VOLUME 11 ISSUE 1 2025

ISSN 2454 – 3055

INTERNATIONAL JOURNAL OF ZOOLOGICAL INVESTIGATIONS

Forum for Biological and Environmental Sciences

Published by Saran Publications, India

International Journal of Zoological Investigations Vol. 11, No. 1, 119-129 (2025)

International Journal of Zoological Investigations
Contents available at Journals Home Page: www.ijzi.net
Editor-in-Chief: Prof. Ajai Kumar Srivastav
Published by: Saran Publications, Gorakhpur, India

ISSN: 2454-3055

Analysis of Avian Communication: An Acoustic Perspective with Special Reference to Studies from India

Singh Manoj[1]*, Behera Monalini[1], Kar Sukla[1], Sahu Trupti Arpita[1], Sharma Pragyan[1], Sharma Urvashi[1], Yashmita-Ulman[2], Bar Ananya[3], Harit Ajay Kumar[1] and Bhattacharyya Sohini[1]

[1]Departmentof Zoology, Kalinga University, Naya Raipur, Chhattisgarh, India
[2]Department of Silviculture and Agroforestry, College of Horticulture and Forestry, Acharya Narendra Deva University of Agriculture and Technology, Ayodhya, Uttar Pradesh, India
[3]Department of Zoology, Wilson College, Mumbai, Maharashtra, India **Corresponding Author*

Received: 26th June, 2024; **Accepted:** 22nd October, 2024; **Published online:** 23rd January, 2025

https://doi.org/10.33745/ijzi.2025.v11i01.012

Abstract: Communication is a crucial element of animal kingdom as most organisms in nature rely on some or the other mode of interaction like visual, auditory, chemical or electrical. This review examines the use of acoustics monitoring in avian conservation efforts, focusing on the discovery, diversity, and anthropogenic impacts on bird populations. The study analyses studies published between 2000 to 2024, highlighting the significance of acoustics methods in the field of avian research. This comprehensive study compares the application of acoustics in the domains, i.e., conservation, bioacoustics monitoring which facilitates the detection of elusive species and assessment of habitat health, enabling targeted species conservation. In the last few decades, the advancement of technology has upgraded from tape recorders to automatic digital recorder, resulting into increased number of studies. For discovery, innovative acoustic techniques uncover new species and cryptic populations, expanding our understanding of avian biodiversity. Furthermore, analysing bird acoustical behaviour elucidates patterns of communication, mating, and territoriality, by synthesizing data from diverse ecological settings. This study underscores the versatility and efficacy of acoustical methods in advancing avian science and enhancing conservation strategies. Conservation and bioacoustics monitoring are pivotal for detecting elusive species and assessing habitat health.

Keywords: Acoustic, Communication, Diversity, Discovery, Anthropogenic, Conservation

Citation: Singh Manoj, Behera Monalini, Kar Sukla, Sahu Trupti Arpita, Sharma Pragyan, Sharma Urvashi, Yashmita-Ulman, Bar Ananya, Harit Ajay Kumar and Bhattacharyya Sohini: Analysis of avian communication: An acoustic perspective with special reference to studies from India. Intern. J. Zool. Invest. 11(1): 119-129, 2025.

https://doi.org/10.33745/ijzi.2025.v11i01.012

Introduction

Bioacoustics is a branch of science which deals about sound, how it is produced and how it affects living organisms. Sound is used by many animals for their communication. Bioacoustics have many

