



CESAB
CENTRE DE SYNTHÈSE ET D'ANALYSE
SUR LA BIODIVERSITÉ

Biodiversity knowledge synthesis: an introduction to meta-analyses and systematic reviews

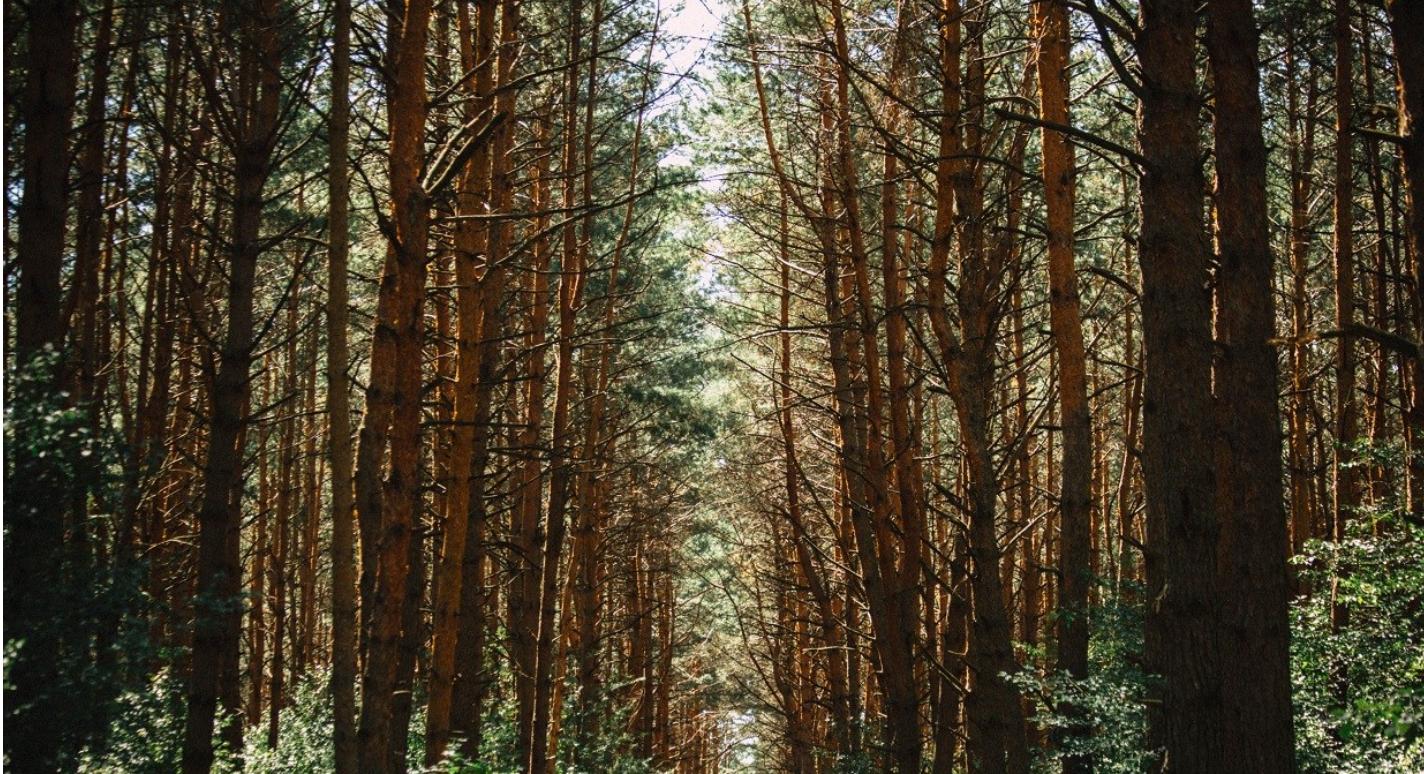
Why do we need systematic review and evidence maps?

October 2023

Beillouin Damien
Chercheur CIRAD- Hortsys



Seeing the forest for the trees



Systematic reviews are the remote-sensing tools of ecology.
They allow us to step back & see a broader, albeit less
detailed overview of how a system operates.
(Hillebrand & Cardinale 2010)

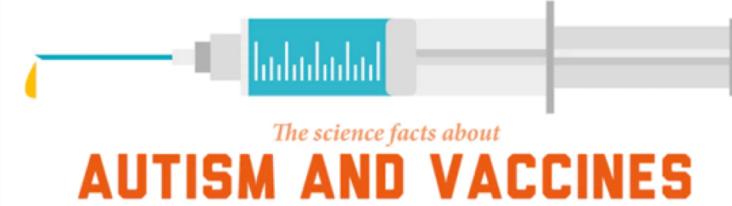
Focus...



Step back!



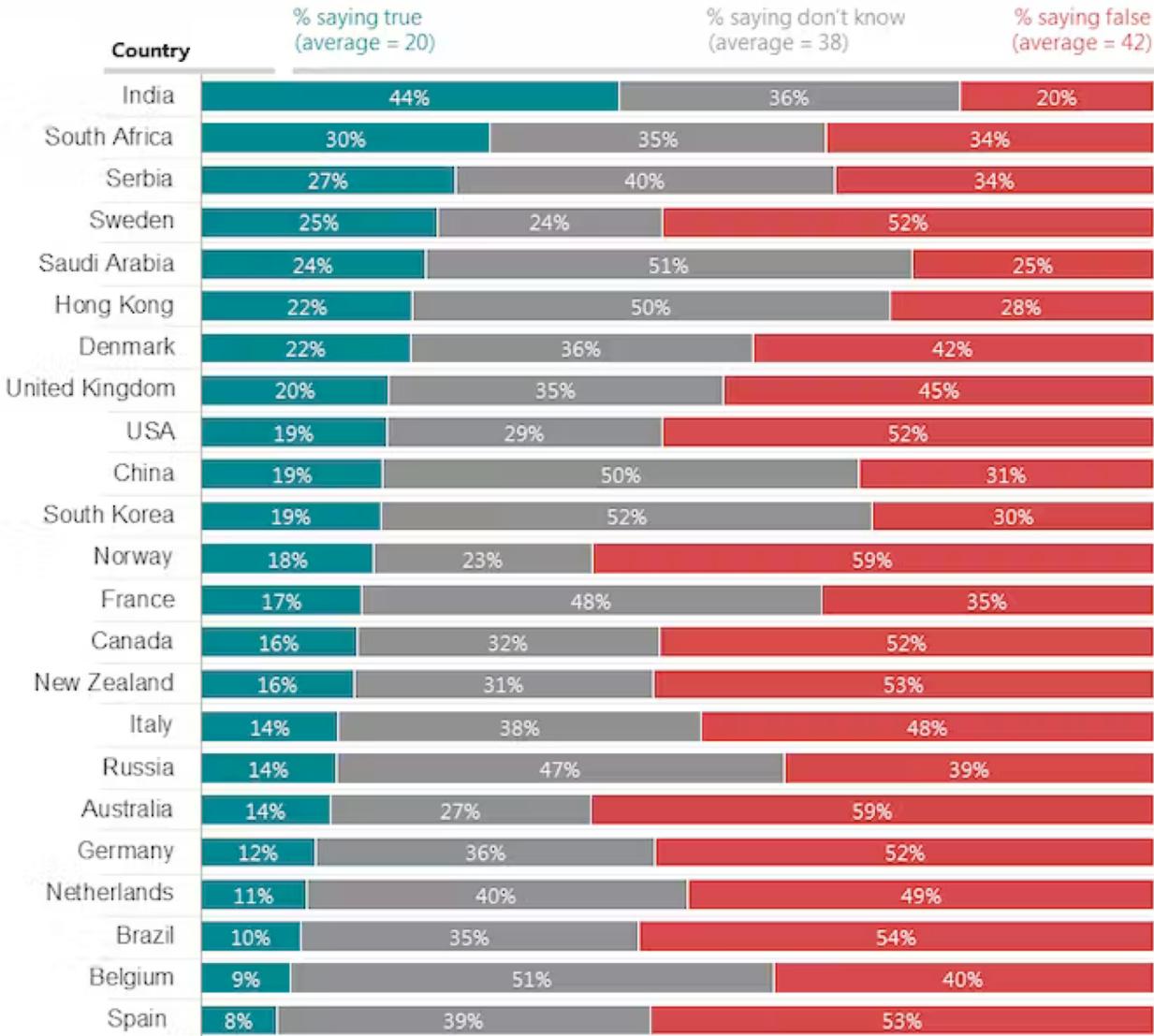
Depicts 106,000 aluminum cans, the number used in the US
every 30s



