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Vegapp: A Mobile Application for Vegetation Field Data Collection

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ABSTRACT

Digital field data collection can streamline workflows, improve data quality and reduce transcription errors, yet few specialised tools are available that fully address the requirements of vegetation science. This report presents Vegapp, a mobile application for vegetation field data collection, publicly available for Android-based systems. The application supports the recording of layered vegetation data, individual-based inventories and aggregated species observations. A range of export options facilitate integration with vegetation databases, interoperability across devices and subsequent numerical analyses. Support of taxon views and data licensing options addresses barriers to data exchange.

1 | Introduction

Over the last two decades, the field of vegetation science has benefited from a wide range of digital data collections, opening up new possibilities for numerical analysis from local to global scales (Dengler et al. 2011). Still, there are obstacles to using them and making them available, including inconsistent taxonomic concepts and a lack of standardisation in exchange formats (Wiser 2016). Another hurdle is the process of digitisation itself, that is, converting handwritten or printed data into a digital format (Inman-Narahari et al. 2010; Bull et al. 2024). Vegapp was designed to cut this laborious and error-prone digitisation step by recording data digitally in the field. Other problems are addressed as well, for example, by providing a standardised exchange format and handling of taxonomic concepts. Given the diversity of concepts associated with taxon names, recording this information is essential for ensuring interpretability and reproducibility. Nevertheless, taxon views have been rarely documented in vegetation surveys (Berendsohn 1995; Jansen and Dengler 2010).

Although powerful general-purpose applications such as ArcGIS Field Maps and QField exist, they do not address the specific needs of vegetation surveys out of the box and require considerable customisation to support specialised workflows and data structures. Other applications provide workflows tailored to the needs of vegetation science but have been developed for specific projects or regions, which limits their transferability. Few tools targeting the international community of vegetation scientists are publicly available, such as TurbovegSD, a mobile extension of the Turboveg database system (Hennekens 2015), and Vegapp. Here, we introduce the latter, which was first released in 2018 and can since then be downloaded for free from the Google Play store.

The data structure partly builds on Veg-X, a proposed XML exchange standard for vegetation data (De Cáceres et al. 2018; Wiser et al. 2011, https://github.com/iavs-org/vegx-standard) and on established database systems such as Turboveg (Hennekens 2015). A comprehensive user guide is available at https://www.vegapp.de. In the following sections, we describe how to use Vegapp, more specifically how to create a project and record plots. Furthermore, we describe the handling of taxonomic reference lists, data exchange and hardware requirements.

2 | Creation of a Project

The recording process begins with the creation of a project. This involves selecting or defining a settings profile that specifies the data-entry fields and, where applicable, their default values. Custom fields can be defined as well. At this stage, a cover or abundance scale and, if required, a layer system can be specified (Figure 1). Several predefined scales and layer systems are available, and custom ones can be created as needed. The selection of a taxonomic reference list is a prerequisite for species entry. Based on these settings, plot records can then be created.

3 | Plot Records

Each plot record combines permanent plot attributes (e.g., location, size and shape), survey metadata (e.g., date and observers), information on site conditions and vegetation data. Depending on the research question or application, the vegetation data may comprise species observations with cover or abundance values, inventories of individual plants and their traits or information on vegetation layers, successional stages and related variables.

The plot record interface is organised into four tabs (Figure 2a). The first tab contains plot attributes, survey metadata, and site and community information, which are commonly referred to as header data (Bruelheide et al. 2019). There are 83 predefined input fields available that can be selectively activated through the project profile; additional custom fields can be defined by the user. To avoid redundant entries when conducting resurveys, it is possible to create duplicates of plots that share an identifier and properties such as location, plot size and shape. When coordinates are recorded, they are displayed in a map view (where they can also be set manually when needed). The positional accuracy achieved depends on the capabilities of the mobile device. The use of a multi-frequency GNSS receiver with RTK fix is recommended to achieve sub-metre accuracy.

The second tab, *Layers*, is used to record information on vegetation strata or tiers, such as cover and height. These attributes can be activated individually, as can individual layers.

