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

Metacoding

October 2024 - Montpellier

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Metacoding

Describe/map the literature answering the question

- quantity
- nature

e.g. what populations are studied?

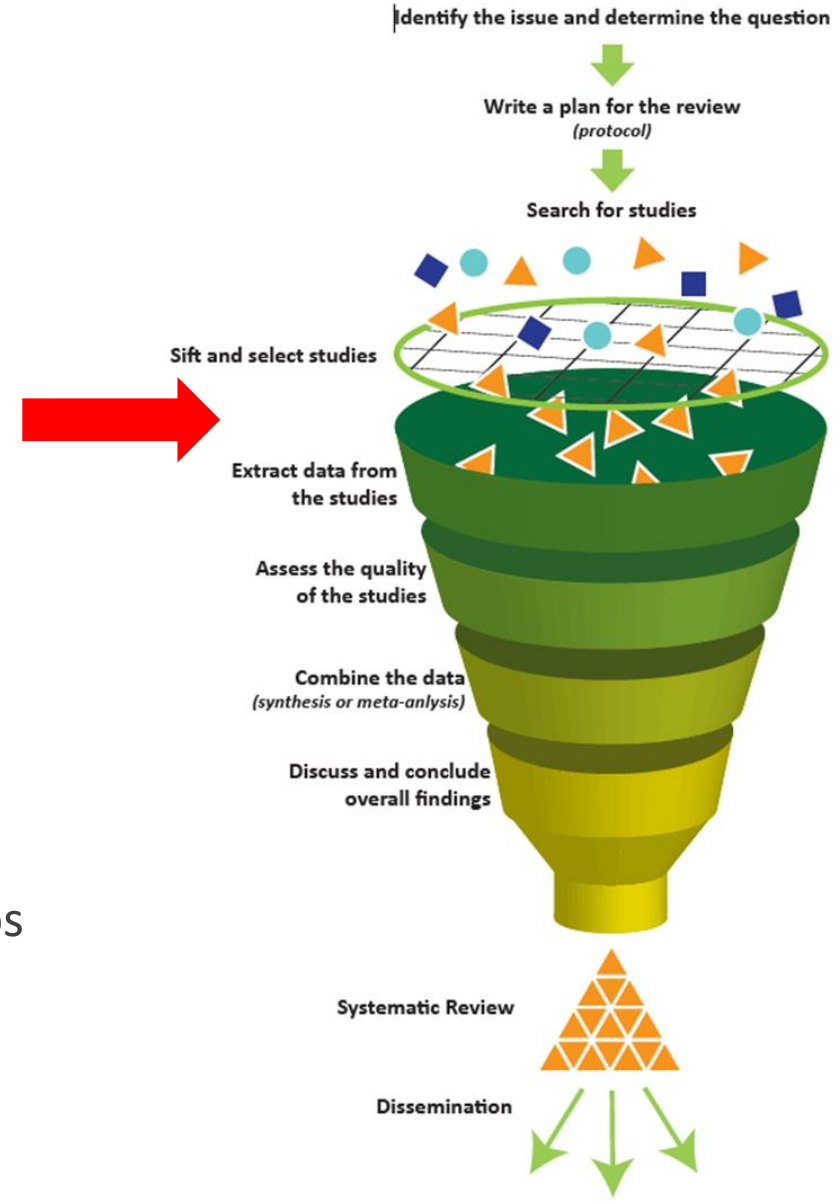
e.g. what types of intervention were studied?

e.g. what responses were measured?

+ how many studies for each category?

→ Identification of knowledge clusters

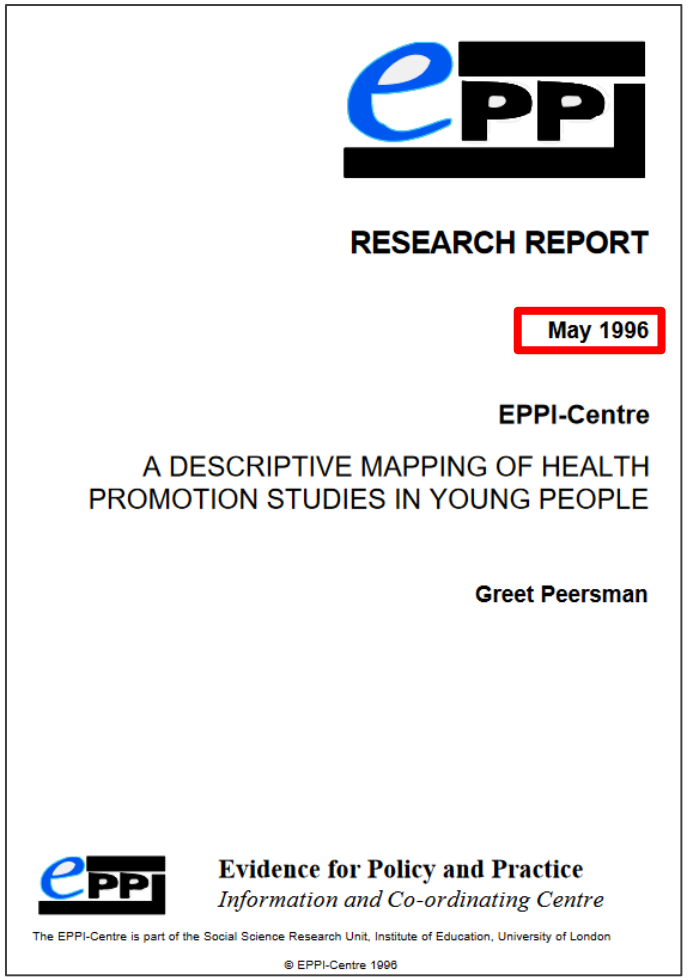
(future reviews / meta-analyses) and knowledge gaps



