Meta-Science & Open Science for Ecology: The Revolution We Need

Dr. Antica Culina
@antica_c

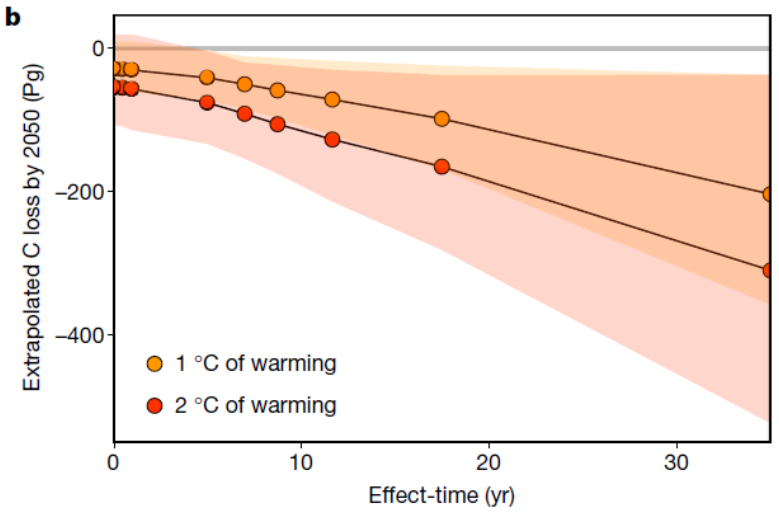
OSC 27 June 2023

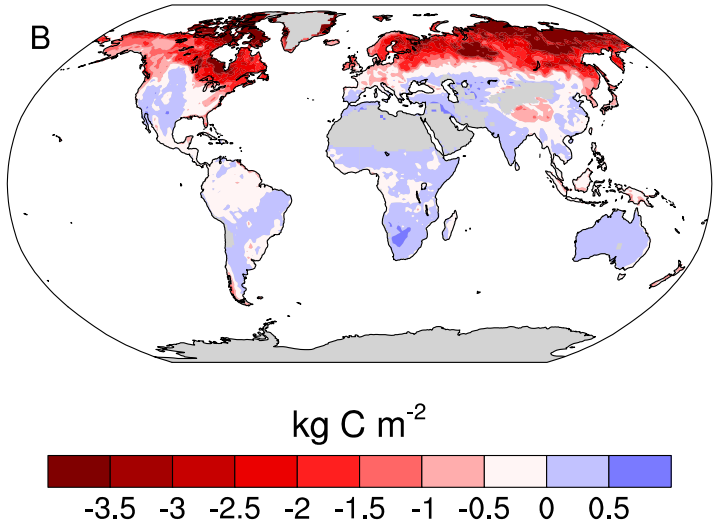
Outline

Challanges & solutions

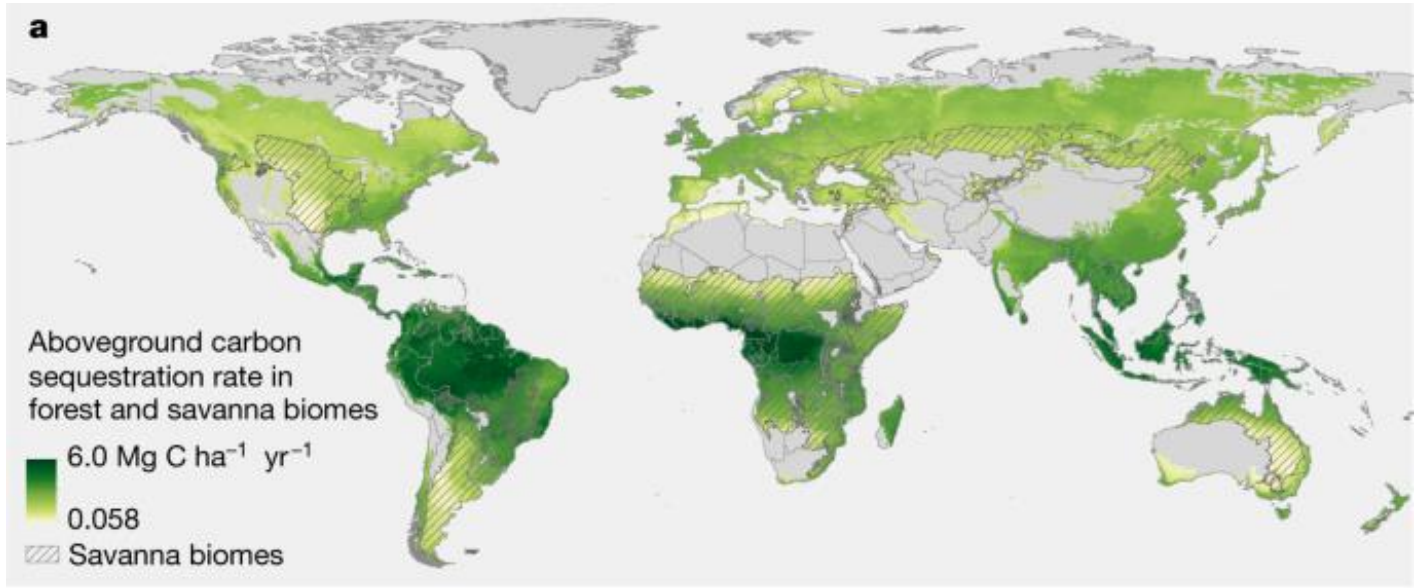
1. Ecology
2. Open & FAIR data
3. Reproduciblity
4. Registration

How will soil carbon stocks fall under climate change?



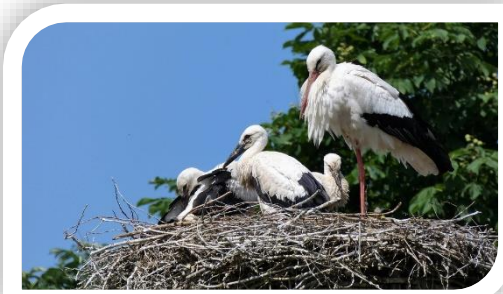


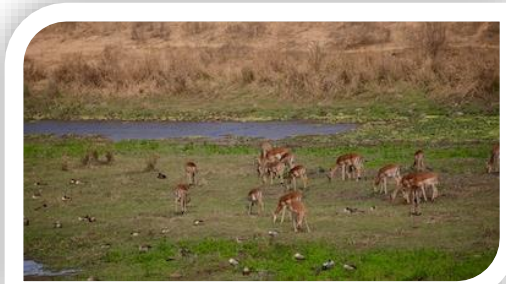
Crowther et al. 2016

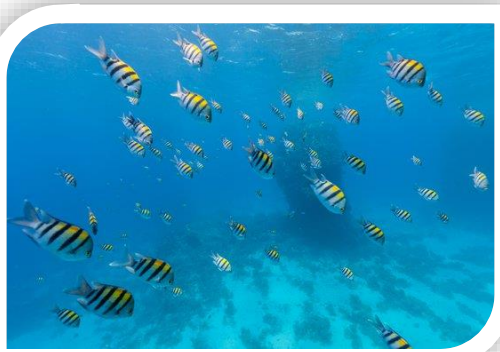


Cook-Patton et al. Nature 2020


Climate change







Ramirez et al., 2018, *Trends in Plant Sciences*

BIOLOGICAL REVIEWS
Cambridge Philosophical Society
Biol. Rev. (2014), pp. 000–000.
doi: 10.1111/brv.12143

Trading up: the fitness consequences of divorce in monogamous birds

Antica Culina*, Reinder Radersma and Ben C. Sheldon
Edward Grey Institute, Department of Zoology, University of Oxford, Oxford, OX1 3PS, U.K.

