Metadata S1. Lorite, J. A. Ros-Candeira, D. Alcaraz-Segura, and C. Salazar-Mendías. 2020. FloraSNevada: a database of the vascular flora of Sierra Nevada, southeast Spain. Ecology.

Class I. Data set descriptors

A. Data set identity

Title: FloraSNevada: a database of the vascular flora of Sierra Nevada, southeast Spain

B. Data set identification codes

FloraSNevada_*.csv

C. Data set description

1. Originators

Juan Lorite[1,2], Andrea Ros-Candeira[2], Domingo Alcaraz-Segura[1,2,3], Carlos Salazar-Mendías[4]

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2. Abstract

Providing a complete data set with species and trait information for a given area is essential for assessing plant conservation, management, and ecological restoration, both for local as well as global applications. Also, these data sets provide additional information for surveys or data collections, establishing the starting point for more detailed studies on plant evolution, vegetation dynamics, and vegetation responses to disturbance and management. This database covers Sierra Nevada mountains (southeastern Spain), a recognized plant biodiversity hotspot within the Mediterranean context. According to previous available data (before this augmented compilation), these mountains host 7% of the 24,000 Mediterranean vascular plants, despite covering just 0.01% of its area. Another characteristic of the Sierra Nevada is the great singularity of its flora, with 95 taxa being endemic to the high-mountain area of Sierra Nevada and surroundings. From these endemic taxa, 70% are endangered by different threats, global warming being a leading cause. In this paper, we seek to provide a complete and updated database of the flora of the Sierra Nevada mountains (southeast Spain). The goal of the present data set is to compile the names of all the vascular plant taxa inhabiting Sierra Nevada, together with relevant features including taxonomical, morphological-ecological traits, distribution, habitats, abundance, and conservation status.

The data were compiled according to all the available information sources on taxonomy, ecology, and plant-species distribution. The resulting data set includes 2,348 taxa belonging to 1,937 species, 377 subspecies and 34 hybrids, from a total of 756 genera and 146 families represented in the collection. For each taxa, together with taxonomical information (Phylum, Class, Family, Genus, Taxa), we compiled plant traits (life-form, spinescence, flower symmetry, flower sexuality, plant gender, androecium:gynoecium ratio, flower color, perianth type, pollinator type, flowering, seed dispersal, vegetative reproduction), and their environmental association (origin, endemic character, general distribution, substrate, elevation, habitat, local abundance, hygrophilous behavior, conservation status). All these traits were compiled from all the available information sources, resulting in a complete and updated database for Sierra Nevada vascular flora. This data set provides valuable information on plant traits in an outstanding micro-hotspot within the Mediterranean hotspot.

Keywords
Sierra Nevada, vascular plant species, plant traits, environmental association, Mediterranean mountain, hotspot, checklist, Spain

Class II. Research origin descriptors

A. "Overall" project description

1. Identity
FloraSNevada: a trait database of the vascular flora of Sierra Nevada (SE Spain)

2. Originator(s)
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3. Period of study
This database has been compiled, completed and updated using all the existing information about the vascular flora of Sierra Nevada, from the first checklist for the area (Molero and Pérez-Raya 1987) to 2019.

4. Objectives

The purpose of FloraSNevada database is to compile the names of all the vascular plant taxa inhabiting the Sierra Nevada hotspot (SE Spain), together with relevant species features, including taxonomy, plant traits and their environmental association.

5. Abstract

Same as above.

6. Source(s) of funding

This work has been performed within the H2020 project "ECOPOTENTIAL: Improving Future Ecosystem Benefits Through Earth Observations" (http://www.ecopotential-project.eu/). The project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 641762. JL and CS were also financed by the project B1-RNM-163-UGR18: "Searching for patterns and paths of anthropic global change in a Mediterranean Mountain, GLOMED", Consejería de Innovación Ciencia y Empresa, Regional Government of Andalusia.

