Post-fire Rehabilitation of Tasmanian *Sphagnum* Mires

Decision Support Tool

2023

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Photo by Scott Nichols

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Importance of *Sphagnum* Mires

Sphagnum mires occur in small, permanently wet areas in high rainfall alpine and mountainous regions. Despite the small area they occupy, alpine *Sphagnum* mires play many important roles including:

- Maintaining catchment hydrology and water quality
- Preventing erosion
- Supporting various endemic species that require year-round moisture

Sphagnum is considered particularly vulnerable to the effects of fire which are expected to become more frequent in the future due to climate change. This document outlines a promising intervention for encouraging post-fire recovery of *Sphagnum* mires in Australia.

Developing a map of current *Sphagnum* distribution in Tasmania will help determine where they are in future fire events.

1 Identify where *Sphagnum* mires are on fire ground

Required immediately after fire occurs

Methods

- Aerial surveys
- Past vegetation mapping
- Satellite imagery
- Ground survey as appropriate

2 Identify area of *Sphagnum* burnt[1,2]

Required in same growing season as fire occurs

Small areas

Field traverse and off the shelf drone

Large areas

Detailed drone mapping using GPS systems

OR

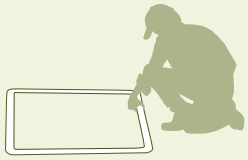
High-resolution satellite imagery

3 Burn classification[3]

Visual assessment
(See page 8 for example images)

Determine percentage of healthy, damaged and killed *Sphagnum* in field based on:

- Colour
- Structure
- Moisture content



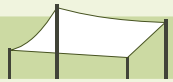
Percentage of *Sphagnum* killed?

- <75% → **Moderate severity**
- ≥75% → **High severity**
  No recovery expected*

Initiate post-fire intervention - likely to minimise further damage and promote recovery

4 Post-fire recovery - interventions[3]

Shadecloth



To determine whether location is appropriate, consider resources required to install, maintain and later remove shade

- Increases rate of post-fire recovery
- Cover moderately damaged *Sphagnum* with shadecloth
- Monitor and maintain shadecloth

Transplants

Problematic demand on donor material for large scale

Fertiliser

Adversely affects *Sphagnum* recovery

$ Budget and resources

- UAS survey, image processing, logistics, resourcing
  $10,000 (approximate cost per ha)
- Field validation resourcing, skilled labour, equipment (RTK GPS)
  3-5 days fieldwork
- Intervention - shadecloth materials, pins/stakes, labour (3+ persons), logistics (helicopter drops)
- Monitoring and removal of shadecloths

* Research required to devise ways to restore severely burned *Sphagnum*. Options: hydrological interventions and propagation and planting of *Sphagnum*

[1] Research required to automate. See Harding et al., 2022 for further details

[2] Nichols et al., 2022

[3] Prior et al., 2022

Photo credit: Scott Nichols

Sphagnum mires

Listed as rare in Tasmania[4], alpine *Sphagnum* bogs and associated fens, collectively termed mires, occupy an estimated 3,100 ha across the state, found primarily in the Tasmanian Central Highlands and Tasmanian Southern Ranges bioregions (Figure 1).

Healthy *Sphagnum* mire

Photo by Scott Nichols

Figure 1

Sphagnum mire locations in Tasmania, indicated by yellow dots. Locations are indicative, not reliable at a fine scale. Locations derived from TasVeg 4.0 category ASP *Sphagnum* Peatland, produced by DPIPWE Tasmania.

Image: Grant Williamson

1

Required immediately after fire occurs

Identify where *Sphagnum* mires occur[1,2]

Aerial surveys of burned areas are an effective way to identify *Sphagnum* mires. The surveys can be specially commissioned campaigns to acquire high resolution multispectral imagery and lidar data; simpler aerial reconnaissance of large areas; or localised surveys, ideally using drones (Unoccupied Aerial Vehicles or UAVs) with high resolution, precisely georeferenced image acquisition but off-the-shelf drones are also appropriate. All aerial surveys require field validation.

