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Chapter- 17

Impact of plastic pollution on faunal survival with probable sustainable solutions

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Keywords: Plastic Pollution, Plastic Waste, Fauna, Ecosystem, Sustainable Solution.

Abstract:

Every day, millions of tons of plastic waste are produced by humans which causes severe impacts on our ecosystem and biodiversity. Nowadays plastic is the main anthropogenic waste material globally due to irrational production, inappropriate and unscientific disposal, and inadequate recycling management of plastic. As a result, the fauna of the terrestrial and aquatic ecosystems both are in danger of plastic pollution. Birds are an important part of our biodiversity and they are affected by plastic pollution. Nowadays, birds use plastic debris for different purposes which ultimately causes the death of birds. Plastic waste occupies the global landscape and has parallel impacts on different species of insects. Bees have started to use plastics as brood material. Marine and land mammals both are severely affected by plastic pollution. Plastic pollution is an emergency danger for coral reefs and all food webs do exist at coral reefs. Every day many fish lose their life by suffocation from entering plastic bags and eating or entangling plastic debris. Plastic pollution has many harmful effects on amphibians and reptiles such as habitat disruption, disease transmission, reproductive and physical health problems, etc. In this book chapter, we have discussed the effect of plastic pollution on different types of faunal survival as well as diversity and also probable sustainable solutions to save our mother earth and its fauna from plastic pollution.

Introduction:

Plastic pollution is also called "white pollution", the most important threat to the global ecosystem. Less than a million tonnes of plastics were produced globally in 1950 which was significantly increased i.e., 368 million tonnes in 2019. Since 2019, the production of plastic products has surged by 5% annually. 51% of plastic is produced and consumed by Asia, while China produces 32% (Anand et al., 2023; Arpia et al., 2021).

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Nowadays, plastic is the main anthropogenic waste material globally due to irrational production, inappropriate and unscientific disposal, and inadequate recycling management of plastic. As a result, the terrestrial and aquatic ecosystems both are in danger of plastic pollution. Plastic waste is disclosed into the environment and it is a great evil for all life forms (Kumar et al., 2021).

Effects of plastics on Avifauna:

Every day, millions of tons of anthropogenic wastes are produced by humans which causes severe impacts on our ecosystem and biodiversity. Birds are an important part of our biodiversity and they are also affected by anthropogenic waste pollution such as plastic pollution (Deb et al., 2020; Das et al., 2022). Un-scientific urbanization and lack of proper disposal of anthropogenic waste by humans are responsible for the anthropogenic waste that birds use today. Birds use plastic debris for different purposes like 1) Nest building. 2) Sometimes building a nest with anthropogenic plastic debris is more useful for attracting a mating partner, increasing the chance of successful mating. 3) In many cases some plastic products give more strength to the nest (Jagiello et al., 2019).

The harmful effects of using these plastic materials for nest building are 1) the chances of increased nest predation because these materials can increase nest visibility (Borges and Marini, 2010). 2) Sometimes medical waste is also found in bird nests as nesting material. It is too dangerous because, through this, human diseases can spread very easily among different birds and animals and many healthy people. 3) Sometimes birds collect toxic anthropogenic materials like used liquid mosquito repellent wicks, which cause different toxic effects on birds, even cause of death. 4) Sometimes in birds, plastic may cause harm by entangling or ingesting when used for nesting (Blem et al., 2002; Townsend & Baker, 2014; Votier et al., 2011).

According to Jagiello et al. (2019), there was a study done on 36 bird's nests and they reported that non-natural anthropogenic waste accounts for 92% of which 88.9% was plastic beings (Jagiello et al., 2019). In another study on 53 nests of black storks in Central Poland, the nests contained almost 26% of products made of plastics (Janic et al., 2023).

We have collected different species of bird's nest photos and nests after birds permanently leave the nest or nest which are destroyed and fall on the ground by storm in South Kolkata. We found different anthropogenic wastes from different bird nests such as nylon threads, hard plastic, plastic bags, fishing line, iron nets, medical wastes, different color sewing threads, synthetic cotton, pieces of cloth, plastic bottle caps, electric wires, plastic straw, different types of rope, plastic strips, etc where most of the anthropogenic wastes in bird nest are plastically born.

Figure 1. A single plastic Chinese manjha thread causes the death of this bird.

Figure 2. Red-vented bulbul, use plastic sack, thread, and bag as nest material.

