

EFFECT OF NOISE ON ANIMALS

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ABSTRACT

Sound plays an important role in animal behaviour, welfare and production. It also helps the animal attendant in communicating with and controlling the animal. When sound becomes unpleasant and disturbing it is termed as noise and causes sound pollution. The threshold of bearing sound is different among animals and is affected by several factors such as age, shape of the ears, species and breed of the animal and health condition. Noise pollution affects behaviour, breeding, growth and well-being of birds. Noise was noted to cause sleep disturbances and affect the endocrine and cardiovascular systems, in laboratory animals. A review is presented on the effect of noise on animals based on the work of various researchers. Methods on how to keep animals safe from sound pollution has also been suggested.

Keywords: Sound, Noise, Aquatic, Farm animals, Birds, Behaviour

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INTRODUCTION

Creatures communicate using a variety of ways that can be classified into four main orders, visual, audile, chemical, and tactile. Nature of communication depends on many factors like the species, breed, social system, behaviour, need, senses involved and the interest of the receiver and communicator (Naguib, 2006). Visual communication includes factors such as color, movement, and display

structures like raised hair or cosmetic feathers. Audible communication uses oral sounds and other styles of generating sound similar as knocking and clicking. The natural sound produced by different animals is presented in Table 3. Chemical communication involves the sensing of chemicals through the taste and smell. Tactile communication requires contact between individuals and can also be due to physical collisions.

A sound is a form of energy that's produced when a vibration propagates as a longitudinal mechanical surge of pressure causing relegation through the air, water, and solid which is picked up by the animal. What

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the animal likes to hear is sound and that which is painful or unwelcome to the animal is noise. Sound has a harmonious pitch, is audible and appealing with a positive effect on health. The intensity of sound is measured in decibels (dB) and the pitch of the sound i.e. frequency is measured in hertz (Hz). Noise is any unwanted chronic or intermittent sound (Brouček, 2014). Noise has varying pitch, can be unrhythmic and has a negative effect on health. Noise can cause noise induced hearing loss, high blood pressure, sleep disturbances, and heart problems. The inflexibility of response to disturbance may, still, vary with species, group size, social groups, age, foliage cover, season, and distance from the sound. The intensity of sound is measured using a sonometer. As per National Geographic encyclopedia, creatures use sound to navigate, find food, attract mates, and avoid bloodsuckers. Noise pollution makes it delicate for them to negotiate these tasks, which affects their capability to survive. Many creatures have been acclimated to the natural sounds of their terrain over time, which help them to distinguish applicable sounds from inapplicable sounds. Audible range of sound in some animals and birds are depicted in Table 1.

Several studies have been conducted on the creation of a data bank on different sounds in the creatures. Singh (2020) proposed a flexible convolutional neural network-based framework to classify animal audio with the development of multimedia and web technology. The exploration concluded with an evaluation of bracket performance using

colorful machine-literacy ways to classify audio in colorful beast classes.

Cattle tolerate moderate amount of noise and can fluently acclimatize to an intensity of 60 - 90 decibels. Above these cattle are oppressively affected to a varying extent depending on a number of factors and which may also vary depending on whether they are exposed to noise on a nonstop or an intermittent base. Animals are more oppressively affected as they don't have the chance to acclimatize to the noise (Esmail, 2017).

Elephants can communicate using veritably low - frequency sounds "infrasounds", with pitches below the range of human ear. These "infrasounds" can travel several kilometers, and provide elephants a "private" communication channel that plays an important part in their complex social life (University of Vienna, 2012). Infrasound has frequency less than 20 Hertz, have long wavelength, low note and cannot be heard by humans. Elephants can communicate with each other at over 10 Km apart, whereas humans can do so only around 100 meters (Homes, 2021).

Aquatic animals are best long-distance communicator. The humpback whale does not produce infrasound. Its sound frequency is between 40 Hz to 4000 Hz which travels thousands of kilometers through the water as sound travels faster in water compared to air (Homes, 2021).

Bats produce sound in the frequency of over 10,000 Hz. This high frequency sound

helps them in echolocation for hunting and navigation. Bats can detect an object the size of a human hair, which indicates the preciseness of the echolocation (Homes, 2021).

EFFECT OF NOISE ON ANIMAL LIFE

Kunc and Schmidt (2019) stressed the negative impact of sound on animals with Kunc stating that that “We always talk about climate change, chemical pollution, plastic pollution and habitat destruction but noise, especially in urban areas, can really have a negative impact on animals”. Noise has a negative effect on animal reproduction and navigation as it changes the fine-tuned balance between predator and prey detection by avoiding and interfering with the use of sounds in communication. Hearing loss and rapid increase in heart rate are some of the ill effects of noise pollution on animals. High-intensity sound induces fear, which can force species to abandon their habitat. Frogs can struggle to find mates, and a population’s evolutionary line can be altered leading to profound inheritable and evolutionary consequences (Knight and Swaddle, 2011). Noise created by traffic impair the foraging efficiency of bats and alter vocal communication in frogs and invertebrates.

