The effect of human-caused noise on birds, with specific reference to the potential impact of blasting on caged exotic birds

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GREENMINDED ENVIRONMENTAL
by

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Executive summary

A literature survey was conducted to determine the potential impact of blasting at the Wansley Quarry near East London (Eastern Cape) on exotic birds located approximately 800 m away.

There are three classes of noise: 1) Continuous (chronic) noise lasts a long time without interruption (*e.g.* urban noise); 2) Impulse noise lasts for a short duration (*e.g.* noise from an explosion); 3) Intermediate or hybrid noise consists of trains of impulses (*e.g.* helicopter rotor noise). Continuous noise and impulse noise differ both in their potential physical effects (*i.e.* hearing damage), and in their sensory-mediated physiological and behavioural effects.

Due to the apparent absence of studies on the impact of impulse noise on caged exotic birds, we have to deduce potential impact scenarios from relevant literature.

The projected features of the impulse noise stimulus from blasting at the Wansley Quarry suggest that there is real potential for a negative impact on the caged birds. However, the nature of this impact is unclear. One of the worst-case scenarios would be if it somehow interfere with breeding, perhaps through failure to find and retain a mate (due to aggressive behaviour?), infertile eggs or neglected eggs/young.

One way to mitigate this would be to limit blasting at the Wansley Quarry as much as possible (especially during the breeding seasons of the birds) and/or deploy noise suppression features (plants?) around the bird enclosures. A complimentary strategy would be for the bird farmer and the management of the quarry to work together on a research project geared towards addressing the current knowledge gap with regards to the impact of impulse noise on caged birds and mitigation strategies.

1 Background

Wansley Quarry has been a trusted suppliers of weathered dolerite in the greater East London area (Eastern Cape) for the past 20 years. To date the mining method entailed removal of the weathered dolerite (gravel) through direct extraction with an excavator. Mining focused on the soft material as blasting was not approved for the mining right approval. Upon excavation of the gravel, a limited stockpile was established as most material was directly loaded onto haul trucks that transported it to the clients. Although Wansley Quarry has been in existence for 20 years, no permanent infrastructure other than the processing plant was established in the mining footprint. The MR Holder submitted an application for consent of the minister to, *inter alia*, add blasting and processing of material to the EMPR. One of the concerns raised was from someone approximately 800 m from the Wansley Quarry who claimed that the blasting could have a negative impact on his exotic bird farming activities. The purpose of this report is to investigate this issue through a brief overview of the relevant scientific literature. Reference to the "caged birds" implies the exotic birds located 800 m from the proposed blasting site.

2 Introduction

One of the earliest studies on the effect of anthropogenic noise on birds was concerned with the potential effects of the, then expanding, civilian and military air bases on poultry production (Stadelman 1958). This study found that daily exposure of chicken eggs in incubators to sound intensities up to 96 dB and 131 dB — using recordings of "background airfield noises, propeller driven aircraft low level flight, or jet planes in low level flight under full power" — had no measurable effect on the hatchability or quality of the chicks produced (Stadelman 1958). That was eggs in incubators, however 11 out of 12 hens exposed to sound intensities of about 115 dB discontinued brooding within 2 hours (Stadelman 1958).

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3 Potential severity of an impact from a noise stimulus

Francis & Barber (2013) proposed a useful framework for understanding noise impacts on wildlife. According to their framework, the potential severity of an impact from a noise

stimulus will depend on the frequency, intensity (*i.e.* loudness or amplitude) and temporal features of the stimulus (Fig. 1). Here we will focus on aspects relevant to the effects of blasting on caged birds.

For a bird to be impacted by blasting 800 m away, it must at least be able to hear/feel it. Modelling of ground vibration and airblast at various distances around the Wansley quarry indicates that at 800 m vibration would be at least 0.56 mm/s, and the airblast will be approximately 110 dB SPL (Sound Pressure Level) (Kohler 2020). Local geological conditions will affect ground vibration levels, and airblast will be affected by prevailing weather conditions (Kohler 2020).

The hearing capabilities of birds varies from one species to the next, but at 110 dB SPL the frequency range of airblast falls well within the hearing range of birds (Dooling 2002). This increases the potential severity of the noise impact (Fig. 1, Frequency). For reference, the human response to airblast has been described as "Strongly perceptible to mildly unpleasant" for values between 90 and 120 dB SPL (Kohler 2020).

The louder the airblast is relative to ambient noise, the greater the potential severity of the noise impact (Fig. 1, Intensity). It is not known what the ambient noise at the site in question is, but it is likely to be substantially lower than the estimated 110 dB SPL of an airblast. This will increase the potential severity of the noise impact. In addition, the ground vibration at 800 m, which will at least be "Distinctly perceptible" to humans (Kohler 2020), will most certainly be felt by birds on the ground as well. This may be particularly important for a bird on a nest.

