

NaturaList, a flexible app for creating taxonomic checklists

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Abstract

A new computer application (app) that creates interactive checklists is described. *NaturaList* is a progressive web app that is simple to implement, requiring only minimal skills in information technology from the developer, while also providing the possibility of an abundance of filter/search tools and links to other resources. The data are supplied in a simple spreadsheet. Once the resulting checklist is established on a webserver, it can be easily modified and updated. After implementation by the developer, it is initially accessed by the user online (looking like a standard webpage), after which it can function offline as a mobile app on any device (laptop, tablet, smartphone, etc.). Two floristic examples (from Vanuatu and Niue) are used to illustrate some of the features of *NaturaList*, but the app could just as easily be applied to any group of organisms, or to folk taxonomies, and allows for multilingual content.

Keywords Catalogue · inventory · natural history · progressive web app · offline access · open data format

Introduction

The compilation of species lists into checklists or catalogues often represents the first step in creating comprehensive floristic (or faunistic) manuals, but such lists can also be highly useful tools in their own right, helping to summarize species diversity across a region or country. Traditionally, checklists have been printed in scientific reports or publications, and this practice continues (e.g., Bartolucci et al., 2018; Chung et al., 2017; De Lange et al., 2006). While useful, these lists are static and thus prone to becoming quickly outdated as taxonomic changes accumulate or as new species are discovered. Such static lists remain useful as “snapshots” of our understanding of a flora (or fauna) at a given time, and there is much merit in archiving different versions of such lists; in our own paper presenting a checklist of vascular

plants from Vanuatu (Plunkett et al., 2022a), we archived the version of the checklist that was active at the time the checklist paper was published because the statistics used to characterize the flora were based on that specific version. It has, however, become increasingly difficult to find journals willing to publish extensive checklists, which can be dozens or even hundreds of pages long. Fortunately, the internet provides a mechanism for disseminating electronic checklists and a means to rapidly update them (e.g., Munzinger et al., 2023). Such electronic checklists can be created using a variety of tools. The simplest methods include creating an HTML-formatted list or uploading a static document, such as a PDF, to a web site. Technical barriers to this approach are very low and updates can be easily made, but they offer little added value beyond the list itself. More powerful solutions are available that can present additional information about each species, such as links to specimen data, distribution maps, related publications, etc. In this approach, checklists can be generated from data stored in online databases (e.g., GBIF, 2024; Symbiota Support Hub, 2024; POWO, 2024; EMu, 2024; BRAHMS, 2023; and Pl@ntNet, 2024, among others), but these approaches often present very steep learning curves and may require advanced information-technology (IT) capacity to master the complex series of tasks related to initial server and software set up, data entry and modification, and generation of the checklist. Herein, we describe a new application (or app) called *NaturaList*

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(Ramík, 2022), which is relatively easy to implement and update, but also provides many useful functions, combining the ease of static, web-based checklists and the benefits of more complex database-driven options while allowing the data to be kept in an open-data format instead of a proprietary database.

NaturaList: A New Option

As part of the multi-year program called *Plants and People of Vanuatu*, the program team completed a floristic checklist of vascular plants of Vanuatu, an archipelago of over 80 islands in the Southwest Pacific. We published a summary and analysis of Vanuatu's vascular flora as a standard journal article (Plunkett et al., 2022a), but the journal requested that the checklist itself be made available as an online, supplemental document. Given the poor state of knowledge regarding plant diversity in Vanuatu, we thought it would be especially useful to develop a tool that would present the checklist in a dynamic format, with copious links to other sources of data related to each taxon, thus providing access of this information to a wide range of stakeholders, including herbarium staff in Vanuatu (and elsewhere), government