1. Values do not match
2. Missing information
3. Unclear methods

.....

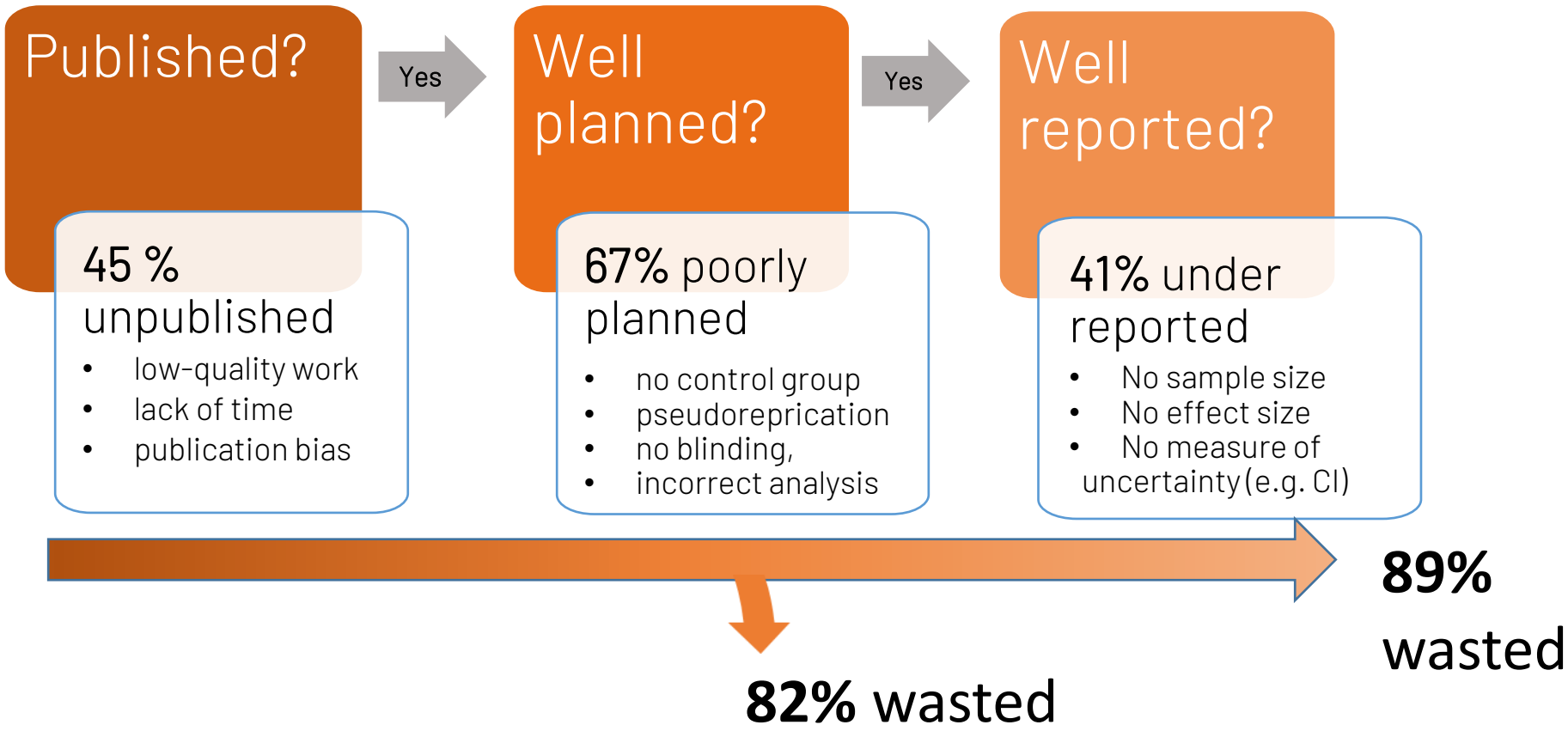
CHECK the DATA

Wasted research (in ecology)

Based on 10 464 studies

Marija Purgar

Tin Klanjscek



From Purgar et al. 2022, Nature Ecology & Evolution


Climate change

Open data

Almost instantaneous data sharing

The National Ecological Observatory Network: Open data to understand how our aquatic and terrestrial ecosystems are changing.

An Airborne Observation Platform

Mobile Deployment Platform (MDP), an example of sensor infrastructure, an example of a field sampling plot.

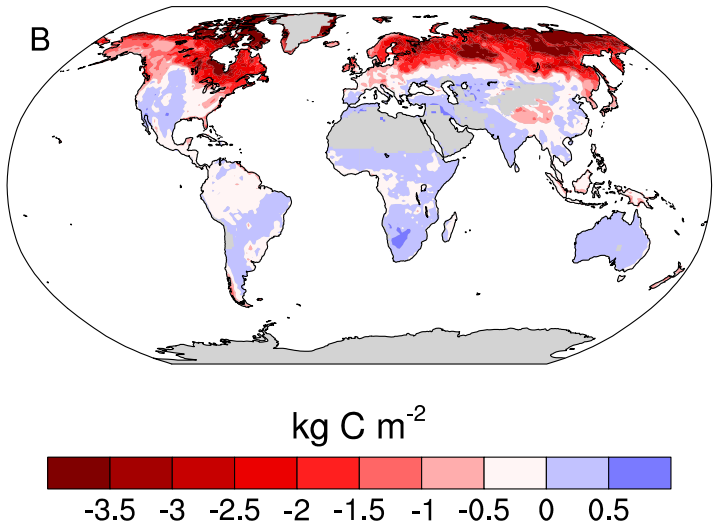
T. Crowther

set the **target of 50 studies** to give a strong regression design

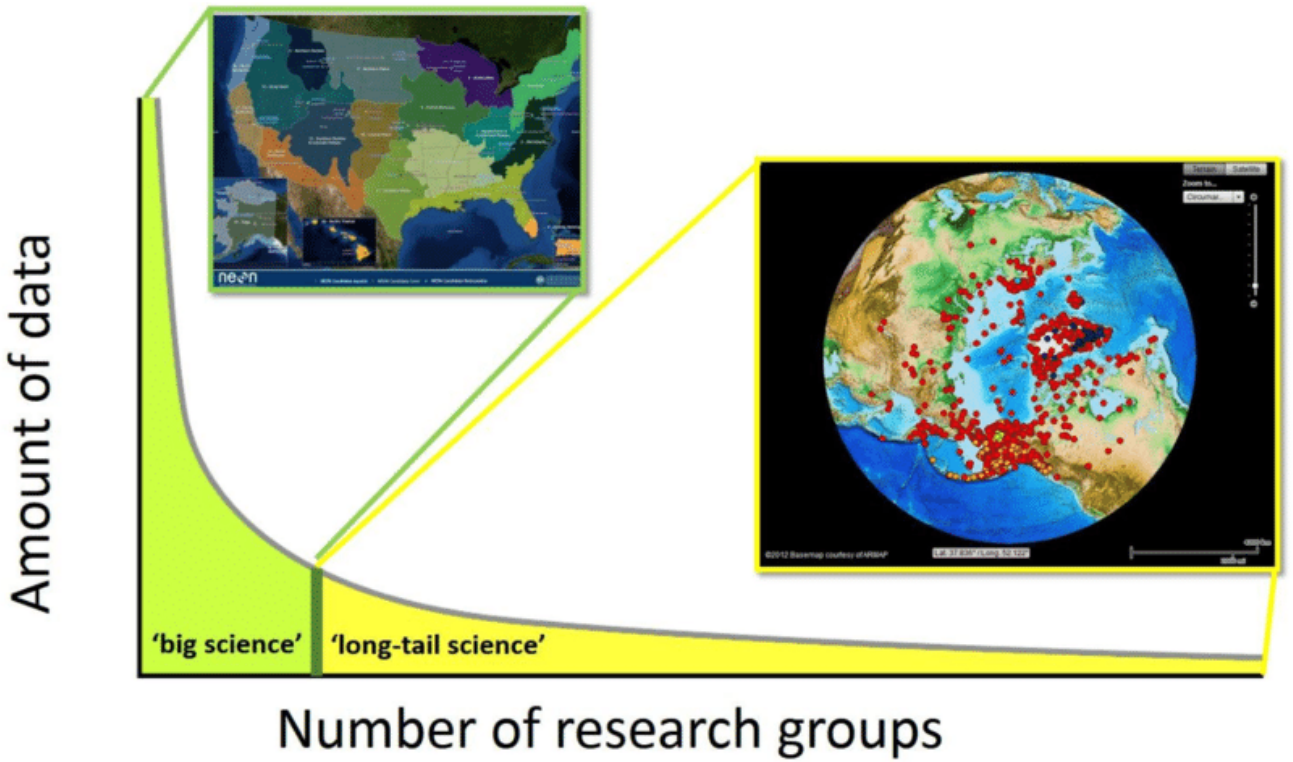
Of thousands of experiments, **only 6** reported changes in C stocks

