kaposi, K. L., Mos, B., Kelaher, B. P., & Dworjanyn, S. A. (2014). *Ingestion of Microplastic Has Limited Impact on a Marine Larva. Environmental Science & Technology, 48(3), 1638–1645.*

Karim, M.S., 2014. Implementation of the MARPOL convention in Bangladesh. Macquarie J. Inter. Comp. Env. Law. 6, 51-82.

Kim, D., Chae, Y., & An, Y. J. (2017). Mixture toxicity of nickel and microplastics with different functional groups on Daphnia magna. *Environmental science & technology*, *51*(21), 12852-12858.

Lee, K.-W., Shim, W. J., Kwon, O. Y., & Kang, J.-H. (2013). *Size-Dependent Effects of Micro Polystyrene Particles in the Marine Copepod Tigriopus japonicus. Environmental Science & Technology, 47(19), 11278–11283.*

Li, J., Qu, X., Su, L., Zhang, W., Yang, D., Kolandhasamy, P., & Shi, H. (2016). Microplastics in mussels along the coastal waters of China. *Environmental pollution*, *214*, 177-184.

Luís, L. G., Ferreira, P., Fonte, E., Oliveira, M., & Guilhermino, L. (2015). Does the presence of microplastics influence the acute toxicity of chromium (VI) to early juveniles of the common goby (Pomatoschistus microps)? A study with juveniles from two wild estuarine populations. *Aquatic Toxicology*, *164*, 163-174.

Martínez-Gómez, C., León, V. M., Calles, S., Gomáriz-Olcina, M., & Vethaak, A. D. (2017). The adverse effects of virgin microplastics on the fertilization and larval development of sea urchins. *Mar. Environ. Res*, *130*, 69-76.

Mattsson, K., Johnson, E. V., Malmendal, A., Linse, S., Hansson, L. A., & Cedervall, T. (2017). Brain damage and behavioural disorders in fish induced by plastic nanoparticles delivered through the food chain. *Scientific reports*, *7*(1), 1-7.

Mazurais, D., Ernande, B., Quazuguel, P., Severe, A., Huelvan, C., Madec, L., & Zambonino-Infante, J. (2015). Evaluation of the impact of polyethylene microbeads ingestion in European sea bass (Dicentrarchus labrax) larvae. *Marine environmental research*, *112*, 78-85.

Nasser, F., & Lynch, I. (2016). Secreted protein eco-corona mediates uptake and impacts of polystyrene nanoparticles on Daphnia magna. *Journal of proteomics*, *137*, 45-51.

Nobre, C. R., Santana, M. F. M., Maluf, A., Cortez, F. S., Cesar, A., Pereira, C. D. S., & Turra, A. (2015). Assessment of microplastic toxicity to embryonic development of the sea urchin Lytechinus variegatus (Echinodermata: Echinoidea). *Marine pollution bulletin*, *92*(1-2), 99-104.

Ogonowski, M., Schür, C., Jarsén, Å., & Gorokhova, E. (2016). The effects of natural and anthropogenic microparticles on individual fitness in Daphnia magna. *PloS one*, *11*(5), e0155063.

Oliveira, M., Ribeiro, A., & Guilhermino, L. (2012). Effects of short-term exposure to microplastics and pyrene on Pomatoschistus microps (Teleostei, Gobiidae). *Comparative Biochemistry and Physiology, Part A*, (163), S20.

Oliveira, M., Ribeiro, A., Hylland, K., & Guilhermino, L. (2013). Single and combined effects of microplastics and pyrene on juveniles (0+ group) of the common goby Pomatoschistus microps (Teleostei, Gobiidae). *Ecological indicators*, *34*, 641-647.

Peda, C., Caccamo, L., Fossi, M. C., Gai, F., Andaloro, F., Genovese, L., & Maricchiolo, G. (2016). Intestinal alterations in European sea bass Dicentrarchus labrax (Linnaeus, 1758) exposed to microplastics: preliminary results. *Environmental pollution*, *212*, 251-256.

Plastics Europe, 2017. Plastics-the facts 2017: An analysis of European plastics production, demand and waste data.

Rehse, S., Kloas, W., & Zarfl, C. (2016). Short-term exposure with high concentrations of pristine microplastic particles leads to immobilisation of Daphnia magna. *Chemosphere*, *153*, 91-99.

Ribeiro, F., Garcia, A. R., Pereira, B. P., Fonseca, M., Mestre, N. C., Fonseca, T. G., ... & Bebianno, M. J. (2017). Microplastics effects in Scrobicularia plana. *Marine pollution bulletin*, *122*(1-2), 379-391.

Rist, S., Baun, A., & Hartmann, N. B. (2017). Ingestion of micro-and nanoplastics in Daphnia magna-Quantification of body burdens and assessment of feeding rates and reproduction. *Environmental pollution*, *228*, 398-407.

Straub, S., Hirsch, P. E., & Burkhardt-Holm, P. (2017). Biodegradable and petroleum-based microplastics do not differ in their ingestion and excretion but in their biological effects in a freshwater invertebrate Gammarus fossarum. *International journal of environmental research and public health*, *14*(7), 774.

Sussarellu, R., Suquet, M., Thomas, Y., Lambert, C., Fabioux, C., Pernet, M. E. J., & Huvet, A. (2016). Oyster reproduction is affected by exposure to polystyrene microplastics. *Proceedings of the national academy of sciences*, *113*(9), 2430-2435.

Van Cauwenberghe, L., Claessens, M., Vandegehuchte, M. B., & Janssen, C. R. (2015). Microplastics are taken up by mussels (Mytilus edulis) and lugworms (Arenicola marina) living in natural habitats. *Environmental pollution*, *199*, 10-17.

Von Moos, N., Burkhardt-Holm, P., & Köhler, A. (2012). Uptake and effects of microplastics on cells and tissue of the blue mussel Mytilus edulis L. after an experimental exposure. *Environmental science & technology*, *46*(20), 11327-11335.

Watts, A. J., Urbina, M. A., Goodhead, R., Moger, J., Lewis, C., & Galloway, T. S. (2016). Effect of microplastic on the gills of the shore crab Carcinus maenas. *Environmental science & technology*, *50*(10), 5364-5369.

Wegner, A., Besseling, E., Foekema, E. M., Kamermans, P., & Koelmans, A. A. (2012). Effects of nanopolystyrene on the feeding behavior of the blue mussel (Mytilus edulis L.). *Environmental Toxicology and Chemistry*, *31*(11), 2490-2497.

Welden, N. A., & Cowie, P. R. (2016). Long-term microplastic retention causes reduced body condition in the langoustine, Nephrops norvegicus. *Environmental pollution*, *218*, 895-900.

World Population Review, (2021). Plastic Pollution by Country 2021. https://worldpopulationreview.com/country-rankings/plastic-pollution-by-country

Wright, S. L., Rowe, D., Thompson, R. C., & Galloway, T. S. (2013a). Microplastic ingestion decreases energy reserves in marine worms. *Current Biology*, *23*(23), R1031-R1033.

THE JOURNAL OF NOAMI

CONTENTS

NATIONAL OCEANOGRAPHIC AND MARITIME INSTITUTE (NOAMI)
DHAKA, BANGLADESH