

1 labeleR: an R package to optimize the generation of collection
2 labels and scientific documents

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9 Software notes

10 We are happy to consider (as ‘research articles’) descriptions of new software that are intended to describe
11 and promote the software as well as act as a citeable resource for developers. Such articles will be considered
12 under the general Ecology and Evolution philosophy of ‘if its useful to the field, we are happy to publish
13 it’. Note that uploading a package to a site such as CRAN or sourceforge in advance is not considered prior
14 publication and will not prevent consideration of an article for publication in Ecology and Evolution.

15 **1 Abstract**

16 **labeleR** is an R package designed to automate the creation of collection labels and documents for scientific
17 events. It simplifies repetitive and time-consuming tasks, offering a practical alternative to manual or costly
18 tools. With **labeleR**, users can generate a wide variety of customizable PDF documents that can also be
19 automatically emailed.

20 The package provides a set of functions classified into two groups: scientific collections (e.g. labels for
21 herbarium or insects) and scientific events organization (e.g. personal badges, abstract books and certificates
22 of attendance and participation). Starting from a tidy dataset, users can easily customize content, incorporate
23 QR codes, logos, images, and edit their own templates. **labeleR** transforms tedious and repetitive workflows
24 into an efficient, reproducible process, contributing to greater scientific productivity. The package is available
25 under an open-source license and can be freely downloaded from CRAN or the GitHub repository (<https://ecologyr.github.io/labeleR/>).

27 **2 Keywords:**

28 R, Rmarkdown, LaTeX, scientific collections, scientific events, herbaria, automation, exams

29 **3 Cover letter**

30 Concise cover letter focused on the question the manuscript attempts to address

31 4 Statement of need

32 The management and design of scientific labels and event documents is a time-consuming task. Large-
 33 scale label generation tools for herbarium and scientific collections (used by institutions such as museums
 34 or botanical gardens) are often paid and proprietary software (e.g. “BRAHMS” (2025) “IrisBG” (2024)).
 35 Microsoft Excel-Word integration through mailing lists is commonly used at a smaller scale, although still
 36 involving paid software with limited large database management capacity. Most free alternatives are not
 37 open-source, require installing a program with limited customization, and are often only compatible with
 38 Windows operating system (e.g. Pando, Lujano, & Cezón (2019) “pLabel” (2020)), or designed for very
 39 specific purposes (e.g. “EntomoLabels” (2022) for insects, “LichenLabler” (2025) for lichens or Zhang, Zhu,
 40 Liu, & Fischer (2016) for plant vouchers). Additionally, credentials and certificates for scientific events
 41 are either created manually one at a time, through paid online servers, or by hiring an event organization
 42 company. To our knowledge, there are no free, customizable tools for the bulk production and distribution
 43 of these documents. **labeleR** fills this gap facilitating the creation of scientific collection labels, conference
 44 badges, attendance and participation certificates, and abstract books, among others.

45 5 Package description

46 The **labeleR** package builds upon the **RMarkdown** ecosystem (Allaire et al. (2024)) to generate PDF doc-
 47 uments from a tidy data frame in R (Figure 1). **labeleR** functions include three types of arguments: (1)
 48 R instructions, such as the data object, paths and file name of the rendered document; (2) “fixed” argu-
 49 ments, text that remains constant across output documents (e.g. event name or image path); (3) “variable”
 50 arguments, linked to columns in the dataframe, thus changing between documents (e.g. taxonomic names
 51 in labels or attendee names in certificates). A QR code can be included either through a fixed argument
 52 or a variable argument, without the need for external software. Users can also edit and adapt the default
 53 **RMarkdown** templates provided by the package for their own purposes.

