Assessing the relative impacts on plant composition and functional composition from mountain biking and hiking

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Introduction

Mountain biking is an increasingly popular activity in natural areas in North America, Europe and Australia. Conflict involving mountain biking in parks often revolves around concerns regarding its relative environmental impacts compared to other activities such as hiking and horse riding (Marion and Wimpey 2007). Despite an increasing literature on the environmental impacts of a range of recreational activities, there is still limited directly comparative research on the impacts of mountain biking and other activities such as hiking (Thurston and Reader 2001; Pickering et al. 2010). Consequently, we compared the relative impacts of mountain bike riding and hiking off trail using a modified common trampling experimental methodology to address this often controversial issue.

Study area

The experiments were conducted in Kosciuszko National Park (6900 km^2), in south eastern Australia, which is a UNESCO biosphere reserve and receives around three million visits a year, although mostly in winter. Mountain biking is an increasingly popular summer activity in the Park and is being actively promoted and supported by ski resorts, the park agency and local tourism operators.

Methods

A randomized block experimental design was used where seven treatments (control with no riding or hiking; 25, 75, 200 and 500 passes by bike riders; and 200 and 500 passes by hikers) were randomly allocated to one of seven 4 x 0.25 m quadrats on untrampled, ungrazed subalpine grassland in six replicate blocks (e.g. 6 replicates for each treatment) (see Pickering et al. 2011 for further details). Plant height, vegetation cover, and the cover of each species was measured in each of the 42 quadrats two weeks after they were ridden on/trampled. Data on four vegetative functional traits that are important in terms of competition and stress (canopy height, leaf area, percentage dry weight of leaves and Specific Leaf Area) for each species were obtained from a database of functional traits for Australia alpine and subalpine plants (Pickering and Venn 2013).

From the trait data, we calculated the functional composition for each quadrat as community trait weighted means (CTWM), where the traits of each species were weighted by its relative cover to give an overall average community trait value per quadrat (Pickering and Venn 2013). Single dependent variables were analysed using One-Way Randomized Complete Block ANOVA, while plant and functional composition were analysed using ordinations and ANOSIM.

Results

Mountain biking and hiking both had negative impacts on vegetation. For mountain biking this included significant reductions in vegetation height, cover and species richness, as well as changes in species composition and increased litter compared to control quadrats. The greatest impact occurred after the largest number of passes, with a 43% reduction in height, 25% reduction in vegetation cover, and 40% few species per quadrat after 500 passes by bike riders. These impacts were either the same or only slightly greater than those from the equivalent number of passes by hikers. After 500 passes by mountain bikers there were greater declines in vegetation cover than from 500 passes by hikers, with herb cover particularly sensitive to riding, resulting in increased litter, and greater reductions in species richness compared to hiking. There were no significant differences between the two activities in their relative impacts on the cover of shrubs and graminoids or vegetation height.

The effects of riding and hiking on dominant species in this community differed. The taller tussock Smooth-blue Snow Grass (*Poa fawcettiae*, 95% overlapping cover) that has large tough leaves was more resistant to both activities than the low growing herbs with small thin leaves such as *Asperula gunnii* (33%). Consequently, the relative cover of *P. fawcettiae* increased with use by mountain bikers and hikers while that of *A. gunnii* dramatically decreased. These changes in the relative proportion of the two species resulted in unanticipated changes in CTWM with the vegetation remaining after mountain biking and hiking dominated by more resistant plants with larger tougher leaves.

Discussion

This research demonstrates that both mountain biking and hiking can damage vegetation when they occur off trails and that their relative impacts per fixed distance may not be as different as previously indicated. The resistance of the vegetation to damage from either activity was primarily driven by the different responses of two species; the dominant grass was relatively resistant to trampling while the most common herb was not. These responses resulted in some unexpected changes in the functional composition of quadrats. Further research in different ecosystems with other combinations of species and functional traits is required to test the generality of the results obtained here. Considering the political and social sensitivity regarding this issue, and its importance in terms of justifying management decisions, such research should be a priority.

References

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Figure 1. Experimental mountain biking riding in action on Australian subalpine grassland.