International Journal of Engineering and Science Invention (IJESI)
ISSN (Online): 2319-6734, ISSN (Print): 2319-6726
www.ijesi.org ||Volume 14 Issue 7 July 2025 || PP 57-63

A Study of Environmental Changes and Their Effects on Animal Behaviour

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Abstract
Environmental changes occurring at an unprecedented pace have significantly altered natural ecosystems, posing serious challenges to wildlife across the globe. Variations in temperature, precipitation patterns, habitat structure, and resource availability—largely driven by climate change and human activities—have increasingly influenced animal behaviour. This study aims to examine how different forms of environmental change affect behavioural patterns in animals, with particular emphasis on feeding strategies, migration, reproduction, communication, and stress responses.Using a qualitative research approach based on an extensive review of secondary data, this paper synthesizes findings from ecological studies, behavioural research, and documented case studies across terrestrial and aquatic species. The analysis reveals that many animals exhibit behavioural plasticity as an adaptive response to environmental stressors, such as altered migration timings, changes in foraging behaviour, and modified social interactions. However, the study also highlights that behavioural adaptation is not always sufficient, and in many cases, rapid environmental changes lead to maladaptive responses, increased stress levels, and declining population stability.
The findings underline the critical link between environmental stability and animal survival, suggesting that behavioural changes can serve as early indicators of ecological imbalance. This research contributes to a deeper understanding of animal–environment interactions and emphasizes the importance of incorporating behavioural perspectives into wildlife conservation and environmental policy frameworks.
Keywords: *Environmental Change, Animal Behaviour, Climate Change, Habitat Loss, Anthropogenic Impact, Adaptation.*

I. Introduction

Environmental change has emerged as one of the most critical challenges affecting natural ecosystems in the modern era. Rapid alterations in climate patterns, land use, and ecological balance—largely driven by human activities—have significantly reshaped the living conditions of countless species. These changes are not limited to physical environments alone; they also exert profound influences on biological processes and behavioural responses in animals. Understanding how animals respond behaviourally to changing environments is essential for assessing ecosystem health and predicting long-term ecological outcomes.Animal behaviour plays a fundamental role in survival, reproduction, and adaptation. Behavioural patterns such as feeding, migration, mating, and social interaction are closely aligned with environmental cues. When these cues are disrupted due to environmental instability, animals are often forced to modify their behaviour to cope with new conditions. In some cases, such behavioural flexibility allows species to survive and adapt. However, when environmental changes occur too rapidly or exceed an animal's adaptive capacity, behavioural responses may become maladaptive, leading to increased stress, reduced reproductive success, and population decline.

In recent decades, environmental changes such as global warming, habitat destruction, pollution, and urban expansion have intensified in both scale and frequency. Rising global temperatures have altered seasonal cycles, affecting migration timings and breeding patterns. Habitat fragmentation has restricted movement and access to resources, while pollution has interfered with sensory communication and physiological functioning in many species. These factors collectively contribute to significant shifts in animal behaviour, often with cascading effects on entire ecosystems.The study of behavioural responses to environmental change provides valuable insights into how animals perceive and interact with their surroundings. Behaviour is often one of the earliest indicators of environmental stress, appearing before visible changes in population size or species distribution. Therefore, analysing behavioural changes not only enhances our understanding of animal ecology but also supports conservation efforts by identifying early warning signs of ecological imbalance.

This research seeks to explore the relationship between environmental changes and animal behaviour by synthesizing existing scientific literature and documented case studies. The primary objective is to examine how different environmental stressors influence behavioural patterns across various animal groups and to evaluate whether these behavioural changes promote adaptation or contribute to vulnerability. By focusing on

behaviour as a key biological response, this study aims to emphasize its importance in wildlife conservation, ecosystem management, and environmental policy development.

