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# Towards an online atlas of the flora of the Alps: Vision, challenges and first steps

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**Abstract:** Online distribution maps covering a biogeographical unit across national borders of two or more countries are exceptions in Europe, most likely because they are challenging to realise. For instance, setting up an online atlas of the flora of the Alps would allow a first update of the comprehensive floristic knowledge since the *Flora Alpina* published by Aeschimann and co-workers two decades ago, but would need an international project involving as many floristic data centres as possible from across the entire Alpine arc. Despite this challenge, the idea of such an atlas prompted 26 participants from at least 17 institutions and 6 countries to attend the kick-off meeting of the so-called 'Atlas Flora Alpina' (AFA) project on March 10-11, 2023, at the Natural History Museum of Canton Ticino in Lugano (Switzerland). In this paper we provide a summary of the workshops and discussions held in the meeting by presenting the results in terms of vision, suggestions, decisions, open questions, and perspectives of the AFA project.

**Keywords:** alpine plants, data centres, Ehrendorfer grid, *Flora Alpina*, geographic distribution

**Verso un atlante online della flora delle Alpi: visione, sfide e primi passi**

**Riassunto:** Le mappe di distribuzione online che coprono un'unità biogeografica attraverso i confini nazionali di due o più Paesi sono un'eccezione in Europa, molto probabilmente perché sono impegnative da realizzare. Ad esempio, la creazione di un atlante online della flora delle Alpi consentirebbe un primo aggiornamento delle conoscenze floristiche complete dalla *Flora Alpina* pubblicata da Aeschimann e collaboratori due decenni fa, ma richiederebbe un progetto internazionale che coinvolga il maggior numero possibile di centri di dati floristici dell'intero arco alpino. Nonostante questa sfida, l'idea di un tale atlante ha spinto 26 partecipanti provenienti da almeno 17 istituzioni e 6 Paesi a partecipare alla riunione di avvio del cosiddetto progetto «Atlas Flora Alpina» (AFA) il 10-11 marzo 2023, presso il Museo di storia naturale del Cantone Ticino a Lugano (Svizzera). In questo articolo forniamo una sintesi dei workshop e delle discussioni tenutesi durante l'incontro, presentando i risultati in termini di visione, suggerimenti, decisioni, domande aperte e prospettive del progetto AFA.

**Parole chiave:** centri dati, distribuzione geografica, flora alpina, griglia Ehrendorfer, piante alpine

## INTRODUCTION

Great efforts have been made during the last thirty years to build up regional and national databases of floristic records in Europe and publish them on web atlas interfaces as online distribution maps. Most of them generally span over a single geopolitical unit (e.g. Botanischer Informationsknoten Bayern, [www.bayernflora.de](http://www.bayernflora.de); FloraFaunaSüdtirol, [www.florafauna.it](http://www.florafauna.it); InfoFlora, [www.infoflora.ch](http://www.infoflora.ch)), whereas those covering a biogeographical unit across national borders of two or more countries are exceptional. One such attempt has been made in the Jura Mountains where the international cooperation between the flora data centres of Switzerland and the neighbouring region in France resulted in the online atlas that has gone online on [www.florajurana.net](http://www.florajurana.net) in 2018. The success of this collaboration prompted the current and more challenging project of an online atlas of the flora of the Alps

(hereafter referred to as 'Atlas Flora Alpina project' and 'AFA project', respectively). Allowing ultimately the first update of the comprehensive floristic knowledge of the Alps since the *Flora Alpina* publication two decades ago (Aeschimann et al. 2004), the AFA project means to set up an international project consisting of as many collaborating floristic data centres as possible from across the entire Alpine arc, and challenges are multiple (Eggenberg et al. 2022).

To start the project, a kick-off meeting was organized by InfoFlora on March 10-11, 2023, at the Natural History Museum of Canton Ticino in Lugano (Switzerland). Twenty-six participants from at least 17 institutions and 6 countries (Austria, France, Germany, Italy, Slovenia and Switzerland) were invited to represent the many floristic regions across the Alps (Fig. 1).