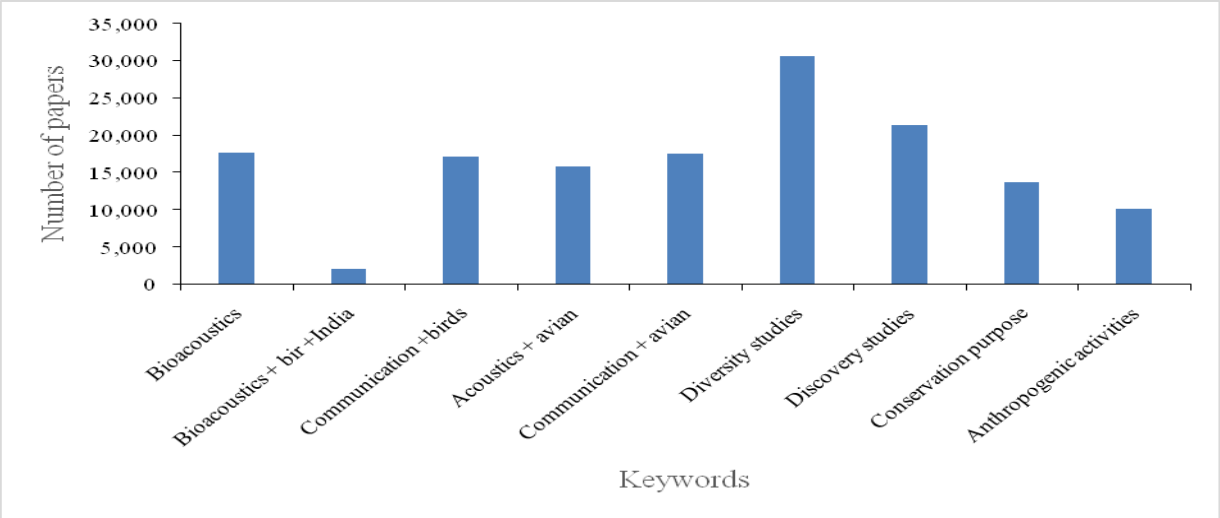

Fig. 1: Number of papers found on the basis of keywords.

applications in different fields like ecology, conservation biology behaviour and biomedical research (Penar *et al*., 2020). Animal communicates with each other by using various acoustical signals such as vocal, visual, chemical, electrical and tactile. The frequency range of almost every animal is ranged between 2 to 8 kHz. (Kumar, 2012). Acoustic monitoring has been widely used to examine the effects of various anthropogenic disturbances on birds. Bioacoustics is also used in various types of field studies, like animal communication, sound production, reception, biosonar, and active and passive acoustic technology for monitoring (Erbe *et al*., 2017).

This review focuses on acoustical analysis in different applications of avian studies such as Diversity, Conservation, Discovery and Anthropogenic studies using literature search by using various Search Engines such as Scopus, Google Scholar and Web of Science. All published literature (between 2000 to 2024) on avian acoustics was systematically collected and reviewed to prepare this systematic review. The key words for the search is shown in Figure 1 (Rubenstein *et al*., 2023).

Birds Communication

Communication is an important function and plays an important role in the life of animals. There are various modes of communication in animal kingdom that is visual, vocal, chemical and electrical. Birds mostly rely on visual and vocal communication (Kumar, 2003) and use different types of sound such as simple call and complex songs, which are used for mating, breeding, sexual selection, cognition, cohesion and foraging (Kumar, 2012). Acoustical analysis plays an important role for avian studies, and sound-producing species are important indicators of environmental health. Acoustic surveys offer an important approach for biodiversity monitoring programs. Animal sounds are used for communication and frequently carry species-specific and unique information that may be used by listeners. For this reason, bioacoustics is well suited for biodiversity monitoring in visually impaired unreachable environments. The primary means of identifying many animal species is sound. There are not many accurate techniques for determining population density using auditory data, despite the fact that songs, calls, and other sounds are frequently utilized for population assessment, such as in bird point counts and hydrophone surveys of cetaceans (Kumar, 2012).

Historical Context

The history of acoustics is rich and diverse, spanning from ancient times to the modern era. The use of acoustics in the study of birds is a

fascinating journey that integrates traditional knowledge with modern scientific approaches. The use of acoustical recording in ornithology began during the mid-20th century. In the 1930s, Ludwig Koch, a German ornithologist, pioneered the use of wax cylinder phonographs to record bird songs. His recordings were among the first to document bird vocalizations accurately and were pivotal in raising awareness about the diversity and complexity of bird songs (Koch, 1935). In the United States, Arthur A. Allen and Peter Paul Kellogg of Cornell University made significant contributions during the 1930s and 1940s. They used portable audio recorders to capture bird sounds, producing the first comprehensive audio guides to North American bird songs. Their work emphasized the importance of sound in avian identification and behaviour studies, influencing subsequent generations of ornithologists (Allen and Kellogg, 1937). The 1960s and 1970s saw further advancements with the development of more portable and reliable recording equipment, such as reel-to-reel tape recorders. These technological improvements allowed researchers to record in a wider range of environments and led to a surge in the collection and analysis of bird sounds. Pioneering ornithologists like Salim Ali, known as the "Birdman of India," started to incorporate portable audio recorders into their fieldwork. These devices allowed the accurate capture of bird sounds, which could then be analysed and compared in detail. Salim Ali's work emphasized the importance of bird vocalizations for species identification and behavioural studies, setting a foundation for modern ornithology in India (Ali and Ripley, 1996). In recent decades, the development of Automated Recording Units (ARUs) has further revolutionized the study of bird acoustics. ARUs are capable of continuously recording environmental sounds over extended periods, which allows researchers to gather comprehensive data on bird vocalizations without the need for constant human presence. (Dinesh, 2001; Kumar, 2003).

Overview of Bioacoustics

The maximum number of papers was found from the combination of "Acoustic + Avian + Diversity studies" while the minimum number of papers was found for the search of "Bioacoustics + bird +India". This Indicates that India is still lacking behind in using this technique of bioacoustics for avian research. We also, searched for papers on the basis of Indian States, by putting keyword such as -Acoustic OR sound OR call OR songs OR birds OR states name. This method helped in narrowing down the search results to find papers specifically related to a particular State (Table 1; Fig. 2).

