



OVERVIEW OF EFFECT OF PLASTIC WASTE POLLUTION ON MARINE ENVIRONMENT




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ABSTRACT

Article History

Received: 8 September 2022

Revised: 10 October 2022

Accepted: 24 October 2022

Published: 15 November 2022

Keywords

Coral reefs

Ecosystem

Environment

Plastic

Plastic debris

Plastic pollution

Sea turtles.

Environmental pollution is one of the most important and critical problems facing the planet and threatening the ecosystem in all its forms. Due to the large quantities of plastic manufactured in different parts of the world and the difficulty of decomposing plastic products, which have a decomposition period of decades. As well as considering the marine environment as one of the most vulnerable ecosystems to pollution with plastic waste, and at the same time, people do not pay attention to this disaster, which directly affects the rest of the environmental systems and causes serious changes to the ecosystem. In this paper, we tried to review some of the direct effects of plastic waste on marine organisms such as coral reefs and sea turtles. As well as review the impact of these organisms' damage on the ecosystem in general. This paper recommends some solutions that will reduce the huge quantities of plastic waste and how to treat it and try to legalize production to control the amount of plastic waste previously produced during the past decades.

Contribution/ Originality: This study contributes to add some ideas to existing literature studies in the field of environmental pollution of the marine environment due to plastic, while highlighting some solutions that could contribute to reducing this type of pollution.

1. INTRODUCTION

Plastic is considered one of the most harmful substances in the environment and at the same time, it is one of the most consumed materials daily all over the world [1]. Plastic has lightweight, highly durable, strong, and cheap price. According to United Nations UN reports, one million bottles of drinking water are consumed every minute, and five billion plastic bags every year [2]. Half the amount of plastic produced is designed for single use only and thrown after use. Plastic production began in the 1950s till the 1970s was small quantities where waste plastic was

easy to control. In the 1990s in two decades plastic production tripled the previous production. In the 2000s the waste of plastic has become more than in the previous 40 years, today we produce 300 million tons every year. Only 9% of the plastic produced is recycled and 12 % is burned while the largest number of plastic turns into waste and accumulates in the land and marine environment. This has led to the increasing accumulation of plastic waste around the world and plastic has become a major hazard and damage to air, water, and land pollution [3].

Human irresponsibility and the lack of serious recycling methods are the main cause of waste transport from the wild environment by rains and wind to rivers and streams to the marine environment. Floods are also natural disasters that lead to the transfer of plastic waste to the marine environment [4]. The volume of waste entering the marine environment depends on the density of the population, the economic situation of the country and the large management system to control this waste, in 2010, (275 million metric tons) of plastic waste entering the marine environment were calculated. If the situation continues to be poorly managed, the proportion will increase significantly by 2025 [5]. These large amounts of plastic waste greatly affect living organisms in the marine environment Fish, seabirds, and marine mammals all of these at risk of extinction. 700 species could become extinct some estimates indicate that 267 species have already been affected. These include 84% of sea turtle species, 44% of seabird species, and 43% of all marine mammal species, this significant impact is due to the ingestion of plastic, suffocation or drowning, and entanglement [6]. According to a Plymouth University study estimates the death toll of marine species is at least 100 million every year because of plastic pollution. In addition, some studies have reported that plastic pollution also affects coral reefs and makes them more susceptible to bacterial diseases 89% of these reefs are susceptible to contracting the disease if they come into contact with plastic while Only 4% are not affected by plastic contact. Scientists predict that by 2050 the total weight of plastic waste will be higher than the total weight of fish in oceans [7]. This makes us can say that we have a seventh continent, which is a huge amount of plastic floating on the surface of the ocean, Where the largest area of the collection of plastic floating waste is found in the North Pacific with an area equivalent to six times the size of France [8, 9].