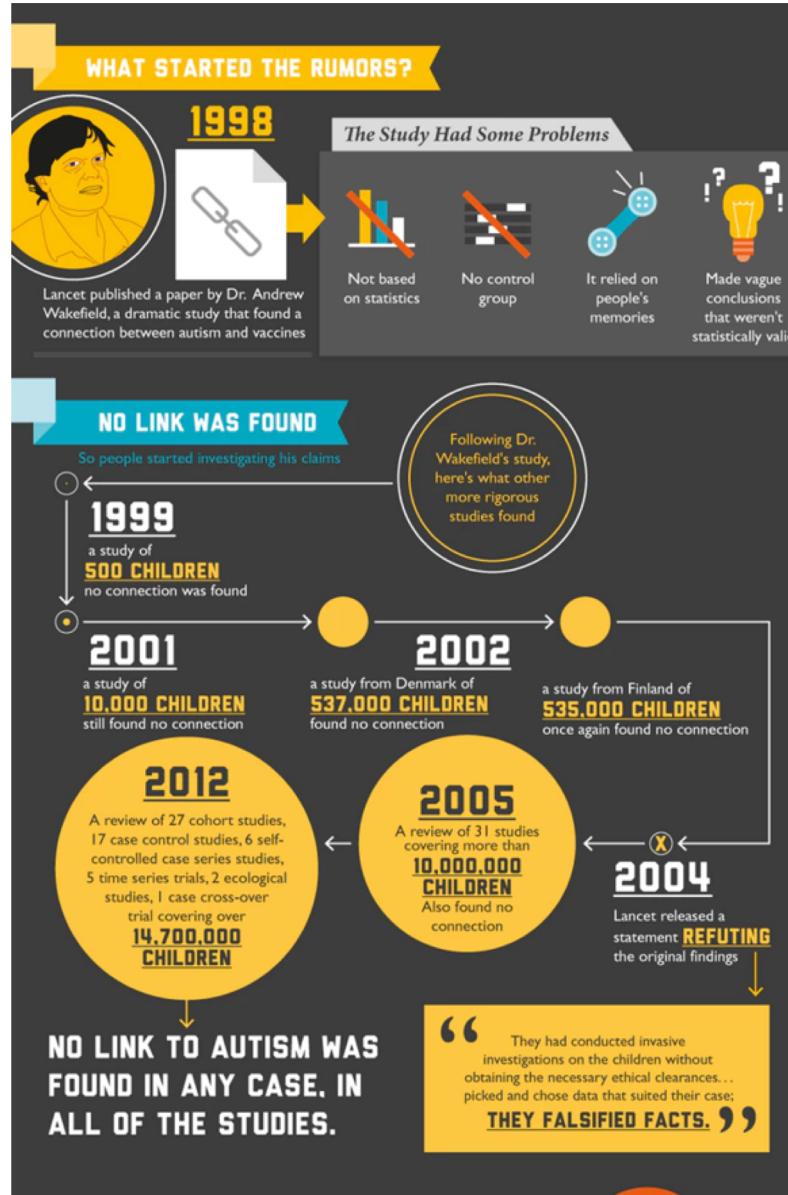
Do you think the following statement is true or false?

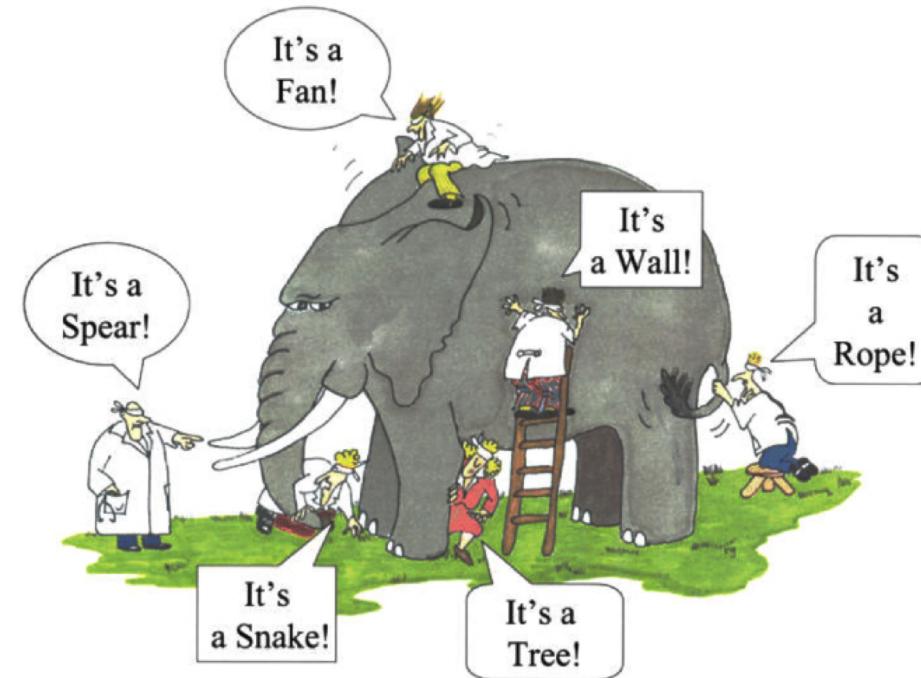
« Some vaccines cause autism in healthy children. »

Misinformation



Misinformation





Contradictory evidence

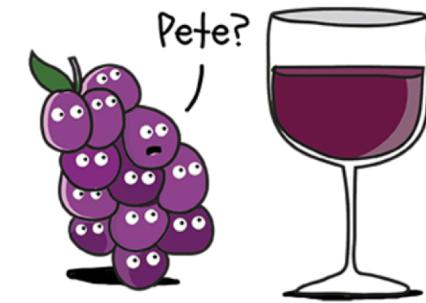
Consulter
le journal

ACTUALITÉS ▾ ÉCONOMIE ▾ VIDÉOS ▾ DÉBATS ▾ CULTURE ▾ M LE MAG ▾

DÉBATS

Deux verres de vin rouge n'augmentent pas les risques de cancer

Mieux vaut boire raisonnablement que s'abstenir en mangeant mal, estiment David Servan-Schreiber, Richard Bélineau et Michel de Lorgeril.