Noise pollution makes it difficult for animals to use sound for navigation, finding food, mating, and avoiding predators, affecting the animal’s ability to survive (Tolliday, 2021). Raghy *et al.* (2023) in their review stated that the shape and size of the ear, breed, age of dog and the suddenness of the noise produced

effect the response of dogs to noise and also their welfare.

Noise and Birds

Birds that reside in places with high sound intensity, have to sing at higher frequencies, bats and owls can have trouble finding prey and terrestrial insectivores lose habitat by avoiding areas with roads and construction (Knight and Swaddle, 2011).

However, noise has some advantages like the humming birds which prefer noisy sites, because the western scrub jay, which preys on its nestlings, tends to avoid those noisy areas. This helps to increase the pollen transfer of humming bird-pollinated plants, such as *Scarlet gilia*, in the noisy sites. The plant and tree populations could also decline due to noise as the animals and birds that are needed for pollination shy away from the noise and can lead to a decline in tree or plant populations. Hence noise has a disturbing effect that can ripple the ecosystem potentially leading to large-scale changes (Francis *et al.*, 2012).

Bird species change their singing behaviour in noisy environments. In areas which are noisy during the day, Robins preferred to sing during the night (Fuller, 2007). Thus, researchers concluded that a correlation exists between birds singing and human-induced noise, although hearing loss could not be detected. Birds change their timing of singing or sing at higher pitch to mask the noise.

Researchers found that noise distracts chaffinches from foraging and finding enough food because they constantly had to keep an eye out for enemies (Luo *et al.*, 2015). In bluebirds, reproduction was affected by the production of fewer chicks (Mulholland *et al.*, 2018).

Noise and Aquatic Animals

Anthropogenic sounds significantly affect the lives of submarine creatures (Popper and Hastings, 2009). Anthropogenic noise must be considered a serious form of environmental change and pollution as it affects both submarine and terrestrial species (Kunc and Schmidt, 2019). Creatures living in the ocean have communication problems due to noise from drilling platforms, vessels, and seismic checks. Whales and dolphins are particularly impacted by noise pollution, which can be as loud as 235 rattles (rapid succession of short sharp noises). These marine mammals calculate on echolocation to communicate, navigate, feed, and find mates, and redundant noise interferes with their capability to effectively echolocate. Research has shown that sonar sounds can cause mass stranding of whales and alter the feeding gesture of risked blue whales (*Balaenoptera musculus*) (National Geographic Society, 2022). Popper and Hastings (2009) editorialized that it affects the survival of the species.

Seismic checks also produce loud blasts of sound within the ocean contributing to the altered behaviour of whales. Stranded dolphins in America have been diagnosed with

hearing loss which is due to human induced noise (Anonymous, 2012).

André and Nachtigall (2007) recorded ocean sounds using instruments called hydrophones. Their design, Coastline (harkening to the Deep Ocean Environment), collected data at 22 different locales and with the aid of computers, identified the different sounds of whales and dolphins. The analysis determined the effect of aquatic noise on these creatures and will find ways to help marine creatures from the troubles of ocean noise.

Noise and Laboratory Animals

Noise has both auditory and extra-auditory impact on lab animals, with the most harmful effect of extra-auditory impact being on sleep (Rabat *et al.*, 2006). Turner *et al.* (2005) in their studies on hearing in laboratory animals described the non-auditory impact of noise on the biology and behavior of various strains and species of laboratory animals. It affects the endocrine and cardiovascular function, causes sleep-wake cycle disturbances, seizure susceptibility, and an array of behavioral changes. The level of change that occurs is determined by the species, strain, noise intensity level and duration of sound. Rabat *et al.* (2006) found that when rats are subjected to chronic exposure to noise, they suffer from long term memory deficit and slow wave sleep disturbances.

Noise and Wildlife

A paper published by Queen's University Belfast (2019) titled 'Biology

Letters' conducted experiments in which different aspects of the animal's behaviour was recorded before and after exposure to noise. They analyzed over one hundred species and divided them into seven groups: amphibians, arthropods, birds, fish, mammals, mollusks, and reptiles. The results found evidence that noise pollution impacts all seven groups of species, and the different groups didn't differ in their response to noise.

