

AFLIBER v.2: Updating the Iberian database of vascular plant distributions

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<https://doi.org/10.5209/mbot.106425>

Received: 12 October 2025 • Accepted: 8 April 2026 • Published online: 30 September 2026

Abstract. AFLIBER v.2 provides an updated synthesis of vascular plant distributions in the Iberian Peninsula and the Balearic Islands, a major Mediterranean biodiversity hotspot. This new release incorporates 368 additional data sources, including open repositories, restricted-access collections, and non-digitized regional floras, resulting in 417,684 new records (121,441 non-duplicated novelties) and a total of 3.13 million distributional records at a 10 × 10 km UTM resolution. Taxonomic updates, recent chorological novelties, and a rigorous validation process—removing over 3,000 doubtful citations—substantially improve data reliability. The new dataset enhances coverage in previously under-sampled territories, particularly the Iberian and Baetic Systems and several Portuguese provinces and confirms the exceptional floristic richness of Mediterranean mountain regions. AFLIBER v.2 constitutes a curated, publicly accessible resource for floristic, ecological, and biogeographical research, providing an essential baseline for conservation planning. Future developments will address nomenclatural harmonization, finer spatial resolution, and automated data workflows within the infrastructure coordinated by the Spanish Botanical Society (SEBOT).

Keywords: Andorra, Balearic Islands, biodiversity data, geographical distribution, Portugal, Spain, vascular plants.

How to cite: Ramos-Gutiérrez, I., Acedo, C., Alfaro-Saiz, E., Arista, M., Arroyo, J., Guardiola, M. Jiménez-Mejías, P., Mateo, R.G., Mateo, G., Peralta, J. Pérez-Latorre, A.V., Romero Zarco, C., Sáez, L.I., Salazar-Mendías, C., Serra-Laliga, L.I. & Moreno-Saiz, J.C. 2026. AFLIBER v.2: Updating the Iberian database of vascular plant distributions. *Mediterr. Bot.* 47(2), e106425. <https://doi.org/10.5029/mbot.106425>

Introduction

Databases on biodiversity occurrence records are becoming increasingly essential in several research topics, from biogeography to conservation-related issues (Ronquillo *et al.*, 2020; Heberling *et al.*, 2021; Keppel *et al.*, 2021). Gradually, more repositories are becoming available, ranging from global open data infrastructures such as GBIF to others focused on specific taxonomic groups or study regions (e.g. Borges *et al.*, 2010; Sanz-Arnal *et al.*, 2025). Nevertheless, several challenges have been identified regarding the availability and quality of information collected in data portals and published data papers, including usage restrictions on data collections and the lack of data curation regarding records from citizen science (e.g. Hortal *et al.*, 2007; Mandeville *et al.*, 2021).

The vascular flora atlas of the Iberian Peninsula (AFLIBER) was published covering open and restricted access floristic data sources (Ramos-Gutiérrez *et al.*, 2021). This atlas filled a gap between ongoing databases collecting occurrence records of vascular plants in the Iberian Peninsula and the Balearic Islands and was subjected to a filtering process to detect mistakes. Later, the website hosting the database was developed to offer distribution maps and data downloads by taxa or by location (iramosgutierrez.github.io/afliber/). Over these years, AFLIBER has been used, among other topics, in projects dealing with conservation, vegetation management or alien species control (e.g. Weerasena *et al.*, 2023; Cires *et al.*, 2025; Riera *et al.*, 2025).

Updating databases is essential to maintaining their usefulness, especially in areas such as the Iberian Peninsula and Balearic Islands, which is a regional hotspot of diversity and where numerous floristic contributions are published every year (Molina-Venegas *et al.*, 2015; Aedo *et al.*, 2017). For this reason, the Spanish Botanical Society (SEBOT) set up a working group on vascular plant distributions with the aim of keeping the occurrence database up to date, expanding its coverage with new databases, strengthening the record curation process, and guaranteeing public access to the database for coming years. Here we present AFLIBER v.2, a new version of the database after nearly five-year time of data compilation.

Material and Methods

The area covered by the database includes the Iberian Peninsula (mainland Portugal, mainland Spain and Andorra), the Balearic Islands and some adjacent islets. To refer to the distributional information, the standard European UTM-grid at 10-km resolution was used, which extends the territory by 6,316 terrestrial UTM grid-cells. The working

list of species and subspecies used in the original database was updated following an exhaustive review of the literature published in recent years, with the aim of incorporating new taxa found or described for the study area.

