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# A Centennial Path Towards Sustainability in Spanish National Parks: Biodiversity Conservation and Socioeconomic Development (1918-2018)

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## Abstract

National Parks (NPs) were the first protected areas (PAs) designated in Spain one century ago. NPs are PAs of exceptional natural and cultural value that are representative of the Spanish natural heritage. Currently, there are 15 NPs in Spain covering almost 400,000 ha, although new site designations are being considered. Spanish NPs' main objectives are closely linked to the sustainability concept: conserving natural and cultural assets in the long term and promoting public use, environmental awareness, research and socioeconomic development. Here, the history of modern nature conservation in Spain is summarized, with special focus on NPs. Moreover, the main monitoring and assessment initiatives in Spanish National Parks are reviewed. Finally, the major results of two current research projects focusing on the sustainability of Spanish NPs, DISESGLOB and SOSTPARK, are provided.

**Keywords:** protected area, assessment, sustainable development, Spain, history

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## 1. Introduction

Places set aside to conserve natural resources such as forests, plants, animals (chiefly game animals) or waters have existed for centuries. European and Asian kings and noblemen established royal reserves or game reserves in their dominions. Those 'reserves' forbade or restricted access and use of resources to laymen for pleasure and enjoyment of the privileged, who were entrusted management and conservation of such sites. Modern protected areas (PAs)

were initially designated to preserve pristine landscapes when impacts from human development started to be conspicuous and widespread [1]. Aesthetic considerations are largely responsible for the mountainous character of initial PAs. The first widely agreed such PA was Yellowstone National Park (NP), designated in 1872 in north-west United States, although some claims are made that Mongolian Bogd Khan Uul NP, designated in 1783, might have been the first modern PA. Whichever the right chronology, the institutionalization of modern PAs can safely be dated by the end of the nineteenth century. The first such PAs were designated under the category of NP in the United States, Australia, Canada and New Zealand in the last quarter of the nineteenth century. In Europe, Sweden designated the first NP in 1909; Russia, in 1912; and Switzerland, in 1914 [2]. Spain followed few years later, in 1918.

Nowadays, NP is among the most widespread PA categories worldwide and virtually every sovereign state has designated NPs in their territories. NP is one of the six (seven?) PA management categories established by the International Union for Conservation of Nature (IUCN) [3]. Most NPs share some characteristics and aims that are synthesized in the IUCN's definition of 'NP' as 'large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities'. NPs normally restrict most human activities within their borders for nature conservation or restoration, although they are not as stringent as Reserves (IUCN's management Category I), allowing and even promoting controlled educational, research and recreational activities.

## 2. History of modern nature conservation in Spain

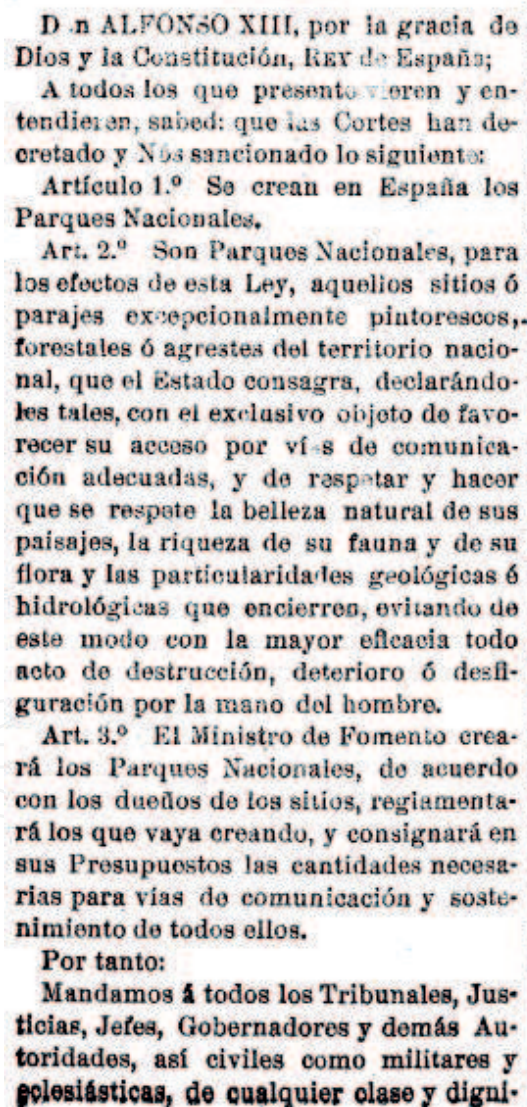
### 2.1. The pioneers: environmental thinking and nature protection between 1862 and 1936

The deficient state of forests in Spain as a result of unsustainable land-use practices has been acknowledged since the seventeenth century [2]. One of the solutions to preserve forests and associated species, soils and landscapes was the creation of protected, state-owned and managed forests included in the 'Forest Register' in 1862, which in 1896 turned to 'Public Utility Forests', a legal register that persists today. Another solution was the designation of PAs.

In spite of its historical, social and cultural backwardness, Spain was among the first nations in the world to designate NPs, creating a pioneering law on 'national parks' in 1916. Pedro Pidal y Bernaldo de Quirós (1869–1941), a nobleman, mountaineer, environmentalist, senator and personal friend of King Alfonso the XIIIth, was the promoter of the law. According to it, NPs were 'those exceptionally picturesque, forested or wild sites of the [Spanish] territory that the state designates in order to promote their adequate access and to respect the natural beauty of their landscapes, their faunal and floral richness, and their geological or hydrological singularities, avoiding avoiding all destruction or degradation by men effectively. One year later, in 1917, a Royal Decree created two new PA designation categories in the country

aimed at those natural sites that merited protection but which were not as environmentally exceptional as NPs: 'Natural Site of National Interest' (NSNI) and 'Natural Monument of National Interest'.

The National Park Central Junta was created that year and, in 1918, the history of Spanish NPs began with the designation of the first two NPs in July and August of 1918, respectively: Montaña de Covadonga NP, designated over 16,925 ha in the Cantabrian mountain range in northern Spain and Valle de Ordesa NP, covering 2046 ha in the Pyrenean range in north-eastern Spain [1]. Both were mountainous NPs designated primarily on landscape grounds. Other PAs, chiefly mountainous sites or geologically original sites, were slowly and sparsely designated across the country under different legal categories from 1918, progressively expanding



D. n ALFONSO XIII, por la gracia de Dios y la Constitución, REY de España;

A todos los que presente vieren y entendieren, sabed: que las Cortes han decretado y Nos sancionado lo siguiente:

Artículo 1.º Se crean en España los Parques Nacionales.

Art. 2.º Son Parques Nacionales, para los efectos de esta Ley, aquellos sitios ó parajes excepcionalmente pintorescos, forestales ó agrestes del territorio nacional, que el Estado consagra, declarándoles tales, con el exclusivo objeto de favorecer su acceso por vías de comunicación adecuadas, y de respetar y hacer que se respete la belleza natural de sus paisajes, la riqueza de su fauna y de su flora y las particularidades geológicas ó hidrológicas que encierren, evitando de este modo con la mayor eficacia todo acto de destrucción, deterioro ó desfiguración por la mano del hombre.

Art. 3.º El Ministro de Fomento creará los Parques Nacionales, de acuerdo con los dueños de los sitios, reglamentará los que vaya creando, y consignará en sus Presupuestos las cantidades necesarias para vías de comunicación y sostenimiento de todos ellos.

