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Classifying and mapping the Australian Alps' Native Vegetation

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Abstract: Strategic and systematic planning for bioregional landscapes that cross jurisdictions is often hampered by different approaches to collecting, classifying and mapping information on the native vegetation cover in terms of major community types. The network of Australian Alps National Parks is one such multi-jurisdictional bioregional landscape consisting of 11 protected areas spanning 1.6 million hectares across Victoria, New South Wales and the Australian Capital Territory. Although the Alps network has a co-operative management program and the parks are listed as National Heritage, there is no common vegetation classification system or map at a scale suitable for management. As part of developing a strategic framework to assist biodiversity conservation for the whole of the Alps Network, a common vegetation classification and map was produced. The new classification utilised existing State vegetation classes and mapping to produce a common system by matching 71 NSW/ACT vegetation groups with 72 Victorian ecological vegetation classes, thereby resulting in 17 common vegetation classes with affinities with other studies described. The 17 vegetation classes also group into five broad vegetation character classes. Expert knowledge was used to match vegetation groups and classes. The resulting classification and map are available as a GIS data layer and as part of a decision support data-pack. This approach provides a low cost method for developing a common vegetation system across multi-jurisdictional landscapes, without replacing State-based systems, and in a format that can be readily updated in light of new field surveys and remotely sensed data. The new classification and map are available for download from an online data repository. This new vegetation information can be applied to help promote a whole-of-landscape approach to planning and management of the Alps Network.

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Introduction

Information on the composition, structure and distribution of major vegetation types is fundamental for the systematic conservation planning and management of protected areas. Providing data sets with a common coverage, however, can be problematic for protected area networks that span large, multi-jurisdictional landscapes. While encompassing the same bioregions and ecosystem types, different vegetation classification and mapping systems often arise independently over time.

The Australian Alps National Parks Network (hereafter, the Alps Network) comprises 11 protected areas spanning 1.6 million ha across the states of Victoria, New South Wales (NSW) and the Australian Capital Territory (ACT) (Table 1, Figure 1). Currently, each State and territory government agency manages the park areas within its jurisdiction. Interagency cooperation is promoted through the Australian Alps Co-operative Management Program (Australian Alps Liaison 2012). There is, however, no whole-of-Alps management plan or common database of biodiversity information. Vegetation classifications and lists of threatened and endangered species are recorded separately using State and Commonwealth based systems with different standards and criteria.

NSW/ACT and Victoria have independently developed vegetation classification and mapping systems. The different methods have resulted in major mismatches which are most apparent at state and territorial borders. The National Vegetation Information System (Department of the Environment and Heritage 2003) has generated continental coverage of native vegetation which spans the Alps Network but the classification and scale of mapping are coarse, omitting a number of vegetation types that are characteristic of the bioregion and providing insufficient detail for park planning and management purposes. There remains the need for an appropriately scaled common vegetation classification and map for the Alps Network that can complement remotely sensed data on land cover change including weed impacts (Deehan *et al*. 2007) and updated information about the flora of this complex bioregion (Doherty *et al*. 2015).

We present here a new classification and map of the Alps Network native vegetation types based on existing data interpreted by expert knowledge, along with a brief description of the source data and discussion on some of the major issues that needed to be resolved and potential applications.

Methods

The definitive approach to developing a new common vegetation system for a large cross-jurisdiction landscape such as the Alps Network would be to undertake a full re-assessment and analysis of the current native vegetation through quantitative on-ground surveys, using these survey plot data to generate a new statistically-based vegetation classification, and then using some form of remote sensing to map the vegetation classes. In the meantime, an alternative, practical approach is to gather available mapped vegetation data from jurisdictions and integrate the different vegetation types into a common classification that can be applied seamlessly across borders, while retaining the original classification units that can be referred to as needed. In addition, descriptive information from other pertinent vegetation surveys can be identified and used to help identify affinities across the vegetation classification systems.

Table 1 National Parks within the Australian Alps National Parks Network.

Jurisdiction	National Park	Area (ha)
Victoria	Alpine National Park	660,550
	Snowy River National Park	98,100
	Avon Wilderness	39,650
	Mount Buffalo National Park	31,000
	Baw Baw National Park	13,300
New South Wales	Kosciuszko National Park	690,425
	Brindabella National Park	18,472
	Scabby Range Nature Reserve	4,982
	Bimberi Nature Reserve	10,886
Australian Capital Territory	Namadgi National Park	105,900
	Tidbinbilla Nature Reserve	5,450
Total area		**1,600,000**

Alpine Bogs and Fens and Alpine Heathlands

Tall Wet Forests

Alpine Grasslands and Herbfields

Moist Montane Forest

Sub alpine Woodlands and Open forests

Rainshadow Woodlands and Open Forests

Fig. 1. Examples of major Alps-wide vegetation classes.