Jessica Kaufman, Cochrane Consumers & Communication Review Group, Centre for Health Communication and Participation, La Trobe University, 2011.

Systematic maps

Methodology developed by EPPI-Centre (social sciences)



RESEARCH REPORT

May 1996

EPPI-Centre

A DESCRIPTIVE MAPPING OF HEALTH PROMOTION STUDIES IN YOUNG PEOPLE

Greet Peersman

Evidence for Policy and Practice
Information and Co-ordinating Centre

The EPPI-Centre is part of the Social Science Research Unit, Institute of Education, University of London

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The politics of evidence and methodology: lessons from the EPPI-Centre

Ann Oakley, David Gough, Sandy Oliver and James Thomas

These challenges of synthesising social science research have led over time to a number of pragmatic adaptations in the technology of systematic reviews. Building on the mapping report commissioned by the DH in 1996 (Peersman, 1996), EPPI-Centre reviews increasingly use a two-stage model of systematic reviews. In stage one, the relevant literature is located and described in order to provide a 'map' of research activity in the area. 'Mapping' the literature is a useful product in itself, and it also helps to counter the objection that too much literature is found and discarded. It also helps researchers and policy makers to see what kinds of questions the research can be used to answer. One implication of a two-stage model is that some reviews may consist simply of a mapping stage; for example, a map of research on the effects of travel on children as a scoping study for further research on children's travel to school (Gough et al, 2001). In the second stage of a review, a smaller subset of studies is used to answer a more focused question. Criteria used to select the smaller

Systematic maps

James *et al. Environ Evid (2016) 5:7*
DOI 10.1186/s13750-016-0059-6

Environmental Evidence

In environmental sciences:

Same rigour as for systematic reviews (protocol, etc.)

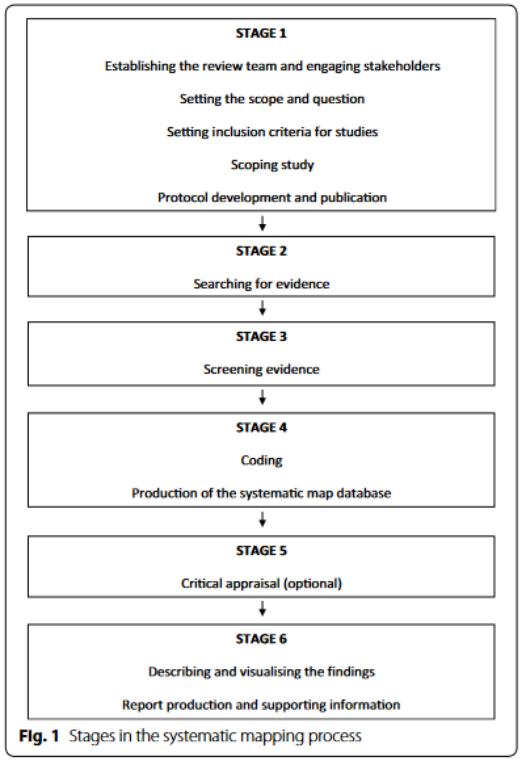

Fig. 1 Stages in the systematic mapping process

METHODOLOGY Open Access

A methodology for systematic mapping in environmental sciences

Katy L. James[1], Nicola P. Randall[1*] and Neal R. Haddaway[2]