Por tanto:

Mandamos á todos los Tribunales, Justicias, Jefes, Gobernadores y demás Autoridades, así civiles como militares y eclesiásticas, de cualquier clase y digni-

Figure 1. Extract from the Spanish law on National Parks from 1916.

site protection at a time when nature conservation was an eccentric idea of the minority elites [2] (**Figure 1**).

## **2.2. Civil war and economic emergency: 1936–1955**

By 1936, the year when the last Spanish civil war started, there were 18 PAs from four categories (NPs, National Sites, NSNIs and Natural Monuments of National Interest) covering 33,500 ha [1]. After the war, economically profitable land uses were promoted by the new authoritarian government at the expense of 'unproductive' nature conservation uses, in a context of extreme economic crisis and resource shortage for many citizens, including food and other basic commodities. Only one new PA (NSNI of Sanabria Lake) was designated (1946) before the new impulse taken by the NP policy, in the mid-1950s. In that decade, three new NPs were designated in peripheral regions: Teide NP (11,866 ha, in 1954) and Caldera de Taburiente NP (3500 ha, in 1954) in the Canary Islands, and Aguastortas y Lago de San Mauricio (9851 ha, in 1955) in Catalonia.

## **2.3. Economic recovery, nature conservation stagnation: 1955–1970**

Another long period of stagnation of nature conservation policies took place between 1955 and 1970, when the socioeconomic progress of the country was significant. The only remarkable conservation milestone from that period was the designation of Doñana NP, thanks to considerable inner and international pressure, in 1969. With 39,225 ha, it was the biggest PA of Spain and accounted for nearly 40% of all protected area in the country by 1970: 103,000 ha [1].

## **2.4. New times for nature conservation: 1970–1980**

In the 1970s, more progressive social thinking, decent life conditions and realization of human impacts on the environment from previous years of massive unsustainable development resulted in a substantial boost of nature conservation policies. The National Institute for Nature Conservation (ICONA), tasked with forest administration and nature conservation activities, including PA management, was created in 1971. In just 2 years (1973–1974), five new PAs were designated, including two NPs: Tablas de Daimiel (in 1973, in central Spain) and Timanfaya (in 1974, in the Canary Islands). In 1975, the first modern law on PAs was passed. It introduced, alongside NPs, new PA categories, most of which are still in force, such as Reserve or Nature Park, and repealed most previous categories, which were subsequently re-categorized. From that year on until 1980, the protected area in Spain nearly doubled, with more than 200,000 ha, which included new PA designations and substantial expansions of existing PAs, such as NPs. Some peripheral protection zones around NPs were additionally designated to buffer the influence of external human uses from surrounding territories [1].

## **2.5. The administrative transition period: 1980–1989**

The Spanish democratic constitution of 1978 established that the autonomous regions (17 regions plus 2 autonomous cities) and not the central government were competent for nature

conservation policies. The central government retained competency for basic, common nature conservation policies, including NP designation and management. Several heterogeneous and insufficiently coordinated regional nature conservation policies, laws, criteria and PA designations from the early 1980s arose [1]. Numerous PAs were regionally designated across the country using the state's law from 1975 or newly passed regional laws in that decade, although those PAs included just one NP: Garajonay, in the Canary Islands, in 1981. In that decade, the first PAs deriving from European legislation, namely Special Protection Areas (SPAs), for the protection of wild bird species [4] started to be designated after the accession of Spain to the European Economic Community in 1985. In 1989, a new basic law on nature conservation including contemporary (and still relevant) conservation principles and concepts, such as natural resource planning, PA buffer zones, genetic diversity preservation, local socio-economic development or invasive species' control, was passed. It devoted a specific chapter to NPs. It stated that the designation of NPs will be on grounds of the nation's general interest and based on the representativity of Spanish 'natural (eco)systems'.

## **2.6. PA expansion and administrative battle for the management of NPs: 1990s**

The autonomous regions appealed against the central government's exclusive management of Spanish NPs as stated in the 1989 law and, in 1995, the Constitutional Court established a shared management and financing system of NPs between the central government and regional governments. A new law on nature conservation from 1997 accounted for that judicial decision and established shared designation (NP continued to be designated by the Spanish parliament though with the acceptance of regional parliaments), management and financing of Spanish NPs between the central government and the regional governments where NPs were located. That law also created the Master Plan for NPs, for setting up common management priorities, and the NP Council for the mixed administration of NPs. Three NPs were designated in that decade, alongside many other 'national' and 'European' PAs (including Sites of Community Importance—SCIs-derived from the Habitats Directive, from 1992): Cabrera Archipelago NP (in the Balearic Islands, in 1991. It was the first Spanish NP including some marine area); Cabañeros NP (in central Spain, in 1995); and Sierra Nevada NP (in Andalusia, in 1999). By 1999, there were 611 PAs in Spain covering some 3,332,000 ha. Of them, 12 were NPs [1].

## **2.7. The consolidation of site conservation and management policies: 2000–2017**

As a result of new appeals by regional governments, in 2005, the Constitutional Court sentenced that NP management was an exclusive competency of autonomous regions in Spain and just bestowed basic network coordination competencies to the central government including common managerial priorities and guidelines through the Master Plan for NPs, since then, two specific national laws on NPs acknowledging those changes have been developed (in 2007 and 2014) and a comprehensive law on natural heritage and biodiversity conservation and use was also passed in 2007. Currently, NP management corresponds entirely to the Spanish regional governments where NPs are located. If NPs are located between different regions, their governance is shared between the involved administrations.

In the last two decades, the Spanish terrestrial PA network has largely been completed with plentiful national and European PA designations. Currently, Spain has 1958 'national' PAs that cover 13% of the Spanish terrestrial territory. Three NPs were the last ones to be added to the NP network: Atlantic Islands (in Galicia, in 2002), Monfragüe NP (in Extremadura, in 2007) and Sierra de Guadarrama (in Madrid, in 2013). The 15 NPs existing by the end of 2017 cover 385,000 ha. By 2016, there were also 1865 Natura 2000 sites (SPAs, SCIs and Special Areas of Conservation) which covered 27.32% of the Spanish land territory [5], largely exceeding international PA coverage targets of 17% for terrestrial ecosystems at national scale [6]. From 2010, important effort is being made to also adequately protect marine biodiversity, according to the internationally agreed marine protected area coverage target of 10% [6]. As a result, 39 new marine SPAs were designated across the Spanish Exclusive Economic Zone in 2014. Those, together with other existing marine and coastal PAs, make approximately 12% of the marine environment under Spanish jurisdiction protected by 2017 [7].

### 2.8. Next steps

Though the Spanish terrestrial PA network can be considered close to completion, considerable effort must still be put in adequately managing those sites, including developing customized management plans and implementing regular surveillance and monitoring of biodiversity and other relevant conservation features consistently [8]. Also, effort should be made to ensure that an adequate representation of the Spanish natural systems established in the law on NPs of 2007 [9], especially steppe, desert and marine systems, is included in the NP network. Work is underway to designate two new NPs in Spain: Sierra de las Nieves NP in Andalusia, which would add to medium and high Mediterranean mountain ecosystem representation in the network, and Mar de las Calmas, in El Hierro, Canary Islands, which would become the first entirely marine NP. Finally, completion of the Spanish marine PA network according to the best available evidence on biodiversity and evolving international targets is still a pending task.

