BOGONG LAND SYSTEM

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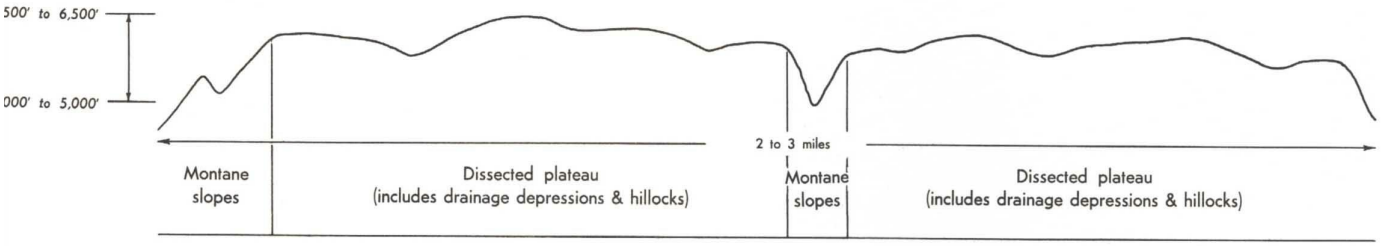
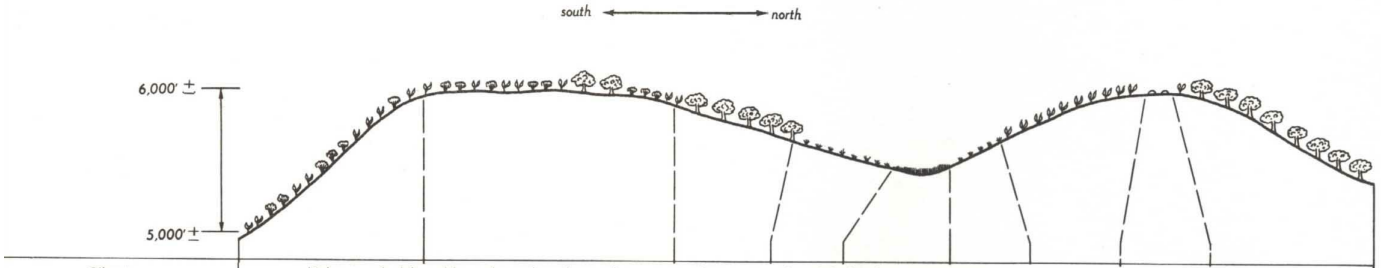
Area: 97 square miles 2·5% of catchment