Impact of plastics on Arthropods:

Plastic waste occupies the global landscape and has parallel impacts on different species of insects. Two species of Megachilid bee use two different types of plastic polyurethane and polyethylene plastics in place of traditional nesting materials. It was reported that *Megachile rotundata* used polyethylene-based plastic bags in place of cut plant leaves which is their traditional nesting material. On the other hand, *Megachile campanulae* used polyurethane-based exterior building sealant in place of plant and tree resins for constructing brood (MacIvor & Moore, 2013). Plastic pollution is everywhere and it is present in aquatic ecosystems from surface water to benthic sediment. Nearly 70,000 species of Crustacea have a large distribution and different roles in the trophic webs. According to Pisani et al., 2022, it is suggested that Crustaceans are at high risk due to an overload of plastic pollution. Plastic is ingested by Crustaceans and through the food web; it is transferred to different trophic levels (Pisani et al., 2022).

Mammals and plastic pollution:

Marine and land mammals both are affected by plastic pollution. 56% of mammals living in marine environments do ingest plastic and 69% are affected by entangled plastics (Ayala et al., 2023). Microplastics are found in marine mammals (Zantis et al., 2021). Most of the Sperm whale's death is caused by plastics. Approximately 29 kg of plastic trash was found from a young whale that died on the coast of Spain in 2018. A few months later another sperm whale death body was found in Indonesia, and hundreds of plastic items were collected from whale stomachs. In the stomach of a young Cuvier's beaked whale, 40kg of plastic bags were reported in 2019 (Kruse et al., 2023). Plastics are also harmful to our domestic mammals and indirectly impact our economy. Dogs, goats, rodents, and cows eat almost everything. They sometimes collect their food from waste dumps where plastic garbage is and eat everything that smells like food and mistakenly entangle plastic waste. Consequently, they face gradually a slow painful death after some days (Muthu and Kamalanathan, 2021).

Coral reefs and their biodiversity collapse to plastic pollution:

Plastic pollution is an emergency danger for coral reefs and all food webs do exist at coral reefs. According to Pinheiro *et al*., 2023, a survey of 84 shallow and deep coral reef ecosystems in 25 different locations of the Pacific, Atlantic, and Indian Oceans was made. Anthropogenic waste was found in 77 out of 84 coral reefs. 88% was plastic debris within all anthropogenic waste (Pinheiro *et al*., 2023).

Fish fauna and plastic pollution:

Every day many fish lose their life by suffocation from entering plastic bags and eating or entangling plastic debris. But now plastic pollution has reached one step which is micro-plastic pollution. The mangrove ecosystem is affected by plastic pollution globally. A study in the Sundarbans mangrove forest on 13 fish species accounts for microplastics in their gastrointestinal tract (Bhattacharjee et al., 2023; Saha & Sarkar, 2022). According to Azevedo-Santos et al., 2021, fish are highly affected by plastic pollution among other fresh-water organisms that recorded plastic ingestion in natural or semi-natural fresh-water ecosystems of the world (Azevedo-Santos et al., 2021).