Only 2 open access datasets, and **neither had** the **necessary location** info

Emailed PIs for raw data and got access to **51 sites in 6 months**



Long tail of data



Credit to Christine M Laney

Facilitating use of Open Data

Culina et al. 2018a, Nature Eco Evo

Paolo Manghi

Miriam Baglioni

Saskia Woutersen-Windhouwer

Marcel Visser

Tom Crowhter

ResourceCatalogue

Welcome to the EcoEvo Catalogue!

It provides a list of best online places (sources) that can be used to conduct a search for ecological and evolutionary datasets.

The catalogue is an evolving list of these sources, and can be amended by the community members. As the amount of EcoEvo datasets that are freely available online is rapidly increasing, we need a comprehensive list of places where these datasets can be searched for in one interface, speeding up the search process and making it more comprehensive..

Each data source is described with features characterizing the data source itself (such as name and organization) and with features of EcoEvo datasets that the source hosts or collects information on (e.g. available metadata formats, content reuse policies).

This catalogue accompanies the paper Culina et al. 2017

Items Search

Insert keywords here

See All

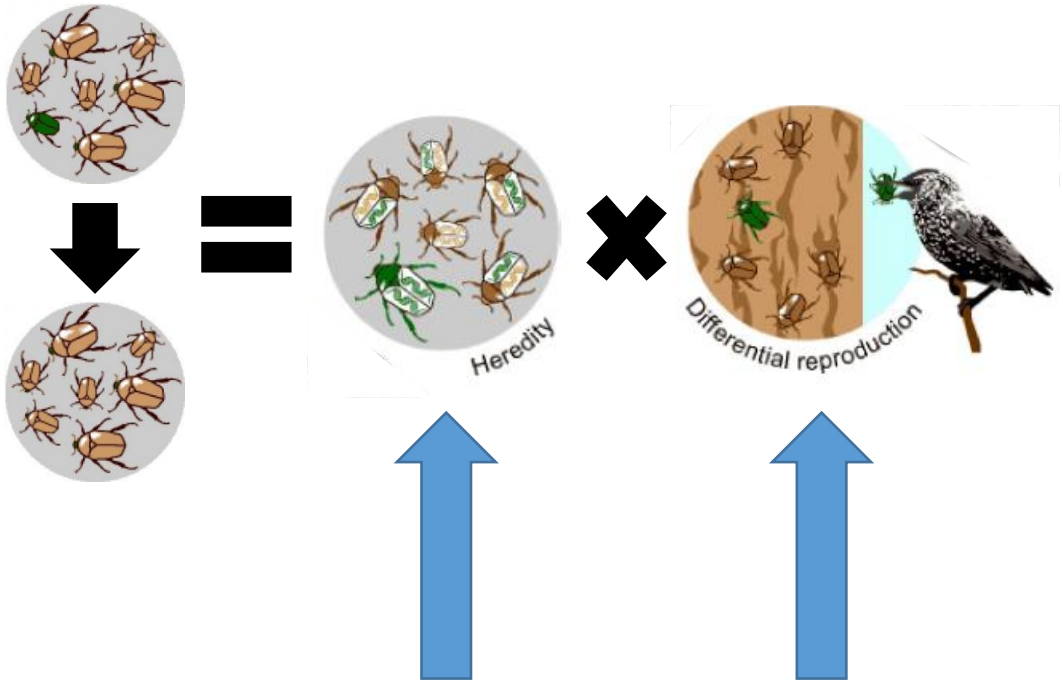
EcoEvo Catalogue statistics

23	1	4
items	organisation	types

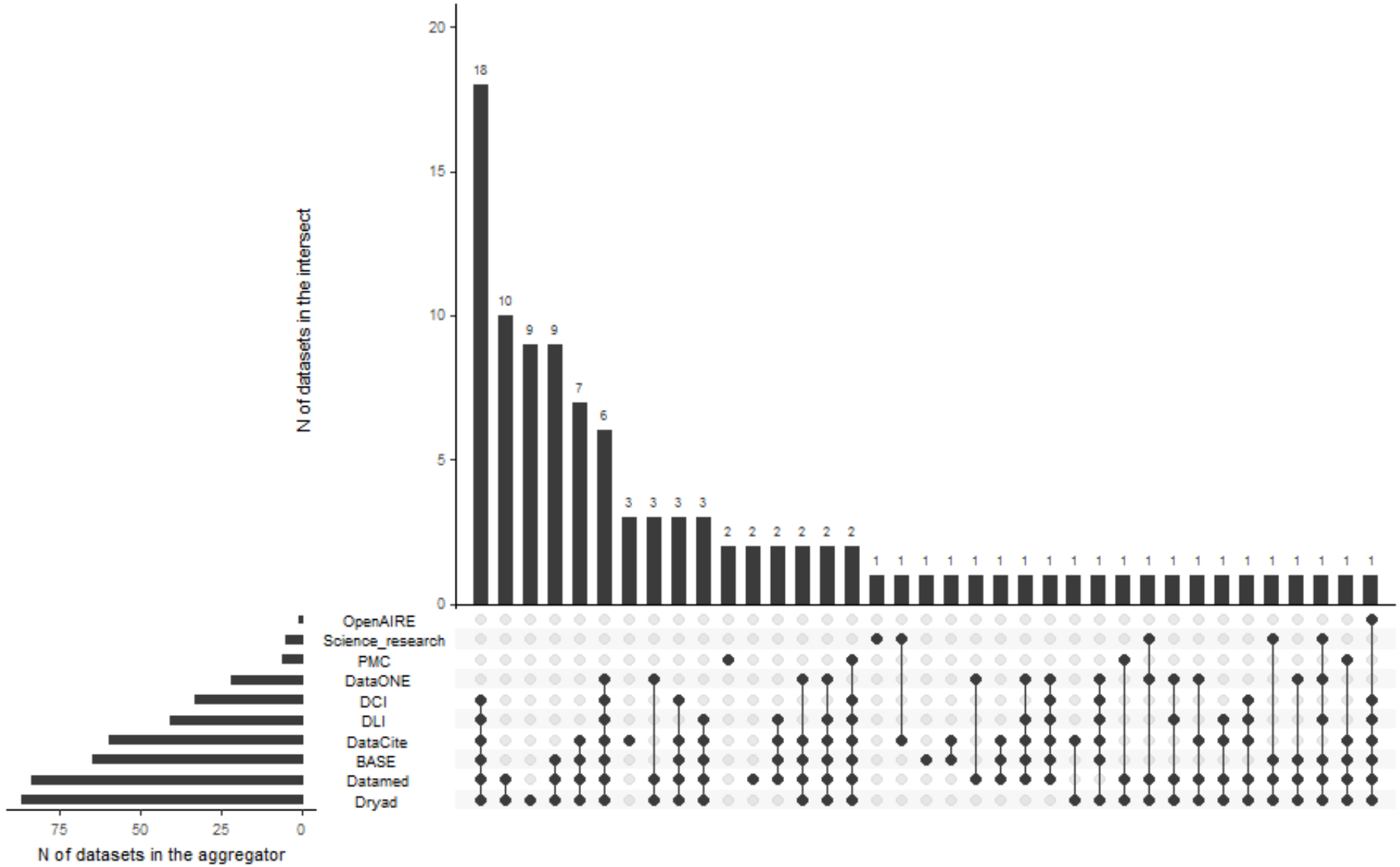
A case study

Is there environmental coupling of heritability & selection

Rate of genetic change depends on heritability and selection



Ramakers et al. 2018, Nature Eco Evo

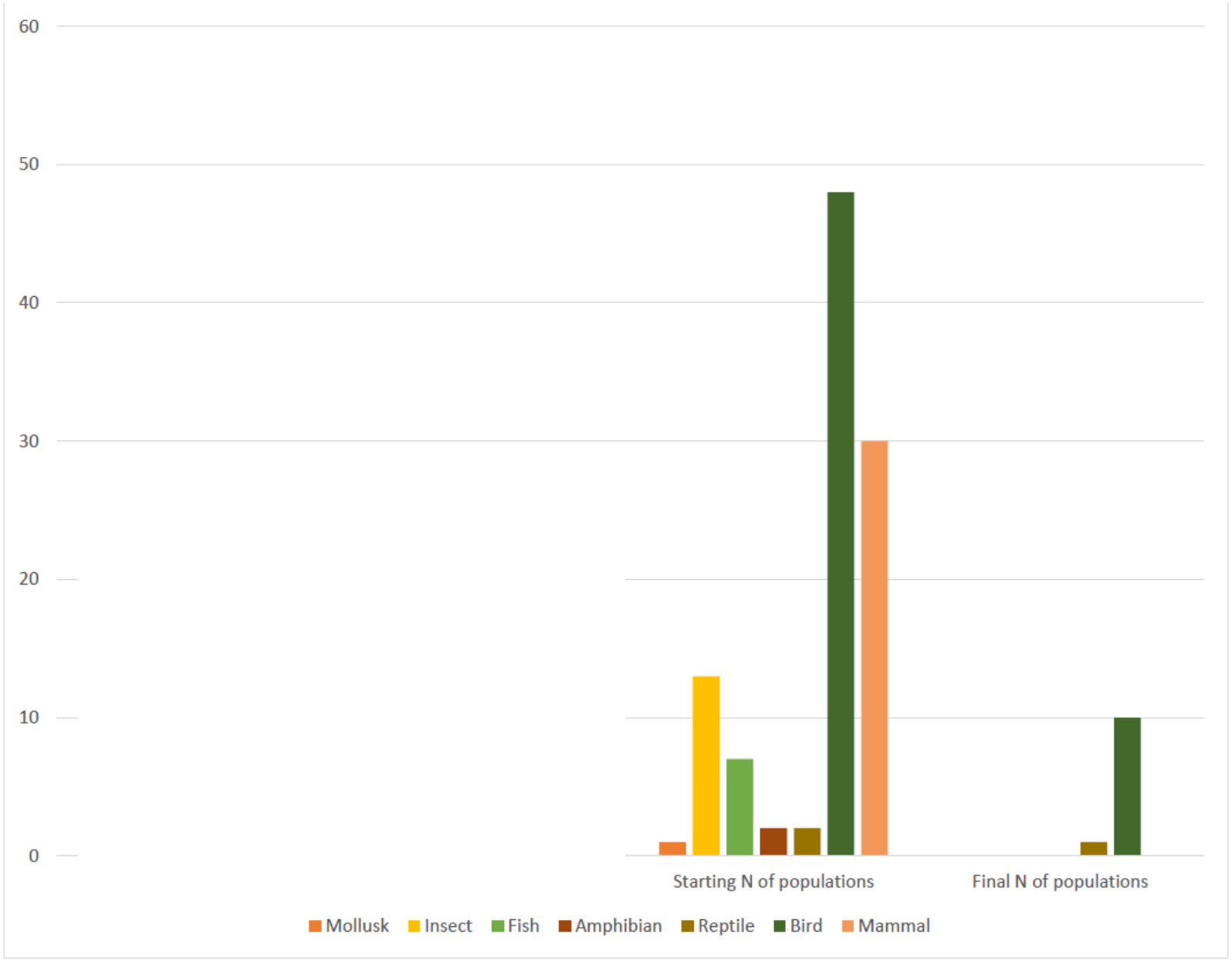


Culina et al. 2018b, Nature Eco Evo

The Open Ecosystem of e-Infrastructures for Data Discovery: A Review

Bardi, Alessia; Kraker, Peter; Juty, Nick; Culina, Antica; Colomb, Julien; Widmann, Heinrich; Goble, Carole; Hiseni, Valentina; Flügel, Anna-Lena; Mathiak, Brigitte; Heger, Tina

Are these data reusable?

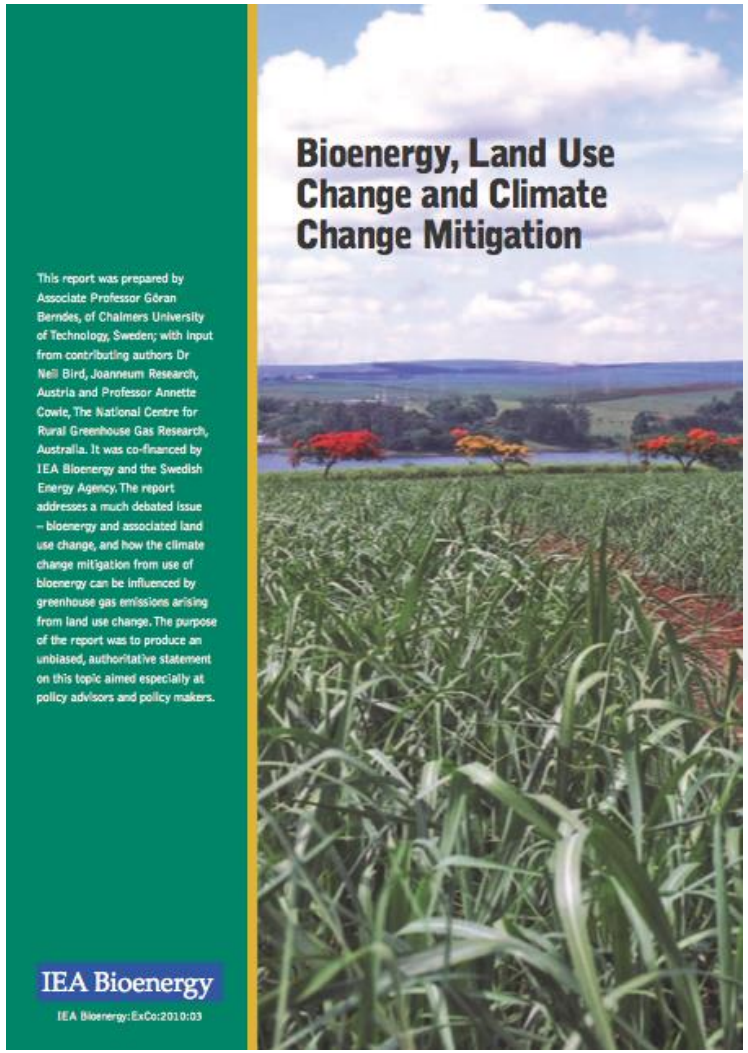


Do you want more data?

