@LynnDicks
Lynn.Dicks@zoo.cam.ac.uk
Lynn.Dicks@uea.ac.uk

ReNature

Promoting research excellence in nature-based solutions for innovation, sustainable economic growth and human well-being in Malta.

Using evidence in decision-making

Dr Lynn Dicks, University of East Anglia

This project receives funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 809988.

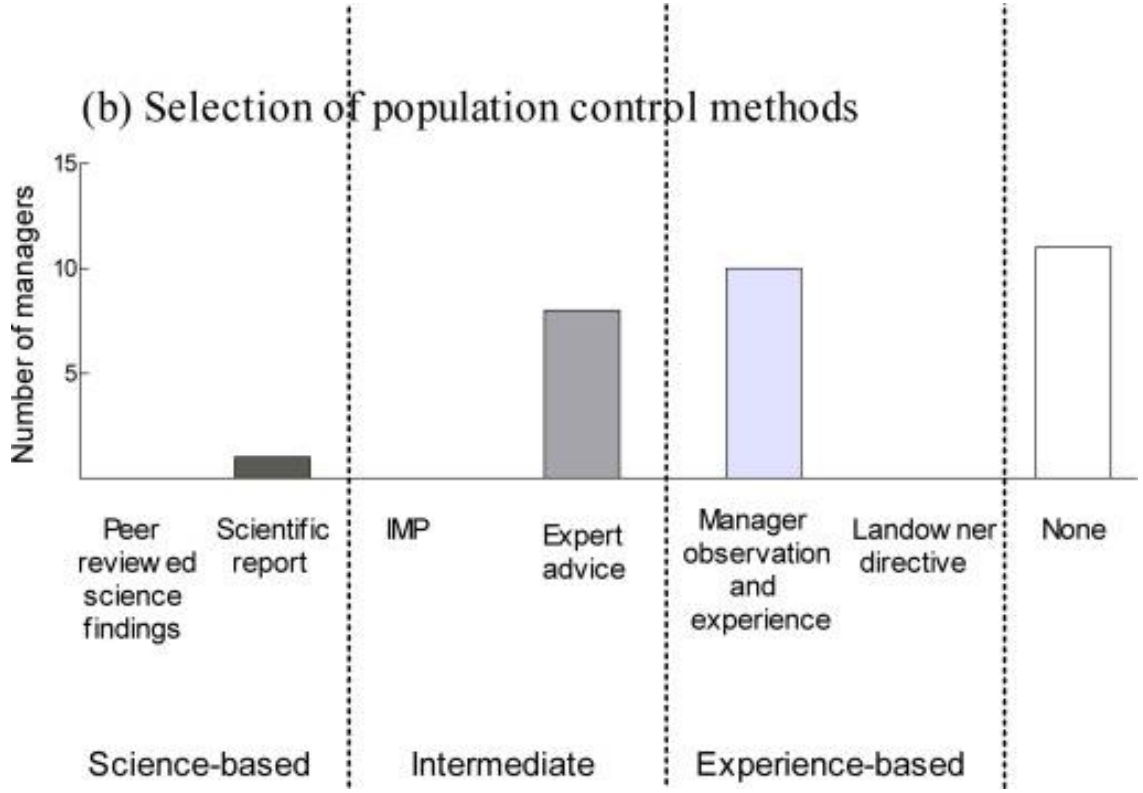
Outline

- What is ‘evidence-based conservation’?
- The importance of good quality evidence synthesis
- Approaches to evidence synthesis
- Asking a good question – PICO approach
- Reliable sources of scientific evidence
- How to design and scope a search protocol
- How to communicate results

What is ‘evidence-based conservation’?

‘Evidence-based conservation’ is the **integration** of **best available** scientific information with experience-based information, **applied in context**, to conserve the natural environment.

The need for evidence-based conservation



- Conservationists often rely on experience and advice
- This can lead to bad decisions and wasted money

ReNature

*Source: Young and Van Aarde (2010) Biological Conservation **144**, 876-885*

An example of bad decisions

- Bat gantries cost around £350,000 to install
- Evidence clearly shows bats hardly use them (eg Berthinussen & Altringham 2012)

Source: Berthinussen A, Altringham J (2012) Do Bat Gantries and Underpasses Help Bats Cross Roads Safely?. PLOS ONE 7(6): e38775. https://doi.org/10.1371/journal.pone.0038775

This doesn't mean all decisions are bad

Conservationists must incorporate the unique and complex features of a site that are not fully known:

- history
- current status
- response to new interventions

Image source: Lota Melamari

ReNature

Calls for evidence-based conservation

Opinion TRENDS in Ecology and Evolution Vol.19 No.6 June 2004

The need for evidence-based conservation

William J. Sutherland[1], Andrew S. Pullin[2], Paul M. Dolman[3] and Teri M. Knight[4]

[1]Centre for Ecology, Evolution and Conservation, School of Biological Sciences, University of East Anglia, Norwich, UK. NR4 7TJ
[2]Centre for Evidence-Based Conservation, School of Biosciences, The University of Birmingham, Edgbaston, Birmingham, UK B15 2TT
[3]Centre for Ecology, Evolution and Conservation, School of Environmental Sciences, University of East Anglia, Norwich, UK, NR4 7TJ
[4]Solihull Primary Care Trust, Solihull, West Midlands, UK. B91 3BU

Much of current conservation practice is based upon anecdote and myth rather than upon the systematic appraisal of the evidence, including experience of others who have tackled the same problem. We suggest that this is a major problem for conservationists and requires a rethinking of the manner in which conservation operates. There is an urgent need for mechanisms that review available information and make recommendations to practitioners. We suggest a format for web-based databases that could provide the required information in accessible form.

The past few decades have seen a revolution in medical practice. Thirty years ago, Archie Cochrane [1] concluded that 'commonly used procedures and therapies were not always the most efficacious' and that 'a not insubstantial amount of practice had not been well evaluated'. Others have pointed out that the introduction of new medical technologies has been influenced more by professional, commercial and public pressures than by a coherent policy

Is there a problem?

Current conservation practice faces the same problems as did old-fashioned medical practice. For example, most decisions are not based upon evidence, but upon anecdotal sources (Box 1). Furthermore, very little evidence is collected on the consequences of current practice so that future decisions cannot be based upon the experience of what does or does not work. Much accumulated experience is solely in the memory of individual practitioners, and the collection of information in a form that could be used by others is very limited.

A problem with using the advice of others or secondary sources is that it is difficult to find the source of the information. It is difficult to tell whether widespread beliefs are based upon the summation of a range of studies, from a well-designed experiment, from experience in one site, or simply from someone using their best guess as to the best approach. It is our experience that it is

Box 1. What information do conservation practitioners

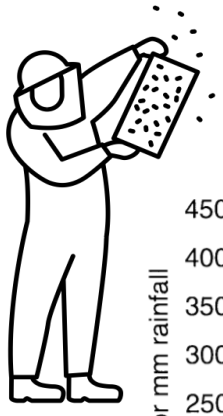
ReNature

Good quality evidence synthesis

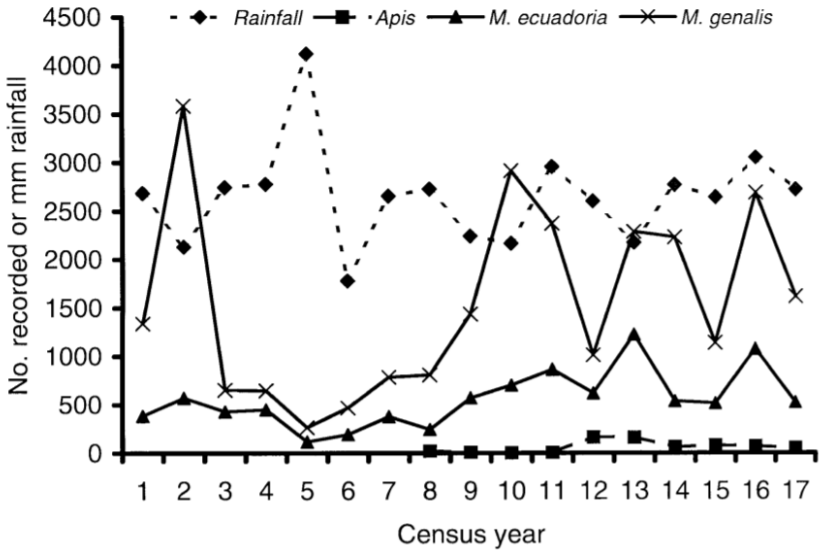
- Evidence synthesis is central to evidence-based conservation
- It is a **series of methods** to collate and evaluate a body of scientific evidence
- Good quality evidence synthesis **avoids bias** and removes the problem of seeing only part of the picture

For example……

Do managed honey bees *Apis mellifera* have negative impacts on wild bees?