Table 1 Differences between a systematic map and systematic review

Stage in 'evidence synthesis'	Systematic map	Systematic review
Objective	Describes the state of knowledge for a question or topic	Aims to answer questions with a quantitative or qualitative answer
Question formulation	Question can be open-framed or closed-framed. Topic can be broad or narrow	Question is usually closed-framed
Search strategy	No limitation on research evidence that can be included (e.g. primary and secondary research)	Evidence is limited to primary qualitative or quantitative research. For example comparative, prevalence or occurrence type studies
Article screening	Articles not obtainable at full text (where the full document is not available) or studies with limited data may be included	Article full text is usually required to extract relevant data
Data extraction	Information describing the study and its methods are extracted. Study results may not be extracted	Information describing the study and its methods and studies' qualitative and or quantitative results extracted
Critical appraisal	Critical appraisal optional	All included studies critically appraised for study internal and external validity
Synthesis	Trends in the literature, knowledge gaps and clusters identified but no 'synthesis of study results' carried out	Qualitative or quantitative synthesis of study results where possible using appropriate methodology (e.g. meta-analysis). Knowledge gaps identified
Report	Describes and catalogues available evidence relating to a topic of interest, identifying knowledge gaps and knowledge clusters. Implications for policy, practice and research made	Narrative and qualitative or quantitative synthesis study results (e.g. meta-analysis) to answer the question (where feasible). Implications for policy and practice, and identification of knowledge gaps for future research

Systematic maps

Environmental Evidence

Recovery of plant nutrients from human excreta and domestic wastewater for reuse in agriculture: a systematic map and evidence platform

Achieving a more circular and efficient use of nutrients found in human excreta and domestic (municipal) wastewater is an integral part of mitigating aquatic nutrient pollution and nutrient insecurity. A synth...

Biljana Macura, Geneviève S. Metson, Jennifer R. McConville and Robin Harder

Environmental Evidence 2024 13:21

Systematic Map | Published on: 20 August 2024

A systematic map of evidence on the relationship between agricultural production and biodiversity in tropical rainforest areas

The tropical rainforest biome plays a significant role in providing habitats for terrestrial biodiversity and delivering ecosystem service values, contributing to agricultural production. However, the increasi...

Via Apriyani, Mukhlish JM Holle and Sonny Mumbunan

Environmental Evidence 2024 13:17

Systematic Map | Published on: 2 June 2024

What evidence exists on the effect of the main European lowland crop and grassland management practices on biodiversity indicator species groups? a systematic map

The intensification of the agricultural practices in Europe over the last decades has drastically transformed the agroecosystems. The simplification of the landscape, the loss of semi-natural habitats and the ...

Coralie Triquet, Marie Perennes, Robin Séchaud, Markus van der Meer, Yvonne Fabian and Philippe Jeanneret

Environmental Evidence 2024 13:20

Systematic Map | Published on: 17 August 2024

Evidence on the ecological and physical effects of built structures in shallow, tropical coral reefs: a systematic map

Shallow, tropical coral reefs face compounding threats from climate change, habitat degradation due to coastal development and pollution, impacts from storms and sea-level rise, and pulse disturbances like bla...

Avery B. Paxton, Iris R. Foxfoot, Christina Cutshaw, D'amy N. Steward, Leanne Poussard, Trevor N. Riley, Todd M. Swannack, Candice D. Piercy, Safra Altman, Brandon J. Puckett, Curt D. Storlazzi and T. Shay Viehman

Environmental Evidence 2024 13:12

Systematic Map | Published on: 14 May 2024

Systematic maps

Bernes *et al. Environ Evid (2017) 6:24*
DOI 10.1186/s13750-017-0103-1

Environmental Evidence

SYSTEMATIC MAP — Open Access

How are biodiversity and dispersal of species affected by the management of roadsides? A systematic map

Claes Bernes[1*], James M. Bullock[2], Simon Jakobsson[3], Maj Rundlöf[4], Kris Verheyen[5] and Regina Lindborg[3]

Population: Roadsides

Intervention: Roadside management, e.g. mowing, removal of shrubs and saplings, pruning, coppicing, control of invasive/nuisance species, herbicide use, sowing or planting, burning, grazing by livestock, tillage and other forms of soil cultivation, mulching, topsoiling, use of erosion-control mats or blankets, fertiliser addition, liming, irrigation, ditching and maintenance of ditches

Comparator: Non-intervention or alternative forms of roadside management

Outcomes: (1) Measures of local or regional diversity of animals, plants, fungi or bacteria, e.g. alpha/beta/gamma species diversity, genetic diversity, abundance of individual species, or abundance of functional/taxonomic groups of organisms (including measures of the total abundance of vegetation).
(2) Measures of species dispersal along roads or roadsides, e.g. species distribution patterns or movement rates of individuals or propagules.