II. Review of Literature

Research on environmental change and animal behaviour has expanded considerably over the past few decades, reflecting growing concern over biodiversity loss and ecosystem instability. Early ecological studies primarily focused on population decline and species extinction; however, more recent research has emphasized behavioural change as an early and sensitive response to environmental stressors. Behavioural shifts often occur before noticeable demographic changes, making them a crucial indicator of environmental disruption.Climate change has been identified as one of the most influential drivers of behavioural change in animals. Several studies have documented alterations in migration timing, breeding cycles, and foraging behaviour as a response to rising global temperatures. Parmesan (2006) demonstrated that many species now exhibit earlier seasonal activities, particularly in temperate regions, suggesting a strong link between climate warming and phenological shifts. Similarly, Walther et al. (2002) highlighted that temperature-related behavioural adjustments are widespread across taxonomic groups, including birds, insects, and mammals.

Habitat loss and fragmentation have also been extensively studied in relation to animal behaviour. Deforestation, agricultural expansion, and urban development reduce habitat size and connectivity, often forcing animals to modify their movement patterns and resource use. Fahrig (2003) emphasized that fragmented habitats restrict dispersal and increase edge effects, leading to altered feeding behaviour and heightened vulnerability to predators. Behavioural changes observed in fragmented landscapes often include reduced territorial ranges, increased human–animal conflict, and shifts in social organization.Pollution represents another critical environmental stressor influencing animal behaviour. Chemical pollutants, noise, and artificial light have been shown to interfere with sensory perception and communication. Studies on aquatic ecosystems reveal that water pollution affects feeding efficiency and predator avoidance in fish and invertebrates (Fleeger et al., 2003). Likewise, noise pollution has been found to disrupt vocal communication in birds and marine mammals, leading to reduced mating success and altered social interactions (Slabbekoorn & Ripmeester, 2008).

Human-induced environmental changes, collectively referred to as anthropogenic stressors, have further intensified behavioural disruptions. Urban environments, in particular, present novel challenges and opportunities for wildlife. While some species exhibit remarkable behavioural plasticity and adaptability to urban settings, others struggle to cope with constant disturbance and habitat modification. Sih et al. (2011) argued that behavioural syndromes, such as boldness or aggression, may determine whether a species successfully adapts to human-altered environments or faces increased extinction risk.Despite the growing body of literature, several research gaps remain. Many studies focus on short-term behavioural responses, while long-term consequences of behavioural adaptation or maladaptation are less understood. Additionally, behavioural studies are often species-specific, limiting the ability to generalize findings across ecosystems. There is also limited integration of behavioural data into conservation planning and environmental policy, highlighting the need for interdisciplinary approaches that combine behavioural ecology with environmental management.

Overall, existing literature strongly supports the notion that environmental changes significantly influence animal behaviour. However, further research is required to understand the thresholds beyond which behavioural adaptation fails and to assess how such changes affect ecosystem resilience. Addressing these gaps is essential for developing effective conservation strategies in the face of accelerating environmental change.

III. Types of Environmental Changes Affecting Animals

Environmental changes influencing animal behaviour are diverse in nature and operate at multiple spatial and temporal scales. These changes may occur gradually over long periods or emerge rapidly due to intensified human activities. Understanding the major types of environmental changes is essential to evaluate how animals respond behaviourally and ecologically to altered conditions.

3.1 Climate Change

Climate change represents one of the most pervasive environmental stressors affecting wildlife globally. Rising temperatures, altered rainfall patterns, increased frequency of extreme weather events, and shifting seasons directly influence animal behaviour. Many species rely on environmental cues such as temperature and daylight to regulate migration, breeding, and feeding activities. Disruptions in these cues have resulted in mismatches between behavioural timing and resource availability. For instance, changes in temperature regimes have been associated with earlier breeding in birds and altered hibernation cycles in mammals, affecting survival and reproductive success.

3.2 Habitat Loss and Fragmentation

Habitat loss, largely driven by deforestation, agriculture, mining, and infrastructure development, significantly alters the spatial environment available to animals. Fragmentation divides continuous habitats into smaller, isolated patches, restricting movement and access to resources. As a behavioural response, animals may reduce their home ranges, alter foraging routes, or increase risk-taking behaviour while searching for food and mates. In many cases, fragmented habitats also intensify competition and increase encounters with predators and humans, leading to elevated stress levels.