All distributional data were retrieved at a 10-km resolution from a systematic search of electronic repositories and scientific literature published up to 31 December 2024. Occurrences from 368 new data sources were added in AFLIBER v.2, including those from additional open data infrastructures, the vast archive of floristic citations from the Iberian System compiled by one of us (GM), to non-digitized articles appearing in local botanical journals (#158-525 in Table S1c, see also Appendix 1 – Supplementary references). Finally, all taxa that had added new grid cells with respect to the original database were mapped and reviewed one by one by the authors in search of erroneous or doubtful occurrences based on expert knowledge of the study region. This process allowed us to identify over 2,800 records that were added to the discarded citations (with a total of 32,050 disregarded records, see Table S1d).

Results and Discussion

Following the review of the botanical literature, the list of vascular plant species and subspecies inhabiting the Iberian Peninsula and the Balearic Islands was modified to reflect taxonomic changes, new taxa described to science, and chorological novelties recorded between 2020 and 2024. However, the working list originally used by AFLIBER was not reviewed in depth, as a complete nomenclatural update is planned to follow the forthcoming publication of the comprehensive checklist being prepared by members of the Spanish Botanical Society. This raised the total figure to 6,471 species and subspecies of vascular plants (Table S1a), confirming the role of the Iberian Peninsula and the Balearic Islands as regional hotspots within the Mediterranean basin (Médail & Quézel, 1997).

The compilation added 417,684 distributional records for AFLIBER v.2 (Table 1; Figure 1a), which included 401,059 unique occurrences (i.e., non-duplicated) at a 10-km grid-cell resolution. Notably, only 121,441 unique occurrences were new to the dataset, emphasizing the noteworthy completeness of the original database. AFLIBER v.2 now covers 3,129,827 distributional records, of which 1,942,697 are unique (i.e. unique combinations of taxon and grid cell; see Table S1b).

Despite the relatively modest number of new contributions to the final database (6.67%), these additions were crucial for filling gaps in areas that were previously under-sampled, particularly in the inland plateaus of Iberia (Ramos-Gutiérrez *et al.*, 2021). Figure 1a shows the areas with the greatest increase in records, highlighting the mountains of

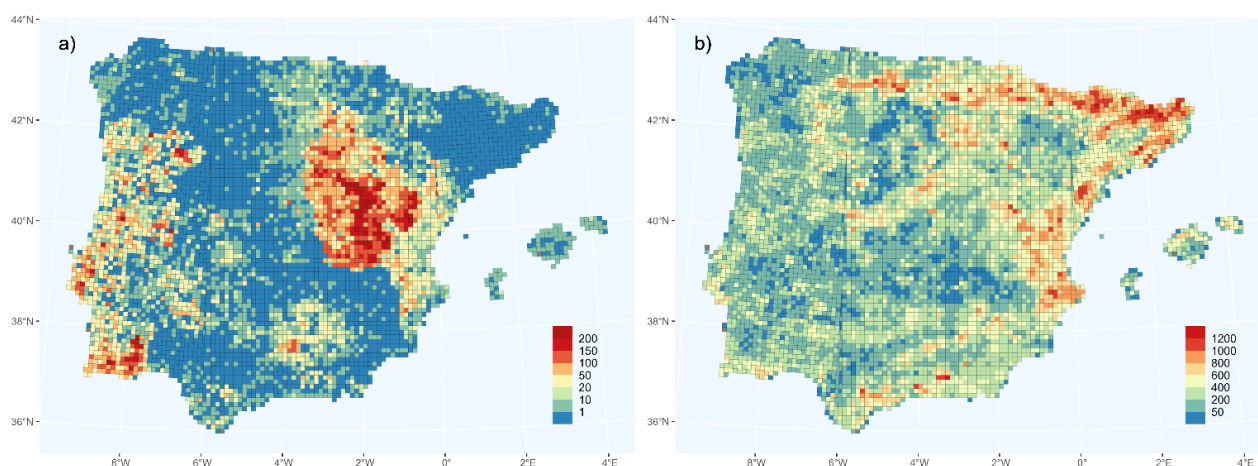


Figure 1. Geographical distribution of AFLIBER v.2. a, new occurrences incorporated in this second version (measured as the difference of occurrences across versions); b, the number of taxa registered for each 10-km UTM grid cell (i.e. species richness).

the Iberian System, the Eastern Baetic System and the Portuguese provinces. Nine empty 10-km cells persisted, all of them corresponding to coastal cells with limited terrestrial surface, or to squares located between UTM adjacent zones. Figure 1b shows the distribution of the total unique data recorded, that is, the Iberian and Balearic distribution of vascular plant richness according to this work. Once again, mountain areas peaked as those with the greatest species diversity and sampling effort (see Figure S1), a pattern that is largely consistent with previous publications (Castro-Parga *et al.*, 1996; Lobo *et al.*, 2001). Sierra Nevada (30SVG70), the Catalan Pyrenees and Pre-Pyrenees (31TDG28, 31TDG38, 31TDG57) and the Montserrat mountain (31TDG00) stood out as cells with more than 1,250 registered taxa.