## 3. The Spanish network of National Parks: attempting sustainability

NPs are 'little transformed PAs of high natural and cultural value whose conservation is priority and in the state's general interest for being representative of the Spanish natural heritage as a result of their exceptional natural values, their representative character, or the singularity of their flora, fauna or geomorphological formations' [10]. The Spanish Network of NPs is an integrated system for the protection and management of the best sample of the Spanish natural heritage. The Network consists of its conforming NPs, their regulations, human and material resources and the institutions that are necessary for its functioning. By September of 2017, the Spanish Network of NPs consisted of 15 NPs. They are scattered across the four biogeographic regions in Spain (**Table 1**) [11].

Thirteen NPs are managed by the governments of the regions in which they are located, whereas the two NPs in Castilla-La Mancha region, Cabañeros NP and Tablas de Daimiel

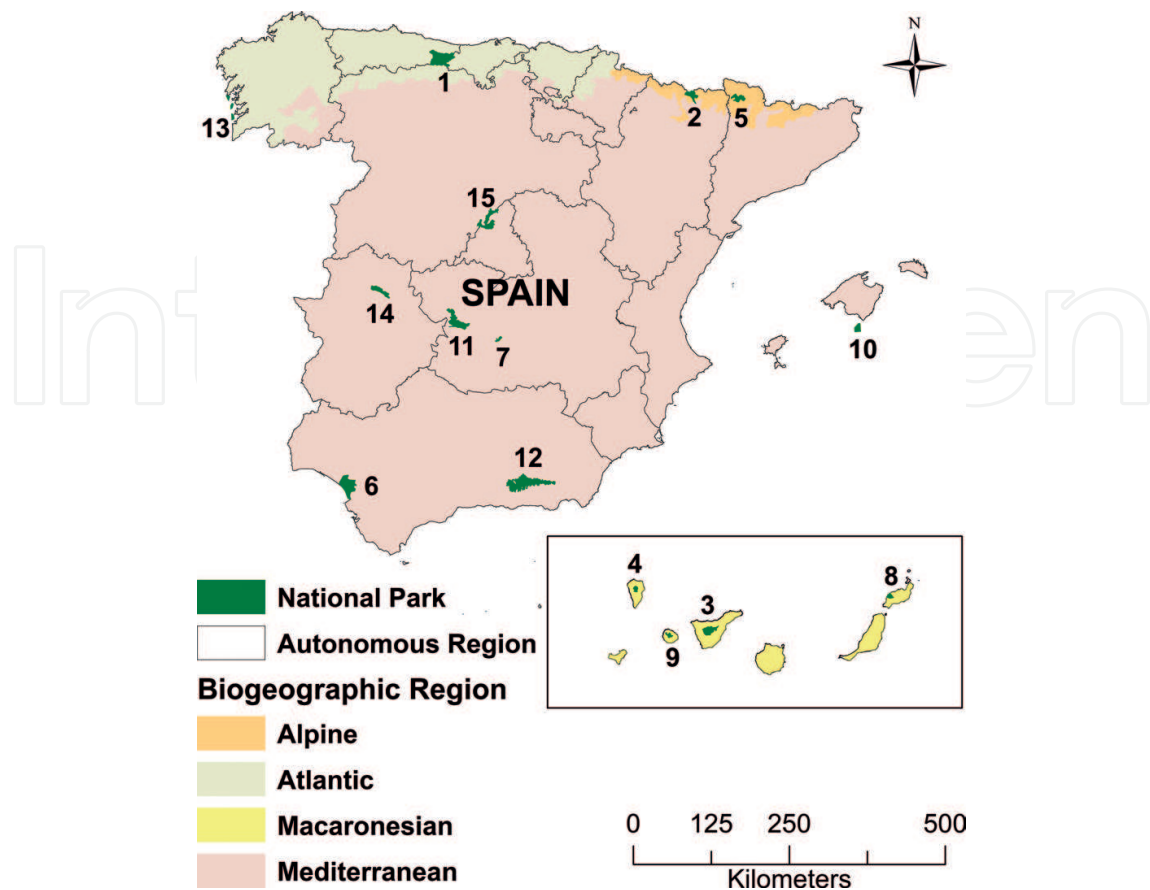
National Park	Designation year	Area (ha)	Biogeographic region	Main ecosystem protected
Picos de Europa	1918	67,127	Atlantic	High Atlantic mountain
Ordesa y Monte Perdido	1918	15,608	Alpine	High Alpine mountain
Teide	1954	18,990	Macaronesian	High Macaronesian mountain
Caldera de Taburiente	1954	4690	Macaronesian	Canarian pine forest
Aigüestortes i estany de Sant Maurici	1955	14,119	Alpine	High Alpine lakes
Doñana	1969	54,252	Mediterranean	Coastal wetland
Tablas de Daimiel	1973	3030	Mediterranean	Inland wetland
Timanfaya	1974	5107	Macaronesian	Volcanic badlands
Garajonay	1981	3984	Macaronesian	Laurel forest
Archipiélago de Cabrera	1991	10,021	Mediterranean	Mediterranean sea and coast
Cabañeros	1995	40,856	Mediterranean	Mediterranean forest
Sierra Nevada	1999	85,883	Mediterranean	High Mediterranean mountain
Islas Atlánticas	2002	8480	Atlantic	Atlantic sea and coast
Monfragüe	2007	18,396	Mediterranean	Mediterranean forest
Sierra de Guadarrama	2013	33,960	Mediterranean	High Mediterranean mountain

**Table 1.** Main characteristics of the 15 National Parks in Spain by September of 2017.

NP, are still being managed by the central government through the NP Autonomous Body (OAPN). The overall state's investment in the Spanish NP Network was approximately €89 million in 2015 [12]. The NP Network is funded by the regional administrations for most ordinary expenses and by the central OAPN, which chiefly finances common actions across the Network including monitoring, research, volunteering, local socioeconomic subsidies, training and dissemination. In contrast to some other countries where entrance fees to NPs apply to all visitors or just to foreign visitors, fees do not apply in Spanish NPs and entrance is free of charge although regulated in order not to exceed the carrying capacity of protected ecosystems (**Figure 2**).

The main official aims of Spanish NPs are (1) ensuring the long-term conservation of biodiversity and cultural features; (2) supporting public use; (3) promoting scientific knowledge on their natural and cultural assets; (4) encouraging social environmental awareness; (5) exchanging experience and knowledge on sustainable development; (6) training and capacity building of staff working in NPs; and (7) participating in international programmes and networks. We could probably add an eighth aim, included in the current law on NPs, which deals with 'promoting local socioeconomic development' [10]. For this, a substantial part of the annual budget of the NP Network provided by the OAPN for common actions across the





**Figure 2.** Location of Spanish National Parks by September of 2017. Numbers indicate order of designation: 1. Picos de Europa; 2. Ordesa y Monte Perdido; 3. Teide; 4. Caldera de Taburiente; 5. Aigüestortes i estany de Sant Maurici; 6. Doñana; 7. Tablas de Daimiel; 8. Timanfaya; 9. Garajonay; 10. Archipiélago de Cabrera; 11. Cabañeros; 12. Sierra Nevada; 13. Islas Atlánticas; 14. Monfragüe; 15. Sierra de Guadarrama.

