National Environmental Research Program

LANDSCAPES & POLICY *hub*

Relic bog with fen. Pretty Valley, Bogong High Plains, Victoria.
Image: Regina Magierowski

Alpine bogs: locating communities most at risk

More than 11,000 bogs in Australia's alpine bioregion rely on the good supply of water either from groundwater sources or drainage catchments.

The bogs are facing multiple threats from the impacts of climate change, particularly more frequent and more intense fires and higher rates of water loss as a result of increasing temperatures.

Domestic livestock; feral horses, deer and pigs; and invasive plants all threaten the ecological condition of alpine bogs by disturbing vegetation and drainage.

We have developed a tool for alps managers to map the location of alpine bogs most likely to be affected by current and future threats.

Research summary

Australia's alpine bogs face multiple threats that will be compounded by the impacts of climate change. Bog communities rely on ground and surface water and are found alongside streams, on valley floors and waterlogged slopes. A key feature of alpine bogs is *Sphagnum* moss, which can hold up to 20 times its weight in water.

Rising air temperatures and reduced daily rainfall lead to higher rates of water loss and increased frequency of fires. These factors also influence the spread of feral animals and invasive plants, which are already having a negative impact on alpine bogs.

We have developed a tool for locating those bogs likely to be most affected by these multiple threats. Alps managers can use the tool to prioritise action based on vulnerability to the greatest number of threats.

The alpine bogs and associated fens community

The Alpine Sphagnum Bogs and Associated Fens ecological community is of high conservation significance. It is listed under the *Environmental Protection and Biodiversity Conservation Act 1999*. The ecological community includes threatened flora and provides habitat for endemic and threatened fauna species. Bogs and fens occur throughout the Australian Alps Bioregion, which stretches from the western margins of the Australian Capital Territory and southern New South Wales to Mount Baw Baw in Victoria. Examples of the listed community can also be found outside of the Australian Alps Bioregion, including in Tasmania.

Bogs can be identified by the presence of layers of organic peat soils in varying stages of decay. The peat is overlain by *Sphagnum* moss, the rush *Empodisma minus* and shrub species such as *Richea continentis* and *Baeckea gunniana*, and often *Carex* sedges. Fens are characterised by a dominance of sedges and occur in areas that are more often saturated by groundwater.

Each ecological community varies between regions, altitude, geology, topography, water availability and past influences such as stock grazing and fire.

Peat is crucial for alpine bogs

The forming of peat is a key feature of bogs and fens. Peat is decomposed plant material that has accumulated over thousands of years because of waterlogged conditions. The depth and rate of decay of peat has a large influence on the water holding capacity and therefore a large influence on the plant community at the surface of bogs.

Once peat is lost, it is difficult to restore because of the time required for it to form and the climatic conditions it requires. Peats that have been disturbed can take many decades to restore water-holding capacity.

Threats to alpine bogs

The Australian Alps Bioregion covers approximately 12,000 km^2, and is mostly higher than 1000 metres above sea level. More than 11,000 individual bogs have been mapped in the bioregion. These plant communities face a number of threats:

- More frequent intense mega fires. Much of the bioregion has been burnt during the past 10–15 years, some areas up to three times.
- Less favourable climatic conditions for bog flora to grow and peat to accumulate.
- Increasing numbers of feral horses, deer and pigs, which disturb vegetation, peat and water movement. Trampling by feral animals reduces the ability of bogs to hold water, leading to increased flows during spring, which causes erosion and scouring of riverbeds.
- Invasive plants which displace native bog species and influence water loss and water movement.

Challenges for alps managers

Cumulative effect of multiple threats

Alps managers need to be able to determine where threats are likely to occur and how these threats may interact and possibly result in far greater impacts. For example:

- More frequent, intense mega fires can burn vegetation and peat layers, which will reduce the water-holding capacity of the bogs and limit their ability to withstand other impacts.
- Changes in rainfall patterns and fire are likely to increase the area suitable for pest animals and plants.

A lack of accessible data

Australia has four jurisdictions responsible for managing alpine areas. While these agencies have mapped, classified and assessed alpine bogs for management purposes, it has not been possible to use this data to assess vulnerability across the whole alps because:

- There are more than 11,000 bogs, most remote and less than one hectare in size, making physical assessment impossible.
- Vulnerability is usually determined by visual assessment which is impractical and potentially damaging for peat.
- Vegetation classification, mapping systems and datasets are not consistent across the different state and territory jurisdictions.
- Broad-scale information on groundwater flows and recharge is not available.

How to locate the most vulnerable communities

Spatial multi-criteria analysis is a method for integrating a range of spatial data that can be used to explore the current and future threats to alpine bogs.

MCAS-S (Multi-Criteria Analysis Shell for Spatial Decision Support) is a free decision-support tool designed by the Australian Bureau of Agricultural and Resource Economics and Sciences for use in workshop situations when data is incomplete and decisions need to be made by consensus.

MCAS-S comes with different 'datapacks'. A datapack consists of spatial data and a guide to combining the data to support decision-making.

We have collated datasets on alpine bogs from across jurisdictions into the Alpine Bogs MCAS-S Datapack. This can be used to identify where multiple threats coincide with those alpine bogs most vulnerable to their impacts.

