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Managing threats to Antarctic terrestrial biodiversity

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Information Paper submitted by Australia, Belgium, France, Japan, New Zealand, Norway, Spain, United Kingdom, United States, SCAR, ASOC, IAATO

Summary

Recent research published in *PLOS Biology* by Lee et al. (2022), on strategies for managing threats to Antarctic terrestrial biodiversity, found that an estimated 65% of terrestrial species groups and land-associated seabirds are likely to decline by 2100 under current trajectories. In assessing the benefits of several possible threat management strategies, it found that influencing global policy to effectively mitigate climate change would deliver the greatest benefits, while a range of actions to minimise threats from activities within the Antarctic region would also be highly beneficial. The study concluded that simultaneously pursuing global and regional efforts would provide the best chance of protecting Antarctica's terrestrial biodiversity into the future. These findings are relevant to the Committee's work on several priority issues, including to maintain awareness of threats to biodiversity, and to prepare for, and build resilience to the environmental impacts of a changing climate.

Background

There is substantial information available to the CEP on threats to Antarctic terrestrial ecosystems, such as non-native species, pollution, human activities, and climate change. However, as identified in the CEP Five-Year Work Plan and Climate Change Response Work Program (CCRWP), there is a need for greater understanding of how vulnerable terrestrial species are to such threats. For example, science, knowledge and information needs identified in the Five-Year Work Plan include to 'improve understanding of current and future changes to the terrestrial biotic and abiotic environment due to climate change', as well as to 'understand population status, trends, vulnerability and distribution of key Antarctic species'. A recent publication in the journal *PLOS Biology* by Lee et al. (2022) on 'Threat management priorities for conserving Antarctic biodiversity' assesses the vulnerability of Antarctic terrestrial species to multiple threats. This paper summarises the research and key findings likely to be of interest to the CEP.

Research approach

The study used a participatory decision-science approach that incorporated expert knowledge and available empirical data, involving 29 diverse experts from 12 countries. Each expert had comprehensive knowledge of at least one of the following: biodiversity, policymaking, logistics, tourism, or conservation.

Terrestrial species were considered in 38 groups, representing species expected to respond similarly to threats and management actions. Experts in each species group assessed the future (2100) status of that group compared to the current (2017) status under existing management mechanisms and under two Intergovernmental Panel on Climate Change (IPCC) Representative Concentration Pathway (RCP) climate forcing scenarios (RCP4.5 and RCP8.5). They then assessed the future status of each group when applying 13 management strategies that could be undertaken by the Antarctic community (Table 1), each of which consisted of a number of independent actions[1] to meet the strategy's objectives. The difference between the current and future status gave the benefit of each strategy for each group.

[1] See supplementary materials – S1 Data.

Key findings

The study estimated that 65% of the species groups (at best 37%, at worst 97%) are likely to decline by 2100 under current management efforts and climate trajectories, with the degree of decline varying for each group (see Figure 1). Groups of highly adapted, endemic species (e.g. emperor penguins, Adélie penguins and dry soil nematodes) were identified as the most vulnerable, with emperor penguins being the only group at risk of extinction by 2100.

Some groups, such as bank-forming moss and the two native vascular plants (*Colobanthus quitensis* and *Deschampsia antarctica*) were predicted to benefit from climate change, and may expand their populations or ranges, at least initially. Gentoo penguins were the only land-associated seabird predicted to benefit from climate change. The study noted these species would not continue expanding indefinitely and the longer-term impacts of environmental change for all species remained uncertain and complex.

The study found implementing ten key management strategies in parallel could benefit up to 84% of species groups. Influencing global policy to effectively mitigate climate change would provide the highest benefit to all groups, while minimising threats from activities within the Antarctic region is also highly beneficial, including managing non-native species and disease, managing and protecting species, and managing transport and new infrastructure (see Figure 2).

