A Study On Correlating Air Quality Index (AQI) And Pollution And Its Impacts On The Appearance Of Wildlife As A Result Of Urbanization Around Jodhpur.

Dr. Meenakshi Meena[1*], Ms. Nandita Purohit[2]

[1*] Associate professor, Department of Zoology, JNV University
[2]M.sc Student, Department of Zoology, Lachoo Memorial College, Jodhpur

***Corresponding Author:** Dr. Meenakshi Meena
*Associate professor, Department of Zoology, JNV University

Abstract: This paper examined the relationship between air quality and the presence of wildlife around Jodhpur, a major city in Rajasthan, India. As Jodhpur and its surrounding areas experienced rapid urban growth and escalating pollution, these environmental changes significantly impacted local wildlife populations. The study incorporated a detailed analysis of Air Quality Index (AQI) data alongside field observations of wildlife within urban settings, exploring how pollution correlated with shifts in species presence. Results indicated a noticeable decrease in certain wildlife species, which appeared to be associated with higher pollution levels. These findings underscored the urgent need for enhanced environmental management strategies to mitigate the adverse effects of pollution on wildlife and preserve biodiversity in urban areas.

Key Words: Air Quality Index (AQI), Air Pollution, Wildlife, Urbanization.

Introduction

Jodhpur, often referred to as the "Blue City" due to its iconic blue-painted buildings, is the second-largest city in the Indian state of Rajasthan. Known for its rich cultural heritage, historical landmarks, and vibrant desert landscapes, Jodhpur has seen rapid urbanization and industrial growth over the past few decades. This expansion, however, has brought with it significant environmental challenges, particularly concerning air quality. The city's growing population, increased vehicle emissions, construction activities, and industrial outputs have led to a marked decline in air quality, which is measured by the Air Quality Index (AQI).

The AQI is a crucial tool for assessing air pollution levels in real-time, indicating the concentration of pollutants such as particulate matter (PM2.5 and PM10), nitrogen oxides(NO_x), sulfur dioxide (SO_2), carbon monoxide (CO), and ozone (O_3). High AQI levels pose serious health risks to humans, including respiratory and cardiovascular problems. However, the impact of poor air quality extends beyond human health, significantly affecting urban wildlife, which often goes unnoticed in public discourse.

The Air Quality Index (AQI) is a standardized system used to measure and communicate air pollution levels and their potential impact on health. It provides a clear, easy-to-understand way to gauge air quality and is calculated based on the concentrations of various pollutants, including:

- **Particulate Matter (PM2.5 and PM10)**: Tiny particles that can penetrate the respiratory system and cause health problems.
- **Nitrogen Oxides (NO_x)**: A gas produced from combustion processes, contributing to respiratory issues and smog formation.
- **Ozone (O3)**: A gas that, while beneficial in the upper atmosphere, can be harmful at ground level, leading to respiratory problems.
- **Sulfur Dioxide (SO2)**: A gas produced by burning fossil fuels, which can cause respiratory issues and contribute to acid rain.

Table .1. AQI range and its possible effects.

Good (0–50)	Minimal Impact	Poor (201–300)	Breathing discomfort to people on prolonged exposure
Satisfactory (51–100)	Minor breathing discomfort to sensitive people	Very Poor (301–400)	Respiratory illness to the people on prolonged exposure
Moderate (101–200)	Breathing discomfort to the people with lung, heart disease, children and older adults	Severe (>401)	Respiratory effects even on healthy people

As cities expand, wildlife increasingly finds itself navigating urban environments. Species like birds, small mammals, and reptiles that once thrived on the fringes of human settlements are now a common sight in urban areas, adapting to new habitats and food sources. However, these animals are not immune to the environmental stressors prevalent in urban landscapes, particularly air pollution.

The relationship between AQI and wildlife appearance in urban areas surrounding Jodhpur has not been extensively studied, leaving a gap in our understanding of how air quality influences the behavior, health, and presence of wildlife.Air pollutants can affect wildlife in numerous ways. High levels of particulate matter can impair respiratory function in birds and small mammals, leading to decreased activity, altered feeding patterns, and reduced reproductive success. Nitrogen oxides and ozone can damage vegetation, disrupting food sources for herbivorous species and affecting the entire urban food web.