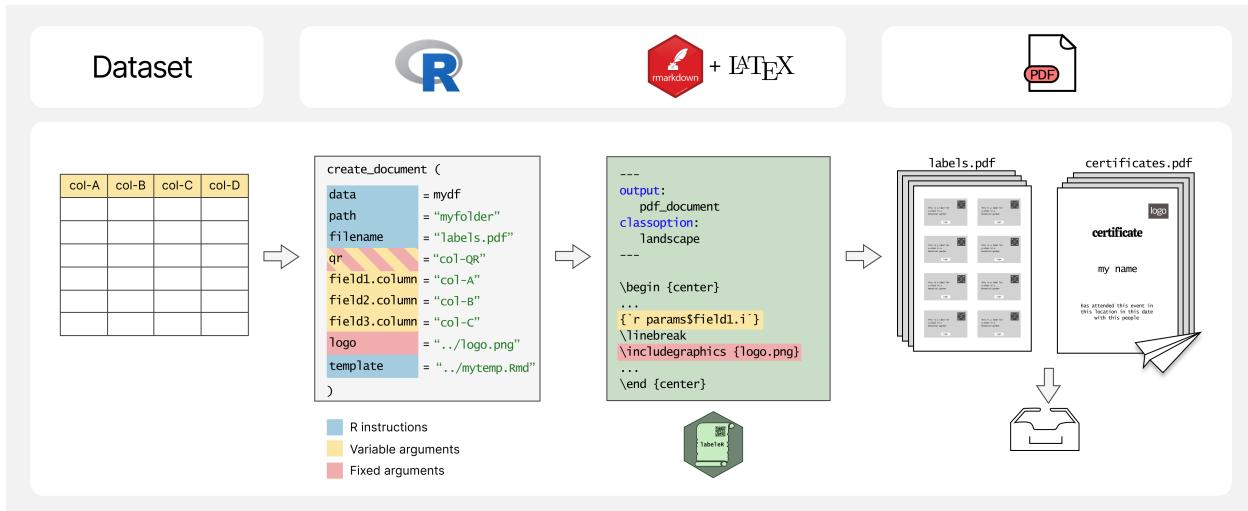


Figure 1: Figure 1. **labeleR** package workflow. Information stored in a dataset passes through an R function into a parameterized **RMarkdown** file using **LaTeX** syntax, and is then rendered as PDF. **labeleR** functions accept three argument types: R instructions which specify the dataset, paths to images or add custom templates (in blue); fixed arguments, such as titles or subtitles (in red), and variable arguments, linked to columns of the dataset (in yellow). Users work directly on R to introduce the parameters, while **labeleR** works in the background with **markdown** and **latex** to produce the results. Output PDF documents can be automatically emailed to participants.

54 6 Documents that can be generated with `labeler`

55 6.1 Labels for collections

56 Appropriate labelling of samples is a fundamental step of the scientific process (i.e., labelling test tubes in
57 laboratories, storing animal or plant materials or displaying collections in museums or botanical gardens).
58 A user-friendly bulk rendering tool is vital for efficiently producing crafted, uniform labels in a reproducible
59 manner. We present three label types: “herbarium” (most complex), “collection” (most aesthetic) and
60 “tinylabels” (compact and simplified, for small insect collections) (Figure 2). These labels can include QR
61 codes (e.g. links to websites, images, or identification codes) without additional tools, making it easy to
62 quickly access and link to external information.

63 6.1.1 Herbarium labels

64 Herbarium labels are one of the documents with more variable parameters. Note that the `family.column`
65 content will always be capitalized, and the `taxon.column` one in italics, recommended to be used as originally
66 defined, while the rest can be interchangeable. The QR can stand for a free text (and therefore remain identical
67 in all labels), or be a column name, and the codes will be rendered with the individual information of each
68 row. Four different labels will fit in each of the A4 pdf pages.

```
create_herbarium_label(  
  data = herbarium.table,  
  path = "labeler_output",  
  filename = "herbarium_labels",  
  qr = "QR_code",  
  title ="Magical flora of the British Isles" ,  
  subtitle = "Project: Eliminating plant blindness in Hogwarts students",  
  family.column = "Family",  
  taxon.column = "Taxon",  
  author.column = "Author",  
  det.column = "det",  
  date.det.column = "Det_date",  
  location.column = "Location",  
  area.description.column = "Area_description",  
  latitude.column = "Latitude",  
  longitude.column = "Longitude",  
  elevation.column = "Elevation",  
  field1.column = "life_form",  
  field2.column = "Observations",  
  field3.column = "Height",  
  collector.column = "Collector",  
  collection.column = "Collection_number",  
  assistants.column = "Assistants",  
  date.column = "Date"  
)
```

69 6.1.2 Collection labels

70 They count with five variable parameters, which are not recommended to be too long, along with the
71 possibility of including a QR code (fixed or variable) and an image (logo or picture). Field 1 will be always
72 capitalized, and Field 2 italicized. Any field can be left blank. The user may manually fix the background