In India, states like Maharashtra, Karnataka, Uttar Pradesh, and West Bengal are leading in avian research and bioacoustical studies. These states have a higher research focus because they have a wide range of habitat, making them attractive for researchers. Additionally, these states host prestigious research institutions and universities that specialize in wildlife and environmental studies.

There are few Indian states where such studies have been limited or have not been conducted extensively. States like Bihar, Jharkhand, Chhattisgarh, Odisha, and Assam have seen comparatively fewer bird acoustic studies. These states may have potential for further research in this field due to their unique bird populations and habitats. Researchers could explore these regions to expand the scope of bird acoustic studies and enhance our understanding of bird communication patterns. The ecological significance of these states, with their diverse habitats and ecosystems, also contributes to the interest in studying bird behaviour and communication. Moreover, the availability of funding and support for conservation efforts in these states may further boosts research activities in bird's acoustic. Conversely, states with fewer studies may lack resources, have lower biodiversity, or place less emphasis on wildlife research.

Table 1: The number of papers found on state wise in the basis of keywords from 2000 to 2024

STATES NAME	NUMBER OF PAPER
Jammu Kashmir	22
Odisha	74
Chhattisgarh	13
Andhra Pradesh	62
Arunachal Pradesh	27
Assam	134
Bihar	98
Goa	198
Haryana	28
Himachal Pradesh	51
Jharkhand	12
Karnataka	134
Kerala	187
Madhya Pradesh	76
Manipur	32
Maharashtra	98
Meghalaya	26
Nagaland	106
Punjab	223
Rajasthan	64
Sikkim	43
Tamil Nadu	136
Telangana	161
Tripura	18
Uttar Pradesh	334
Uttarakhand	37
West Bengal	794

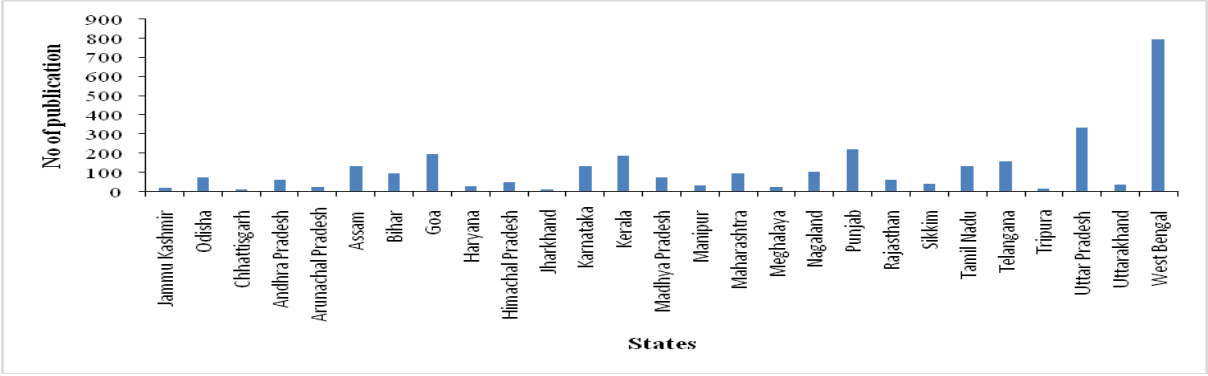

Fig. 2: The total number of papers shown by using above mentioned keywords, state wise in India.

Application of Acoustics in Avian studies

Bioacoustics plays a crucial role in conservation, diversity, discovery, and understanding anthropogenic impacts on ecosystems. In conservation, bioacoustics monitoring helps track endangered species, monitor habitats, and assess ecosystem health by capturing sounds from wildlife. This non-invasive method provides valuable data on species diversity, behaviour, and population dynamics. In terms of discovery, acoustics enables the identification of new species and the study of elusive or nocturnal animals that are difficult to observe visually. Additionally, analysing soundscapes allows scientists to assess the impact of human activities, such as urbanization and industrial noise, on natural environments. Table 2 depicts research trends in bioacoustics application in avian research.

