Managing visitor impacts in the Australian Alps: a case study in informal track development and track recovery

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Abstract

Visitation to protected areas is increasing worldwide, causing increasing pressures on areas that are often principally conserved for their natural and cultural heritage values. The Australian Alps have been no exception with a continuing increase occurring over the last 25 years. Visitation to the Kosciuszko Summit Area (Australia's highest mountain) in Kosciuszko National Park, for example, has increased from an estimated 20 000 visits per annum in the late 1970s to over 100 000 per annum by the year 2000. The most common activity of these visitors is walking from one of two main park entrance points to key landmarks within the area. While hardened areas can contain some of the impacts of these visitors, damage from off-track walking can rapidly occur and is slow to recover in this alpine environment. This paper presents a case study from the Kosciuszko Summit Area on track development and recovery in tall alpine herbfields, the area's dominant vegetation community. Results from experimental off-track walking studies demonstrate that longer-term damage can occur after only moderate usage levels (as little as 200 passes). Results from a study on a closed walking track in the area further provide examples of the slow recovery of the vegetation and soils once damage has occurred, with significant differences from undisturbed conditions remaining evident for vegetation cover, soil nutrients and species composition 20 years after track closure. Locally appropriate solutions are required to ensure that a sustainable level of tourism and visitor use can continue to occur in the area. The use of proactive management tools is discussed with regard to a damage prevention/minimisation approach.
Keywords: track recovery, visitor impacts, Australian Alps, protected area management, trampling.

1 Introduction

Ecosystem conservation is becoming increasingly important amid global trends of declining biodiversity, multiplying land use activities and mounting external pressures such as enhanced climate change [1, 2]. Mountain areas contain some of the last relatively undisturbed terrestrial ecosystems due to their generally remote locations and harsh environments. These environments often exhibit high species diversities in relatively small areas due to an extensive range of microclimates arising from exaggerated environmental gradients [3].

Anthropogenic pressures in mountain areas arising from activities such as forestry, livestock grazing, mining and tourism can dramatically increase the rate and extent of change occurring in dynamic natural ecosystems [4]. Negative impacts from human land use can, however, be limited through planning and management. At the same time, stabilisation and restoration efforts are often required to mitigate effects of previous land use activities [5]. A sustainable management response to deal with such pressures requires a detailed understanding of the ecology of the ecosystems, including the response to anthropogenic disturbances and subsequent recovery processes [2, 6, 7].

Many of these ecosystems have been protected in parks and reserves which were established to protect biodiversity, scenery, and to provide recreational opportunities [4, 8]. For example, 79% of the alpine bioregion of Australia is conserved in a series of linked protected areas [9]. Globally, about 32% of protected areas are in mountain regions [4].

Tourism around the world often occurs in natural areas that have high conservation value. The natural environment itself may be the attraction, or it may provide the setting for some other activity such as bushwalking or camping. Although it is difficult to accurately estimate visitation levels for protected areas around the world, tourism and recreational use has increased in natural areas over the last 30 years: tourism to natural areas has risen from approximately 2% of all tourism in the late 1980s to an estimated 20% of all tourism after 2000 [10].

Within Australia, visitation to protected areas has also followed this trend with significant growth over the last 10 years. In New South Wales for example, visitation to protected areas was estimated as approximately 18 million in 1995 but has grown to an estimated 22 million in 2005 [11, 12]. Recreational use in Kosciuszko National Park, one of the most popular parks in New South Wales and containing a substantial portion of Australia's alpine and subalpine environments, has also shown increases during the non-winter period. In the late 1970's, visitation to the Kosciuszko Summit Area, the main alpine area surrounding Mt Kosciuszko (Australia's highest mountain), was estimated at 20 000 visits during the non-winter period (when most visitor impacts occur) [13]. Visitation had risen, however, to an estimated 102 000 visits during the 1999/2000 non-winter period with approximately 47 000 visits undertaking activities of a half a day or more.

The gathering and application of information on natural systems, and changes occurring in them, is fundamental to sustainable management [14, 15]. This is particularly important in parks where the conservation of land and provision of sustainable recreation opportunities is mandated through legislation. Information about the resilience of different vegetation communities from increasing visitor use and about their ability to recover after disturbance will allow more informed management decisions and assist with balancing conservation and recreation objectives [16].