Materials and Methods

Study area: Jodhpur, often referred to as the "Sun City" for its bright, sunny climate, is a historic and culturally rich city in Rajasthan, India. Founded in 1459 by Rao Jodha, the city is renowned for its majestic forts, palaces, and vibrant blue-painted buildings that characterize its old city. The surrounding areas of Jodhpur, along with the city itself, have experienced significant economic growth and urbanization over recent decades.

This expansion has led to increased industrial activity and residential development throughout the region. As a result, both Jodhpur and its surrounding areas have faced intensified environmental challenges, particularly concerning air quality. The city's strategic location along major trade routes and its role as a commercial hub further exacerbate pollution issues, making the entire region a crucial area for studying the effects of urbanization on wildlife.

Data Collection: Data for this study was collected from official monitoring stations in Jodhpur, (Collectorate, Jodhpur, RSPCB). The data spanned **28 months, from February 2021 to May 2023**, and covered key pollutants such as **PM2.5, PM10, NOx, O_3, and SO_2**. Systematic field surveys were carried out in various urban areas, including public parks, residential neighborhoods, and industrial zones, to document wildlife presence, behavior, and habitat conditions. Additionally, interviews with locals provided insights into animal and bird sightings. The analysis involved comparing seasonal variations in AQI with wildlife activity, revealing that peak pollution periods.

Results and Discussion

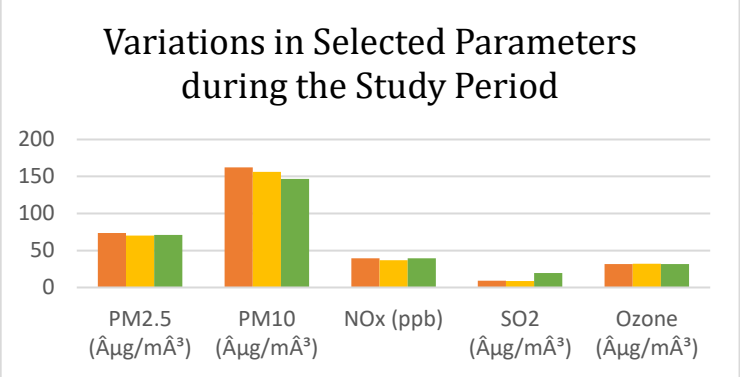
The analysis of Air Quality Index (AQI) trends in Jodhpur and areas around it, highlighted a significant challenge related to the city's air quality. Elevated AQI levels were a recurring issue, especially during the winter months when pollution concentrations were at their highest. This seasonal spike was primarily driven by increased vehicular emissions, intensified construction activities, and frequent dust storms, which contributed to higher levels of particulate matter such as PM2.5 and PM10. These pollutants, which were prevalent in the city's air, led to a deterioration in air quality that was reflected in the AQI readings.

On average, the AQI in Jodhpur and its surrounding areas frequently fell within the "Moderate" to "Poor" categories, indicating that while air quality was often acceptable for the general population, it could still pose health risks.

Table 2. Year-wise data showing an average of pollutant concentration.

Yearly Average	PM2.5 (Âµg/mÂ³)	PM10 (Âµg/mÂ³)	NOx (ppb)	SO_2 (Âµg/mÂ³)	Ozone (Âµg/mÂ³)
2021(Feb to Dec)	73.65729179	162.4580956	39.4726832121	9.290335707	31.53619348
2022(Jan to Dec)	70.091745 61	156.0950877	37.0561193 2	8.554890041	32.11017058
2023 (Jan to May)	71.030334 83	146.8819774	39.3161331 76	19.571735 76	31.82352533

Graph 1. Average pollutant concentration (Feb 2021-May 2023)



Month	AQI
Jan 2022	161
Feb 2022	182
Mar 2022	178
Apr 2022	185
May 2022	221
June 2022	147
July 2022	75
Aug 2022	97
Sept 2022	97
Oct 2022	149
Nov 2022	165
Dec 2022	137

