SARAS WINDECKER + DANIEL FALSTER

REPRODUCIBLE RESEARCH

NATURE | NEWS FEATURE

1,500 scientists lift the lid on reproducibility

Survey sheds light on the ‘crisis’ rocking research.

Monya Baker

25 May 2016 | Corrected: 28 July 2016

NATURE | NEWS FEATURE

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25 May 2016

THE CONVERSATION

Academic rigour, journalistic flair

Arts + Culture Business + Economy Cities Education Environment + Energy Health + Medicine Politics +

The science 'reproducibility crisis' – and what can be done about it

March 15, 2017 8.49pm AEDT

IRREPRODUCIBLE RESULTS… WHY?

Fidler F, Chee YE, Wintle BC, Burgman MA, McCarthy MA, Gordon A. Metaresearch for Evaluating Reproducibility in Ecology and Evolution. *Bioscience*. 2017;67(3):282–289. doi:10.1093/biosci/biw159

IRREPRODUCIBLE RESULTS… WHY?

1. PUBLICATION BIAS
2. QUESTIONABLE RESEARCH PRACTICES IN ‘PUBLISH OR PERISH’ CULTURE
3. INADEQUATE DATA REPORTING
4. INSUFFICIENT INCENTIVES FOR SHARING CODE & DATA

Fidler F, Chee YE, Wintle BC, Burgman MA, McCarthy MA, Gordon A. Metaresearch for Evaluating Reproducibility in Ecology and Evolution. *Bioscience*. 2017;67(3):282–289. doi:10.1093/biosci/biw159

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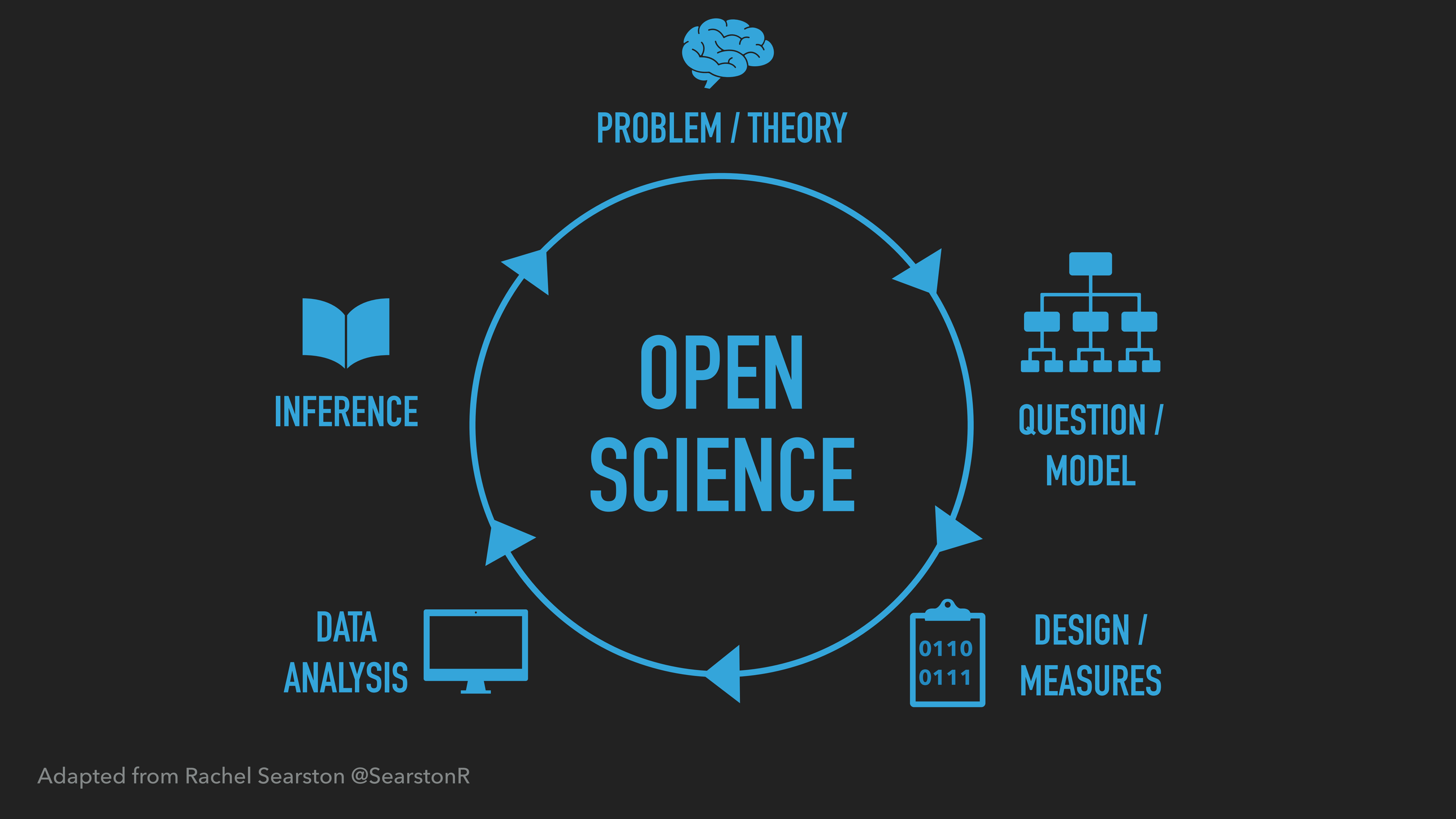
March 15, 2017 8.49p