The third tab, *Individuals*, is used to record inventories of individual plants. Locations and commonly assessed attributes or traits, such as diameter at breast height (DBH), girth and parameters required for the point-centred quarter method (PCQM, Cottam and Curtis 1956) can likewise be activated. Additional individual-level traits can be recorded through custom fields.

The fourth tab, *Species* (Figure 2), is used to record aggregated taxon observations, that is, species with associated cover or abundance values. If a multi-layer system is selected, observations are entered separately for each layer. The species entry supports different workflows: Users may rapidly compile species lists and assign cover or abundance values in a second run-through, or they may add species via a more comprehensive attributes form that allows the entry of additional properties, including custom fields.

For additional documentation, users can capture photographs of plots, species and individual plants. Filenames include the corresponding identifiers (plot, species or individual) and date–time information, which are also stored in the image's EXIF metadata. A built-in photo browser enables users to view and

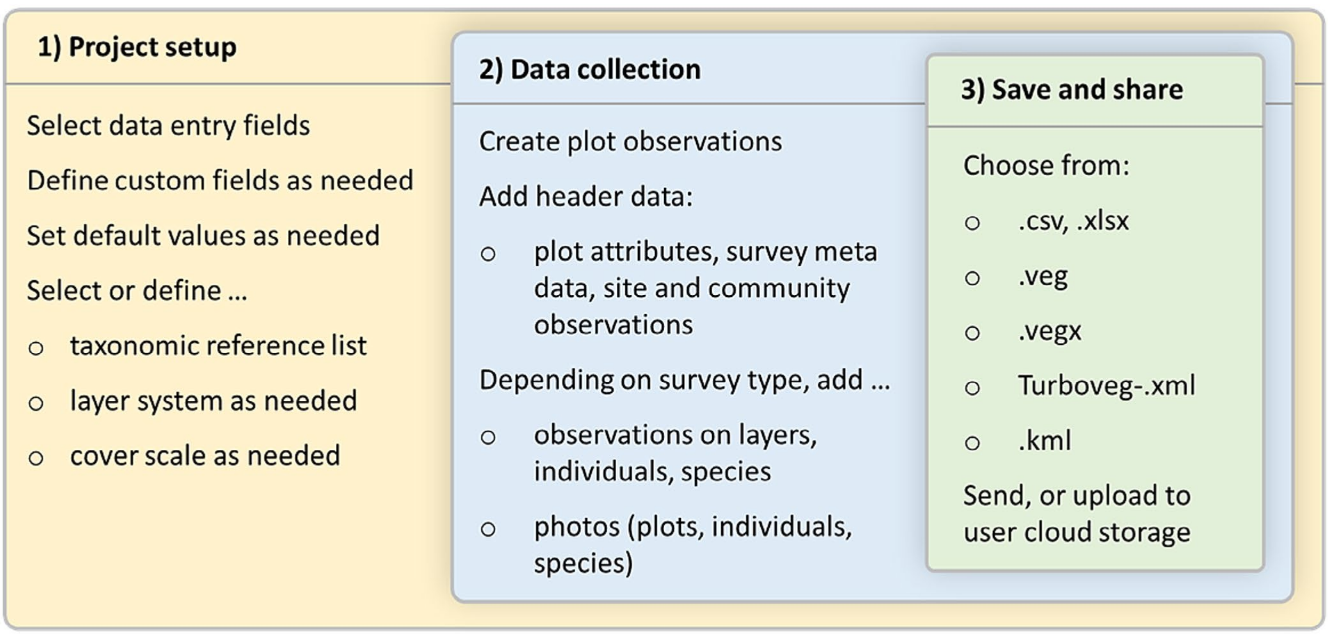

FIGURE 1 | Simplified overview of the workflow for field surveys using Vegapp.

