

Environmental impact on animals' behaviour and health: Implications for conservation strategies

AUTHORS DETAIL

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Abstract

The environment of every living thing unambiguously impacts the behaviour and survival of that particular species, either flora or fauna. A healthy environment supports and favors a handsome number of species. Conversely, the degradation of environmental factors including pollution of air, water and soil not only adversely affects the mental status of animals but also compromises the survival chance and well-being. In this chapter, the environmental impact on the behaviour of animals and the factors that contribute to the changing animal behavior including stressors are comprehensively discussed. Appropriate suggestions and recommendations are given to maintain a healthy nexus between animals' behaviour and the environment.

Keywords: Environment, Behavior, implications, conservation

Introduction

Animal health and welfare demand a healthy environment with a proper functioning ecosystem. Animal health is affected directly or indirectly due to the deterioration of environment (Brief, 2024). Our planet is damaged badly due to pollution. Animals are losing their homes, habitats, or changing their habitat due to pollution. Many invasive or alien species are involved in the spread of diseases in native animals through breeding in an ecosystem. Dangerous chemicals are also present in the environment that accumulate in it and cause negative impact on animals. Fish are a key protein source in numerous regions of the world and a valuable aquatic animal model in environmental research. The zebrafish and mouse model synergism are a critical resource to research the reproductive toxicity of Ciprofloxacin antibiotics. The inquiry conducted by Lirui et al. (2022) identifies the possible toxicity of fluoroquinolones on the male reproductive system. Moreover, this study evaluated the effect of various antibiotics on fish and mouse reproductive ability. It was done by C16/17 CIP on male zebrafish following blood testosterone test, spermatozoal hematoxylin and eosin staining, and transcriptome analysis (Hou et al., 2022). Climate changing is another factor that affects animal health and behaviour. All these factors make it difficult for animals and plants to survive (Usman et al., 2023).

Relationship between Environment and Animal Behavior and Health

Earth land surface is altered 77% due to human activities, and 66% ocean water is negatively affected, and wetlands lost is 85%. The combined effect of habitat fragmentation, land use, overharvesting, pollution, climate change and invasive species estimate that 70% population of vertebrate since 1970 at the extinction rates. We are present on the verge of mass extinction due to the extreme risks to species according to the scientific agreement. The fifth was the Cretaceous Paleogene extinction event, which wiped out all non-avian dinosaurs 66 million years ago (Nielsen et al., 2021).

There is a reflection between animal health and animal behaviour. Globally, the problem of wildlife is increasing due to environmental pollution. Animals are facing challenges with different forms of pollution in which chemicals, light, noise, and heat cause destruction in the biological processes such as reproduction. The reproductive process disturbs that dramatically affects the number and quality of offspring produced by the exposed individuals. Thus, ecology and evolution of the impacted populations may be further impacted. In wildlife, different components of reproduction, reproductive physiology, and development repercussions the sexual communication, sexual selection, and parental care, as well as on the quality and function of gametes (Aulsebrook et al., 2020).

The aquatic animals' species that are impacted by ecotoxic effects of antibiotics include fishes and invertebrates as well as algae. Vulnerable species develop psychological disturbances, stunted development and death even at minor dosage (Nasri et al., 2020). In addition, the far-reaching antibiotics contamination of these environments lead to the pollution of the fundamental basis of aquatic biocenosis and the extinction of vulnerable populations as well as disturbance of ecological balance (Diniz et al., 2021).

Importance of Animal Behavior and Health for Ecosystem Stability

A chain of reactions can be induced by behavioral response with the network of interactions among species and trait mediated connections. Behavioral responses are mediated by the impact on population due to environmental changes. At the early stages of environmental changes, it occurs. To the environmental pollution, behavioral changes occur directly by moving animals from the polluted or disturbed area according to their habitat or there is a change in the life history traits in which small sized and highly stressed ecosystems are included at the age of maturity (Rahman & Candolin, 2022).

The impact of anthropogenic disturbance on the animals can be predicted and understood with the help of animal behaviour. Animal behaviour and animal health are used as tools for the conservation of the environment. It is considered a powerful environmental conservation tool (Greggor et al., 2019). Due to a change in animal behaviour, the first clue or early warning signs produce environmental degradation. Change in reproduction and some other behaviour occur slowly at environmental disruption. The change is observed when the population size is disturbed (Greggor et al., 2019).

