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Anthropogenic noise in Antarctic terrestrial environments

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Information Paper submitted by SCAR

Summary

Anthropogenic noise resulting from human activities can have detrimental effects on both Antarctic wildlife and wilderness and aesthetic values. This paper provides information on sources, methods of monitoring and wildlife impacts of terrestrial anthropogenic noise, which is an emerging area of Antarctic research¹.

Background

Anthropogenic noise is a common by-product of human activities, and its effects on wildlife and ecosystem function have been reported worldwide. A substantial body of research exists concerning noise from anthropogenic sources in the marine environment, including issues such as sources and levels of anthropogenic underwater noise, and the potential for interactions and impacts on Antarctic marine wildlife. Much of the relevant research has been presented to the Committee previously (ATCM XXVI WP 34, ATCM XXX IP 80, ATCM XLII WP 68, ATCM XLII IP 31, ATCM XLIV IP 38). In contrast, less attention has been given to the specific effects of terrestrial anthropogenic noise on Antarctic environmental, scientific, wilderness and aesthetic values (ATCM XL WP20; ATCM XXVII WP10; ATCM XXXVI WP35). For example, little is known about the short- or longer-term impacts of terrestrial noise on flying birds, penguins and seals, or how the potential effects of noise on penguins and seals differs between marine and terrestrial environments.

The topic of anthropogenic noise in terrestrial environments is of relevance to several CEP priority issues as set out in the CEP Five-Year Work Plan, including:

- ‘Tourism and NGO activities’ (Priority 1)
- ‘Monitoring and state of the environment reporting’ (Priority 2); and
- ‘Implementing and improving the EIA provisions of Annex I’ (Priority 2).

The aim of this Information Paper is to bring to the attention of the Committee the emerging issue of terrestrial noise derived from human activities as a potential source of impact on Antarctic wildlife and intrinsic values. This paper also highlights the fact that acoustic monitoring could be integrated into the set of environmental monitoring and assessment tools in Antarctica, as it can provide information on species, ecosystems health, and human intervention impacts.

Anthropogenic noise in terrestrial Antarctica: sources and potential impacts

The ‘soundscape’ is composed of all the sounds present in a landscape. Sounds from animals and from non-biological sources such as wind or rain are the most notable components of soundscapes in terrestrial natural environments. Urban areas are more characterized by sounds

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produced by humans, which are called anthrophonies. However, there is increasing evidence that humans have an acoustic footprint that extends beyond those areas subject to direct human activity.

Sources

Human activities are almost always accompanied by noise, which may propagate to areas well beyond the line of sight of the sound source. Terrestrial environments may be subject to potentially uncontrolled and unpredictable sources of noise. Furthermore, even if anthropogenic sources of noise tend to be concentrated around human settlements, human-generated noise can travel beyond settlement boundaries into natural areas.

In Antarctica, the main sources of terrestrial anthropogenic noise are from aircraft, vessels, land vehicles, and diesel generators. Other sources of noise include construction and repair work, and some types of scientific activities such as coring or drilling. Sound sources may vary in duration and intensity (power or volume) and may range from, e.g., transient-low intensity to continuous-high intensity sounds.

Impacts

Depending on their intensity, spectral frequency and duration, different sounds may provoke varying responses and effects on wildlife. Empirical data on the effects of noise on wildlife in terrestrial and aquatic environments elsewhere in the world show that these manifest on different levels, with varying degrees of severity. Responses are frequently behavioural, or noise may affect behavioural patterns. However, animal responses to noise exposure can also be physiological, with existing research reporting impacts such as hearing loss, elevated stress hormones and hypertension (reviewed in Shannon *et al.* 2016). It is worth highlighting that physiological responses can be cryptic, i.e., there may be no external (visible) effects on wildlife.

In extreme cases, animal deaths have been caused indirectly by human noise. One such example concerns a mass mortality of penguins on sub-Antarctic Macquarie Island after a stampede, the most probable cause of which has been attributed to an overflight of a large aircraft near the bird colony (Rounsevell and Binns 1991, as cited in Harris, 2005). Although not representative of the most common effects on wildlife, this incident highlights that some types of noise could have substantial negative impacts on Antarctic wildlife and intrinsic values.

As reported for protected areas in other parts of the world, noise can travel into Antarctic Specially Protected Areas (ASPAs) and Historic Sites and Monuments (HSMs), and could impact upon the values under protection, including wilderness and aesthetic values. While some attention has been paid to the visual impact of the placement of man-made objects and structures on Antarctic wilderness and aesthetic values, the impacts of noise have been less considered, leaving scope for further research. A preliminary systematic mapping analysis on noise in terrestrial ecosystems in Antarctica (Acosta 2021) identified less than 10 scientific articles mentioning terrestrial anthropogenic noise as important issue to be considered when assessing impacts of human activities.

Monitoring anthropogenic noise in Antarctica

Technological advances in passive acoustic monitoring coupled with the on-site provision of power from renewable sources, allow for the gathering of detailed information with little need for on-going human attention. Once the data are collected, powerful software and algorithms enable researchers to analyse often large audio datasets.

Noise in terrestrial environments has received little attention from the scientific community; however, since 2020, an ongoing project undertaken by researchers from Uruguay has monitored the structure of the acoustic landscapes on Fildes Peninsula and the incidence of

sources of noise from human activities. Fildes Peninsula is a logistic hub on the South Shetland Islands, Antarctic Peninsula, which is used for scientific, logistic and touristic purposes. The project relies on the use of passive acoustic recording units to gather hourly acoustic data at sites across Fildes Peninsula throughout the Antarctic summer (Nov-Dec to Mar-Apr). Monitored sites were chosen to represent the diversity of landscapes and attributes/uses of Fildes Peninsula, and include the surroundings of scientific bases, main connecting roads, ASPAs and remote/isolated sites without nearby human settlements. Results obtained in this area could be useful to understand potential noise sources and characteristics in other geographic areas of human activity in Antarctica.

Conclusions

To help Parties in their management of anthropogenic noise in the Antarctic terrestrial environment, further research is required, including the identification of noise sources, their spectral and temporal characteristics, their daily and year-around patterns and their location and cumulative impacts. Research concerning short and longer-term impacts of noise upon wildlife is also needed, preferably using standardised methodologies and experimental approaches in order to have comparable results across sites and species. Such research may help inform the management of terrestrial anthropogenic noise, including through the environmental impact assessment process and the development of management plans for protected areas (particularly those near areas with high levels of human activity). Furthermore, acoustic monitoring could be incorporated as a tool to provide information on wildlife, ecosystem structure and function, and human interventions, contributing to regular environmental monitoring in Antarctica.

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