⁷³ and text colors to their preference, using HTML color codes. Eight different labels will fit in each of the A4
⁷⁴ pdf pages.

```
create_collection_label(
  data = collection.table,
  path = "labeleR_output",
  filename = "labels",
  qr = "QR_code",
  field1.column = "field1",
  field2.column = "field2",
  field3.column = "field3",
  field4.column = "field6",
  field5.column = "field7",
  system.file("rmarkdown/pictures/Hogwarts_BnW.png", package = "labeleR"),
  bgcolor = "#D0ECC1", #White is "FFFFFF",
  textcolor = "#1E3F20" #Black is "000000"
)
```

⁷⁵ 6.1.3 Tiny labels

⁷⁶ This type of labels is a simplified version of the collection label, including just five variable fields and the
⁷⁷ possibility of including a QR code. It is recommended to write short texts in the variable arguments and in
⁷⁸ the QR, as they might become difficult to read. 16 different labels will fit in each of the A4 pdf pages.

```
create_tiny_label(
  data = tiny.table,
  qr = "QR_code",
  path = "labeleR_output",
  filename = "tinylabels",
  field1.column ="field2",
  field2.column ="field1",
  field3.column ="field3",
  field4.column ="field4",
  field5.column ="field5"
)
```

⁷⁹ 6.2 Documents for scientific events

⁸⁰ Scientific events often host a high number of participants, and require the creation of different documentation,
⁸¹ such as abstract books, personal identification badges and certificates for attendees and participants. Bulk
⁸² rendering significantly decreases the amount of time invested in the creation of these documents. Moreover,
⁸³ to deliver attendance and participation certificates automatically, those `labeleR` functions allow users to
⁸⁴ automatically send individual documents to email addresses stored in a column.

⁸⁵ 6.2.1 Abstract book

⁸⁶ Abstract books result in a single pdf document with multiple pages. Each abstract will appear on a different
⁸⁷ page, following the same order as in the dataframe rows. If other order of appearance is desired, it is
⁸⁸ necessary to first arrange the columns in the original dataframe. Each page will include four variable fields
⁸⁹ (title, author names, affiliations and the abstract texts). The output document can include a table of contents