Network (approximately 58% in 2015) [12] is devoted to subsidies aimed at compensating local dwellers in the municipalities included in NPs for the restrictions to natural or cultural resource use from NPs' regulations and at promoting sustainable economic practices. Thus, the aims of the Spanish NP Network are closely aligned with those of sustainable development: environmental conservation, social equity and economic profitability. But are NPs attaining them?

#### 4. Assessment of the environmental and socioeconomic effects of Spanish National Parks

Regular monitoring, assessment and evaluation are essential to gauge effectiveness of PAs and of any other public initiative or policy. Four types of assessments in Spanish NPs can be identified.

#### 4.1. Regular inner assessments

Regular censuses or samplings of biodiversity of conservation concern (e.g. endangered species) are regularly carried out in each NP according to their management planning using their own means and staff. Other features of conservation concerns, such as cultural or geomorphological features, are subject to regular surveillance and more sporadic (normally reactive) monitoring.

#### 4.2. External assessments: project calls

The OAPN finances annual calls for research projects on natural values, cultural heritage, socioeconomic aspects and traditional knowledge in NPs since 2002. Those calls are included in the Spanish Research, Development & Innovation Plan. Research priorities in Spanish NPs are established in the NP Master Plan. According to it, funding precedence will be given to projects that monitor global change effects, projects that include more than one NP and projects

The image is a screenshot of the Spanish Ministry of Environment's website. At the top, there is a header with the Spanish flag, the text 'GOBIERNO DE ESPAÑA MINISTERIO DE AGRICULTURA Y PESCA, ALIMENTACIÓN Y MEDIO AMBIENTE', and navigation links in multiple languages: 'Bienvenidos', 'Benvinguts', 'Benvidos', 'Ongi etorri', 'Beninguts', 'Welcome', 'Bienvenues'. Below this is a search bar and 'A A A | Mapa Web'. A secondary navigation bar contains links like 'Ministerio', 'Áreas de actividad', 'Participación pública', 'Cartografía y SIG', 'Estadísticas', 'Sede electrónica', and 'Sala de prensa'. The main content area is titled 'Red de Parques Nacionales' and features a large advertisement for the 'Programa de investigación - Convocatoria 2015'. The ad includes a sidebar with a menu: 'Nuestros Parques', 'La Red', 'Conservación y seguimiento', 'Investigación' (highlighted), 'SIG: Cartografía', 'Voluntariado', 'Subvenciones', 'Boletín de la Red', 'Central de Reservas', 'Divulgación', and 'Novedades'. The main ad text reads: 'Subvenciones para la realización de proyectos de investigación científica en la Red de Parques Nacionales'. It features an image of a bird being held in a hand. The text states: 'Se convocan subvenciones para la realización de proyectos de investigación científica en el marco del Plan Nacional I+D+i para el año 2015. La cuantía estimada de la subvención en la convocatoria es de 619.047 € (seiscientos diecinueve mil cuarenta y siete euros). El objetivo fundamental de estas ayudas es promover un mejor conocimiento científico en materias relacionadas con la Red de Parques Nacionales y el fomento de la investigación científica. Este conocimiento científico básico será susceptible de ser puesto al servicio de la conservación de los Parques nacionales que integran la Red, generando nuevos conocimientos aplicables al conjunto de la Red, y contribuyendo al perfeccionamiento de su protección ambiental.' Below the text is a link: 'Convocatoria 2015 de subvenciones para la realización de proyectos de investigación científica en la Red de Parques Nacionales'. To the right of the ad are several sidebars: 'Centenario Parques Nacionales' with '1916 100 años de Parques Nacionales 2016', 'Divulgación' with 'Investigar para conservar Fallata divulgativa', 'Catálogo' with 'Referencias sobre Investigación en la Red de Parques Nacionales', and 'Documentos' with 'Ley de Parques Nacionales The National Parks Act' and 'Plan Director'.

Figure 3. OAPN's funded 2015 research call on National Park's advertisement on the Spanish Ministry of Environment's website.

whose results are applicable to the whole NP Network. Eleven 3-year projects were funded under this call in 2015, with an overall budget of 619,000€. The OAPN convenes annual joint dissemination sessions between NP managers and scientists who develop research funded by the OAPN in NPs [13] (**Figure 3**).

In addition to this specific call, other more generic or complementary research calls by the central government or by the regional governments that can be used to fund research in NPs are opened yearly. One example of this is the multi-annual Spanish R + D + I Plan, which funds research projects that can be carried out in NPs through its two main lines: basic science (Excellence Call) and applied science (Societal Challenges Call). The Spanish R + D + I Plan 2013–2016 actually funded two projects on NPs and other PAs that will be mentioned in more detail in this chapter: DISESGLOB and SOSTPARK.

### **4.3. Institutional assessments: monitoring programmes**

As a result of common research priorities identified in the 1999 NP Master Plan, the central and regional governments started developing, from 2008, a NP Monitoring and Assessment Plan. It was endorsed in 2011 and continued to develop according to the mandates in the Law 30/2014, on NPs, that confers the central government (through the OAPN) the competencies for: (1) monitoring and assessment of the NP Network, (2) communication and knowledge exchange among NPs, (3) promoting scientific research and dissemination, and (4) encouraging sustainable development in municipalities in NPs [10]. The NP Monitoring and Assessment Plan is structured in three areas:

#### *4.3.1. Functional monitoring*

It assesses the global functioning, coherence and meeting of the overall objectives of the NP Network. It results in yearbooks (by NP and of the network) and in a 3-year report on the status of the NP Network.

#### *4.3.2. Ecological monitoring*

It seeks to gather information on the state of conservation and ecological functioning of natural systems in the NP Network according to verified protocols and to assess the current status of biodiversity, its changes and future prospects in a context of global change. So far, the variables that are being monitored relate to forest health, plant phenology, climate change, ecosystem productivity, ecosystem structure, natural system cartography, common bird species, butterflies and marine environment.

#### *4.3.3. Sociological monitoring*

It studies the social effect of the NP Network on three target groups: local residents, visitors and the whole Spanish society. Indicators under this area refer to: social perception, socio-economic data in municipalities included in NPs, effect of subsidies on those municipalities and social impact of the Network (on scientists, PA managers and environmental NGOs).

#### 4.4. Other assessments

There are plenty of other studies on Spanish NPs carried out by universities and research centers every year—degree, master or PhD theses are examples of such short- or medium-term research effort developed in NPs-. Those studies help to better understand the environmental and socioeconomic status of NPs, although they rarely align with research priorities in NPs but rather with external aims or interests. Moreover, no standardized register of such research is kept and results are rarely put across to NP managers.

Even if the research done in PAs is in accordance to official needs, the results of those studies may be published but are seldom conveyed in an understandable manner to PA managers, yet substantial amounts of primary information (e.g. from internal monitoring programmes), services and/or permission are usually asked from managers by researchers from the onset. Sometimes, lack of collaboration comes from the managers' side [14]. This bi-directional information flow mismatch is common in PAs in Spain [8] and elsewhere [15] and results in that there exists much more valuable information on PAs than that at the disposal of managers and scientists. To prevent this mismatch and make Spanish NP managers aware of some of the most relevant research that affects their sites, the NP Master Plan of 2016 establishes the creation of a public-access research database where results of every authorized study in NPs are communicated to and stored by the OAPN (**Figure 4**).