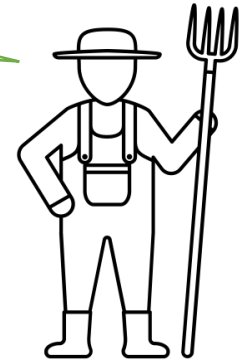


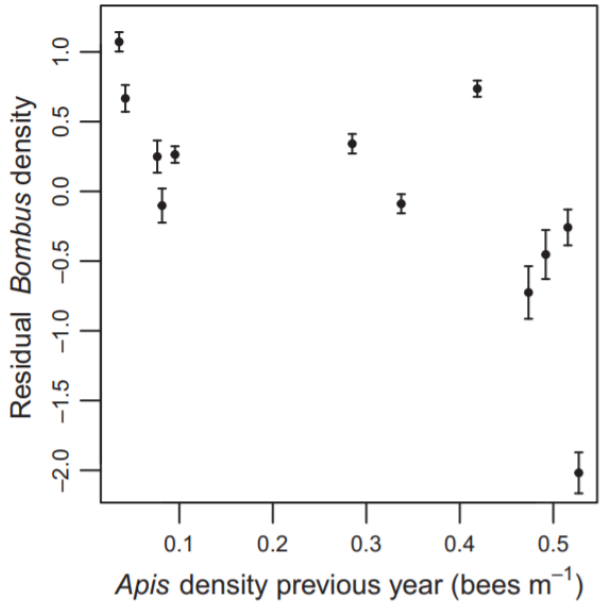
No



Roubik, D. W. and Wolda, H. (2001), Do competing honey bees matter? Dynamics and abundance of native bees before and after honey bee invasion. *Popul Ecol*, 43: 53-62.

Yes





Thomson, D. (2016), Local bumble bee decline linked to recovery of honey bees, drought effects on floral resources. *Ecology Letters*, 19: 1247-1255.

ReNature

Mallinger et al. 2017. 'Do managed bees have negative effects on wild bees?: A systematic review of the literature', PLoS ONE, 12: e0189268

Another example

- **Bioenergy** is fuel or energy derived from biological feedstocks
- Using bioenergy to replace fossil fuel is **promoted in policy** as a climate change mitigation measure
- This has been controversial because bioenergy pathways can create *more* emissions than fossil fuel, if they lead to loss of primary forest.

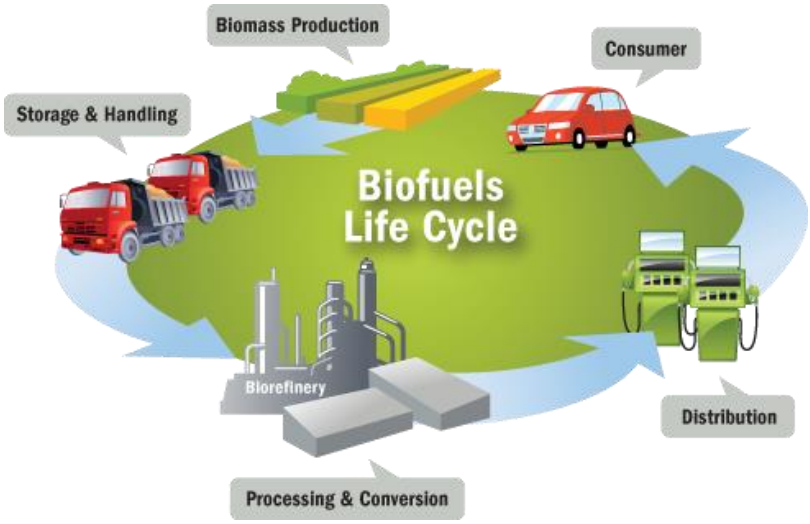
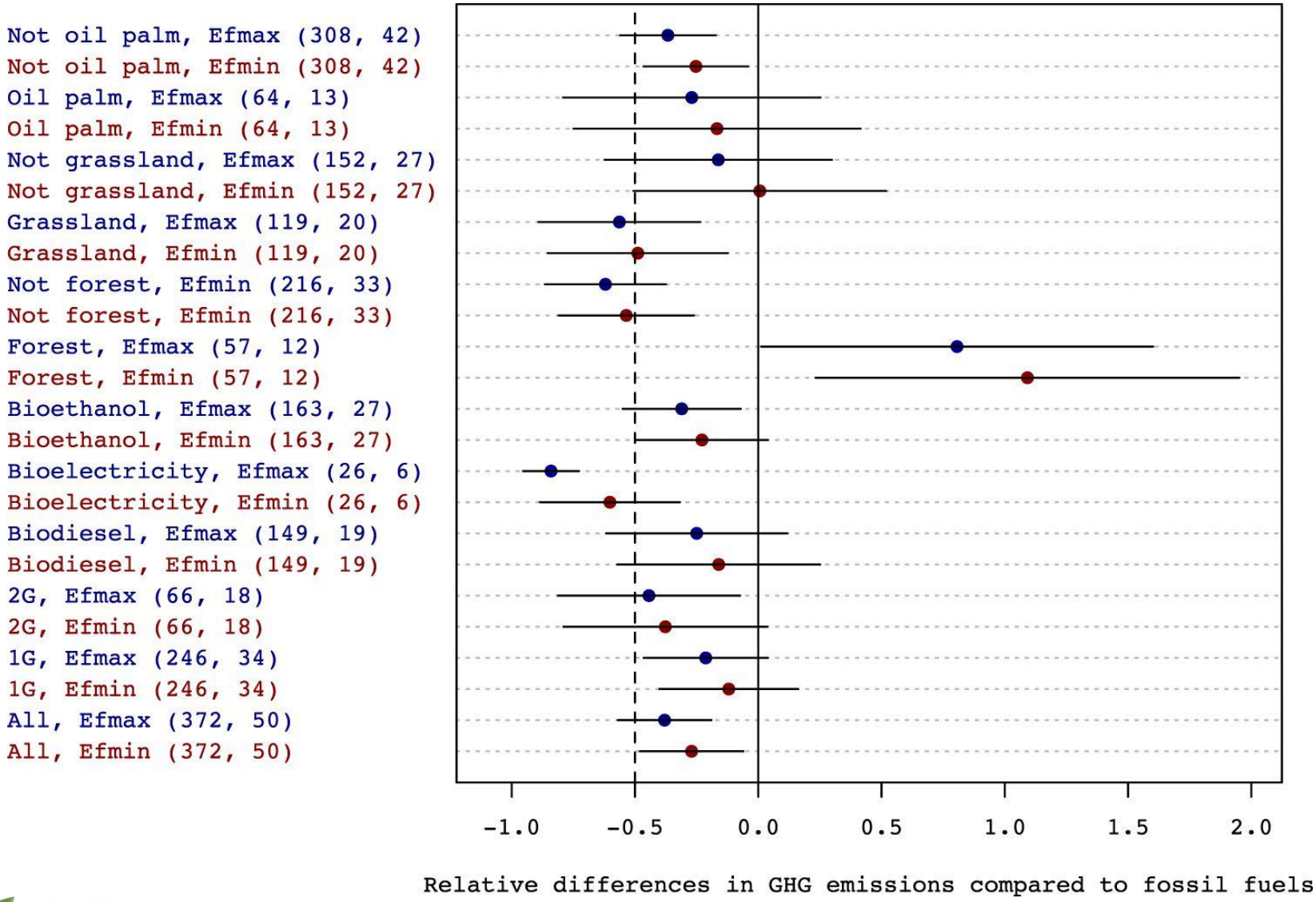


Image: http://www.performanceplants.com

Evidence synthesis can reveal clear underlying patterns



ReNature

Source: El Akkari et al (2018). 'A meta-analysis of the greenhouse gas abatement of bioenergy factoring in land use changes', Scientific Reports, 8: 8563

Approaches to evidence synthesis

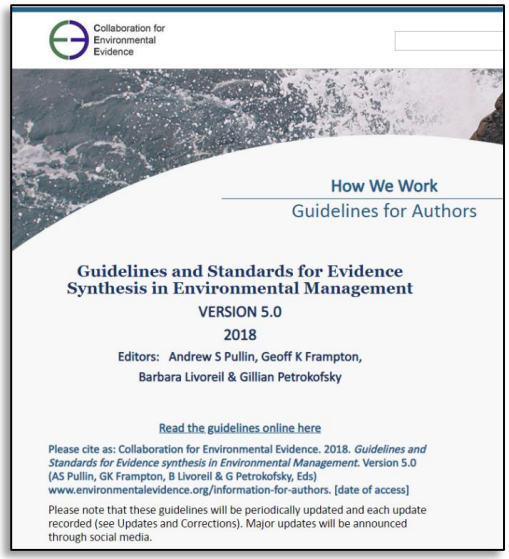
Systematic review

www.cochrane.org
www.environmentalevidence.org
www.campbellcollaboration.org

A structured, step-wise methodology following an ***a priori*** protocol to comprehensively collate, critically appraise and synthesise existing research evidence (academic and grey literature).