EFFECT OF NOISE ON FARM ANIMALS

Noise has been identified as a potential stressor to exposed animals not only in housing but also during transport and at the abattoir. The detailed effects of noise on feed intake, metabolic processes, the endocrine system, reproduction, milk production and behaviour in farm animals have been detailed below.

Feed Intake

Esmail (2017) observed that when cow bells are attached to the neck of grazing cows (to identify their location), animals tend to decrease head movements to avoid the generation of the sound. This result in reduced feeding and ruminating durations as both behaviour include head movements. This further leads to a reduction in feeding times causing reduced utilization of pasture plants and lower growth rates of young animals. The reduction in rumination time might result in a reduction of saliva production and eventually challenge health through an increased risk of rumen acidosis. Wearing a bell may further lead to a change in vago-sympathetic balance, which is used as an animal welfare indicator

allowing comparison of different management procedures.

Noise causes stress affecting adrenal cortex secretion (Spreng, 2000). It decreases animal feed intake due to slower passage of digested feed, distension of the foregut, and the delayed entry of digested feed into the small intestine. This in turn leads to lower-than-expected rate of body weight gain.

Metabolic Processes

Noise increases the release of free radicals which are produced during normal metabolism (Özgüner *et al.*, 1999). The levels of these free radicals may increase to the point where the enzyme's antioxidative capacity is insufficient to alleviate their effects. The increased level of such products is an indication of the damage to polyunsaturated fatty acids, which initiate the lipid peroxidation reactions to other metabolic changes that might be toxic to cellular components.

Endocrine System

Noise production affects the adrenal cortex (Gądek-Michalska *et al.*, 2012). It causes decreased production of cyclic adenosine monophosphate (cAMP), increases the release of glucocorticoids which causes a rapid breakdown of glycogen in the muscle cells, leading to a decline in pH and a delay in the temperature drop after slaughter. Noise also adversely affects the release of reproductive hormones estrogen and progesterone (Shafiei *et al.*, 2017).

Table 1. Audible range of sound in various animals (West, 1985)

Sl. No.	Animal	Audible Range (Hertz)
1	Dog	67 - 45,000
2	Cat	45 - 64,000
3	Cow	23 - 35,000
4	Horse	55 – 33,000
5	Sheep	100 – 30,000
6	Elephant	16 – 12,000
7	Rabbit	360 – 42,000
8	Rat	200 – 76,000
9	Bat	2,000 – 1,10,000
10	Owl	200 – 12,000
11	Chicken	125 – 2,000
12	Parakeet	200 – 8,500
13	Canary	250 – 8,000
14	Goldfish	20 – 3,000
15	Porpoise	75 – 1,50,000
16	Whale (Beluga)	1,000 – 1,23,000

Reproduction

Noise stress provoked an increase in serum corticosteroid, causing an 80% decline in testosterone concentration, which in turn affects the quality of ejaculates and subsequent fertility, marked reduction in epididymis sperm number and increased agglutination of sperms and number of dead sperms (Knol, 1991). The effects of noise on the reproductive functions of farm animals have yet to be established, but

a great deal of work has been done in this area on laboratory animals.

In female rats exposed to 110 dB for five minutes 15 times per day for 11 days at 375 -500 Hz, the size of ovaries and the uterus diminished significantly (Brouček, 2014). Noise also increases abortion frequency, fetus resorption and fetal weight reduction. This is due to the decrease in the uterine blood flow, gas interchange, nutrition and interchange of waste products between the fetus and mother.

Table 2. Acoustic characteristics of vocalizations (c.f. Laurijs *et al.*, 2021)

Animal	Acoustic characteristics of vocalizations associated with positive emotions	Vocalization types mostly associated with positive emotions
Pigs	Shorter, lower frequency (except for grunts in which the frequency is higher in positive than negative situations)	–
Horses	Shorter, lower frequency	Nickers, possibly snorts
Cows	Lower frequency	Possibly 'murmuring' calls
Goats	Less variable F0	–
Chickens	Shorter, more rhythmic	Food calls and fast clucks

Castelhano-Carlos and Baumans (2009), observed that the exposure of rats to noise of 50-80 kHz at 80-90 dB for four days during the mating period reduced fertility by 73.2 %. Exposure to 100 dB of 3-12 kHz for one nanosecond during the four days of mating reduced fertility by 70-80 percent.