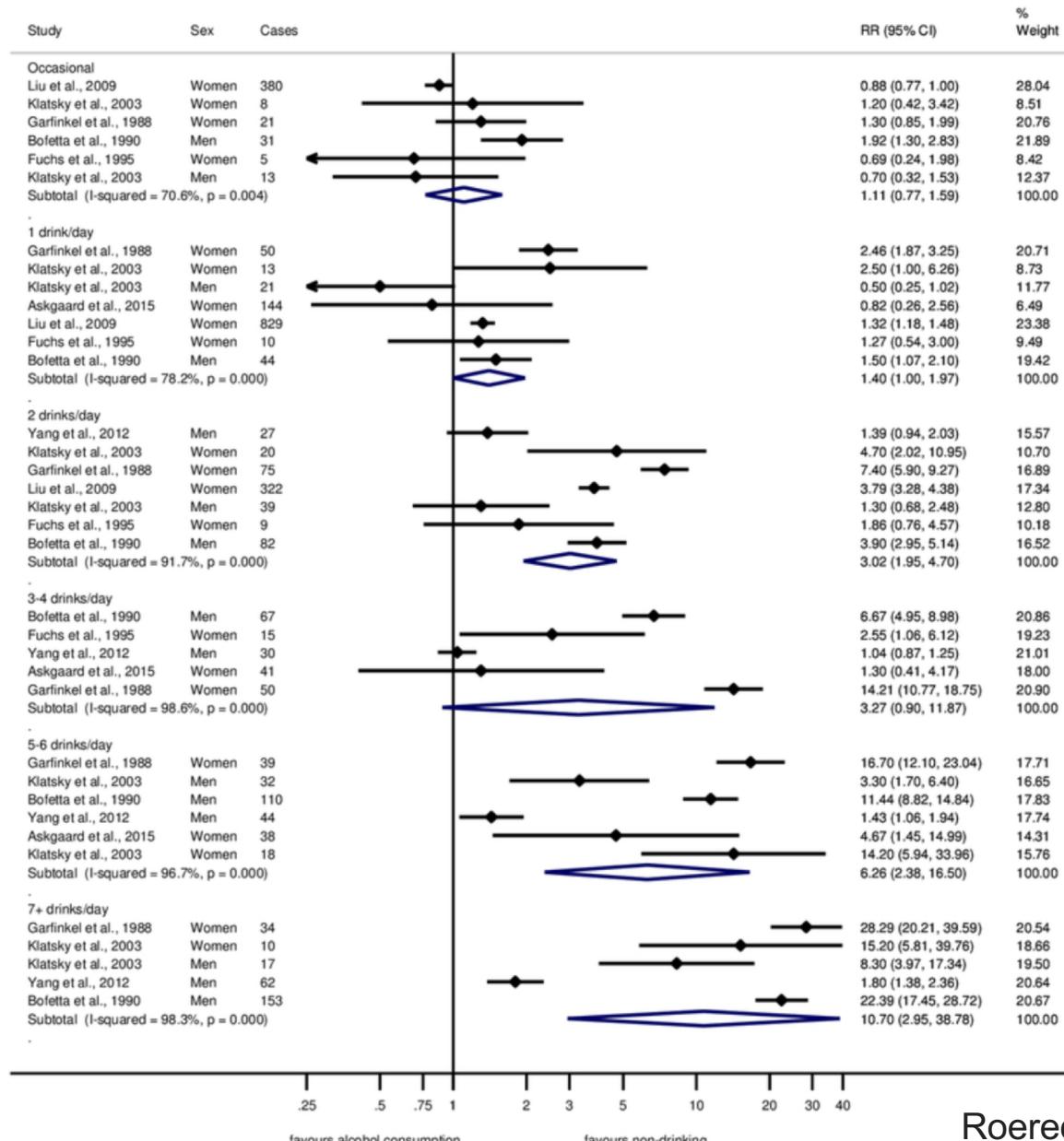
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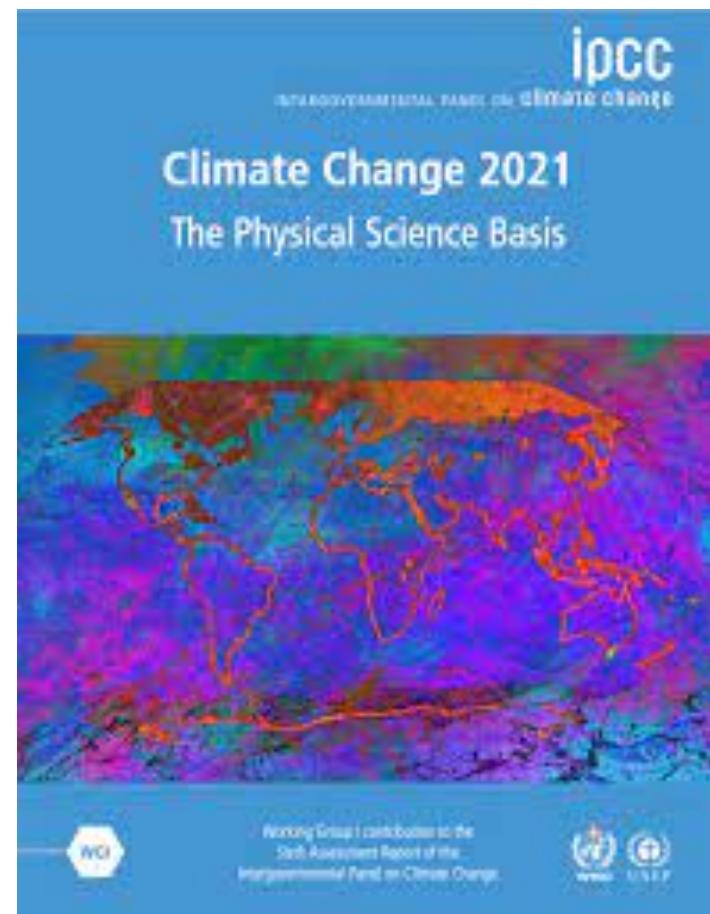
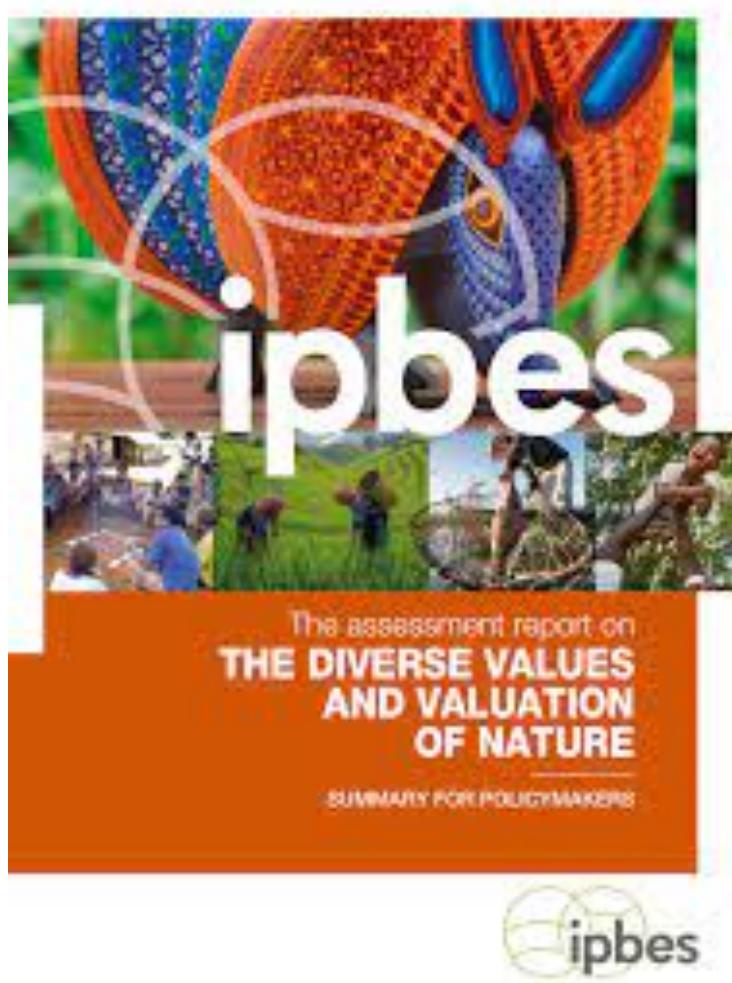
Médecine | Santé Publique | Bien-être | Famille | Sex

Actualités Santé > Santé publique

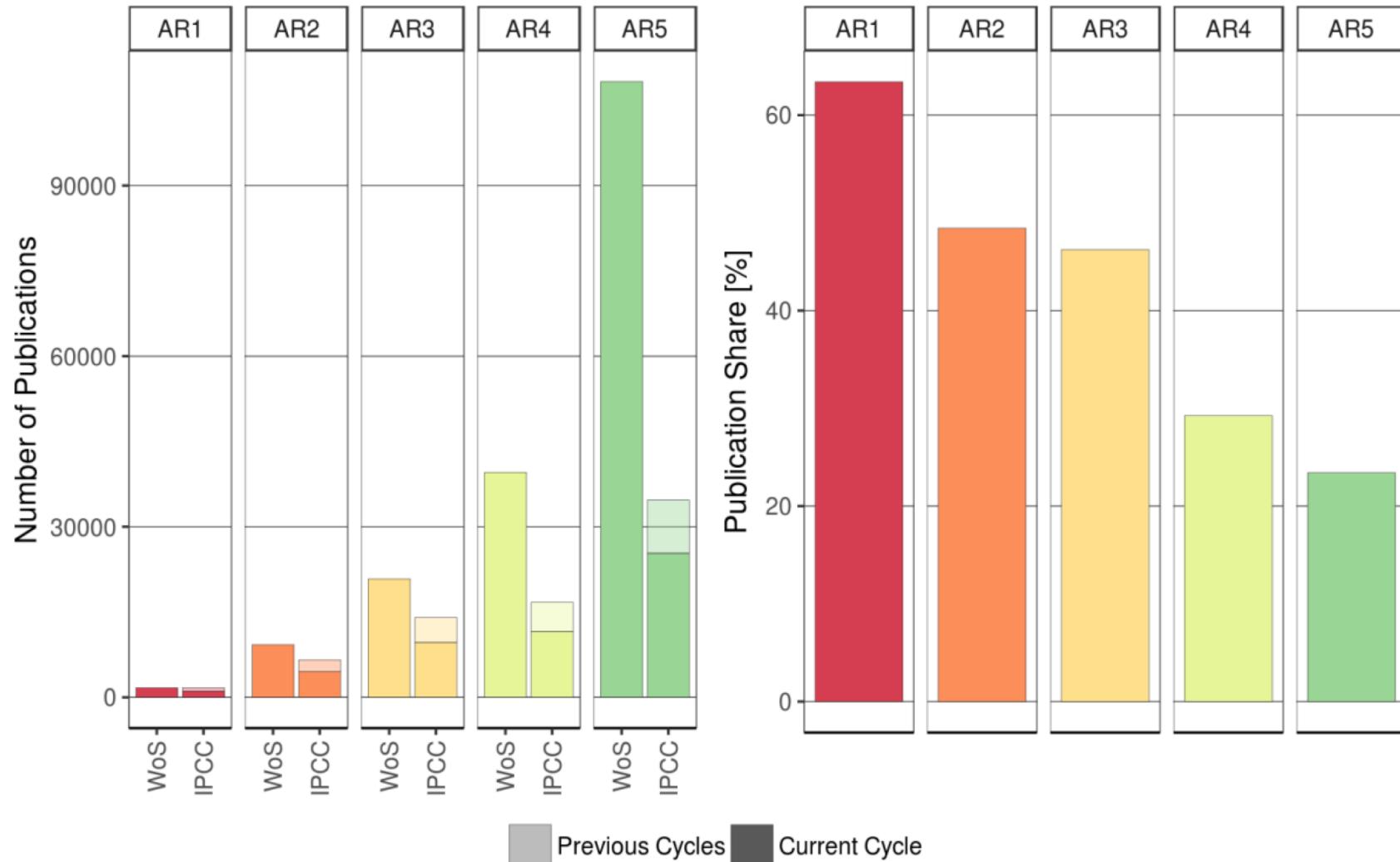
Un verre de vin quotidien suffit à augmenter le risque de certains cancers