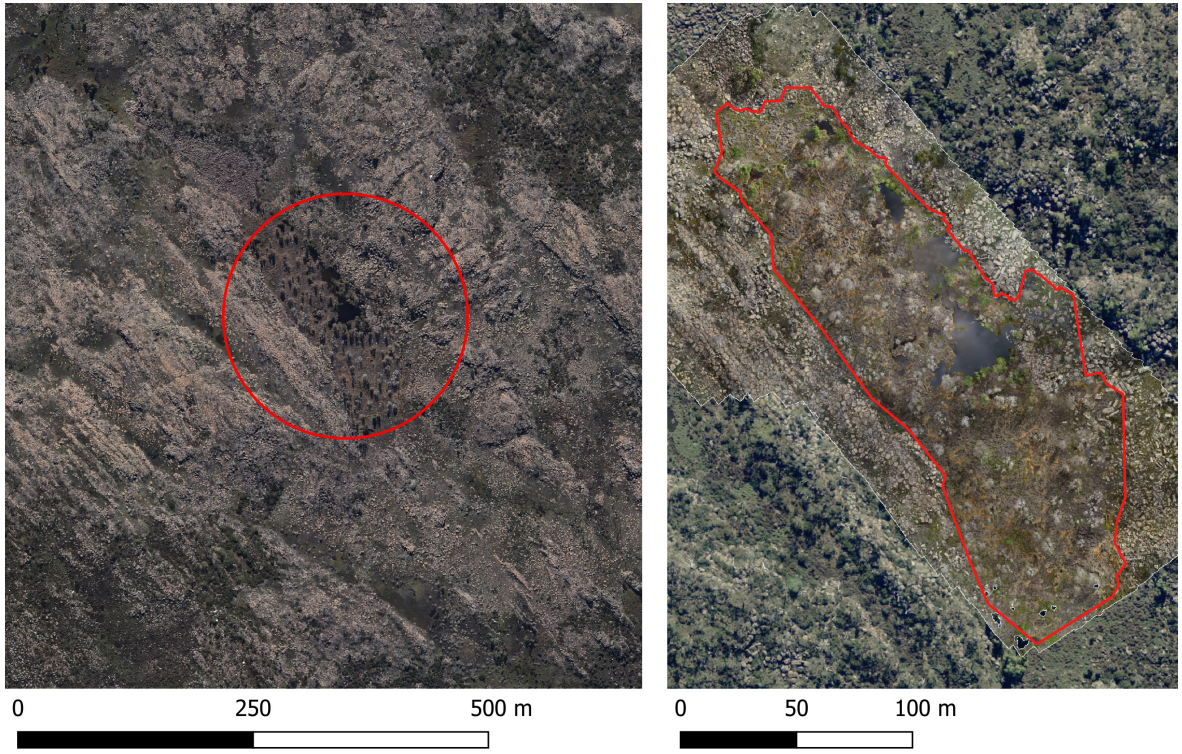


Figure 2

(left) Aerial photo centred on the Eagle Valley mire, and (right) drone image showing the mire at higher resolution. Figures 3 and 4 show burn severity classifications of this mire.

Image: Grant Williamson and Darren Turner, photography in left figure from Tasmania LIST state aerial orthophoto.

2

Required in same growing season as fire occurs

Identify area of *Sphagnum* burnt[2]

- Raw drone images
- Manual mapping of imagery with grid (5 m x 5 m) of area burned
- Processed burn severity imagery

Imagery needs to be interpreted to map the extent and severity of fires in *Sphagnum* mires. This can be done manually using simple classificatory rules. Automated machine classification of fire severity is also possible in principle, but in practice, further research and development is needed[1]. All maps need to be field validated using broad vegetation categories. It is important this mapping is done as soon as possible after a fire event before regrowth obscures the categories.

Figure 3

Drone-derived images of burnt mire showing areas classed as burnt *Sphagnum*, unburnt *Sphagnum*, burnt other vegetation, unburnt other vegetation and free water. The raw images for Eagle Valley (top right) are shown in Figure 2.
Image source: Figure S4, Prior et al., 2022

2

Mainland experience shows that stream erosion can occur in *Sphagnum* mires damaged by fire. This drains the *Sphagnum*, further degrading the ecosystem. It is important to watch for this process while working in and around *Sphagnum* communities, and to manage such erosion should it occur.

