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Role of site management in influencing visitor use along trails in multiple alpine protected areas in Norway

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ABSTRACT

Site-level management such as the construction of parking lots, formal trails and other visitor facilities is a common means of confining visitor use in protected areas. The effectiveness of site management, in terms of providing visitor access while limiting impacts, has not been broadly evaluated in parks in the Nordic regions given the tradition of open access and the prevalence of multiple entry points. Moreover, in Norwegian parks, visitor facilities are often provided by the Norwegian Trekking Association, which is the country's largest outdoor organization, and have originally been designed for public access to recreation rather than to meet management objectives in protected areas. In this study, we explored whether formal trails tend to focus visitor use by assessing observable indicators of visitor use along 64 formal trails (417.3 km) and 234 informal trails (66.9 km). The assessment was conducted across a vast geographic area consisting of 11 protected areas in the Alpine North Environmental Zone in Norway. We found that Norwegian protected areas generally have low level of observable visitor use along informal trails. In comparisons, importance of site management was statistically evident only for the presence of trash, as facilities such as marked trails and parking lots were negatively related to amount of trash along associated informal trails. There was also a trend of less use along informal trails depending on the degree of site management present in the parks.

Management implications:

- Site-level management tends to confine visitors to established routes thereby minimizing the proliferation of visitor impacts in protected areas.
- Marked trails and parking lots result in less dispersion of visitor use.
- Broad scale monitoring by line transect sampling provides a cost-effective method to compare visitor use distribution and observable visitor impacts in multiple protected areas.

1. Introduction

Recreation and tourism use in protected areas continues to increase in many locations worldwide (Balmford et al., 2015; Cordell, 2008). Although the degree of ecological impact caused by visitor use is dependent on many factors such as ecosystem type, use intensity, timing of use, and type of visitor activity (Hammitt, Cole, & Monz, 2018; Pickering, 2010), understanding the spatial distribution of visitor use has been receiving increased attention in the literature recently (e.g., Monz, Cole, Leung, & Marion., 2010; D'Antonio and Monz, 2016). This increased focus on the spatial aspects of use is due to the importance in understanding use characteristics at a range of spatial scales and in managing the overall area affected by recreation in many protected areas (Cole, 2004; Monz & Leung, 2006).

The assessment of informal trails created by visitors is often used as an indicator of off-trail hiking behavior. Understanding the physical characteristics of informal trails, which can often form extensive networks, provides information on the spatial extent of human activities in parks and other protected areas (Hagen, Vistad, Eide, Flyen, & Fangel, 2012; Leung, Newburger, Jones, Kuhn, & Woiderski, 2011; Marion, Leung, & Nepal, 2006; Monz et al., 2010; Monz, Marion, & Reed, 2012; Walden-Schreiner & Leung, 2013; Wimpey & Marion, 2011). However, as trails could also be created by livestock and wildlife, knowledge about the visitor use of informal trails is crucial for managing protected areas. This is particularly the case in Norway where sheep and reindeer grazing are prevalent (Austrheim, Solberg, & Mysterud, 2011) and the public right of access or *Allemannsretten*, grants locals and tourists alike rights to access and move freely on all open lands either public or

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private (Anononmous, 1957). In addition to hiking and camping, *Allemannsretten* also allows for traditional activities such as harvesting berries, mushrooms, herbs or other plants, and the preferred locations of these activities may not always be served by the formal trail system (Hammitt, Kaltenborn, Emmelin, & Teigland, 2013; Kaltenborn, Haaland, & Sandell, 2001; Gundersen, Mehmetoglu, Vistad, & Andersen, 2015). Increased visitor use of informal trails in remote areas could increase access to vulnerable sites, disturb wildlife and their habitats, spread weeds and non-native species, and fragment landscapes (Bradford & McIntyre, 2007; Hagen et al., 2012; Leung & Marion, 2000; Manning, Jacobi, & Marion, 2006; Pickering, 2010; Wimpey & Marion, 2011). For example, the protected area networks in southern Norway support the last remaining populations of wild reindeer (*Rangifer tarandus*) in Europe and increased visitor use has been associated with changes in their condition and spatial distribution (Gundersen et al., 2015; Gundersen, Nerhoel, Strand, & Panzacchi, 2013; Strand et al., 2014). Resource subsidies (i.e., food) brought by visitor use may further favor generalist predators or scavengers on behalf on the native wildlife species such as ground nesting birds and Arctic fox (*Vulpes lagopus,* e.g., Hagen et al., 2012; Newsome et al., 2015). Therefore the dispersion of visitor use along the trails and around visitor facilities needs to be monitored and managed.