Contradictory evidence





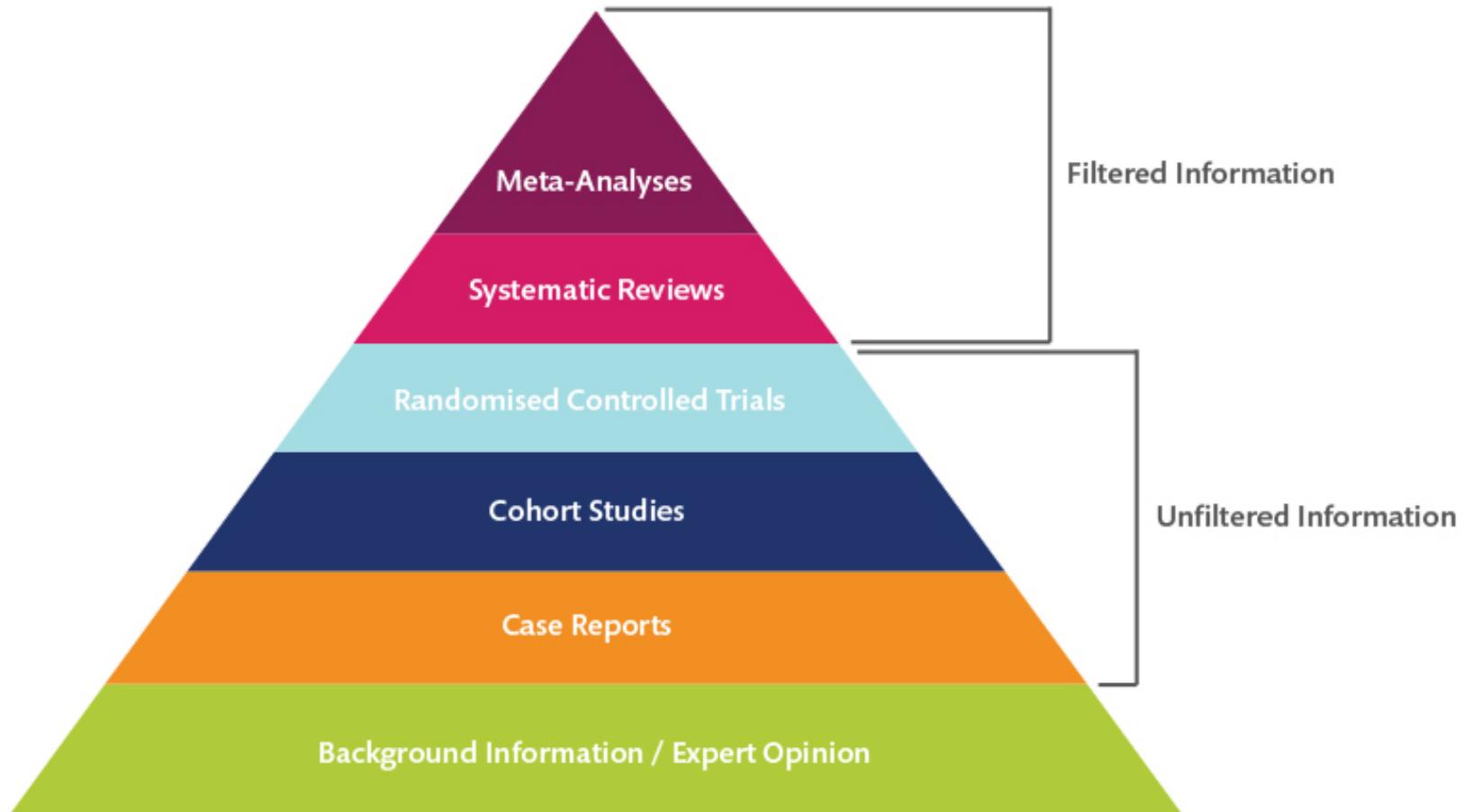
A plethora of scientific articles



A real need for reliable evidence

- Objectify knowledge
- Accurately estimate phenomena and their effects

Levels of evidence pyramid



Research synthesis are trendy...



Some labs specifically focus on synthesis



The PREDICTS project

PREDICTS - Projecting Responses of Ecological Diversity In Changing Terrestrial Systems - is a collaborative project aiming to use a meta-analytic approach to investigate how local biodiversity typically responds to human pressures such as land-use change, pollution, invasive species and infrastructure, and ultimately improve our ability to predict future biodiversity changes.

Human activities are causing major changes in biological communities worldwide, and these changes can harm biodiversity and ecosystem function. Ecosystem function is important in supporting plant and animal communities, as well as ensuring the long-term survival of human populations. Understanding how human pressures influence global biodiversity at a local scale can help us make predictions of future changes, and can inform conservation policy at national and global levels.

Read more about [conservation and global biodiversity declines](#).

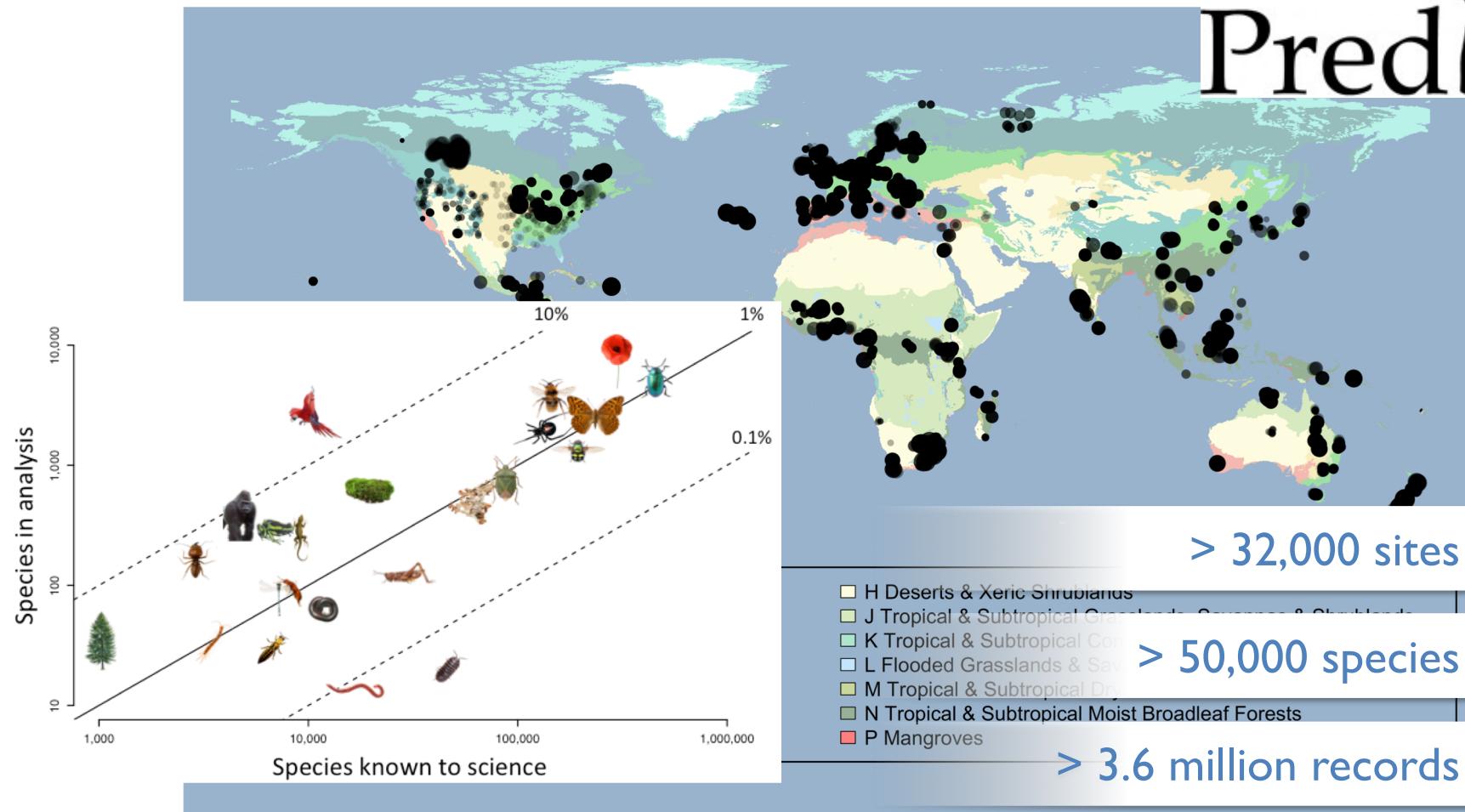


We need more data!

Predicts Database



Predicts



Hudson *et al.* (2014), *Ecology and Evolution*

Predicts Database

Has land use pushed terrestrial biodiversity beyond the planetary boundary? A global assessment

Tim Newbold,^{1,2*} Lawrence N. Hudson,³ Andrew P. Arnell,¹ Sara Contu,³ Adriana De Palma,^{3,4} Simon Ferrier,⁵ Samantha L. L. Hill,^{1,3} Andrew J. Hoskins,⁵ Igor Lysenko,⁴ Helen R. P. Phillips,^{3,4} Victoria J. Burton,³ Charlotte W. T. Chng,³ Susan Emerson,³ Di Gao,³ Gwilym Pask-Hale,³ Jon Hutton,^{1,6} Martin Jung,^{7,8} Katia Sanchez-Ortiz,³ Benno I. Simmons,^{3,4} Sarah Whitmee,² Hanbin Zhang,³ Jörn P. W. Scharlemann,^{1,8} Andy Purvis^{3,4}

Land use and related pressures have reduced local terrestrial biodiversity, but it is unclear how the magnitude of change relates to the recently proposed planetary boundary ("safe limit"). We estimate that land use and related pressures have already reduced local biodiversity intactness—the average proportion of natural biodiversity remaining in local ecosystems—beyond its recently proposed planetary boundary across 58.1% of the world's land surface, where 71.4% of the human population live. Biodiversity intactness within most biomes (especially grassland biomes), most biodiversity hotspots, and even some wilderness areas is inferred to be beyond the boundary. Such widespread transgression of safe limits suggests that biodiversity loss, if unchecked, will undermine efforts toward long-term sustainable development.