officers in need of biodiversity information, Pacific-region botanists and biogeographers, conservationists, and concerned members of the general public. At the same time, we wanted this tool to be easy to set up and update. The result was *NaturaList*, developed by the first author (Ramík, 2022). *NaturaList* is a “progressive web app”, a technological approach wherein an application is created that is accessible as a standard webpage, but once accessed, it is installed seamlessly as a mobile application and can be used offline. *NaturaList* provides a flexible taxonomic checklist app capable of visualizing a wide variety of data. It can be applied either to scientific or to Indigenous/folk taxonomies, and has powerful filtering and search capabilities. *NaturaList* does not come with pre-defined sets of taxonomic data or database structure to which users must conform. Instead, users have the freedom to define the types of data that get displayed, and how they are displayed. The taxonomy used in the app is pulled from a user-defined spreadsheet. Making updates, changing the appearance, or even adding new types of information merely involves making changes to the spreadsheet, and thus does not require extensive IT expertise or complex software packages. The app has been developed to run using any standard web browser, and once downloaded, it operates locally (like any other installed app),

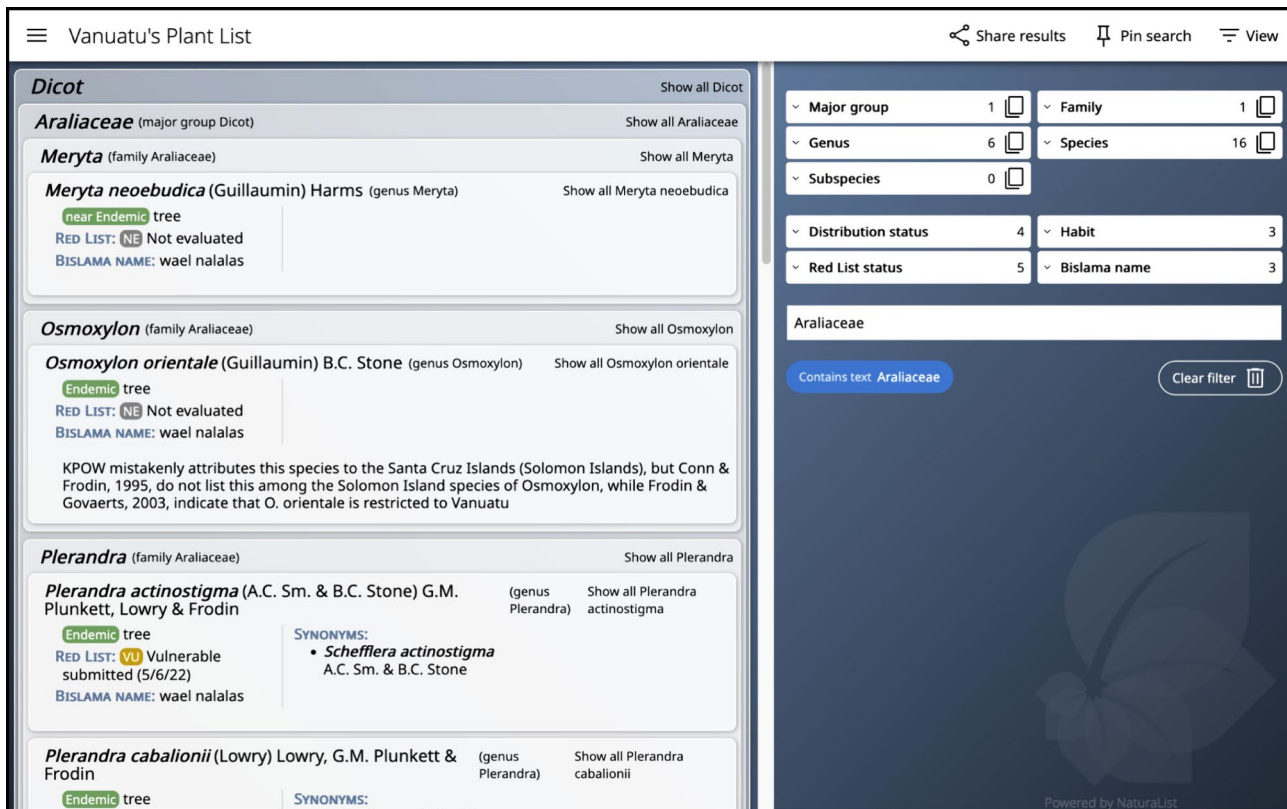


Fig. 1. *NaturaList* starting page configured for a widescreen monitor (desktop or laptop), showing checklist details (left side) and the search/filter panel (right side); from *Vanuatu's Plant List* (Plunkett et al., 2022b).

