



ORIGINAL RESEARCH PAPER

Biological Science

REVIEW ON ACCUMULATION AND FRAGMENTATION OF ANTHROPOGENIC MATERIALS ON, IN AND AROUND BIRDS

KEY WORDS: Anthropogenic materials, Birds, Micro plastics

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ABSTRACT

Anthropogenic material is worldwide issue and certainly a crucial threat for avian ecosystem. There are large number of avian species use anthropogenic debris in their nests. Anthropogenic material comprises plastic, foil, masks, cigarette butts, clothes pieces, etc. Fragmentation of plastic and cigarette butts cause lethal effect on physical fitness of birds. Breakdown of plastic into extremely small pieces and converts into micro plastics. Cigarette fragmentation which turns into cigarette litter and that damage the birds sustainability. Entanglement of plastic string in birds morphological structures and lead to difficulties in their existence, sometimes it cause lethal effect to the birds, that is debate in these present study. Mortality in birds by nestling is more to that area where the more anthropogenic debris present. The ingestion of micro plastics is directly effect on physiological functions of birds. Accumulation of micro plastics in birds gastrointestinal (digestive) and respiratory tract may results into deadly effect on birds. Cigarette litter accumulation also lead to consequential result on female birds fertility. The use of plastic debris in nest construction is one of the response of birds to plastic pollution, and the changes in the natural especially terrestrial environment may result in reduced availability of natural nestling material, it forcing individual birds to seek replacements. (Jagiello, Zuzanna, et al. 2019)[1]. Urban areas with higher population density produce more plastic waste, as evidenced by city residents generating twice as much waste as their rural areas and it is happen by the extensive use of packaged products and increased food waste. (Wayman, Chloe, et al. 2024)[2]. Quantifying the presence of plastic and other anthropogenic materials in the nests of these species over time can also serve as a useful indicator of plastic pollution in the environment and should be closely monitored. Therefore, in an increasing urbanization scenario, it becomes essential to raise public awareness on the potential consequences of the presence of anthropogenic waste in the environment. In addition, we encourage future studies focusing on the causes and consequences of the incorporation of anthropogenic materials in avian nests, with special emphasis on potential adverse consequences of their use. Girao, Joana, et al. (2024)[3]. Anthropogenic activities and human pressure affect on survival of avian species. Using anthropogenic debris by birds in their nest reflects the indicator and marker of global environmental pollution.

INTRODUCTION:-

Anthropogenic debris viz any manufactured or processed solid waste materials that enters the surrounding from any source, represents one of the main hazards for the natural ecosystems for all over the globe. The impact of anthropogenic materials on ecosystem depends on intrinsic morpho- anatomic, evaluative and eco-ethological characteristics of the species or an extrinsic characteristics of anthropogenic debris (Battisti, Corrado, et al., 2019)^[4]. The recent study presents that increased anthropogenic material in birds nest construction. Mostly the material which occurs in nestling is strings, papers, textiles and pieces of plastics (Girao, Joana, et al., 2024)^[3]. Other anthropogenic debris also occur in birds nests like masks, cigarette butts, wool, threads, etc. From past few decades birds consistently using anthropogenic debris for their nests building. Probably more birds mortality occurs due to entanglement or ingestion of debris. The area where higher number of anthropogenic material present in surrounding environment, in that area more number of birds use anthropogenic material in their nest (Jagiello, Zuzanna A., et al., 2018)^[5]. A recent study represent that, birds uses anthropogenic material for their nests construction because of higher human pressure. Entanglement due to anthropogenic debris and suffocation by ingesting anthropogenic materials lead to adverse effect on birds (Jagiello, Zuzanna, et al., 2023)^[6]. Globally it is greater issue, the ingestion of plastic effect on health of birds. These effect comprises physical impairment like intestinal blockage, ulcers, perforation of the gut and fake satiety, also the toxicological effect including reproductive disorder, activation of inflammatory responses and immune deficiency, it can results into the mortality in birds (Tokunaga, Yurika, et al., 2023)^[7]. It is widely reported that, the ingestion of anthropogenic material by the biota. Plastic debris can physically cause the threats on wildlife. (Rochman, Chelsea M.

et al., 2013)^[8].