Land use and related pressures have been the main drivers of terrestrial biodiversity change (1) and are increasing (2). Biodiversity has already experienced widespread large net losses (3), potentially compromising its contribution to resilient provision of ecosystem functions and services, such as biomass production and pollination, that underpin human well-being (4–7). Species-

removal experiments suggest that loss of ecosystem function accelerates with ongoing species loss (5), implying that there may be thresholds beyond which human intervention is needed to ensure adequate local ecosystem function (8, 9). The loss of 20% of species—which affects ecosystem productivity as strongly as other direct drivers (5)—is one possible threshold, but it is unclear by which

ARTICLE

doi:10.1038/nature14324



Global effects of land use on local terrestrial biodiversity

Tim Newbold^{1,2*}, Lawrence N. Hudson^{3*}, Samantha L. L. Hill^{1,3}, Sara Contu³, Igor Lysenko⁴, Rebecca A. Senior^{1†}, Luca Börger⁵, Dominic J. Bennett^{4†}, Argyrios Choinas^{3,4}, Ben Collen⁶, Julie Day^{4†}, Adriana De Palma^{3,4}, Sandra Diaz⁷, Susy Echeverría-Londoño³, Melania J. Edgar³, Anat Feldman⁸, Morgan Garon⁴, Michelle L. K. Harrison⁴, Tamara Alhusseini⁴, Daniel J. Ingram^{4†}, Yuval Itescu⁸, Jens Kattge^{9,10}, Victoria Kemp⁴, Lucinda Kirkpatrick^{4†}, Michael Kleyer¹¹, David Laginha Pinto Correia³, Callum D. Martin⁴, Shai Meir⁸, Maria Novosolov⁸, Yuan Pan⁴, Helen R. P. Phillips^{3,4}, Drew W. Purves², Alexandra Robinson⁴, Jake Simpson⁴, Sean L. Tuck¹², Evan Weiher¹³, Hannah J. White^{4†}, Robert M. Ewers⁴, Georgina M. Mace⁶, Jörn P. W. Scharlemann^{1,14} & Andy Purvis^{3,4}

Human activities, especially conversion and degradation of habitats, are causing global biodiversity declines. How local ecological assemblages are responding is less clear—a concern given their importance for many ecosystem functions and services. We analysed a terrestrial assemblage database of unprecedented geographic and taxonomic coverage to quantify local biodiversity responses to land use and related changes. Here we show that in the worst-affected habitats, these pressures reduce within-sample species richness by an average of 76.5%, total abundance by 39.5% and rarefaction-based richness by 40.3%. We estimate that, globally, these pressures have already slightly reduced average within-sample richness (by 13.6%), total abundance (10.7%) and rarefaction-based richness (8.1%), with changes showing marked spatial variation. Rapid further losses are predicted under a business-as-usual land-use scenario; within-sample richness is projected to fall by a further 3.4% globally by 2100, with losses concentrated in biodiverse but economically poor countries. Strong mitigation can deliver much more positive biodiversity changes (up to a 1.9% average increase) that are less strongly related to countries' socioeconomic status.

Newbold *et al.* (2015), *Nature*



About iDiv

History

Structure

Governance

Consortium

Support for Scientists

Positions and Theses

Contact and Directions

Missions



German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig

Hotspot in Biodiversity Science

iDiv is a DFG research centre with more than 450 employees and members based primarily in Halle, Jena and Leipzig. Here, researchers from 40 nations establish the scientific basis for the sustainable management of our planet's biodiversity.

Biodiversity refers to the diversity of life – not only species diversity but also genetic diversity, diversity of functions, interactions and ecosystems. We know that our actions dramatically change this diversity: species become extinct, genetic information and entire ecosystems



But there is another one..

Le CESAB



News Events FR



ABOUT THE FOUNDATION

THE FRB IN ACTION

BIODIVERSITY CHALLENGES

PUBLICATIONS

CESAB

CESAB – Centre for the Synthesis and Analysis of Biodiversity – is a key program of the FRB (Foundation for Research on Biodiversity) and is an original, innovative and internationally recognized tool that offers researchers a place and time to synthesize and analyze already existing data and information in the field of biodiversity research.



With the major crisis facing biodiversity, the need to synthesize scientific data in ecology has never been greater. An unprecedented work has been initiated by international experts within [IPBES](#) to assess the current status of biodiversity and its contribution to human societies. These reports are based on studies already published in scientific journals and databases already compiled. When pooled, these existing data can be used to address new issues, significantly advance knowledge and provide recommendations for decision-makers.



CESAB
CENTRE FOR THE SYNTHESIS AND ANALYSIS
OF BIODIVERSITY

CONTACT

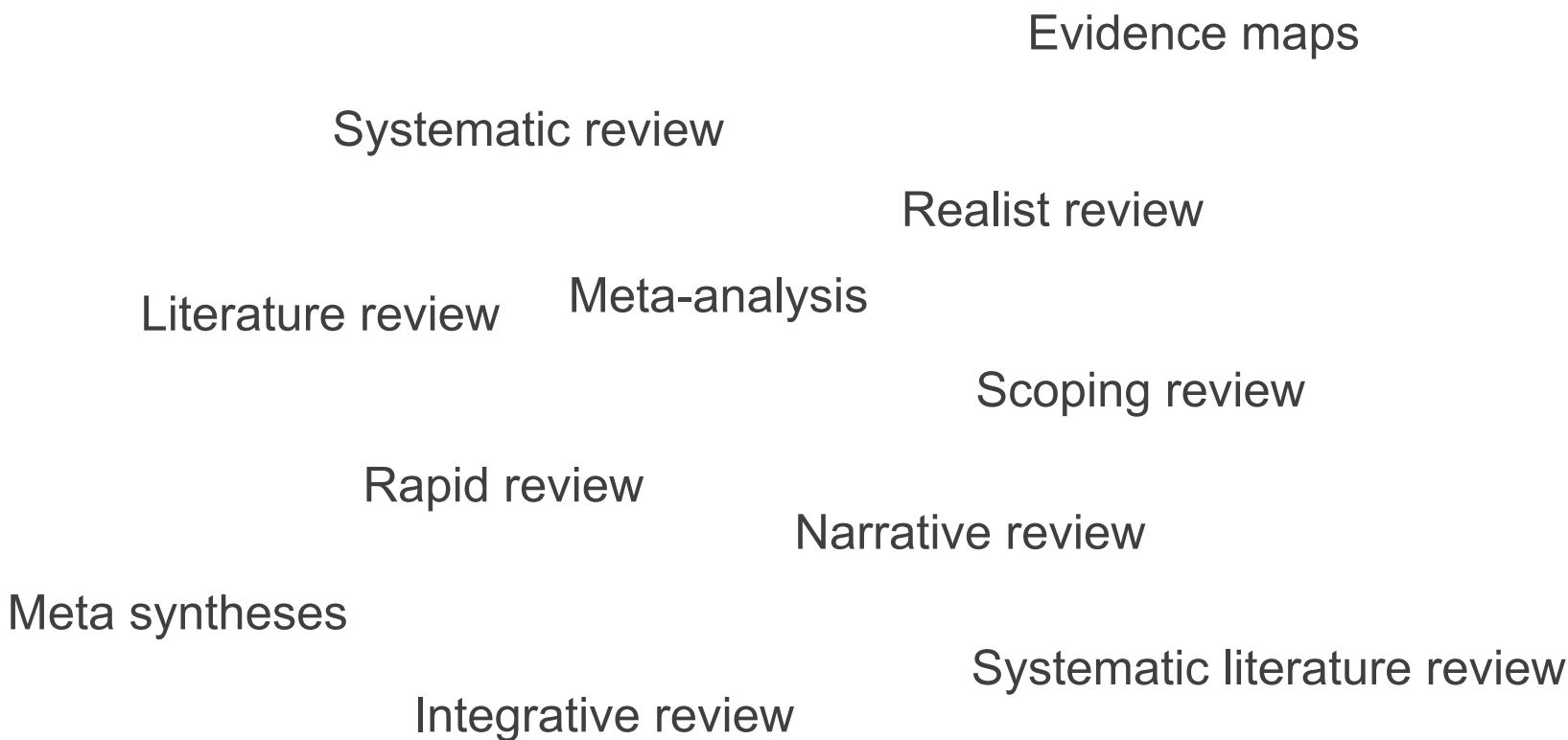
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Scientific director
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Maud CALMET
Administrative Manager
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A review is?