B. "Specific subproject" description

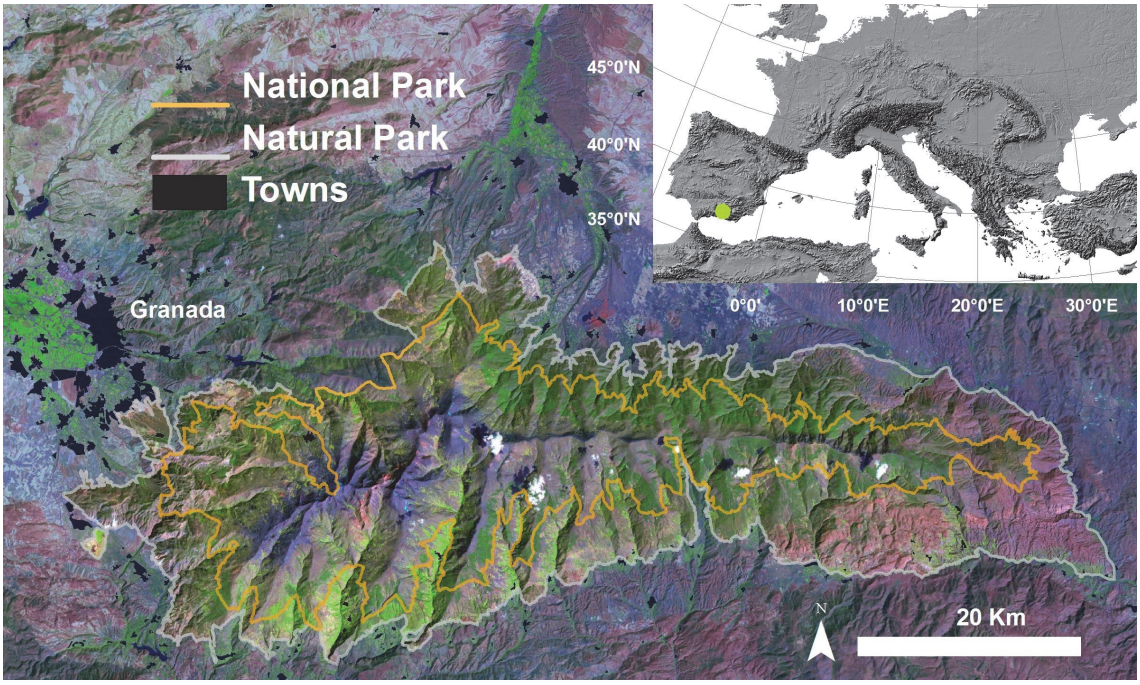
1. Site description

The Sierra Nevada mountain range is a European and Mediterranean biodiversity micro-hotspot (a core within a hotspot) located in southeastern Spain (36°50'24"N and 37°15'0"N Latitude; 3°44'24"W and 2°35'24"W Longitude, Figure 1). With a surface area of 2,100 km^2, it has complex orography with a broad elevational range, from 200 m to 3,482 m a.s.l. (Mulhacén Peak). The climate is Mediterranean, characterized by cold winters and hot summers, with pronounced summer drought (July-August) (Gómez 2002). The average temperatures fall below 0ºC during winter with a snow cover that can persist up to 8 months on the summits (occasionally up to 10 months in small, sheltered areas). The average annual rainfall is highly irregular, with values ranging between 250 and 700 mm per year, depending mostly on elevation and on the complex orography. Winter precipitation takes the form mainly of snow above 2,000 m a.s.l. Geologically, the core area is composed of siliceous rocks, primarily mica-schists, surrounded by limestone and dolomite (Jabaloy et al. 2008).

Sierra Nevada is an isolated high mountain, more than 700 km away from other comparable mountain ranges in terms of maximum altitude, such as the Pyrenees (N Iberian Peninsula) in the north or the High and Middle Atlas (N Morocco) in the south. This mountain marks the southernmost limit of the influence of the Quaternary glaciations in Europe, when it was covered with glaciers only in areas above 2,500 m a.s.l., while large areas of it remained free of permanent ice (Gómez-Ortiz et al. 2013). All this helped to make Sierra Nevada a refuge for many plant species during glacial ages as well as for isolated populations that have evolved under particular conditions, such as specific soil types or isolated summit habitats (Blanca et al. 1998). This has encouraged speciation, resulting in a high number of plant species (Lorite 2016), with more than 100 endemic taxa (Lorite et al. 2007, Lorite 2016). For this reason, it is considered one of the most important biodiversity hotspots within the

Mediterranean region (Blanca et al. 1998, Médail and Quezel 1999, Médail and Diadema 2009, Cañadas et al. 2014).
Sierra Nevada is under different legal levels of protection: Special Protection Area and Site of Community Importance (Natura 2000 network); Natural and National Park of Spain, Biosphere Reserve MAB Committee UNESCO. The range is populated by 61 municipalities with more than 90,000 inhabitants. The main economic activities are agriculture, beekeeping, mining, tourism, and skiing (Bonet et al. 2010).

