

# 9.1. Temporal evolution and distribution of ecosystem services of Sierra Nevada

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## Abstract

Evaluations of ecosystem services for environmental management have been increasing considerably in recent years. However, there are hardly any applications to the management of protected areas. Therefore, a participative workshop was organized with managers and researchers associated with the Sierra Nevada National Park, in order to evaluate the perceptions of the participants on the time evolution of the ecosystem services and their spatial distribution (including the supply and demand of services). The results show that certain ecosystem services such as the control of erosion or the aesthetic values are diminishing, while others, such as eco-tourism, rural tourism and scientific knowledge are increasing. The services are generated primarily by the protected ecosystems of the Sierra Nevada, especially the summit areas, while most of the beneficiaries of these services live outside the limits of the National Park, in Granada and other nearby populations.

### > Aims and methodology

The creation of protected areas is one of the main strategies to conserve nature [1,5]. Several international initiatives have highlighted the importance of considering the ecosystem services in conservation, emphasizing the Millennium Ecosystem Assessment (MA), The Economics of Ecosystems and Biodiversity (TEEB), and the Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES). In this work, a preliminary approach to the inclusion of ecosystem services in the management of the Sierra Nevada Protected Area (SNPA) is presented. Protected area managers, environmental decision-makers as well as researchers of the Universities of Granada and Almería participated in this research. These participants selected the most important ecosystem services in the SNPA, as well as their evolution in the last few decades to the present. Afterwards they mapped the Service Provision Hotspots (SPHs), the SPHs in decline, and the beneficiaries of the services. The maps were photographed by an SLR digital camera and were imported and analysed by a geographic information system (ArcGIS 9.2).

### > Results

The most important services considered, their trends, and the scales of their beneficiaries are detailed in Table 1. The services associated with water are considered key in the SNPA, as well as the habitats for species. On the other hand, erosion control, climate regulation, aesthetic va-

lues, and food from extensive agriculture should be considered priority services due to their regressive tendency. Finally, it can be appreciated that the scale at which these services are received span the local to the global scale.

**Table 1**

Ecosystem service	Relative importance of the service (%)	Trend	Scale of beneficiaries
Water provision	27	↑	Regional-local
Habitat for species	17	↔	Global-regional-local
Hydrological regulation	17	↔	Regional-local
Eco-tourism	7	↑	Global-regional-local
Rural tourism	7	↑	Global-regional-local
Climate regulation	6	↓	Global-regional-local
Air quality	5	↔	Global-regional-local
Erosion control	4	↓	Regional-local
Scientific knowledge	4	↑	Global-regional-local
Ski tourism	4	↔	Regional-local
Aesthetic values	2	↓	Global-regional-local
Food from non-intensive farming	1	↓	Local

Ecosystem services generated by the SNPA that are most important for the wellbeing of humans according to the participants of the workshop, relative importance of these services with respect to the total services selected, trend perceived, and scale of the beneficiaries.

The participative mapping of the ecosystem services has resulted in the maps in Figure 1. The ecosystems included within the limit of the national park appear as the main suppliers

of ecosystem services, highlighting the high summits for the importance of the services associated with water. The SPHs perceived in decline coincide mainly with the ski resort of

Pradollano (Figure 1 B). The beneficiaries of the services live mainly in the metropolitan area of Granada and Almería.