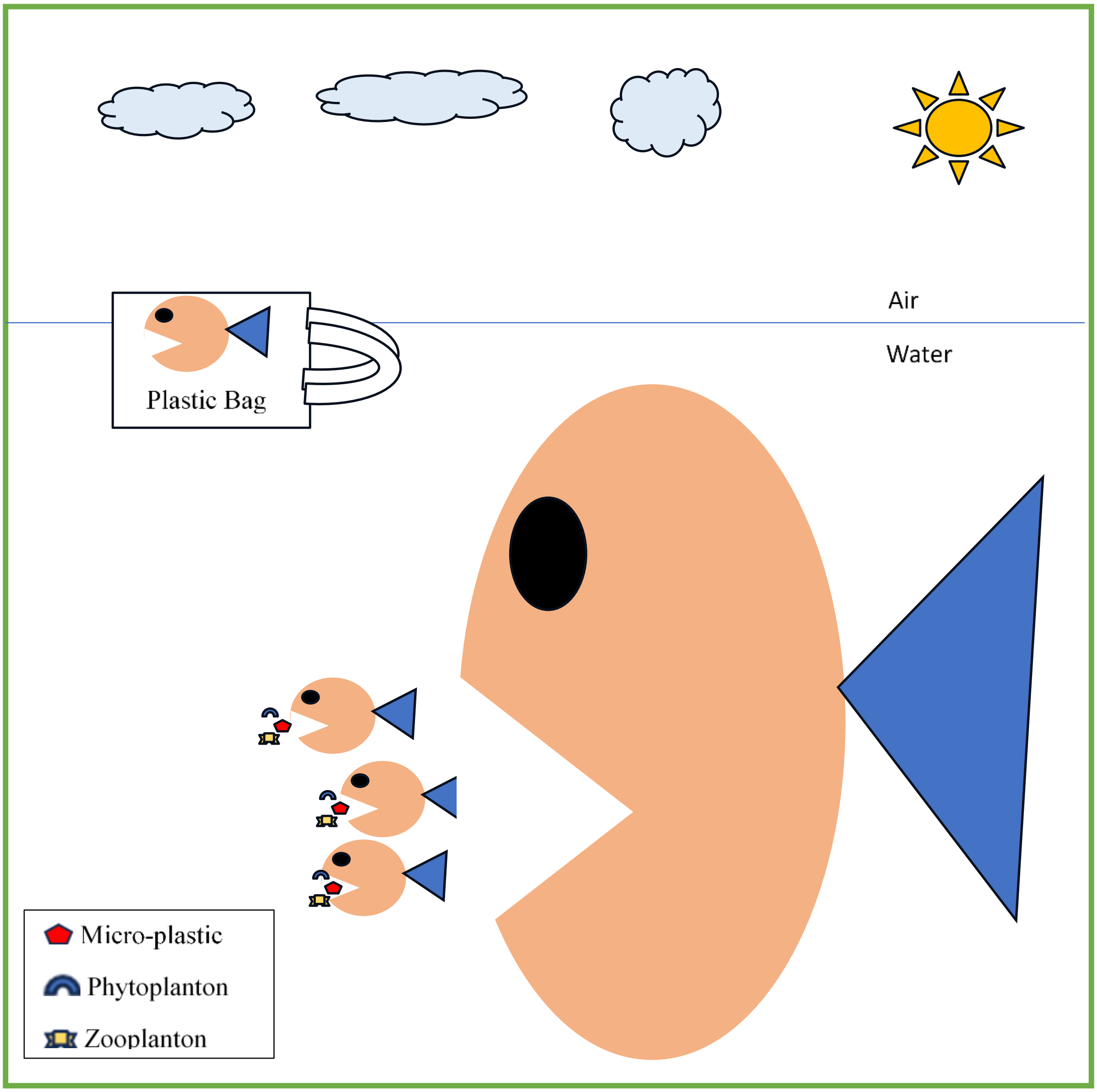

Figure 3. How plastic pollution affects fish fauna.

Amphibian and Reptile fauna's interaction with plastic pollution:

Plastic pollution has many harmful effects on amphibians and reptiles such as habitat disruption, disease transmission, reproductive and physical health problems, etc. According to Hou & Rao, 2022, microplastics are recorded in tadpoles, turtles, snakes, lizards, and crocodiles' bodies. However, it demands more research on the effects of microplastic on amphibians and reptiles (Hou & Rao, 2022).