Systematic reviews should follow rigorous standards demanded by review coordinating bodies such as the **Cochrane Collaboration**, the **Collaboration for Environmental Evidence** and the **Campbell Collaboration** (see links below).

Reporting requirements include: protocol of methods, fates of all articles screened at full text, transparent documenting of all methods used.

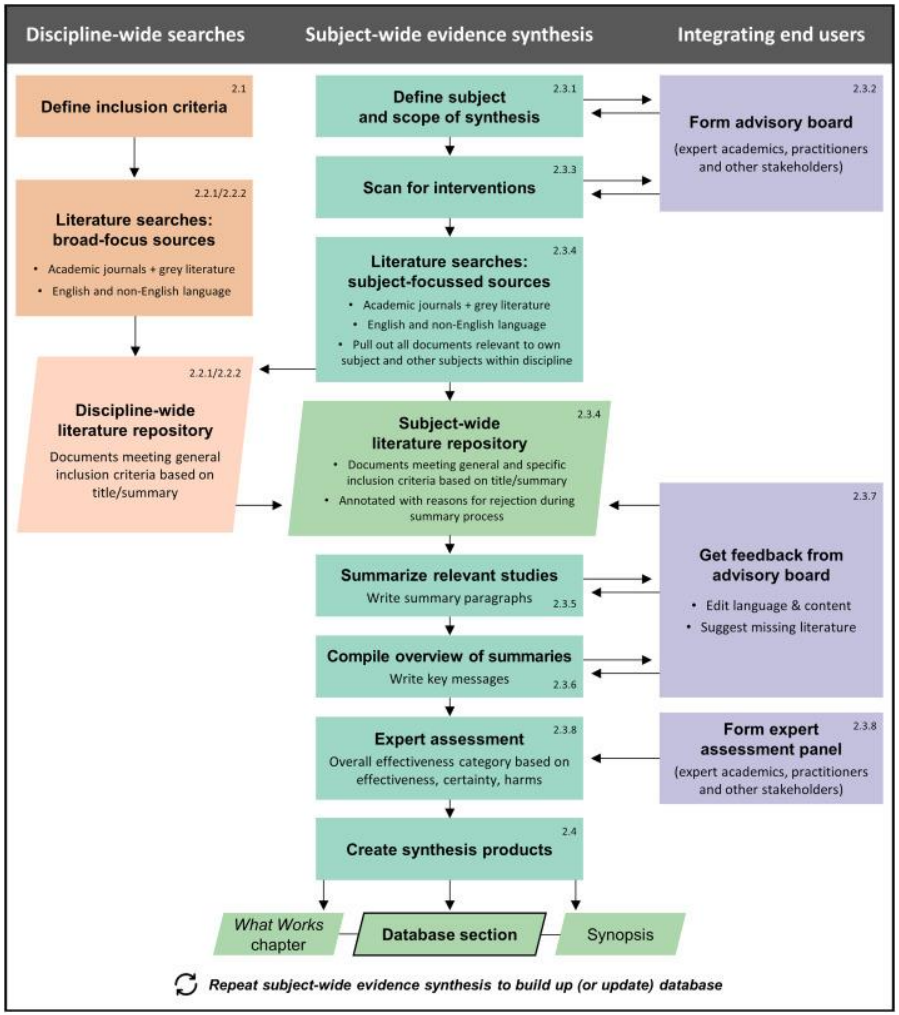


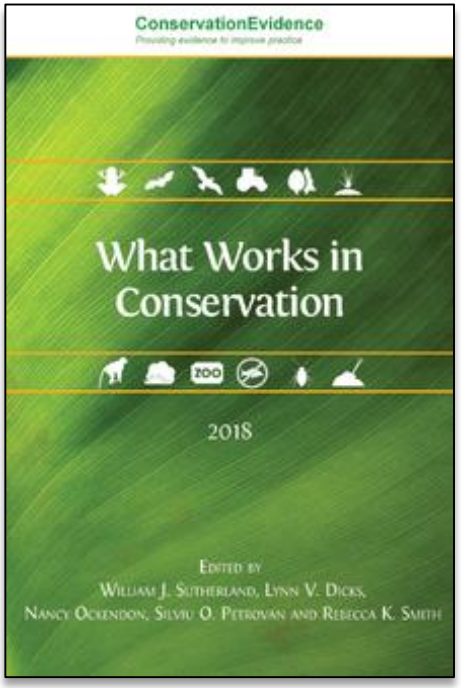
Collaboration for Environmental Evidence. 2018. *Guidelines and Standards for Evidence synthesis in Environmental Management*. Version 5.0 (AS Pullin, GK Frampton, B Livoreil & G Petrokofsky, Eds) www.environmentalevidence.org/information-for-authors.

Approaches to evidence synthesis

Subject-wide evidence synthesis

www.conservationevidence.com

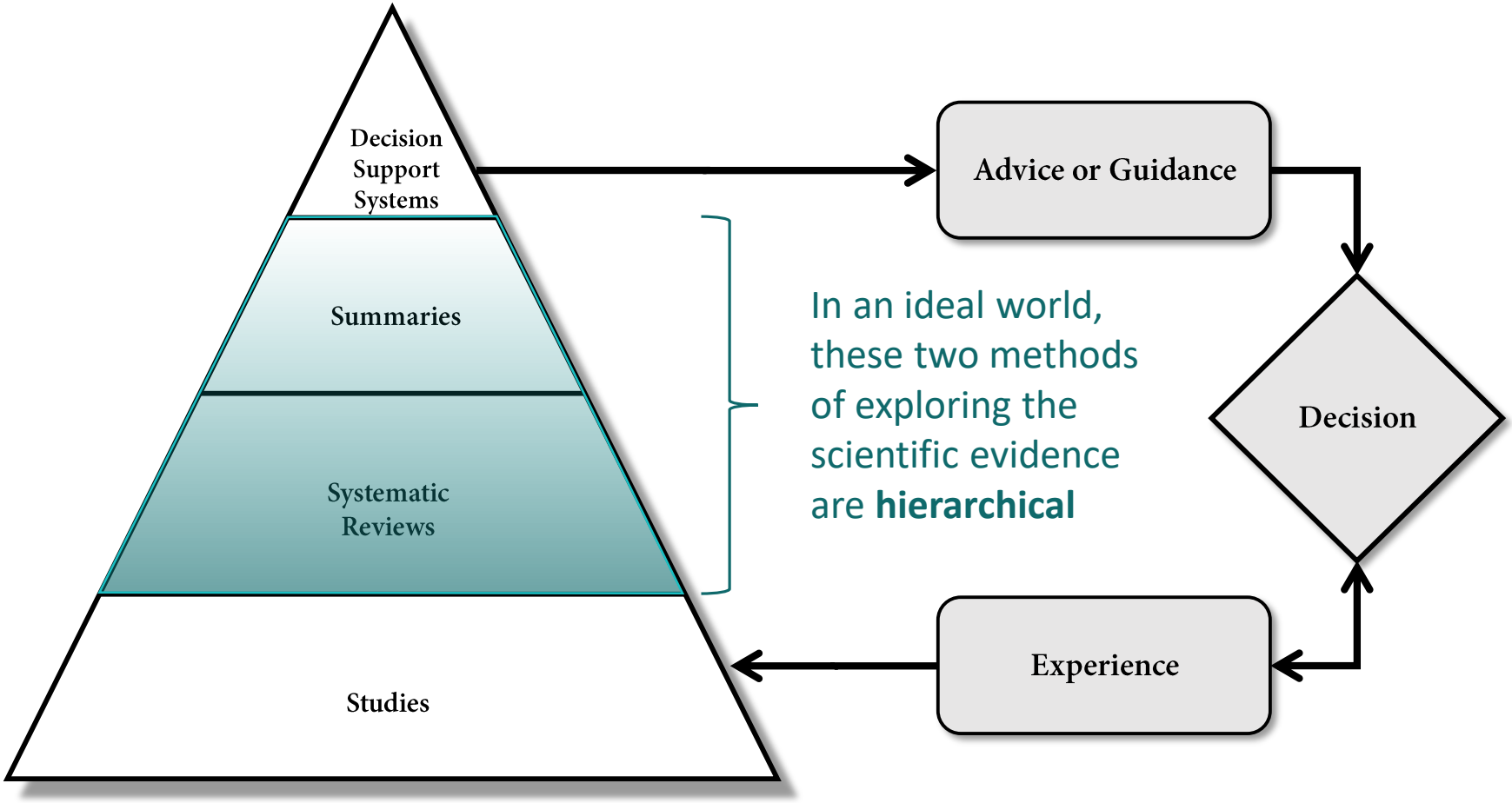




ReNature

Source: Sutherland et al. (2019) Biological Conservation, 238, 108199. https://doi.org/10.1016/j.biocon.2019.108199