without need of a network connection (except for associated links that point to external internet sites). The user interface has been translated into several languages, so data may be supplied in any one of these languages, or in several languages to create multilingual projects. *NaturaList* is freely available as open-source code (under the Creative Commons BY-NC-SA license). Instructions for downloading the app and setting up an online checklist using it may be found at the following URL: <https://naturalist.netlify.app/>.

For Users: Functionalities, with Two Examples

To present the checklist of Vanuatu's vascular plants, *NaturaList* was implemented to create *Vanuatu's Plant List* (Plunkett et al., 2022b; <https://checklist.pvnh.net/>), which serves as a useful exemplar of the app's capabilities. We also describe a few differences used in a second implementation of *NaturaList* that is focused on Niue, a small Pacific-Island country located to the east of Samoa and Tonga (*Niue's Plant List*, Heenan, 2024; <https://niueprivate.pvnh.net/#!/checklist>). Both examples are focused on plant groups, but *NaturaList* is not limited to floristic checklists, and can just as easily be used to develop checklists of animals or any other group of organisms.

In *Vanuatu's Plant List*, the vascular-plant species are presented in a hierarchically arranged checklist, and users can browse through the entire list of species (currently 1,649 spp.). Each entry includes the full species name (including authorities) as well as other attributes under the following headings: synonymy, habit, vernacular name in Bislama (Vanuatu's national creole language), IUCN Red List status (e.g., LC, VU, EN, CR), and distributional status (e.g., endemic, native, introduced); the last two attributes are presented as color-coded "badges" to improve rapid viewing, and if data for any attribute are missing, its heading does not appear. A "notes" section is also provided; in *Vanuatu's Plant List*, this was used to provide a variety of information, such as disputes regarding taxonomic status, distinguishing morphological characteristics, and distributional information, among others. The layout of *Niue's Plant List* is similar, but some attributes use alternative headers (e.g., "biostat" rather than "distribution status"), and the Niue site also includes vernacular names in two languages (Niuean and English). Other differences in the Niue site include the manner in which threatened species are presented, and an extra provision for providing literature references.

On larger monitors (i.e., those typical of desktops and laptops, as well as larger tablets when viewed in landscape mode), *NaturaList* presents the species list itself in a panel on the left-hand side of the screen (Fig. 1). *NaturaList* automatically adjusts for screen widths, so the same information is presented in alternative arrangements on smaller screens (such