The image shows a screenshot of the Spanish Ministry of Environment's website, specifically the 'Buscador de Proyectos de investigación' (Research Project Searcher) section. The page features a navigation menu on the left with options like 'Nuestros Parques', 'La Red', 'Conservación y seguimiento', 'Investigación', 'SIG: Cartografía', 'Voluntariado', 'Subvenciones', 'Boletín de la Red', 'Central de Reservas', 'Divulgación', and 'Novedades'. The main content area includes a search form with fields for 'Parque Nacional' (National Park), 'Año' (Year), and 'Área conocimiento' (Knowledge Area), along with 'Limpiar' (Clear) and 'Buscar' (Search) buttons. On the right side, there are several informational boxes: 'Centenario Parques Nacionales' (1916-2016), 'Divulgación' (Investigación para conservar), 'Catálogo' (Referencias sobre Investigación en la Red de Parques nacionales), and 'Documentos' (Ley de Parques Nacionales, Plan Director).

**Figure 4.** Online national park research project searcher on the Spanish Ministry of Environment's website.

## 5. Two projects looking at the sustainability of Spanish National Parks: DISESGLOB and SOSTPARK

### 5.1. DISESGLOB: Design of a methodology to assess the global sustainability of national parks

The DISESGLOB Project forms part of the Spanish Research, Development and Innovation Plan for 2013–2016, whereby the state programmes its scientific research priorities. It was awarded a budget of 25,000€ and its duration was 3 years, from 2014 to 2017. The Project sought to respond to the following research questions: Are NPs effective to achieve their conservation objectives? Are the municipalities in which NPs are designated sustainable? Are NP managers and territorial planners aware of future opportunities and risks to conservation under different scenarios of change? (Figure 5).

As a pilot study, different methods were applied to two emblematic NPs: Ordesa NP, designated on the Pyrenean Mountains in 1918, and Guadarrama NP, the last NP of the Spanish network, designated in the Central Mountain Range, between the provinces of Madrid and Segovia, in 2013. Both NPs protect high mountain biodiversity but have clear historical, geographical and socioeconomic differences. Ordesa NP is a long-history, rural, peripheral NP with very low population density and relatively difficult accessibility. In contrast, Guadarrama NP is a new, peri-urban, easily accessible NP located just 40 min away by car from the city of Madrid. Those differences determine different states of, pressures on and responses for conservation features.



Figure 5. Logo of the DISESGLOB project.

### 5.2. SOSTPARK: Analysis of sustainability of Spanish protected areas: implications for the sustainability of the territory

The SOSTPARK Project is also part of the Spanish Research, Development and Innovation Plan for 2013–2016. It was funded with 193.000€ by the Spanish Ministry of Economy, Industry and Competitiveness for 3 years, from 2015 to 2018 (Figures 6 and 7).



Figure 6. Logo of the SOSTPARK project.

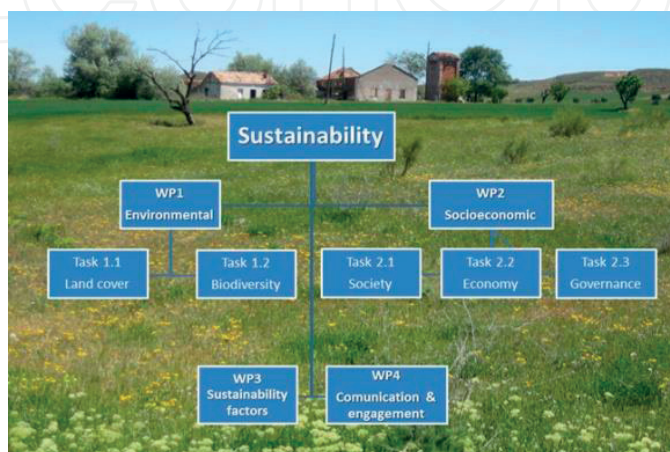


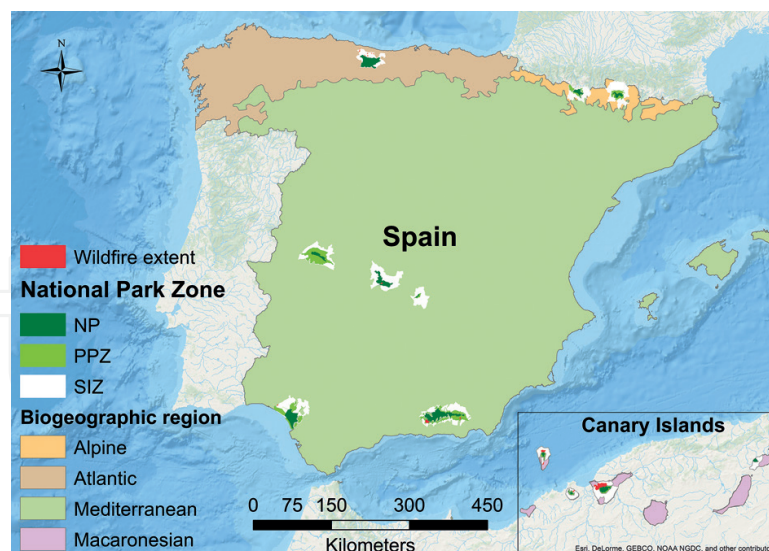
Figure 7. Outline of the SOSTPARK project.

The project seeks to assess the environmental, social, economic and institutional effects of five terrestrial PA networks and one marine PA network with clear legal and managerial characteristics in Spain. The five terrestrial PA networks include nature reserves, NPs, nature parks, SCIs/SACs and SPAs. The environmental effects of those networks were assessed using indicators of two essential natural resources: soil and biodiversity. Their socioeconomic and institutional effects were assessed through indicators such as employment, education or existence of basic infrastructure in PAs and their surrounding areas.

### 5.3. Environmental sustainability: main results of both projects

Environmental sustainability in 12 of the 15 Spanish NPs, including their statutory peripheral zones, between 2005 and 2011, was assessed by the SOSTPARK project (Figure 8). Those NPs represent 85% of the whole NP network area, 83% of the peripheral protection zone area in the network and 87% of the socioeconomic influence zone area of the network by November of 2015. Two indicators of environmental sustainability were analyzed: land use-land cover (LULC) changes and wildfires.

Results show that wildfires were the most widespread pressure in Spanish NPs in the 2005–2011 period (Figure 8). Three NPs, and their respective external zones, showed great LULC stability in that period, suggesting effective conservation inside and outside NPs: Ordesa y Monte Perdido NP, Aguastortas y Lago de San Mauricio NP and Caldera de Taburiente NP. The greatest proportion of LULC changes occurred in the statutory zones of Teide NP, Doñana NP, Tablas de Daimiel NP, Cabañeros NP and Sierra Nevada NP. Of these, clearly negative LULC changes occurred in



**Figure 8.** Location of wildfire area between 2005 and 2012 in each national park network zone included in the study across the Spanish biogeographic regions. NP: National Park; PPZ: Peripheral protection zone; SIZ: Socioeconomic influence zone.

Teide's three statutory zones, including extensive land artificialization in the NP's external zones. It was also the NP most impacted by wildfires, which affected its three zones. Both facts make Teide NP the Spanish NP with the most worrisome recent environmental trends [16] (**Figure 8**).