Diversity and Species Discovery

Animal sounds are used for communication and frequently carry species-specific and unique information that may be used by listeners. For this reason, bioacoustics is well suited for biodiversity monitoring at remote location. In India, researchers have employed acoustic surveys to assess avian diversity in various habitats, including forests, grasslands, wetlands and urban habitats (Maraler and Slabbekoorn, 2004). Acoustic monitoring has led to the discovery of new bird species and subspecies, particularly in remote and understudied regions. In India, studies by researchers have highlighted the significance of vocalization differences in identifying cryptic species within the Western Ghats biodiversity hotspot (Sinha *et al*., 2011). Acoustic surveys have also revealed previously unrecognized populations and provided insights into the distribution and diversity of avian communities in various Indian ecosystems (Ranjan *et al*., 2013). For instance, a study by automated records is used for monitoring bird diversity in the Western Ghats, revealing significant differences in species composition across different altitudinal gradients (Pankaj and Sinha, 2015). Internationally, acoustic methods have been extensively used to study bird diversity in tropical rainforests, temperate woodlands, and urban environments. A comprehensive study by Aide *et al.* (2013), demonstrated the effectiveness of real-time bioacoustics monitoring and automated species identification in diverse ecosystems, enhancing the accuracy and efficiency of biodiversity assessments. These acoustic techniques have also facilitated the discovery of new species and the documentation of previously unknown vocalizations, as used for assessing spread of invasive bird species in Hawaii.(Kirschel *et al.*, 2011).

Conservation Purpose

In the world of bird conservation research, the use of acoustics has become a valuable tool for studying and monitoring bird populations. Acoustic monitoring has been instrumental in conservation efforts, enabling the detection and monitoring of endangered species, forming the management practices, and evaluating the impact of environmental changes. By analysing the sounds of bird habitats, researchers can gain important insights into species diversity, behaviour, and the overall health of ecosystems (Balakrishnan, 2016). Bird's acoustics and conservation emphasized the relationship between bird song diversity and habitat conservation. Acoustic methods have become increasingly vital in bird conservation efforts, providing a non-invasive, efficient means to monitor and protect avian species. In India, researchers have leveraged acoustic surveys to track the presence and abundance of endangered species in diverse habitats. For instance, Sethi and Bhatt (2008), used automated recording devices to monitor the critically endangered *Houbaropsis bengalensis* (Bengal Florican) in the grasslands of Uttarakhand, highlighting its declining population due to habitat loss and prompting conservation actions. Similarly, Kumar *et al*. (2017), employed acoustic monitoring to study the distribution of the Indian Nightjar (*Caprimulgus asiaticus*) in fragmented forest habitats, contributing valuable data for its conservation management. Internationally, acoustic methods have been

Table 2: Details of research articles compiled in this review and used to characterize publication and research trends in bioacoustics application in avian research

S. No.	References	Location	Category	Species
1	Kumar and Bhatt (2001)	India	Acoustical Behaviour	Oriental Magpie
2	Brawn (2001)	Delhi, India	Diversity study	Purple Sunbird
3	Brumm(2004)	Germany	Anthropogenic study	Territorial bird
4	Maraler and Slabbekoorn (2004)	California	Diversity study	Avian studies
5	Kroodsma (2005)	Various location in North America	Conservation study	Bird's species
6	Borges and Wcislo (2006)	India	Discovery studies	Indian Babbler
7	Shahabuddin and Kumar (2006)	Rajasthan, India	Anthropogenic study	Bird community
8	Francis (2009)	Southwestern United States	Anthropogenic study	Avian studies
9	Bardeli (2010)	Germany	Discovery studies	Warbler Species
10	Tobias (2010)	Europe	Diversity study	Bird's species
11	Laiolo (2010)	Various global location	Conservation study	Bird's species
12	Farina (2011)	Italy	Diversity study	Bird's species
13	Blumstein *et al*. (2011)	Various global location	Diversity study	Bird's species
14	Sinha and Kumar (2011)	Kolkata	Discovery studies	Indian Babblers
15	Depraetere *et al*. (2012)	France	Diversity study	Community level
16	Kumar (2012)	Himachal Pradesh	Behavioural study	Indian Birds
17	Aide *et al*. (2013)	Puerto Rico	Diversity study	Bird's species
18	Gasc *et al*. (2013)	France	Discovery studies	Bird's species
19	Menon *et al*. (2016)	India (Tiruchirappali)	Anthropogenic study	Birds community
20	Kumar and Sinha (2014)	Western Ghats, India.	Diversity and conservation studies	Birds community
21	Ranjan *et al.* (2013)	Eastern Himalayas	Diversity study	Indian robin

22	Joshi and Narayan (2015)	India	Anthropogenic study	Indian Robin
23	Balakrishna (2016)	India	Diversity study	Avian Diversity
24	Darras *et al*. (2019)	Indonesia	Conservation study	Bird's species
25	Sullivan *et al*. (2017)	U S A	Conservation study	Bird's species
26	Boxton *et al*. (2018)	Karnataka	Acoustical monitoring	Avian Diversity
27	Divyapriya and Promod (2019)	Tamil Nadu	Acoustical study	Bird's species
28	Singh *et al*. (2019)	Delhi	Anthropogenic and conservation study	Bird's species
29	Jagiello *et al*. (2019)	Poland	Anthropogeny study	Avifauna
30	Sethi and Bhatt (2020)	Uttarakhand, India	Anthropogenic study	Oriental Magpie Robin
31	Pawar *et al*. (2020)	Mumbai	Anthropogenic study	Bird community
32	Matuoka *et al*. (2020)	Brazil	Anthropogenic study	Birds study
33	Lawrence *et al*. (2020)	North America (Panama)	Diversity study	Avian species
34	Melo *et al*. (2021)	Brazil	Conservation study	Faunal Species
35	Lahiri *et al*. (2021)	Arunachal Pradesh	Diversity study	Avian community
36	Kler *et al*. (2022)	Punjab	Anthropogenic study	Avian species
37	Ramesh *et al*. (2023)	Kerala (Annamalai)	Conservation study	Avian Diversity