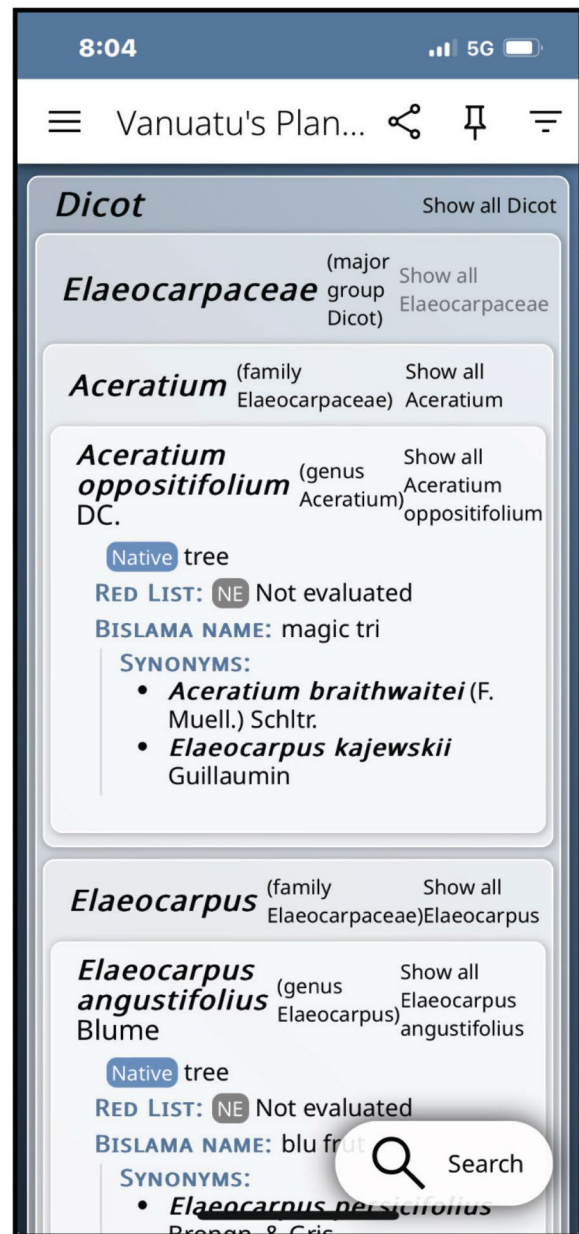


Fig. 2. *NaturaList* starting page, configured for a narrow screen (e.g., smart phone). The default view is the checklist itself. The search/filter panel appears when the "search" button (lower right) is selected; from *Vanuatu's Plant List* (Plunkett et al., 2022b).

as those found on smart phones; Fig. 2). Both configurations provide all available options, but here we limit our description to wide-screen arrangements, for the sake of simplicity.

On the right-hand panel of widescreen configurations, the default is a series of options allowing users to filter and search by any of the defined fields, which then limits the number of species displayed on the left-hand panel accordingly (Fig. 1). Filters are structured as a series of dropdown menus, into which terms can be entered or boxes ticked for all available options. There is also a text box that allows for

freeform searches of any field, which is especially useful for searching synonyms or information contained in the “notes” fields. Two or more filter and search functions can be used together to narrow the species list even further, and once completed, an internet link is created that allows the search results to be saved for later use or shared with other users. Copy functions facilitate the rapid generation of species lists that match the search parameters. Thus, for example, a user may search for all species of “Rubiaceae” that are “trees” having a Red List status of “CR”, and then to copy the resulting list from *NaturaList* and paste it into some other document (e.g., a text document being used to develop a report).

The number of fields listed under each species (and appearing in the search panel) is not limited to those currently used in the exemplar checklists for Vanuatu or Niue. For example, *NaturaList* could accommodate any number of morphological traits (bark features, leaf shape, sepal number, petal color, fruit type, etc.), as well as phenological traits (flowering and fruiting times), habitat and soil types, elevational range, ethnobotanical uses, etc. By adding more of these fields, the filter and search

functions could serve as a species identification tool, essentially acting like a multi-access key to identify taxa, or at least to narrow down the list of options. Specimen data can also be listed, either as a primary field, or through linked search results from online herbarium databases (as was done in the Vanuatu and Niue checklists), or both.

Another important function in *NaturaList* is the presentation of links to outside internet resources. At any point, either before or after a search is executed, all taxon names at every rank (including synonyms) are presented as “active links” (Fig. 3). By clicking on one of these links, the right-hand filter and search panel is automatically replaced with an options box, which can have any number of tabs at the top. In both the Vanuatu and Niue implementations, one tab presents links to a selection of “virtual herbarium” sites that hold important historical collections for those countries (Fig. 3A). Selecting one of these links opens a new browser window, which then displays all online specimens for that taxon. The same tab also provides links to an additional series of sites, such as GBIF (2024), POWO (2024), IPNI (2024), JSTOR Global Plants