3.3 Pollution

Pollution in its various forms—air, water, noise, and light—poses serious behavioural challenges to animals. Chemical pollutants can interfere with neurological and hormonal systems, affecting feeding behaviour, reproduction, and predator avoidance. Noise pollution disrupts acoustic communication, which is critical for mating, territorial defence, and group coordination in many species. Similarly, artificial light alters natural activity cycles, often causing changes in nocturnal behaviour, navigation, and sleep patterns. Such disruptions can have long-term implications for fitness and population stability.

3.4 Urbanization and Industrial Expansion

Urbanization introduces highly modified environments characterized by constant disturbance, altered landscapes, and novel resources. Animals living in or near urban areas often exhibit behavioural flexibility, such as changes in activity patterns, reduced fear of humans, and modified diets. While some species successfully adapt to urban environments, others experience behavioural stress, increased aggression, or displacement. Industrial activities further exacerbate these effects through habitat degradation and pollution, compounding behavioural challenges.

3.5 Invasive Species and Ecosystem Imbalance

The introduction of invasive species alters existing ecological interactions and resource dynamics. Native animals may be forced to change their behaviour in response to new competitors, predators, or diseases. Such behavioural adjustments may include altered foraging strategies, shifts in habitat use, or changes in reproductive behaviour. In many cases, native species lack effective behavioural responses to invasive threats, leading to population declines and ecosystem imbalance.

IV. Impact of Environmental Changes on Animal Behaviour

Environmental changes influence animal behaviour in complex and multifaceted ways. Behavioural responses often represent the most immediate adjustment mechanism through which animals attempt to cope with altered environmental conditions. Changes in climate, habitat structure, and human disturbance have been shown to affect key behavioural domains, including feeding, reproduction, migration, communication, and stress regulation (Sih et al., 2011).

4.1 Changes in Feeding Behaviour

Feeding behaviour is highly sensitive to environmental variation, particularly changes in temperature, resource availability, and habitat quality. Climate change has altered the distribution and seasonal availability of food resources, forcing many species to modify their foraging strategies. Studies have shown that animals may expand their dietary range, alter feeding times, or increase foraging effort under resource-scarce conditions (Walther et al., 2002). In aquatic ecosystems, pollution and temperature changes have been found to reduce prey detection efficiency, leading to decreased feeding success and increased energy expenditure (Fleeger et al., 2003).

4.2 Alterations in Reproductive Behaviour

Environmental stability plays a critical role in regulating reproductive behaviour. Changes in temperature and photoperiod can disrupt breeding cycles, courtship behaviour, and mating success. Research indicates that many bird and amphibian species now breed earlier in the year in response to warmer temperatures, which can lead to mismatches between offspring emergence and food availability (Parmesan, 2006). Habitat degradation further affects reproductive behaviour by reducing suitable nesting or breeding sites, thereby increasing competition and lowering reproductive output.

4.3 Migration Pattern Shifts

Migration is a behaviour closely linked to environmental cues such as temperature, rainfall, and food abundance. Environmental changes have significantly altered traditional migration routes and timings across numerous species. Long-distance migratory birds, for example, have shown shifts in departure and arrival times

as a response to climate-driven seasonal changes (Both et al., 2009). Such shifts can have serious consequences, including increased mortality and reduced reproductive success, particularly when migratory timing becomes misaligned with optimal environmental conditions.

4.4 Changes in Communication and Social Behaviour

Effective communication is essential for social organization, mating, and predator avoidance. Environmental stressors such as noise and light pollution interfere with acoustic and visual signals used by animals. Research has demonstrated that anthropogenic noise can mask vocal signals in birds and marine mammals, forcing individuals to alter call frequency, duration, or timing (Slabbekoorn & Ripmeester, 2008). These behavioural adjustments may reduce communication efficiency and negatively affect social cohesion and mating success.