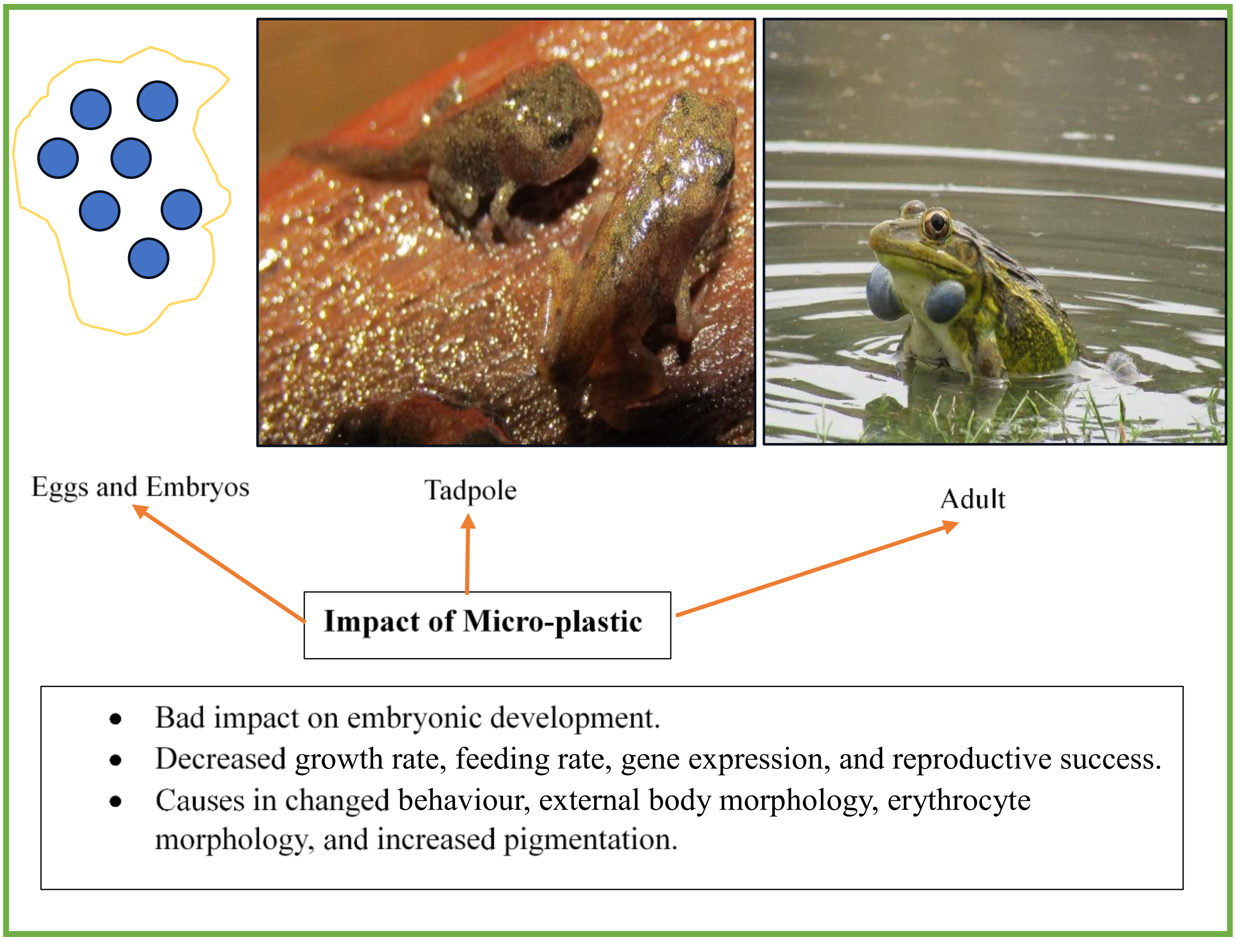

Figure 4. Impact of micro-plastics on different phases of the lifecycle of a frog.

How to protect the animal world from evil plastic pollution:

Controlling plastic pollution is a complex issue that requires a multifaceted approach. The use of plastics can be decreased at the production level by (a) using eco-friendly, biodegradable, or alternative materials (like glass); (b) enhancing product design to minimize plastic usage, increase product longevity, permit repair and reuse, and enhance recyclability by reducing the number of polymers, additives, and mixtures; and (c) outlawing specific single-use plastics (Walker & Xanthos, 2018; Browne et al., 2011). By creating lids that are inseparable from plastic bottles to promote proper disposal is an example of enhanced design. A long-term strategy to reduce the consumption of plastics, for example, is to raise consumer awareness of the environmental impacts of their choices through formal (i.e., in educational institutions) or informal (i.e., news, clean-up tasks) education (Chang et al., 2015; Ambrose et al., 2019).

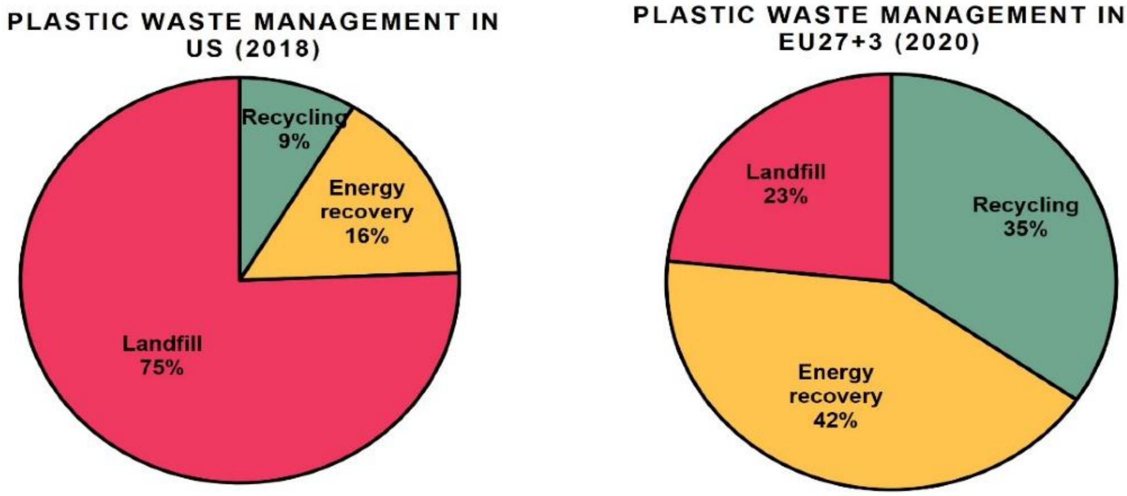

Figure 5. Post-consumer plastic waste management in the US (2018) and EU27+3 (2020). The figure is created according to the data from the US EPA and Plastics Europe (Lomwongsopon & Varrone, 2022).