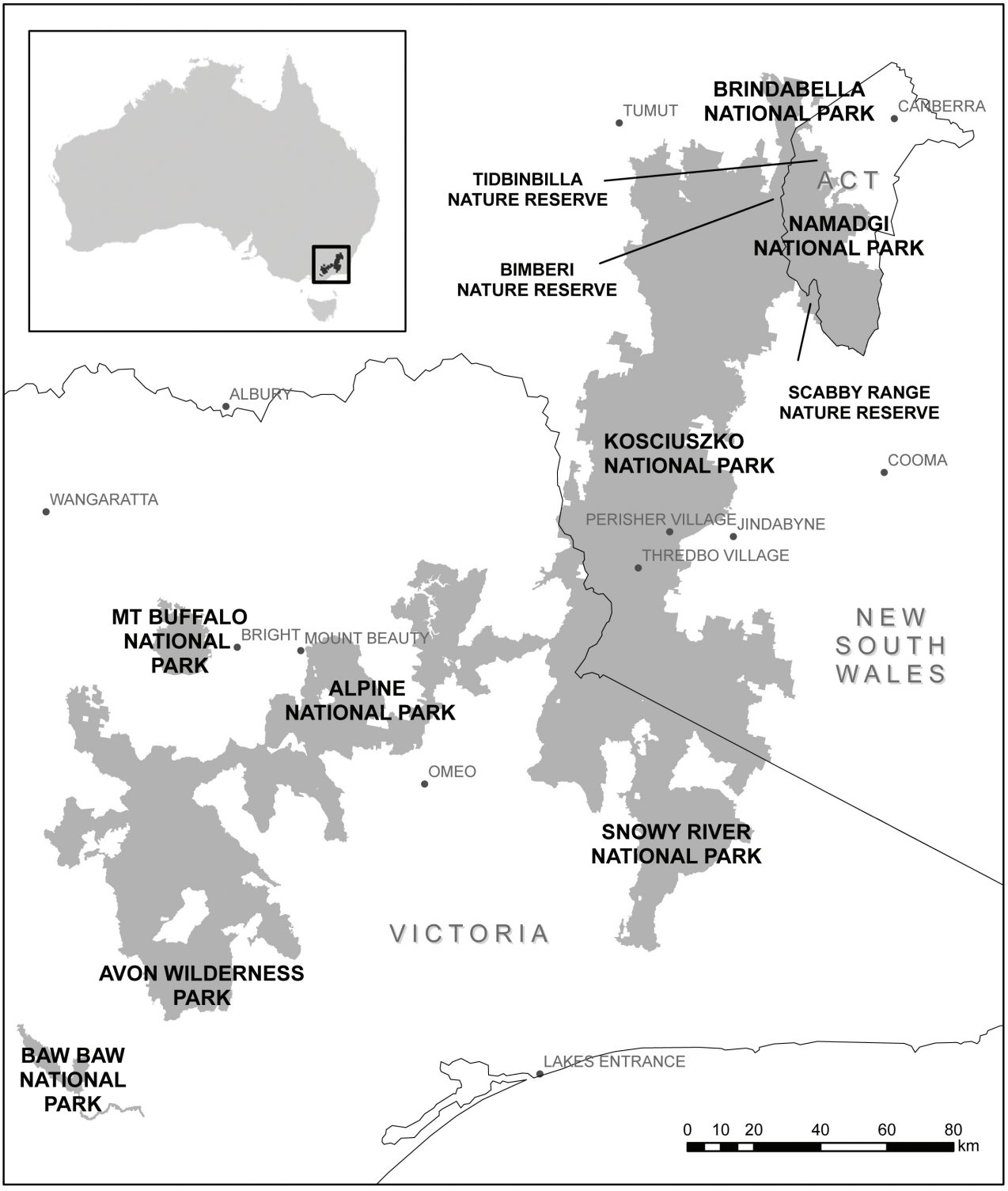

Fig. 2. Location of the Australian Alps National Parks Network.