(A)

Month	AQI
Jan 2023	137
Feb 2023	193
Mar 2023	133
Apr 2023	171
May 2023	188

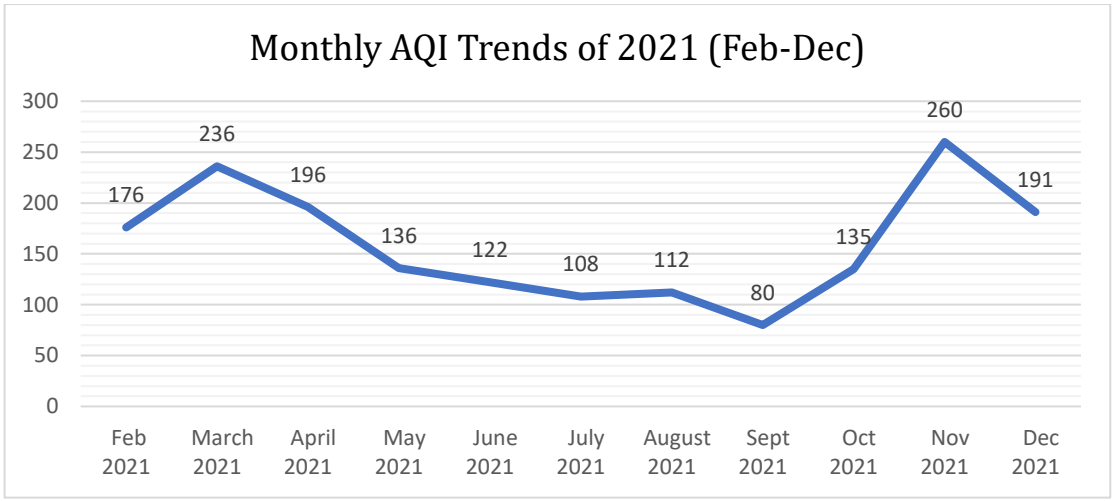
(B)

Month	AQI
Feb 2021	176
March 2021	236
April 2021	196
May 2021	136
June 2021	122
July 2021	108
August 2021	112
Sept 2021	80
Oct 2021	135
Nov 2021	260
Dec 2021	191

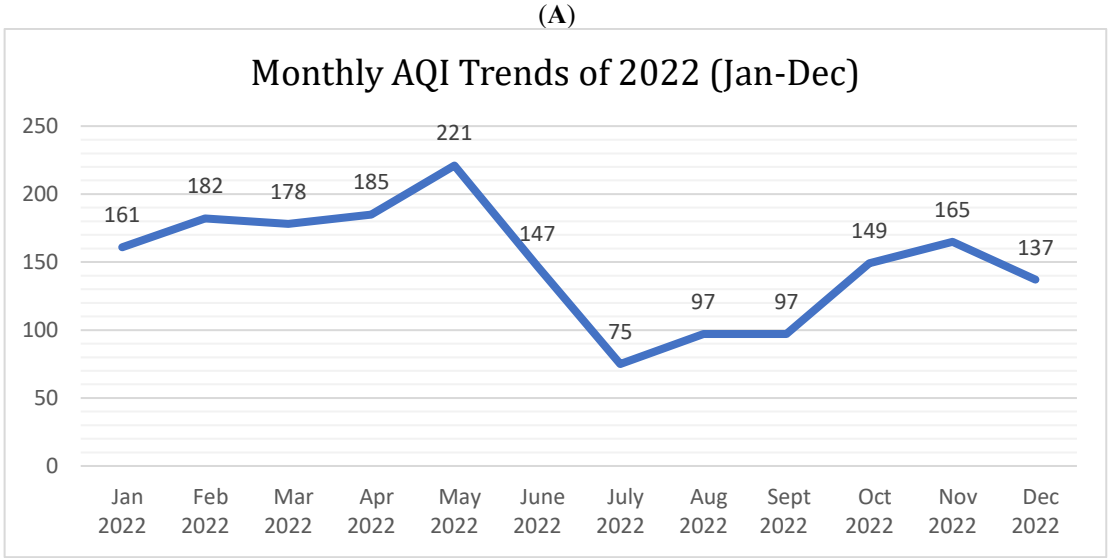
(C)

Table. 3. Monthly Average AQI data of (A) Feb 2021 to Dec 2021 (B) Jan 2022-Dec 2022 (C) Jan 2023-May 2023.