Table 2 Combinations of interventions and organism groups studied (No. of studies)

Intervention	Organism group													
	Graminoids	Herbs/ forbs	Woody plants	Bryophytes	Lichens	Fungi	Mammals	Birds	Reptiles	Insects	Other arthropods	Other invertebrates	Bacteria	All species
Vegetation disturbance														
Mowing	54	61	28	1	0	1	5	7	0	12	1	1	0	*85*
Pruning	1	1	1	0	0	0	0	0	0	0	0	0	0	*1*
Removal of shrubs/ saplings	2	3	4	0	0	0	3	2	1	1	0	1	0	*9*
Grazing	3	3	6	0	0	0	0	0	0	0	0	0	0	*6*
Burning	11	12	4	0	0	0	0	1	0	1	0	0	0	*14*
Heating	1	1	0	0	0	0	0	0	0	0	0	0	0	*1*
Herbicide use	67	72	21	0	0	0	0	0	0	1	0	1	0	*86*
Biological amendment														
Sowing	63	76	21	2	1	0	0	1	0	3	0	1	3	*86*
Planting	11	12	10	1	1	0	0	2	1	1	0	0	0	*19*
Mycorrhizal treatment	4	2	4	0	0	0	0	0	0	0	0	0	0	*7*
Soil amendment														
Fertiliser addition	31	31	13	0	0	1	0	0	0	0	0	0	1	*39*
Liming	9	17	1	0	0	0	0	0	0	0	0	0	0	*18*
Topsoiling	11	11	7	0	0	0	0	0	0	0	0	0	0	*11*
Mulching or compost application	32	33	17	0	0	1	0	0	0	0	0	0	3	*41*
Use of erosion-control mats/blankets	11	10	7	0	0	0	0	0	0	0	0	1	0	*11*
Irrigation	6	5	4	0	0	0	0	0	0	0	0	0	1	*7*
Soil cultivation (e.g. tillage)	13	19	6	1	1	0	0	0	0	0	0	0	0	*23*
Ditching or ditch maintenance	3	3	3	1	0	0	0	0	0	0	0	0	0	*3*
Control of invasive/nuisance species	43	52	18	0	0	0	0	0	0	1	0	0	0	*61*
Other interventions	5	6	3	0	0	0	0	0	0	2	0	0	0	*11*
All interventions	*207*	*232*	*105*	*5*	*2*	*2*	*5*	*10*	*1*	*17*	*1*	*2*	*3*	

Systematic maps

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Mowing	54	61	28	1	0	1	5	7	0	12	1	1	0	*85*
Pruning	1	1	1	0	0	0	0	0	0	0	0	0	0	*1*
Removal of shrubs/ saplings	2	3	4	0	0	0	3	2	1	1	0	1	0	*9*
Grazing	3	3	6	0	0	0	0	0	0	0	0	0	0	*6*
Burning	11	12	4	0	0	0	0	1	0	1	0	0	0	*14*
Heating	1	1	0	0	0	0	0	0	0	0	0	0	0	*1*
Herbicide use	67	72	21	0	0	0	0	0	0	1	0	1	0	*86*
Biological amendment														
Sowing	63	76	21	2	1	0	0	1	0	3	0	1	3	*86*
Planting	11	12	10	1	1	0	0	2	1	1	0	0	0	*19*
Mycorrhizal treatment	4	2	4	0	0	0	0	0	0	0	0	0	0	*7*
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Soil cultivation (e.g. tillage)	13	19	6	1	1	0	0	0	0	0	0	0	0	*23*
Ditching or ditch maintenance	3	3	3	1	0	0	0	0	0	0	0	0	0	*3*
Control of invasive/nuisance species	43	52	18	0	0	0	0	0	0	1	0	0	0	*61*
Other interventions	5	6	3	0	0	0	0	0	0	2	0	0	0	*11*
All interventions	*207*	*232*	*105*	*5*	*2*	*2*	*5*	*10*	*1*	*17*	*1*	*2*	*3*	

7

Meta-analysis possible only on the impacts of mowing (including different mowing regimes) on overall species richness and species diversity of plants, and abundance (cover) of forbs, graminoids and woody plants.

Jakobsson *et al. Environ Evid (2018) 7:17*
https://doi.org/10.1186/s13750-018-0129-z

Environmental Evidence

SYSTEMATIC REVIEW — Open Access

How does roadside vegetation management affect the diversity of vascular plants and invertebrates? A systematic review