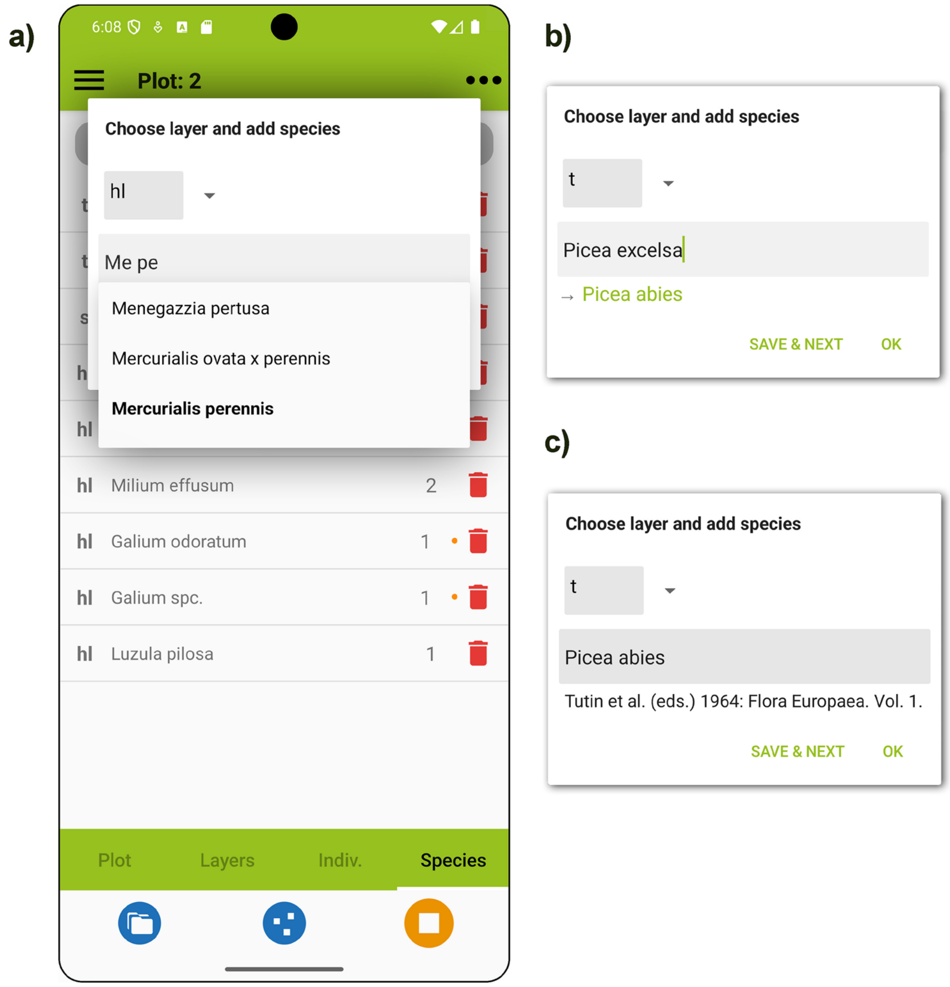

FIGURE 2 | (a) Taxon entry using autocomplete in the Species tab: Prefix search with progressive disambiguation triggers a dropdown menu, here displaying synonyms and accepted names (in bold, according to the reference list). The orange dots indicate nested taxa. The three-button navigation bar at the bottom lets you switch between the project list, plot list and plot content. The plot content is divided into four tabs (Species tab is open). (b) When entering synonyms, the accepted name can be suggested. (c) Added taxon view.

delete photos within a project and transfer them to the device's gallery where they are accessible for other apps.

4 | Taxonomic Reference Lists and Taxon Views

In the *Individuals* and *Species* tabs, taxon names are selected from an active taxonomic reference list. Ad hoctaxa can also be added, but using a predefined list simplifies data entry and helps avoid errors. These lists may include synonyms, which can be automatically redirected to the accepted names (Figure 2b, the display of synonyms can be switched off). A *taxon view* (taxon concept) can also be specified. Vegapp allows adding such views as free text entries denoting the identification keys used (Figure 2c). By retaining the most recent entry for reuse and remembering entries already added for individual taxa, minimal effort is required.