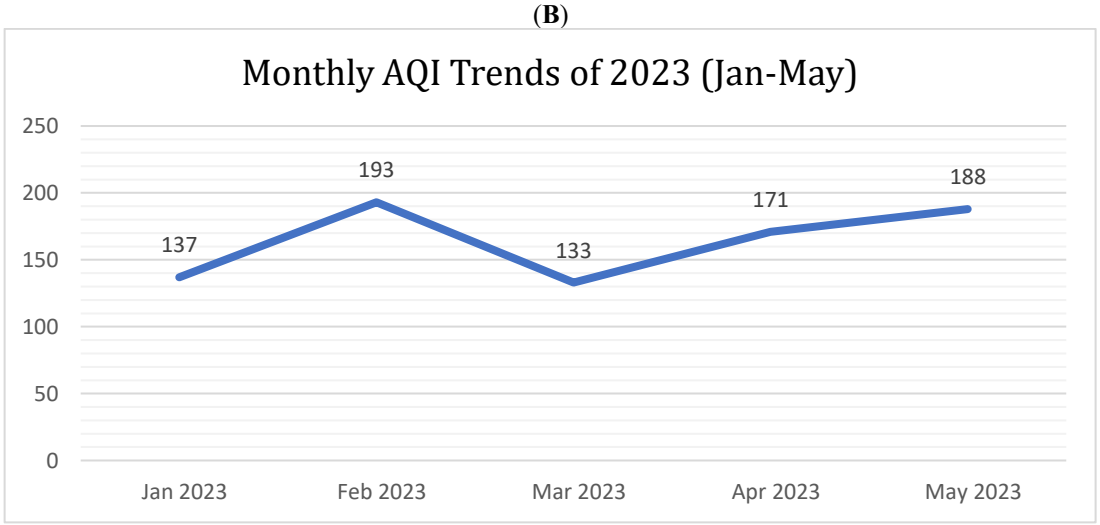
The AQI was calculated by using PM2.5, PM10, NO_x, SO_2, O_3. The data was collected from the monitoring station and the AQI was calculated using **Standard Procedures and Formulas laid by the Central Pollution Control Board (CPCB)**. A monthly average was calculated and was compared to the AQI Range Chart laid by CPCB.



(A)



(B)



(C)

Graph 2. Monthly Average AQI trends of (A)Feb 2021 to Dec 2021 (B)Jan 2022-Dec 2022 (C) Jan 2023-May 2023.

The study identified several instances of **elevated AQI, with notable spikes occurring in Feb, March, April, November, and December 2021, February, March, April, and May 2022, and February, April, and May 2023**. During these periods, AQI levels reached the "Very Poor" range, indicating severe pollution episodes with significant potential impacts on public health and the environment. Conversely, there were several months with **AQI values below 110, including July 2021, September 2021, July 2022, August 2022, and September 2022**. This improvement in air quality during these

months could be attributed to the monsoon season, which brought substantial rainfall in 2022 and led to decreased particulate matter and improved overall air quality.

Interviews with local residents revealed a significant decline in sightings of various wildlife species within the city. Participants consistently noted a sharp reduction in the presence of animals such as the **Hanuman Langur** (*Presbytis entellus*), **Bats** (*Pteropus giganteus giganteus*), **Eagles** (*Clanga clanga*), and **House Sparrows** (*Passer domesticus*), which were previously common in Jodhpur's urban areas. This decline indicated a notable shift in wildlife patterns. Furthermore, species like the **Nilgai** (*Boselaphustragocamelus*), **Peacock,** and **Peahen** (*Pavo cristatus*), which were once prevalent in the outskirts of the city, were now rarely observed even in their traditional habitats. This trend highlighted the broader ecological impacts of urban expansion and pollution.