4.5 Stress Responses and Aggressive Behaviour

Environmental disturbances often elevate stress levels in animals, triggering behavioural responses such as heightened aggression, avoidance behaviour, or reduced activity. Chronic exposure to stressors like habitat fragmentation and human disturbance has been associated with increased stress hormone levels, which can impair learning, reproduction, and immune function (Wingfield et al., 1998). Behavioural signs of stress, including abnormal repetitive actions and increased vigilance, are commonly observed in disturbed environments and may signal declining animal welfare.

V. Case Studies and Empirical Evidence

Case studies provide concrete evidence of how environmental changes translate into measurable behavioural shifts in animals. By examining species across different ecosystems, it becomes possible to understand both adaptive and maladaptive behavioural responses under real-world environmental pressures.

5.1 Climate Change and Behavioural Changes in Polar Bears

Polar bears represent one of the most extensively studied examples of behavioural response to climate change. The rapid decline of Arctic sea ice has significantly altered their hunting behaviour and movement patterns. Polar bears depend on sea ice platforms to hunt seals; however, reduced ice cover has forced them to swim longer distances, spend more time fasting, and increasingly forage on land-based food sources (Stirling & Derocher, 2012). These behavioural changes have been linked to increased energy expenditure, reduced body condition, and lower reproductive success, highlighting the limits of behavioural adaptation in rapidly changing environments.

5.2 Urbanization and Behavioural Adaptation in Birds

Urban environments present novel ecological conditions characterized by noise, artificial light, and human disturbance. Several studies have documented behavioural modifications in urban-dwelling birds, including changes in vocalization patterns, reduced flight initiation distance, and altered feeding behaviour. For example, urban birds often sing at higher frequencies to overcome background noise pollution (Slabbekoorn & Peet, 2003). While such behavioural flexibility allows some species to thrive in cities, others experience chronic stress and population decline, indicating that adaptability varies across species.

5.3 Ocean Pollution and Marine Animal Behaviour

Marine ecosystems have been heavily affected by pollution, particularly chemical contaminants and plastic waste. Research has shown that pollutants can interfere with sensory systems in marine animals, leading to altered feeding and predator avoidance behaviour. Lönnstedt and Eklöv (2016) demonstrated that microplastic exposure in fish impairs olfactory-based decision-making, increasing vulnerability to predators. These behavioural disruptions not only affect individual survival but may also have long-term consequences for marine food webs.

5.4 Habitat Loss and Behavioural Changes in Terrestrial Mammals

Habitat loss due to deforestation and land-use change has profoundly affected the behaviour of terrestrial mammals. Large mammals such as elephants and primates have been observed altering their movement routes and activity patterns in response to shrinking habitats and increased human presence. Studies indicate that such behavioural shifts often result in heightened human–animal conflict, increased nocturnal activity, and elevated stress levels (Foley et al., 2015). These changes can reduce reproductive success and threaten long-term population viability.

VI. Methodology

The present study adopts a qualitative research design aimed at understanding the relationship between environmental changes and animal behaviour through systematic analysis of existing scientific literature. Given the broad and interdisciplinary nature of the topic, a qualitative approach is considered appropriate, as it allows for the integration of ecological, behavioural, and environmental perspectives without restricting the analysis to a single species or ecosystem (Creswell, 2014).

6.1 Research Design

This research is based on a descriptive and analytical design, focusing on identifying patterns and trends in behavioural responses to environmental changes. Rather than generating primary experimental data, the study synthesizes findings from peer-reviewed journals, books, and authoritative reports to develop a comprehensive understanding of how animals respond behaviourally to environmental stressors. Such an approach is commonly used in ecological and behavioural research where large-scale experimental manipulation is impractical or unethical (Sutherland et al., 2004).