This paper discusses two studies within the Australian Alps that examine the consequences of increasing visitor use within an area of high conservation value. The first study considers the development of tracks as a result of trampling activities while the second study considers the recovery of a closed trail after years of high use.

2 Visitor management in the Australian Alps

2.1 The Australian Alps: what sets them apart

Only 1.5% of the global alpine areas are located between the southern latitudes of 30° and 40° [17]. This band includes the Australian Alps which form the southern end of the Great Dividing Range, running parallel to Australia’s east coast for over 2000 km, about 50 to 150 km inland. The Australian Alps extend from the high country of the Australian Capital Territory (ACT), through the Snowy Mountains in New South Wales (NSW) to the highlands of Victoria. Other alpine and subalpine areas are found in Tasmania, south of the Australian mainland.

The Australian Alps are distinctive from mountain areas in other parts of the world in many ways, including aspects of soils, flora, fauna, climate and topography [18, 19]. Many of the values of the Australian Alps are found in the differences from, rather than conformity to, the stereotypic images of steep slopes, high rocky outcrops and towering mountain peaks, which are often associated with alpine areas elsewhere [18].

The deep alpine humus soils cover almost the entire area and have formed independently of the underlying rock types [20]. Compared to most mountains elsewhere, which have been subject to centuries of human occupation and associated uses, the Australian Alps are in a relatively ‘untouched’ state [21]. Its alpine biota has evolved in the absence of substantial grazing and trampling by vertebrates. Only recently, with the introduction of hard-hoofed livestock (e.g. cattle and sheep) and feral animals (e.g. pigs, horses and hares), has the vegetation been affected by large herbivores [18, 22, 23].

The tree line is around 1830 m which, like in many other mountain environments, coincides with a mean temperature during the warmest month of about 10°C [17, 24]. The alpine zone is dominated by tall alpine herbfields and heath communities with other smaller communities occurring in areas limited by physiographic limitations. Tall alpine herbfields are the most widespread and species rich of the alpine communities and occur wherever well developed alpine humus soils are found [25]. The community is dominated by snow grasses (*Poa* spp.) and herbs including snow daisies (*Celmisia* spp.) and billy buttons (*Craspedia* spp.) that produce spectacular flower displays during the summer months.

2.2 Visitor activities in Kosciuszko National Park

Kosciuszko National Park is the largest protected area within the Australian Alps and contains the largest contiguous alpine area in Australia (100 km^2) which is centred around Mt Kosciuszko. This area is recognized as an area of 'Outstanding Natural Value' by the 1982 Kosciuszko National Park Plan of Management. At an international level, Kosciuszko National Park is recognized as a World Biosphere Reserve under the UNESCO Man and the Biosphere program and is one of 167 centres of biodiversity identified by the World Conservation Monitoring Centre [26].

Tourism is the single largest form of land use in the alpine area of Kosciuszko National Park. During the non-winter months many visitors are attracted to the area to ascend the Mt Kosciuszko summit while others are attracted to the unique natural scenery and mass floral displays.

Of those arriving in the Kosciuszko Summit Area, almost 80% are undertaking walking activities with more than half of this number (approximately 47 000 visits) undertaking walks of a half day or more [26]. Almost 2 000 visits to the area each year undertake camping activities (about 1.9% of total visitors), with mountain biking and sightseeing also occurring [26].

While many visitors tend to remain on the hardened tracks, others depart for untracked destinations and can often cause damage to the environment. Pad and informal track creation is one result of this behaviour where visitors head off to mountain top peaks that had no specific trail access [27]. Damage to vegetation cover in this particular case may be exacerbated as a result of physiographic factors (such as slope) that can lead to greater erosion risk.

2.3 Visitor impacts

2.3.1 Trail development from trampling

The impacts of trampling on vegetation and soils are perhaps one of the most extensively studied areas in recreation ecology with studies undertaken in a diversity of environments around the world [28]. These studies have indicated that the intensity of impact and the time of recovery can vary depending on specific environmental conditions.

