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Impact of Sound Energy on Biodiversity

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Abstract : We live in a noisy environment, and humans are responsible for much of it. Humans have polluted the world with constant barrage of sound. Recent studies show that our increasingly noisy world is having adverse effects on humans and a range of animals across various habitats. It is also affecting the biological activities of biodiversity. In this paper, the authors highlight and study the impact of sound energy and noise on different organisms in biodiversity.

(Keywords: Sound energy, noise pollution, biodiversity, decibels**)**

Introduction

Nature can indeed be noisy- bird calls, winds, thunder etc. Thus, noise is created and used by the natural world in a sophisticated information network. The majority of animals, on the other hand, has adapted to the natural noises in their surroundings – they are aware of them, understand them, and know how to use and interpret them.

On the other hand, it is crucial to observe that environmental pollution is a significant problem faced by all countries worldwide. Rapid industrial and urban development has resulted in massive amounts of potentially dangerous waste products being released into the environment. The tremendous increase in the number of people and automobiles has resulted in major worries about noise pollution, which has now become a major issue for society.

Noise pollution is impacting the communities' development as it affects human activities such as education, production, economic processes, and social aspects in both direct and indirect ways. Noise effects have different impacts on humans' mental and physical health and disturbance of daily activities. Those effects can cause temporary or permanent hearing loss, ranging from slight impairment to nearly total deafness.

Sound is measured in Decibels (dB). Sounds at 85 decibels or above can harm a person's ears.The following table shows a glimpse of the noise levels produced by different causes:

S. No.	Source	Noise Produced (in dB)
1.	Pop Music	50
2.	Populated office	80
3.	Heavy Traffic/ Noisy Restaurants	90
4.	Trains	90
5.	Engineering Workshop	100
6.	Motor Horns	110
7.	Chainsaw	110
8.	Disco Music	120
9.	Fighter Jet	150
10.	Rocket Launch	180

When humans introduce artificial, new noises to natural soundscapes, the acoustic environment of these marine and terrestrial environments can be altered, resulting in a variety of issues. It can impair an animal's hearing or make it difficult for them to find food, avoid predators etc.It can also complicate certain instincts and behaviors such as navigation, communication, reproduction, and engagement in routine activities. Interest in the way sound affects wildlife has intensified over the last decade as more and more studies begin to explore how these changes in behavior could have flow-on effects for not only individual animals and their populations but also whole ecosystems.

Impact on Biodiversity:

In this part, the authors elaborate on the impact of noise pollution on different species across biodiversity and highlight the change in their behaviors.

(a) Flying Species

It has been observed that when subjected to constant noise caused by urban areas such as roads, cities, and industrial sites, the population and diversity of certain bird populations has been proven to diminish or change.Several species have adjusted their vocal calls in an attempt to be heard above the urban noise. Hence, noise has been seen to behave as a sort of sensory pollution, requiring animals to either adjust their calls to be heard over it or flee the area entirely.

(b) Land Species

A similar observation can be deduced in the behavior of land species. Road noise can alter key survival behaviors of living land species. It may not necessarily drive these animals away from a site, but it may alter their established behaviors, and it can also have a less-obvious negative effect on their physical well-being.

(c) Marine Species

One may believe that marine animals swim in the unfathomable depths of oceans with only the gentle lapping of waves to listen to. Unfortunately, the noise made by humans is increasingly disrupting life below the surface, with many marine animals being affected.

Shipping traffic, industrial noise from oil and gas development, seismic surveys, military sonar, and other sources all contribute to increasing levels of strong underwater sound. For marine species that rely on hearing as their primary sense for mating, hunting, and communication, this cacophony can cause a variety of issues. Some species in the open ocean can hear sounds thousands of kilometers away, such as waves breaking on the shore or ice cracking. This information is used to assist them navigate and plan their moves.

With the observations mentioned above and reflections, it can be said that noise pollution is an invisible danger. It cannot be seen, although it is present both on land and beneath the water. Any undesired or irritating sound that impacts the health and well-being of humans and other organisms is referred to as noise pollution.But, what are we doing about it? The authors will tackle this indispensable question in the next part.

Controlling Noise Pollution:

(a) On Land

Noise pollution from traffic can be reduced in a variety of ways, including the development of quieter roads and cars, the installation of noise-reduction barriers around major traffic areas, the lowering of speed limits, driver education, and the implementation of relevant legislation to gradually reduce noise. Other options include using better materials, better site design, and conducting extensive environmental evaluations prior to allowing building on residences and industrial sites, with follow-up assessments once the work is completed.

(b) In the Sea

The government should establish quiet zones for marine species, lower noise levels in

crucial habitats, develop greener technologies, such as quieter ships and machinery, and advocate for national noise regulations.

(c) Conversion of Noise into Electrical Energy

Noise is a kind of energy but with sound pressure levels higher than the audible levels by the human ear. According to the third law of thermodynamics, mechanical energy can be converted to electrical energy, thus sound as a form of mechanical energy can be converted to electric energy. There are three approaches to convert sonic energy to electric energy: heating, using the diaphragm, and piezoelectric materials. The authors highlight the method of piezoelectricity in this part.

Piezoelectricity is the electricity resulting from pressure. The emergence of an electrical potential (a voltage) across the surfaces of a crystal when it is subjected to mechanical stress is its scientific definition. This is accomplished by converting mechanical energy to electric energy or vice versa utilizing crystals.

When the application of external stress deforms the crystal, electric charges appear on the crystal surfaces. When the direction of the strain reverses, the polarity of the electric charge is reversed. This is called the direct piezoelectric effect.

When a piezoelectric crystal is put in an electric field or when charges are given to its faces by external sources, the crystal exhibits strain, which causes the crystal's dimensions to change. The inverse piezoelectric effect occurs when the direction of the applied electric field is reversed, causing the direction of the generated strain to reverse.

Piezoelectric material experiences strain when an electrical field is applied to it and develops an internal electric field. The following equations can express the relationship between the electrical and elastic properties of the material: D = d T + [^{T} E and S = s^{E} T + d E Where (*D*) is electric flux density or dielectric displacement, (*T*) is the mechanical stress, (*E*) is the electric field strength, (*S*) is the mechanical strain, (*d*) is the piezoelectric charge coefficient, ($\int^{T}$) is the dielectric permittivity for constant T and (s^{E}) is the elastic coefficient for constant E. These small-signal coefficients can be found in the material data table for each material. Thus, the above method can also be a solution to convert or utilize the noise to convert it into electrical energy.

Conclusion:

On a daily basis, millions of people are affected by noise pollution. Loud noise can also lead to high blood pressure, heart disease, sleep problems, and stress. These health issues can impact people of all ages, but notably children.

Noise Pollution also impacts the health and well-being of wildlife.Animals use sound for various reasons, including navigating, finding food, attracting mates, and avoiding predators. Noise pollution makes it difficult for them to accomplish these tasks, which affects their ability to survive.

All sectors will have to contribute solutions. Governments will need to be proactive in enacting legislation that limits or restricts periods and types of noise, and the rest of us can take minor efforts to reduce our own noise emissions. Science can help us better understand the issues and problems these species are facing. Moreover, technical innovation will need to provide improved, quieter technologies will need to be adopted.

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