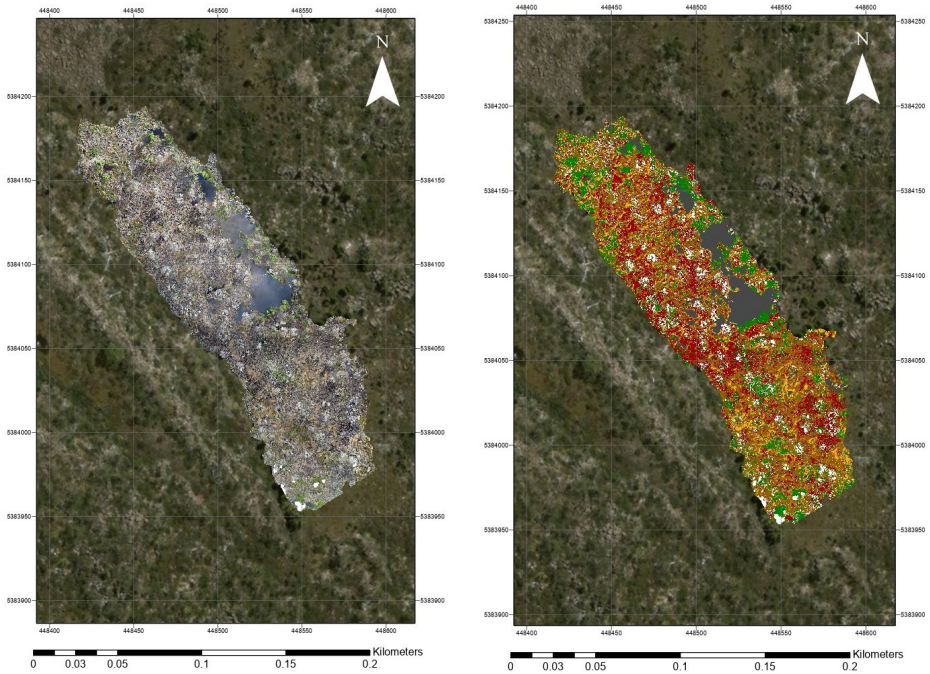


Figure 4

Paired maps of orthorectified aerial imagery (left) and *Sphagnum* burn severity classification map derived from a machine classification (right) of Eagle Valley site overlaying a Google Earth base image. Right map displays three fire severity classes (healthy *Sphagnum* (orange); damaged *Sphagnum* (brown); killed *Sphagnum* (red)) as well as three ground cover types (non-*Sphagnum* vegetation (green), rock, dead wood and bare soil (white); and water (grey)). The machine classification of burn severity was based on an ENVI workflow and at this site had reasonable agreement with field measurements of fire severity. Geographic coordinates and grid references are shown at 500 metre intervals.

