THE RESILIENCE OF ECOLOGICAL NETWORKS

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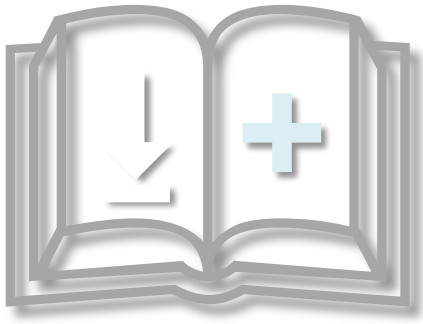

R bookdown+

CONTENTS

1 KEYSTONENESS, CENTRALITY, AND THE STRUCTURAL CONTROLLABILITY OF ECOLOGICAL NETWORKS 1

1.1 Abstract 1

2 FEATURES 3

3 QUICK START 5

3.1 Preparation 5

3.2 Installation 5

3.3 Generate demo files 5

3.4 Build a demo book 5

3.5 Write your own 5

3.6 More outputs 6

3.7 Recommendations 6

3.8 Models 6

4 RESULTS 7

5 CONCLUSIONS 9

LIST OF FIGURES

Figure 1 caption 7

LIST OF TABLES

Table 1 Here is a nice table! 8

ACRONYMS

DRY Don't Repeat Yourself

API Application Programming Interface

UML Unified Modeling Language

1

KEYSTONENESS, CENTRALITY, AND THE STRUCTURAL CONTROLLABILITY OF ECOLOGICAL NETWORKS

1.1 ABSTRACT

1. An important dimension of a species' role is its ability to alter the state and maintain the diversity of its community. Centrality metrics have often been used to identify these species, which are sometimes referred as "keystone" species. However, the relationship between centrality and keystoneness is largely phenomenological and based mostly on our intuition regarding what constitutes an important species. While centrality is useful when predicting which species' extinctions could cause the largest change in a community, it says little about how these species could be used to attain or preserve a particular community state.

2. Here we introduce structural controllability, an approach that allows us to quantify the extent to which network topology can be harnessed to achieve a desired state. It also allows us to quantify a species' control capacity—its relative importance—and identify the set of species that are critical in this context because they have the largest possible control capacity. We illustrate the application of structural controllability with ten pairs of uninvaded and invaded plant-pollinator communities.

3. We found that the controllability of a community is not dependent on its invasion status, but on the asymmetric nature of its mutual dependences. While central species were also likely to have a large control capacity, centrality fails to identify species that, despite being less connected, were critical in their communities. Interestingly, this set of critical species was mostly composed of plants and included every invasive species in our dataset. We also found that species with high control capacity, and in particular critical species, contribute the most to the stable coexistence of their community. This result was true, even when controlling for the species' degree, abundance/interaction strength, and the relative dependence of their partners.

4. *Synthesis*: Structural controllability is strongly related to the stability of a network and measures the difficulty of managing an ecological community. It also identifies species that are critical to sustain biodiversity and to change or maintain the state of

their community and are therefore likely to be very relevant for management and conservation.

The R package `bookdownplus` [2] is an extension of `bookdown` [1]. It is a collection of multiple templates on the basis of LaTeX, which are tailored so that I can work happily under the umbrella of `bookdown`. `bookdownplus` helps you write academic journal articles, guitar books, chemical equations, mails, calendars, and diaries.

You can put some additional information here

2 FEATURES

`bookdownplus` extends the features of `bookdown`, and simplifies the procedure. Users only have to choose a template, clarify the book title and author name, and then focus on writing the text. No need to struggle in YAML and LaTeX.

With `bookdownplus` users can

- record guitar chords,
- write a mail in an elegant layout,
- write a laboratory journal, or a personal diary,
- draw a monthly or weekly or conference calendar,
- and, of course, write academic articles in your favourite way,
- with chemical molecular formulae and equations,
- even in Chinese,
- and more wonders will come soon.

Full documentation can be found in the book R bookdownplus Textbook. The webpage looks so-so, while the pdf file might give you a little surprise.

3

QUICK START

Although this section might not be the latest version, the general idea won't change. Please see R bookdownplus Textbook to keep up with the update.