Organic and Biodegradable Polymers as Substitutes for Traditional Plastics :

The quest for environmentally friendly materials has intensified due to the growing significance of environmental sustainability. The goal is to substitute renewable resources of petroleum and other fossil fuels and raise recycling goals and waste management effectiveness (Iriarte et al., 2009; Lambert & Wagner, 2017; Napper et al., 2020). Bio-based polymers, sometimes known as bioplastics, are made without regard to biodegradability, such as bio-polyethylene, and are alternatively produced from renewable feedstocks, or biomass. Regardless of the source of their feedstock, naturally occurring microorganisms (like bacteria, fungi, or algae) break down biodegradable polymers into carbon dioxide, and organic matter (mineralization). Furthermore, when subjected to particular plastic-degrading organisms (such as *Zalerion maritimum*), typical plastics may biodegrade, generating valuable biological products or organic matter and providing an alternative to contaminated or deteriorated plastics (Prata et al., 2019).

Recycling of plastic waste:

Current technologies frequently tend to lessen the characteristics of monomers created from plastic trash and speed up their end-of-lifetime, even while standard recycling procedures lower the amount of plastic that ends up in landfills. Consequently, recent research is beginning to highlight microbiological recycling techniques as an essential supplementary means of addressing the end-of-life of those difficult-to-recycle plastic waste streams. In reality, using biological depolymerization and bio-recycling to process plastic waste offers the chance to create higher-value products under environmentally friendly and sustainable conditions (lower energy and temperature requirements, no hazardous chemicals, etc.), all without any requirement to pre-sorting (Lomwongsopon & Varrone, 2022; Bandyopadhyay et al., 2023).

Degradation of plastic waste by Microorganisms:

One of the most promising methods for recycling plastic waste is the microbial and enzymatic breakdown of the polymers. This process can also be used to convert waste plastics into higher-value bioproducts, like biodegradable polymers through mineralization. Plastics undergo biodegradation by the release of extracellular enzymes by the microbe, the enzyme binds to the plastic's surface which initiates the hydrolysis of short polymer intermediates, which are then taken up by microbial cells and used as a carbon source to generate CO_2. Although these plastics are synthetic compounds, several microbes that can break down these polymers have been discovered recently.

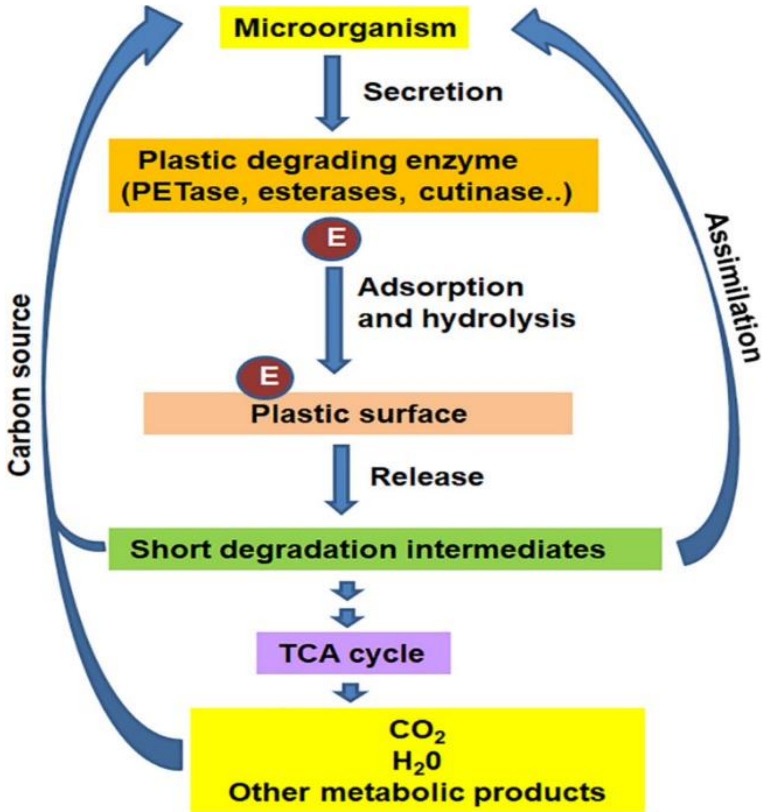

Figure 6. The general mechanism for biological degradation of plastic waste under aerobic conditions (Mohanan et al., 2020).

Numerous *Pseudomonas* sp. and *Bacillus* sp. have been linked to the partial breakdown of a broad range of petro-plastics, including Polyethylene (PE), Polystyrene (PS), Polypropylene (PP), Polyvinyl chloride (PVC), Polyethylene terephthalate (PET), and ester-based Polyurethane (PU) (Mondal et al., 2022). An innovative method for plastic breakdown, particularly for persistent non-hydrolyzable polymers, may result from research on the digestive enzyme(s) in plastic-degrading invertebrates and associated gut microorganisms. Implementing genetic engineering techniques to produce recombinant microbial strains and/or enzymes could be the best course of action to improve the biodegradation of synthetic plastic waste derived from petroleum.