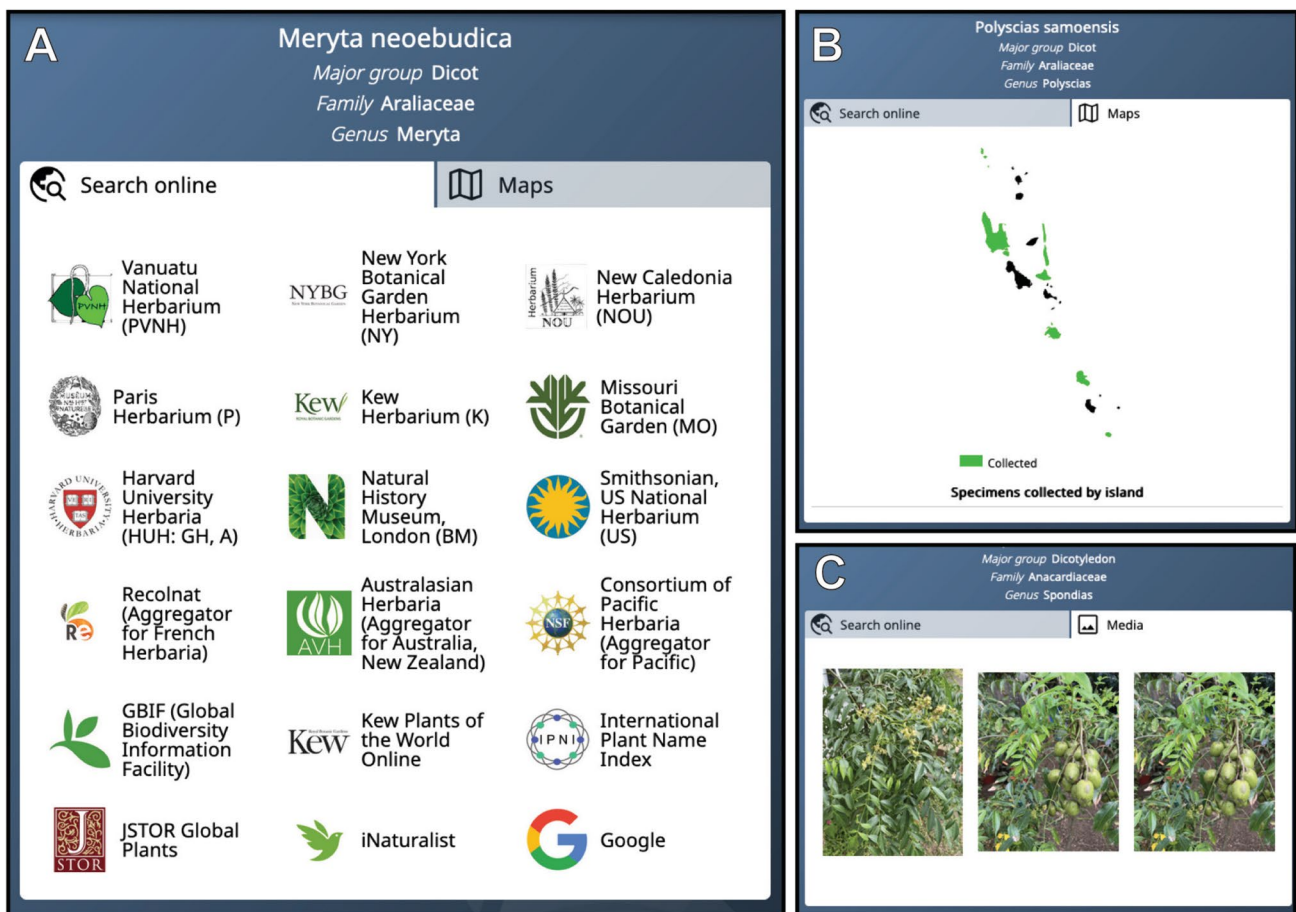


Fig. 3. Alternatives to the search/filter panel. When a taxon is selected from the checklist, a new panel takes the place of the search/filter panel. Any number of tabs can be configured. **A–B.** Online links (A) and distribution maps (B); from *Vanuatu's Plant List* (Plunkett et al., 2022b). **C.** Media tab showing photographs of the selected species; from *Niue's Plant List* (Heenan, 2024).