The ‘4S’ model evidence-based decision making

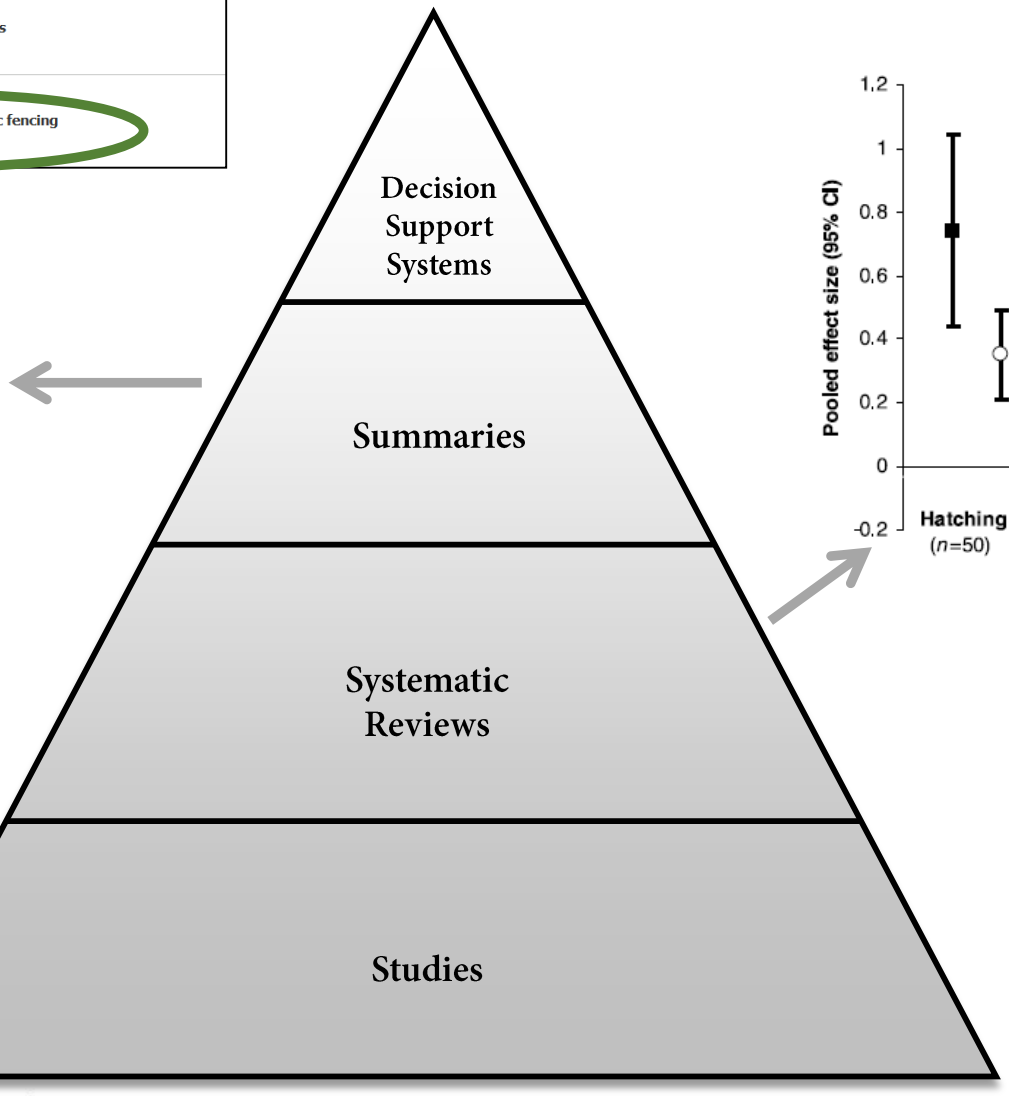


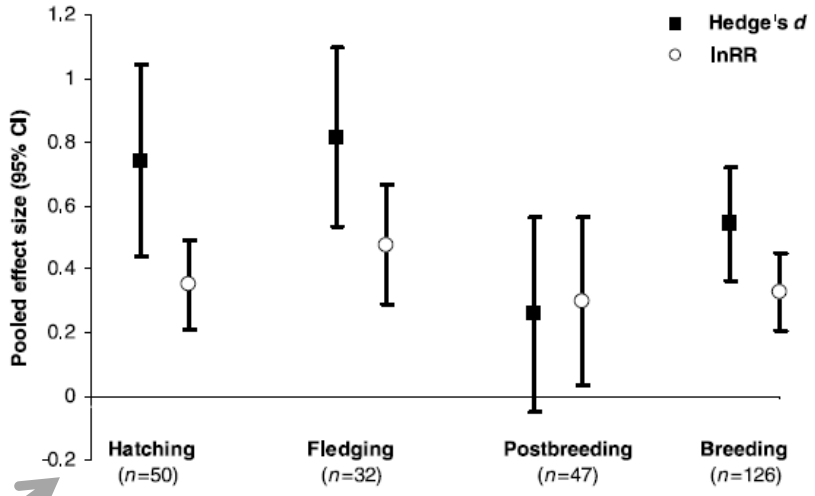
*Source: Dicks et al. (2014) Trends in Ecology and Evolution **29**, 607-613*
Borrowed from: Haynes (2001) Evid. Based Med., 6, 36–38

ReNature

Collected evidence (122) | Individual studies (708)

- Control predators not on islands for wildfowl
  Based on: 8 studies
- Control predators not on islands for cranes
  Based on: 1 study
- Control predators not on islands
  Based on: 1 study
- Protect bird nests using electric fencing
  Based on: 6 studies

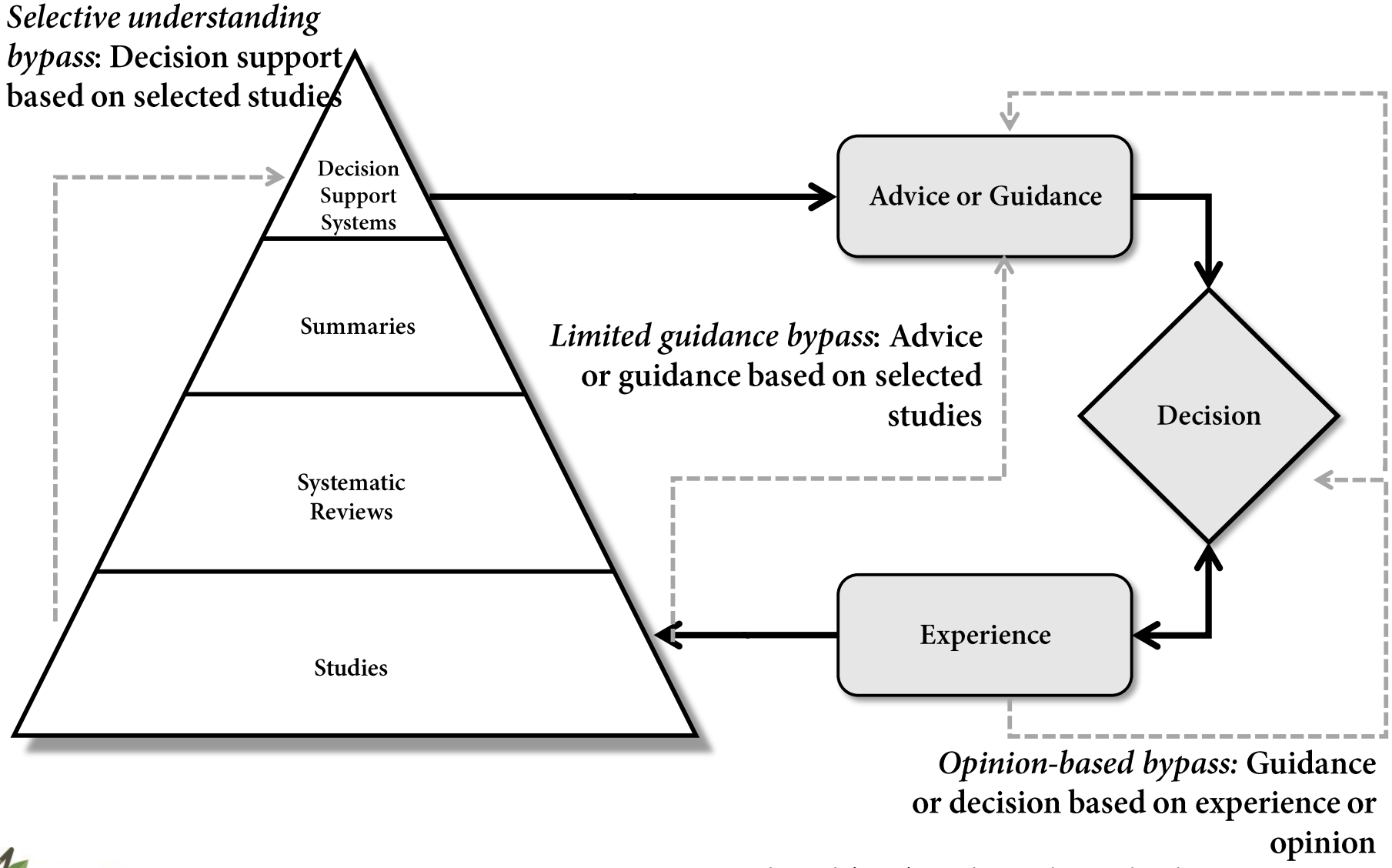




Smith *et al.* (2010) *Cons Biol* **24**, 820-829
Meta-analysis of 83 studies, 128 bird species

ReNature

Synthesized evidence should inform decisions



*Source: Dicks et al. (2014) Trends in Ecology and Evolution **29**, 607-613*

ReNature

Approaches to evidence synthesis

Systematic map

Structured, step-wise methodology following an **a priori** protocol to comprehensively *collate* and *describe* existing research evidence (academic and grey literature).