Still it is not understood that the entire and potential health effect of anthropogenic material. It is mainly for that birds which are most affected by micro plastics and anthropogenic materials ingestion. As compared to fishes and invertebrates, still birds are understudied. For the study of ingestion of micro plastics and anthropogenic debris in birds, the data mostly comes from observational studies. Observational study of birds is very opportunistic because it required samples from post mortem analysis as well as analysis of fecal matter and regurgitated pellets. It is very tough task to capture and euthanasia of wild birds. Due to the lots of seasons this method cannot be applied in large extent, because of ethical reasons and their behavior, the large number of birds species threatened world wide (Monclus, Laura, et al, 2022)^[9].

The existence of human-made materials such as microplastics cause the large impacts on the fitness of organisms belongs to marine and terrestrial ecosystems (Lato K.A., et al., 2021)^[10]. Fragmentation of plastic occur by the action of UV radiation, photodegradation, mechanical transformation that is wave action and microbial degradation. The breakdown of plastics results into microscopic particles of the plastic material which called as microplastics (Carlin, Julia, et al., 2021)^[11]. Recently reported that, by ingestion and inhalation of microplastics can enter in trophic webs, and it can cause potential detrimental effect on wildlife and humans (Wayman, Chloe, et al., 2024)^[13]. Microplastics serve as a transport vehicles for plastic associated contaminants, comprises Legacy Persistent Organic Pollutants (POPs), trace metals and organic additive (Suhring, Roxana, et al., 2022)^[14]. It very difficult task the sampling and extracting the accumulated particles from stomachs and tissues from insects, birds, marine mammals and turtles (Ribeiro,

Francisca, et al., 2019)^[15]. Ingestion of large and sharp microplastics (<5mm) can cause the blockage, ulcers and perforation in digestive tract also it altered in feeding behavior and lead to starvation. When the macroplastic fragmentation occur after ingestion it can convert into smaller pieces, it is belonging into either micro (1um-5mm) or nanoplastics (<1um). Fragmentation occur through digestion and mechanical grinding. These microplastics fragments can be absorbed by the digestive tract, transported around body through blood stream and accumulate in tissues and organs. Microplastic which is <20 um can able to penetrate and pierce into most of organs. The microplastics is <20µm can cross the cell membranes, potentially damaging tissues and intracellular structures. Microplastics also able to cross the blood-brain bonnier and the placenta(Charlton-Howard, Hayley S.,et al., 2023)^[16]. It is studied that the ingestion of microplastics by birds lead to reduction in body biomass. It is also seen that increase in malondialdehyde secretion in the liver, brain, intestine and gizzard of the birds. It is studied that, it can cause suppressive effect on hepatic nitric oxide production and superoxide dismutase activity in the liver and intestine (de Souza, Sindoval silva, et al., 2022)^[17].

Birds mostly used cigarette butts at the time of nest construction, to line their nests. Cigarette butts contains most of toxic substances that can enters into avian physiological systems through their skin. Using of cigarette butts in nest construction can cause effect on genotoxicity of females during breeding (Saurez- Rodriguez, Monserrat, Regina D. Montero- Montoya, and Constantino Macias.,2017)^[18].

In these review we summarized current situation and evaluate the role of ingestion, incorporation and accumulation of anthropogenic materials globally in avian ecosystem. The main aim focus on these review is to become distended awareness about practicable effect of anthropogenic materials mainly the micro plastics on avian physiological systems.

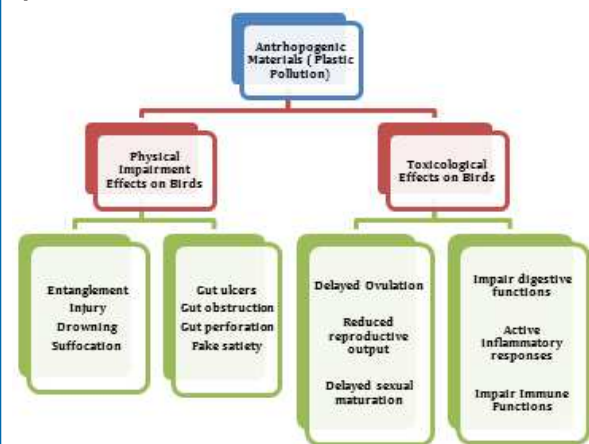


Fig.1: The physical impairment and toxicological effects of anthropogenic materials on birds (Wang, Limin, et al.,2021)^[26].