nature ecology & evolution

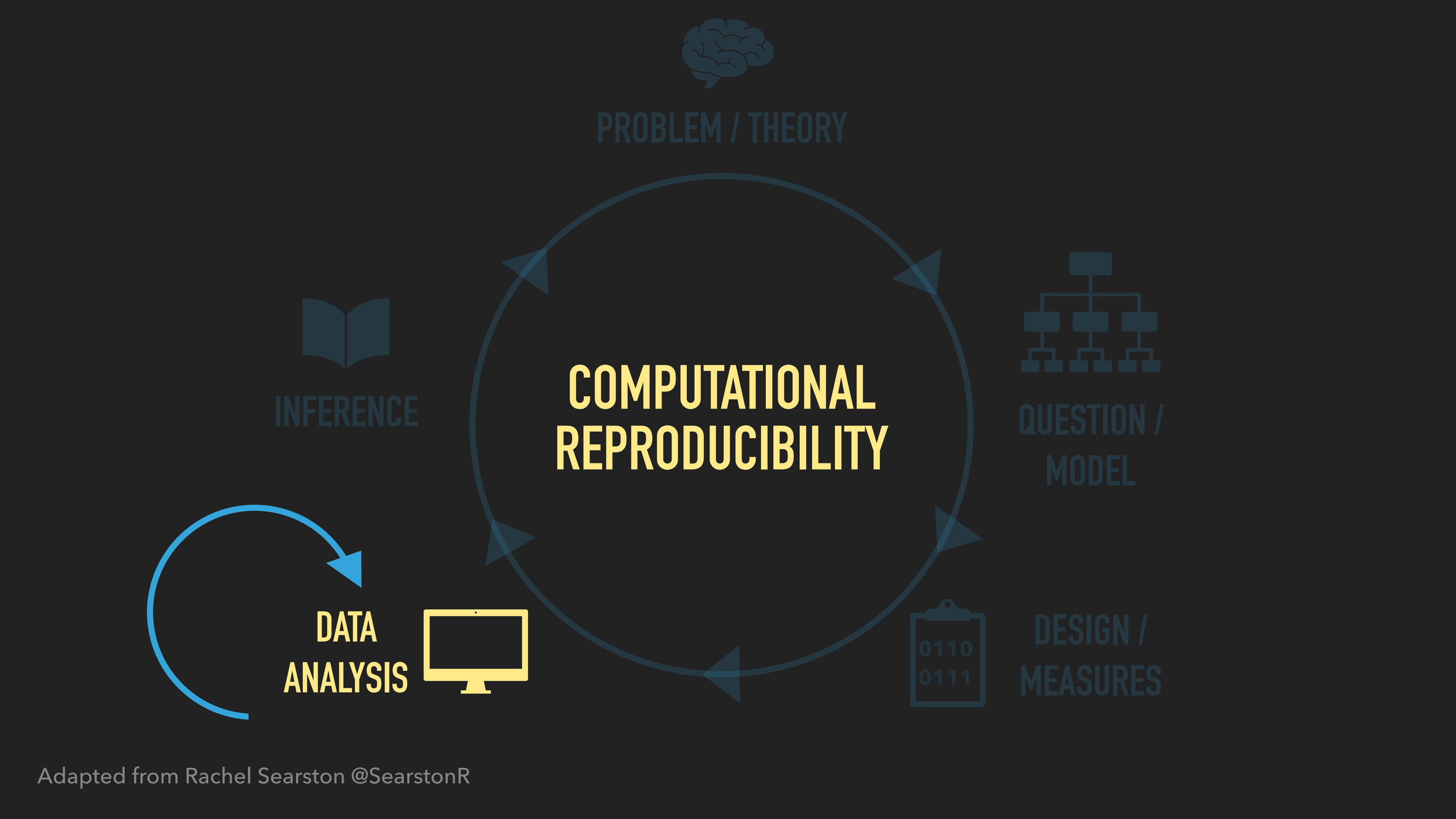
Perspective | Published: 23 May 2017

Our path to better science in less time using open data science tools

Julia S. Stewart Lowndes, Benjamin D. Best, Courtney Scarborough, Jamie C. Afflerbach, Melanie R. Frazier, Casey C. O'Hara, Ning Jiang & Benjamin S. Halpern