a) Distribution of land forms



b) Land system diagram



Climate	Alpine to sub-alpine with regular and persistent winter snow. Average annual precipitation from 50 in. to 90 in. (+). Summers mild, winters cold. Strong winds.							
Geology	Mixed rock types : grey granite, gneiss, schist, Tertiary basalt, Ordovician mudstones and shales							
Topography	Steep to very steep	Undulating to hilly	Rolling to hilly or moderately steep	Undulating or gently sloping	Rolling to hilly or steep		Rolling	Steep
Land Form	Montane slopes	Mildly dissected plateau remnant		Drainage depression			Hillock	
Soil Groups	Lithosols with some alpine humus soils	Alpine humus soils to transitional alpine humus soils at lower elevations ; lithosols on exposed sites		Peats (Humified peats)	Alpine humus soils		Lithosols	Alpine humus soils to transitional alpine humus soils and lithosols
Vegetation Structure	Alpine herbfield Alpine shrub community	Alpine herbfield Alpine shrub community Sub-alpine woodland occasionally	Sub-alpine woodland	Sod-tussock grassland	Bog and fen	Sod-tussock grassland	Alpine herb-field ; alpine shrub community	Feldmark	Sub-alpine woodland
Vegetation Floristics	*Celmisia longifolia–Poa australis* alliance ; *Oxylobium ellipticum–Hovea longifolia–Orites lancifolia* alliance	*Celmisia longifolia–Poa australis* alliance ; *Oxylobium ellipticum–Hovea longifolia–Orites lancifolia* alliance ; *Eucalyptus pauciflora* alliance	*E. pauciflora* alliance	*Poa australis* alliance	*Sphagnum cristatum* alliance ; *Carex gaudichaudiana* alliance	*Poa australis* alliance	*C. longifolia –P. australis* alliance ; *O. ellipticum –H. longifolia –O. lancifolia* alliance	*Ewartia nubigena* alliance	*E. pauciflora* alliance
Present Land-use	Plays a vital part in the hydrology of the Hume catchment. Summer grazing by beef cattle. Some tourist activities with summer hiking and winter snowsports. Water from some areas is tapped by racelines and diverted into the Kiewa catchment to augment the supplies used for hydro-electric power generation							
Potential Land-use	Primarily a water supply area ; regulation of all activities to ensure maximum efficiency for this purpose							
	Complete protection	Controlled grazing		Complete protection	Controlled grazing		Complete protection	Controlled grazing
Hazards	Deterioration of ground cover resulting from fire, over-grazing, vehicular traffic, road making, and other earth works, leading to sheet erosion, excessive overland flows and stream entrenchment			Trampling of peats, lowering of water-table, loss of hydro-logic efficiency	Deterioration of ground cover leading to sheet erosion, excessive overland flows and stream entrenchment			
Problems	Fire protection							
	Prevention of stock access. Restoration of vegetative cover.	Regulation of stock numbers and length of grazing season, based on seasonal conditions. Provision of stock water. Design, construction, and maintenance of roads, racelines and dams, if needed		Prevention of stock access. Rehabilitation of degenerate vegetation communities	Regulation of grazing. Design, construction and maintenance of earth works, if needed		Prevention of stock access	Regulation of grazing. Design, construction and maintenance of earth works, if needed

Fig. 20 – Bogong Land System

This land system occupies the highest country in the survey area, mainly along the south-western boundary of the catchment. A small part of the Bogong High Plains is included in the land system, but most of the plains are in the adjacent Kiewa River catchment. Other areas included are Mt. Bogong, the Spion Kopje-Mt. Nels-Hollands Knob area (Plate 31), the broad ridge between Middle Creek and the Big River, Mt. Cope and the ridge running to the east, Braithwaites Top extending east from the High Plains between the Cobungra River and Bundarrah River, Mt. Loch, Mt. Hotham and a narrow strip along the Great Dividing Range to Mt. Phipps that includes the headwaters of Spring Creek, and a strip of country between the Cobungra and Victoria Rivers. In the eastern portion of the catchment there are several small occurrences of this land system on, and adjacent to, the Davies Plain ridge. Much of the country above about 4,500 feet elevation is in this land system. It occupies 97 square miles which is about 2½ per cent of the catchment.

The land system is made up mainly of rolling to hilly country at high elevation, surrounded by generally steep to very steep montane slopes which fall away to country of lower elevations (Figure 20).

The average elevation of most of this country is about 5,500 feet and falls to about 4,500 feet around Mt. Phipps, but some high peaks, such as Mt. Bogong 6,509 feet, Mt. Hotham. 6,100 feet and Mt. Cope 6,015 feet are higher. The plateaux probably represent the remnants of a Tertiary surface of low relief (David 1950) on which the present peaks were, even then, prominent. The westerly extension of the Kosciusko uplift caused reversal of drainage of southerly flowing streams originating in the north. Entrenchment of streams draining the uplift resulted in destruction of most of the old surface. Because the other plateau remnants in the catchment are mainly to the north of the axis of the uplift, they are of lower elevation than those of the Bogong land system and are placed in other land systems.

On the south-western boundary of the catchment the main rock type is gneiss with occasional isolated remnants of "Older" basalt (mid-Tertiary), the largest of which occurs around Mt. Jim. Ordovician shales and mudstones occur around Mt. Hotham, and schists predominate on Mt. Bogong. The eastern occurrence of the land system is on grey granite. The most characteristic feature of the climate of the land system is the general and regular occurrence of snow during the colder months, normally between May and October. Snow may lie for up to four or five months, and longer in sheltered sites. Very low temperatures and severe frosts occur during these months. Because of its high elevation, daily summer temperatures are rarely very high and night temperatures are low (Figure 4). Annual precipitation is generally high ; the average over 18 years at Hotham. Heights is 58 inches. The distribution throughout the year is fairly uniform but there is a tendency to lower rainfall during November to March, and a peak of over 6 inches in August (Figure 2). Very strong and persistent winds, usually from the north-west, are common.