MATERIALS& METHODS

For these review we used data from bibliographic search. We collected data by using Google Scholar. We searched data by using succeeding keywords viz anthropogenic material, birds & micro plastics. Firstly we searched the research papers and articles on anthropogenic materials. By followed these searches we studied anthropogenic material in birds nests from published data. We noted the different types of anthropogenic material which is used by birds in their nests such as plastic strings, threads, masks, cigarette butts, paper, etc. We mostly searched the effect of micro plastics and Cigarette butts on birds health. We also noted the entanglement difficulties in birds. We also noted the harmful effect of anthropogenic debris on, in and around the birds We noted whether the presence of anthropogenic debris in nest

could be used as an indicator and signal of plastic pollution (Jagiello,Zuzanna,et al.,2019)^[11]. For these review we collected the recent contemporary data from the bibliographic exploration

RESULTS AND DISCUSSION

The results of these survey is based on bibliographic exploration. Anthropogenic material is considered as Crucial hazard for avian fauna. Plastic and other anthropogenic debris viz baler twine, fragments of balloons and crisp, pieces of paper were found in 112 (35%) of the 325 Pied Flycatcher nests from 17 wood-lands across Great Britain (Briggs, Kevin B., D.Charles Deeming, and Mark C. Plan- Mainwaring., 2023)^[19]. (Votier, Stephen C., et al., 2011)^[20] reported that, on average 65.63±26.05 (range of minima 33-109) birds were entangled with plastic nesting material an every year, mainly entanglement occur around the legs and feet, but often it occur around the wings.(Jagiello,Zuzanna A.,et al.,2018)^[6] reported that the white stork Ciconia ciconia sampled in Western Poland, they used anthropogenic debris in their nests. Studies revealed that due to the plastic string which may cause entanglement and due to the rubber elements, plastic tape or string which may cause strangulation or wire and other metals elements leads to injuries. (Janic, Bartosz, et al., 2023)^[21] carried work in central Poland, from the report of that studies, 53 Black Stork nests were surveyed and the anthropogenic materials was found in 14 nests (26%). The plastic debris were found in nests which was comprises that polypropylene string, fragments of plastic shopping bags, wrapping foil, fragments of polypropylene bags used in agriculture, and plastic textiles. (Provencher, Jennifer F., et al., 2018)^[22] investigated that the industrial and user anthropogenic material were found in Fulmars were collected from Labrador Sea. By the examination of fecal precursors samples of these birds, it was found that the occurrence of fibers, film, pellet, foam and rubber. (Lato, K.A., et al., 2021)^[23] reported the occurrence of micro plastics in gull nest, which consist 34.4% of Herring Gull nests and 43.3%. of Blacked Gull nests, which were sample from United States in 2018. (Carlin, Julia, et al., 2020)^[11] reported the appearance of micro plastics in GI traits of 63 birds from Central Florida in 2020. The collection showed that 1032 pieces of plastic debris which were followed by micro fragments (155 pieces), macro plastics (8 pieces) and micro beads (2 pieces). The greatest number of micro plastics were found in gastrointestinal tracts of Red shouldered Hawk species. From the Coastal Marshes region of Mississippi. (Weitzel, Spencer L., et al., 2021)^[12] reported that the ingestion of plastic by two species of resident marsh bird, Clapper Rails (*Rallus repitans*) and Seaside Sparrows (*Ammospiza maritima*). The detection revealed that the micro plastics in 64% of marsh sediment samples, 83% of Clapper Rail and 69% of Seaside sparrow proventriculus samples.

(Suhring, Roxana, et al., 2022)^[14] investigated that the occurrence and pattern of organic and inorganic co-contaminants of micro plastics in two seabird species from the Canadian Arctic- Northern Fulmar (*Fulmarus glacialis*) and Black-Legged kittiwake (*Rissatridactyla*). Studies found that the fulmars had higher level of plastic contamination and emerging organic compounds (plastic addictive) than kittiwakes, whereas higher concentrations of legacy POPs were found in kittiwakes than the Fulmars. (Charlton-Howard, Hayley S, et al., 2023)^[16] investigated the plastic induced diseased in Flesh-Footed Shearwaters (*Aredennacarneipes*) and defined that disease as a Plasticosis. These studies reported from the Lord Howe Island, Australia in 2021. (de Souza, Sindoval Silva, et al., 2022)^[17] observed the ingestion of naturally aged micro plastics affected on health of Japanese Quail (*Coturnix Coturnixjaponica*). The studies that investigated the MPs in birds showed a significant reduction in body biomass. (Wayman, Chloe, et al., 2024)^[13] Investigated the occurrence of anthropogenic debris in the digestive and respiratory systems of four binds namely: Common Buzzard