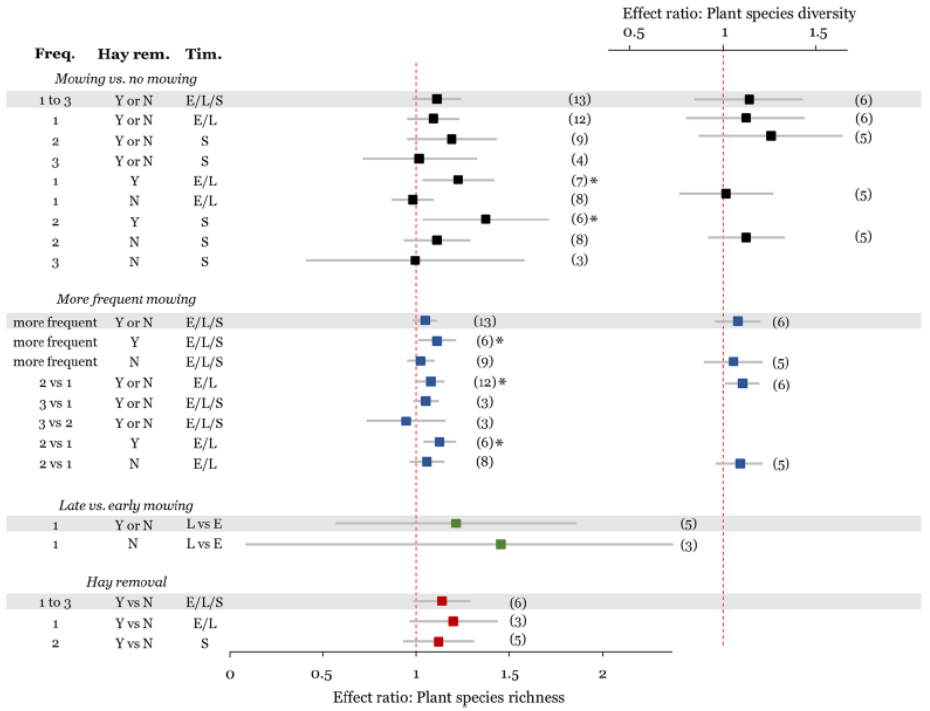
Simon Jakobsson[1*], Claes Bernes[2], James M. Bullock[3], Kris Verheyen[4] and Regina Lindborg[1]

Population: roadside habitats and the species of vascular plants and invertebrates found within them.

Intervention: maintenance or restoration of roadside habitats based on non-chemical vegetation removal such as mowing, grazing, burning, clearance of shrubs and saplings, coppicing, pruning, or mechanical removal of invasive plants.

Comparator: non-intervention or alternative forms of the interventions.

Outcomes: measures of functional/taxonomic diversity (including abundance) of vascular plants or invertebrates.



Metacoding

Extraction of meta-data = extraction of information describing **the study** and its methods

Coding = process of assigning **categories** to each **study** for a series of variables describing the framework and design of the study

→ Define the **study** (an article may contain several studies)

→ Define the variables to be extracted/coded and the categories (**code book**)

Metacoding

James KL, Randall NP, Haddaway NR. A methodology for systematic mapping in environmental sciences. Environ Evid. 2016;5:7.

Table 2 Examples of coding variables for systematic maps

Coding variable	Example of information that may be recorded
Full reference	Author(s), title, date, publisher
Year of publication	Date of publication in years
Publication type	Academic journal, book, conference paper or thesis
Language	Article language
Study country	Name of country
Linked study	Other articles reporting the same study
Data source	e.g. Primary or secondary research
Data type	e.g. Quantitative or qualitative
Study design	e.g. Experimental, quasi-experimental, observational, survey
Population(s)	e.g. Species, group
Intervention(s)	Type(s) of intervention investigated
Exposure(s)	Type(s) of exposure investigated
Comparator(s)	Type(s) of comparator used
Outcome(s) assessed	Types of outcome assessed
Sampling strategy	e.g. None specified, randomised, systematic
Length/period of study	e.g. Number of days, weeks, months, years or time period over which study was undertaken

Metacoding

! Warning !

Metacoding is time-consuming: **trade-off** between the number of variables describing the study and the resources available to code.

→ What information is most relevant to the question?

Importance of **testing the coding book** on a sample of articles to check that it matches the content of the studies

Document the work (transparency, repeatability)

Decide what to do in case of **missing information** ("Not stated", contact the authors, complete via linked studies)

Coding book: example

Haddaway et al. Environmental Evidence (2022) 11:30
https://doi.org/10.1186/s13750-022-00282-y

Environmental Evidence

SYSTEMATIC MAP Open Access

Evidence of the impacts of metal mining and the effectiveness of mining mitigation measures on social–ecological systems in Arctic and boreal regions: a systematic map

Neal R. Haddaway[1,2,3*], Adrienne Smith[4], Jessica J. Taylor[4], Christopher Andrews[4], Steven J. Cooke[4], Annika E. Nilsson[5] and Pamela Lesser[6]