The MCAS–S Datapack includes two types of variables (layers):

Threats

Those variables with the potential to directly impact the ecology of alpine bogs:

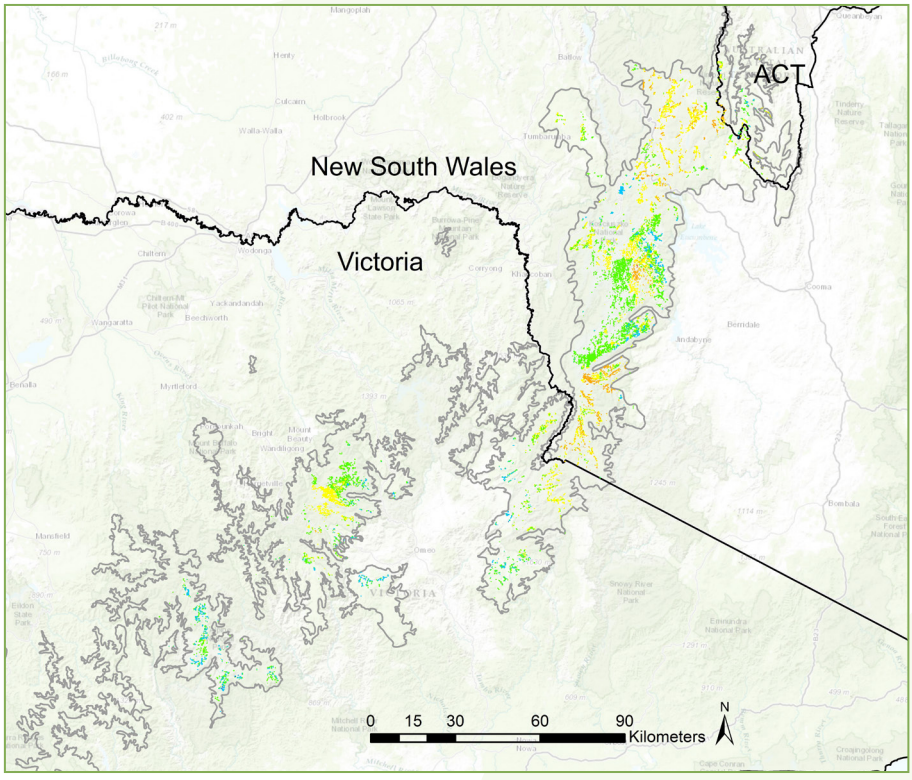
- projected change in solar radiation
- projected change in daily rainfall
- projected change in maximum summer temperature
- land use
- habitat suitability for horses
- invasive plants such as willows and hawkweed
- feral animals such as pigs, deer and foxes

Vulnerability

Those variables with the potential to affect the vulnerability of alpine bogs to threats:

- groundwater flows
- fire history
- flammability of bog vegetation
- palatability to feral animals.

Threat Levels to Alpine Bogs in the Australian Alps



Threat coincidence: Variability in inferred threat levels to bogs across the Australian Alps Bioregion. Threat level from low to very high: blue, green, yellow, orange and red.

Source: Base data from Department of the Environment and ESRI (© OpenStreetMap contributors, and the GIS User Community)

Where to from here?

Combining spatial data on threats and vulnerabilities using MCAS-S enables alps managers to infer the levels of threat to bogs across the Australian Alps Bioregion.

The Landscapes and Policy Hub has produced additional data layers for the Australian Alps. These are contained within other MCAS-S datapacks, for example, the Australian Alps Icons and Threats MCAS-S datapack and are compatible with the Alpine Bogs Datapack. Alps managers can therefore mix and match data layers to perform their own queries.

Who are the researchers?

Dr Regina Magierowski

Reg is a freshwater ecologist at the University of Tasmania. Her research focuses on understanding patterns and processes in aquatic ecosystems to better understand the influence of humans on aquatic ecosystem health.

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Anita is a plant ecologist who specialises in alpine and wetland ecosystem monitoring, conservation and restoration. She works with land managers to understand ecosystem resilience, risk prioritisation and on ground mitigation activities.

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Collaborators

The Australian Alps national parks Cooperative Management Program helped fund the research.

Further reading

Magierowski RH, Wild A, Anderson G, Gaynor SM, Lefroy EC & Davies PE (2015) *MCAS-S Datapack for Alpine Bogs of the Australian Alps Bioregion: A worked example using the MCAS-S tool to map the coincidence of threats in the Australian Alps.* Landscapes and Policy Hub. University of Tasmania.

Porfirio LL, Hugh S, Carter L & Mackey B (2014) *MCAS-S Datapack for the Australian Alps Icons and Threats: a worked example using the MCAS-S tool to map the coincidence of landscape icons and threats in the Australian Alps.* Landscapes and Policy Hub, Hobart, Tasmania.

About the NERP Landscapes and Policy Hub

The Landscapes and Policy Hub is one of five research hubs funded by the National Environmental Research Program (NERP) for four years (2011–2014) to study biodiversity conservation.

We integrate ecology and social science to provide guidance for policymakers on planning and managing biodiversity at a regional scale. We develop tools, techniques and policy options to integrate biodiversity into regional-scale planning.

The University of Tasmania hosts the hub.

www.nerplandscapes.edu.au

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