Figure 1. Location of Sierra Nevada mountains (southern Spain). The boundaries of the National and Natural Parks are shown. We used a Landsat 5 image (2001) as background.



2. Research methods

The starting point in assembling this database was the checklist of the flora of Sierra Nevada (Lorite 2016). Species features were compiled using primarily *Flora Vascular de Andalucía Oriental* (Blanca et al. 2011) *Flora iberica* and (Castroviejo 1986-2019) for families published after 2011. Data on the species distribution, as well as other morphological and ecological features were completed from the review of the herbaria located in the study area (ALME, GDA, HUAL, JAEN and MGC), in addition to the most relevant ones in Spain (mainly BC, BCF, MA, MAF, and SEV) and in different countries (COI, G, MPU, among others). We also compiled the information from GBIF (http://www.gbif.org/) for herbarium sheets, and the Anthos-Spanish Plant Information System (http://www.anthos.es/) for bibliographic data. In addition, we reviewed the recent monographic literature for collection records in the area.
With all the data compiled, we constructed a matrix of 2,348 rows by 35 columns (see trait details in Table 1).

Table 1. List of the traits (variable name), factors (values included), and description of values, following Garnier et al. (2017) for major categories (i.e. "plant traits" and "environmental association"). References: [1]Castroviejo (1987-2019), [2]Blanca et al. (2011); [3]Hinchliff et al. (2015); [4]APGIII. Angiosperm Phylogeny Group (2003); [5]Raunkiaer (1934); [6]Lorite (2016); [7]Blanca et al. (2001); [9]Rivas-Martínez et al. (2002); [9]IUCN (2001). Note: If not specified, terminology follows Allaby (2006) and Font-Quer (1985).

Trait/Variable name	Factors/Values	Description
Taxonomy		
taxon[1,2]		Accepted scientific name
taxaRank[1,2]	species	Species
	subspecies	Subspecies
	hybrid	Hybrid
phylum[3]		Phylum for a given taxon
class[3]		Class for a given taxon
family[4]		Family for a given taxon
genus[1,2]		Genus for a given taxon
species[1,2]		Specific epithet for a given taxon
subspecies[1,2]		Subspecific epithet for a given taxon (if applicable)
author[1,2]		Authority for a given taxon
Plant traits		
LifeForm[1,2,5,6]	therophyte	Annual plant completing its cycle in few months and surviving unfavorable periods by means of seeds
	geophyte	Plant surviving unfavorable periods by means of underground food-storage organs
	hemicryptophyte	Plant having perennating buds at or near the soil surface (including biennial species)

	chamaephyte	Plant having buds on persistent shoots under 50 cm.
	phanerophyte	Perennial and usually woody plant with their resting buds being more than 50 cm above the soil surface (shrubs or trees)
	helophyte	Plant surviving unfavorable periods by means of food-storage organs resting in marshy or wet soil
	hydrophyte	Plant growing either partly or totally submerged in water
Spinescence[1,2]	yes	Having spiny organs (including spines, prickles, glochidia and calyx teeth)
	no	Not having spiny organs
FlowerSymmetry[1,2]	actinomorphic	Having radially symmetric flowers or pseudanthia
	zygomorphic	Not having radially symmetric flowers (including bisymmetric and asymmetric)
	actinomorphic+zygomorphic	Having both symmetric and asymmetric flowers
FlowerSexuality[1,2]	hermaphroditic	Hermaphroditic flowers
	unisexual	Unisexual flowers (having monoecious or dioecious)
	female+hermaphroditic	Female and hermaphroditic flowers
	male+hermaphroditic	Male and hermaphroditic flowers
	polygamous	Male, female and hermaphroditic flowers
PlantGender[1,2]	hermaphroditic	Male and female organs in the same flower and individual
	dioecious	Male and female organs in

		different individuals
	monoecious	Male and female organs in different flowers of the same individual
	otherwise	Including andromonoecious, gynomonoecious, androdioecious, gynodioecious, monoecious/dioecious
RatioAndroeciumGynoecium[1,2]	<1	Number of stamens/number of carpels <1
	1	Number of stamens/number of carpels =1
	>1	Number of stamens/number of carpels >1
FlowerColor[1,2]	colored	Colored flowers (vivid colors)
	non_colored	Flowers with brownish/greenish color
PerianthType[1,2]	heteroclamideous	Double perianth with petals (corolla) and sepals (calyx)
	homoclamideous	Double perigonium with tepals
	simple	Simple perianth (with either calyx or corolla is absent)
	absent	No perianth (including much reduced)
PollinationType[1,2]	biotic	Biotic agents (mostly insect)
	abiotic	Abiotic agents (wind or water)
FloweringStart[1,2,7]	month within a year (1-12)	Beginning of flowering period
FloweringEnd[1,2,7]	month within a year (1-12)	Ending of flowering period
SeedDispersal[1,2,7]	biotic	Biotic agents (exozoochory and endozoochory)
	abiotic	Wind (including barochory)
VegetativeReproduction[1,2,7]	yes	Presence of clonal and/or