You were not even born when I started to collect the data

Case study II

How are methanotroph communities structured by their environment?

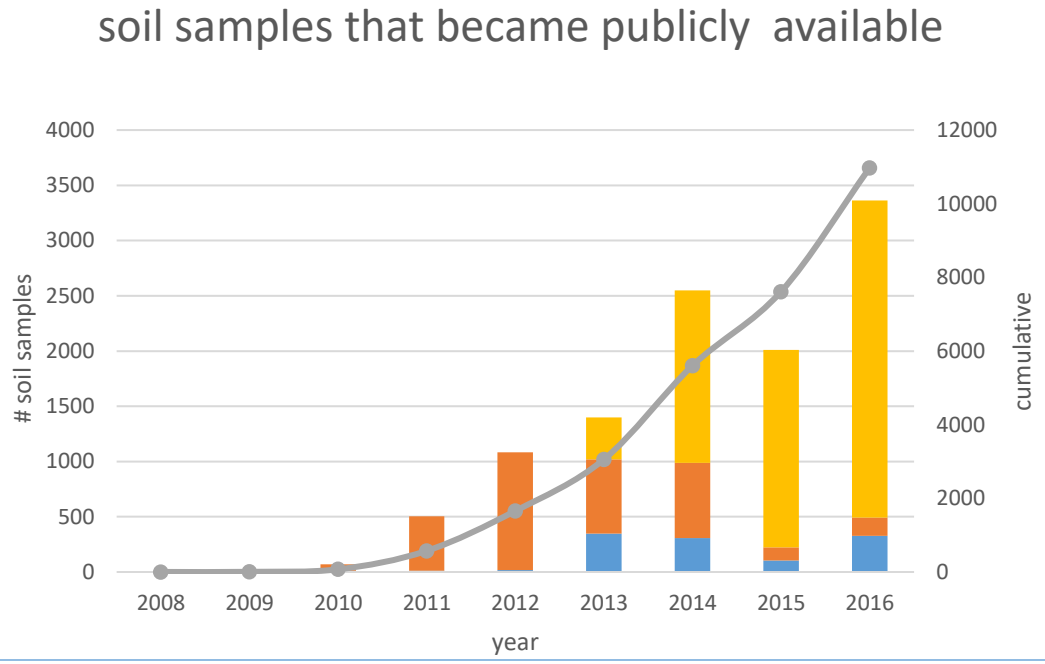


A. Aldas Vargas

M. Aaldering

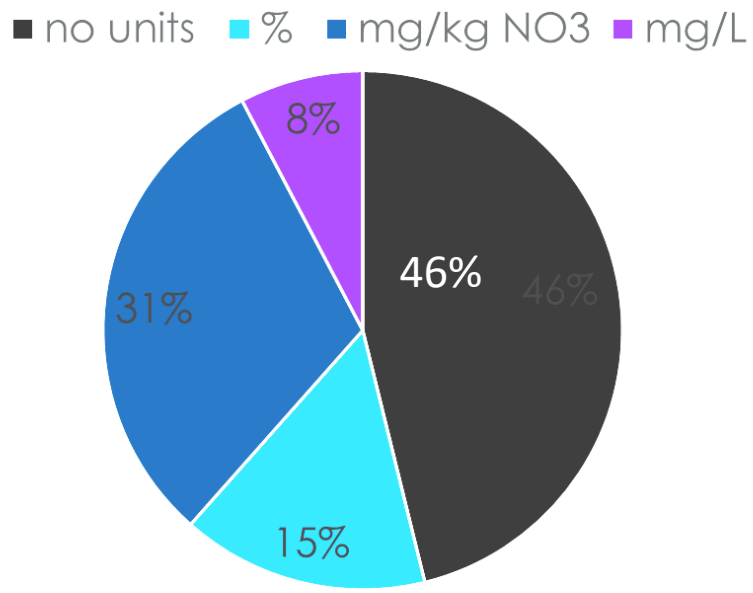
A. Veraart

Open metagenome data
Community structure

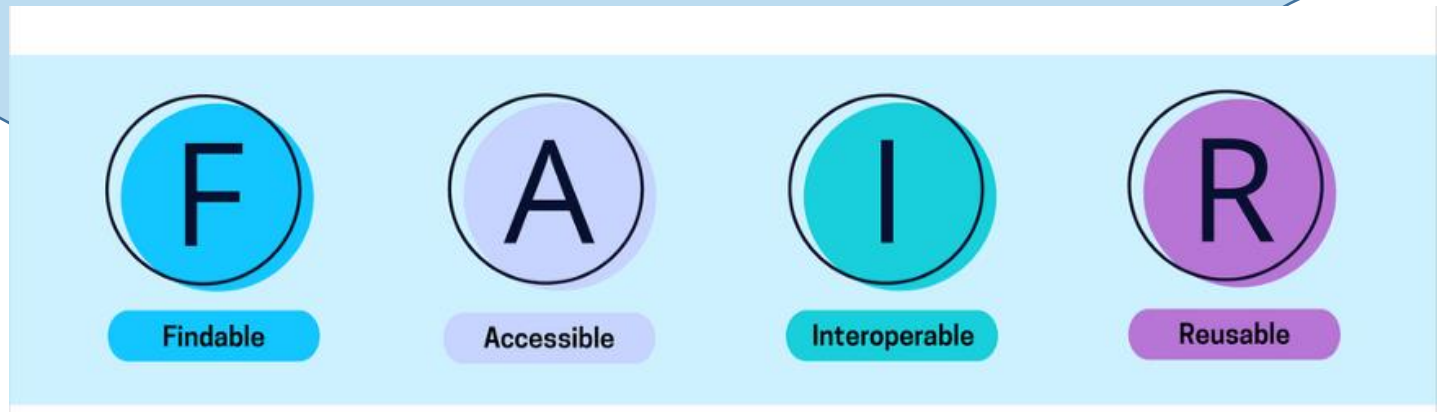


pH, Temp

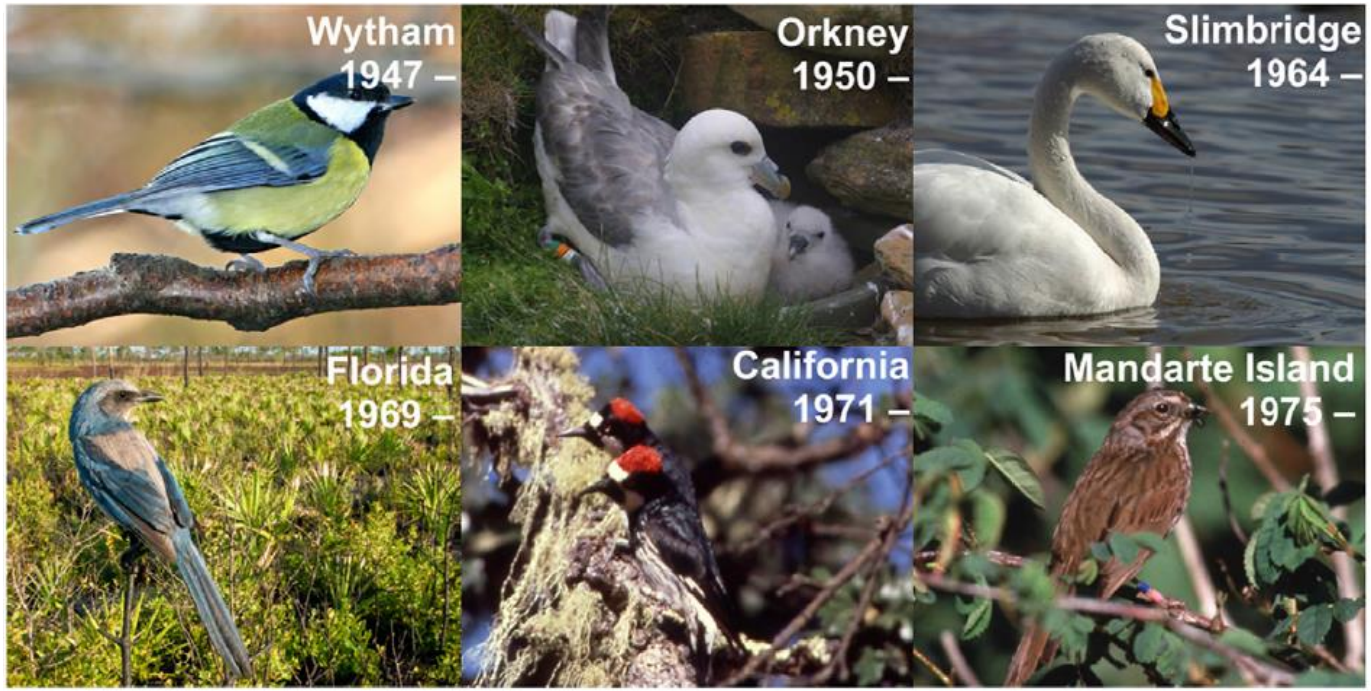
C, N



FAIR data