## > Discussion and conclusions

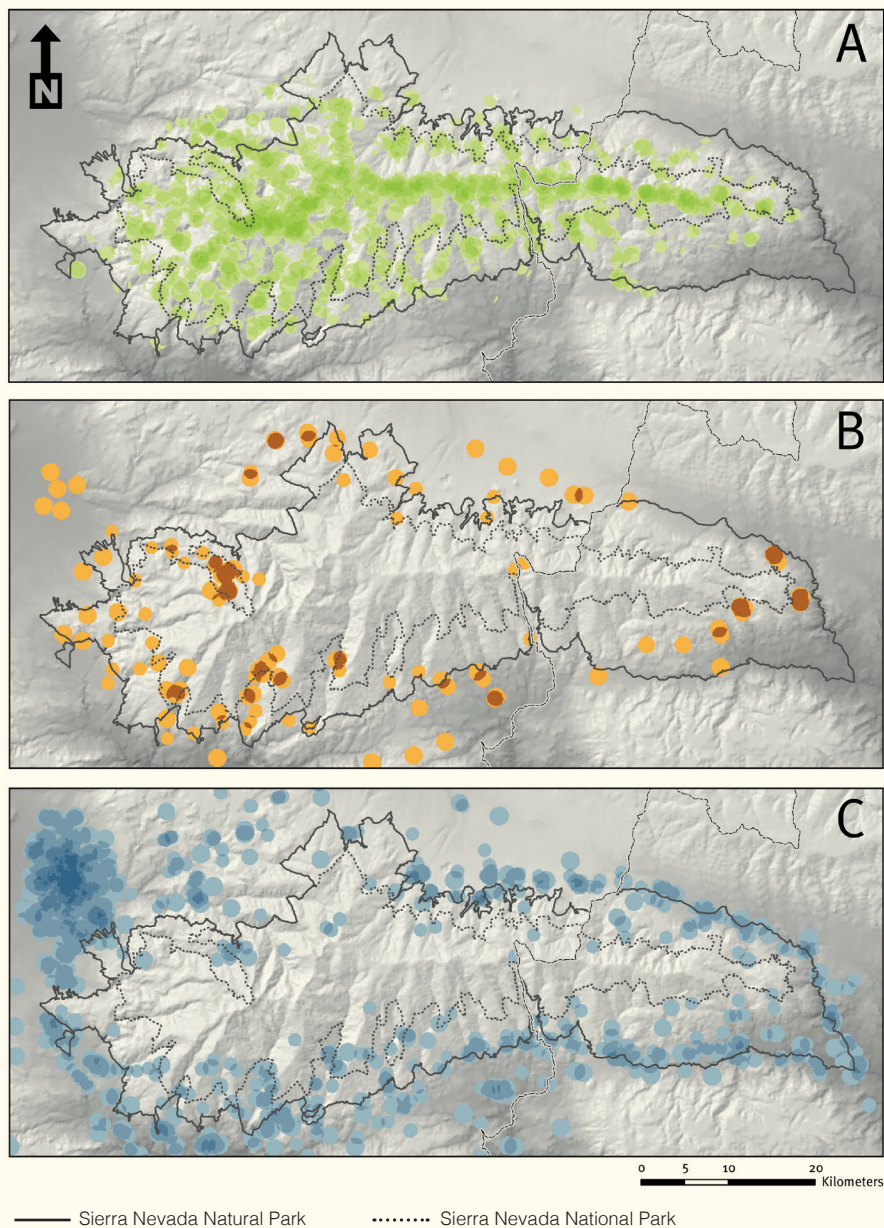
The present work constitutes a preliminary approach to the management of protected areas under the framework of ecosystem services [4]. The inclusion of ecosystem services reconnects humans and nature by the explicit recognition of intrinsic values [2]. Specifically, for protected areas, this strategy seeks to strengthen social support for these spaces, on showing the multiple services provided.

The results show that certain ecosystem services are in regression, some (e.g. climate regulation or the loss of aesthetic value) are due to global change. The results indicate furthermore that the SNPA should be managed on multiple spatial scales, given that beneficiaries of those services pertain to local, regional, and global scales. This scalar uncoupling between the supply and demand for services has been shown in other studies with services associated with the forests of Sierra Nevada [3].

The mapping of services has enabled the identification of specific areas for management. For example, the area of Güejar Sierra annex of the national park (which has not been declared a natural park) should be considered a priority zone for management since it delivers multiple services and is not protected. Pradollano appears as an example of an area with services in decline and thus could be considered a priority zone for restoration.

The character of the study undertaken, by the participation of researchers and managers, has made it possible to outline a new theoretic framework and methodology for managing the SNPA. This is relevant, given the calls from international organizations such as the International Union for Nature Conservation or the European Union to introduce ecosystem services into the management of protected areas. Furthermore, participation permits bringing closer research and management.

Figure 1



Spatial distribution of the Service Provision Hotspots (SPHs) (A: green), the SPHs in decline (B: red) and the beneficiaries of the services (C: blue) according to the perceptions of the participants.