

## Waste management in mountain protected areas

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### Abstract

Mountainous protected areas are increasingly popular tourist destinations. This increases the amount of waste generated, which is particularly difficult to manage because of remoteness, difficult terrain and extreme environmental conditions. The 'Waste Management Outlook for Mountain Regions - Sources and Solutions' report finds that waste in mountains deserves further attention from scientists, protected areas managers, policy makers and tourists. The poster 'Waste management in high altitude protected areas' will present key findings of the report relevant to both scientists and protected areas managers, as well as suggestions for how to jointly address these issues by concerned actors.

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### Keywords

protected areas, tourism, recreation, waste, pollution, waste management, mountains

### Introduction

Mountains cover 23 per cent of the world's total land surface and represent 32 per cent of the extent of the world's terrestrial protected areas (PAs) (SPEHN et al. 2005). Due to the high geodiversity of mountains, these ecosystems are associated with the high biodiversity and species endemism (THORSELL & HAMILTON 2002). Many mountain PAs are experiencing a growing solid waste problem from increasing tourism, but options do exist to prevent and manage waste in mountain environments, in ways that protect mountain ecosystems and prevent problems from flowing downstream.

### Methods

The poster 'Waste management in mountain PAs' presents the main findings of the report 'Waste Management Outlook for Mountain Regions - Sources and Solutions' (ALFTHAN et al. 2016) as part of a series on waste management issues by UN Environment and its International Environmental Technology Centre (IETC). The report was developed based on desk research and a consultation meeting at the World Mountain Forum in Mbale, Uganda in 2016 with stakeholders from mountain regions in Africa, Latin America and Europe. An advisory board consisting of waste and mountain experts, representatives of national ministries, regional and international organizations including the International Centre for Integrated Mountain Development (ICIMOD), provided additional input. The Outlook applies a definition for mountains which combines elevation and slope angles (KAPOS et al. 2000).

### Results

PAs in mountain regions are increasingly popular tourist destinations (THORSELL & HAMILTON 2002). For example, the number of foreign visitors to the Huascarán National Park, Peru increased from 10,678 in 2011 to 48,971 in 2015, representing an almost fivefold increase in visitor numbers. The growth in tourists in popular mountain PAs is accompanied by increasing waste issues. Factors such as seasonality of mountain tourism, and lack of infrastructure, makes it difficult to manage waste. For example, up to 140,000kg of solid waste is estimated to remain in the Sagarmatha National Park in Nepal after 60 years of mountaineering expeditions to reach Mount Everest (KELLIHER 2014). During the peak tourist season, the amount of waste generated there can reach double the amount of waste generated during the rest of the year. In this National Park and its buffer zone, waste generation ranges from 4.6 tons per day during the peak season to 2 tons per day at other times of the year (MANFREDI et al. 2010).

## Discussion

The most common forms of waste from mountaineering are human waste (excreta and urine), other solid waste material associated with equipment and supplies (for example, tin cans, oxygen bottles, batteries, plastic bags, etc.), as well as waste from pack animals (UNEP, 2007). Waste from pack animals, coupled with human waste, increases eutrophication, algal growth and toxicity of water bodies (DERLET et al. 2008). In parts of some mountain PAs, such as in the Huascarán and Aconcagua National Parks in Peru and Argentina, pastoralism adds to the environmental stress and waste issues. Bacteria and other pathogens associated with human waste contaminate waterways and soil surfaces and can persist in these environments despite the extreme conditions (DERLET et al. 2008; GOODWIN et al. 2012). Gravity and rivers also enlarge the footprint of mountain waste, given the potential they have to transport and carry this waste downstream. Therefore, inadequate treatment or disposal of waste in mountains, not only creates risks for ecosystems and humans in mountains, but also pose impacts for regions downstream.

For PAs in the developing world it is particularly difficult to address the surge of litter from tourists. Remoteness, difficult terrain, low temperatures and other extreme environmental conditions, poor socio-economic conditions, and vulnerability to natural hazards, makes waste management in mountains more challenging than in lowland areas. Removal of waste from remote areas, such as with fly-out systems and the use of advanced technologies for on-site treatment at high altitudes, is often very expensive (ROBINSON 2010; GOODWIN et al. 2012). Lower temperatures at higher altitudes also result in slower rate of decomposition of organic matter (COOPERBAND 2002). The most common practice for waste disposal adopted by mountaineers in remote alpine environments is to leave the waste behind, buried in soil or snow, or dropped in glacier crevasses (DERLET et al. 2008; PICKERING & BARROS 2015).

In line with the polluter pays principle, the mountain tourism industry and tourists themselves should contribute and bear some of the responsibility for financing the management of their waste. PA authorities should also share and bear this responsibility as part of their mandate to protect. Partnerships between tourism operators and PAs should be encouraged. Waste management should be integrated in the tourism industry, such as bring-back-your-waste policies and re-directing fees (e.g. entry fees) into waste management. Tools such as Corporate Social Responsibility and tourism eco-labels should be considered for the mountain context. Global mountaineering organizations such as the International Climbing and Mountaineering Federation (UIAA) and the International Federation of Mountain Guide Associations (IFMGA), as well as national organizations should revise procedures, guidelines, training and certification practices to integrate awareness for waste issues in mountains. Mountaineers should also actively engage in the broader policy and management discussions to bring their experiences to the decision-making table both in PAs and in national policy.

## Conclusion

Studies indicate that the composition and volume of waste in mountain PAs across the globe can change rapidly, when these areas experience increasing numbers of visitors. However, in many cases there has still not been the necessary behavioral and policy changes to address the associated problems. Major knowledge gaps exist in terms of waste generation and treatment solutions in mountain regions and PAs in particular. Research is also needed to better understand the relationship between different waste streams and their biophysical impacts on sensitive mountain environments as well as on downstream areas. Applied and participatory research with PAs is particularly important to better understand existing attitudes to waste and how to best trigger behavioral change among mountaineers and other visitors as well as technical solutions suitable to challenging environments and different socioeconomic conditions.

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