Conclusions

This research is relevant to the Committee's work on several priority issues, including to 'maintain awareness of threats to existing biodiversity', and to 'prepare for, and build resilience to the environmental impacts of a changing climate' through implementation and review of the CCRWP. It is also likely to be valuable for work in other priority areas, including management of non-native species, tourism and non-governmental activities, and repair or remediation of environmental damage, as well as discussions on reviewing the Committee's strategic priorities and associated actions. Consistent with ATCM Resolution 8 (2021) on Antarctica in a Changing Climate, the findings reaffirm the importance of simultaneously pursuing global and regional efforts to protect Antarctica's terrestrial biodiversity into the future

References

Lee J.R., Terauds A., Carwardine J., Shaw J.D., Fuller R.A., Possingham H.P., Chown S.L., Convey, P., Gilbert, N., Hughes, K.A., McIvor, E., Robinson, S.A., Ropert-Coudert, Y., Bergstrom, D.M., Biersma, E.M., Christian, C., Cowan, D.A., Frenot, Y., Jenouvrier, S., Kelley, L., Lee, M.J., Lynch, H., Njåstad, B., Quesada, A., Roura, R., Shaw, E.A., Stanwell-Smith, D., Tsujimoto, M., Wall, D.H., Wilmotte, A., Chadès, I. (2022) Threat management priorities for conserving Antarctic biodiversity. *PLOS Biology* 20(12):e3001921. doi:10.1371/journal.pbio.3001921

The actions underlying each of the management strategies are available on the journal website in the supplementary material (S1 Data).

The intactness values representing how vulnerable species groups are, and how much each management strategy benefits them, are publicly available for download from the Australian Antarctic Data Centre: https://doi.org/10.26179/5da8f8e7a2256

Table 1. Overview of proposed strategies for managing threats to terrestrial Antarctic biodiversity. Shorthand strategy names are given in brackets. ‘Current’ refers to the state of the Antarctic environment and associated management actions in 2017. Grey shading identifies global strategies or a combination of regional and global strategies. More details on each strategy are provided in S1 Data.

Strategy Name	**Objectives and details**
Business as usual *(Baseline)*	*Continue with actions and strategies currently in use, but neither expand on these strategies nor employ new strategies*. Baseline against which to measure other strategies.
Remediation *(Remediate)*	*Increase amount of, or improve, quality of habitat available to biodiversity in comparison to habitat currently available*. By remediating 20 environmentally damaged (physically, chemically, biologically) sites (including freshwater) that will provide the greatest benefit to biodiversity, including remediation of legacy waste sites if necessary.
Manage existing infrastructure *(Exist infra.)*	*Reduce and minimise impacts of existing infrastructure compared to current levels.*
Manage new infrastructure *(New infra.)*	*Prevent, reduce and minimise impacts of new infrastructure.*
Transport management *(Transport)*	*Reduce and minimise impacts of transport compared to current levels.*
Manage non-native species and disease *(Non-native)*	*Reduce impacts of non-native species and disease on native biodiversity.* Where possible prevent establishment of new populations of non-native species. Eradicate or, if not possible, minimise impacts of established non-native species.
Protect vegetation from physical impacts *(Protect vegetation)*	*Reduce physical impacts of human activities and native vertebrate activities on vegetation*. Halt the decline (or loss) of vegetation and associated species due to direct physical damage/impact at key sites in the Antarctic Peninsula (e.g. animal damage).
Protecting areas *(Protecting areas)*	*Reduce impacts of human activities on biodiversity by increasing the amount and representation of habitat in protected areas.* Develop the Antarctic Specially Protected Area (ASPA) system to improve representation of the values specified in the Environmental Protocol and ensure the network incorporates contemporary systematic conservation planning pillars.
Managing and protecting species *(Protecting species)*	*Reduce threatening impacts on taxonomic groups identified as threatened by 2100*. 1. Identify and protect threatened species (assume 10 - 15 species to be identified and listed under this strategy) 2. Prevent extinction of native species in-situ.
Minimise impacts of human activity *(Human activities)*	*Prevent and minimise physical impacts on biodiversity and habitats compared to current levels that stem from human activities in Antarctica (e.g. fieldwork, tourism, station activities)*. Relevant where improving education and training, and implementing standard practices, on-ground operating procedures and compliance is likely to reduce impacts through changes in human behaviour.
Influence external policy *(Influence ext. policy)*	*Minimise or reduce impacts of threats (primarily climate change) on Antarctic biodiversity that originate externally via engagement with appropriate policy bodies and raising public awareness.* **Note:** Outcome of strategy is an assumption that the Paris Climate Agreement of <2 °C warming is achieved. Use RCP2.6 instead of 4.5/8.5.
All strategies excluding ‘influence external policy’ *(All strats. excl IEP)*	All management strategies combined except ‘Influence external policy’.
All strategies combined *(All strategies)*	All management strategies combined.