Image source: Figure 3, Harding et al., 2022

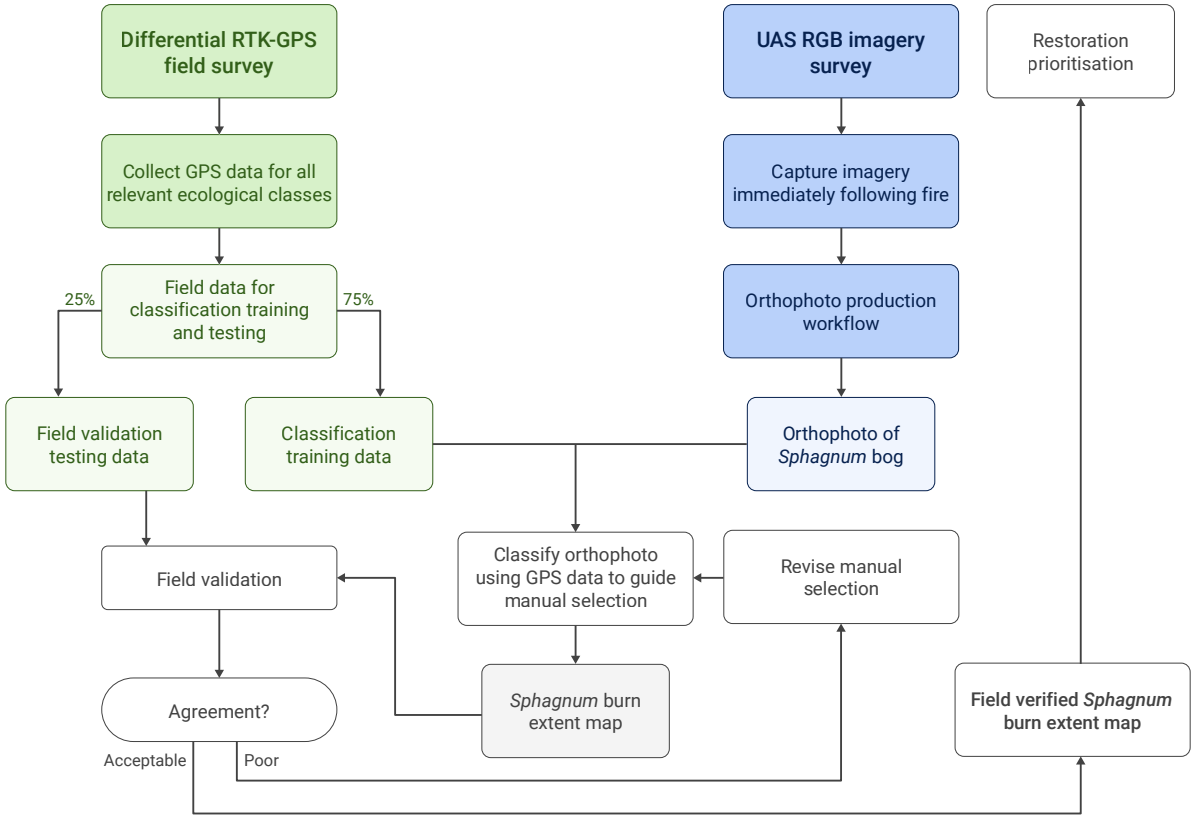


Figure 5

Flow diagram of an improved workflow recommended for future capture, classification and validation of *Sphagnum* burn impact maps.
Image source: Figure 7, Harding et al., 2022

3

Burn severity classification[2]

Visual assessment

In a 5 m x 5 m quadrat grid, *Sphagnum* health is visually assessed based on a combination of:

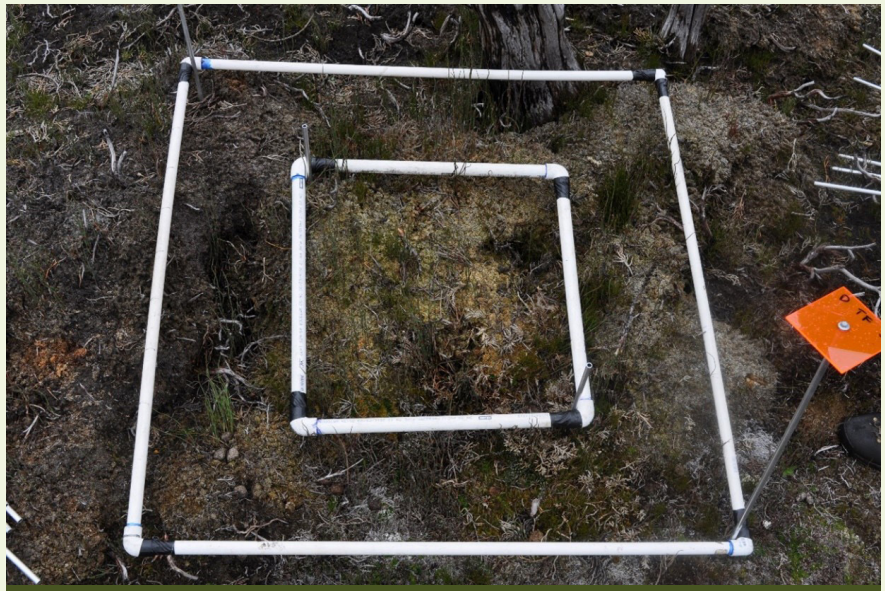
Apparent colour

Structure

Moisture content of foliage

A percentage score for health (to the nearest 5%) is assigned to each quadrat grid:

- **<75% killed** quadrats are classified as **moderate severity** - initiate post fire recovery intervention (page 9).
- **≥75% killed** quadrats are classified as **high severity** - no recovery expected.



Plot showing outer and inner quadrats (PVC tubing removed after vegetation assessments and application of treatments)
Photo by Scott Nichols

Healthy *Sphagnum*

Colours
Green, yellow or orange

Structure
Maintains typical structure of tightly clustered capitula or heads

Moisture
Hydrated

Damaged *Sphagnum*

Has a combination of characteristics in varying stages found within the plot (living but with burned foliage)

Killed *Sphagnum*

Colours
White, grey or brown

Structure
Capitula crumbling and the mound structurally breaking down

Moisture
Obviously desiccated

Photos by Scott Nichols

4

Post-fire recovery - shadecloth[2,3]

Shadecloth is important in increasing post-fire recovery of moderately damaged *Sphagnum*. Key considerations for shadecloth interventions:

- Wind resistance
- GPS locations
- Markers to show up on drone imagery (optional) - to precisely locate treatments on imagery if ongoing monitoring is undertaken

Shadecloth preparation and installation

For practical reasons (cover of shrubs, site accessibility, transport logistics), our trial deployed shadecloth in small square patches. An alternative would be to apply shadecloth in larger continuous pieces. Whichever technique is used, it is important to consider transport of material to site, and how to fasten shadecloth securely in areas with high shrub cover, trees and uneven terrain, to withstand strong winds, snow and wildlife.