- Does not usually critically appraise or synthesize results
- Can address much broader questions
- Often the first step of an **evidence synthesis pathway**

HUMAN WELL-BEING	Area Protection	Land/Water Management	Resource management	Species management	Education & awareness	Law & Policy	Livelihood incentives	Ext. Capacity Building	Sustainable Use	Other
	CONSERVATION INTERVENTION									
Economic living standards	247	213	278	91	34	149	248	80	22	9
Material living standards	158	151	185	52	20	99	119	28	16	5
Health	22	16	24	6	6	12	17	4	0	3
Education	49	43	68	23	41	30	56	17	5	5
Social relations	102	105	140	45	18	75	89	47	13	2
Security & safety	45	29	33	21	5	19	16	13	3	1
Governance & empowerment	133	162	202	58	31	134	109	54	16	6
Subjective well-being	36	37	23	19	15	24	47	25	10	3
Culture/Spirituality	21	17	10	11	5	6	21	8	2	3
Freedom of choice/action	1	3	3	1	1	2	2	1	0	0
Other	0	0	4	2	0	2	3	0	1	0

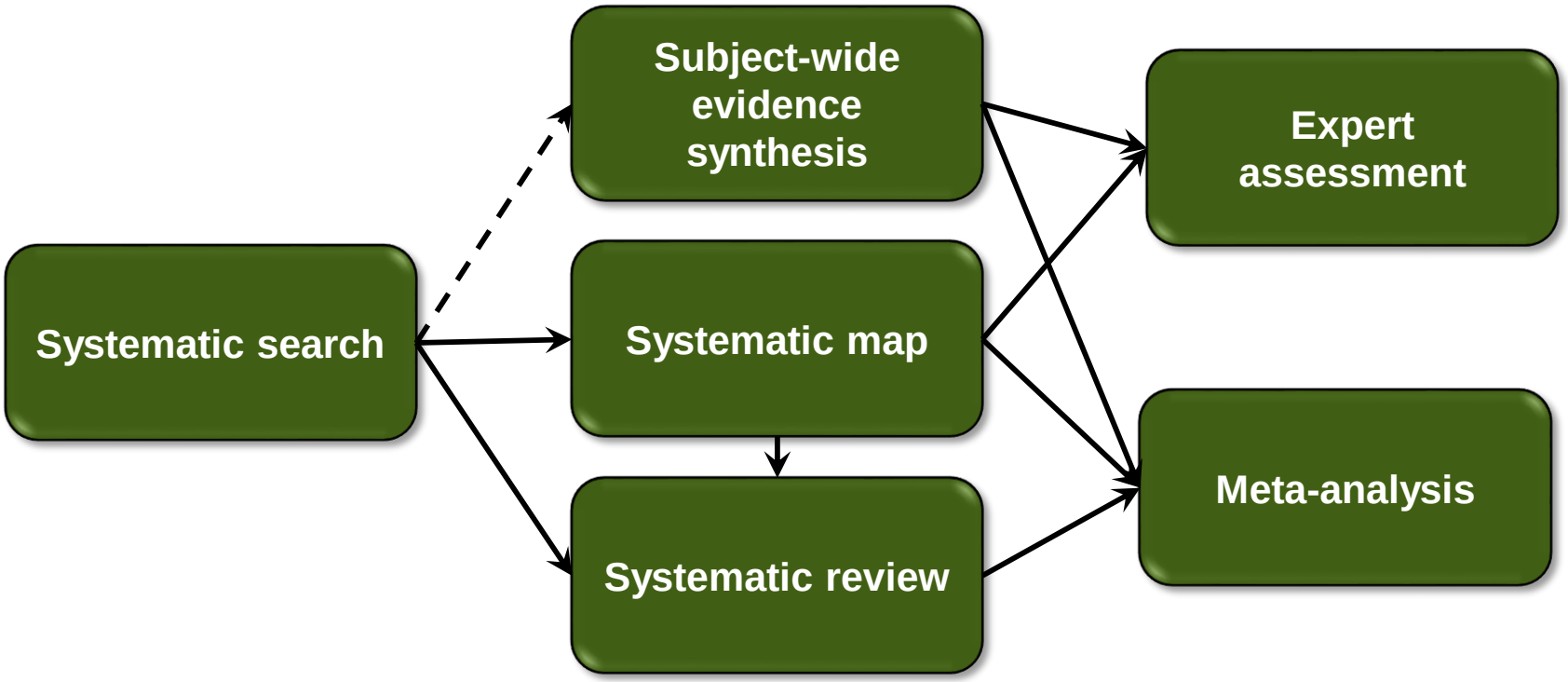
NO. OF STUDIES

0 50 100 150 200 250

Source: McKinnon et al (2016) *Environmental Evidence* 5,1

ReNature

Evidence synthesis pathways



Examples of evidence pathways beginning with a systematic search

- Dicks et al (2016) What works in conservation? … *Biodiversity and Conservation 25*, 1383-1399.
- Jakobsson et al (2018) How does roadside vegetation management affect the diversity of vascular plants and invertebrates? A systematic review. *Environmental Evidence* 8, 17.

Method	Time and resource requirement	Risk of bias
Systematic Review	High	Low
Solutions Scanning	Low	Medium
Summaries and Synopses	High	Low
Meta-Analysis$^{\phi}$	Low	Low
Rapid Evidence Assessment	Medium	Medium
Scoping Review	Medium	Medium
Systematic Map	High	Low
Vote-Counting	Low	High
Non-Systematic Literature Review	Medium	High
Expert Consultation	Low	High
Multiple Expert Consultation with Formal Consensus Method such as Delphi	Low	Medium
Causal Criteria Analysis*	Low	Medium
Bayesian Belief Networks*	Medium	Medium
Focus Groups	Low	High
Discourse Analysis	Medium	Medium
Joint Fact Finding (JFF)	Medium	High
Scenario Analysis	Low	Medium
Structured Decision Making	Medium	Medium
Collaborative Adaptive Management*	High	Low
Participatory Mapping	Medium	Medium
Multi Criteria Decision Analysis	Medium	Medium

ϕ Meta-analysis is not a standalone method, but relies on a pre-existing review, with its accompanying costs and risk of bias.

* These three methods usually employ other KSMs, such as forms of review and expert consultation, as integral to the process.

A dialogue for selecting among methods

Questions that **constrain** the available methods: What is possible?

- What **type of question** is it?
- How much **time** and **money** are available?
- How **narrow/broad** is the knowledge need?

Questions that **inform**: Which methods are most likely to be useful?