The proposed blasting activity represent an infrequent (once or twice monthly), sudden (impulse) and unpredictable noise stimuli, attributes which increases the potential severity of the noise impact (Fig. 1, Temporal). Being at the one extreme of a "disturbance-interference continuum", it could be perceived by the birds as a threat, in which case it may trigger a startle/hide responses similar to responses to real predation risk or non-lethal human disturbance (*i.e.* the risk-disturbance hypothesis, which posits that animal responses to human activities are analogous to their responses to real predation risk; see Frid & Dill (2002)).

4 What type of impact?

Collectively, the frequency, intensity and temporal features of the noise stimulus caused by blasting 800 m away indicates that it could potentially have a significant negative impact on the caged birds. However, it is difficult to provide specifics about the nature of this impact, partly because the study of the effect of anthropogenic noise on birds is a relatively new research field (Francis & Blickley 2012; Jerem & Mathews 2020; Shannon *et al.* 2016), and partly because most studies investigate chronic anthropogenic noise such as road and urban noise (Francis & Blickley 2012; Jerem & Mathews 2020; Ortega 2012) — not to

mention the fact that no specific studies on the impact of impulse noise on caged birds was found. As a consequence, statements made about noise is often in reference to chronic noise, and when no clear distinction is made between it and impulse noise — both differ in their potential physical effects (*i.e.* hearing damage), and in their sensory-mediated physiological and behavioural effects (Francis & Barber 2013; Larkin 2005) — it can be confusing. For example, in their review on how and why "environmental noise" impact animals, Kight & Swaddle (2011) examined the effects of noise on the neuroendocrine system, reproduction and development, metabolism, cardiovascular health, cognition and sleep, audition, the immune system, and DNA integrity and gene expression. However, it would take some effort to determine which parts refer to chronic noise and which parts refer to impulse noise. That kind of analysis is beyond the scope of the present report. We will illustrate potential outcome scenarios by way of relevant impulse noise examples for the literature.

It is unlikely that the blasting will cause permanent or temporary hearing loss in the caged birds as this might only occur when a bird is extremely close to the source of the noise (Dooling & Popper 2007). In addition, it is unlikely that it would have a negative impact on fertile eggs and the embryos therein because not even sonic booms can break bird eggs or reduce the hatchability of the embryos (Bowles *et al.* 1991; Bowles *et al.* 1994; Ting *et al.* 2002; See also Stadelman 1958). Instead, the airblast may have its greatest influence on the behaviour of the birds, which then translates into fitness costs (Francis & Barber 2013).

Studies on impulse noise predominantly involve low-level passes by jet aircraft and sonic boom. For example:

- Holthuijzen *et al.* (2002) investigated the effects of aircraft noise on Peregrine Falcons (*Falco peregrinus*) in Alaska. They concluded that inexperienced pairs prospecting for nesting territories in marginal habitats may, upon disturbance, abandon nesting attempts before or shortly after eggs are laid. On the other hand, jet aircraft appear to have little or no effect on nesting success or productivity of established pairs with long histories of breeding at traditional territories (Holthuijzen *et al.* 2002).

- In the study by Goudie & Jones (2004), the initial responses of Harlequin Ducks (*Histrionicus histrionicus*) to low-level passes (30--100 m above ground level) by military jets was alert behaviour (generally <1 minute) that was especially intensified when noise exceeded 80 dBA. Subsequently, deviations from normal behaviour patterns included decreased courtship behaviour for up to 1.5 hours after, and increased intraspecific aggressive behaviour for up to 2 hours after military jet over-flights.

Only a few studies involving blasting was located:

- Holthuijzen *et al.* (1990) investigated the response of Prairie Falcons (*Falco mexicanus*) to ongoing construction blasting and experimental charges placed at fixed

distances from nest sites not normally exposed to blasting at such distances. Unfortunately, there are several methodological issues which make it difficult to draw firm conclusions from this study (see Larkin 2005).

- Bednarz (1984) conducted a correlational study of three comparable isolated mountain ranges in New Mexico, one of which has been intensively impacted by mining operations (including blasting) and associated human intrusions for several years. During surveys at each mountain in 1980, he found Prairie Falcon (*Falco mexicanus*) nests at two of the mountains, and none at the one with mining operations.

5 Discussion

In the apparent absence of studies on the impact of impulse noise on caged exotic birds, we have to deduce potential impact scenarios from relevant literature such as those mentioned above.