The meeting started with three invited talks. Luise Schratt-Ehrendorfer (Universität Wien, Austria) and Thomas Wilhalm (Naturmuseum Südtirol, Bozen,



Figure 1: Participants at the kick-off meeting of the Atlas Flora Alpina project, 10-11.3.2023, Lugano, Switzerland. The meeting took place at the Natural History Museum of Canton Ticino. Line in the back, from left: Sylvain Abdulkhak, Beat Bäumler, Gilles Paches, Luise Schratt-Ehrendorfer, Thomas Wilhelm, Adrian Möhl, Simonetta Peccenini, Andrea Mainetti, Stefan Eggenberg, Gilberto Parolo, Boštjan Surina, Jörg Ewald, Filippo Prosser, Julia Wellsow, Maurizio Bovio. Line in front, from left: Michael Kleih, Jérémie van Es, Philippe Juillerat, Gabriele Casazza, Sebastiano Andreatta, Brigitte Marazzi, Alessio Bertolli, Giulia Tomasi, Roberto Delavedova, Alberto Selvaggi, Branko Vreš.

Italy) presented the data from the Floristic Mapping of Central Europe and consequences that this data could have for an Atlas Flora Alpina project. Sylvain Abdulkhak (Conservatoire Botanique National Alpin, Gap, France) provided feedback from the ALCOTRA BIODIVALP-Cobiodiv cooperation programme aimed at sharing knowledge on flora and habitats in the French-Italian alpine space. Philippe Juillerat (InfoFlora, Geneva, Switzerland) talked about the basic technical structure that can be provided for the Atlas Flora Alpina showing also an example of a web page hosting the atlas. These presentations set the stage for the rest of the meeting.

To begin with, participants were asked to share their vision about the AFA project and ways to organize it, including thoughts about its existence in the long term. The main goal of the meeting was, however, to discuss how to start the project and set up a first version of the online atlas in ideally up to two years. This period was called 'phase 1' by the meeting organizers. As a starting point for discussions, the following working scenario was presented to participants for phase 1 (Eggenberg et al. 2022): the map of the Flora Alpina publication by Aeschimann et al. (2004) would serve as a starting base map delimiting the geographic area considered in the project (Fig. 2). In this initial phase, point maps and subsequent online distribution maps would be generated via compilation of data from the floristic databases of the project members. The resulting AFA maps would then be made freely accessible on a website created on purpose, resulting in the first version of the online atlas to go live. After phase 1, data compilation in subsequent phases would aim at improving the online atlas in time, as both data and maps would be updated regularly. Linked to this working scenario, a number of workshops during the kick-off meeting allowed par-

ticipants to address fundamental questions such as: Which taxonomy should be used? On what grid and with what symbols should the data be displayed? How should the perimeter of the atlas be defined? How to deal with data export and data policy? What should be the next steps to concretely start the project?

The goal of the present paper is to provide an overview of the meeting results in terms of vision, suggestions, decisions, open questions, and perspectives from these workshops.

## PROJECT VISION AND ORGANIZATION

Before focusing on aspects linked to phase 1 of the AFA project, participants were asked to share their vision about the project and their thoughts on ways they could contribute to the project, on main problems they would expect to exist in such a project, and on conditions they would consider important to keep the project alive in the long term. Answers were presented individually, discussed in the group, and are summarized in a general form here.