2. EFFECT OF PLASTIC POLLUTION ON THE MARINE ENVIRONMENT

2.1. Coral Reefs

According to United Nations Development Programme UNDP, coral reefs in addition to their aesthetic value are a major source of living and breathing for many marine organisms within the marine system (source of life) [10]. Although it occupies a small area where it does not exceed 0.1% of the surface of the world's oceans. However, it is the main provider of all kinds of life for 25% of marine organisms, It is also a means of protection for coastal areas where it is described as the natural barrier from hurricanes and rising sea levels [11].

Coral reefs are the main source of food and livelihood for more than 275 million people. In addition to being an important part of a large ecosystem, coral reefs are essential in supporting most of the marine environment. In fact, there are about 1-8 million species still unexplored in coral reefs [5, 12]. To find out the impact of plastics on coral reefs, a group of American and Australian researchers have been conducting research to determine the extent of impact and the probability of disease spread by contaminating these reefs with plastic. According to this study, plastic pollution helps spread and develop diseases on contaminated corals 22 times faster than healthy ones. This type of pollution causes the most common diseases among coral reefs (skeletal eroding band, white syndromes, black band, growth anomalies, brown band, and atramentous necrosis), three of these diseases are among the most serious diseases that cause rapid death of reefs. The study also confirmed that plastic debris affects coral reefs by preventing light and oxygen from reaching them, causing tissue damage to these reefs, and making them more susceptible to bacteria accumulated around plastic debris as shown in Figure 1 [13]. Another worrying study suggests that corals are attracting plastic to them because of the taste of the plastic. This study suggested the presence of chemicals added to the plastic mechanism of chemical reception [14].



Figure 1. Spawning coral wrapped in plastic [13].

2.1.1. Impact of Coral Reefs Extinction on the Ecosystem

According to International Union for Conservation of Nature IUCN, coral reefs are home to the highest biodiversity and contain more than a quarter of marine fish and many other animals, providing many ecosystem services such as food, flood prevention, and risk reduction [15]. Thus, the disappearance of coral reefs is the cause of many economic, health, and environmental problems. Since coral reefs are a major centre of biodiversity and no less important than forests, their vulnerability to damage or extinction will affect many edible fish species that feed on these reefs and this will make the cost of these fish high and affect the human economy [16]. Coral reefs are of great importance in the ecosystem as they are a major source of nitrogen and nutrients necessary for seafood chains. It has a major role in fixing nitrogen and carbon and works on recycling nutrients in the marine environment [17]. The coral reefs are important to the health of the ecosystem as an important source of food and medicines and services provided by the marine ecosystem for purification of air and creating soil rich in nutrients and reducing pollutants [18].

3. SEA TURTLES

Healthy oceans need sea turtles, Sea turtles are major components that have a significant impact on all surrounding organisms any defect of these turtles will affect the marine and terrestrial ecosystems [19]. An important example of the role of sea turtles in the marine ecosystem is tropical sea turtles (hawksbills), which feed on a type of sea sponge that grows among coral reefs. With this type of feeding, turtles prevent excessive growth of this marine sponge and thus protect coral reefs from suffocation and death due to excessive growth of this sponge [20]. Plastic reaches the turtles through random feeding, as turtles sometimes do not differentiate between food and plastic, especially that plastic, which is very similar to turtle food [21]. There are two ways for plastic to reach sea turtles direct and indirect road, direct ingestion of plastic parts and bags where this is observed in all types of sea turtles Figure 2 [22, 23].