Uncertainty in species identification can be documented by annotating taxa with the prefix 'cf.' to the genus or species level. This helps information on uncertainty from being lost during data processing, a problem highlighted by Jansen and Dengler (2010). Another issue is the use of taxa that are not mutually exclusive, for example when subspecies and their parent species occur in the same dataset (Jansen and Dengler 2010). The latest generation of Vegapp taxon lists is designed to allow nested taxa to be explicitly marked in the species list and in exported tables.

Users can download taxonomic reference lists from within the app. The number of shared lists ranging from regional- to continental scale is increasing, and more lists are added on request. Alternatively, users can build their own lists. The online guide (https://www.vegapp.de) provides access to a JavaScript-based *species list builder* for creating compatible lists.

5 | Data Exchange

Vegapp provides several options for saving and sharing data files and photographs. Export formats include a simple spreadsheet (.xlsx) for a quick overview and a ZIP archive of CSV files suitable for scientific analysis. While Vegapp does not provide tools for data analysis, it supports subsequent analyses. For instance, if species cover has been recorded separately for each layer, the total cover can be estimated during export according to Fischer (2015).

As there was no general standard for exchanging vegetation data, the IAVS Ecoinformatics Working Group initiated its development (De Cáceres et al. 2018; Wiser et al. 2011). Vegapp provides the resulting schema, Veg-X, as an export option (.vegx). Other supported export formats include Turboveg XML, enabling interoperability with Turboveg software for vegetation data storage (Hennekens 2015), and KML, allowing the import of plot positions into geographic information systems and online map services.

Vegapp supports several native file formats. The most important of these is the .veg format, an XML representation of Vegapp projects. Files in .veg format can be re-imported and shared between users and are suitable for backups. Such files can be merged with an online tool provided at https://www.vegapp.de and then re-imported. This allows users to generate a common output for multi-user projects that share the same layer system and cover scale. Project profiles and layer systems can be stored separately as .vegp and .vegl files, respectively; these can likewise be imported and exchanged between users. As a data-entry tool, Vegapp does not support the import of non-native file formats.

All export formats can be shared directly via email or other wireless options using the native export and transfer functions of the device. This usually includes the option to back up files in cloud storage. Photographs are not included in standard project exports but can be made available separately, either by exporting them project-wise as ZIP archives or by releasing them to the device's gallery, from which standard distribution options are available. Vegapp does not transmit data automatically. All entered data are stored locally on the device unless they are explicitly exported or shared by the user.

6 | Hardware Requirements

As of 2026, Vegapp runs on Android devices from API level 24 (Android 7.0) or higher. To ensure reliable performance in typical use cases, devices with at least 3 GB of RAM are recommended, particularly when working with large taxonomic reference lists. The app is designed for offline fieldwork; however, species lists must be downloaded in advance. GPS functionality is required for georeferencing plots, and offline maps are supported if map tiles have been cached beforehand.

7 | Outlook

Since its initial release in 2018, Vegapp has undergone continuous development in close exchange with its user community. There are plenty of ideas for future improvements, and we always welcome suggestions. For example, future versions will include extra validity checks to help spot inconsistencies early on. Throughout the development process, care is taken to keep the complexity of the codebase within reasonable limits so that the maintenance burden does not become excessive. One way of extending functionality without increasing the application's footprint is to offer features through cloud-based services. Such tools are already available for generating custom taxonomic reference lists and for merging projects. The cloud-based approach would also be suitable for providing data analysis tools that fall outside the app's scope. Third-party contributions of this kind are expressly encouraged.

Author Contributions

S.S. wrote the initial draft. M.E., A.L. and J.A.S. reviewed and edited the manuscript.

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Conflicts of Interest

M.E. and S.S. are editorial board members of *Applied Vegetation Science*. They were excluded from editorial decision-making related to the acceptance of this article for publication in the journal.

Data Availability Statement

Vegapp is publicly available on the Google Play Store. Online documentation is indexed on Figshare at https://doi.org/10.6084/m9.figshare.27771642. The Veg-X export module source code is available at https://github.com/SebSchmidtlein/Vegapp-VegX-Export. No datasets were generated or analysed in this study.

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