The DISESGLOB project sought to optimize the System for the Integrated Assessment of PAs (SIAPA) [17], a tool developed to evaluate potential environmental effectiveness of PAs. It was applied to two pilot, emblematic Spanish NPs: Ordesa NP and Guadarrama NP. The SIAPA allows NP managers to easily identify conservation strengths and weaknesses for enhanced PA effectiveness. **Tables 2** and **3** show the summary results<sup>1</sup> of implementing the optimized version of the SIAPA to both NPs [14].

The DISESGLOB project also produced land use-land cover (LULC) scenarios for both NPs and their surroundings between 2006 and 2030, taking into account recent developmental trends [18]. The results show that no major LULC changes are expected inside both NPs. Only inside Guadarrama NP is it likely that some grassland and scrubland areas will become forest areas, following natural succession. However, worrisome changes from agrarian and forest areas to urban areas are expected in the southern part of this NP as a result of easy access and proximity to the city of Madrid (in red in **Figure 9**).











#### 5.4. Socioeconomic sustainability: main results of the DISESGLOB project

Extensive surveys on social perception and valuation of the project's pilot NPs, Ordesa y Monte Perdido NP and Sierra de Guadarrama NP, were conducted on two key stakeholder groups: local residents (n = 401) and visitors (n = 542) [19]. There were similarities and differences between stakeholder groups and NPs. Both samples were mostly made of middle-aged women employed in the tertiary sector in the two NPs, although the proportion of residents

<sup>1</sup>The specific results from which these summary results were obtained can be freely accessed from: <http://www.mdpi.com/2076-3298/4/4/68>.









Ordesa y Monte Perdido National Park				
National Park area (ha): 15,608	Peripheral Protection Zone area (ha): 19,679		Socioeconomic Influence Zone area (ha): 89,341	
Designation date: 1918 (1982 re-classified)	Evaluation date: 2016–2017		Evaluation: 1st	
Index/indicator	Value	State	Trend	Evaluation period
STATE OF CONSERVATION	0			
Population trends of endangered species or subspecies	2		NA	2012–2015
Changes in the extent of focal habitats	0		NA	2013
Changes in the features for which the PA was designated	0		NA	2012–2015
Visual impact	1		NA	2010
Surface water quality	2		↔	2014–2015
Health of vegetation	1		↓	2012; 2013; 2015
PLANNING	2			
Appropriateness of protection regulation	1		NA	2017
Existence of updated management plan	2		NA	2017
Existence of updated socioeconomic plan	2		NA	2017
MANAGEMENT	1			
Degree of fulfillment of management objectives				
Effectiveness of public participation bodies	2		↔	2012–2015
Existence of sufficient management staff	1		↔	2014–2015
Existence of environmental education and volunteering activities	2		↔	2014–2015
SOCIOECONOMIC CONTEXT	0			
Local population density	0		↓	2015–2016









Ordesa y Monte Perdido National Park				
National Park area (ha): 15,608	Peripheral Protection Zone area (ha): 19,679		Socioeconomic Influence Zone area (ha): 89,341	
Designation date: 1918 (1982 re-classified)	Evaluation date: 2016–2017		Evaluation: 1st	
Index/indicator	Value	State	Trend	Evaluation period
Land use changes	1		NA	2006; 2012
<b>SOCIAL PERCEPTION AND VALUATION</b>				
Degree of knowledge on the PA	2		NA	2016
Personal importance	2		NA	2016
<b>THREATS TO CONSERVATION</b>				
Fragmentation	0		↔	2006; 2012
Density of alien invasive species	0		NA	2016
Density of visitors	1		↓	2014–2015
Activities performed by visitors	0		NA	2016
Climate change	2		NA	1976–2016
Pasture encroachment by woody vegetation	0		NA	2006; 2012
<b>EFFECTIVENESS</b>				
	1			

**Table 2.** Summary results of the implementation of the optimized SIAPA in Ordesa National Park.

employed in the primary sector was substantially greater in Ordesa NP. Residents visited Guadarrama NP less frequently than Ordesa NP, whereas visitors to Guadarrama NP visited it much more regularly than visitors to Ordesa NP, most of which were first-timers. The proportion of foreign visitors was five times greater in Ordesa NP, as it is located on the border with France. Both stakeholder groups perceived the conservation state of Ordesa NP to be better than Guadarrama's, something unsurprising given their contrasting geographic and demographic contexts. They, however, coincided in their main perceived threats to both NPs: wildfires, massive visitation and insufficient environmental awareness by visitors. Residents deemed local participation in NPs' management improvable in both cases. Both

Sierra de Guadarrama National Park <sup>a</sup>				
National Park area (ha): 33,960	Peripheral Protection Zone area (ha): 62,687		Socioeconomic Influence Zone area (ha): 173,632	
Designation date: 2013	Evaluation date: 2016–2017		Evaluation: 1st	
Index/indicator	Value	State	Trend	Evaluation period
<b>STATE OF CONSERVATION</b>	1			
Population trends of endangered species or sub-species				
Changes in the extent of focal habitats				
Changes in the features for which the PA was designated				
Visual impact	0		NA	2010
Surface water quality	2		↔	2014–2015
Health of vegetation	1		↑	2014–2015
<b>PLANNING</b>	1			
Appropriateness of protection regulation	2		NA	2017
Existence of updated management plan	0		NA	2017
Existence of updated socioeconomic plan	2		NA	2017
<b>MANAGEMENT</b>	1			
Degree of fulfillment of management objectives				
Effectiveness of public participation bodies	1		↔	2015
Existence of sufficient management staff				
Existence of environmental education and volunteering activities	2		NA	2014
<b>SOCIOECONOMIC CONTEXT</b>	2			
Local population density	2		↑	2015–2016