Visions were largely similar among participants: to have a website – serving as an online platform – and a related smartphone application of the AFA-project, to be able to validate floristic data and adopt common criteria across the involved countries, to have usable floristic data, to create a common work space for experts across the Alps, and also to make the project known to a broad public across the Alps. Participants could see themselves involved in the project in a wide range of ways: gathering new data in the field and from the literature, compiling and providing already existing data, coordinating local or regional citizen-science efforts and passionate data collectors (the latter including



both hobby and professional botanists), contributing to data validation, species list compilation and taxonomic problem solving, and hosting one of the future regular meetings of the project. Sufficient funding, good health, a solid operational basis, recognition of work done, respect of the deontological rules requested by data providers are among the main conditions that were listed by participants in order for them to be willing to be involved in and contribute to the project. Problems and challenges were expected to emerge initially especially with the current taxonomy, data property and data policy, but also with how to keep up with future taxonomic changes, make regular updates, and coordinate the collective validation in the long term. But, no participant would see it as problematic, if web hosting and maintenance of the atlas would be granted by InfoFlora.

Finally, for a long-term persistence of the atlas project, participants agreed that it is fundamental to create a consortium and a number of working groups that take care of problems and routine maintenance, but also guarantee long-term functionality and visibility of the project. The consortium needs a Directive Committee that defines the working groups, sets minimum requirements, makes sure that all areas of the Alps and their respective reference persons are contacted, organizes leaders for taxonomic groups, involves also taxonomic experts from outside the project area, and most importantly dictates timelines and ensures that set goals are met.

## PHASE 1 OF THE PROJECT

The participants were informed about the working scenario in which the main goal of phase 1 would be to have a first version of the atlas going online within two years. To meet this goal and ensure the long-term continuation of the project, four topics were identified as crucial and were each discussed in a workshop for about an hour. In the following, the main thoughts and results of each workshop are reported.

### Taxonomy

There was no doubt among participants on the fact that taxonomy will be one of the biggest challenges for a common data aggregation. For most countries national checklists exist, but there can be considerable divergences in the way they are applied at the regional scale, because regional data centres may use alternative interpretations for some taxa. Furthermore, national checklists differ among countries, and such differences can be substantial. Two difficult questions were addressed during this workshop.

The first was about what taxonomy shall be applied in phase 1 to allow a first online version to be available in the short term. The taxonomy presented by Flora Alpina (Aeschimann et al. 2004) seems to be the only more or less complete set of taxa covering the entire Alps, across all countries. However, many taxon names are outdated and quite a few taxonomic