Understanding the ecological consequences of disturbances to vegetation and soils in high elevation vegetation communities, including disturbance from trampling, is important as these environments are easily damaged and can require long periods to recover from even limited degradation [17, 29]. Accordingly, trampling studies have been conducted in mountain environments around the world including North America [30-32], Europe [33, 34] and in Tasmania, Australia [35, 36].

Using methods proposed by Cole and Bayfield [37], the damage caused by increasing intensities of trampling (0, 30, 100, 200, 500 and 700 passes) have been assessed within five tall alpine herbfield sites in Kosciuszko Summit Area. Vegetation parameters examined included height, cover and diversity. Initial trampling intensities were applied over a single day during the early summer with repeat trampling of the same intensities occurring at each site one year later.

Following initial trampling, significant changes were found for some vegetation parameters. Initial trampling at intensities of 500 passes caused an immediate reduction in height with some differences from the control remaining evident after one year. Repeat trampling one year after initial trampling once again reduced height. Significant differences from the controls now remained evident after one year's recovery for 200 passes [28].

Vegetation cover was also significantly affected by trampling, though no changes appeared to occur for species diversity. During initial trampling, dead material increased from around 15% cover to more than 50% cover two weeks after trampling. An estimated 400 passes were required to cause this damage. There was limited or no evidence of recovery after one year. Repeat trampling one year after initial trampling appeared to further compound the damage with a 50% reduction in vegetation cover now evident from 200 passes and significant differences from the controls evident after 100 passes [28].

Despite decreases in live vegetation cover as a result of intense trampling, little bare ground was exposed after initial trampling at any intensity applied. The dead material tended to remain in place limiting soil exposure. After repeat trampling, however, some bare ground was exposed after high intensities of trampling (500+ passes) [28]. While this represented less than 5% of cover, it is of concern as resilience is low and continued trampling will result in clearly defined informal tracks. As the dead material becomes detached and removed, the amount of bare ground could potentially increase attracting more walkers along the developing track.

Although impacts from trampling are often significant, as demonstrated in the Australian Alps, the total area of disturbance has been described in other mountain areas as being small [38]. If not effectively managed however, the impact of trampling can develop to a point that degrades the environment as well as visually marks and fragments the landscape. This is of particular concern in the Australian Alps because of its extensive soil and vegetation cover, which once disturbed, is highly susceptible to erosion.

As one of the most common communities in the Kosciuszko Summit Area, identification of thresholds of disturbance in tall alpine herbfields is important in ensuring appropriate management regimes continue. While resistance to damage is moderate, resilience is low and this compounds with repeat trampling. Such results are of concern as many of the other vegetation communities found in the area are likely to have even lower resistance to damage while retaining a low level of resilience. This slow rate of recovery of tall alpine herbfields is examined further in the following case study (section 2.3.2).

These results of trampling damage in this area reinforce that where recreation use cannot be maintained beneath sustainable levels, substantial damage is inevitable [36, 39]. Throughout Kosciuszko National Park, a policy of dispersal currently exists when going off designated tracks and generally this appears to have been effective, as informal track creation appears to be minimal. This policy is likely to remain effective if use levels remain low and visitors continue to spread out when off designated tracks.

2.3.2 Recovery of closed tracks

Where trampling intensities are substantially higher and are not catered for through appropriate management actions, the damage caused can be substantially larger and last significantly longer. Most tracks in the Kosciuszko Summit Area are user defined and thus have often developed without due regard to topography, vegetation and substrate. Combined with the physical characteristics of the area's hydrology, extensive soil cover and erosive climatic conditions, track deterioration has been an ongoing problem and has been addressed in many different ways which has generally focused on fixing problems on the existing tracks. A variety of hardening techniques have been applied.

Along one of the key access routes to Mt Kosciuszko, the access track from the alpine village of Thredbo, increasing levels of visitor use over a period of about 15 years resulted in severe damage to vegetation and soils. The track, which lead largely through tall alpine herbfield vegetation, had developed from informal use by visitors keen to access key vantage points. With increasing use the track became severely eroded and widened as extensive ribboning occurred. After trialling different methods of track improvements, park management decided to construct a raised metal walkway and to close and rehabilitate the existing track.