an overview or summary of existing research



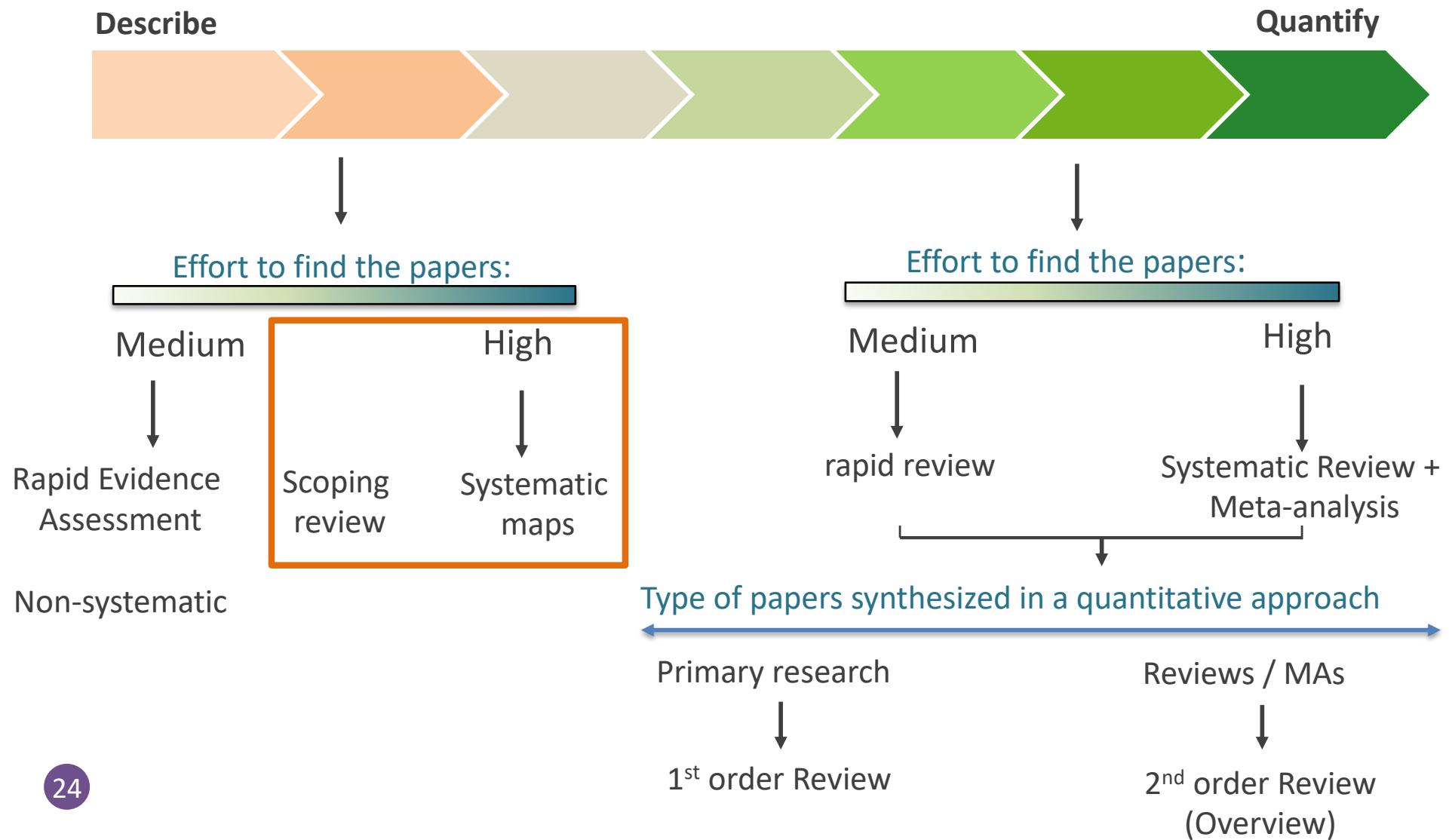
What types of reviews exist ?

- Rapid Evidence Assessment (REA)
- Scoping Review (SR)
- Non-systematic reviews (NSR)
- **Systematique Review (SR)**
- **Systematic maps (SM)**
- **Meta-analysis (MA)**



- Expert consultation (EC)
- Multiple Expert Consultation with Formal Methods (Delphi)
- Focus Groups (FG)
- Discourse Analysis (DA)

What types of reviews exist ?



Systematic (evidence) map

- **Purpose:** they provide an overview or “landscape of knowledge” on a given issue.
-> It does not evaluate/quantify the results of primary studies.
- **They aim to highlight:**
- Knowledge “gaps” = prioritization for research ?
- Knowledge “clusters”

Systematic (evidence) map

Geographical analysis

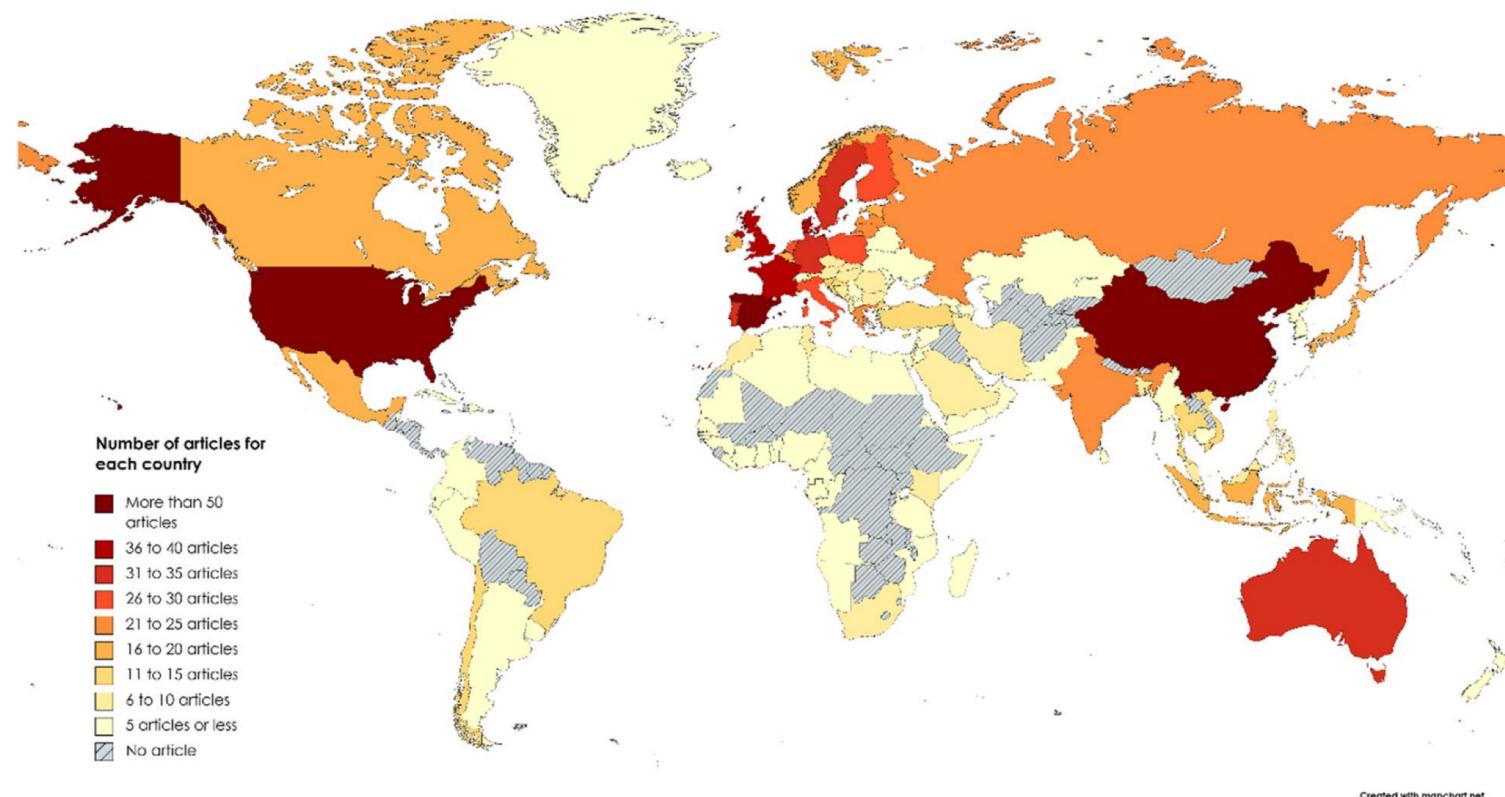


Fig. 3 Spatial distribution of the number of articles per country

Systematic (evidence) map

Contingency tables

Table 5 Distribution of the number of articles per ecosystem service values and components (cells are shaded according to the high (dark) and low (light) values for each column separately)

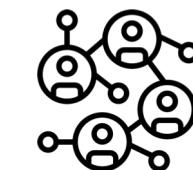
		Ecosystem service values and components																															
		Food provision		Raw materials		Genetic materials		Water provision		Air quality regulation		Coastal protection		Climate regulation		Weather regulation		Nutrients cycling		Habitat provision		Pest and disease control		Symbolic and aesthetic		Recreation		Tourism		Cognitive effects		Educational opportunities	
		Total		433	50	17	28	53	18	89	183	20	41	40	19	64	93	87	42	43													
Economic		196		139	36	12	16	31	13	46	51	12	17	19	11	37	53	52	26	28													
Socio-cultural values		22		17	5	4	4	5	1	6	2	2	1	3	5	9	12	12	7	6													
Biophysical		592		397	29	8	17	39	9	64	165	14	35	29	12	37	61	56	26	26													

Strengths of evidence maps

1. Visual representation of the knowledge accumulated/gaps
(i.e. no need to read hundreds of primary studies!)



2. Typology/categorization of the research
(often term and definition varies a lot to represent a same phenomena/practice)



3. Offer a foundation for further, more focused research synthesis
(a first step for a new meta-analysis)



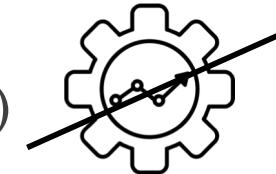
4. Political/scientific agenda for future research



Weakness of evidence maps

1. Only descriptive – no analyses

(i.e. do not inform on the effectiveness of the tested interventions)