This paper provides a comprehensive, updated and quality-assessed database of plant distribution records across the Iberian Peninsula, offering an essential resource for biogeographical, ecological, floristic, and conservation research. By integrating new heterogeneous data sources, AFLIBER v.2 maintains the initial objective of serving as a robust foundation for large-scale analyses of floristic patterns and environmental drivers of biodiversity. Future updates will continue adding further restricted-access databases and floristic publications to the infrastructure, paying special attention to cover under-sampled areas (a project already started sampling some pilot grid cells). Next steps will involve i) adapting the taxonomy and nomenclature to the checklist being finalized by the Spanish Botanical Society, ii) increasing the resolution of the database with information referring to the 1-km square grids, iii) automating the process of incorporating and filtering floristic data into the infrastructure of Iberian vascular plant distributions, and iv) ultimately increasing the functionalities of AFLIBER within the resources offered by the Spanish Botanical Society.

Acknowledgements

We thank students and colleagues from the Universidad Autónoma de Madrid for digitizing, providing (A. Alonso, J. Boyano, E. Castillo, M. Coca de la Iglesia, A. Gallego, M. Marquerie) and curating data

records (V. Valcárcel). The authors also acknowledge J. Lorite and C. Quesada (Universidad de Granada, GDA herbarium), and P. Fernández-Díaz (SEV herbarium) for their collaboration. J. Puente (Government of Aragón) kindly resolved some distributional queries. Bill Clark gave permission to use the © Earth Point portal to transform massive number of coordinates. Finally, we would like to thank the rest of Spanish Botanical Society Chorological Working Group members for their fruitful discussions and contributions. The project FlorAnd was funded by three projects FEDER-Regional Government of Andalusia-University of Sevilla-1265280; PAIDI P18-RT-3651 2020 Regional Government of Andalusia; and TED2021-131037B-I00 Spanish Ministry of Science and Innovation. This work was funded by the Spanish Ministry of Science and Innovation-European Union NextGenerationEU/PRTR through the Connect2restore project (TED2021-129589B-I00), and by the Spanish Ministry of Science and Innovation-FEDER “Una manera de hacer Europa” through the NextDive Project (PID2021-124187NB-I00).

Authorship

IR-G: conceptualization, data curation, formal analysis, design of software, research, visualization, writing - review and editing; CA, EAS, MA, JA, LSL, MG, MA, JP, AVP, CR-Z, CS-M, LS: data curation, resources, writing - review and editing; RGM: data curation, fundraising, writing - review and editing; PJ-M: data curation, writing - review and editing; GM: resources, writing - review and editing. JCM-S: conceptualization, fundraising, data curation, resources, writing - first draft.

Conflict of interest

None

Data Availability Statement

Supplementary data, including taxonomic and distributional information, as well as compiled references and erased occurrences will be stored in Dryad Digital Repository (doi: 10.5061/dryad.gmsbcc2kv), and referenced from the AFLIBER database website (iramosgutierrez.github.io/afliber).

Table 1. Main data sources and number of occurrences provided to AFLIBER v.2. All data sources with less than 3,000 occurrences have been merged as “Others”. The total number of references incorporated is 368.

Data source	Number of occurrences
Mateo, G. (2024). Personal Database	227,261
Flora-On: Flora de Portugal Interactiva. Last accessed February, 2025	75,397
Buira, A. <i>et al.</i> (2020). doi: 10.5061/dryad.c59zw3r5r	38,989
Folia Botanica Extremadurensis	22,227
Salazar Mendías, C. (2024). Herbario de la Universidad de Jaén (JAEN). Version 1.7. Universidad de Jaén. doi: 10.15470/wiadvo	8,206
Peralta de Andrés, J. (2024). Herbario de la Universidad Pública de Navarra	6,710
FlorAnd: Flora de Andalucía online. servicio.us.es/florand	6,451
MACB (2024). Herbario de la Facultad de Ciencias Biológicas de la Universidad Complutense de Madrid (MACB). doi: 10.15470/akznr	3,650
Others	28,796

To refer to the general methodology of the atlas compilation, which includes the gathering and filtering of records, as well as patterns of species richness, endemism, and completeness, please cite version 1 (Ramos-Gutiérrez *et al.*, 2021; doi: 10.1111/geb.13363). To refer to the current version 2 of AFLIBER, please cite this article. To refer the proper database, please also cite the dataset stored on Dryad, specifying the queried version.

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