Variables

	Column	Description	Dropdown/Meta-data	Example
Publication	Reviewer ID	Name of the reviewer who is extracting the meta-data	Meta-data	
	EPPI ID	Unique document ID	Meta-data	
	Citation	As Written	Meta-data	
	Authors	As Written	Meta-data	
	Title	As Written	Meta-data	
	Year	As Written	Meta-data	
	Journal	As Written	Meta-data	
	Pub Type	Type of article	Dropdown	
Mine description	Country	Country where mine is located	Dropdown	
	Region	Region or state where mine is located	Meta-data	
	Location	Specific name of the locality where the impact is being measured (site name)	Meta-data	City, impacted site name, etc.
	Mine/project name	Name of the mine or project	Meta-data	
	Latitude	Decimal degree location of site where research occurred	Meta-data	If not reported, retrieve external to paper based on closest available location or maps provided
	Longitude	Decimal degree location of site where research occurred	Meta-data	If not reported, retrieve external to paper based on closest available location or maps provided
	Key metals/ore extracted	The main ore extracted from the mine	Dropdown	
	Multiple metals list	If multiple selected in previous, List multiple metals extracted at the mine separate by se	Meta-data	Separate metas by semi colon (eg. Gold; Silver; Iron)
	Type or mine	Type of mining activity, expand the drop-down as necessary	Dropdown	e.g. open pit
	Prospecting	Y/N/NR/NS	Dropdown	
	Exploration	Y/N/NR/NS	Dropdown	
	Construction	Y/N/NR/NS	Dropdown	
	Operation	Y/N/NR/NS	Dropdown	
	Decomissioning & Closure	Y/N/NR/NS	Dropdown	
	Post-closure	Y/N/NR/NS	Dropdown	
	Remediation	Y/N/NR/NS	Dropdown	
	Abandonment	Y/N/NR/NS	Dropdown	
	Expansion	Y/N/NR/NS	Dropdown	
	Comment		Meta-data	
Study decription	Study Design	CI, BA, BACI, RCT, correlative, other	Dropdown	
	Study Design comments		Meta-data	
	Comparator Type	Description of the comparator used in the study	Dropdown	
	Study Setting		Dropdown	
	Study Design context	In situ, mesocosm, ex situ	Dropdown	
System	Population (who/what is affected) Description	Authors description of the population/system being impacted	Meta-data	Coastal habitat, as written by the author
	Population System	Is this a social, technological, or environmental	Dropdown	What system does the population described generally fall into.
	System affected	Describe population/system impacted (See sheet Impact coding)	Dropdown	
	Component affected	Follow coding based on system chosen (See sheet Impact coding)	Dropdown	
	Factor affected	Follow coding based on factor chosen (See sheet Impact coding)	Dropdown	
Impact/Mitigation	Impacts?	Does the study empirically investigate the impacts of mining?	Dropdown	Y/N/NR/NS
	Impact pathway (what is impacting the population)	Authors' short description of the impact	Meta-data	Compaction of the soil from mine traffic
	Mitigation?	Does the study empirically investigate mitigation measures? Y/N/unclear	Meta-data	Y/N/NR/NS
	Mitigation description	Authors' short description of the mitigation measure	Meta-data	Tarpaulin covers on trucks to reduce dust
	Impact being mitigated	Name the impact being mitigated	Dropdown	
Outcome	Measured outcome	Short description from authors of the outcome measured	Meta-data	
	Data Type	Quantitative or Qualitative data	Dropdown	
	Source of the information	Page or table from which outcome meta data can be found	Meta-data	

Coding book: example

Haddaway et al. Environmental Evidence (2022) 11:30
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Categories

Codes	Notes		Codes	Notes
Publication Type			**Country**	
Article	journal articles		Canada	
Thesis	thesis (Masters or PhD)		USA	Alaska only
Conf	conference proceeding		Greenland	
Book	book		Iceland	
Book Chap	chapter in a book		Norway	including Svalbard
Report	report (government, consultant)		Sweden	
Other/Unlcear	e.g., news article, presentation etc.		Finland	
			Russia	
Key metals/ore extracted			The Faroe Islands	
Gold				
Iron			**Type of mine**	
Copper			Open pit	
Nickel			Strip mine	
Zinc			Quarry	
Silver			Underground mine	
Molybdenum			Surface mine	
Lead			Placer mine	
NR			Unclear	
Multiple			Expand as necessary	
Study design			**Comparator Type**	
BACI	Before-After-Control-Impact i.e.,		Same site/pop- Before	BA designs; no control site only before and after
BA	Before-after i.e., measured outcome		Reference site/population	Different unimpacted site/population; reference site;
CI	Control-impact i.e., measures outcome		Control	Where there are only two possible outcomes, e.g. positive
RCT	Randomized Controlled Trial; A study		Background values	Impacted sites/populations are compared to standard or
Correlative	Statistical relationship between		No control	No comparator; after impact only or correlative
I/A only	No comparator; after impact only		BACI (reference/control/before/after)	
			Expand as necessary	
Study Setting				
Field	Experimental, descriptive field study		**Study design context**	
Field+Lab analysis	Field work done and samples analyzed		In situ	Situated in the original, natural, or existing place or
Lab Experiment	Including indoor/outdoor facilities/app		ex situ	Outside, off site, or away from the natural location. For
Lab Exp + Field test	Prototype studied in lab/facility and tes		mesocosm	Bounded and partially enclosed outdoor experiment
Lab analysis	Sample analysis only			
Modelling				
Social Science	Interviews, surveys			