Table 1: List of some Microorganisms that are capable of plastics degradation (Mohanan et al., 2020).

Examined polymer (polymer under examination)	Species	Source	Cultivation conditions	Polymer degradation		Reference
				In vitro conditions	Degradation efficiency	
Polystyrene	*Pseudomonas sp.*	Soil samples were taken from the plastic dump yard	Mineral medium with 0.85% NaCl and HIPS film at 30^0C, 150 rpm	30 days incubation at 30^0C	>10% weight loss	Mohan et al., 2016
Polypropylene	*Pseudomonas sp.* *Aspergillus niger*	Plastic dump yard	Mineral medium (B7) with 0.05% glucose and 0.05% sodium lactate at 30◦C	175 days incubation at neutral pH at 30^0C	60% weight loss	Cacciari et al., 1993
Polyethylene terephthalate	*Ideonella sakaiensis*	Polyethylene terephthalate recycling factory	Nutrient broth medium with PET at 30^0C	42 days incubation at 30^0C	Almost complete degradation achieved	Yoshida et al., 2016
Polyurethane	*Pseudomonas chlororaphis*	Microbial consortium from the Naval Research Laboratory, Washington, DC, United States	LB (Luria broth) medium at 30^0C, 180 rpm	6 h incubation at 23^0C on plates with Impranil	A zone of clearance was observed	Stern and Howard, 2000

Conclusion:

In addition to discussing the effect of plastic on the animal world, this study offers probable sustainable solutions to save Mother Earth and its faunal beings from plastic pollution. The life cycle of plastic needs to be extended through an integrated waste management system, minimizing its negative effects on the environment and according to the hierarchy of waste management, which is based on the four R: reduce, reuse, recycle, and recover.

References:

Ambrose, K. K., Box, C., Boxall, J., Brooks, A., Eriksen, M., Fabres, J., Fylakis, G., & Walker, T. R. (2019). Spatial trends and drivers of marine debris accumulation on shorelines in South Eleuthera, The Bahamas using citizen science. *Marine Pollution Bulletin*, *142*, 145–154. https://doi.org/10.1016/j.marpolbul.2019.03.036

Anand, U., Dey, S., Bontempi, E., Ducoli, S., Vethaak, A. D., Dey, A., & Federici, S. (2023). Biotechnological methods to remove microplastics: a review. *Environmental Chemistry Letters*, *21*(3), 1787–1810. https://doi.org/10.1007/s10311-022-01552-4

Arpia, A. A., Chen, W.-H., Ubando, A. T., Naqvi, S. R., & Culaba, A. B. (2021). Microplastic degradation as a sustainable concurrent approach for producing biofuel and obliterating hazardous environmental effects: A state-of-the-art review. *Journal of Hazardous Materials*, *418*, 126381. https://doi.org/10.1016/j.jhazmat.2021.126381

Ayala, F., Vizcarra, J. K., Castillo-Morales, K., Torres-Zevallos, U., Cordero-Maldonado, C., Ampuero-Merino, L., Herrera-Peralta, K., De-la-Torre, G. E., Angulo, F., & Cárdenas-Alayza, S. (2023). From social networks to bird enthusiasts: reporting interactions between plastic waste and birds in Peru. *Environmental Conservation*, *50*(2), 136–141. https://doi.org/10.1017/S037689292300005X

Azevedo-Santos, V. M., Brito, M. F. G., Manoel, P. S., Perroca, J. F., Rodrigues-Filho, J. L., Paschoal, L. R. P., Gonçalves, G. R. L., Wolf, M. R., Blettler, M. C. M., Andrade, M. C., Nobile, A. B., Lima, F. P., Ruocco, A. M. C., Silva, C. V., Perbiche-Neves, G., Portinho, J. L., Giarrizzo, T., Arcifa, M. S., &Pelicice, F. M. (2021). Plastic pollution: A focus on freshwater biodiversity. *Ambio*, *50*(7), 1313–1324. https://doi.org/10.1007/s13280-020-01496-5

Bandyopadhyay, A., Sinha, A., Thakur, P., Thakur, S., & Ahmed, M. (2023). A review of soil pollution from LDPE mulching films and the consequences of the substitute biodegradable plastic on soil health. *Int. J. Exp. Res. Rev.*, *32*, 15-39. https://doi.org/10.52756/ijerr.2023.v32.002

Bhattacharjee, Sh., Mandal, B., Das, R., Bhattacharyya, S., Chaudhuri, P., Mukherjee, A. (2023). Microplastics in the gastrointestinal tract of estuarine fish from the mangrove ecosystem of Indian Sundarbans. *Iranian Journal of Fisheries Sciences*, 317–338.