3.1 PREPARATION

Before starting, you have to install R, RStudio, bookdown package, and other software and packages (i.e. Pandoc, LaTeX, rmarkdown, rticle, knitr, etc.) which bookdown depends on. See the official manual of bookdown for details. Additionally, if you want to produce a poster, phython must be installed before using, and the path of phython might have to be added to the environmental variables for Windows users.

3.2 INSTALLATION

```
install.package("bookdownplus")
# or
devtools::install_github("pzhaonet/bookdownplus")
```

3.3 GENERATE DEMO FILES

Run the following codes, and you will get some files (e.g. `index.Rmd`, `body.Rmd`, `bookdownplus.Rproj`) and folders in your working directory.

```
getwd() # this is your working directory. run setwd() to change it.
bookdownplus::bookdownplus()
```

3.4 BUILD A DEMO BOOK

Now open `bookdownplus.Rproj` with RStudio, and press `ctrl+shift+b` to compile it. Your will get a book file named `*.pdf` in `_book/`folder.

3.5 WRITE YOUR OWN

Write your own text in `index.Rmd` and `body.Rmd`, and build your own lovely book.

3.6 MORE OUTPUTS

By default, the book is in a pdf file. From 'bookdownplus' 1.0.3, users can get more output formats, including 'word', 'html' and 'epub'. Run:

```
bookdownplus::bookdownplus(template = 'article', more_output = c('html',
```

3.7 RECOMMENDATIONS

I have been developing some other packages, which bring more features into 'bookdown', such as:

- mindr [3], which can extract the outline of your book and turn it into a mind map, and
- pinyin [4], which can automatically generate '{#ID}' of the chapter headers even if there are Chinese characters in them.

Both of them have been released on CRAN and can be installed via:

```
install.packages('mindr')
install.packages('pinyin')
```

Enjoy your bookdowning!

3.8 MODELS

Eq. (1) is an equation.

$$E = mc^2 \tag{1}$$

It can be written as $E = mc^2$.

4

RESULTS

Fig. 1 psum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua.

Tab. 1 psum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua.

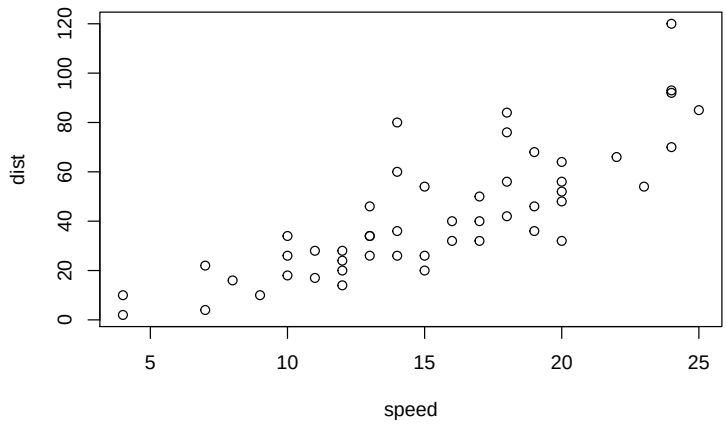

Figure 1: caption

Table 1: Here is a nice table!

Sepal.Length	Sepal.Width	Petal.Length	Petal.Width	Species
5.1	3.5	1.4	0.2	setosa
4.9	3.0	1.4	0.2	setosa
4.7	3.2	1.3	0.2	setosa
4.6	3.1	1.5	0.2	setosa
5.0	3.6	1.4	0.2	setosa
5.4	3.9	1.7	0.4	setosa
4.6	3.4	1.4	0.3	setosa
5.0	3.4	1.5	0.2	setosa
4.4	2.9	1.4	0.2	setosa
4.9	3.1	1.5	0.1	setosa
5.4	3.7	1.5	0.2	setosa
4.8	3.4	1.6	0.2	setosa
4.8	3.0	1.4	0.1	setosa
4.3	3.0	1.1	0.1	setosa
5.8	4.0	1.2	0.2	setosa
5.7	4.4	1.5	0.4	setosa
5.4	3.9	1.3	0.4	setosa
5.1	3.5	1.4	0.3	setosa
5.7	3.8	1.7	0.3	setosa
5.1	3.8	1.5	0.3	setosa

5

CONCLUSIONS

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum

BIBLIOGRAPHY

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[4] Peng Zhao. *pinyin: Convert Chinese Characters into Pinyin*, 2017. URL https://github.com/pzhaonet/pinyin. R package version 1.0.2.