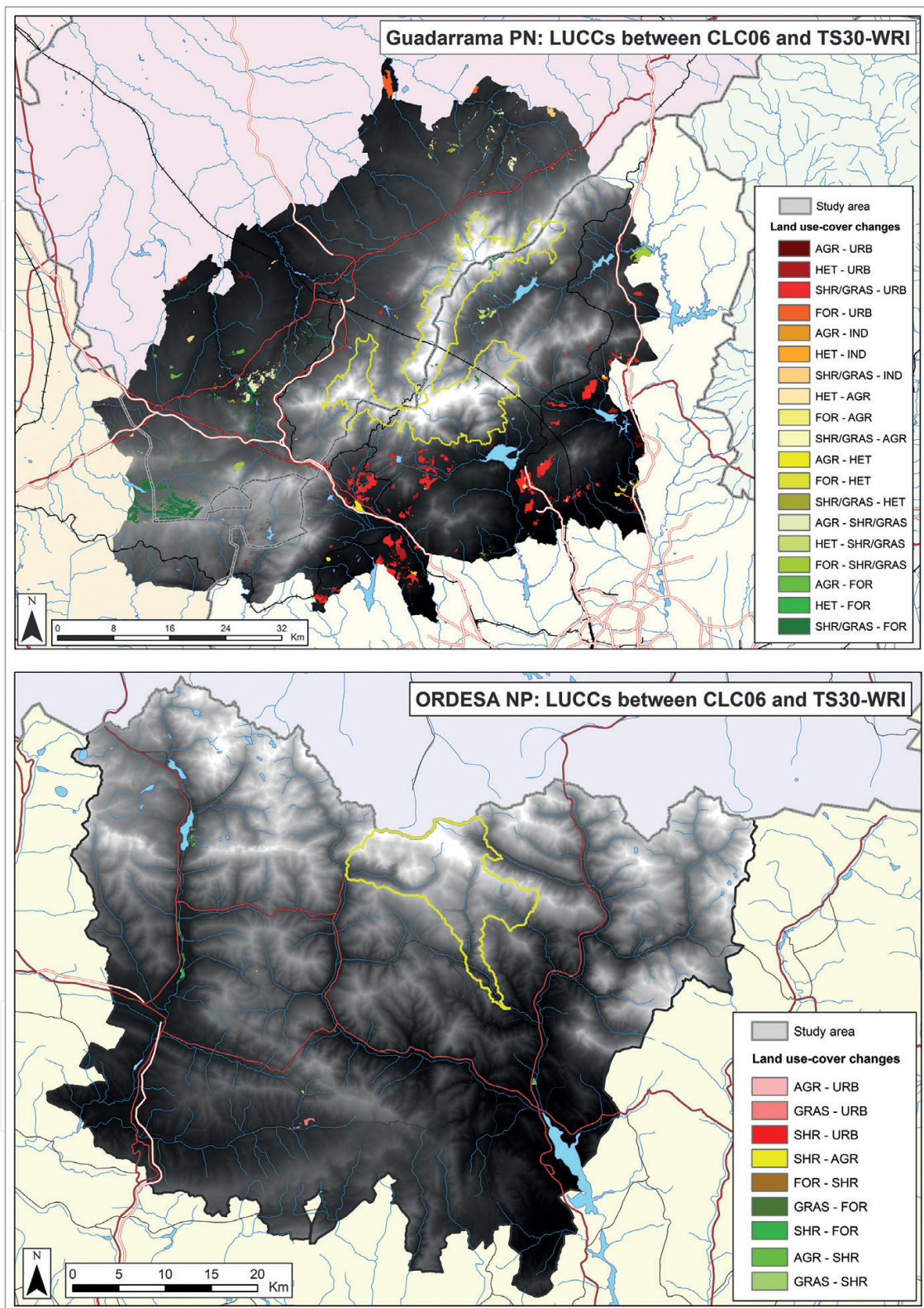
Sierra de Guadarrama National Park <sup>a</sup>				
National Park area (ha): 33,960	Peripheral Protection Zone area (ha): 62,687		Socioeconomic Influence Zone area (ha): 173,632	
Designation date: 2013	Evaluation date: 2016–2017		Evaluation: 1st	
Index/indicator	Value	State	Trend	Evaluation period
Land use changes				
SOCIAL PERCEPTION AND VALUATION	2			
Degree of knowledge on the PA	2		NA	2016
Personal importance	2		NA	2016
THREATS TO CONSERVATION	2			
Fragmentation				
Density of alien invasive species				
Density of visitors	2		↓	2014–2015
Activities performed by visitors				
Climate change				
EFFECTIVENESS	0			

<sup>a</sup>The relatively high proportion of blank boxes relate to indicators that could not be evaluated due to lack of raw data provision by the NP managers.

**Table 3.** Summary results of the implementation of the optimized SIAPA in Guadarrama National Park.

social groups highly valued the two NPs from a subjective perspective. However, only half of residents and two-thirds of visitors would be willing to pay an entrance fee to those NPs (**Figure 10**). Most residents and visitors who were willing to pay an entrance fee to the NPs considered that 3€ per person per day would be an acceptable fee. Willingness to pay was negatively correlated with the frequency of visits in Guadarrama NP.

On average, approximately 25% of residents and 50% of visitors who were initially reluctant to pay an entrance fee to those NPs would change their minds if measures to ensure equity, such as exemptions to less favored groups, transparency (clear use of collected funds) and accountability (investment of funds in the NP) were implemented. These results provide interesting information on social worries, preferences and attitudes to help NP management, for instance, by considering implementing entrance fees as a response to massive visitation in some NPs, such as Guadarrama NP [12], or by designing evidence-based environmental education programmes.



**Figure 9.** Simulated model of LULCs between 2006 and 2030 in a trend scenario with restrictions and incentives (TS30-WRI) in the Guadarrama NP and its surroundings (above) and in Ordesa NP (below). URB=urban areas; IND = Industrial areas; AGR = Agricultural areas; HET = Heterogeneous agricultural areas; GRAS = Grasslands; SHR = Shrubs; SHR-GRAS=shrubs and grasslands, FOR = Forests. The yellow perimeters represent the boundaries of each NP. Black and white colors represent increasing altitude, ranking from 473 to 3337 m in Ordesa NP's study area, and from 605 to 2462 m in Guadarrama NP's.