(JSTOR, 2024), iNaturalist (2024), and Google Images, but any online resource could be included.

In *Vanuatu's Plant List*, a second tab presents a distribution map of the archipelago (Fig. 3B), which is used to display the presence or absence of each species at the level of individual islands (but any user-defined subdivision of the study area is possible). In *NaturaList*, the selection list of links and the use of tabs is user-defined, so checklist projects of other regions could employ many more and/or different tab and link options than those chosen for Vanuatu. For example, *Niue's Plant List* includes a media tab (Fig. 3C), which displays photographs of each species uploaded by the Niue site developer/manager. Videos files are also possible in the media tab. For plants, audio files would hardly be useful, but these may be highly desirable for animal groups having distinctive calls, such as birds. *NaturaList* can also easily be used to present many other types of data not currently used in the checklists of either Vanuatu or Niue. For example, rich texts can be presented for each record and displayed in a separate tab.

For Developers: Implementation

The *NaturaList* app must be installed on a web server, using either PHP-enabled or a simple static webhosting. No database capability is required for the web server. Detailed instructions are provided at <https://naturalist.netlify.app/demo/docs/>. This same site describes the construction and format of the necessary data tables, which are entered into a multi-tabbed Excel spreadsheet. These tables provide details of the species checklist itself, as well as the definitions and formatting for the search options, internet links, distribution maps, etc. The data stored in these Excel tabs are simple and easy to implement, even for those with only basic IT skills. After the app is installed on the webserver and the data file uploaded, the app is functional and ready to be accessed by the public.

If updates need to be made, or additional functionality added, *NaturaList* provides an easy mechanism for making such changes. By selecting the main menu (≡), a data manager can select the “Manage” option, which presents a screen allowing the upload of a modified version of the checklist spreadsheet. This action uploads the new data only locally, providing the manager an opportunity to inspect the changes before publishing them to the internet. Theoretically, anyone can complete this action, but permission to publish changes to the internet can be password protected on PHP-enabled webhosting. If static webhosting was used, users must download the packaged data file as part of the update process, and then upload the new file manually into the “data” folder in the app installation folder, using an FTP client or the file upload facility provided by the webhosting service. In either case, modification and updating of the app is quite simple.

Conclusion

For the past two years, the *Plants and People of Vanuatu* team has used and tested adaptations to *NaturaList*, and during this time, the app has served as a simple but powerful tool to explore the vascular flora of the archipelago. Once made public, it has garnered considerable attention within Vanuatu, helping to raise awareness of the diversity of the country's vascular flora. Local stakeholders have expressed surprise that Vanuatu has 165 endemic taxa, and dismay that so few species overall have been assessed for the IUCN Red List (currently, only ~ 12.7% of all species). Local government officers in Vanuatu's Forestry and Environment departments particularly enjoy the fact that the app, once downloaded, can work without a network connection, making it especially valuable in remote field sites. For these reasons, *NaturaList* has proved to be an important tool to increase the visibility of Vanuatu's plant diversity and to highlight conservation needs and gaps. Unlike Vanuatu, the implementation of *NaturaList* in Niue is being carried out as the checklist data are being assembled, and thus it has served to help organize and explore these data from the start.

Our present age provides nearly endless options for collecting and storing data, but we are convinced that *NaturaList* provides a simple and accessible approach to quickly publish dynamic, interactive checklists that are easy to create, maintain, and update.

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Author Contributions

DMR conceived and created the *NaturaList* app, implemented the initial version of *Vanuatu's Plant List* and all subsequent updates, assisted with the implementation of *Niue's Plant List*, and edited the manuscript. GMP provided the initial dataset used to develop the app, tested various versions and provided feedback for improvements, and drafted and edited the manuscript.

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Declarations

Competing Interests

GMP is Editor-in-Chief of *Brittonia*, but was not involved in the peer review of this article or the decision to publish, which instead were handled through the journal's Managing Editor. The authors declare that they have no known competing interests that could have appeared to undermine the objectivity or integrity of the work reported in this paper.

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