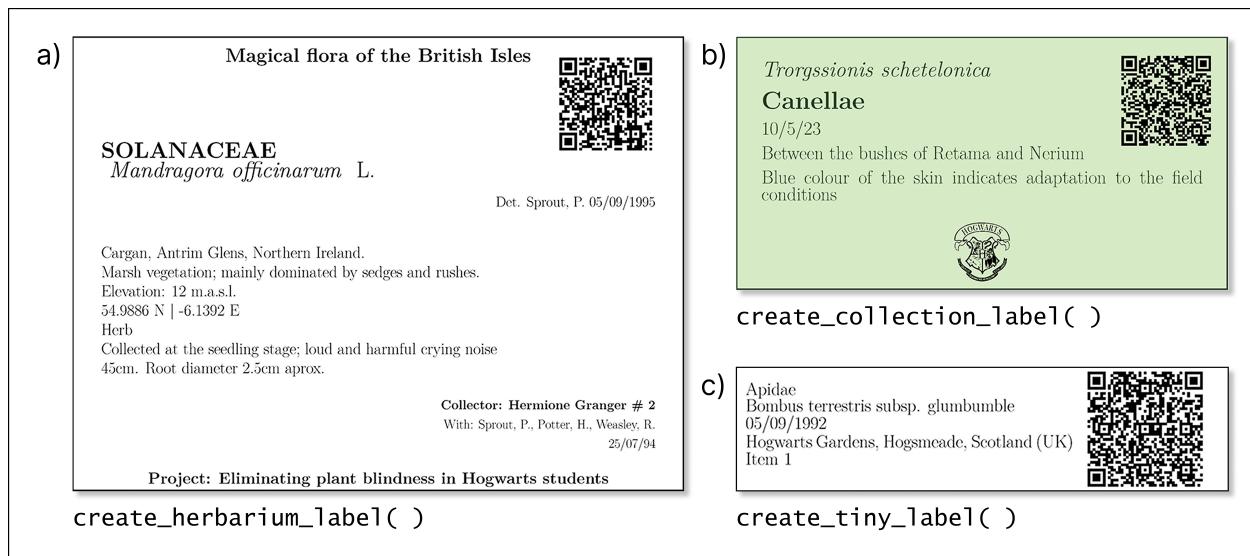


Figure 2: Figure 2. Examples of the outcomes from each label-related function in `labeleR`. a) Herbarium label: for stored plant vouchers; includes fixed fields (title, subtitle) and variable fields (e.g. taxon, date, coordinates, elevation). The family field is by default capitalized and bold, and species name italic. Size: 4 labels/page. b) Collection label: includes variable fields (first field in italics, second in bold), a customizable logo, font and background colors. Size: 8/page. c) Tinylabel: a simplified collection label with five fields. Size: 16/page. All three functions can include an optional QR code.

90 with the titles and page numbers of all abstracts. Additionally, is possible to insert a custom front page that
91 appearing at the beginning of the document.

```
create_abstractbook(
  data=abstract.table,
  path = "labeleR_output",
  filename = "congress_abstractbook",
  title.column = "abstract_title",
  authors.column = "authors",
  affiliation.column = "affiliation",
  text.column = "abstract_text",
  title.cex = 20,
  authors.cex = 15,
  affiliations.cex = 14,
  text.cex = 12,
  frontpage = "Congress_frontpage.pdf"
)
```

92 6.2.2 Badges

93 Badges can be used for personal accreditation in congresses, courses, meetings, etc. They have only two
94 variable fields (name and affiliation), and can include two top logos or images. Accreditation badges include
95 a dot line in the bottom for individual hand-edition once printed.

```
create_badge(
  data = badges.table,
  path = "labeleR_output",
```

```

filename = "badges",
event = "INTERNATIONAL CONFERENCE OF MUGGLEOLOGY",
name.column = "List",
affiliation.column = "Affiliation",
rpic = system.file("rmarkdown/pictures/Hogwartslogo.png", package = "labeler"),
lpic = system.file("rmarkdown/pictures/MinMagic.png", package = "labeler")
)

```

96 6.2.3 Attendance certificates

97 Attendance certificates the only variable parameter is the name of the attendees. It allows to include a
 98 signature as an image, implying that the signer does not have to sign them individually. This certificate is
 99 available both in English and Spanish.

```

create_attendance_certificate(
  data = attendance.table,
  path = "labeler_output",
  filename = "attendance_certificates",
  language = "English",
  name.column = "Names",
  type = "class",
  title = "Potions (year 1992-1993)",
  date = "23/06/1993",
  hours = "200",
  freetext = "taught by Professor S. Snape",
  signer = "A.P.W.B. Dumbledore",
  signer.role = "School Headmaster",
  rpic = system.file("rmarkdown/pictures/Hogwartslogo.png", package = "labeler"),
  lpic = system.file("rmarkdown/pictures/Hogwartslogo.png", package = "labeler"),
  signature.pic = system.file("rmarkdown/pictures/dumbledore.png", package = "labeler")
)

```

100 6.2.4 Participation certificates

101 Participation certificates include multiple variable parameters (such as speaker, affiliation, title, etc.). These
 102 documents can be rendered in English and in Spanish.

```

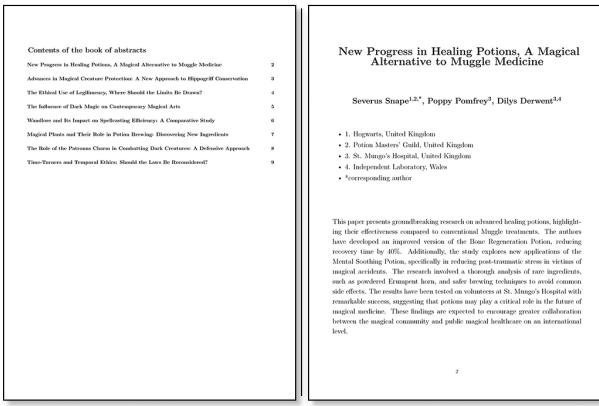
create_participation_certificate(
  data = participation.table,
  path = "labeler_output",
  filename = "participation_certificates",
  language = "English",
  name.column = "Name",
  affiliation.column = "House",
  comm.type.column = "Comm.type",
  title.column = "Title",
  date.column = "Date",
  type = "online",
  event = "seminar",
  freetext = "organized by Hogwarts School of Magic and Wizardry",
  signer = "A.P.W.B. Dumbledore",
  signer.role = "School Headmaster",
)