6.2 Data Collection Methods

Data for this study were collected through an extensive review of secondary sources. Academic databases such as Google Scholar, Web of Science, and ScienceDirect were used to identify relevant literature. Keywords including *environmental change*, *animal behaviour*, *climate change*, *habitat loss*, and *behavioural adaptation* were employed to ensure broad coverage of the topic. Only studies published in peer-reviewed journals or reports by recognized scientific organizations were included to maintain data reliability and academic rigor.

6.3 Data Analysis and Synthesis

The selected literature was analyzed thematically, with emphasis on identifying recurring behavioural responses across different taxa and ecosystems. Themes such as feeding behaviour, migration, reproduction, communication, and stress responses were used as analytical categories. Findings from different studies were compared and contrasted to assess consistency, variation, and context-dependence of behavioural responses. This thematic synthesis approach allows for the integration of diverse research findings while preserving their ecological and behavioural context (Thomas & Harden, 2008).

6.4 Ethical Considerations

As this study relies exclusively on secondary data, no direct interaction with animals or human participants was involved. Nevertheless, ethical considerations were maintained by accurately representing original research findings and providing proper citations to all sources used. This ensures academic integrity and respects the intellectual contributions of previous researchers.

6.5 Limitations of the Study

Despite its comprehensive scope, this study has certain limitations. The reliance on secondary data restricts the ability to control for methodological differences among studies, such as variations in sample size, study duration, and geographic focus. Additionally, behavioural responses may vary significantly among species, making broad generalizations challenging. However, by drawing on a wide range of studies and ecosystems, the research aims to minimize these limitations and provide a balanced synthesis of existing knowledge (Parmesan, 2006).

VII. Discussion

The findings synthesized in this study demonstrate that environmental changes exert a profound and multidimensional influence on animal behaviour. Across ecosystems and taxa, behavioural responses emerge as immediate and flexible mechanisms through which animals attempt to cope with altered environmental conditions. Consistent with earlier research, this study supports the view that behaviour often changes prior to detectable physiological damage or population decline, making it a sensitive indicator of environmental stress (Sih et al., 2011).One of the most prominent patterns observed is the role of behavioural plasticity in mediating responses to environmental change. Species exhibiting higher behavioural flexibility—such as altered foraging strategies or modified activity patterns—appear more capable of short-term adjustment. This aligns with the findings of Wong and Candolin (2015), who emphasized that behavioural plasticity can buffer the immediate impacts of environmental disturbance. However, the present analysis also highlights that plasticity has limits. When environmental changes are rapid or persistent, behavioural adjustments may become energetically costly or maladaptive, ultimately reducing fitness and survival.The discussion of feeding and migration behaviour underscores the importance of environmental predictability. Disruptions in temperature regimes and seasonal

cues have resulted in mismatches between behaviour and resource availability, particularly among migratory species. Such mismatches have been widely documented in climate change literature and are associated with reduced reproductive success and increased mortality (Both et al., 2009; Parmesan, 2006). These findings suggest that behavioural adaptation alone may not be sufficient to counteract the ecological consequences of accelerated climate change.

Changes in communication and social behaviour further illustrate how anthropogenic stressors interfere with fundamental behavioural processes. Noise and light pollution alter signalling systems that are essential for mating and social coordination. Although some species demonstrate compensatory behavioural changes, such as increased call frequency or altered timing, these responses may compromise communication efficiency and social stability (Slabbekoorn & Ripmeester, 2008). This highlights a critical trade-off between behavioural adjustment and functional effectiveness.Stress-related behavioural changes observed across multiple studies indicate that chronic environmental disturbance can have long-term consequences for animal welfare and population viability. Elevated stress responses, including increased aggression or avoidance behaviour, may initially enhance survival but often lead to reduced reproductive output and impaired learning over time (Wingfield et al., 1998). Such findings reinforce the argument that behavioural indicators should be integrated into ecological monitoring frameworks.

Overall, this discussion emphasizes that behavioural responses to environmental change are context-dependent and species-specific. While some animals successfully adjust to altered conditions, others face behavioural constraints that increase vulnerability. The variability in responses underscores the need for caution when generalizing behavioural outcomes and highlights the importance of incorporating behavioural ecology into conservation planning. By interpreting behavioural changes not merely as adaptations but as potential signals of ecological stress, researchers and policymakers can better anticipate long-term environmental consequences.