		vegetative organs for reproduction (fragmentation not included)
	no	Absence of clonal and/or vegetative organs
Environmental association		
Origin[1,2,6]	native	Occurring naturally in the area
	alien	Introduced (intentionally or unintentionally)
Endemic[2,6,7]	yes	Endemic to Sierra Nevada
	subendemic	Subendemic to Sierra Nevada
	no	Distribution area exceeding Sierra Nevada
GeneralDistribution[1,2,7]	Wide	Wide distribution (exceeding Mediterranean boundaries)
	Mediterranean	Mediterranean region (occasionally including Macaronesia)
	W_Mediterranean	Western Mediterranean (occasionally including Macaronesia)
	Iberian_N_African	Iberian Peninsula and Northern Africa
	Baetic_N_African	Baetic mountains and Northern Africa
	Iberian	Endemic to Iberian Peninsula
	S_Iberian	Endemic to Southern Iberian Peninsula
	SE_Iberian	Endemic to Southeastern Iberian Peninsula
	E_Iberian	Endemic to Eastern Iberian Peninsula
	Baetic	Endemic to Baetic mountains

	Sierra_Nevada_subendemic	Endemic to Sierra Nevada mountains, and also appearing scattered in neighboring areas
	Sierra_Nevada_endemic	Endemic to Sierra Nevada mountains
Habitat/Abundance		
Substrate[1,2]	Calcicolous	Appearing in calcareous substrates (mainly limestone)
	Calcifugous	Appearing in non-calcareous substrates (mainly schist or quartzite)
	Indifferent	Appearing in different substrates
	Special	special substrates (dolomite, gypsum, saline, marls)
ElevationMin[1,2,7]	minimum elevation (meters)	lower altitude elevation boundary
ElevationMax[1,2,7]	maximum elevation (meters)	upper elevation boundary
Habitat[1,2,7,8]	1	Floating or rooted submerged aquatic vegetation
	2	Amphibious vegetation of fresh-waters, springs and fens
	3	Coastal and continental halophilous and sand-dune vegetation
	4	Chasmophytic, epiphytic and scree vegetation
	5	Synanthropic, fringe and megaphorbic vegetation
	6	Supra-timberline climactical zonal vegetation on cryophilous geliturbated soils
	7	Grassland and meadow vegetation

	8	Heathland, dwarf scrub and scrub vegetation
	9	Forest, woodland, semi-desert and desert potential natural vegetation
LocalAbundance[2]	co	Common, very abundant and dominant
	fr	Frequent, very abundant, not dominant
	oc	Occasional, many localities without being dominant
	ra	Rare, some localities being scarce in all of them, or few localities being locally abundant
	rr	Very rare, few populations with few individuals
Hygrophilous[1,2,7,8]	yes	Preferring moist habitats
	no	Not preferring moist habitats
ConservationStatus[1,2,6,7,9]	No_th	Not threatened (i.e. it includes Least Concern and Not Evaluated species)
	NT	Near threatened
	DD	Data deficient
	VU	Vulnerable
	EN	Endangered
	CR	Critically endangered
	EX	Extinct
Others		
Comments		Additional comment/s on the taxon

3. Project personnel

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Class III. Data set status and accessibility

A. Status

1. Latest update

10 December 2019

2. Latest archive date

10 December 2019

3. Metadata status

10 December 2019

4. Data verification

Data set was completely checked and verified before publication. If a user identifies any potential mistake or absence, please notify to Juan Lorite, Carlos Salazar-Mendías, Domingo Alcaraz-Segura, or Andrea Ros-Candeira (see contacts below).

B. Accessibility

1. Storage location and medium

The data set is available on the PANGAEA repository (https://issues.pangaea.de/browse/PDI-22453) as a living and updating resource. The static version of the data set is also stored as a Supporting Information Data File with this ESA data paper publication (see DataS1.zip).

