

A REVIEW ON THE IMPACT OF ANTHROPOGENIC NOISE ON BIRDS

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ABSTRACT. *This review addresses the impacts of noise, the vital role of acoustic communication and the response of birds in overcoming the increased anthropogenic noise. The rapid development in human activities nowadays induce the noise that interrupt the acoustic communication of birds. Disturbance of the signals transmission causes detrimental impact on the birds as they are highly depending on the acoustic communication for their survival, territory defense and reproduction. Continuous exposure of the noise then results in the declination of species richness of which have been stated by several past studies. Although most of the studies stated that the negative impact as a consequence from the anthropogenic noise, however there is positive effect contributed by the noise of which are also recorded in other studies. Moreover, the impacts of other variables such as vegetation density that cause major changes to the bird population as compared to noise have also been highlighted in several studies. This indicates that several influencing factors are important in measuring impact that lead to the changes which occur within the bird population. Thus, in depth studies on the impacts of anthropogenic noise towards the species of birds by taking into account other contributing variables are important to enable that noise management to be conducted effectively especially in developing areas as a way in conserving the biodiversity of the bird population.*

KEYWORDS. Anthropogenic noise, avian community, bird's population, acoustic communication

INTRODUCTION

Anthropogenic noise can affect a large scale of natural habitat (Barber *et al.*, 2009). It is not only seen as a highly potential disturbance in affecting the wildlife across the global landscape (Blickley and Patricelli, 2010) but also being regards as one of the factors that causes serious impact on the ecology (Forman and Alexander, 1998) of which arises the concern towards the biodiversity of the avian community.

Birds play vital roles as the agents for seed dispersal and pollinator (Peh *et al.*, 2005). Apart from that, this taxa is also a biological indicator (Sodhi *et al.*, 2005) that are widely used by other researchers and is capable in determining the health of the habitat's ecosystem (Miller *et al.*, 2004). Most of the previous studies that have been done focus on the impact of the noise on species level and the response of the birds in mitigating this effect. This review will address the impacts of the noise towards the bird, the significant role of acoustic communication to the birds and the response of the birds to overcome the noise.

The Impact of Anthropogenic Noise on Bird

Anthropogenic noise is a current phenomenon that disturbs the acoustic communication of wildlife (Chan *et al.*, 2010; Luther and Baptista, 2010; Diaz *et al.*, 2011). This type of noise is one of the factors that has a significant effect on the habitat quality of birds (Habib *et al.*, 2007; Bayne *et al.*, 2008). The serious impacts of the anthropogenic noise toward the bird population have been documented in several studies that of which not only looking on the effect at species and population level, but also on the aspect of restricting the ability of the bird itself. Most of the published studies about anthropogenic noise are done in Europe and American countries, however it is still very scarce in Asian countries, such as Malaysia.

The impact of the noise from the population level perspective shows negative changes in the avian population behaviour based on study done by (Brumm, 2004). Several studies such as (Bottalico *et al.*, 2015; Dutilleux, 2012) have found that the increase of noise causes a decrease in the population density of bird. On the contrary, this finding is opposite from study conducted by (Wiacek *et al.*, 2015) as their result shows that there is no impact received by the bird population from the anthropogenic noise as the bird population is majorly affected by the forest edge effect. This has shown that the availability of various food source along forest edge has outweighed the effect of noise by attracting the birds to forage at that area (Helldin and Seiler, 2003).

To date, the effect of noise at species level have been documented in previous studies such as by (Kight *et al.*, 2012; Arroyo-Solis *et al.*, 2013; Hana *et al.*, 2011; Nordt and Klenke, 2013; Polak, 2014). Goodwin and Shriver (2010) stated that noise derived from human activities is a significant factor that cause the reduction of the number bird species in a habitat. The inability of some species to adapt their acoustic communication in an environment that contain high level of anthropogenic noise has resulted in the decreasing of individuals for that particular species (Francis *et al.*, 2011). Interestingly, the result from the study done by (Summers *et al.*, 2011) shows that the noise exposure does not seem to show any threats towards the species of bird that are being experimented in their study.

There are a few effects that are caused by the extreme anthropogenic noise on the birds' social behaviour. These passive effects such as psychological stress through the increasing of bird heart rate is among the consequences received by the avian in dealing with the high anthropogenic noise level (Slabbekoorn, 2012). According to Herrera-Montes and Aide (2011), the ability of the birds in nurturing and navigating were affected by the extensive noise. Apart from that, the noisy background also hinders them from detecting their predators (Dooling and Popper, 2007) due to the loss of hearing ability (Rabin *et al.*, 2003) as well as impaired them in selecting their mating partner (Bayne *et al.*, 2008).