Long-term individual based studies of animals



SPI-Birds Network and Database

@spibirds

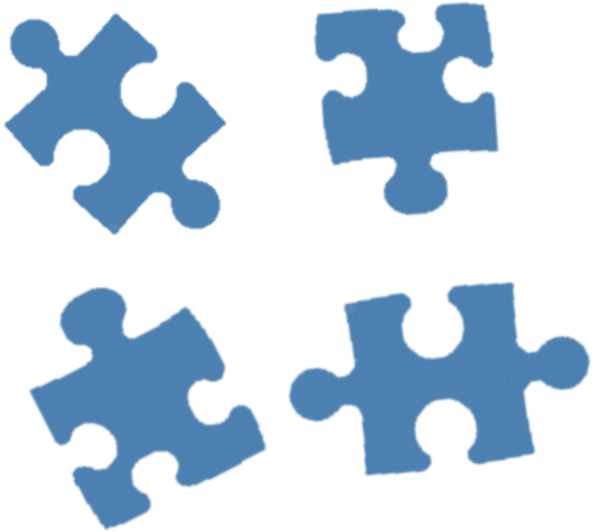
Issues

A diversity of data management strategies

How are variables coded?

How are data stored?

Quality checks?

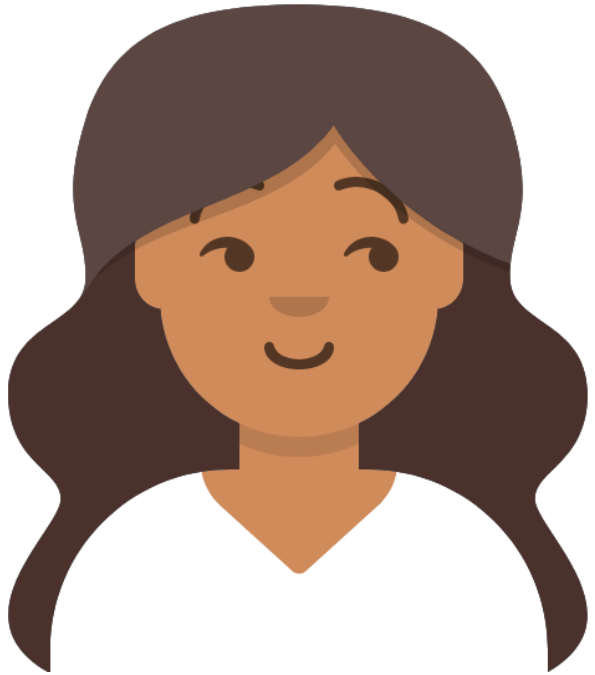


Combining multiple populations extremely time-consuming

Considerations

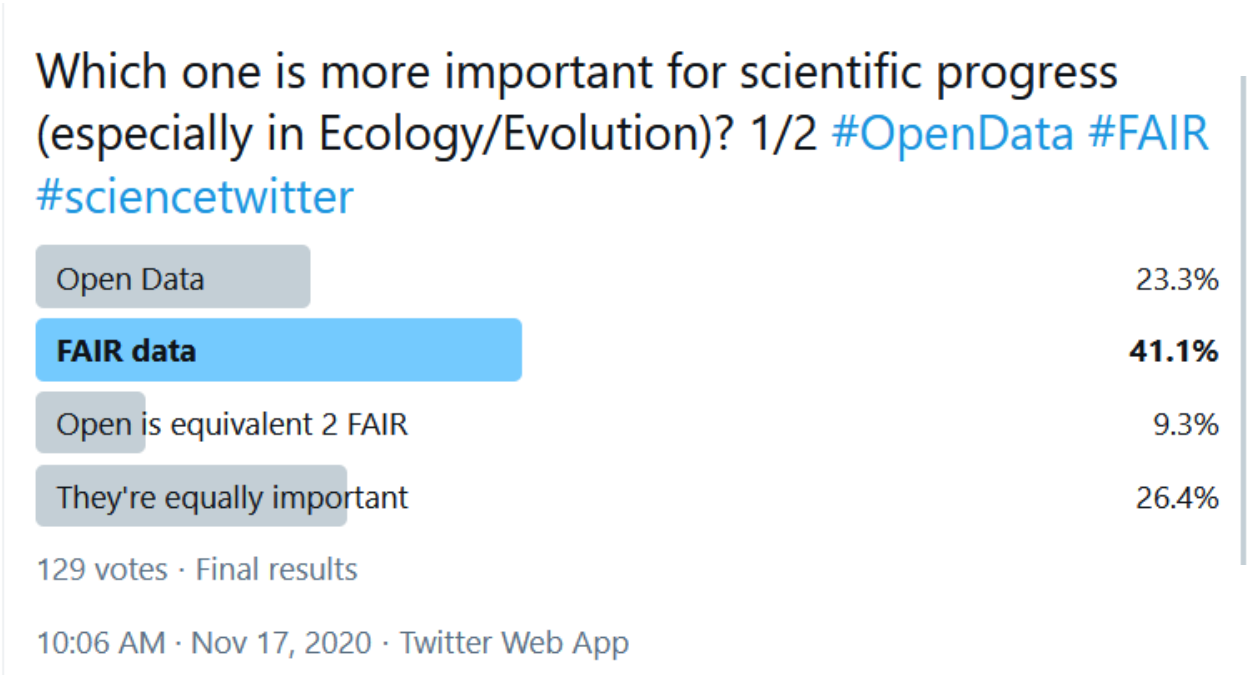
I don't want my long-collected data to be OPEN