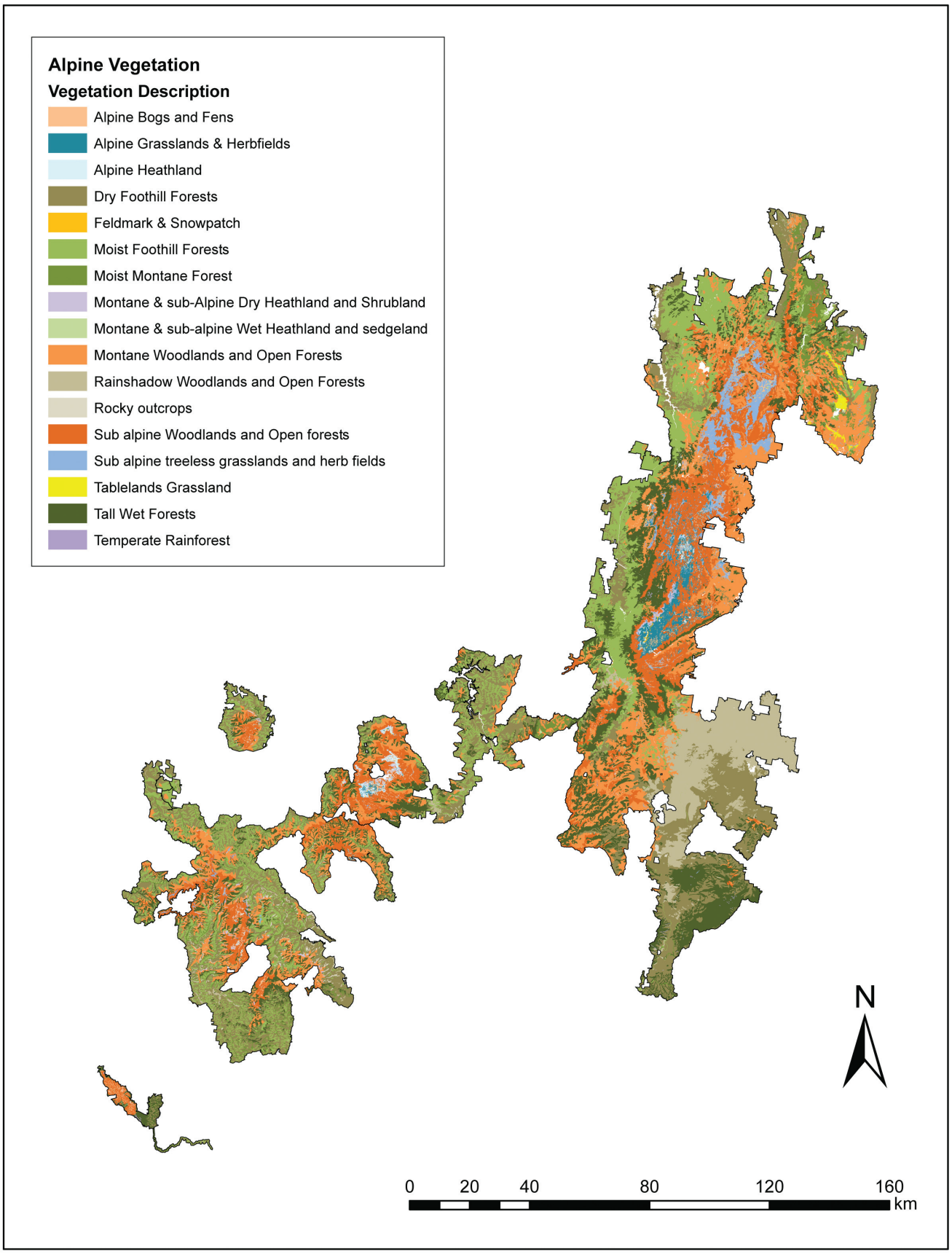

Fig. 3. Major vegetation types recognized by the new vegetation classification of the Alps Network.

While several studies describe the Alps Network vegetation to various degrees, the only two spatial datasets that were suitable for this study were those of Gellie (2005) for NSW and ACT and the Department of Sustainability and Environment (2015) for Victoria. The first step was to identify the distinctive and recognisable vegetation types that characterise the Australian Alps Network landscapes. The second step was to align and match the vegetation units of the NSW/ACT and Victorian classification systems. For Victoria, these are called Ecological Vegetation Classes and for NSW/ACT, Vegetation Groups.

To provide additional and updated information on vegetation types within each common class, vegetation community descriptions were also drawn from Armstrong *et al*. (2013) for NSW/ACT, along with those of McDougall & Walsh (2006) for treeless areas. A vegetation type of special concern is the Alpine Peatlands and Bog community, which is a nationally listed community (DEWHA 2009). This community type is incompletely mapped by both Gellie (2006) and by DSE's EVCs. Consequently, an additional Alpine Peatlands and Bogs layer was produced by combining more accurate Peatland mapping (Office of Environment and Heritage 2012; Arthur Rylah Institute 2008). In synthesising and integrating the available information about vegetation types, we drew upon our own knowledge of the region's ecology along with advice gained from consultations with three vegetation experts as detailed in the *Acknowledgements* section below.

The vegetation map was developed based on the new vegetation classification using a combination of the two base maps provided by Gellie (2005) and Office of Environment and Heritage (2012) for NSW/ACT and the Department of Environment, Land, Water and Planning (2014) for Victoria, along with the afore mentioned updated Alpine Peatlands and Bogs layer. The combined Alpine Vegetation map was created using ArcGIS desktop (ESRI 2014) and R software (R Core Team 2015). The new map was then clipped to the Australian Alps national park boundaries. All polygons classified as 'Alpine Bog and Fens' were merged into neighbouring polygons with the largest area or the longest shared border using the eliminate tool in the Generalization Toolbox of the Data Management Tools (ESRI 2014). The Alpine Peatlands and Bogs layer was then over-laid as the Alpine Bog and Fens classification.