Blem, C.R., Blem, L.B., & Harmata, P.J. (2002). Twine causes significant mortality in nestling ospreyse Wilson Bulletin, 114(4), 528-529.

Borges, F.J.A., & Marini, M.Â. (2010). Birds nesting survival in disturbed and protected Neotropical savannas. Biodiversity and Conservation, 19(1), 223-236.

Browne, M. A., Crump, P., Niven, S. J., Teuten, E., Tonkin, A., Galloway, T., & Thompson, R. (2011). Accumulation of Microplastic on Shorelines Woldwide: Sources and Sinks. *Environmental Science & Technology*, *45*(21), 9175–9179. https://doi.org/10.1021/es201811s

Cacciari, I., Quatrini, P., Zirletta, G., Mincione, E., Vinciguerra, V., Lupattelli, P., Sermanni,G.G.,(1993). Isotactic polypropylene biodegradation by a microbial community:physicochemical characterization of metabolites produced. *Applied Environmental Microbiology*. *59,* 3695–3700. doi: 10.1128/AEM.59.11.3695-3700.1993

Chang M. (2015). Reducing microplastics from facial exfoliating cleansers in wastewater through treatment versus consumer product decisions. *Marine pollution bulletin*, *101*(1), 330–333. https://doi.org/10.1016/j.marpolbul.2015.10.074

Das, S. K., Karan, S., & Sen, K. (2022). Biodiversity of avifauna in chilkigarh, jhargram, west bengal, india. *World Journal of Environmental Biosciences*, *11*(3), 8–13. https://doi.org/10.51847/jNtkP7dkxS

Deb, H., Sanyal, T., Kaviraj, A., & Saha, S. (2020). Hazards of wind turbines on avifauna—A preliminary appraisal within the Indian context. *Journal of Threatened Taxa*, *12*(4), 15414–15425. https://doi.org/10.11609/jott.5165.12.4.15414-15425

Hou, D.-M., & Rao, D.-Q. (2022). Microplastics: Their Effects on Amphibians and Reptiles-A Review. *Pakistan Journal of Zoology*, *54*(6). https://doi.org/10.17582/journal.pjz/20210820080823

Iriarte, A., Gabarrell, X., & Rieradevall, J. (2009). LCA of selective waste collection systems in dense urban areas. *Waste management (New York, N.Y.)*, *29*(2), 903–914. https://doi.org/10.1016/j.wasman.2008.06.002

Jagiello, Z., Dylewski, Ł., Tobolka, M., & Aguirre, J. I. (2019). Life in a polluted world: A global review of anthropogenic materials in bird nests. *Environmental Pollution*, *251*, 717–722. https://doi.org/10.1016/j.envpol.2019.05.028

Janic, B., Bańbura, J., Glądalski, M., Kaliński, A., Kamiński, M., Marszał, L., Pieniak, D., Wawrzyniak, J., & Zieliński, P. (2023). Plastic occurrence in nests of a large forest bird. *Ecological Indicators*, *153*, 110470. https://doi.org/10.1016/j.ecolind.2023.110470

Kruse, K., Knickmeier, K., Brennecke, D., Unger, B., & Siebert, U. (2023). Plastic Debris and Its Impacts on Marine Mammals. In *Marine Mammals* (pp. 49–62). Springer International Publishing. https://doi.org/10.1007/978-3-031-06836-2_4

Kumar, R., Verma, A., Shome, A., Sinha, R., Sinha, S., Jha, P. K., Kumar, R., Kumar, P., Shubham, Das, S., Sharma, P., & Vara Prasad, P. V. (2021). Impacts of Plastic Pollution on Ecosystem Services, Sustainable Development Goals, and Need to Focus on Circular

Economy and Policy Interventions. *Sustainability*, *13*(17), 9963. https://doi.org/10.3390/su13179963

Lambert, S., & Wagner, M. (2017). Environmental performance of bio-based and biodegradable plastics: the road ahead. *Chemical Society reviews*, *46*(22), 6855–6871. https://doi.org/10.1039/c7cs00149e

Lomwongsopon, P., & Varrone, C. (2022). Critical Review on the Progress of Plastic Bioupcycling Technology as a Potential Solution for Sustainable Plastic Waste Management. *Polymers*, *14*(22), 4996. https://doi.org/10.3390/polym14224996

MacIvor, J. S., & Moore, A. E. (2013). Bees collect polyurethane and polyethylene plastics as novel nest materials. *Ecosphere*, *4*(12), 1–6. https://doi.org/10.1890/ES13-00308.1

Mohan, A. J., Sekhar, V. C., Bhaskar, T., and Nampoothiri, K. M. (2016). Microbial assisted high impact polystyrene (HIP) degradation. *Bioresource Technology*, *213*, 204–207. https://doi.org/10.1016/j.biortech.2016.03.021