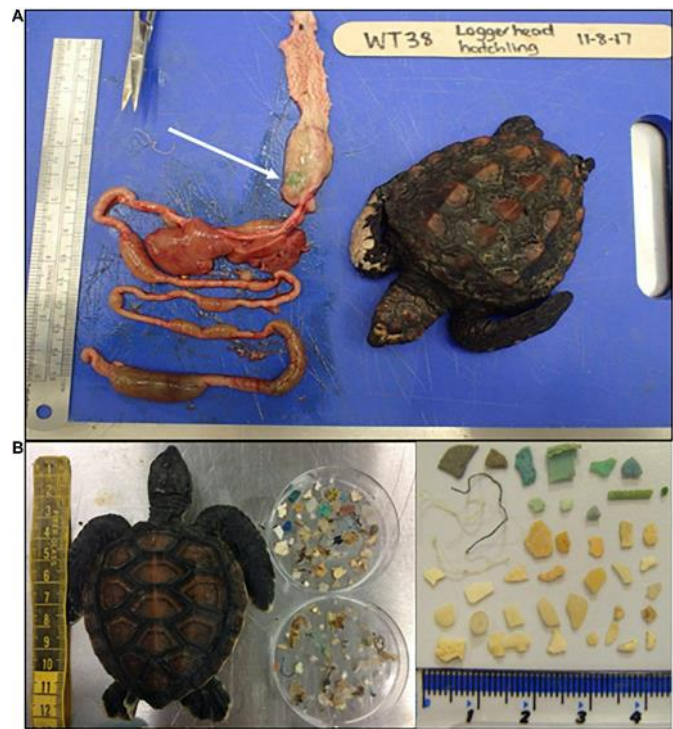


Figure 2(a). The digestive system of the turtle contains pieces of plastic. **(b)** Plastic erupting from a green turtle's cloaca on Cocos Island, Costa Rica **(c)** the pieces of plastic and the size of it.

Ingestion sometimes occurs directly when plastic pieces are mixed with the food of choice for these sea turtles, for example, a study found that small green turtles (*Chelonia mydas*) inside their digestive system contain pieces of plastic because they feed on a type of macro algae that had plastic pieces attached to it [Di Benedetto and Awabdi \[24\]](#). Indirect ingestion where the plastic particles are within the prey tissues that feed on sea turtles like some molluscs and crustaceans [\[25\]](#). In addition to plastic ingested by sea turtles, there are other possible effects of plastic pollution, sea turtles intertwine with plastic waste from fishing nets and other fishing gear that causing difficulty moving to avoid predators or loss of turtle tips. Several cases were recorded in this regard [\[26\]](#).

Plastic pollution also causes habitat destruction in which sea turtles live, the Beaches are often draining for plastic waste; As a result, female turtles have difficulty laying their eggs and plastic is a barrier to hatching snails. In addition, plastic waste changes the physical nature of beaches from temperature and permeability as they change due to the presence of plastic debris. All these factors affect the reproduction rate of sea turtles [\[27\]](#). Malaysia is home to four of the seven species of sea turtles in the world, which are the green, hawksbill, olive ridley and leatherback turtles. Sea turtles in Malaysia are endangered as World Wildlife Fund WWF has shown leatherback turtles have fallen by 99% compared to their numbers in 1960, olive ridley decreased by more than 95%, On the other hand, it has been noted that the proportion of green sea turtles in large numbers in the state of Terengganu and Sarawak has also decreased significantly since 1970 [\[28\]](#). The Malaysian Marine Fisheries and Mammals Network has indicated that most of the dissected marine animals have plastic parts in their abdomen, As a result, plastic residues have played a significant role in the rise in sea turtle mortality in Malaysia plastic bags are eaten by mistake because their shape is similar to jellyfish, which is a food for those turtles Eating plastic bags also clogs turtles, choking and dying [\[29\]](#).

3.1. Impact of Turtle Sea Extinction on the Ecosystem

Sea turtles play a major role in sustaining the ecosystem by preserving seaweed found in the seabed and oceans, preserving reefs, and providing key habitats for other marine organisms. In doing so, it helps to balance the marine and terrestrial food cycle. For example, green sea turtles are one of the species that feed on seaweed and thus help

to maintain these seaweeds by increasing the productivity of these herbs and increasing the nutritional content of them [30].