The most widespread soils of the land system are alpine-humus soils in which a dominant feature is a thick organic A-horizon. The accumulation of organic matter is aided by the generally low temperatures which also restrict chemical weathering of the rocks, and result in only limited clay formation. These soils occur over most of the area where drainage is not restricted. On exposed ridges and peaks however, the soils are usually lithosols. Peats are found where drainage water accumulates. At elevations of about 4,500 feet or lower, the effect of low temperatures is less marked and in these situations transitional alpine humus soils occur.

The rigours of the climate are such that only one tree species, *E. pauciflora,* occurs in the upper parts of the land system. It occurs in a woodland formation, referred to by Beadle and Costin (1952) as a sub-alpine woodland. Where the virgin condition has been altered by fire and the trees have regenerated by coppice growth, the present formation is more typical of a wet mallee or wet scrub. At the higher part of its range, it is generally restricted to areas where snow is least persistent, but it is more widespread at lower elevations. *E. pauciflora* does not occur on poorly-drained soils or in cold-air-drainage depressions. A closed sward of *Poa australis,* and sometimes shrubs of various species, form the ground flora.

The sod-tussock grassland of *Poa australis is* generally limited to areas of cold-air drainage. Alpine herbfields, in which *Poa australis* and *Celmisia longifolia* are dominant, and shrub communities, in which *Oxylobium ellipticum, Hovea longifolia, Orites lancifolia* and others (p. 86) are widespread, form a mosaic over most of the higher-elevation country within the land system.

The feldmark community has a limited occurrence and may be a feral community on the erosion pavements on some of the most exposed peaks, such as Mt. Loch.

The vegetation on areas which are permanently wet is usually a bog community in which moss, *Sphagnum cristatum, is* dominant or a fen with the sedge *Carex gaudichaudiana* as the dominant species.

The vegetative communities of this land system have been described in detail by Costin (1957a). The distribution of the grassland, herbfield and shrub communities is thought by Costin (1957b) to have been modified by fire and grazing.

The vegetation of the land system is sensitive to damage, most of which is caused by bad land-use. In many areas, opening up of the grassy sward has exposed the friable soil of the inter-tussock spaces to erosion by wind and water. The most severe erosion is on the Mt. Hotham-Mt. Loch ridge, and on Mt. Bogong. The erosion of inter-tussock spaces leads to further deterioration of the tussocks with consequent enlargement of the bare spaces. The loss of the soil, in many cases down to a stony or pebble pavement (Plate 21) makes the revegetation of these areas difficult. Combined with this are the effects of extremes of temperature, and frost heave, which make seedling regeneration on bare soil very difficult and unreliable. Thus, once damaged, the grassland and herbfield vegetation is slow to recover. Shrubs are the most effective colonisers of bare soil in this land system (Carr 1962). The opening of the sward and exposure of bare ground also has an adverse effect on infiltration and run-off. (Costin, Wimbush and Kerr 1960).

Trampling by cattle, and possibly burning in the 1939 fire, have resulted in widespread deterioration of the bogs. Trampling allows water to become channeled and results in lowering of the water-table in the bogs, which, as they dry out, become more accessible and suffer progressively more damage. Severe gully erosion occurs in some areas where drainage water from the Harrietville-Omeo road is channeled into drainage lines.