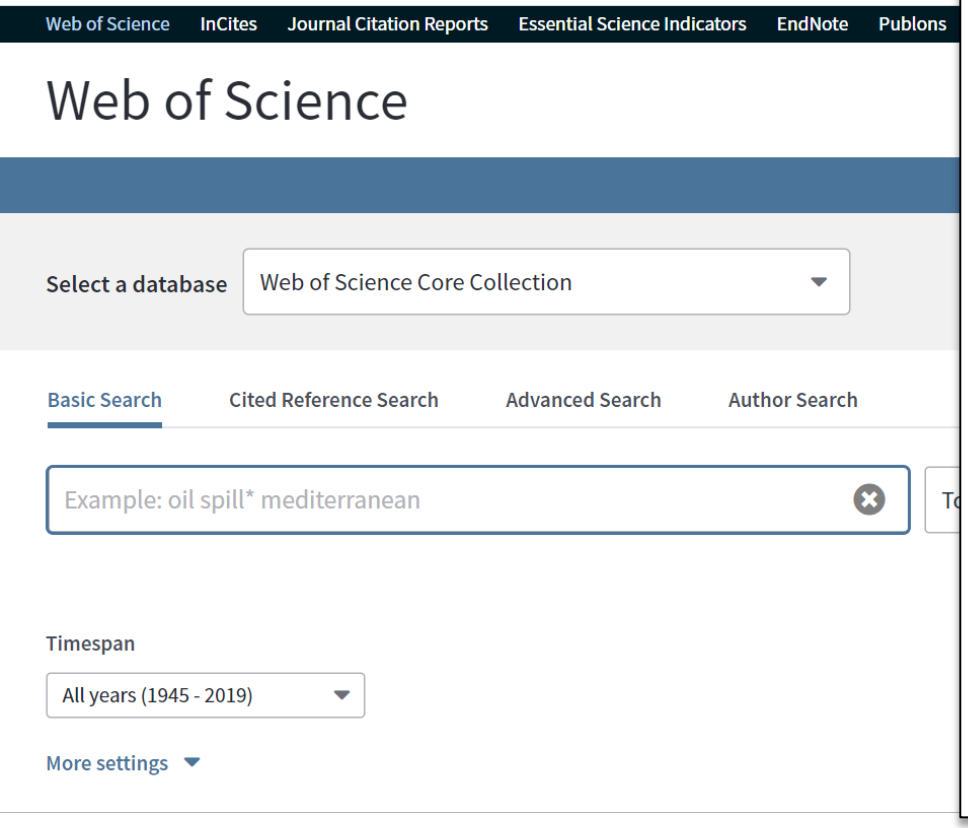
- What sources of knowledge are important?
- What types of information are relevant?
- Is it worth big, up-front investment?
- How controversial is the topic?
- What are the consequences of getting it wrong?
- What existing knowledge are we aware of?

Download
Knowledge Synthesis Method
Number 20 of 21

Adapted from Pullin et al (2016). Selecting appropriate methods of knowledge synthesis to inform biodiversity policy. *Biodiversity & Conservation* 25, 1285-1300.

See also Cook et al (2017) *Biological Conservation*, 213, 135-145.
Haddaway & Dicks (2018) *Biological Conservation*, 218, 289-290.

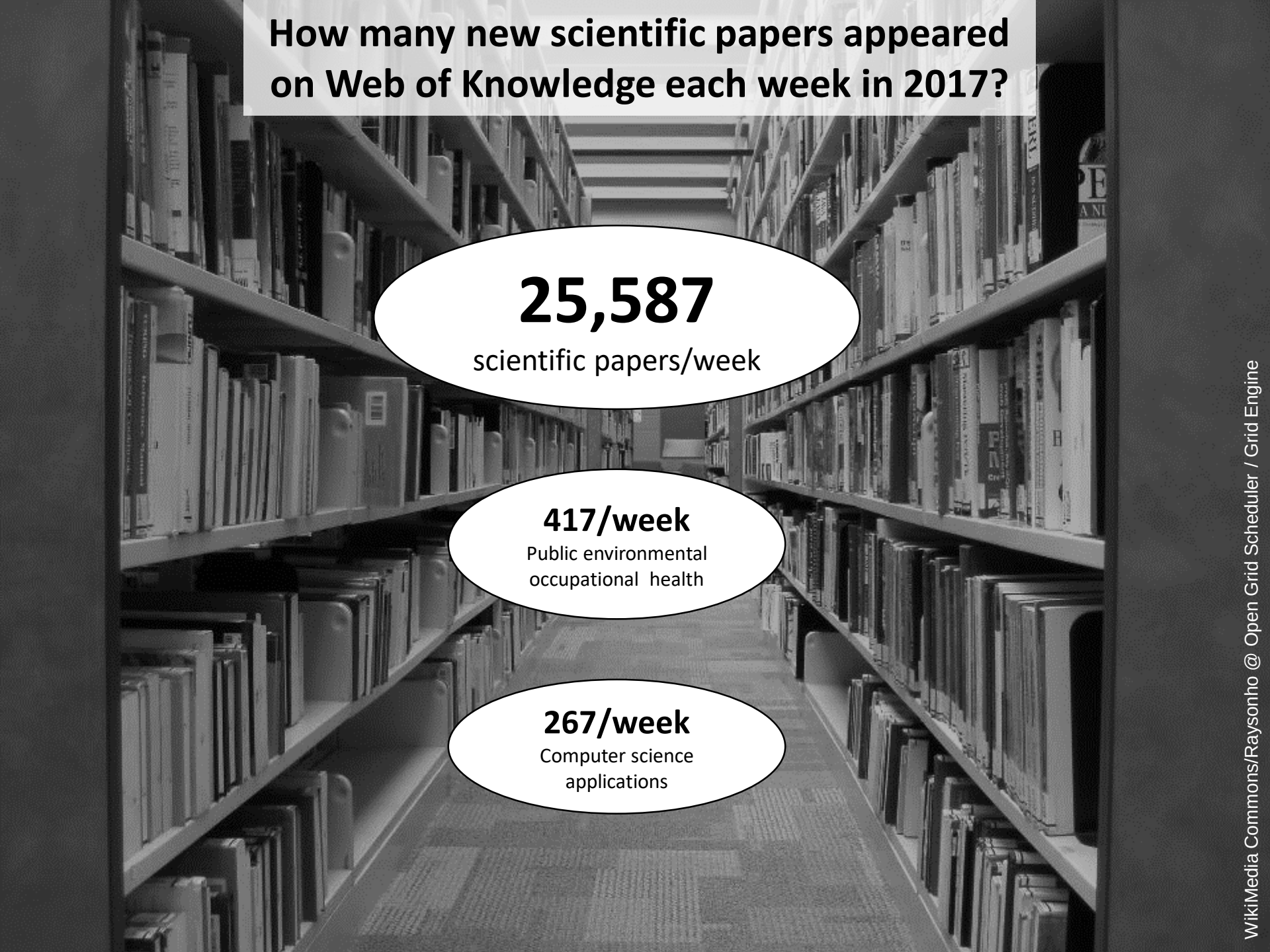
Reliable sources of evidence



1. Medline
2. Web of science
3. Geobase
4. PROQUEST database: Environmental sciences and pollution management sub-files (Bangor University)
5. CAB (Commonwealth Agricultural Bureau)
6. Directory of open access journals
7. Copac: joint catalogue of academic libraries
8. Index to theses online
9. Greenfile
10. Geo ref preview database
11. AGRICOLA
12. BIOSIS
13. SCOPUS

- There are many scientific databases
- They don't all index the same journals
- There are also non-English databases

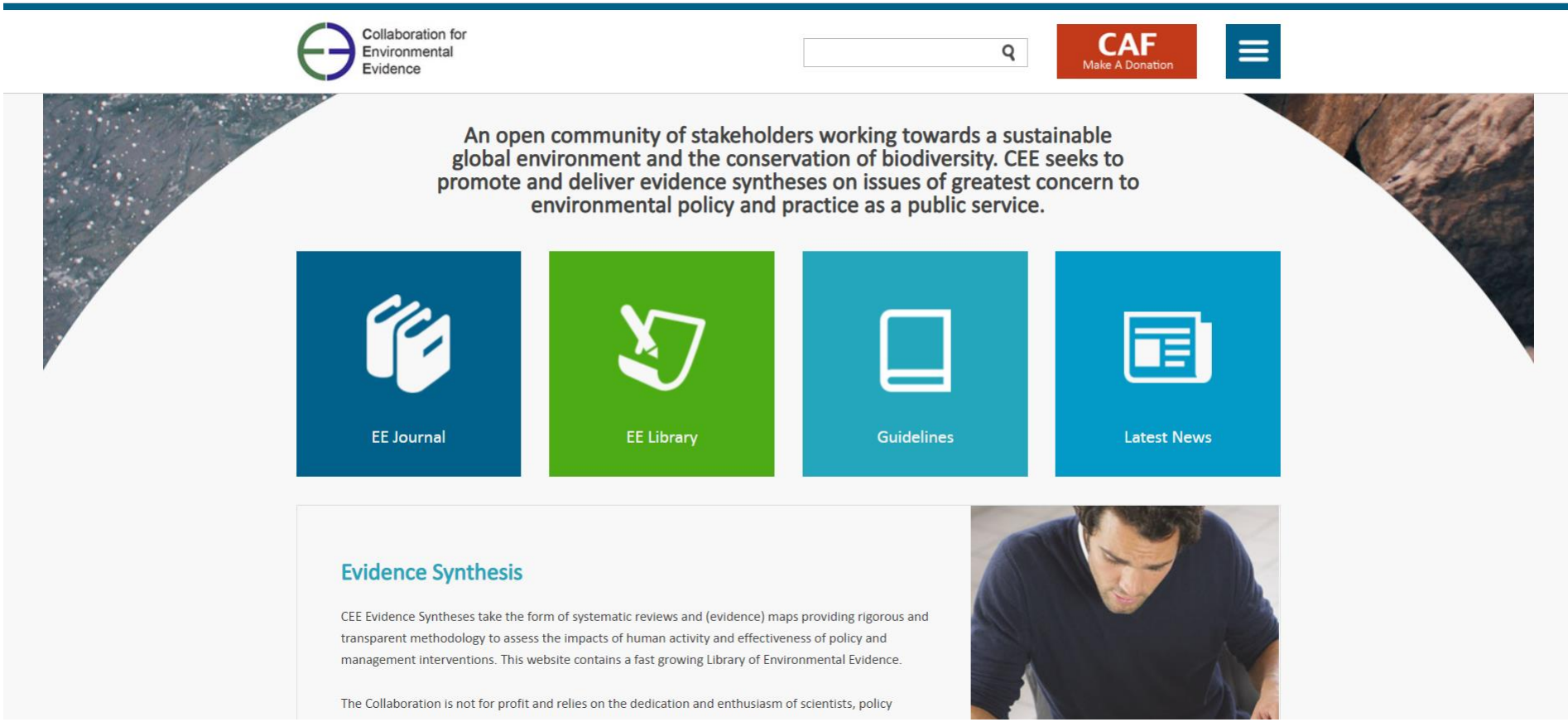
How many new scientific papers appeared on Web of Knowledge each week in 2017?