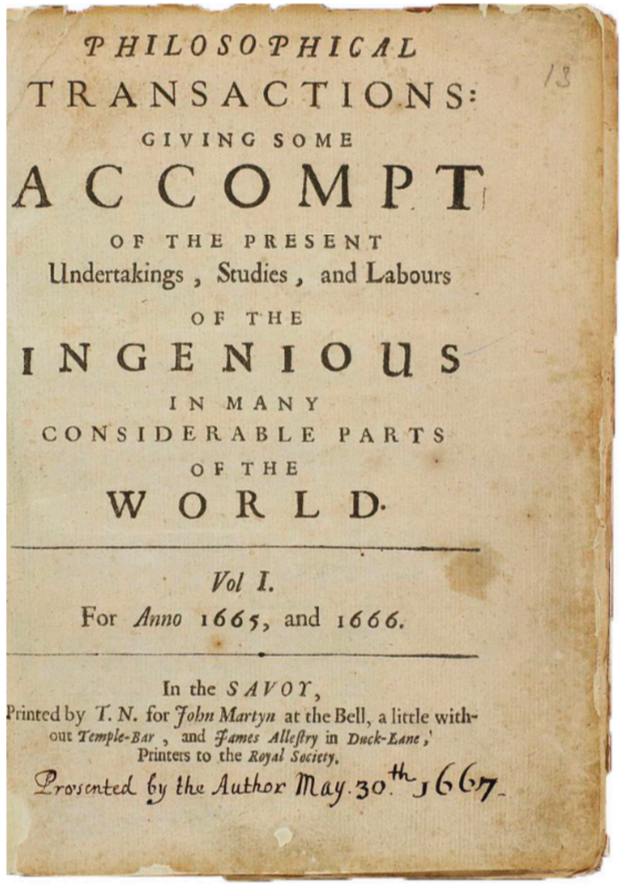


Adapted from Rachel Searston @SearstonR



Adapted from Rachel Searston @SearstonR

1666 – 2010



PHILOSOPHICAL
TRANSACTIONS:
GIVING SOME
ACCOMPT
OF THE PRESENT
Undertakings, Studies, and Labours
OF THE
INGENIOUS
IN MANY
CONSIDERABLE PARTS
OF THE
WORLD.