extensively used to support bird conservation initiatives across various ecosystems. A study by Oppel *et al*. (2014) utilized acoustic monitoring to assess the population status of the critically endangered Seychelles Magpie Robin (*Copsychus sechellarum*) enabling targeted conservation interventions that significantly improved its numbers. Additionally, the effectiveness of autonomous recording units has been used in monitoring bird communities in remote areas, such as the Galápagos Islands, where traditional survey methods are challenging (Buxton *et al.*, 2017). Thus, acoustic techniques have significantly enhanced bird conservation efforts by offering detailed insights into species distribution, population trends, and habitat use, supporting more informed and effective conservation planning.

These studies underscore the role of acoustic monitoring in providing continuous, real-time data that informs conservation strategies and measures the impact of environmental changes and human activities on bird populations.

Acoustical techniques have facilitated the identification and protection of critical habitats. For example, Aide *et al.* (2013) used bioacoustics

monitoring to map bird diversity hotspots in the Neotropics and guiding the habitat preservation efforts. Another study, highlighted the use of passive acoustic monitoring to detect illegal logging activities in protected areas, thereby safeguarding bird habitats from anthropogenic threats (Blumstein *et al*., 2011).

Estimating the impact of Anthropogenic activities

Acoustic monitoring has been instrumental in assessing the impact of anthropogenic activities on bird populations, offering precise and continuous data that traditional methods may overlook (Divyapriya and Promod, 2019). Researchers have employed acoustic techniques to study the effects of urbanization, industrial noise, and habitat fragmentation on bird communities. For instance, Singh and Raghubanshi (2012) used acoustic recordings to evaluate the impact of urban noise pollution on the vocal behavior of Indian House Crows in Varanasi, revealing significant changes in their call frequencies and patterns due to high noise levels. A study by Francis *et al*. (2011) in North America utilized autonomous recording units to investigate the impact of chronic noise from natural gas extraction on the nesting success of woodland bird species. The findings indicated that noise pollution led to reduced reproductive success and altered species composition, emphasizing the need for noise mitigation in conservation planning. Additionally, Dooling and Popper (2016) reviewed the broader implications of human-generated noise on bird auditory systems, suggesting that prolonged exposure to loud noises can cause temporary or permanent hearing loss in birds, affecting their ability to communicate, forage, and avoid predators. This study provided critical insights into how urban environments alter avian communication and behavior, informing urban planning and wildlife management strategies. Studies have shown that noise pollution can mask important acoustic signals, leading to changes in vocalization patterns, reduced reproductive success, and altered community dynamics (Joshi and Narayanan, 2015). Birds may modify their songs by increasing the amplitude, frequency, or duration to overcome background noise (Singh *et al.*, 2019; Sethi and Bhatt, 2020). In response to noise, birds may alter their vocal behavior by increasing the amplitude (Lombard effect), changing the pitch, or modifying the timing of their songs (Brumm, 2004). These adjustments, however, can have energy costs and affect the efficiency of communication (Nemeth, 2010). Human activities have led to increased levels of ambient noise in various ecosystems, profoundly affecting wildlife, particularly birds. Birds rely heavily on acoustic signals for communication, navigation, and reproduction, making them vulnerable to noise pollution. Highways, railways, and airports contribute significantly to noise pollution. The low-frequency noise generated by these sources can travel long distances, affecting bird populations even in relatively remote areas (Kight and Swaddle, 2011). Industrial operations, such as mining, drilling, and manufacturing, produce persistent noise that can disrupt bird habitats. These noises often overlap with the frequency range of bird vocalizations, leading to interference (Barber *et al*., 2010) and causes decline in bird population, low reproductive success etc.

Conclusion

The use of acoustics in bird studies has been predominantly observed in biodiversity assessments, conservation efforts, and the study of the impacts of anthropogenic activities. Acoustic methods are extensively used in biodiversity assessments because they enable continuous, non-invasive monitoring of bird populations across various habitats, including remote and densely vegetated areas where visual surveys are challenging. Conversely, acoustic methods are less frequently used in studies that require direct physical examination of birds, such as those involving genetic analysis or detailed physiological measurements, where capturing and handling the birds are necessary. Additionally, while acoustics provides valuable data on vocal behaviour and population dynamics, it is less effective for studies

focusing solely on visual traits or behaviours that do not involve sound production. Overall, the field of biodiversity assessments sees the highest use of acoustic methods due to their efficiency and ability to provide comprehensive data on species presence and distribution across varied environments. This widespread application underscores the critical role of acoustics in advancing our understanding and conservation of bird diversity in the face of global environmental changes.