Results

The aligned and matched EVCs and VGs, along with the new common Alps vegetation classes are described in Table 2. By way of summary, the classification matching exercise grouped 71 NSW/ACT vegetation groups (Gellie 2005) with 72 Victorian ecological vegetation classes (DSE 2015) to produce 17 common vegetation classes (see Figures 2 and 3). These 17 vegetation classes were then further grouped into five broad vegetation character classes (A-E below):

A. Lower to mid elevation forests and woodlands[1]: (1) Temperate Rainforest; (2) Moist Foothill Forests: (3) Dry Foothill Forests; (4) Rainshadow Woodlands and Open Forests;

B. Montane grasslands, forests and woodlands: (5) Tablelands Grassland: (6) Moist Montane Forest: (7) Tall Wet Forests; (8) Montane Woodlands and Open Forests;

C. Open Rocky outcrops: (9) Rocky outcrops;

D. Sub-alpine woodlands, open forest and treeless: (10) Sub alpine Woodlands and Open forests; (11) Sub alpine treeless grasslands and herb fields; (12) Montane & sub-alpine Wet Heathland and Sedgeland; (13) Montane & sub-Alpine Dry Heathland and Shrubland; and

E. Alpine treeless: (14) Alpine Bogs and Fens; (15) Alpine Heathland; (16) Feldmark & Snowpatch Herbfield; (17) Alpine Grasslands & Herbfields.

The vegetation information summarised in Table 2 and a detailed digital version of the vegetation map (Figure 3) are available to download from the Terra Nova Climate Change Information Climate Change Adaptation Information Portal at <https://terranova.org.au/repository/australian-alps-network-vegetation-classification>

A version of the new vegetation map is also available as part of a MCAS-S data pack that can be downloaded from <http://www.nerplandscapes.edu.au/data-packs - *Alps Icons & Threats Data Pack*>. The Multi-Criteria Analysis Shell for Spatial Decision Support (MCAS-S) (Lesslie *et al*. 2008) is a decision support tool designed specifically for non-GIS experts to easily visualise and analyse spatial data when addressing natural resource management and planning problems.

Discussion

The development of the new vegetation classification and map was primarily limited by the availability of spatial vegetation data. These available spatial data were developed a decade ago and while there have been more recent vegetation and floristic studies in the bioregion the mapped data have not been updated to reflect recent findings and land cover changes. As noted in the methods section, where available, some more recent vegetation survey and descriptive work was incorporated into the new classification, however this information was not geographically comprehensive. At the time of our analyses, NSW was in the process of updating its state-wide biometric data, which could only be partly used, and is also incomplete in terms of coverage.

1 Lower to mid elevation refers to areas that extend from the lowest to the median elevation areas of the Australian Alps (i.e.100m up to around 1000m ASL), (see Table 2).

Table 2 Vegetation Units descriptions of the Australian Alps national parks.

MAPPED VEGETATION GROUPS & CLASSES				ALPS WIDE VEGETATION CLASSES		
NSW/ACT: VEGETATION GROUPS (Gellie 2005)		VICTORIA: ECOLOGICAL VEGETATION CLASS (EVC)		ALPS INTEGRATED VEGETATION CATEGORIES		
VEGETATION GROUPS	CODE[2]	COMPARABLE EVC CLASS IN GROUPING	EVC No	COMBINED ALPS VEGETATION CLASS	DESCRIPTION[3] AND TYPICAL SPECIES[4]	VEGETATION CHARACTER
Kosciuszko Western Escarpment Cool Temperate Rainforest	172	Cool Temperate Rainforest	31	**Temperate Rainforest**	Rainforests are closed forests not dominated by eucalypts. Cool temperate rainforest commonly contains *Atherosperma moschatum* & *Dicksonia antarctica* with *Nothafagus cunninghamii* in some cases in Victoria and has a strong floristic affinity with the Tall Wet Forests. Warm Temperate rainforest occurs in East Gippsland and the southern fall in Victoria, commonly containing *Acmena smithii, Acacia melanoxylon* & *Rapanea howittiana.* The Dry Rainforests of East Gippsland contain *R. howittiana* along with *Pittosporum undulatum* & *Brachychiton populneaus*.	**Lower to mid elevation forests and woodlands**
		Warm Temperate Rainforest	32			
		Dry Rainforest	34			
Western Montane Acacia Fern-Herb Forest	82	Valley Grassy Forest	47	**Moist Foothill Forests**	Moist Foothill Forests are mixed species herb rich and shrubby forests of foothills and mid slopes occurring from the lower elevations around 100m generally up to 1000 m ASL, with some occurrences up to 1200m. The moister conditions (than that of dry foothill forest) are largely due to aspect and/or soil type. Generally, their elevation range is limited as they merge into the higher Montane Forest and Woodlands or Tall Wet Forests at around 900m to1000 m ASL. Commonly dominated by *Eucalyptus radiata* & *E. robertsonii* with occurrences of *E. dives, E. bridgesiana, E. cypellocarpa, E. dalrympleana, E. mannifera E. rubida* & *E. rossi* with *E. camphora* in wetter areas. *E. obliqua* and *E. fastigata* may occur in moist deep soils & *E. macrorrhyncha* where drier, particularly in the north. Mid storey species may include *Acacia melanoxylon* & *A. dealbata*. Includes riparian woodlands, scrubs & shrublands, which may merge into montane heathlands.	**Lower to mid elevation forests and woodlands**
Riparian Acacia Shrub-Grass-Herb Forest	53	Riverine Escarpment Scrub	82			
		Swampy Riparian Woodland	83			
		Riparian Shrubland	19			
Tableland Acacia-Herb-Grass Forest	104	Lowland Forest	16			
Eastern Dry Shrub-Herb-Grass Forest	81					
Northern Tablelands Acacia Herb/Grass Dry Forest	90					
Western Tablelands Herb-Grass Dry Forest	93					
South West Slopes Acacia Dry Herb-Grass Forest	94	Shrubby Foothill Forest/ Damp Forest Complex	315			
Montane Dry Shrub-Tussock Forest	106	Herb-rich Foothill Forest	23			

2 From Gellie (2005), not the NSW State Classification system.

3 Elevation ranges for vegetation classes vary significantly with latitude and aspect, therefore elevation ranges stated are general indications only.