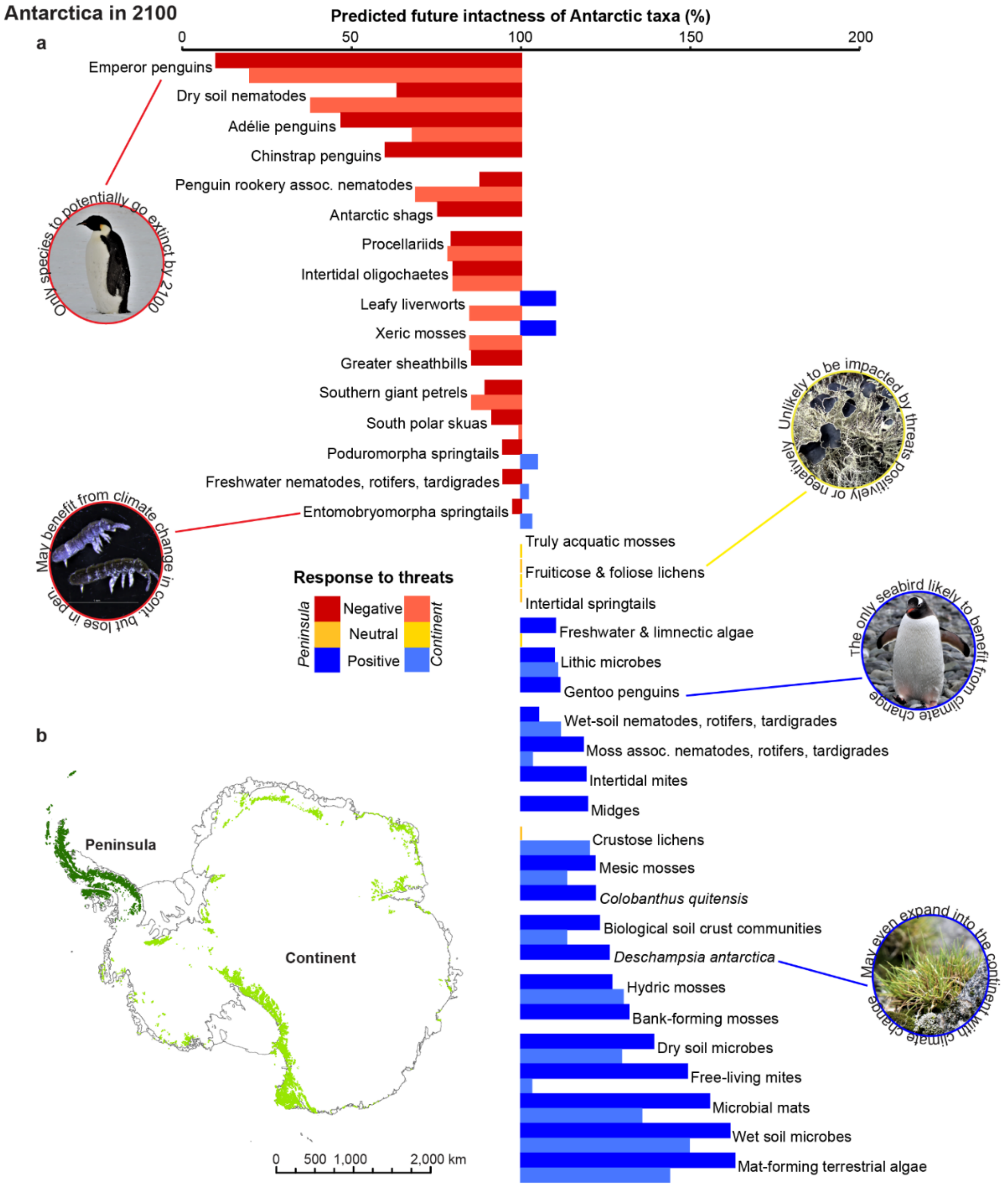

Figure 1.a. Regional vulnerability of terrestrial Antarctica biodiversity groups to all potential threats under climate forcing scenario RCP8.5. Colours represent each species group's expected response (positive, neutral, negative) to threats, with darker/lighter shadings denoting the regional delineation as peninsula or continent, respectively. Bars represent experts' best estimate of the future status of each group relative to current (100%) status if no additional conservation strategies are implemented. Groups