Acknowledgements

Authors extend thanks to the Authorities of Kalinga University for providing infrastructural support during the research work.

Conflict of Interest

The authors declare no conflicts of interest.

References

Aide T M, Corrada-Bravo C, Campos-Cerqueira M, Milan C, Vega G and Alvarez R. (2013) Real-time bioacoustics monitoring and automated species identification. PeerJ. 1: e103.

Ali S and Ripley SD. (1996) Handbook of the Birds of India and Pakistan. Oxford University Press.

Allen AA and Kellogg PP. (1937) American Bird Songs. Ithaca, NY, Cornell University.

Anthony FM and Tiwari G. (2022) Anthropogenic noise reduces bird species richness and diversity along a Rur-urban gradient: A case study from a city in central India during nationwide lockdown amid COVID-19. J Biodiversity Environ Sci. 20(1): 1-9.

Arroyo-Solís A, Castillo JM, Figueroa E, López-Sánchez JL and Slabbekoorn H. (2013) Experimental evidence for an impact of anthropogenic noise on dawn chorus timing in urban birds. J Avian Biol. 44(3): 288-296.

Balakrishnan R. (2016) Acoustic monitoring of avian diversity: Potential and pitfalls. Resonance 21(5): 403-417.

Barber JR. (2021) Anthropogenic noise in US national parks – sources and spatial extent. Front Ecol Environ. 19(1): 10-20.

Barber JR, Crooks KR and Fristrup KM. (2010) The costs of chronic noise exposure for terrestrial organisms. Trends Ecol Evol. 25(3): 180-189.

Beecher MD. (1996) Birdsong learning in the laboratory and field. In: Ecology and evolution of acoustic communication in birds, (eds.) Kroodsma D. E. and Miller E. H., Cornell University Press, pp. 61-78.

Blickley JL and Patricelli GL. (2012) Potential acoustic masking of Greater Sage-Grouse (*Centrocercus urophasianus*) display components by chronic industrial noise. Ornitholog Monographs 74(1): 23-35.

Blumstein DT and Turner AC. (2005) Acoustic monitoring in terrestrial environments. J Avian Biol. 36(5): 365-374.

Blumstein DT, Mennill DJ, Clemins P, Girod L, Yao K, Patricelli G, Deppe JL, Krakauer AH, Clark C, Cortopassi KA, Hanser SF, McCowan B, Ali AM and Kirschel ANG. (2011) Acoustic monitoring in terrestrial environments using microphone arrays: Applications, technological considerations and prospectus. J Appl Ecol. 48(3): 758-767.

Borges RM and Wcislo WT. (2006) Specialized vocalizations in social communication: Evidence from an Indian babbler. J Ethology 24(3): 263-270.

Bradbury JW and Vehrencamp SL. (2011) Principles of animal communication. Sinauer Associates.

Bradfer-Lawrence T, Bunnefeld N, Gardner N, Willis SG and Dent DH. (2020) Rapid assessment of avian species richness and abundance using acoustic indices. Ecological Indicators 115: 106400.

Brumm H. (2004) The impact of environmental noise on song amplitude in a territorial bird. J Anim Ecol. 73(3): 434-440.

Brumm H and Slabbekoorn H. (2005) Acoustic communication in noise. Adv Study Behavior 35: 151-209.

Buxton RT and Jones IL. (2017) Bird community monitoring using autonomous recording units. Ecological Indicators 82: 107-116.

Buxton RT, Agnihotri S, Robin VV, Goel A and Balakrishnan R. (2018) Acoustic indices as rapid indicators of avian diversity in different land-use types in an Indian biodiversity hotspot. J Ecoacoustics 2(1): 8.

Buxton RT, McKenna MF, Mennitt D, Fristrup K, Crooks K, Angeloni L and Wittemyer G. (2017) Noise pollution is pervasive in US protected areas. Science356(6337): 531-533.

Campos-Cerqueira M and Aide TM. (2018) Improving the accuracy of automated bird song recognition. Bioacoustics27(3): 235-248.

Catchpole CK and Slater PJB. (2008) Bird song: Biological themes and variations. Cambridge University Press.

Darras K, Batáry P, Furnas BJ, Grass I, Mulyani YA and

Tscharntke T. (2019) Autonomous sound recording outperforms human observation for sampling birds: a systematic map and user guide. Ecological Applications 29(6): e01954.

Depraetere M, Pavoine S, Jiguet F, Gasc A, Duvail S and Sueur J. (2012) Monitoring animal diversity using acoustic indices: Implementation in a temperate woodland. Ecological Indicators 13(1): 46-54.