(Buteobuteo), Black kite (Milvusmigrans), Eurasian sparrowhawk (Accipiternisus), and Northern Goshawk (Accipitergentilis) from the Madrid region of the Spain. The results described that the contamination in all species with micro plastics (MPs) and cellulosic anthropogenic fibers, with an average of 7.9 MPs and 9.2 AFs per specimen. The digestive system contains at least 1 MP, while the 65% of specimens contains MPs in their respiratory systems. Cellulose fibers were the evidence of industrial treatment.

(Tokunaga, Yurika, et al., 2023)^[7] investigated that the airborne microplastics (AMPs) from the lungs samples of rock doves (Columbalivia), black kites (Milvusmigrans) and barn Swallows (Hirundorustica). Inhalation and accumulation of AMPs within lungs occurred in wild birds. (Corrales - Moya, Josue, et al., 2023)^[24] reported that the anthropogenic materials used in nests of common dweller species, the clay-colored thrush (Turdusgrayi). Due to uses of anthropogenic materials in nests there is reduction of reproductive success and population size. (Saurez-Rodriguez, Monserrat, Regina D. Montero - Montoya, and Constantino Macias Gracia., 2017)^[18] investigated the fluctuating levels of genotoxic damaged measured as the red blood cells with nuclear abnormalities in breeding of Passerdomesticus and Corpodacsmexicanus of both sexes, by the uses of the amount of Cigarette butts for their nests construction.

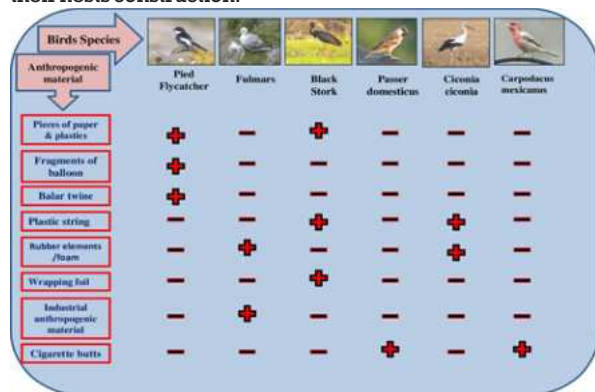


Fig.2 :Occurrence of type of anthropogenic material in birds nest from the above results

More anthropogenic material occurred in nests where more intensity of anthropogenic activities happened. Use of anthropogenic debris in nest of great tit (Parusmajor) and blue tit (Cyanistescaeruleus) from Portugal during the breeding seasons of 2020 and 2021 (Girao, Joana, et al., 2024)^[2]. Accumulation of micro plastics leads to potentially blockage of digestive system, ulcers and perforation of digestive system, micro plastics penetrates into the most of organs, it can cause false sense of fullness and causing the bird to stop eating, into which results malnutrition, starvation and death of bird. Ingestion of plastic leads to decreased feeding stimuli, gastrointestinal blockage, it lead to decreasing gastric enzyme secretion and decreasing steroid hormone secretion which can lead to infertility in birds (Susanti, N.K.Y., A. Mardiatuti and Wardiatno., 2020)^[28].

In the 1960s, less than 5% of birds that content plastic in their stomachs. Twenty years later, more about 80% birds found plastic in their stomachs. It is predicted that by 2050, 99% of all bird species will be ingesting plastic (<https://oceanblueproject.org/the-effects-of-plastic-p-on-seabirds/>)^[28]. It is very prerequisite to control the anthropogenic activities worldwide for conservation of avian fauna.

The major factor in anthropogenic materials which is harmful for birds ecosystems is plastic, which takes hundreds of years to break down. By considering the huge figures of birds mortality, it is individuals efforts to minimize the risk of plastic to birds. It is necessary to reduce the use of plastic, use

alternatives instead of plastics, recycle properly whenever there is possible conditions, participate and organize Community and Beach cleanup.



Fig 3:Global distribution of plastic nests according to social's posts (Gallitelli, L., Battisti, C., & Scalici, M. 2023)^[27].

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