As a guide, we outline the materials and methods from our trial, which used 1.2 m x 1.2 m squares (folded at the edges to measure 1 m x 1 m).

Construct shadecloth squares off site from beige 70% black out shadecloth material:

- Cut 1200 mm x 1200 mm squares
- Fold and crease four edges at 100 mm
- Hold square together using stainless steel eyelets at each corner, forming a total shade square of 1 m^2

Installation on site:

- Thread outer quadrat aluminium marker stakes plus two additional corner stakes through eyelets and into the ground surface
- Cinch and securely fix stakes with plastic cable ties

Note: During trials, shadecloths were checked for secureness after one year, revealing little damage from wind or animals (3 of the 132 checked shadecloths needing re-securing).

Shadecloths in landscape
Photo by Scott Nichols

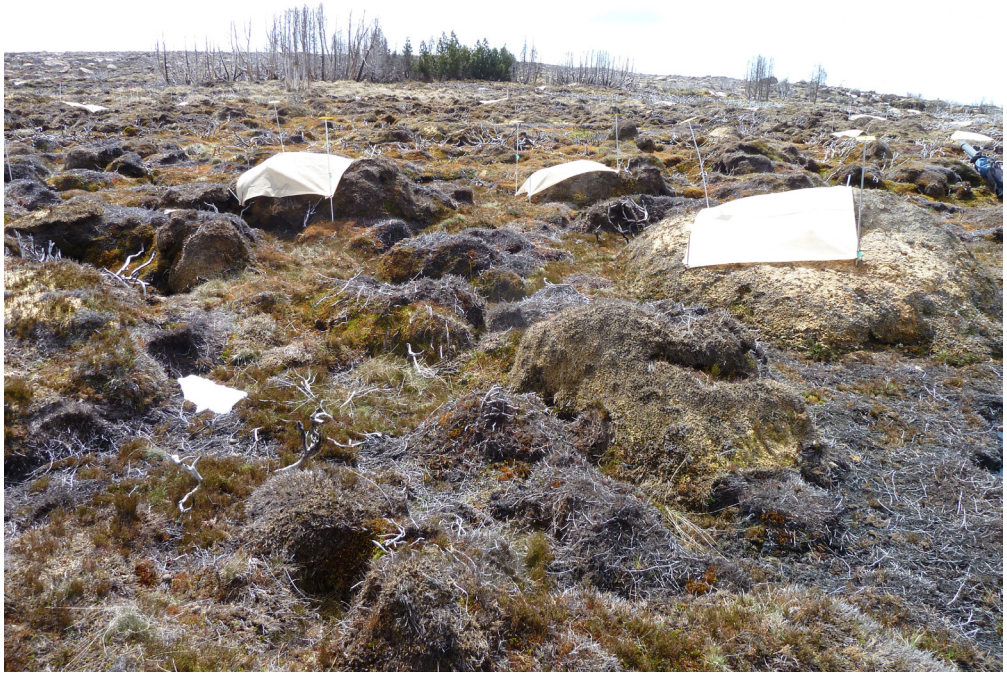
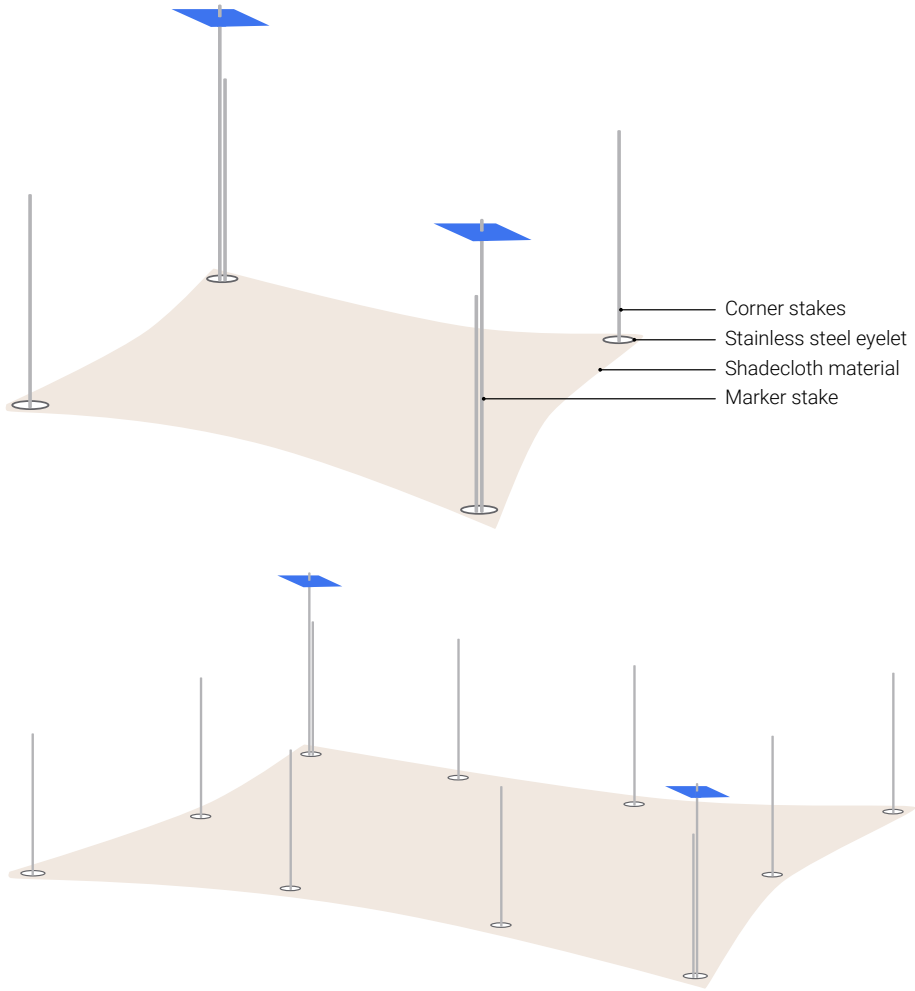