Milk Production

Esmail (2017) reported that dairy cows exposed to sudden noise just before attaching the milking machine, resulted in an immediate cessation of milk production, presumably due to the increased adrenaline secretion and the change of other neuroendocrine biographies following exposure to unforeseen noise. When the same animals were exposed to a sudden high-intensity noise (110 dB), such as low-altitude jet aircraft overflights at milking time, the effectiveness of the milk ejection reflex was reduced, and decreased efficiency of milk removal and increased residual milk were also observed with an overall reduction in milk

yield. However, with frequent exposure to high-intensity noise, the response may not be as negative. In support of this view, the milk yield of dairy cows in an area of frequent sonic booms (4-5 times per day) was similar to the yield of control dairy cows. With high intensity noise, the somatic cell count (SCC) increases, indicating damage to milk producing tissue in the udder caused by loss of epithelial cells. The increased cell count is also an indicator of the keeping ability of milk, its taste, and how well it can be made into other dairy products such as yogurt or cheese. In extreme cases, i.e. milk with an SCC of more than 400,000 the milk is considered as being unfit for human consumption by the European Union (Li *et al.* 2014).

Kochewad *et al.* (2022) observed that animals exposed to music exhibited a significant ($p < 0.05$) difference in milking time, milking speed, cortisol hormones and behavioural parameters such as milk letdown,

Table 3. Natural Sound produced by different animals(Source: [https://en.wikipedia.org/wiki/List of animal sounds](https://en.wikipedia.org/wiki/List_of_animal_sounds))

Domestic Animals		Wild Animals	
Cattle	Moo, Bellow	Rhinoceros	Bellow
Horses	Neigh, snort, whine, nicker	Wolves	Howl, cry, yell
Sheep / Goats / Lambs / Giraffe	Bleat	Foxes	Bark, yelp, simper
Camels	Grunt	Tigers	Growl, roar
Elephants	Trumpet, roar	Hyenas	Laugh, scream
Donkeys	Bray	Jackals	Howl
Dogs	Bark	Lions	Roar, growl
Cats	Mew, purr, meow, hiss, yowl	Zebras	Whinny
Pigs / Hogs	Snort, grunt, squeal, oink	Apes	Gibber
Birds		Bears	Growl
Cocks	Crow	Deer	Bell
Eagles / Vultures / Peacocks	Scream	Monkeys	Chatter, gibber, whoop, screech
Ducks	Quack	Aquatic animals	
Turkeys	Gobble		
Geese	Cackle, quack	Dolphins	Click
Doves/ Pigeons	Coo	Seals	Bark
Crows	Caw	Whales	Sing
Owls	Hoot, scream, screech, shriek		
Parrots	Talk, screech, squawk		
Ostriches	Chirp, bark, hiss, low hum		

as compared to the control group. Their results have significant implications relating to the behavioural fitness and welfare of dairy animals. A pair of psychologists at the University of Leicester in England, in the year 2001, demonstrated that slow music played at a large dairy farm increased the cow's milk production by 3 percent as compared to fast music which had no effect (<https://modernfarmer.com/2014/02/milking-music/>). Similarly, Lemcke *et al.* (2021) explored the effects of music inside an automatic milking system (AMS) on cows' milk yield and behavior. No differences were found in milking interval and daily milk yield. Their results suggest that the cows perceived the selected music as attractive and that playing music might be a practical tool to reduce the necessary efforts of driving cows to milking parlour.

Immunity

Animals born to mothers kept in the noisy environment had smaller thymus weights shortly after birth, as well as lower serum IgG levels, indicating impairment of the secondary immune response. Prenatally stressed animals displayed significant decreases in their humoral immune responses (decreased numbers of T cells and decreases in phagocytic activity). These effects appeared to be mediated by sex, with females generally more impaired than males. Heterophil-to-lymphocyte ratio (H:L) also increased under high-noise conditions due to the increased release of corticosterone (Zollinger *et al.*, 2019). Animals with high H:L ratio have

been subject to a variety of diseases like liver damage, several infections, inflammatory disorders, cancer. The noise-immunity relationship has been well established in laboratory animals, and again further investigations are still needed to determine whether such relationship exists in cattle and other domestic animals. Apart from increasing focus, acoustic waves of some musical pieces may alleviate pain, change heart rate, reduce anxiety, reduce stress hormone (e.g., cortisol) production, and even significantly improve natural killer (NK) cell levels and activity (Hasegawa, 2001).

Behavioural Changes

The behavioural response of the animals to noise depends upon the intensity of the noise, age, and species of the animal and whether the sound produced is instant or continuous. Animals may either jump, bolt or freeze in fright, smaller animals may defecate, pregnant animals may abort, milk let down may be stopped temporarily, they may stop their activity till they recover, may try to hide in the group and take protective action. Many animals give a wide-eyed stance. Johns *et al.* (2017) demonstrated that on exposure to noise of 85dB as compared to 65dB – there was increased arousal, avoidance, heart rate variations and increased sympathetic activation. They concluded that this may reflect an altered acoustic perception of the playback stimulus due to noise habituation leading to a low-reactive animal in general. The habituation of cattle towards increasing sound intensity occurs between 60-90 decibel.