WikiMedia Commons/Raysonho @ Open Grid Scheduler / Grid Engine

EnvironmentalEvidence.org

A library of systematic maps and reviews



ConservationEvidence.com

a database of evidence summaries and assessments

Refine results

352 actions found

Sort by: Number of studies | Relevance | Title ▲

Category

- [x] Bat Conservation (190)
- [x] Primate Conservation (162)

Keywords

Habitat

- [ ] Artificial Habitats
- [ ] Forest & Woodland
- [ ] Savanna

More ▾

Threat

- [ ] Agriculture & aquaculture
- [ ] Biological resource use

- [ ] Adapt bat roost structures to buffer against temperature extremes
  No evidence found (no assessment) | Based on: 0 studies
- [ ] Allow primates to adapt to local habitat conditions for some time before introduction to the wild
  Unknown effectiveness (limited evidence) | Based on: 25 studies
- [ ] Apply textured coating to turbines
  No evidence found (no assessment) | Based on: 0 studies
- [ ] Automatically reduce turbine blade rotation when bat activity is high
  Likely to be beneficial | Based on: 2 studies
- [ ] Avoid building roads in key habitat or migration routes
  No evidence found (no assessment) | Based on: 0 studies
- [ ] Avoid contact between wild primates and human-raised primates
  No evidence found (no assessment) | Based on: 0 studies

ReNature

Asking a good question: PICO

		For example:
Population	What is the population of interest?	Wild pollinating insects
Impact	What *impact* or *intervention* are you interested in the effect of?	Presence, or increased abundance of managed bees, including *Apis mellifera* and *Bombus terrestris/impatiens*
Comparator	What will you compare with, to measure the existence or size of the effect	Absence, or lower abundance of managed bees
Outcome	What outcomes will be measured?	Abundance, species richness, foraging behaviour of wild pollinating insects

How does switching to bioenergy affect greenhouse gas emissions?

		Bioenergy example:
Population	What is the population of interest?	GHG stock in the atmosphere
Impact	What *impact* or *intervention* are you interested in the effect of?	Switch to bioenergy – first generation (from food crops) or second generation (e.g. from waste)
Comparator	With what will you compare, to measure the existence or size of the effect	Fossil fuel alternative (coal, gas or oil-derived)
Outcome	What outcomes will be measured?	Life cycle greenhouse gas emissions of entire energy production chain, including land use change

How to design a search protocol

1. **Devise** search terms for each of the PICO elements

2. Make use of **logic** and pay attention to **synonyms**

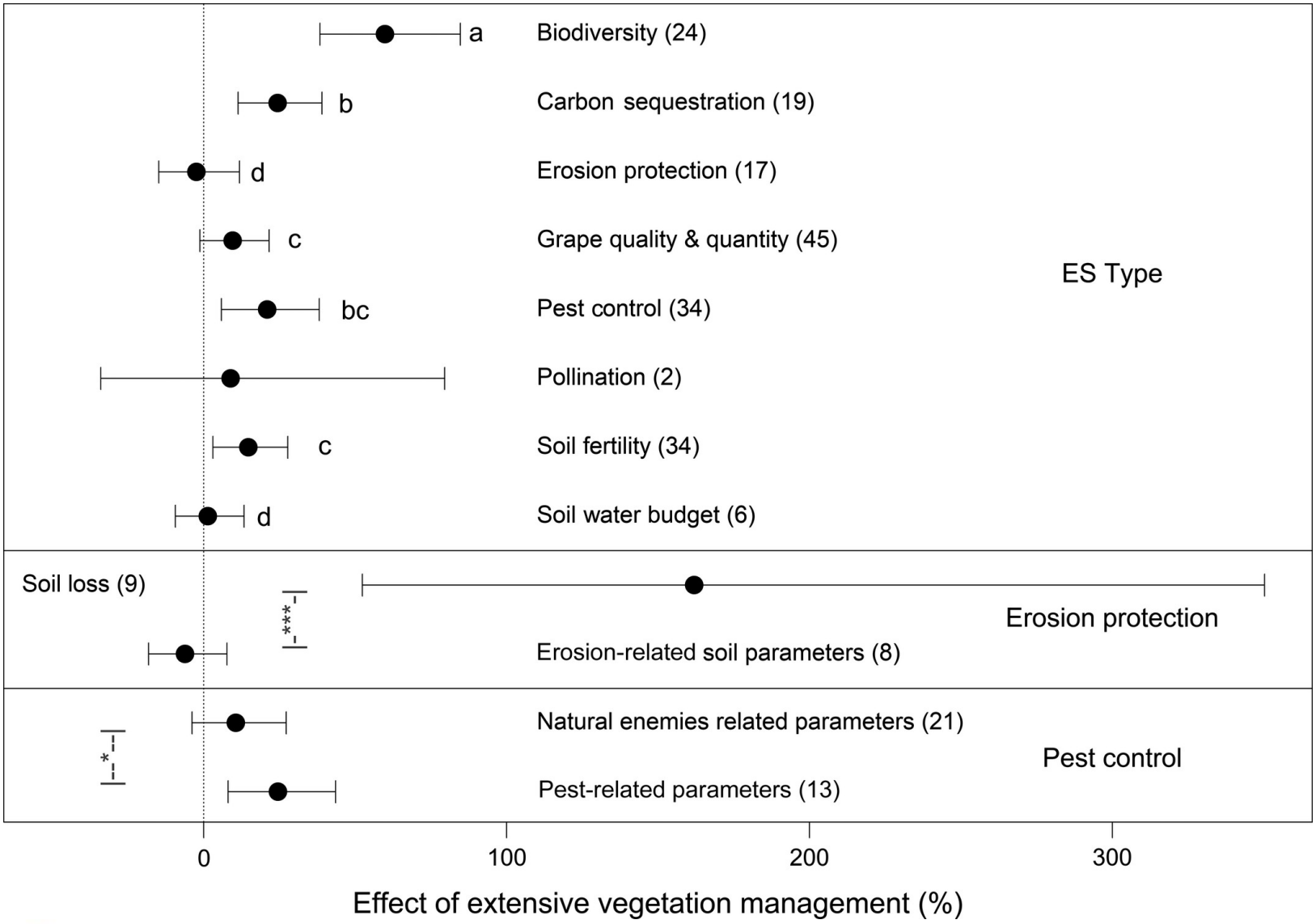
3. **Test** the search terms with a set of papers that you know should be captured

Population : roadside*, “road side*”, (road* AND (verge* OR edge*)), roundabout*, “traffic island*”, “median strip*”, “central reservation*”, boulevard*, parkway*, (avenue* AND tree*)

Source: Bernes et al (2017) How does roadside vegetation management affect the diversity of vascular plants and invertebrates? A systematic review protocol. Environmental Evidence 6, 16.