4 Species and their composition vary with localities and between vegetation groups/EVC's in the combined Alps class. The typical species are a selection only, drawn from Gellie (2005), Department of Sustainability and Environment. (2015), Armstrong et al. (2013) and McDougall, K.L. & Walsh, N.G. (2007) and are not intended to be comprehensive.

Western Escarpment Dry Shrub Forest	70	Heathy Dry Forest/ Grassy Dry Forest	320	**Dry Foothill Forests**	Dry Foothill Forests are mixed species foothill and mid slope forests occurring from the lower elevations around 100m up to 1000 m ASL. They occur in drier situations than moist foothill forest due to aspect or soil type. Generally, their elevation range is limited as they merge into the higher Montane Forest and Woodlands or Tall Wet Forests at around 800-1000 m ASL. Commonly dominated by *Eucalyptus dives,* along with *E. mannifera, E. rubida* and *E. rossii,* the box species, *E. goniocalyx, E. nortonii, E. bridgesiana, E. polyanthemos* and *E. melliodora,* & stringybarks such as *E. macrorhyncha* and *E. dalrympleana* may mix in at higher elevations. *Daviesia latifolia, D.ulicfolia* & *Cassinia longifolia* are likely to be found in the understory.	**Lower to mid elevation forests and woodlands**
Tablelands Dry Shrub-Tussock Grass Forest	114	Dry Valley Forest	169			
Western Tableland Dry Shrub Forest	71	Grassy Dry Forest	22			
Western Tablelands Dry Herb-Grass Forest	108	Heathy Dry Forest	20			
Widespread Tablelands Dry Shrub-Tussock Grass Forest	109	Valley Heathy	127			
Tablelands Shrub-Tussock Grass Forest	75	Shrubby Foothill Forest	45			
Montane Dry Shrub-Tussock Grass Forest	79					
Tablelands Dry Shrub-Grass Forest	110	Clay Heathland	7			
South East Tablelands Dry Shrub-Tussock Grass Forest	115					
Western Slopes Grass-Herb Dry Forest	121	Valley Slopes Dry Forest	177			
Western Slopes Dry Shrub-Grass Forest	119					
South Eastern Tablelands Dry Shrub-Grass-Herb Forest	74					
Eastern Tableland Dry Shrub-Grass Forest	73					
SC-CT-ST Herb-Grass Forest on Limestone	198					
Western Montane Dry Fern-Grass Forest	103	Shrubby Dry Forest	21			
ACT Dry Shrub-Herb Forest	80					
Lower Snowy White Box Dry Shrub-Herb Woodland	78	Grassy Woodland	175	**Rainshadow Woodlands and Open Forests**	Rainshadow Woodlands and Open Forests are lower elevation dry woodlands and open forests occurring on steep dry slopes from 110m up to about 700 m ASL on poorly structured soils. They include the Snowy River Valley rainshadow woodlands. Generally dominated by *Eucalyptus albens, E. nortonii* & *E. goniocalyx,* with *E. dives, E. macrorhyncha, E. mannifera, E. blakelyi* & *E. polyanthemos* which may be present along with *Callitris glaucophylla, Brachychiton populneus, Exocarpus cuppressiformis, Acacia mearnsi* & *A. implexa.* Includes dry scrubs of *Acacia silvestris* & *Eriostemon trachyphyllus.*	
Western Slopes Herb-Grassy Woodland	116					
Lower Snowy Rain Shadow Woodland - Shrubland	41	Granitic Hills Woodland	72			
Lower Snowy Dry Shrub-Tussock Grass Forest	77					