The projected features of the impulse noise stimulus from blasting at the Wansley Quarry suggest that there is real potential for a negative impact on the caged birds (Fig. 1). However, the nature of this impact is unclear. One of the worst-case scenarios would be if it somehow interfere with breeding, perhaps through failure to find and retain a mate (due to aggressive behaviour?), infertile eggs or neglected eggs/young.

One way to mitigate this would be to limit blasting at the Wansley Quarry as much as possible (especially during the breeding seasons of the birds) and/or deploy noise suppression features (plants?) around the bird enclosures.

A complimentary strategy would be for the bird farmer and the management of the quarry to work together on a research project addressing the current knowledge gap with regards to the impact of impulse noise on caged birds.

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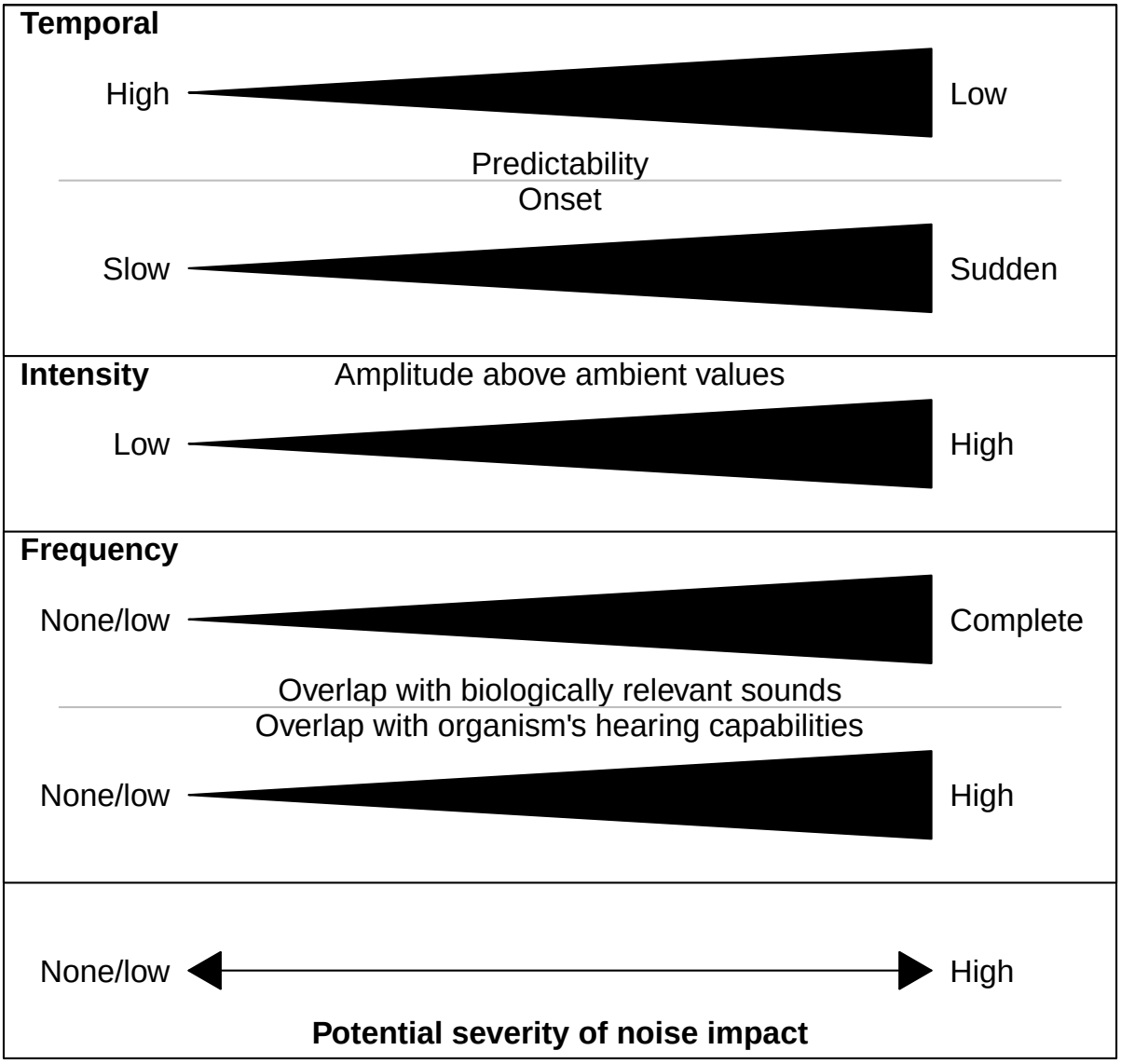

Figure 1: The potential severity of a noise impact from a noise stimulus will depend on the temporal, intensity, and frequency features of the stimulus. Adapted from Figure 2b in Francis & Barber (2013).