VIII. Implications of the Study

The findings of this study have important implications for wildlife conservation, ecological management, and environmental policy. By highlighting behaviour as an early and sensitive response to environmental change, this research emphasizes the need to move beyond population-level indicators and incorporate behavioural metrics into environmental assessment frameworks.

8.1 Implications for Wildlife Conservation

Understanding behavioural responses to environmental change can significantly enhance conservation efforts. Behavioural changes such as altered migration timing, reduced breeding activity, or increased stress-related actions often precede population decline. Incorporating behavioural indicators into conservation monitoring can therefore provide early warnings of ecological stress, allowing timely intervention (Sutherland et al., 2004). Conservation strategies that account for behavioural needs—such as preserving migration corridors or minimizing human disturbance during breeding seasons—are more likely to support long-term species survival.

8.2 Implications for Wildlife Management and Habitat Planning

From a management perspective, this study underscores the importance of designing habitats that accommodate natural behavioural patterns. Habitat fragmentation and urban expansion frequently force animals to adopt risky or energetically costly behaviours. Behaviour-informed management practices, such as creating wildlife crossings, buffer zones, and noise-reduction strategies, can reduce stress and human–animal conflict (Fahrig, 2003). Recognizing behavioural diversity among species also helps managers avoid one-size-fits-all approaches, which may be ineffective or harmful.

8.3 Policy and Environmental Governance Implications

The integration of behavioural ecology into environmental policy can strengthen decision-making processes. Environmental impact assessments often focus on physical habitat loss while underestimating behavioural disruption caused by pollution, noise, or artificial light. This study supports calls for more comprehensive policy frameworks that consider behavioural consequences of development projects (Slabbekoorn & Ripmeester, 2008). Policies informed by behavioural evidence can promote sustainable development while minimizing unintended ecological harm.

8.4 Implications for Future Research

This study highlights several directions for future research. Long-term studies examining behavioural changes across generations are needed to assess whether observed behavioural shifts lead to adaptation or long-term vulnerability. Additionally, interdisciplinary research combining behavioural ecology, physiology, and

climate science could provide deeper insights into the mechanisms underlying behavioural responses (Wong & Candolin, 2015). Expanding research across under-studied species and regions will further enhance the generalizability of findings.

IX. Conclusion

Environmental changes have emerged as a defining challenge for wildlife in the contemporary world, influencing not only species distribution and population dynamics but also fundamental behavioural processes. This study demonstrates that animal behaviour is deeply intertwined with environmental conditions and serves as one of the earliest and most sensitive indicators of ecological disturbance. Changes in climate, habitat structure, pollution levels, and human activity consistently alter behavioural patterns related to feeding, reproduction, migration, communication, and stress regulation.The synthesis of existing literature and case studies reveals that while some animals exhibit behavioural plasticity that allows short-term adjustment to changing environments, such flexibility is not universally sufficient. Rapid and persistent environmental changes often exceed adaptive limits, resulting in maladaptive behaviours that compromise survival and reproductive success. These findings reinforce the idea that behavioural change should not always be interpreted as successful adaptation but may instead signal underlying ecological stress.

Importantly, this study highlights the value of integrating behavioural perspectives into conservation biology and environmental management. Behavioural indicators can provide early warnings of ecosystem imbalance, enabling more timely and effective conservation interventions. Furthermore, recognizing species-specific behavioural responses can help policymakers and wildlife managers design strategies that minimize disturbance and support ecological resilience.In conclusion, understanding the behavioural consequences of environmental change is essential for predicting long-term ecological outcomes and safeguarding biodiversity. As environmental pressures continue to intensify, future research and policy efforts must prioritize behavioural insights alongside traditional ecological measures to ensure more holistic and sustainable approaches to wildlife conservation.

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