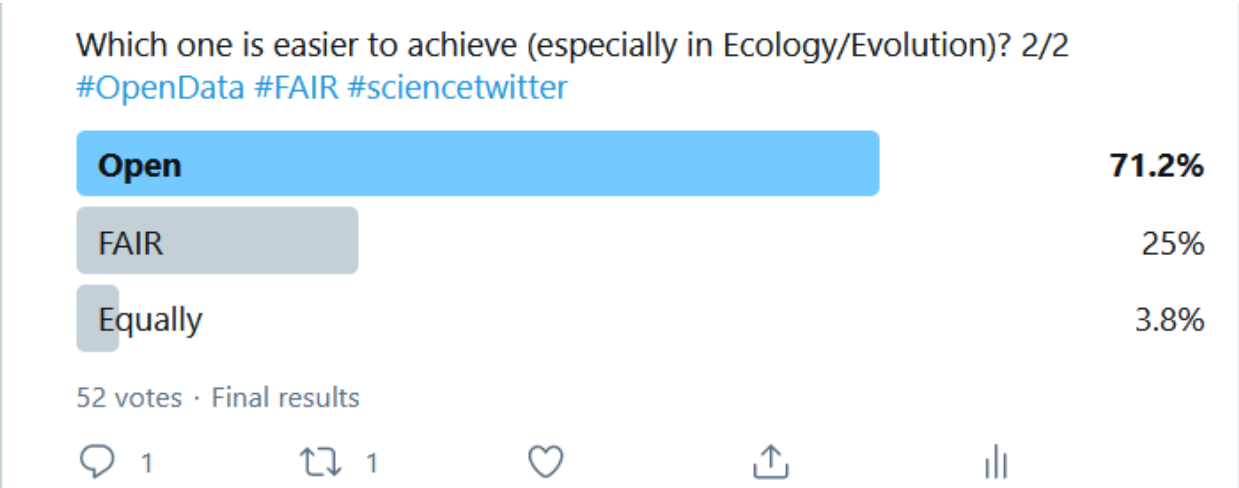
I want my data to be used, and use others data



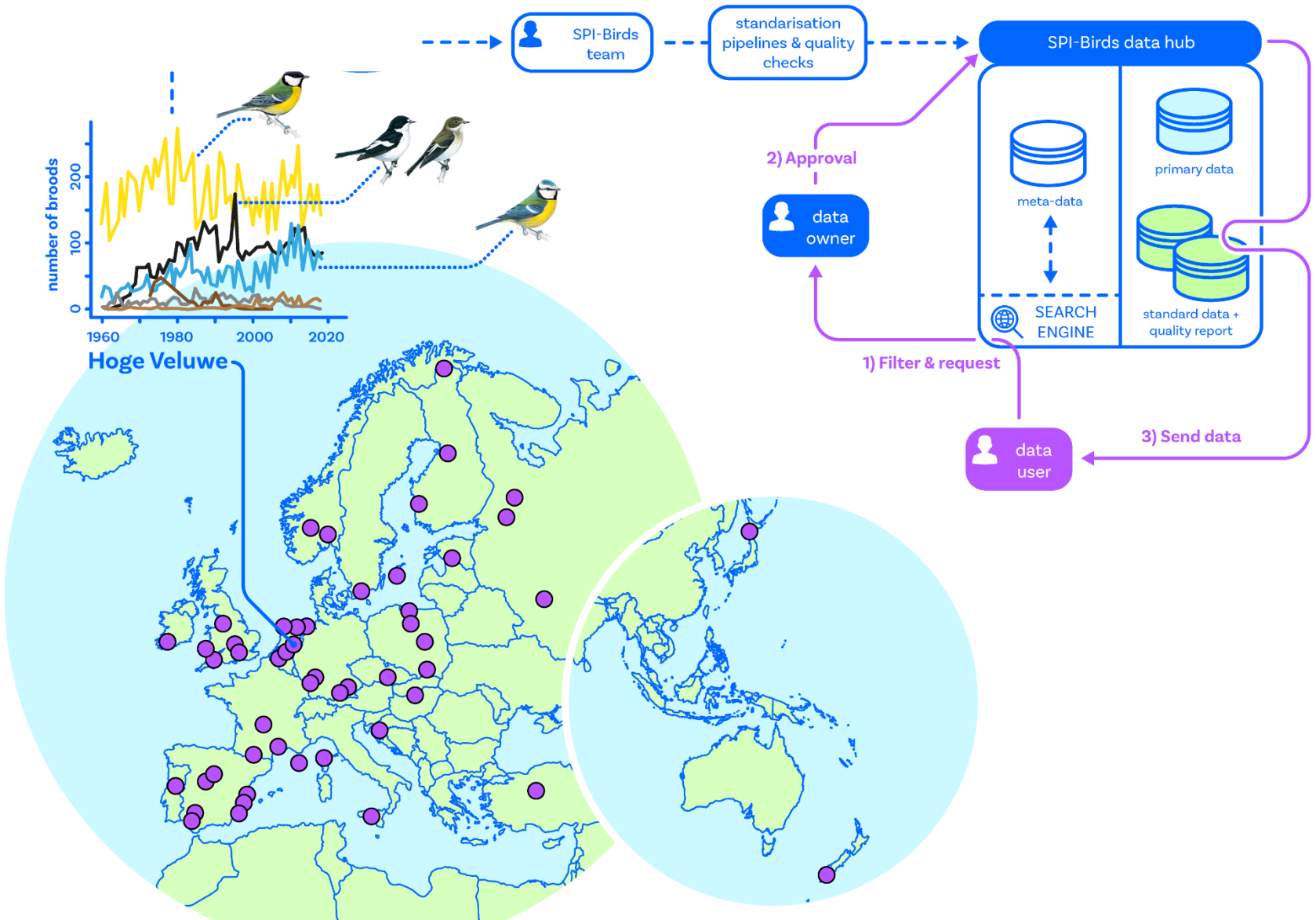
I see the benefits of a common data format but do not have capacity to change my data format

SUPPORT in FAIR DATA





Workflow


number of broods
0
100
200
1960
1980
2000
2020
Hoge Veluwe

SPI-Birds team
standarisation pipelines & quality checks
SPI-Birds data hub
meta-data
primary data
SEARCH ENGINE
standard data + quality report
2) Approval
data owner
1) Filter & request
3) Send data
data user

Connecting ecological research

Map existing efforts

Standardize data

Standardize data processing & analysis

Data collection

Data formats

We should aim to connect at all these levels

Data processing & analysis

- One single solitary line of code, a “1 –“ that does not belong, and you have a positive result where it should be a negative result.
- ‘why don’t we review R code (or other custom software) as part of the peer-review process?’

http://ecoevoevoeco.blogspot.com/2016/12/wrong-lot.html

Evolutionary Ecology Research, 2009, **11**: 1217–1233

Morphological and dietary differences between individuals are ~~weakly but positively~~ NOT correlated within a population of threespine stickleback

Daniel I. Bolnick and Jeffrey S. Paull

Section of Integrative Biology, University of Texas at Austin, Austin, Texas, USA

ABSTRACT

Background: Many theoretical models of speciation and niche evolution assume that the ecological similarity between conspecific individuals depends on their phenotypic similarity. Thus, competition between individuals is expected to depend on their phenotypic similarity. Theoretical models often assume that this intraspecific competition function is Gaussian.

Questions: Are morphological similarity and diet similarity positively correlated? If so, is this relationship non-linear?

Data: Stomach contents, stable isotope ratios ($\delta^{13}C$ and $\delta^{15}N$), and trophic morphology (standard length, gape width, body width, gill raker number, and gill raker length) for 265 threespine sticklebacks (*Gasterosteus aculeatus*) from a single population from a lake in British Columbia.