Mohanan, N., Montazer, Z., Sharma, P. K., & Levin, D. B. (2020). Microbial and Enzymatic Degradation of Synthetic Plastics. *Frontiers in Microbiology*, *11*. https://doi.org/10.3389/fmicb.2020.580709

Mondal, P., Adhikary, P., Sadhu, S., Choudhary, D., Thakur, D., Shadab, M., Mukherjee, D., Parvez, S., Pradhan, S., Kuntia, M., Manna, U., & Das, A. (2022). Assessment of the impact of the different point sources of pollutants on the river water quality and the evaluation of bioaccumulation of heavy metals into the fish ecosystem thereof. *Int. J. Exp. Res. Rev.*, *27*, 32-38. https://doi.org/10.52756/ijerr.2022.v27.003

Muthu, B., Kamalanathan, A. (2021). Digestive impact of cow when ingest plastic waste. *Linguistics and Culture Review*, 1257–1264.

Napper, I. E., & Thompson, R. C. (2019). Environmental Deterioration of Biodegradable, Oxo-biodegradable, Compostable, and Conventional Plastic Carrier Bags in the Sea, Soil, and Open-Air Over a 3-Year Period. *Environmental science & technology*, *53*(9), 4775–4783. https://doi.org/10.1021/acs.est.8b06984

Napper, I. E., Davies, B. F. R., Clifford, H., Elvin, S., Koldewey, H. J., Mayewski, P. A., Miner, K. R., Potocki, M., Elmore, A. C., Gajurel, A. P., & Thompson, R. C. (2020). Reaching New Heights in Plastic Pollution—Preliminary Findings of Microplastics on Mount Everest. *One Earth*, *3*(5), 621–630. https://doi.org/10.1016/j.oneear.2020.10.020

Pinheiro, H. T., MacDonald, C., Santos, R. G., Ali, R., Bobat, A., Cresswell, B. J., Francini-Filho, R., Freitas, R., Galbraith, G. F., Musembi, P., Phelps, T. A., Quimbayo, J. P., Quiros, T. E. A. L., Shepherd, B., Stefanoudis, P. V., Talma, S., Teixeira, J. B., Woodall, L. C., & Rocha, L. A. (2023). Plastic pollution on the world's coral reefs. *Nature*, *619*(7969), 311–316. https://doi.org/10.1038/s41586-023-06113-5

Pisani, X. G., Lompré, J. S., Pires, A., & Greco, L. L. (2022). Plastics in scene: A review of the effect of plastics in aquatic crustaceans. *Environmental Research*, *212*, 113484. https://doi.org/10.1016/j.envres.2022.113484

Prata, J. C., Silva, A. L. P., da Costa, J. P., Mouneyrac, C., Walker, T. R., Duarte, A. C., & Rocha-Santos, T. (2019). Solutions and Integrated Strategies for the Control and Mitigation of Plastic and Microplastic Pollution. *International Journal of Environmental Research and Public Health*, *16*(13), 2411. https://doi.org/10.3390/ijerph16132411

Saha, A., & Sarkar, C. (2022). Protecting The Precious Sundarbans: A Comprehensive Review of Biodiversity, Threats and Conservation Strategies In The Mangrove Ecosystem. *Conscientia*, *10*, 60-80.

Stern, R. V., and Howard, G. T. (2000). The polyester polyurethanase gene (pueA) from Pseudomonas chlororaphis encodes a lipase. *FEMS Microbiology Letters*,*185*, 163–168. doi: 10.1111/j.1574-6968.2000.tb09056.x

Townsend, A. K., & Barker, C. M. (2014). Plastic and the Nest Entanglement of Urban and Agricultural Crows. *PLoS ONE*, *9*(1), e88006. https://doi.org/10.1371/journal.pone.0088006

Votier, S.C., Archibald, K., Morgan G., & Morgan, L. (2011). e use of plastic debris as nesting material by a colonial seabird and associated entanglement mortality. Marine Pollution Bulletin, 62(1), 168 – 172.

Walker, T. R., & Xanthos, D. (2018). A call for Canada to move toward zero plastic waste by reducing and recycling single-use plastics. *Resources, Conservation and Recycling*, *133*, 99–100. https://doi.org/10.1016/j.resconrec.2018.02.014

Yoshida, S., Hiraga, K., Takehara, T., and Oda, K. (2016). A bacterium that degrades and assimilates poly(ethylene terephthalate). *Science*,*351*, 1196–1199. https://doi.org/10.1126/science.aad6359

Zantis, L. J., Carroll, E. L., Nelms, S. E., & Bosker, T. (2021). Marine mammals and microplastics: A systematic review and call for standardisation. *Environmental Pollution*, *269*, 116142. https://doi.org/10.1016/j.envpol.2020.116142

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