When animals are exposed to environmental pollution, different animals show different responses according to their sensitivity to the environment. Every pollutant has the capacity to cause the fatality in animals, reduced reproduction success, and elevated occurrence of diseases in animals living in a degraded site (Relić & Đukić-Stojčić, 2023).

Effect of animal behavior and health disruption on ecosystem

The negative impact of the environment causes a reduction in the biodiversity and health of animals. Protecting the animal from these hazardous impacts needs to conserve and protect the environment where animals live. The path for conservation of animals' health and behavior faces many hurdles. Due to the persistent expansion of the human population and their activities that cause negative impact on the environment. Other obstacles in the way of animal conservation and management efforts pose distinct threats to stability and variety of ecosystems. To develop effective conservation strategies, we need to understand these challenges (Du et al., 2023).

Environmental Stressor

Stress is a wide phrase with a negative meaning that refers to the increasing negative impact of several conditions on the well-being and productivity of animals. When multiple variables negatively impact an animal's health, it can become stressed and unable to sustain a normal physiological state. In biology, the word "stress" is frequently used to refer to a group of physical and behavioral variations taken on by hostile stimuli. Stress, as defined by Cannon (1929), is the sympathetic adreno-medullary (SAM) system's scrap to maintain homeostasis in the aspect of a range of disagreeable stimuli or stressors. When it comes to physical, mental, or emotional stimuli that pitch off a person's homeostasis, stress is the peak of all biological reactions to those stimuli. Consequently, any internal or external stimulus or threat that interrupts the body's homeostasis and causes the body to stand a coordinated physiological reaction in an effort to restore it can be top secret as a stressor. A chemical or biological agent, an environmental circumstance, an outside stimulus, or an occurrence that puts an organism under stress and sets off the stress response are all considered stressors (Gebregeziabhear et al., 2015).

Impact of Climate Change on Animal Health

Climate change may have a direct and indirect impact on animal health. Animal health effected mainly by changes in air temperature, relative humidity, precipitation and the frequency and intensity of extreme events such as heatwaves, severe drought, extreme precipitation events and coastal floods. It should be emphasized that a variety of complicated components,

including social and conservation elements, economic interests, individual and collective behaviors and environmental forces that contribute to the health effect of climate change. The direct impact of climate change include metabolic disorders, oxidative stress, immune suppression, and death. The indirect impact includes water borne diseases, food and water shortages (Lacetera, 2019).

Domesticated Animals

When an animal's capacity to control its body temperature is compromised by extremes in temperature, humidity, sun radiation, wind speed or any amalgamation of these factors, it can lead to heat stress in domesticated animals. All domesticated animals are affected by the negative consequences of high temperature which decreased animals' welfare, increased susceptibility to illness and in severe cases, increased death. Variations occur massively in how an individual animal will react to heat stress, to rise in temperature animals' production losses. It depends on factors such as age, breed, species, genetic potential, nutritional status, animal size, with high yielding individuals. For instance, dairy cows are more vulnerable than beef cattle. Holsteins are less able to tolerate heat than Jersey and Brown Swiss. The result of heat stress on livestock is the decrease in food intake. Rise in temperature severely affect the hypothalamic appetite center by reducing food consumption. Less intake of food is the mechanism that purposes to reduce the production of heat due to the metabolism in animals (Thornton Philip, 2021).

Farm animals i.e., goats and sheep are ruminants that contest against temperature variations. With less intake of dry matte in goats, there is reduction in milk production as compared to other ruminants. When outside temperature arises at 25-26°C lactating cows food intake starts to decline. When temperature reaches 40°C the reduction in food intake can reach 40%. Buffalo intakes decrease by 8-10%, dairy goats' intake can be lowered by 22-35% at this temperature. Due to tropical environmental situations, animals are vulnerable to heat stress. In summer extreme heat stress has a harmful impact on the growth and reproductive characteristics of growing male and female animals. It weakens animals' resistance to diseases, causes infertility in farm animals. The effect of heat stress on female animals' age at pubescence include oestrous symptoms, ovulation time, ova quality, embryonic development and hormonal imbalance. Male hormones and the number of dead sperms increases with heat stress (Para Ahmad Irshad, 2018).