Tableland Dry Heath Shrub-Herb-Grass Woodland	38	Foothill Box Ironbark Forest	24			
South Coast and Byadbo Acacia Scrubs	35	Blackthorn Scrub	27			
Tableland Moist Herb-Grassland	152			**Tablelands Grassland**	Tablelands Grassland is dominated *by Themeda australis* & *Poa sieberiana*. It occupies a small area in the alps, occurring in sub-alpine valleys in Namadgi National Park and is known to occur also in Victoria's eastern high country but is not mapped.	**Montane grasslands, forests and woodlands**
Tableland Tussock Grassland -Sedgeland	148					
Tableland and Escarpment Wet Layered Shrub Forest	58	Shrubby Damp Forest	316	**Moist Montane Forest**	Moist Montane Forest is a Tall mixed species forest, commonly occurring in higher moist situations ranging from 1000 m to 1500m ASL, but lower in Riparian forest areas, particularly in the south. It is generally positioned above the foothill forests and mixing at that elevation with the Tall Wet Forests and Montane Woodlands and Open Forests. Forest are generally dominated by *Eucalyptus dalrympleana* & *E. fastigata*, with occurrences of *E. robertsonii, E. dives, E. cypellocarpa, E. chapmaniana, E. viminalis, E.rubida* & *E. obliqua. E. pauciflora* may mix in at higher elevations. *Acacia dealbata, A.melanxylon, Daviesia ilicifolia, Exocarpus strictus* & *Persoonia chamaepitys* may occur in the understorey.	**Montane grasslands, forests and woodlands**
Montane Riparian Moist Shrub-Grass-Herb Forest	83	Riparian Forest/Creekline Grassy Woodland Mosaic	293			
Montane Riparian Moist Shrub/ Sedge/GrassForest	85	Riparian Forest/Swampy Riparian Woodland/ Riparian Shrubland/Riverine Escarpment Scrub Mosaic	84			
ACT Montane Dry Shrub Forest	105	Riparian Forest	18			
Central Tableland-ACT Montane Dry Shrub Forest	107	Montane Herb-rich Woodland	319			
Western Escarpment Shrub-Grass Forest	88					
Eastern Tablelands Acacia-Herb-Grass Forest	89					
Western Escarpment Moist Shrub-Herb-Grass Forest	87	Montane Damp Forest	38	**Tall Wet Forests**	Tall Wet Forests are the tallest forests in the Australian Alps typically dominated by *Eucalyptus delegatensis*. *E. delegatensis* forests occur throughout the alps high on the upper slopes between 900 and 1450 m ASL, mixing with *E. dalrympleana* & *E. pauciflora* at higher elevations. The understorey is commonly shrubby with species such as *Acacia obliquinervia*, *Daviesia ulicifolia* & *D.latifolia*, with a ground layer generally including herbs, tree ferns and grasses. *E. delegatensis* is very fire sensitive and an obligate seeder. Many stands have been burnt in the last 20 years, with large single age stands now in a scrubby regrowth stage and vulnerable to further fires until they mature. *E. regnans* forests are less common in the Australian alps, occurring on deep soils in moist gullies mainly on the southern fall between 300 m and 1100m ASL.	
Western Sub-alpine Moist Shrub Forest	86					
		Damp Forest	29			
		Wet Forest	30			
		Tableland Damp Forest	35			
		Montane Wet Forest	39			
		Shrubby Wet Forest	201			

Tableland Acacia Moist Herb Forest	95			**Montane Woodlands and Open Forests**	Montane Woodlands and Open Forests, including woodlands in riparian areas, occur widely between 800m and 1600m ASL on drier exposed slopes. Generally lower and more open than the moist tall montane forest at similar elevation, it is charactarised by the association of *Eucalyptus pauciflora* with *E. dalrympleana, E. rubida* & *E. dives* with *E. stellulata* & *E. camphora* in wetter and riparian areas. Understory may include *Acacia dealbata, A.obliquinervia, Cassinia aculeate, Hakea microcarpa, Epacris breviflora, Baeckea utilis, Daviesia ulicifolia, D.latifolia, D. mimosoides, Exocarpus strictus* & grasses, *Poa sieberiana* & *Themeda australis.*	
Western Montane Wet Heath-Herb Grass Woodland	124					
Western Montane Moist Shrub Forest	98					
		Montane Riparian Woodland	40			
		Treed Montane Riparian Woodland	40-61			
Brindabella Montane Dry Fern-Grass Forest	102	Montane Dry Woodland	36			
Tableland Tussock Grass/Herb Forest	96					
Montane Acacia-Dry Shrub-Herb-Grass Forest	97					
Tablelands Acacia Grass/Herb/ Dry Forest	101					
Central Tablelands Shrub-Grass Dry Forest	76					
ACT Montane Dry Shrub-Grass Forest	100	Montane Grassy Woodland	37			
Rock Outcrops	190	Alpine Crag Complex	1000	**Rocky Outcrops**	Rocky Outcrops are open rocky areas including scree slopes, with little or sparse vegetation, occurring at a range of elevations.	**Open Rocky outcrops**
		Rocky Outcrop Shrubland/ Rocky Outcrop Herbland Mosaic	73			
		Rocky Outcrop Shrubland	28			
Tableland Dry Herb-Grass Woodland	146	Sub-alpine damp heathy Woodland	978	**Sub alpine Woodlands and Low Open Forests**	Snow Gum Woodlands and low open forests are the highest treed areas in the Australian Alps and widespread, occurring generally between 1200m and up to 2000m ASL. They are dominated by *Eucalyptus pauciflora* or *E. niphophila*; small rocky exposed areas are dominated by other eucalypts, including *E. debeuzevillei, E. kybeanensis, E. glaucescens, E. forresterae & E. mitchelliana.* The understory ranges from grassy to scrubby. Species may include *Acacia obliquinervia, Oxylobium ellipticum, O.alpestre, Bossiaea foliosa, Kunzea muelleri*, *Olearia phlogopappa, Tasmannia xerophil, Leucopogon hookeri* & *Stellaria pungens* with several grasses including *Poa sieberiana P. hiemata* & *P. fawcettiae*.	**Sub-alpine woodlands, open forest and treeless**
Montane Dry Shrub-Herb-Grass Forest	99					
Scabby Range Dry Shrub Woodland	37					
Sub-alpine Dry Shrub-Herb-Grass Woodland	127					
Sub-alpine Dry Shrub-Herb Woodland	128					