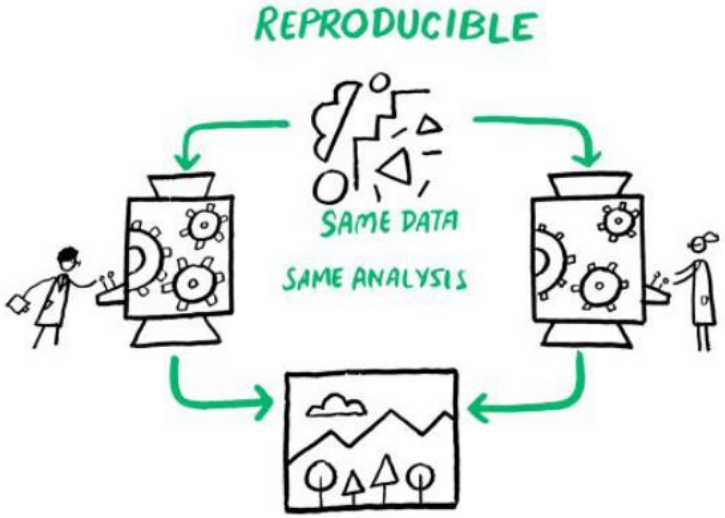
Analysis: We calculated the diet similarity and morphological similarity between all pairs of individuals in our sample. We examined the correlation between diet and morphological similarity, and tested whether the relationship exhibits any non-linearity.

Conclusions: Similarity in trophic morphology is correlated with dietary similarity between individuals. ~~However~~, both body size and trophic morphology explained ~~remarkably small percentages~~ NONE of the variance in diet overlap. Also, we found no evidence of curvature in the intraspecific competition function. NOT

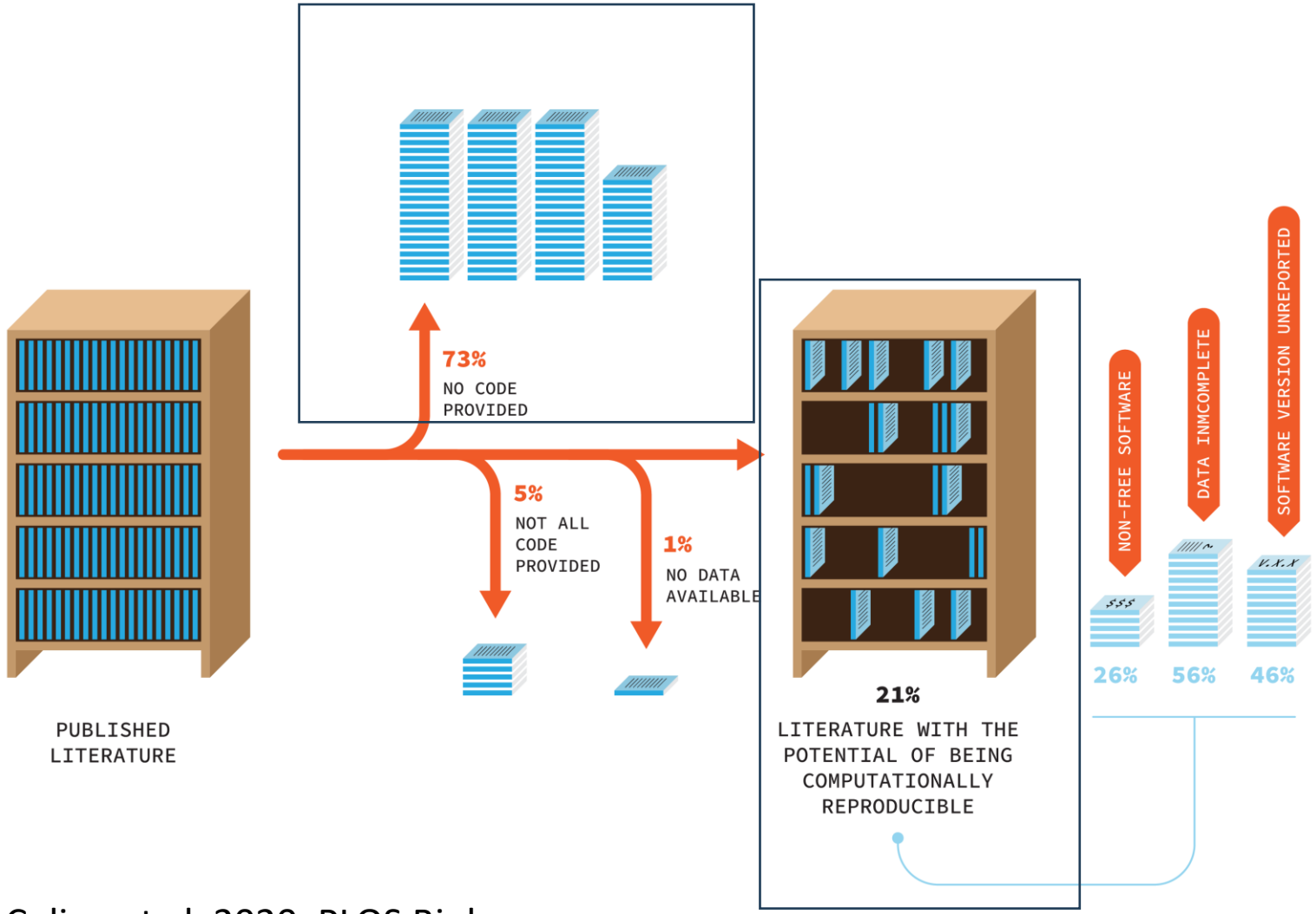
Having code helps:

1) Understand the analysis
2) Evaluate conclusions
3) Re-use
4) Increase trust in science:

➢ contributes to reproducibility



Reproducibility in Eco & Evo



Culina et al. 2020, PLOS Biol

Alfredo Sánchez-Tójar

Simon Evans

Ilona van den Berg

Watch out for Aya’s talk….

12:45 - 13:00

Do Journal Code-sharing Policies Increase Code Availability? [Highlight Talk]

↓ click for abstract

By **Aya Bezine** Bielefeld University

tba

Authors:

Aya Bezine[1], Alfredo Sánchez-Tójar[1], Antica Culina[2], Marija Purgar[2]

Organisation(s): 1: Bielefeld University; 2: Ruder Boskovic Institute, Zagreb

Registration

Registered reports & pre-registration

Credit to the Royal Society

Evidence its better?

Well planned	18 yes / 0 no
Well reported	4 yes / 1 no
Results	15 yes / 1 no

In Ecology

- 26 as of 2023 introduces Registered Reprots
- Pre-registration very low

Specific Issues:

- many non-experimental studies
- diversity of studies and systems

14:30 - 16:30

How Can Open Science Reduce Research Waste across Fields [Workshop 2]

↓ click for details

Antica Culina[1], *Maria Cruz*[2], *Matthew Grainger*[3], *Tin Klanjscek*[1], *Shinichi Nakagawa*[4], *Marija Purgar*[1]

Organisation(s): 1: Ruđer Bošković Institute; 2: Dutch Research Council; 3: Norwegian Institute for Nature Research; 4: UNSW Sidney

Don’t judge

- Open is not equaly open to everyone
- FAIR is not equaly fair to everyone

Thank you, questions

- aculina@irb.hr
- @antica_c

Marija Purgar
Shinichi Nakagawa
Tin Klanjscek
Aya Bezine
Paolo Manghi
Miriam Baglioni
Saskia Woutersen-Windhouwer
Tom Crowther
Marcel Visser
Paul Glasziou
Jip Ramakers
Andrea Aldas Vargas
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Annelies Veraart
Alfredo Sánchez-Tójar
Ilona van den Berg
Simon Evans
Maria Cruz
Matthew Grainger
Fiona Fidler
Stefan Vriend
SPI-Birds Network