Derryberry EP, Phillips JN, Derryberry GE, Blum MJ and Luther D. (2020) Singing in a silent spring: Birds respond to a half-century soundscape reversion during the COVID-19 shutdown. Science 370(6516): 575-579.

Dinesh K. (2001) Birds in Ancient Indian Literature. East West Books, Chennai.

Divyapriya C and Pramod P. (2019) Ornithophony in the soundscape of Anaikatty Hills, Coimbatore, Tamil Nadu, India. J Threatened Taxa 11(12): 14471-14483.

Dooling RJ and Popper AN. (2016) Effects of anthropogenic noise on birds. Springer Handbook Auditory Res. 47: 1-20.

Dowling JL, Luther DA and Marra PP. (2012) Comparative effects of urban development and anthropogenic noise on bird songs. Behavioral Ecology 23(1): 201-209.

Erbe C and Dent ML. (2016) What is animal bioacoustics. J Acoust Soc Am. 139: 65-67.

Francis CD and Barber JR. (2013) A framework for understanding noise impacts on wildlife: an urgent conservation priority. Front Ecology Environ. 11(6): 305-313.

Francis CD, Ortega CP and Cruz A. (2009) Noise pollution changes avian communities and species interactions. Curr Biol. 19(16): 1415-1419.

Fuller RA, Warren PH and Gaston KJ. (2007) Daytime noise predicts nocturnal singing in urban robins. Biol Letts. 3(4): 368-370.

Gasc A, Sueur J, Jiguet F, Devictor V, Grandcolas P, Burrow C, Depraetere M and Pavoine S. (2013) Assessing biodiversity with sound: Do acoustic diversity indices reflect phylogenetic and functional diversities of bird communities?. Ecological Indicators 25: 279-287.

Gil D and Gahr M. (2002) The honesty of bird song: Multiple constraints for multiple traits. Trends Ecol Evol. 17(3): 133-141.

Jagiello Z, Dylewski Ł, Tobolka M and Aguirre JI. (2019) Life in a polluted world: a global review of anthropogenic materials in bird nests. Environ Pollut. 251: 717-722.

Joshi D and Narayanan M. (2015) Impact of urban noise on the vocalization patterns of the Indian Robin (*Saxicoloides fulicatus*). Urban Ecosystems 18(2): 547-555.

Kirschel ANG, Cody ML, Harlow ZT, Promponas VJ and Vallejo EE. (2011) Birdsongs track biological invasions: Acoustic monitoring of Hawaiian birds. PLoS One 6(2): e20210.

Kler TK, Kumar M, Kumar S and Sidhu SK. (2022) Avian diversity in agricultural habitats of Punjab State. Agricult Res J. 59(6): 1100-1110.

Knight EC, Hannah KC, Foley GJ, Scott CD, Brigham RM and Bayne EM. (2021) Opportunities and challenges for using bioacoustics to monitor biodiversity. J Appl Ecol. 58(5): 1061-1072.

Koch L. (1935) Vogelstimmen. Berlin. Verlag von Quelle and Meyer.

Kociolek AV, Clevenger AP, St Clair CC and Proppe DS. (2011) Effects of road networks on bird populations. Conserv Biol. 25(2): 241-249.

Kroodsma DE. (2005) The singing life of birds: The art and science of listening to birdsong. Mariner Books, pp. 496.

Kumar A. (2003) Animal communication. Curr Sci. 85: 1398-1400.

Kumar, A. (2012). Breeding biology of Indian Robin *Saxicoloides fulicata* in northern India. J Exp Zool India 15(1): 57-61.

Kumar A and Bhatt D. (2001) Characteristics of songs of the Oriental Magpie Robin (*Copsychus saularis*). Curr Sci. 80(1): 77-82.

Kumar A, Bhat HR and Naik RM. (2017) Acoustic monitoring of Indian Nightjar *Caprimulgus asiaticus* in fragmented forests of Central India. J Threatened Taxa 9(8): 10523-10530.

Kumar A, Sinha A and Ranjan R. (2014) Assessing the effects of habitat fragmentation on bird communities using bioacoustic methods in the Western Ghats, India. Biodiversity Conservation 23(5): 1197-1210.

Kumar S. (2018) Bioacoustics: A tool for avian conservation. J Indian Ornithol. 35(2): 45-58.

Lahiri S, Pathaw NA and Krishnan A. (2021) Convergent acoustic community structure in South Asian dry and wet grassland birds. Biology Open 10(6): Bio058612.

Laiolo P. (2010) The emerging significance of bioacoustics in animal species conservation. Biological Conservation 143(7): 1635-1645.

Leach EC, Burwell CJ, Ashton LA, Jones DN and Kitching RL. (2016) Comparison of point counts and automated acoustic monitoring: detecting birds in a rainforest biodiversity survey. Emu 116(3): 305-309.