Discussion

The results of this study highlighted a concerning link between elevated AQI levels in and around Jodhpur and the reduced presence of wildlife. The negative impact of air pollution on wildlife was evident, particularly among species commonly seen in urban areas, such as sparrows, pigeons, squirrels, and garden lizards. These species, although adaptable to urban environments, still exhibited noticeable stress responses to poor air quality.

Impact of Air Pollution on Urban Wildlife—High levels of particulate matter (PM2.5 and PM10) were particularly detrimental, as these pollutants could penetrate deep into the respiratory systems of birds and small mammals. This often resulted in decreased mobility, altered feeding behavior, and increased susceptibility to disease. For example, during periods of high pollution, reduced bird activity was noted, with fewer sightings of sparrows and pigeons, especially during morning and evening hours when air quality tended to worsen.

Ecological Implications—The decline in wildlife presence during high AQI periods suggested broader ecological implications. Birds and small mammals played crucial roles in urban ecosystems, from seed dispersal and pest control to maintaining the balance of local food webs. Reduced activity or declining populations of these species could lead to cascading effects, such as overpopulation of pests or changes in plant growth dynamics due to altered pollination patterns. These changes could, in turn, affect the overall health and sustainability of the urban environment.

Adaptive Behaviors and Resilience—Interestingly, some species exhibited adaptive behaviors that enabled them to cope with poor air quality. For example, birds were observed modifying their daily routines, such as foraging during mid-day hours when AQI levels were relatively lower compared to early morning or evening. These behavioral adjustments indicated a level of resilience but also highlighted the physiological stress these animals endured to survive in polluted environments.

Need for Improved Environmental Management—The findings underscored the need for targeted environmental management strategies in urban areas like Jodhpur. Expanding green spaces, controlling vehicular emissions, and enforcing stricter regulations on industrial pollution were critical steps to mitigate air quality issues. Additionally, incorporating wildlife-friendly practices in urban planning, such as creating habitats that buffered against pollution, could help sustain urban biodiversity.

References

1. Bakker, V. J., & Murtaugh, P. A. (2020). Urban Wildlife Responses to Air Pollution: Behavioral Changes in Urban Birds. Urban Ecosystems, 23(4), 957-968.
2. Central Pollution Control Board (CPCB) (2021). Annual Report on Air Quality Trends in Indian Cities.
3. Central Pollution Control Board (CPCB) (2022). Annual Report on Air Quality Trends in Indian Cities.
4. Ganguly, D., & Saxena, R. (2018).Effect of Air Pollution on Avian Species: A Study in Urban Habitats of India. Environmental Science and Pollution Research, 25(12), 11912-11919.
5. Ghosh, R., & Banerjee, S. (2021). Impact of Urban Air Pollution on Bird Communities: A Case Study from Kolkata, India. Environmental Monitoring and Assessment, 193(6), 352.
6. Gupta, P., & Nema, A. (2021). Assessment of Air Quality in Indian Cities and Its Implications for Urban Biodiversity. Science of the Total Environment, 754, 142139.
7. Kumar, P., & Gupta, S. (2022). Environmental Stressors and Their Impact on Urban Wildlife: A Focus on Air Quality and Habitat Fragmentation. Ecology and Society, 27(1), 10.
8. Patel, A., & Yadav, R. (2019). Urbanization and Its Impact on Biodiversity: A Case Study of Rajasthan, India. International Journal of Ecology and Environmental Sciences, 45(2), 123-135.
9. Sethi, V., & Jindal, A. (2020). Air Quality Index and Its Implications for Human and Ecosystem Health in Indian Cities. Journal of Environmental Management, 255, 109877.
10. Sharma, M., & Dikshit, O. (2016). Comprehensive Study on Air Pollution and Its Impact on Human Health and Wildlife in Delhi, India. Atmospheric Environment, 127, 272-283.
11. Sundar, K. S. G., & Choudhary, V. (2019).Impacts of Air Pollution on Urban Wildlife: A Case Study of Delhi NCR. Indian Journal of Ecology, 46(4), 924-932.