The extinction of this species of turtles will lead to excessive growth of seagrass and this intensive growth will cause the difficulty of lighting access to the rest of the marine organisms as well as the decomposition of these herbs make it a suitable place to be muds [31]. Older portions of seagrass beds tend to be overgrown with microorganisms, algae, invertebrates and fungi [32]. As for hawksbill turtles, characterized by having beak-like mouths [33] play an important role in the preservation of coral reefs through their dependence in feeding on a type of sponge that grows among coral reefs where they limit the intensive growth of this sponge and thus provide the ideal environment for coral reefs, Without this type of turtle, the sponge will cover the coral reefs, restrict its growth and lead to a change in the coral reef ecosystem. It should be noted that this sponge has a kind of chemical and physical defence that prevent fish and other marine life from eating it. When hawksbills tear off this sponge, it reduces its defensive capabilities and is therefore vulnerable to other predators. With this high selectivity of hawksbills, it preserves the biodiversity of coral reefs [34]. There is another effect of turtles on the ecosystem, through the impact of turtle eggs on the distribution and biological diversity of beaches that lay eggs where they work to improve the quality of the beach and provide important nutrients such as nitrogen, phosphorus and potassium and thus help these elements of the continued growth of vegetation, which helps to stabilize these sand and provide plants that are food for other neighbourhoods in the environment [35].

There are many important roles played by these sea turtles, which requires us to work to stop plastic pollution, which is one of the main causes of increasing the deaths of these turtles and also causes a lot of digestion problems or loss of organs of their bodies. It is possible to note the significant impact of the extinction of these turtles through its impact on the marine and terrestrial food cycle and causes many problems for the terrestrial and marine ecosystem.

4. SOLUTIONS TO REDUCE PLASTIC POLLUTION IN THE MARINE ENVIRONMENT

The problem of pollution of the marine environment due to plastic is a problem that grows rapidly day by day in 2017, (335) million metric tons of plastic were produced This amount is increasing and is expected to reach 1,100 million metric tons by 2050 [36]. About 8,300 million tons of plastic have been produced to date Only 9% were recycled of these, and 12% were burned the remaining 79% were buried or ended up in the marine environment [37].

Waste entering the marine environment is one of the most important problems facing organisms living in the marine environment it is estimated that the amount of plastic waste enters between (4.8-12.7) million metric tons each year [5]. These percentages make us face a big and complex problem where there are many ways in which plastic enters the marine environment. There are many economic sectors that are responsible for this huge amount of pollution from the production, packaging, agriculture, and fishing sectors, In addition to these sectors consumer behaviour plays a major role in this problem as well as technological change in recent years and the political decision has an impact to stand around this problem That's why the plastic waste problem requires a multifaceted effort to address or mitigate it and needs international regulation and coordination, such as the work of marine pollution conventions [38].

One of the solutions that some countries have taken is to reduce the consumption of single-use plastic through bans and fees Some of these countries have banned the use of disposable plastics, but according to UNEP, this measure was not enough to reduce the problem of plastic contamination. Plastic pollution is a global problem and must be addressed in a sustainable manner. There are some ways in which plastic waste entering the environment can be minimized, try as much as possible to reduce our daily consumption of disposable plastic such as water bottles, plastic bags, cups, and any other plastic items that are used once and then discarded. Recycling plastic waste where recycling helps keep plastic waste outside the environment. Carrying out clean-up campaigns for beaches or

rivers where these campaigns helped to remove plastic waste and prevent their access to the marine environment is one of the most direct and useful ways to combat ocean pollution with plastic. Support the ban on the use of disposable plastics as this helps reduce the consumption of this type of product. Avoid using products containing microbeads which are small plastic particles where that are found in some facial exfoliators, toothpaste, and bodywashes, these molecules easily enter the marine environment and then into hundreds of species in the marine environment [39]. According to IUCN, recycling, reuse, and the manufacture of environmentally friendly plastics play an important role in the disposal of plastic waste and reducing their entry into the aquatic environment. These processes help to achieve an environment that is largely free of plastic waste (as shown in Figure 3).