Marler P and Slabbekoorn H. (2004) Nature's Music: The science of birdsong. Elsevier Academic Press.

Matuoka MA, Benchimol M, de Almeida-Rocha JM and Morante-Filho JC. (2020) Effects of anthropogenic disturbances on bird functional diversity: A global meta-analysis. Ecological Indicators 116: 106471.

Melo TND, Cerqueira MC, D'Horta FM, Tuomisto H, Doninck JV and Ribas CC. (2021) Impacts of a large hydroelectric dam on the Madeira River (Brazil) on floodplain avifauna. Acta Amazonica 51: 298-310.

Mennill DJ and Vehrencamp SL. (2008) Acoustic monitoring of tropical forest birds. Ecological Applications 18(1): 63-73.

Menon M and Rangaswamy M. (2016) Avifaunal richness and abundance along an urban rural gradient with emphasis on vegetative and anthropogenic attributes in Tiruchirappalli, India. Landscape Res. 41(1): 131-148.

Morton ES. (1975) Ecological sources of selection on avian sounds. American Naturalist 109(965): 17-34.

Mukherjee S, Sharma R and Bhatt D. (2018) Acoustic ecology of the Himalayan Monal in response to habitat changes. J Ornithol. 159(3): 621-630.

Oppel S, Pain DJ, Harrison J and Green RE. (2014) Acoustic monitoring for conservation of threatened birds in remote areas. Conservation Biology 28(2): 346-355.

Pankaj S and Sinha RK. (2015) Acoustic monitoring of avian diversity in the Western Ghats, India. J Environ Biol. 36(5): 1039-1045.

Pawar Prabhakar R., Rokade Anil G., Supnekar Santosh P., Meshram Leena N and Pawar Namdeo B. (2020) Anthropogenic impact on species diversity and distribution of birds from coastal region of Panvel, Navi Mumbai, India. Intern J Zool Invest. 6(2): 260-271.

Penar W, Magiera A and Klocek C. (2020) Applications of bioacoustics in animal ecology. Ecological Complexity 43: 100847.

Rajan SC, Athira K, Jaishanker R, Sooraj NP and Sarojkumar V. (2019) Rapid assessment of biodiversity using acoustic indices. Biodiversity Conservation 28: 2371-2383.

Ranjan R, Singh A and Kumar A. (2013) Acoustic identification of bird species in mixed habitats of the Eastern Himalayas. Bioacoustics 22(4): 267-278.

Sethi VK and Bhatt D. (2008) Current status of Bengal Florican *Houbaropsis bengalensis* in Uttarakhand, India. Indian Birds 4(1): 11-14.

Sethi VK and Bhatt D. (2020) Effects of noise pollution on the vocal communication of the Oriental Magpie-Robin. Ecological Res. 35(1): 33-44.

Seyfarth RM, Cheney DL and Marler P. (1980) Monkey responses to three different alarm calls: Evidence of predator classification and semantic communication. Science 210(4471): 801-803.

Singh M, Jaiswal A, Ulman Y and Kumar K. (2019) Vocal adjustments in Purple Sunbird (*Cinnyris asiaticus*) at noisy habitats. Acta Acustica united with Acustica 105(2): 294-300.

Singh P and Raghubanshi AS. (2012) Impact of anthropogenic noise on avian communication and cognition: A study on Indian House Crow. J Environ Biol. 33(3): 517-520.

Sinha A, Balakrishnan R and Kumar A. (2011) Cryptic species and vocal divergence in a group of Indian babblers (*Turdoides spp*.). PLoS One 6(8): e23729.

Slabbekoorn H and Ripmeester EAP. (2008) Birdsong and anthropogenic noise: Implications and applications for conservation. Molec Ecol. 17(1): 72-83.

Sullivan BL, Phillips T, Dayer AA, Wood CL, Farnsworth A, Iliff Marshall J, Davies IJ, Wiggins A, Fink D, Hochachka WM, Rodewald AD, Rosenberg KV, Bonney R and Kelling S. (2017) Using open access observational data for conservation action: A case study for birds. Biological Conservation 208: 5-14.

Teixeira D, Maron Mand van Rensburg BJ. (2019) Bioacoustic monitoring of animal vocal behavior for conservation. Conserv Sci Practice 1(8): e72.

Templeton CN, Greene E and Davis K. (2005) Allometry of alarm calls: Black-capped chickadees encode information about predator size. Science 308(5730): 1934-1937.

Tobias JA, Seddon N, Spottiswoode CN, Pilgrim JD, Fishpool LDC and Collar NJ. (2010) Quantitative criteria for species delimitation. Ibis 152(4): 724-746.

Wiley RH and Richards DG. (1978) Physical constraints on acoustic communication in the atmosphere: Implications for the evolution of animal vocalizations. Behavioral Ecol Sociobiol. 3(1): 69-94.