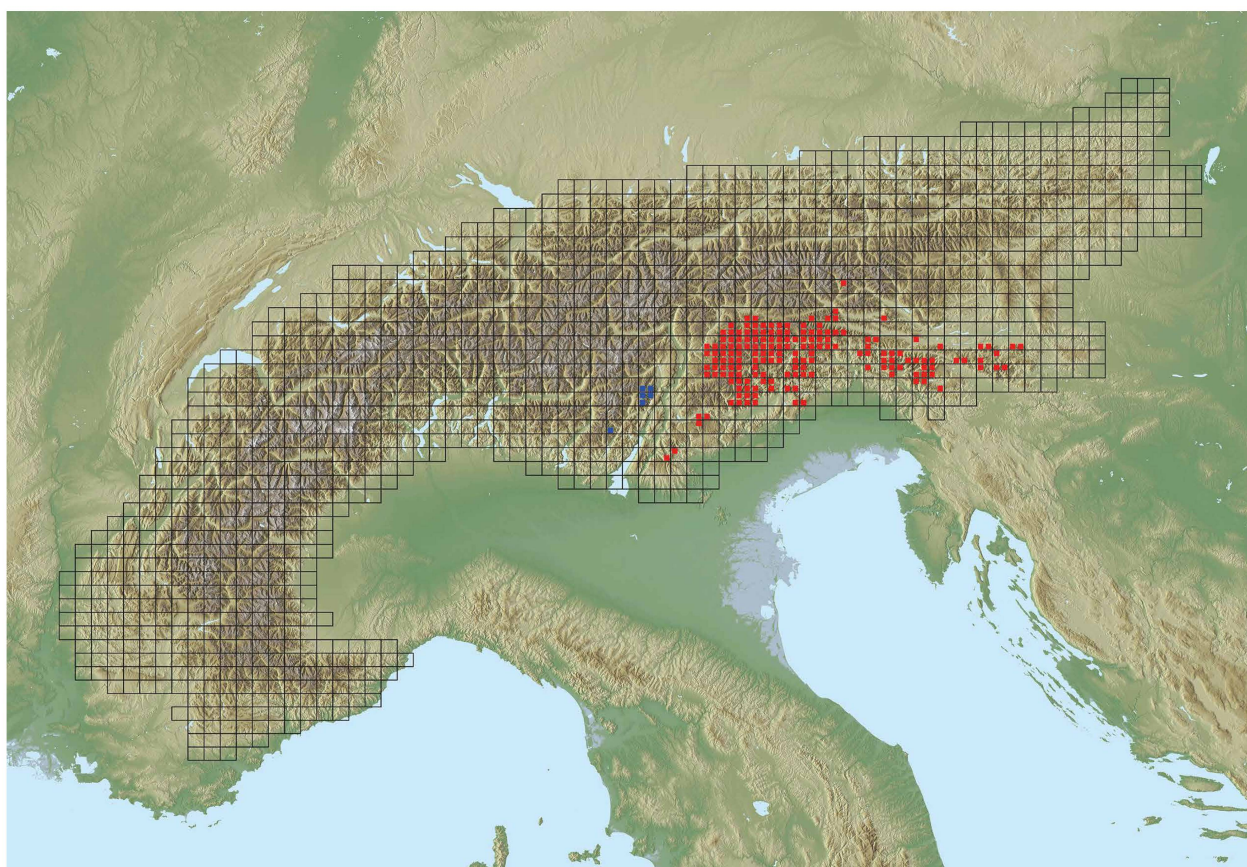


Figure 2: Example of taxon distributions displayed on the online atlas of the flora of the Alps. Ehrendorfer grid (Ehrendorfer & Hamann 1965) spanning the geographic delimitation of the alps inferred from Flora Alpina (Aeschimann et al. 2004). The blue and red markings show the distribution of *Gentiana brentae* Prosser & Bertolli (based on Prosser & Bertolli 2008) and *G. terglouensis* Hacq. (based on Aeschimann et al. 2004), respectively.



concepts are far from being up to date. An alternative is provided by the checklist created for data aggregation in the Western Alps (among France, Piedmont and Valle d'Aosta), although taxa of the central and eastern Alps are missing in this checklist. Nonetheless, based on the experience in doing this preliminary work of data aggregation, it is possible to learn how to tackle the difficulties of checklist matching. Apparently, there are tools by the Global Biodiversity Information Facility (GBIF, [gbif.org](http://gbif.org)) that are suitable for this purpose. For a first version of the atlas, it seems thus reasonable to apply the taxonomic concepts of Aeschmann et al. (2004, but with an updated nomenclature) as a backbone and offer a “translation” from this backbone list to the checklists used by the data centres by means of the GBIF tools.

The second question addressed was about taxonomically problematic genera in the AFA-project. For instance, while matching unambiguous taxa like *Arabidopsis thaliana* or *Alchemilla pentaphylla* (to cite examples that are common and not planted) among different checklists should be straightforward, the question arises on how to deal with taxonomically complex taxa from genera like *Alchemilla*, *Rubus* and *Hieracium*. Participants agreed to deal with these genera very pragmatically in a first phase, if necessary by creating new (intermediate) aggregates. Taxonomic consensus for these taxa is then sought in subsequent phases. The AFA project offers a unique opportunity to promote and support efforts in taxonomy at the international level and especially the collaboration on solving taxonomic problematic genera and species in the future.