2. Contact person(s)

Juan Lorite, Department of Botany, University of Granada and Interuniversity Institute for Earth System Research. Granada 18071. Spain, email: jlorite@ugr.es.

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3. Copyright restrictions

This data set can be freely used for non-commercial purposes.

4. Proprietary restrictions

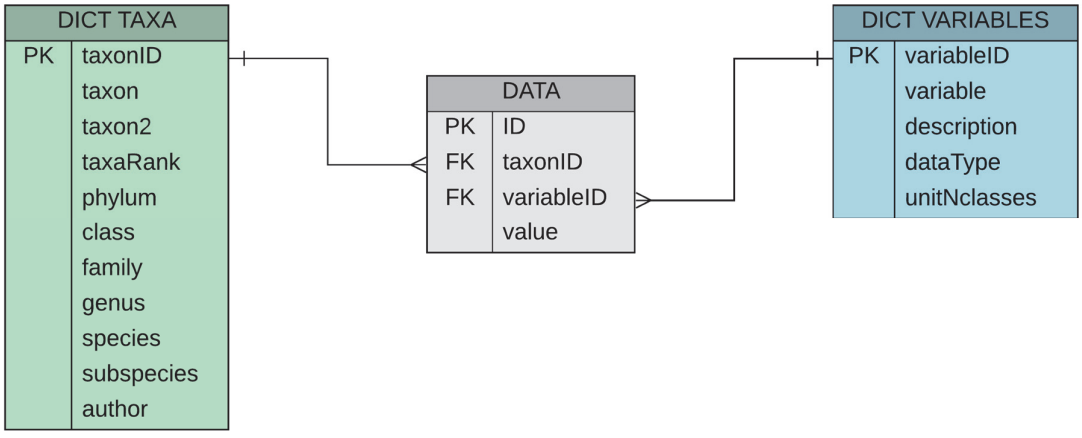
Citation: Lorite, J., Ros-Candeira, A., Alcaraz-Segura, D. and C. Salazar-Mendías. 2020. FloraSNevada: a trait database of the vascular flora of Sierra Nevada, southeast Spain. Ecology. https://doi.org/10.1002/ecy.3091.

Class IV. Data structural descriptors

A. Data set file

Due to the multiple possibilities of data manipulation and in order to offer greater practicality to potential users, we provide the FloraSNevada data set in both a wide and long data format. The long format is represented in the storage of the data set in a relational database, which is structured by three linked tables (Figure 2). In addition, we offer a matrix with all the information in the wide format (each row corresponds to one species and each column to a variable/trait). A detailed description of each table is given below.

Figure 2. Diagram illustrating FloraSNevada database model, showing its structure, the relationship between the tables, and the individual fields.



1. Identity:
A) FloraSNevada_dict_taxa.csv
B) FloraSNevada_dict_variables.csv
C) FloraSNevada_data.csv
D) FloraSNevada_complete_matrix.csv

2. Size:
A) 2348 rows (excluding the header), 11 columns.
B) 23 rows (excluding the header), 5 columns.
C) 56352 rows (excluding the header), 4 columns.
D) 2348 rows (excluding the header), 35 columns.

3. Format and storage mode:
The four tables are available as comma-separated values (csv) files, with encoding UTF-8.

4. Header information:
A) See Table 2.
B) See Table 3.
C) See Table 4.
D) See Table 5.

5. Special characters/fields
A null value (empty cell) indicates that no information was available for a cell, while "n/a" indicates that a variable/trait was not applicable for a species.
D) In the "Comments" column, the different comments provided by the author are separated by a vertical bar (|).

B. Variable information

Table 2. Header information of "FloraSNevada_dict_taxa.csv"

Field name	Definition
taxonID	Unique identifier of the taxon
taxon	Taxon name with author names
taxon2	Parts of the taxon name separated by underscore and without authors' names
taxaRank	The taxonomic rank of the most specific name in the taxon
phylum	The scientific name of the phylum in which the taxon is classified
class	The scientific name of the class in which the taxon is classified
family	The scientific name of the family in which the taxon is classified
genus	The scientific name of the genus in which the taxon is classified

species	The name of the first or species epithet of the taxon
subspecies	The name of the lowest or terminal infraspecific epithet of the taxon
author	The authorship information for the taxon name

Table 3. Header information of "FloraSNevada_dict_variables.csv"