A study done by Slabbekoorn and Ripmeester (2007) shows that both birds that exhibit high and low frequencies songs received the masking effect of the anthropogenic noise. The masking of the male bird's song that is used to attract female bird can lead to the reduction of pairing (Habib *et al.*, 2007; Swaddle and Page, 2007) and reproduction success (Halfwerk *et al.*, 2011; Reijnen *et al.*, 1996) of that species. However, the result from Meillere *et al.*, (2015) shows that anthropogenic noise is not the main factor that affect the reproduction success of birds. Apart from that, (Francis *et al.*, 2009) discussed that the disturbance on the prey-predator interaction has indirectly causes positive effect to reproduction especially the adaptive species. In addition, (Gonzalez-Orejo *et al.*, 2012) also found that the noise also support the nesting of birds in urban areas.

The interference of the transmission of acoustic signals also affect the fitness of the birds (Nemeth and Brumm, 2010) as it will force them to acquire more energy in overcoming the masking of the anthropogenic noise. Tragically, the declination of the survival rate of the young birds during their early development stage (Schroeder *et al.*, 2012) and the tendency of misdetection towards their parents call (Leonard and Horn, 2012) are also due to the increase of the noise in their surrounding environment. This indicates that birds face extreme challenges to survive in areas that have high level of anthropogenic noise (Diaz *et al.*, 2011).

The Roles of Acoustic Communication

The avian community depends heavily on acoustic signals as their tool of communication for the success in selection of mating partner (Brumm, 2004). The vocal communication is very important to the birds as acoustic signals that are transmitted to receive contained messages about the birds' identity and their ability (Slabbekorn and Ripmeester, 2007). According to (Riebel, 2003; Verziden *et al.*, 2010), these signals are used by the male bird in attracting the female birds during the period of mate selection. The signals are needed to be transmitted well as (Legnage and Slater, 2002) states that birds depend on the transmission of their acoustic signals in order to successfully find their suitable mating partner.

Acoustic communication plays significant role for the survival of the birds as it is part of their defence system to avoid the predators (Brumm, 2004; Santana, 2011) through projection of alarm calls (Potvin *et al.*, 2014). In addition, the birds use the acoustic signals in search for food (Herrera-Montes and Aide, 2011). Hence, it shows that the acoustic communication is important for the survival of the birds particularly in areas that have scarce food.

The Response of Birds toward Noise

There are several studies that have recorded on the response of birds toward anthropogenic noise. However, the response can be different among species from the same family (Francis and Blickley, 2012). Francis *et al.*, (2010) found that differences of the response can be seen through the vocal song features and also their preference in selecting a habitat to mitigate the restriction of anthropogenic noise.

Shifting the time of calling activity is one of the strategy that is used by the birds to avoid the noisy period that interfere their communication (Nemeth *et al.*, 2013; Cartwright *et al.*, 2013). Meanwhile, vocal plasticity exhibited by birds are also found to be effective in adapting in noisy areas (Francis *et al.*, 2011). Parris and Schneider (2008) explains that vocal adjustment is usually used especially for birds that sing in low frequency to communicate in high-traffic site areas. Apart from changing the song frequency, studies by (Slabberkoorn and Ripmeester, 2007; Brumm and Zollinger, 2011) documented that birds also rise the amplitude of their song known as the Lombard effect to mitigate being masked by anthropogenic noise. However, the consequence of this mechanism consumes a lot of energy on the bird (Patricelli and Blickley, 2006). In addition, Cardoso *et al.*, (2011) state that some species of birds increase both amplitude and frequency to overcome the disturbance of their signals transmission by the noise.

The increase of noise in the environment led to the tendency of the birds in abandoning their habitat (Francis *et al.*, 2010; Bayne *et al.*, 2008). According to McClure *et al.*, (2013), the extreme noise can cause birds especially migratory species to move away. This indicates that the migratory birds prefers quieter environment that will enable the communication signals to be transmitted well (Rabin *et al.*, 2003).

CONCLUSION

In conclusion, anthropogenic noise does cause impacts on the avian community through the disturbance on their acoustic communication. Although most of the reviewed studies reveal the negative impact of the noise, yet there is also positive relationship of the noise toward the birds. Moreover, other factors have also been identified that cause major impact as compared to the noise. Hence, it is recommended that future studies needed to take into account on other variables, such as vegetation density and vehicle in measuring the degree of impact of noise towards the birds, in order to fill the gap of understanding about the effect of this disturbance that will be very useful for noise management especially in the developing areas.

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