with values below 100% are predicted to be vulnerable, whilst groups with values beyond 100% are predicted to benefit. **b.** The two main Antarctic regions considered in the study.

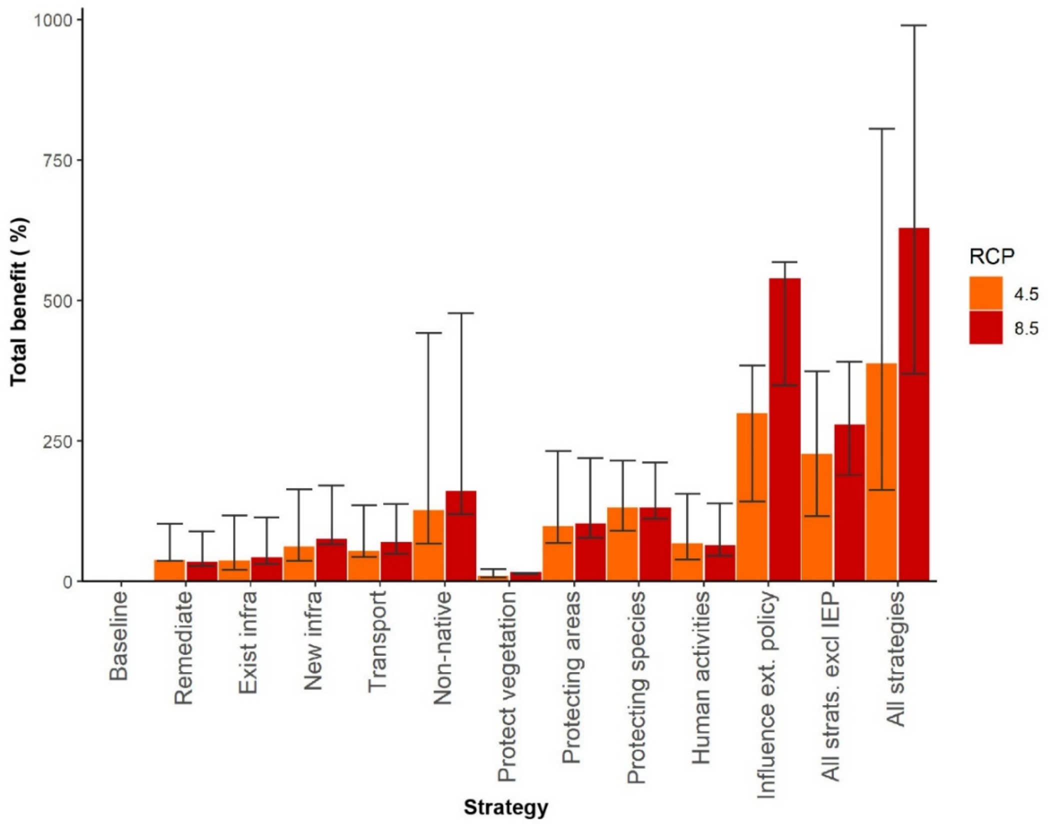

Figure 2. Total expected benefit of management strategies summed for all species groups and both regions under two climate forcing scenarios (RCP4.5, RCP8.5). Bars represent the experts' best estimates when assessing benefit, whilst error bars represent upper (best case scenario) and lower (worst case scenario) bounds.