The easterly extensions of the Bogong land system on the Bundarrah-Cobungra divide, the Cobungra-Victoria divide and along the catchment boundary to Mt. Phipps, gradually decrease in elevation towards the east. As the precipitation decreases fairly sharply within the rain-shadow areas to the south-east of Mt. Hotham, the soils and vegetation become somewhat more typical of the adjacent Livingstone land system. Cryptopodzols and other weakly podzolised red and yellowish soils occur with sub-alpine woodland or tall woodland of *E. pauciflora*, and *E.* rubida enters the alliance in the drier, lower-elevation areas. In these areas, woodland of *E. stellulata* often occurs as a marginal strip between the woodland and the normal sod-tussock grassland and shrub communities of the cold-air-drainage areas. Sphagnum moss bogs occur in permanently wet situations. The soils of these colder areas are alpine humus soils to transitional alpine humus soils.

What appears to be slight deterioration of vegetative cover in this land system may actually be quite serious when the slowness of recovery is considered. All forms of use which are likely to cause damage should be closely studied and carefully regulated. The areas most likely to deteriorate rapidly are those exposed to the unbroken force of the north-westerly winds, and the bogs and other vegetation which are dependent on a high water-table.

This land system is of particular importance for water conservation because of its snow fields which delay the release of water to the streams and help to maintain summer flows. Grazing of cattle under annual licence has been the only form of direct exploitation. On the Bogong High Plains this is now controlled by a committee on which cattlemen, the Soil Conservation Authority, the State Electricity Commission and the Lands Department are represented. Grazing has been eliminated from parts of Mt. Bogong and the Hotham-Loch area for several years. Provided a satisfactory vegetative cover can be maintained, it may be possible to allow controlled grazing of parts of the land system. The *E. pauciflora* woodlands at the lower elevations seem to be the most suitable vegetative communities for grazing in this land system. Critical areas, such as bogs and ridge tops, should not be grazed.

One of the difficulties of allowing grazing in this area is the cost of fencing out vulnerable areas, which are usually long narrow strips, and which require considerable length of fencing to protect a relatively small area. Furthermore, maintenance costs, especially on ridge-top fences, could be high because of

damage by drifting snow during the winter. Stock watering points away from bog areas should be provided if grazing is to continue.

Studies by Costin et. al. (1961) have demonstrated the importance of the mature woodland form of *E. pauciflora* in these areas in encouraging snow-drift formation and delaying snow-melt. Thus for water conservation purposes, the replacement of the woodlands by coppice is undesirable. Thinning of the coppice regrowth to assist the rapid re-establishment of the woodland form would be desirable. Experiments should be carried out to determine the best way to achieve this.

From theoretical considerations and observation it seems that the presence of woody vegetation in the snow pack induces early and more rapid melting (A. S. Rundle priv. comm). This means that the extension of shrub communities at the expense of grassland or herbfield can be regarded as undesirable, and methods of hastening the shrub succession and the re-establishment of the herbaceous vegetation should be investigated. Carr (1962) suggested that the shrub life cycle is prolonged by pruning as a result of trampling by grazing stock. This is an argument for exclusion of grazing from shrub areas.

Other urgent problems are re-establishment of the bogs and the attaining of a closed vegetative cover on eroded areas. The rehabilitation of the bogs may be speeded by the provision of small, temporary stream blocks to raise the water-table and provide a suitable environment for the spread of remnants of moss.

In places, the snow-grass cover is so damaged that active conservation measures may have to be undertaken to assist revegetation. Some form of mulch may provide sufficient protection to allow the establishment of vegetation on such areas. However revegetation works of this nature are expensive. Costin and Wimbush (1963) have reported success in encouraging secondary succession on eroded areas in the Snowy Mountains by the use of naturally-occurring herbaceous mulch.

Many parts of the area are popular for winter snow sports, and it has a constant appeal to the tourist in either summer or winter. Control of tourist activities, particularly the siting of huts, lodges and access tracks, is necessary, and to ensure that erosion is not started, traffic should be restricted to established tracks.

Where the road from Harrietville to Omeo passes through this area another problem occurs. Adequate drainage is essential for the maintenance of the road, and because of the large surface flows during the thaw, frequent culverts are necessary. The concentration of drainage water from above the road and from the road surface into the easily-damaged vegetation can result in severe gully erosion. Some form of water-spreading device should be used to ensure that water from culverts is distributed over a wide area which should be in sound condition and capable of withstanding the additional water.