Limiting access by area wide or individual track restrictions, is a management strategy rarely applied in Norwegian protected areas (Engen et al., 2018; Gundersen et al., 2015). Visitors often enter from multiple locations without registering or paying fees regardless of whether facilities are available (Hausner, Engen, Bludd, & Yoccoz, 2017). Site management is therefore a preferred management strategy, with the use of physical infrastructure and visitor facilities becoming more common (Gundersen et al., 2015). Site level management has been widely used to manage human impacts in sensitive ecosystems by limiting spatial extent of visitor use (Yale, 1991; Hall & McArthur, 1993; Curthoys, 1998; Kuo, 2002; Hammitt et al., in press). Park facilities such as formal trails, boardwalks, and designated sites often serve the dual objective of providing visitor amenities and access while protecting park resources. The utility and appropriateness of designating trails and providing facilities is dependent on the context, with factors such as desired objectives, visitation levels, and activity types influencing specific designs and applications (Marion & Reid, 2007). Regardless, appropriate management of gateways and trails concentrates visitor use and influences the formation of destinations and travel routes in parks, often referred to as the node and linkage patterns (Manning, 1979; Monz, Cole et al., 2010). Particularly, formal trails can protect resources by concentrating visitor use impacts, and are regarded as one of the most important park facilities in protected areas (Hill & Pickering, 2009; Marion & Leung, 2001, 2004). While the absence of visitor facilities may remain the best strategy from a visitor experience perspective in some protected areas, controlling the spatial distribution of visitor use by site level management (e.g., concentrating visitor use impacts on maintained formal trails) is generally considered desirable for protected areas with increasing visitation levels (Leung & Marion, 1999; Marion & Leung, 2004; Park, Manning, Marion, Lawson, & Jacobi, 2008; Wimpey & Marion, 2011).

Managers and scientists need to monitor and assess visitor use impacts on ecosystems at larger spatial scales (e.g., potentially across several protected areas) to understand the dynamics of visitor use impacts at the ecosystem level (Fancy, Gross, & Carter, 2009; Monz, Cole et al., 2010). Also, many protected area agencies are currently not able to conduct visitor monitoring sufficiently due to limited financial and human resources (Buckley, 2003; Hadwen, Hill, & Pickering, 2007). In Norway, visitor monitoring has been limited, but a new national park branding and visitor management strategy is currently being implemented, that expects all national parks to have a plan for visitor monitoring in place by 2020 (Higham et al., 2016). The new visitor management strategy strives to increase local value creation through attracting visitors to Norwegian national parks by providing good visitor experiences, while strengthening the protection of park qualities by improved visitor management (Norwegian Environmental Agency, 2015). A broad scale approach using a sampling of observable indicators can provide a cost effective method to document visitor use distribution on park level and could be useful for implementing this new visitor management strategy.

Given this background, we designed this study to better understand visitor use and associated impacts along formal and informal trails in eleven Norwegian protected areas. In these locations, actual counts of visitors are difficult to obtain due to many of the aforementioned issues. We therefore relied on assessing the occurrence and location of physical evidence of visitors as indicators of use. This objective was particularly challenging given the lack of formal access points in many locations, so our study relied on a sampling strategy of likely access locations and indirect, observable measures of visitor use. Specifically, the study addressed the following research questions:

- What are the primary observable indicators of visitor use in Norwegian Protected areas?
- Using observable indicators of visitor use, how does use vary on formal trails and informal trails?
- Does the level of park infrastructure affect the frequency of occurrence and distribution of observable indicators of use?

2. Methods

2.1. Study area and park selection

Approximately 17% of mainland Norway is protected by 37 national parks (10%), 202 protected landscapes (4.5%), and other types of protected areas (2.5%) under the Nature Diversity Act (Statistics Norway, 2014). Many of the protected areas are located in the Alpine North Environmental Zone, a region derived from a stratification of Europe based on climate, geomorphology, geology and soil characteristics. The Alpine North covers mountains and uplands in Scandinavia, and is dominated by arctic, arctic-alpine and dwarf shrub tundra, and various forest types (Jongman et al., 2006; Metzger, Bunce, Jongman, Mucher, & Watkins, 2005).

We included a large number of parks in effort to contrast the levels of park management, that is, some parks are highly managed with formal trails and other infrastructure, while others have little management presence and infrastructure. The selection criteria were that the park: (1) should be alpine and situated within the Alpine North Environmental Zone; (2) must have been established earlier than 2003; and (3) needs to have a management plan, so that information about the management is available for analysis. We also included two protected areas that did not have management plans (Stabbursdalen NP and Øvre Dividal NP) in Northern Norway to ensure a wide geographic gradient, which covers a distance of over 1200 km from south to north. One park (Stabbursdalen NP) was later excluded due to logistical difficulties. We sampled five national parks (NP) and six protected landscapes (PL) during the summer visitor season, from late June to early September (Fig. 1).

2.2. Selection of sampling locations

We first identified entry points on topographical maps (1:50,000 scale) for trails leading into the parks. A circular arc was drawn from the road access point to 5, 7.5 or 10 km radius, depending on the size and shape of the protected area (Fig. 2). A sufficient number of circular arcs were randomly selected until the arcs represented approximately 10% of the total area in each protected area. All formal and informal trails located in these circular arcs were sampled.