Photo by Scott Nichols



Position stakes every 2 – 5 m according to topography

Budget and resources*

Quadrat surveys

Materials

- Shadecloth (70% beige) $360 per 3.65 x 50 m
- Corner stakes - aluminium extrusion $9 per 6.5 m length 10 mm diameter
- Cable ties $12.90 packet of 500
- Eyelets 12 mm stainless steel - $5.60 per packet of 50
- Plot markers (drone) $2,200 - (1728 squares)
- Hex head screws 35 mm 500 box $75.00 (2 per maker stake)

Labour

- 5 minutes per square - 12 squares per hour

Field installation

20 squares per hour 1-2 person (no survey) + field traverse

4 squares per hour 1-2 person (with survey) + field traverse

Field removal

60 squares per hour 1-2 person (no survey) + field traverse

6 squares per hour 1-2 person (with survey) + field traverse

Resources

- Helicopter $2,637 per hour including standard insurance, additional organisation-specific insurance may be stipulated
- Permits submission and approval process
- Drone surveys
- Data management

*Indicative costs based on the Lake Mackenzie trial conducted in 2019-20

References

[1] Harding M, Turner D, Williamson G, Nichols S, Bowman D (2022) Post-fire impact assessment of Tasmanian *Sphagnum* bogs. Unmanned aerial system mapping trails and method development. Bushfire and Natural Hazards CRC, Melbourne, Australia.

[2] Nichols SC, Prior LD, Bowman DMJS (2022) Lake Mackenzie Rehabilitation Trials: *Sphagnum*. Establishment Report for the Lake Mackenzie Rehabilitation Trials. Department of Natural Resources and Environment Tasmania, Hobart.

[3] Prior LD, Nichols SC, Williamson GJ, Bowman DMJS (2022) Post-fire restoration of *Sphagnum* bogs in the Tasmanian Wilderness World Heritage Area, Australia. *Restoration Ecology* e13797. http://doi.org/10.1111/rec.13797

[4] Threatened Species Scientific Committee (2009) Commonwealth Listing Advice on Alpine *Sphagnum* Bogs and Associated Fens. Department of the Environment, Water, Heritage and the Arts, Canberra.

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