Beyond this limit, physiological processes are disturbed causing milk yield decrease, increase in somatic cell number in milk and may also lead to reproductive problems (Johns *et al.*, 2017, Esmail, 2017). Yadav *et al.* (2018) observed that excessive noise causes fertility problems in bulls. The level of stress to noise can be reduced by properly selecting music type, intensity and tempo. However, silence is equally important and necessary for the welfare of animals (Ciborowska *et al.*, 2021)

Vocalizations in Farm Animals for Positive Welfare

There is now substantial evidence that the production of vocal sounds is affected by the emotional state of the animal. The rate of vocalization and aural structure (frequency, breadth and duration) of speech change across species. Furthermore, the evidence that vocalizations are involved in emotional expression is supported by the role of the amygdala in animal vocal production (Jürgens, 1982). The acoustic characteristics for different animals are described in Table 2. Animal vocalization help to understand their physiological state and also state of well-being. Green *et al.* (2018) noted that the recognition of vocal sounds should be done at the herd level of cattle. Researchers are working on using vocalization as an indicator of animal welfare (Meen *et al.*, 2015).

THE BENEFICIAL EFFECT OF SOUND WAVES IN ANIMAL MEDICINE

Sound waves can be used for

1. Therapy –
 - a. Acoustic Sound Wave Therapy (ASWT) and Sonic Wave Therapy (SWT) are used to treat erectile dysfunction, while Extracorporeal Shock Wave Therapy (ESWT) to treat pain. Sound waves are used to inspire natural, safe reactions within a tissue that helps to return that tissue to its optimal and homeostatic state. They encourage natural healing processes in the body.
 - b. Can be used to treat kidney stones (Lithotripsy) by sending focused ultrasonic energy or shock waves directly to the stone. Shock waves break a large stone into smaller stones that will pass through the urinary system.
 - c. High-Intensity Focused Ultrasound (HIFU) can be used to destroy or damage cancer cells
 - d. Shock wave Therapy helps in the treatment of arthritis.
2. Imaging –
 - a. Ultra Sound waves can also be used beneficially as an imaging method to produce images of structures within the body, which provide valuable information for diagnosing and directing treatment for a variety of diseases and conditions like pregnancy diagnosis, and abnormalities in the internal organ structure.

3. Pain relief –

- a. Applying acoustic pressure waves at the site of pain or injury stimulate blood circulation, enhance healing and relieve pain in the tissues or organ. It is highly useful in muscular, tendon and ligament pain arising due to injury or inflammation (<https://oceanusamerica.com/>)

TIPS TO ALLEVIATE NOISE EFFECT

There are a number of strategies that can help to alleviate the effects of excessive noise on farm animals

- Locate the farm as far away as possible from the city or noisy areas. Farm animals should be housed in areas with less noises
- Electrical appliances (heating, ventilation, generator machines) that produce sound should be kept as far away as possible from the animals
- Where noise stress cannot be avoided, due to the expanding city limits, feed the animals additional antioxidants supplements like vitamins and certain minerals such as potassium, iron, selenium to alleviate the problems relating to adverse metabolic reactions and to prevent the production of free radicals
- A widespread solution used to protect horses from noise exposure is the use of hearing protection devices such as ear plugs (Macfarlane *et al.*, 2010).

- To provide a silent calm environment to the animals, human lifestyle changes are highly necessary to combat the invisible enemy in the form of noise pollution by avoiding noisy leisure activities, using quieter means of transport, avoiding air horns, avoiding shouting or speaking in a loud noise in the shed of the animal and choosing buildings with installed noise insulation
- National Parks and Zoos should be located in the silent zone
- The role of the government in establishing silent zones, no horn zones, preventing the plying of high sound-producing unfit vehicles is also of utmost importance in reducing noise pollution
- Soothing music will help to increasingly enrich the living environment of the animals.

CONCLUSION

The intention of this review is to validate and compare the results of former studies on noise assessment, particular in housing situations and to demonstrate the impact and significance of the noise problem for farm animals, casing, design, and operation. Environmental and communication noises are present in animal shelters. Although the majority of the literature suggests that farm creatures and wildlife species get adapted after repeated exposure to noise, careful

planning should be done before construction of the animal shelter structure, in order to avoid stressful sounds to the animals both from the labour force and environment. An environment should be provided to the animals in which their exposure to noise is under limits which do not affect their physiological and psychological state.

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