```

```

rpic = system.file("rmarkdown/pictures/Hogwartslogo.png", package = "labeleR"),
lpic = system.file("rmarkdown/pictures/MinMagic.png", package = "labeleR"),
signature.pic = system.file("rmarkdown/pictures/dumbledore.png", package = "labeleR")
)

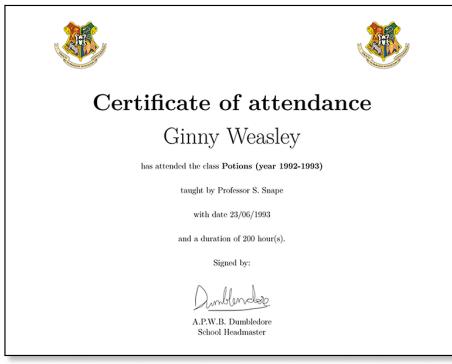
```

a) 

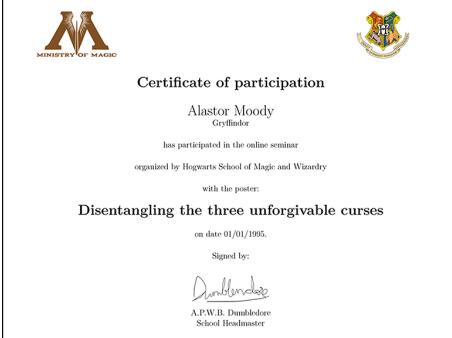
`create_abstractbook()`

b) 

`create_badge()`

c) 

`create_attendance_certificate()`

d) 

`create_participation_certificate()`

Figure 3: Figure 3. Examples of outcomes from each event-related function in ‘labeleR. a) Abstract book: creates pages with title, authors, affiliations and abstract (variable fields) and can include a table of contents and front page. b) Badges: include name, affiliation, a fixed field for the title, the option to add two images on top, and a dashed line at the bottom for additional hand-written information. c) Attendance certificate: attendee name is a variable field, while event name, signer, and date are fixed fields. d) Participation certificate: includes name, affiliation and title of the communication, and several fixed fields. Both certificate functions allow two images on top, a signature at the bottom, and offer Spanish and English templates.

103 7 Customizable templates

104 In case pictures look too big or small, it is possible to modify their size in the template.....

105 8 Further applications

106 The **labeleR** philosophy is quite simple: creating multiple documents with a common design from a dataset
 107 containing the required information. It offers a modular structure that allows for customization and extension
 108 for new applications. For instance, the newly added `create_multichoice` function generates multichoice

109 tests randomizing the order of questions and possible answers from a given table (question bank). New
110 developments will happen in the GitHub repository (<https://github.com/EcologyR/labeleR>) and eventually
111 pushed to CRAN. User feedback and code contributions are welcome in the same repository to keep 'labeleR'
112 as an open and dynamic tool.

113 **9 Figure legends**

114 **10 Data Accessibility Statement**

115 **11 Competing Interests Statement**

116 **12 Author Contributions section**

117 **13 Acknowledgements**

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133 **References**

- 134 Allaire, J., Xie, Y., Dervieux, C., McPherson, J., Luraschi, J., Ushey, K., Atkins, A., et al. (2024). *Rmark-*
135 *down: Dynamic documents for r*. Retrieved from <https://github.com/rstudio/rmarkdown>
- 136 BRAHMS. (2025). Retrieved from <https://herbaria.plants.ox.ac.uk/bol/brahms>
- 137 EntomoLabels. (2022). Retrieved from <https://labels.entomo.pl/>
- 138 IrisBG. (2024). Retrieved from <https://www.irisbg.com>
- 139 LichenLabler. (2025). Retrieved from <https://lichenportal.org/>
- 140 Pando, F., Lujano, C., & Cezón, K. (2019). Elysia: Programa de gestión de colecciones de biodiversidad
141 (v.2.0). Digital.CSIC. doi:10.20350/DIGITALCSIC/14520
- 142 pLabel. (2020). Retrieved from <http://pfind.net/software/pLabel/index.html>
- 143 Zhang, J., Zhu, H., Liu, J., & Fischer, G. A. (2016). Principles behind designing herbarium specimen labels
144 and the R package 'herblabel'. *Biodiversity Science*, 24(12), 1345–1352.