Coding book: example

Haddaway et al. Environmental Evidence (2022) 11:30
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Extraction sheet

A3

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Publication									Mine description										
2	Article #	Reviewer ID	EPPI ID	Citation	Authors	Title	Year	Pub Type	Journal	Country	Region/State	Location	Mine/project name	Latitude	Longitude	Key metals/ore extracted	List Multiple Metals (semi-colon s	Type of mine	Prospecting	Exploration
3																				
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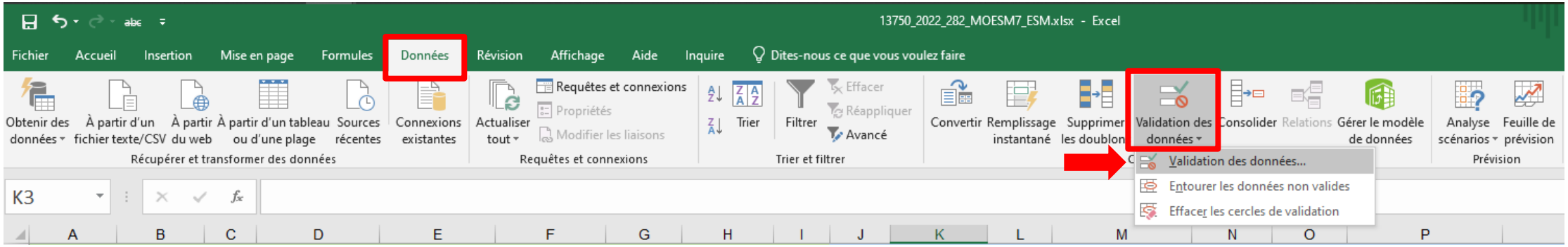
Variable descriptions | Possible codes | Extraction sheet

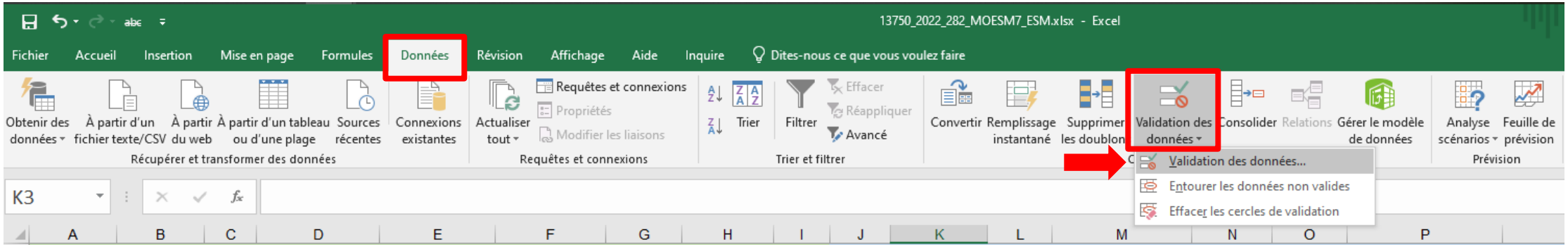
Coding: in practice with Excel

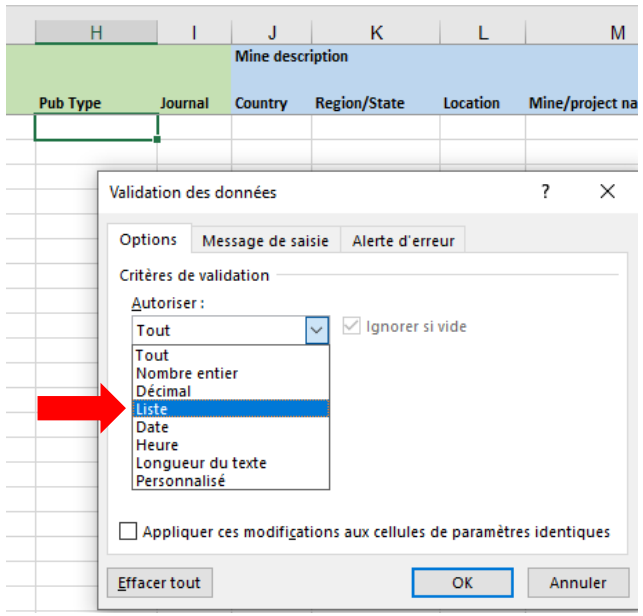
Defining constrained cells / drop-down lists