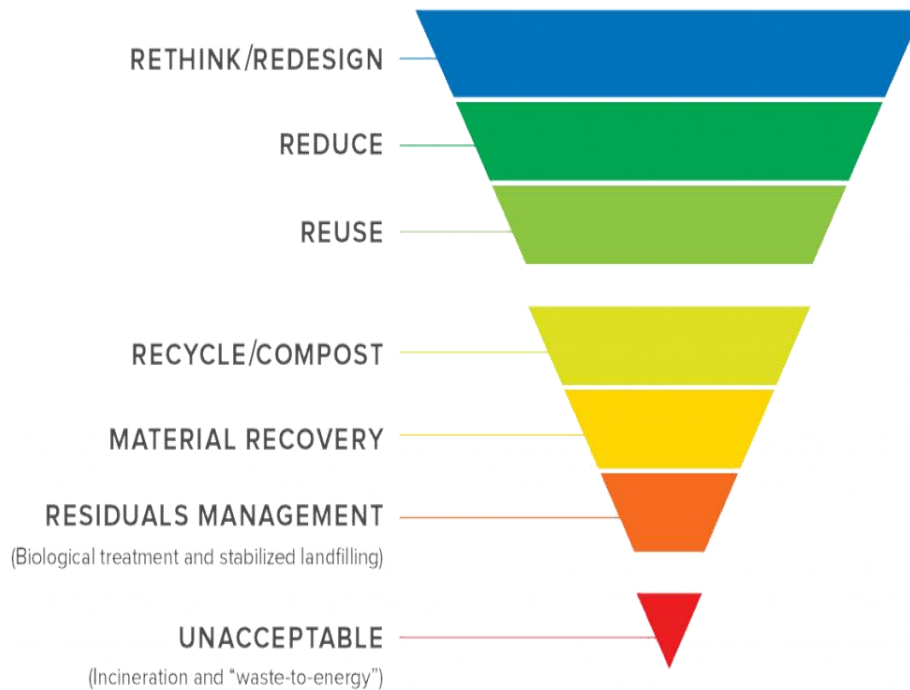


Figure 3. Photo: Waste hierarchy, according to the zero waste international Alliance. Credit: Zero Waste International alliance.

Nowadays it is possible to observe the world has realized the seriousness of the plastic waste problem Therefore, many international research centers are working to find a radical solution for the disposal of plastic waste. Either by creating new types of plastic that can be biodegradable in a short period of time or through the maximum economic exploitation of plastic, This is done by improving the quality of the plastic produced to enable use for more than one purpose and thus will reduce the waste of plastics and reduce access to the environment this is also done through the development of plastics with renewable sources that are easy to recycle [40].

5. CONCLUSION

We can be concluded from what has been presented in this research that the issue of pollution of the marine environment with plastic waste is the main cause of human beings through the production of very large quantities of plastic without realizing the seriousness of these products on the rest of living organisms and the impact on the ecosystem, whether the wild environment or the marine environment. All this mass production must be matched by a real pricing of the value of the polluted environment, which is difficult to return to its original nature because it takes a long period of time to recover up to hundreds of years. These high levels of plastic waste can be minimized by intensifying awareness campaigns and having the community understand how serious this problem is today and how it affects future generations. This is done through the creation of a responsible society and a sense of belonging to this ecosystem and developing a sense that this ecosystem is for all living organisms and that natural resources

are to serve all existing organisms. It should also be noted that the process of recycling and reuse is only the process of extending the time or delaying the arrival of plastic waste to the ecosystem, therefore the culture of responsibility must be spread among members of society to avoid this kind of pollution.

Funding: This study received no specific financial support.

Competing Interests: The authors declare that they have no competing interests.

Authors' Contributions: All authors contributed equally to the conception and design of the study.

Acknowledgement: The authors thank the Faculty of Applied Sciences, Universiti Teknologi MARA, Shah Alam Branch for the technical support towards this research.

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