Sub-alpine Shrub-Grass Woodland	130	Sub-alpine Woodland	43			**Sub-alpine woodlands, open forest and treeless**
		Sub-alpine wet heathy woodland	977			
Tablelands Moist Sedge-Herb-Grassland	147			**Sub alpine treeless grasslands and herb fields**	The Sub alpine treeless grasslands and herb fields commonly occur on the treeless high plains and frost hollows of the sub alpine area generally between 1200m and 1500 m ASL where snow persists for long periods over poorly drained soils. Grasses dominate with *Poa sieberiana P. labillardieri, P. costiniana* & *P. fawcettiae* occurring. A diverse range of other species occur including shrubs such as *Grevillia australis, Baeckea gunniana & Hovea montana,* the herbs *Scleranthus biflorus, Plantago antarctica, Ranunculus granticola* & *Craspedia spp.*, and the sedge *Carex gaudichaudiana.*	
Sub-alpine Grassland	131	subalpine grasslands	206			
Sub-alpine Dry Herb-Grassland	132					
		Sub-alpine Treeless Mosaic: Early mapping unit. Subject to recent mapping, may now include: 156, 171, 202, 206, 41, 42, 170, 210, 239, 288, 913,905, 1001, 1002, 1003, 1004, 1011,1012,1013, 1014	44			
Montane Wet Heath-Herb Grassland	125	Sub-alpine Wet Heathland/ Sub-alpine Grassland Mosaic	317	**Montane & sub-Alpine Wet Heathland and Sedgeland**	The Montane & sub-Alpine Wet Heathland and Sedgeland occur in treeless areas generally between 1000m and 1200m ASL, where soils are permanently wet, often along soaks and drainage lines. Sedges commonly include sedges *Carex gaudichaudiana, Juncus brevibracteus & J.falcatus,* shrubs may include *Epacris breviflora, Leptospermum myrtifolium, Baeckea utilis,* & *Hakea microcarpa,* with the herbs, *Neopaxia australasica* & several *Ranunculus spp.* and grass *Poa labillardieri.* This Wet Heathland does not include the Sphagnum spp. peat forming Alpine Bogs and Fens, which are listed below.	
Montane Wet Sedge land	126	Montane Swamp	318			
		Montane Riparian thicket	41			
		Montane Wet Heathland	184			
		Sub Alpine Damp Heathland	204			
Montane/Sub-alpine wet heath/ bog	123	Sub-alpine Riparian Shrubland	208			
Montane - Sub-Alpine Dry Rocky Shrubland	36	Montane Rocky Shrubland	192	**Montane & sub-Alpine Dry Heathland and Shrubland**	Montane & sub-Alpine Dry Heathland and Shrubland occurs generally between 1100m and 1500m ASL in a harsh environment often on exposed rocky areas on poor soils amongst stunted Snow Gums. Shrub species may include *Bossiaea riparia, B.foliosa, Hakea microcarpa, Oxylobium ellipticum Asterolasia trymalioides, Leptospernum micromyrtus, Podolobium alpestre, Kunzea muelleri* & *K. ericoides,* with grasses *Poa fawcettiae, P. tenera* & other Poa spp.	
		Sub-alpine Shrubland	42			
		Sub-alpine Dry Shrubland	1003			

"Alpine Bogs" Layer (Australian Alps composite bogs dataset) from OEH Technical Report: Peat-forming bogs and fens of the Snowy Mountains of NSW		"Alpine Bogs" Layer (Australian Alps composite bogs dataset). In Vic contains 288, 210, 1011, 171, 211 and other peatlands.		**Alpine Bogs and Fens**	Alpine Sphagnum Bogs and associated Fens occur in waterlogged and permanently wet treeless areas, such as along streams, drainage lines, valley edges and valley floors generally between 1200m to 1800m m ASL. They differ from Wet Heathland and Sedgeland in that they contain Sphagnum spp. (which is typically underlain by peat), the most common of which is *Sphagnum cristatum*, along with a diversity of sedges, herbs and shrubs. Species commonly include *Empodisma minus, Epacris glacialis, E. paludosa, Baeckea gunniana, B. utilis, Pratia surrepens* & *Richea continentis*. Fens adjoin the bog and are devoid of woody vegetation, commonly dominated by sedges such as *Carex gaudichaudiana*. The Alpine Sphagnum Bogs and associated Fens vegetation community is listed as endangered under the EPBC Act. (Department of the Environment, Water, Heritage and the Arts. 2009).	**Alpine Treeless**
Sub-alpine Wet Herb-Grassland-Bog	133	Sub-alpine Wet Heathland	210			
		Alpine Fen	171			
		Alpine Valley Peatland Raised Bog	288-61			
		Alpine Valley Peatland Valley Bog	288-62			
		Alpine peaty Heathland	1011			**Alpine Treeless**
		Sub-alpine Wet Heathland/ Alpine Valley Peatland Mosaic	211			
Alpine Rocky Low Open Heathland	207			**Alpine Heathland**	Alpine Heathland is a low open heathland occurring typically at high elevations from 1400m to over 2000m ASL. It is found high on slopes and rocky exposed areas on shallow soils. Shrubs may include *Podocarpus lawrencii, Prostanthera cuneata, Grevillia australis, Leucopogon spp. Hovea montana* & *Oxylobium ellipticum* with inter shrub spaces containing the herbs *Craspedia spp.* & *Celmisia spp.* and grasses *Poa fawcettiae* & *P. hiemata.*	
		Alpine Coniferous shrubland	156			
		Alpine Grassy Heathland	1004			
		Alpine Dwarf Heathland	170			
		Alpine Rocky Outcrop Heathland	1013			
		Alpine Rocky Outcrop Heathland/Alpine Dwarf Heathland Mosaic	1105			
		Alpine Grassy Heathland/ Alpine Grassland Mosaic	1005			