Field name	Definition
variableID	Unique identifier of the functional trait or variable
variable	The functional trait or variable name
description	A brief description of the functional trait or variable
dataType	The data types used in each functional trait or variable
unitNclasses	Units for quantitative data; number of classes for categorical and semi-quantitative data

Table 4. Header information of "FloraSNevada_data.csv"

Field name	Definition
ID	Unique identifier
taxonID	Unique identifier of the taxon
variableID	Unique identifier of the functional trait or variable
value	The value of the variable for each taxon

Table 5. Header information of "FloraSNevada_complete_matrix.csv"

Field name	Definition
taxonID	Unique identifier of the taxon
taxon	Taxon name with author names
taxon2	Parts of the taxon name separated by underscore and without authors' names
taxaRank	Taxonomic rank of the taxon (i.e. species, subspecies or hybrid species)
phylum	Scientific name of the phylum in which the taxon is classified

class	Scientific name of the class in which the taxon is classified
family	Scientific name of the family in which the taxon is classified
genus	Scientific name of the genus in which the taxon is classified
species	Specific epithet of the taxon
subspecies	Subspecific epithet of the taxon
author	Authorship information of the taxon
LifeForm	Biotype or biological form of the taxon
Spinescence	Presence/absence of spiny organs in the taxon
FlowerSymmetry	Flower symmetry of the taxon
FlowerSexuality	Arrangement of male and female reproductive organs
PlantGender	Gender of the plants
RatioAndroeciumGynoecium	Number of male pieces per number of female pieces in the flower
FlowerColor	Presence/absence of colored flowers
PerianthType	Perianth type (having calyx and corolla, only calyx, perygonium, only corolla or absent)
PollinationType	Pollination type (biotic vs. abiotic)
FloweringStart	Beginning of flowering period (month within a year 1-12)
FloweringEnd	Ending of flowering period (month within a year 1-12)
SeedDispersal	Seed dispersal modes (biotic vs. abiotic)
VegetativeReproduction	Presence/absence or clonal and/or vegetative organs for reproduction
Origin	Native vs. alien
Endemic	Endemic, subendemic, or non-endemic to Sierra Nevada
GeneralDistribution	Distribution range of the taxon
Substrate	Type of preferred substrate of the taxon
ElevationMin	Lower elevational boundary in the area

ElevationMax	Upper elevational boundary in the area
Habitat	Main habitat type of the taxon
LocalAbundance	Categorized local abundance of the taxon in the area
Hygrophilous	Preferring vs. not preferring moist habitats
ConservationStatus	Conservation status according to IUCN categories
Comments	Brief additional comments provided by the authors

Class V. Supplemental descriptors

A. Data acquisition

Review of bibliographic sources detailed in Tables 1 and 2.

B. Quality assurance/quality control procedures

Cross-validation among the different data sources detailed in Tables 1 and 2.

C. Related materials

All bibliographic sources are publicly available.

D. Computer programs and data-processing algorithms

We used the PostgreSQL relational database management system (RDBMS) to organize the data set in a relational database.

E. Archiving

1. Archival procedures

The data set is permanently archived in the PANGAEA repository specified above.

2. Redundant archival sites

Not applicable.

F. Publications and results

Blanca, G., López-Onieva, M. R., Lorite, J. et al. (2001). Flora amenazada y endémica de Sierra Nevada. Granada: Universidad de Granada.

Cañadas, E. M., Fenu, G. Peñas, J. et al. (2014(. Hotspots within hotspots: Endemic plant richness, environmental drivers, and implications for conservation. *Biological Conservation* 170: 282–291.

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G. History of data set usage

See section “publications and results”.

Acknowledgments

This work has been carried out within the H2020 project “ECOPOTENTIAL: Improving Future Ecosystem Benefits Through Earth Observations” (http://www.ecopotential-project.eu/). The project has received funding from the European Union’s Horizon 2020 research and innovation program under grant agreement No 641762. JL and CS were also funded by the project B1-RNM-163-UGR18: “Searching for patterns and paths of anthropic global change in a Mediterranean Mountain, GLOMED”, Consejería de Innovación Ciencia y Empresa, Regional government of Andalusia. Also, it was partially conducted under the agreement "Convenio de Colaboración entre la Consejería de Medio Ambiente y Ordenación del Territorio y la Universidad de Granada para el desarrollo de actividades vinculadas al Observatorio de Cambio Global de Sierra Nevada, en el marco de la Red de Observatorios de Cambio Global de Andalucía". David Nesbitt has made a language revision of the manuscript.

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