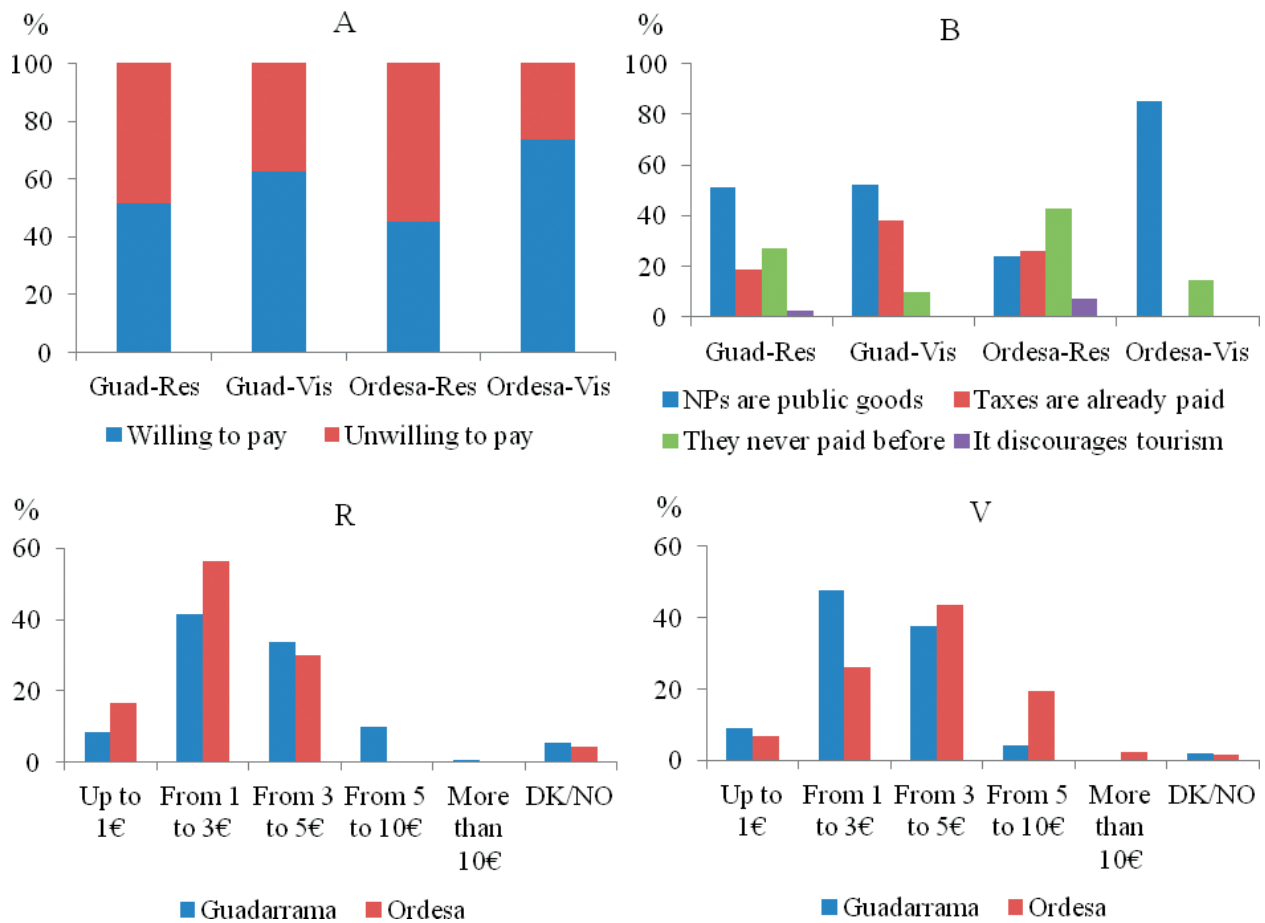
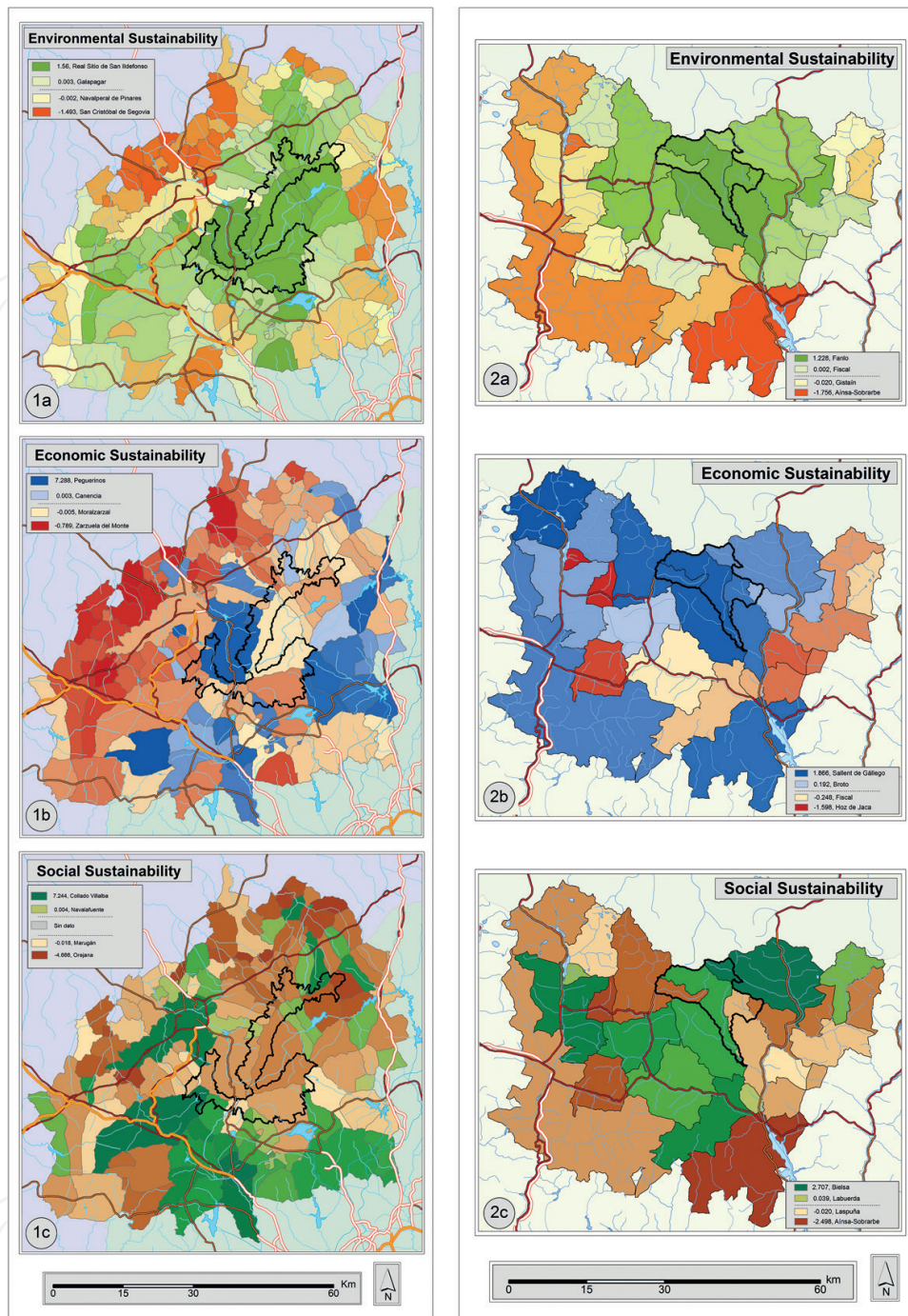


Figure 10. Results on willingness to pay and entrance fee by residents (R) around and visitors (V) to Guadarrama NP and Ordesa NP.

		Guadarrama NP		Ordesa NP	
		NP municipalities	External municipalities	NP municipalities	External municipalities
ESI	Median	0.98	-0.74	0.95	-0.23
	Standard deviation	0.52	0.90	0.14	0.91
SSI	Median	-0.12	-0.12	0.02	-0.15
	Standard deviation	0.51	1.16	1.09	0.93
ECSI	Median	-0.09	-0.34	0.97	-0.56
	Standard deviation	-0.44	1.18	0.54	0.97

The values of the indices rank from  $+\infty$  (highest sustainability) to  $-\infty$  (lowest sustainability). ESI: Environmental sustainability; SSI: Social sustainability; ECSI: Economic sustainability.

Table 4. Descriptive statistics on the three indices of municipal sustainability by municipality type.



**Figure 11.** Sustainability maps of municipalities included in Guadarrama NP (left column) and Ordesa NP (right column) and their external municipalities. The values of (a) environmental, (b) economic and (c) social sustainability indexes are shown. National Park boundaries are depicted in black. Maps' legends only show extreme municipal values.

### 5.5. Global sustainability: main results of the DISESGLOB project

A Municipal Sustainability Assessment Indicator System was developed whereby the municipalities included in Ordesa NP (n = 6) and Guadarrama NP (n = 35) as well as adjacent external municipalities (n = 16 and n = 72, respectively) were assessed according to five environmental

indicators, five social indicators and five economic indicators [20]. Those indicators were subsequently integrated in three indices depicting Environmental Sustainability, Social Sustainability and Economic Sustainability. The results show that, generally, the municipalities included in both NPs were more sustainable than those located outside them (**Table 4**).

Ninety-one percent and 83% of the municipalities included in Guadarrama NP and Ordesa NP were in the first and second quartiles of environmental sustainability, respectively. In contrast, only 29 and 31% of the external municipalities were in those quartiles. In Ordesa NP, 100% and 31% of the municipalities inside and outside the NP were in the first or second quartiles of economic sustainability, respectively. There is not a clear pattern on local social sustainability, though. In Guadarrama NP, external municipalities close to the cities of Madrid (to the south) and Segovia (to the north) showed greater social sustainability (**Figure 11**).

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