Heat stress affects the poultry behavior. High temperature surpasses limits for normal thermo-regulation of broiler and layer chickens, pigs could result in persistent heat stress for these animals in a range of different environments. Direct effect of higher temperature on sheep and goats are less severe as compared to others (Wasti Sanjeev, 2020).

Environmental Pollution

Animals' health and physiology are affected by environmental pollution. The major harmful effects are infant mortality, respiratory disorders, allergy, prenatal disorders, increase in stress oxidative, and various other harmful effects. The effects of environmental pollution on domestic animals and wildlife can generally be classified as physiological and behavioral changes, sub-clinical effects with slight pathological changes, specific toxicity with high rates of morbidity or mortality (Priyadarshane et al., 2022).

Effect of Pollution on Animals

All living organisms, including microscopic to mammals depend on oxygen that is present in the atmosphere. Many dangerous gases are inhaled laterally with contaminated air when someone breathes it in to get oxygen. These gases have identical effect on animals as they do on humans. Animals may come into touch with dangerous pollutants not only through direct inhalation but also through food consumption and skin absorption. Animals are more vulnerable to air pollution than humans because they lack the defense mechanism. Farm animals are housed in pasture in urban and peri-urban regions may be impacted more by outdoor air pollution. Prize shins who were kept in the city for a cow showing were experiencing respiratory difficulty in 1952 due to a catastrophic pollution crisis in London. High level of Sulphur dioxide causes the acute bronchitis, emphysema and right-sided heart failure. Production animals' absorption of pollutants inhaled are lower than those of companion animals residing in city centers or adjacent to industrial areas (Guan et al., 2022).

Due to water pollution waterborne diseases such as ascariasis, hookworm, amoebiasis occur that can disrupt development and reproductive processes. Polluted water can result in the proliferation of toxic algae which is consumed by other aquatic animals and can be fatal. Health of animals may be affected by tenacious organic pollutants which result in decline, malformation and death of fish from dirty water (PAL Mahendra, 2015).

Impact of Environment on Animal Behavior and Health

In a study it was found that pollution affects the various aquatic invertebrates in freshwater habitats. Field surveys were performed by researchers in contaminated and unpolluted freshwater systems for collecting samples from benthic invertebrates and assessing water quality parameters. They compared the richness, abundance, and community composition of species. It was found that species diversity reduced, and community organization changed in contaminated freshwater habitats. Pollution was linked with decreasing abundance of invertebrate and extinction of pollution-sensitive species. The significance of lowering pollution inputs into freshwater systems and adopting efficient water quality management approaches to protect aquatic invertebrate diversity were highlighted in the findings (Liess et al., 2015).

There was a case study of Japan in which habitat loss and water pollution led to the extinction of variety of freshwater fish species, which resulted in a reduction of species diversity in rivers and lakes. Habitat loss and fragmentation are two major reasons that significantly contributed to reduced species diversity in the United States. The change of natural landscapes into urban areas, agricultural fields and development of infrastructure has led to the loss of important habitats for several species (Nakano et al., 2016).

A study showed that the loss of nearly 50% of original wetland areas in the contiguous United States has resulted in a drop in wetland-dependent species diversity. Another cause for this significant loss is pollution, especially in aquatic habitats. Industrial and agricultural pollutants and chemical contaminants have affected water quality and destroyed aquatic life organisms, resulting in reducing species diversity in rivers, lakes, and coastal environments (Leidner and Haddad, 2011).