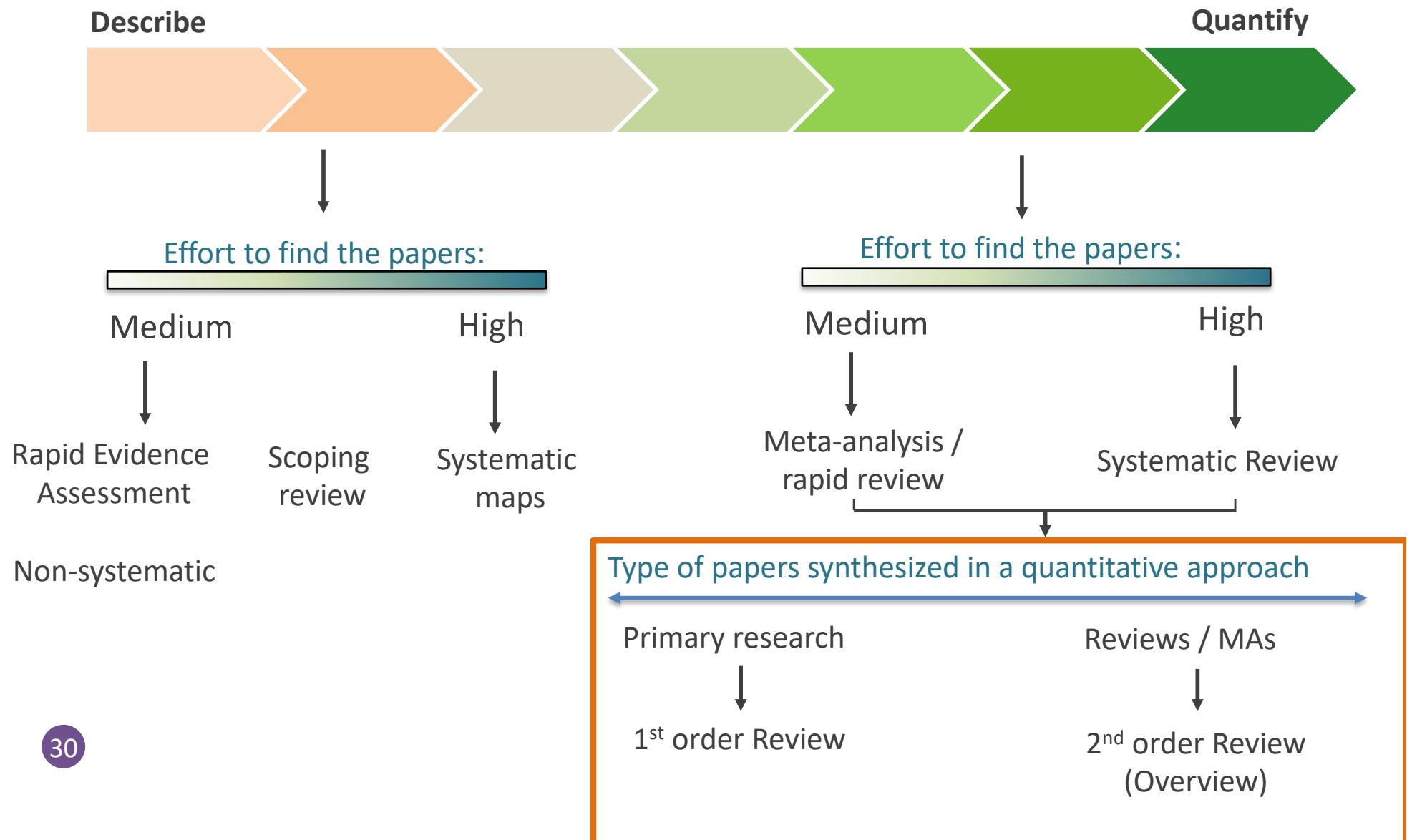


2. The results could also be presented in meta-analyses

(beware of redundancies!)



What are the differences ?



Meta-analysis

- **Purpose:** they provide an quantification on an effect, identify source of heterogeneity, identify the effect of moderators.
 - > It integrates “all” primary publication on a subject, and weight their evidence by their precision.

Meta-analysis

7608

Experiments



138

Effect_sizes

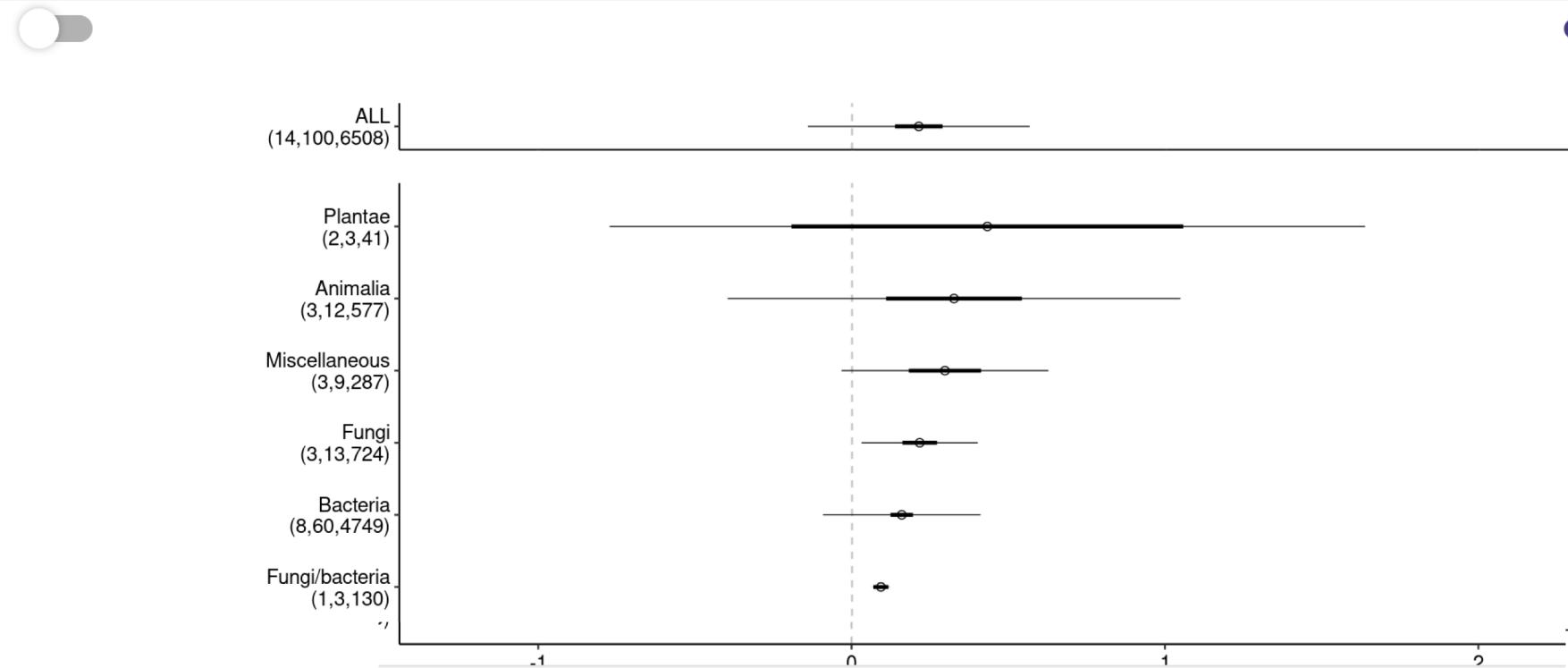


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Meta-analyses



Effect sizes for **ALL** diversification strategies



Strengths of meta-analyses

1. See the forest for the trees

(i.e. see effects and relationships that might not be visible in individual studies)



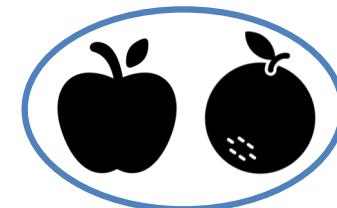
2. Synthesize knowledge on controversial issues

(find average effect while trying to minimize bias)



3. Can compare apples and oranges (to some degree)

(meta-analysis is specifically designed to deal with heterogeneity)



4. Examine reasons for variation (to some degree)



Weakness of meta-analyses

1. See the tree for the forest

(i.e. apply results to individuals)



2. Cannot overcome bias

(e.g. partial synthesis, publication bias, subjective methods choices)



3. Comparing apples and oranges

(combining things that should not be combined)



4. Not representative

(Study population = scientific studies, **≠ population of interest**)



5. Not able to examine causality



La revue systématique : 4 collaborations internationales

- Method originating in the medical field (Cochrane) intended to objectify decision-making (medical treatments).
- Now the approach is fully developed in the field of ecology (Collaboration for Environmental Evidence) and in the social sciences (Campbell collaboration).