		Snow Patch herbland	202	**Feldmark & Snowpatch Herbfields**	Feldmark & Snowpatch Herbfields are bare low open alpine herbfields on barely developed soils at very high elevations, from 1600m to above 2000m ASL. Feldmark herbfields occur on exposed windswept ridges and summits and commonly include *Epacris petrophila, E. gunnii, Colobanthus pulvinatus, Ewartia nubigena, Chionohebe densifolia & Ranunculus acrophilus*. Snowpatch herbfields occur on the outwash of accumulations of late thawing snow which may persist into summer, truncating the growing season. Snowpatch species commonly include *Coprosma niphophila, Colobanthus nivicola, Neopaxia australasica, Oreobolus pumilio & various Ranunculus spp*. Grasses such as *Poa fawcettiae & Agrostis muelleriana* may occur in both.	**Alpine Treeless**
Snowpatch Alpine Feldmark	205	Snowpatch Grassland	1012			
		Alpine Creekline herbland	239			
Exposed Feldmark	204					
		Late -lying Snowpatch Herbland	1014			
Alpine Tall Herbfield	129			**Alpine Grasslands & Herbfields**	Alpine Grasslands & Herbfields occur from 1500m to the highest peaks above 2000m ASL where snow cover is more prolonged. They range from extensive thick grassy swards on the high treeless plains to the grassy herbfields of the high peaks and ridges. Shrubs may include *Grevillea australis, Pimelia axiflora, P. alpina, Pentachondra pumila, Olearia Phlogopappa, Epacris glacialis, Acena spp. & Oreobolus pumilio*. Of the herbs, *Celmisia spp., Craspedia spp., Aciphylla glacialis, Plantago muelleri & Caltha introloba* may be present. Grasses include *Poa fawcettiae P. constiniana, P. saxicola & Rytidosperma nivicolum* along with the sedge *Carex gaudichaudiana*.	
Short Alpine Herbfield	206	Alpine Short herbland	905			
		Alpine Grassland	1001			
		Alpine Damp Grassland	1002			
		Alpine Pond Herbland	913			

The mapped vegetation classes varied in the accuracy of their mapping, and of particular concern were the treeless areas (K. McDougall, personal communication, 2014; A. Tolsma, personal communication, 2014) for which the more recent Alpine Peatlands and Bogs mapping allowed a significant improvement. Despite the limitations and inconsistencies of data, the new vegetation classification and map is considered by the authors and experts who were consulted to be of sufficient accuracy for broad scale park planning and management purposes. Furthermore, being a digital, GIS-based information product, the new vegetation classification and map is readily refined and updated in response to new information from multiple sources including field survey data and remotely sensed data.

We therefore encourage the Australian Alps Co-operative management program to further refine this new vegetation information system by updating mapping of selected areas and incorporating contemporary ecological studies. The priority for further work should be based on the most sensitive and complex vegetation types and in particular the Sub-alpine and Alpine Treeless Areas, the Moist Montane Forests and their relationship with Montane Woodlands and Open forest, and Tall Wet Forests and their relationship with Cool Temperate Rainforest.

Providing information about the composition and structure of major vegetation classes in a common form across the multi-jurisdictional landscape provides fundamental information for protected area managers and practitioners working within the Australian Alps Network co-operative management framework. Mapped common vegetation classes can function as spatial planning units that serve a range of purposes including: locating representative monitoring plots; extrapolating management prescriptions; identification of nature-based tourist activities; establishing baselines for tracking ecosystem-level responses to climate change and fire regimes; and as inputs to models of wildlife habitat and species distributions.

Conclusion

In geographically extensive multi-jurisdictional protected area landscapes, a common vegetation mapping system is an essential information layer for systematic conservation planning and management. As we have shown here, this can be developed at a low cost utilising existing mapped data and integrating existing vegetation classifications by aligning and matching classes across the jurisdictions into a common system. This approach retains the connections to wider National and State or Territory corporate systems while generating a classification that recognised here both the common and distinctive vegetation character of the diverse landscapes that comprise the Alps Network.

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