Vol I.
For *Anno* 1665, and 1666.

In the *SAVOY*,
Printed by *T. N.* for *John Martyn* at the Bell, a little without *Temple-Bar*, and *James Allestry* in *Duck-Lane*,
Printers to the *Royal Society*.
Presented by the Author May. 30th 1667.

2010 →

100 YEARS Journal of Ecology

Journal of Ecology 2014, **102**, 1266–1272 doi: 10.1111/1365-2745.12260

How much of the world is woody?

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Summary

1. The question posed by the title of this study is a basic one, and it is surprising that the answer is not known. Recently, assembled trait data sets provide an opportunity to address this, but scaling these data sets to the global scale is challenging because of sampling bias. Although we currently know the growth form of tens of thousands of species, these data are not a random sample of global diversity; some clades are exhaustively characterized, while others we know little to nothing about.

2. Starting with a data base of woodiness for 39 313 species of vascular plants (12% of taxonomically resolved species, 59% of which were woody), we estimated the status of the remaining taxonomically resolved species by randomization. To compare the results of our method to conventional wisdom, we informally surveyed a broad community of biologists. No consensus answer to the question existed, with estimates ranging from 1% to 90% (mean: 31.7%).

3. After accounting for sampling bias, we estimated the proportion of woodiness among the world's vascular plants to be between 45% and 48%. This was much lower than a simple mean of our data set and much higher than the conventional wisdom.

4. *Synthesis.* Alongside an understanding of global taxonomic diversity (i.e. number of species globally), building a functional understanding of global diversity is an important emerging research direction. This approach represents a novel way to account for sampling bias in functional trait data sets and to answer basic questions about functional diversity at a global scale.

Key-words: data bases, determinantes of plant community diversity and structure, functional diversity, herbaceousness, macroecology, sampling bias, woodiness

Introduction

The distinction between a woody and non-woody growth form is probably the most profound contrast among terrestrial plants and ecosystems: for instance, a forest is dominated by woody taxa, while a grassland is dominated by herbs. The recognition of the fundamental importance of this divide dates back at least to *Enquiry into Plants* by Theophrastus of Eresus (371–287 BC), a student of Plato and Aristotle, who began his investigation into plant form and function by classifying the hundreds of plants in his garden into woody and herbaceous categories (Theophrastus 1916).

The last two thousand years of research into wood since Theophrastus classified his garden have uncovered its origin in the early Devonian (~400 Mya; Gerrienne *et al.* 2011); that prevalence of woodiness varies with climate (Moles *et al.* 2009); that wood has been lost many times in diverse groups, both extant and extinct (Judd, Sanders & Donoghue 1994), often as an adaptation to freezing temperatures (Zanne *et al.* 2014); that it has also been gained many times, particularly on island systems (Carlquist 1974; Givnish 1998); and that many different forms of pseudo-woody growth habit have appeared across groups that have lost true woodiness or diverged before true woodiness evolved (Cornwell *et al.* 2009). We know about its mechanical properties and developmental pathways, its patterns of decomposition and their effects on ecosystem function (Cornwell *et al.* 2009) and that

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†These authors contributed equally.

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Knowledge is shared, peer reviewed, attributable

data: 10.5061/dryad.v7m14.2

code: github.com/richfitz/wood

blog: ropensci.org/blog/2014/06/09/reproducibility/

MY IDEAL PAPER ANALYSIS

(What you can already do)

- All analyses and data in single folder
- Code runs, produces figures, tables
- Informative readme
- You can can reproduce & build on results

(What you can learn in future)

- Analyses under version control
- Archive code and data, links in paper
- Anyone can reproduce & build on research

“YOU’RE ALWAYS COLLABORATING WITH FUTURE YOU!”