The Cochrane Collaboration
Working together to provide the best evidence for health care

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Latest: Madrid Colloquium: Registration is now open!

evidence aid

Resources for Japanese earthquake and tsunami
Collections of resources for flooding- and earthquake-related injuries

JOHNS HOPKINS BLOOMBERG SCHOOL of PUBLIC HEALTH

Johns Hopkins Bloomberg School of Public Health

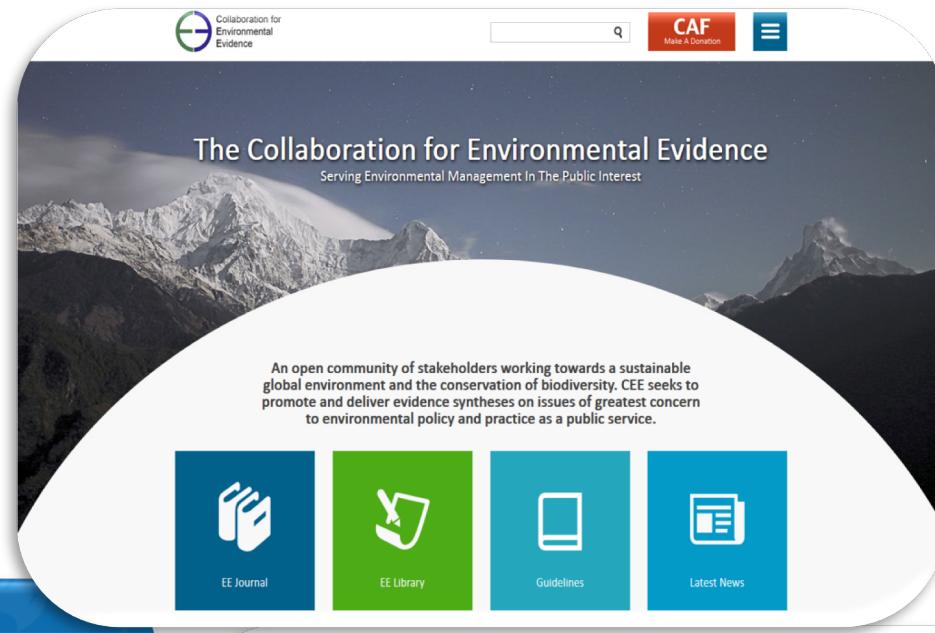
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ebtc
Evidence-based Toxicology Collaboration

OUR PEOPLE

EBTC was founded in 2011 at Johns Hopkins Bloomberg School of Public Health with the vision to make evidence-based methodologies the standard that is used to ensure public health, a healthy environment and a sustainable future.



Collaboration for Environmental Evidence

CAF Make A Donation

The Collaboration for Environmental Evidence
Serving Environmental Management In The Public Interest

An open community of stakeholders working towards a sustainable global environment and the conservation of biodiversity. CEE seeks to promote and deliver evidence syntheses on issues of greatest concern to environmental policy and practice as a public service.

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Cochrane Handbook for Systematic Reviews of Interventions

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Español 简体中文

June 2017: Handbook Editors' Update

The Handbook editorial team is currently updating Handbook versions 5.0, 5.1 and 5.2 for a planned release of Version 6 in 2018. This is a major update. Senior Scientific Editors Julian Higgins and James Thomas have reorganized some material to include recent developments. There are also several new chapters including writing a protocol, equity and specific populations, complex interventions, network meta-analysis, and synthesizing findings using non-statistical methods. Please note following the introduction of the Methodological Expectations for Cochrane Intervention Review (MECIR) standards, we set out to produce a minor Handbook update, version 5.2 to include these standards. Due to limited editorial capacity, we only produced a limited number of chapters. These chapters are 1, 8, 9, 10, 11, 12, and 21 and are available as pdf versions for Cochrane members. These chapters only include minor edits to improve clarity, some limited new material and updating. There are currently no substantive changes to methods in these chapters, we expect to include these in Version 6. For more details see the What's new? page.

[Click here to browse Handbook version 5.1 online](#)

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So you want to write a Campbell systematic review?

We welcome proposals for new reviews to be registered with the Campbell Collaboration and, subsequently, published in the Campbell Library.

There are three stages in the production of a Campbell review: (1) title registration, (2) protocol, and (3) review. You will find a Word template for each of these three stages, with a 'Campbell template instructions' document in our online library.

1. Title registration

The first step is to complete the title registration form (TRF). Please read the document 'Campbell template instructions' before filling in the form.

The proposed title for your systematic review should clearly state the scope of the review. This scope should be determined in consultation with key stakeholders including intended end users. Guidance on formulating the review title may be found in the [Cochrane Handbook](#), which is the basis for the suggested title format you will find in the TRF template.

An additional resource to assist at the title stage is [The Equity Checklist](#).

The completed TRF should be sent directly to the Managing Editor of the Coordinating Group with which the review

Guidelines and standards: a need for **rigour, objectivity and transparency**

Collaboration for Environmental Evidence CAF Make A Donation

How We Work Guidelines for Authors

Guidelines and Standards for Evidence Synthesis in Environmental Management
VERSION 5.0
2018

Please note that these guidelines will be periodically updated and each update recorded (see [Updates and Corrections](#)). Major updates will be announced through social media.

[Read the guidelines online here](#)

Please cite as:
Collaboration for Environmental Evidence. 2018. *Guidelines and Standards for Evidence synthesis in Environmental Management*. Version 5.0. www.environmentalevidence.org/information-for-authors [date of access].

Acknowledgements:
Thanks to the editorial team for this version of the CEE Guidelines and Standards (in alphabetical order): Geoff Frampton, Barbara Livoreil, Gillian Petrokofsky and Andrew Pullin

We thank all authors contributing to this version of the CEE Guidelines and Standards and the papers on which some sections were based (in alphabetical order): Helen Bayliss, Alison Bethel,

Find Out More

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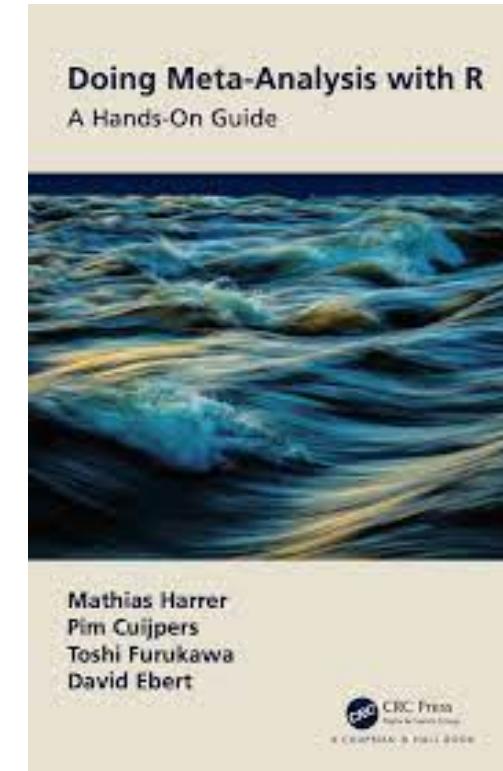
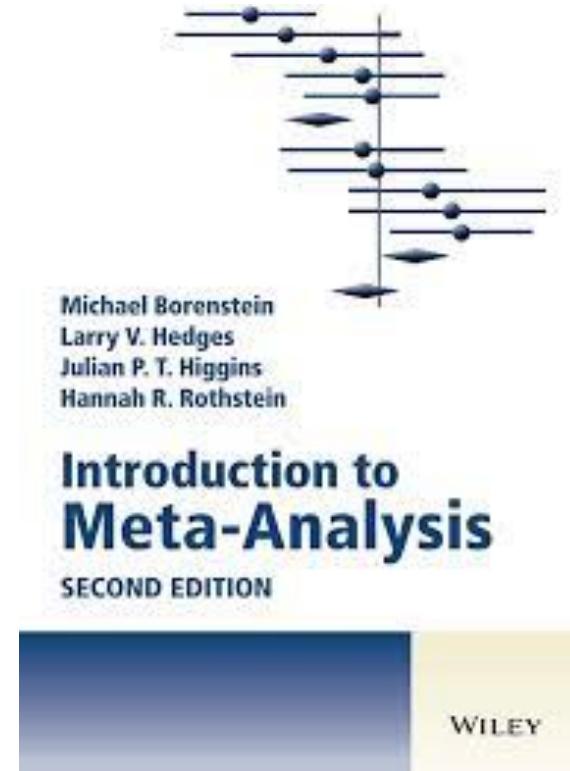
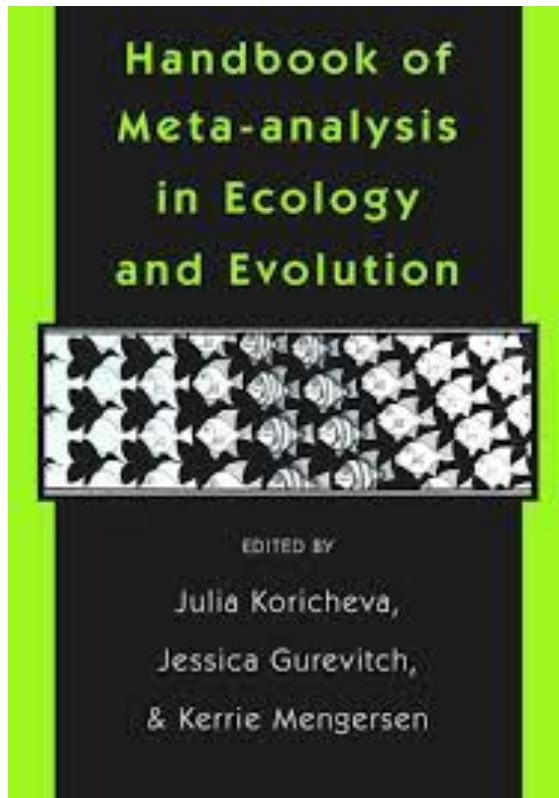


In France, The FRB is the representing scientific structure for the CEE network.

The different steps to perform a systematic review



Recommended literature



+ All pots/stackoverflow of Viechtbauer W.