### Grid and symbols

This workshop started with an overview presentation by Michael Kleih on advantages and disadvantages of various existing coordinate and grid systems (based on his own work, cf. Kleih 2018). The discussion that followed about the grid immediately converged to the conclusion that the Ehrendorfer grid (Ehrendorfer & Hamann 1965) should be used as a grid system in the AFA project, because it is used by most atlases in Italy, Austria and Germany. Using a number of different grid systems would not be so much a problem for modern, precise data, because they can be assigned to any grid system, but problems could occur especially when using data (especially older data) from comprehensive mappings that follow an area logic. For this reason, using a grid based on the WGS 84 / ETRS 89 coordinate system resulted in probably the best solution.

In addition to displaying the presence of taxa across the Alps, symbols of data points on the map can convey a variety of information by using different shapes and colours. Participants agreed that they should carry a large amount of information and still be clear. One such information should be the degree of establishment, meaning that the symbol should express the origin – if natural or alien – of a population. Moreover, the age of an observation (or the age of the last observation in a grid cell) should be expressed by a symbol as well. Another useful information would be the type of source of an information: for instance, if the floristic

data comes from the literature, a herbarium specimen or field work. There was a wide agreement that data validation should also be expressed through symbols.

### Geographical delimitation of the Alps

As easy as the question of the geographical delimitation of the alpine arc in general might appear, as many questions can be asked if it comes to the details. Many partners of the AFA project wished for a better delimitation of the Alps as it is proposed by the Flora Alpina (Aeschmann et al. 2004) and chosen for phase 1 of the project (cf. Eggenberg et al. 2022; Fig. 2). It goes without saying that the local groups should decide on the final limits of the Alps. There was some debate on how to decide when to add a grid cell to the project area: the majority agreed upon that at least 20% of a grid cell should be within the delimitation of the alpine arc in order to be shown in the atlas, but others then argued that it would be easier to start by using any grid that would intersect with the delimitation, then focus on outliers and exclude or include them by a case by case analysis. The best way to adapt the exact border of the atlas would be a QGIS project in which the exact borders could be redefined at least during the first phase of the atlas project until a final perimeter upon which all AFA participants agree can be found.

### Data exchange and policy

The implementation of the atlas project is largely about data exchange, among the participating data centres and with users in the form of possible future downloads by them. The workshop on data exchange addressed four questions: on the format of the data exchange, the (minimal) data fields to be transferred, how to organise the data updates or data increments and whether the distribution data should be made downloadable. All participants agreed upon the fact that a CSV exchange format should be easy for everybody. The minimum information for each taxon should consist of the common taxon ID, the grid ID, and the year of the last verified observation. All other information such as number of observations per grid ID, status regarding the degree of establishment etc. must still be agreed in detail in future workshops. Concerning updates, as long as databases are not dynamically linked, an annual update in the agreed format seems to be sufficient. In the discussion about the download, it was noted that from a technical point of view, it is obvious that displaying data on raster maps by an online atlas is basically a download of atlas data. But, the question arose, if it makes sense to offer download tools as well, so that we can “control” the download and facilitate local data retrieval. This option seems to make a lot of sense, at least in a second development phase of the AFA project. Such tools can then be used to declare the terms and conditions and define the citations. Download menus with query filters also allow generating specific DOI (digital object identifier).

## NEXT STEPS AND PERSPECTIVES

Three next steps were identified. The first next step after the meeting was the present publication of the meeting results, as to keep an historical record. Second, participants agreed on creating four working groups (WG) each with their own goals to be met and advances to be presented at the next meeting of the consortium: 1) Pilot Project WG, 2) Perimeter Delimitation WG, 3) Funding WG, and 4) Taxonomy WG. Names of WG participants and leaders were assigned to each group. It was already discussed that the Funding WG would immediately be working in parallel on a pre-project proposal to apply for EU-funding. France would lead this WG and the proposal effort as well, in collaboration with interested parties from Austria, Germany, Slovenia and possibly also Italy, while Switzerland would remain involved on a different bureaucratic level. Finally, the next consortium meeting was set to be organized in Spring 2024 and hosted in Rovereto (Italy) at the Museo Civico.

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