Time-lapse camera monitoring of species in the Antarctic Treaty area

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**Information Paper submitted by the United Kingdom**

Summary

The United Kingdom presents a summary of remote camera monitoring in the Antarctic Treaty Area and workflows for raw data processing into policy-ready summaries.

***Background***

Many of the species in decline around the world are subject to different environmental stressors across their range, so large-scale monitoring programmes, with replication of sites, are necessary to disentangle the relative impacts of these stressors. This is certainly true of the Antarctic Treaty area, where threats overlap, particularly on the Antarctic Peninsula.

For those sites where a single vantage point can be used to observe individuals or ecological processes, time-lapse cameras can provide a cost-effective way of collecting time series data. This can be replicated at variable spatial scales that would otherwise be impossible with conventional monitoring approaches. Such targets include penguin and shag colonies, seal breeding beaches, fine scale sea-ice monitoring and glacial monitoring sites.

Networks of time-lapse cameras covering such a range of species or processes creates a problem in that the scale of data collection generates a significant overhead for processing the raw imagery. Citizen science and machine learning provide solutions to scaling data extraction and analysis (such as locating all animals in an image). Within Antarctica, several such citizen science projects now exist including [Penguin Watch](http://www.penguinwatch.org/), [Happy Whale](https://happywhale.com/), [Weddell Seal Count](https://www.zooniverse.org/projects/slg0808/weddell-seal-count), and Seal Watch (launching soon).

***Camera Networks***

Camera networks are now employed (for example) by the Australian Antarctic Division, Antarctica New Zealand and by members of the [CEMP camera network](https://www.ccamlr.org/en/wg-emm-17/16-rev-1).

A UK camera network, currently running out of Oxford University, operates and maintains 95 cameras located on terrestrial sites around the coastline of the Southern Ocean, with 60 sites in the Antarctic Treaty area. Each camera captures images once per hour during daylight hours year-round. Data collection from such networks is now routine, with the network’s ability to collect data far outstripping its ability to process all the useful information from it.

***Steps for effective camera monitoring***

*Data collection:* A number of camera networks have now been established following the pioneering work of the Australian Antarctic Division1,2, meaning that the data collection step is now routinely used, although opportunities exist to increase data collection. However, no standard repository for such high volume data exists and may be necessary for continent-wide studies.

*Processing:* Three possibilities exist; researcher-extraction3, citizen science4, computer vision5 – or a combination of all three6. The ability of existing computer vision tools to identify penguins should in turn encourage researchers to be much bolder in their data collection.

*Analysis:* Methods of analysis are highly dependent upon individual research questions, from mark recapture to movement analysis7. Many parameter estimates, such as first arrival, will not be consistent between studies and will require standard definitions to allow consistent long-term monitoring between sites, some of which have already been proposed3. Open access data are available4,6 that will enable the further development of such standard measures and cross-validation of studies.

*Interpretation:* To be useful at the continental scale, there is a need for a general repository of sites, metadata and summary data.

***Conclusion***

The processes to enable mass processing of image data are well-developed, at least for most Antarctic penguin species, and there is substantial progress in the development of equivalent processes for seals and other seabirds. There is also scope for much more data to be collected on traditionally sensitive and hard to monitor species such as shags. Additionally, the frequency of monitoring could be increased so that environmentally sensitive behaviour could be monitored.

***Cited Literature***

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