Similar declines in species diversity can be seen in developing countries. Deforestation is increasing in Brazil, a country known for its biodiversity. This has resulted in the extinction of many species of plant and animal, including those located in the Amazon jungle. It was found in a case study that deforestation and land-use changes have decreased the diversity of species in the Brazilian Amazon. In India rapid industrialization and urbanization have also led to the decline of species variety. It was reported in a study that degradation of habitat and rise in pollution level have led to the reduction of variety of species, especially in freshwater habitats and woodlands. In developing countries, the loss of species variety has a substantial impact on both ecological balance and socioeconomic impacts (Ali et al., 2019). Habitat loss and land-use changes have resulted in the extinction of various species in India. Forest habitats have been severely impacted by logging, encroachment of agricultural land, and development of infrastructure. The reduction of forest cover has a detrimental impact on tigers, elephants, and endemic bird species. A report focuses on conservation measures, for reducing the effects of habitat degradation and safeguard India's diversified species diversity (Roy, 2019).

The Niche Theory is important for understanding the impacts of environmental changes on species diversity. Environmental changes can affect availability of resources, interaction of species, and ecological structures of niche. Investigating the environmental changes affects the dynamics of niche, and interaction of species can give insights into species changes diversity. For example, research on freshwater fish populations discovered that the changes in environment such as habitat destruction and pollution, are creating increased niche overlap and reduced species variety (Mason, 2012).

Health Implications of Environmental Degradation

Materials made of polymers, particularly synthetic polymers, have become indispensable in many aspects of modern life due to their outstanding physical and chemical characteristics. They are widely used in packaging, construction, electronics, and healthcare (Neu and Hammes, 2020). The persistence and buildup of compounds made of polymers in the environment pose serious ecological and health risks. These materials, especially micro-plastics, have been found in seas, rivers, soils, and even the air (Heidarzadeh et al., 2023).

Polymers may absorb and concentrate hazardous substances from the environment, therefore acting as pollution vectors. Ingestion of these chemicals by wildlife, including fish, birds, and terrestrial animals, can cause physical obstructions, toxicological consequences, and disturb the food chain, compromising human health (Malfeev et al., 2023).

Environmental change has had a detrimental impact on the majority of biological systems of our planet, raising concerns about the health and survival of many species. At the level of organisms, effects not only include endocrine disruptions, changes in sex-ratio, and decreased reproductive parameters, but also teratogenic and genotoxic effects, immunosuppression, and other

immune-system impairments that can directly cause disease or increase the risk of disease acquisition (Acevedo-Whitehouse et al., 2009).

Conservation Strategies for protecting Wildlife from Environmental Pollution

Wildlife conservation refers to the preservation and protection of animals, plants, and their ecosystems. Wildlife conservation prioritizes preservation of habitat, protection of breeding stock, and prohibition of illicit trade and slaughter of animals. Habitat degradation is the leading driver of reduced animal populations. Habitat degradation is caused by human activities such as deforestation, industrialization, urbanization, agriculture, and mining. Forest fires and climate changes are natural causes. Plantation and forestation increase survival rate of whole area in natural environment, and it offers new methods to boost agricultural productivity without increasing acreage. Habitat corridors promote genetic diversity and decrease human-wildlife interactions. The forest will attract insects, which can aid pollination. So, the environment can turn greener (Cowieson, 2009). The amount of waste on the globe is steadily increasing. A study found 5.25 trillion bits of plastic garbage in the seas alone. It poses a severe danger to marine life. In addition to plastic trash, oil spills, and untreated sewage, industrial chemicals also emit harmful pollutants. Carbon dioxide, nitrogen dioxide, sulfur dioxide, and ozone will have an impact on humans and animals. To decrease pollution, we should reduce the use of plastics, and increase recycle and reuse of garbage, clean up the ocean, use microorganisms and plants, and treat industrial waste water before disposal to reduce environmental contamination. The most significant aspect is that all wastes are produced by humans only. We should take care to clean the environment (Erren et al., 2009).

Conclusion

Worldwide, environmental contamination is becoming a bigger issue for animals. Numerous types of pollution, such as chemicals, light, noise, and heat, are present in animals' environments and can interfere with vital biological functions including reproduction. Reproductive process disruptions can significantly lower the quantity and caliber of children born to exposed people, which can further impact the ecology and evolutionary history of impacted populations. Animals can use behavioral change as a buffer to protect themselves from the immediate harmful impacts of environmental change. For example, a modification can make up for higher mortality or poor reproductive success brought on by environmental change. Animals can also learn more about the changed surroundings by altering their behavior.

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