Twenty years after track closure, vegetation and soils along the four kilometre walking track were compared with adjacent undisturbed vegetation and soils. Results showed clear differences remaining in soil nutrients, extent of vegetation cover, plant species composition and height of vegetation between the track and adjacent undisturbed vegetation. Soil nutrient levels (Ca, Mn, N, Mg, P), organic content, and conductivity on the closed track were significantly lower than in undisturbed vegetation, indicating that time alone is not sufficient to achieve soil recovery in the shorter term, particularly where erosion is likely to contribute to further nutrient loss [40, 41]. Bulkdensity, an indicator of compaction, remained significantly higher of the track than in undisturbed vegetation [41]. Vegetation cover and height also remained significantly lower on the track compared to undisturbed vegetation [41]. Vegetation cover on the track was found to be only 64% compared to 89% in undisturbed vegetation areas while bare ground cover remained at 26% and 1% for each area respectively [40]. The remaining cover was attributed to litter (8%; 9%) or rock (3%; 1%)[40]. The seed mix applied after track closure contained significant amounts of non-native species that remained prevalent after 20 years of recovery, providing 32% of overlapping vegetation cover on the track, compared to less than 1% in undisturbed vegetation [40].

The results of this study highlight the need for prevention of disturbance and for ongoing rehabilitation in areas that have been disturbed, as natural recovery is very slow and there is potential for further deterioration because of continuing exposure of bare ground. It also indicates that when non-native species are used in rehabilitation, they may not necessarily be succeeded by natives, particularly if soil conditions do not return to a state similar to undisturbed areas.

3 Management implications: some lessons from the roof of Australia

Damage within the Australian Alps from tourism and/or recreation activities can occur relatively easily but, as occurs in many other alpine environments, is slow to recover. Prevention of damage remains the most effective approach to the conservation of the area. The development of sustainable visitation plans and approaches is therefore essential in achieving this.

Within the Australian Alps, the provision of appropriate visitor facilities, the promotion of minimal impact practices and continued research is ensuring that damage caused by visitors remains minimised or at least contained. The installation of a raised metal walkway from the major access point of the alpine village of Thredbo to Mt Kosciuszko, for example, has minimised the impacts associated with track development and other site hardening as demonstrated in the above study and in others [42]. This approach contains visitors to the walkway as they are reluctant to step off into undisturbed vegetation (personal observation by authors). Loss of vegetation cover and soil has been minimised and subsequent rehabilitation of the area, should the track ever be removed, would be minimal, as the light transmitting walkway design does not inhibit vegetation growth even directly underneath it [42].

Minimal impact codes promoted within the wider area also positively assist in containing the damage caused by visitors. While many of the visitors to the Kosciuszko Summit Area remain on tracks each year, almost 2 000 visitors depart off track as a part of camping activities, with significantly more likely to depart tracks to view wild flower displays and reach untracked mountain peaks. The research undertaken on thresholds for tall alpine herbfields demonstrates that this level of visitation could rapidly result in informal track formation. Despite this, a maze of informal tracks is not found in the area. This perhaps can be attributed to the promotion of visitor dispersal when off track.

Continued visitor research in environments that are sensitive to disturbance such as this is essential. If damage is slow to recover, then having an understanding of what levels of sustainable use can occur (such as trampling limits) is invaluable in ensuring that appropriate approaches to visitor management are taken. Conversely, such research will also provide an indication of visitor use levels where new tracks are being formed within untracked areas. Appropriate management decisions can subsequently be made either to close off the area or provide some form of appropriate visitor infrastructure.

Sustainable visitation of mountain conservation areas requires a clear strategy on dealing with changing visitor numbers through identifying key assets and values and focussing management decisions to maintain or enhance them. Monitoring of current activities and proactive research to understand the underlying ecological systems is important and should be given a high priority to be able to address potential problem issues before they arrive. A comprehensive management approach should include education and interpretation to support the effectiveness of provided infrastructure and encourage damage prevention in areas with little or no infrastructure. While track hardening is often the preferred option in high use areas, the effectiveness and costs (including environmental, maintenance, and potential removal and rehabilitation costs) of different hardening options should be evaluated. As shown in the track recovery study, where disturbance has occurred, an ongoing commitment to restoration is required as natural recovery is very slow to occur.

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