ReNature

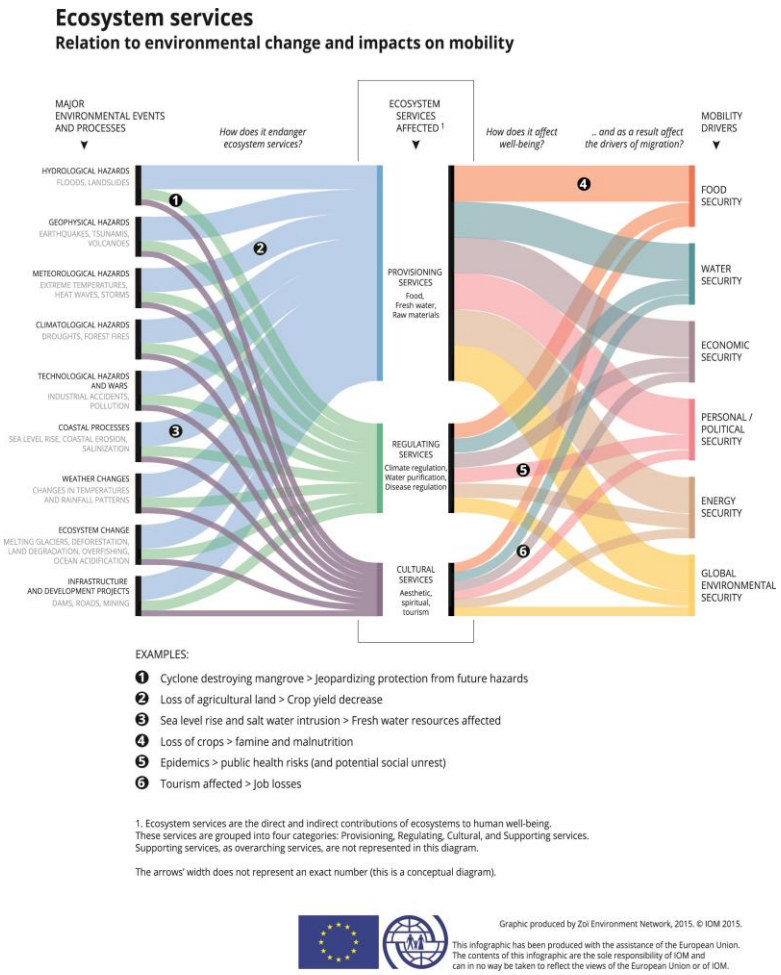
How to communicate results

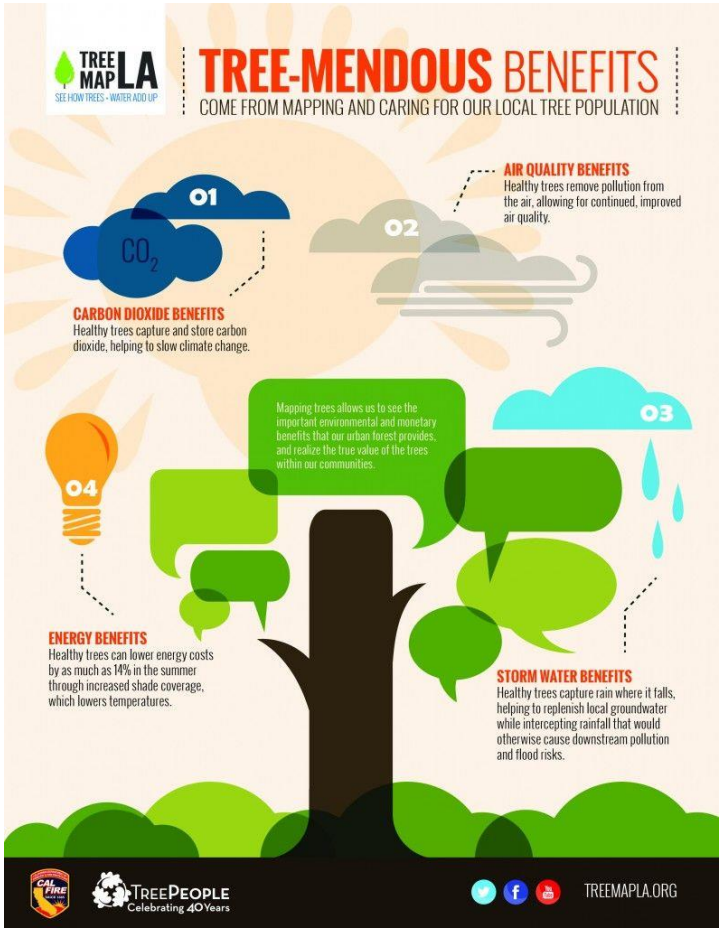


ReNature

Winter et al. (2018) Effects of vegetation management intensity on biodiversity and ecosystem services in vineyards: A meta-analysis. J Appl Ecol. 55:2484–2495. https://doi.org/10.1111/1365-2664.13124

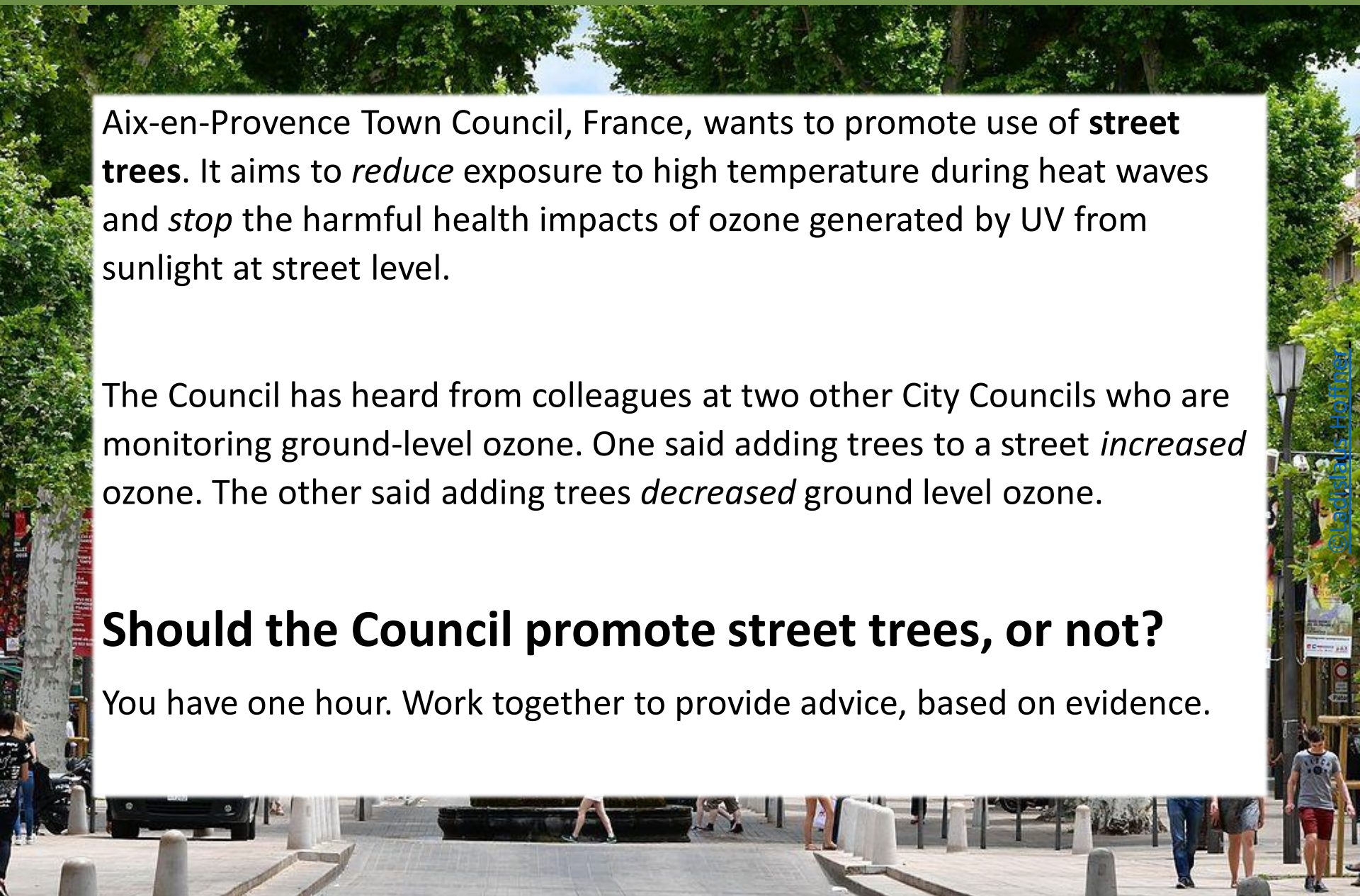
How to communicate results





ReNature

Now over to you….



Aix-en-Provence Town Council, France, wants to promote use of **street trees**. It aims to *reduce* exposure to high temperature during heat waves and *stop* the harmful health impacts of ozone generated by UV from sunlight at street level.

The Council has heard from colleagues at two other City Councils who are monitoring ground-level ozone. One said adding trees to a street *increased* ozone. The other said adding trees *decreased* ground level ozone.

Should the Council promote street trees, or not?

You have one hour. Work together to provide advice, based on evidence.

A process to follow

1. Discuss the problem. What are you possible explanations for the different reported experiences?

2. Define the questions you need evidence for. Use PICO

3. Decide on and test a search strategy

4. Identify sources of evidence, work individually, search, collate.

5. Re-group – what evidence have you found? How do you understand the problem now? Can you answer any of your questions? If not, what's your next step?

Groups will have up to 5 minutes to provide succinct, evidence-based advice. You choose what to present and how.