Coding: in practice with Excel

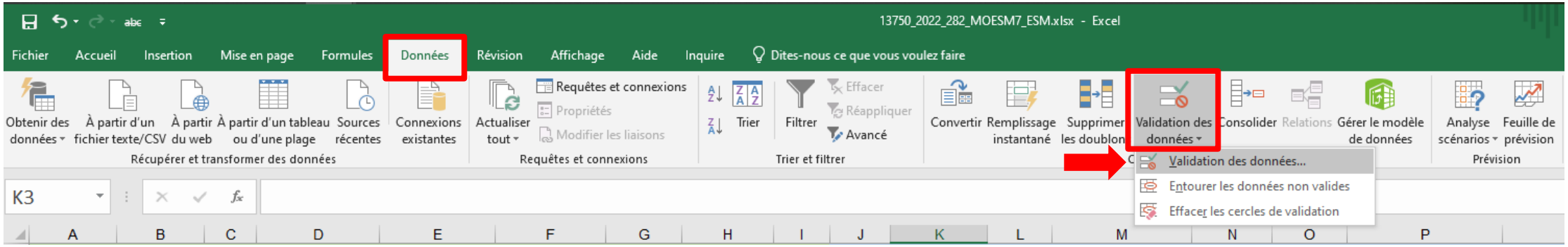
Defining constrained cells / drop-down lists

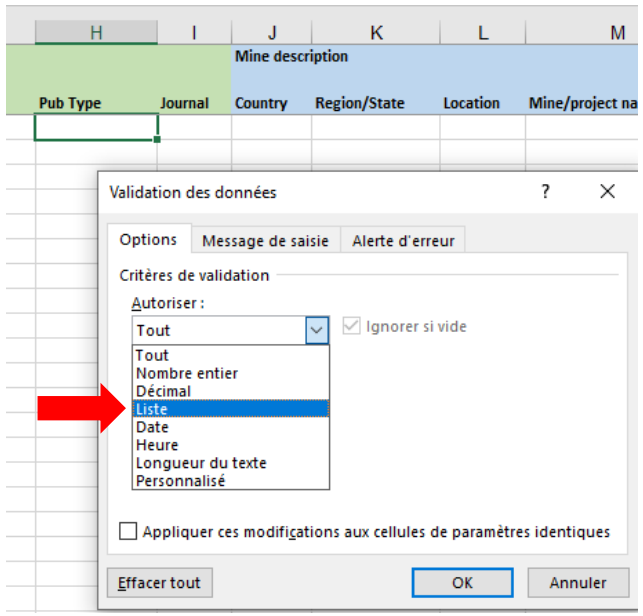


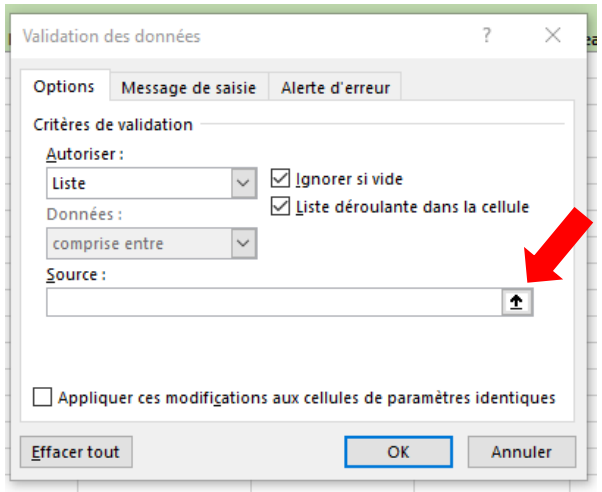


Coding: in practice with Excel

Defining constrained cells / drop-down lists

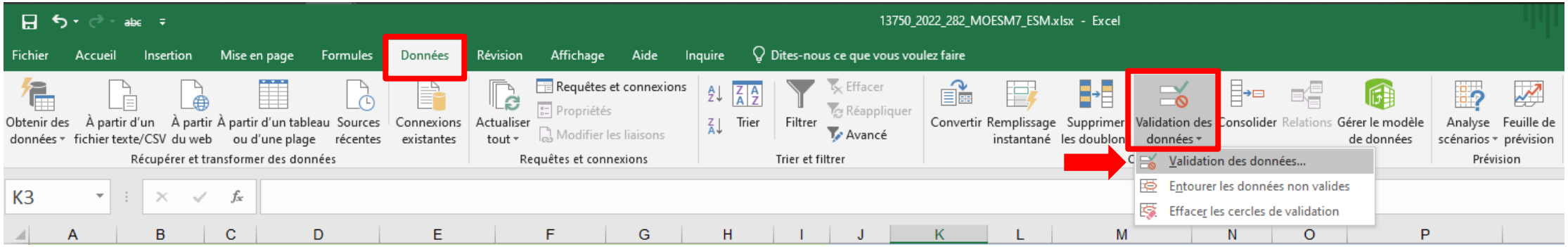


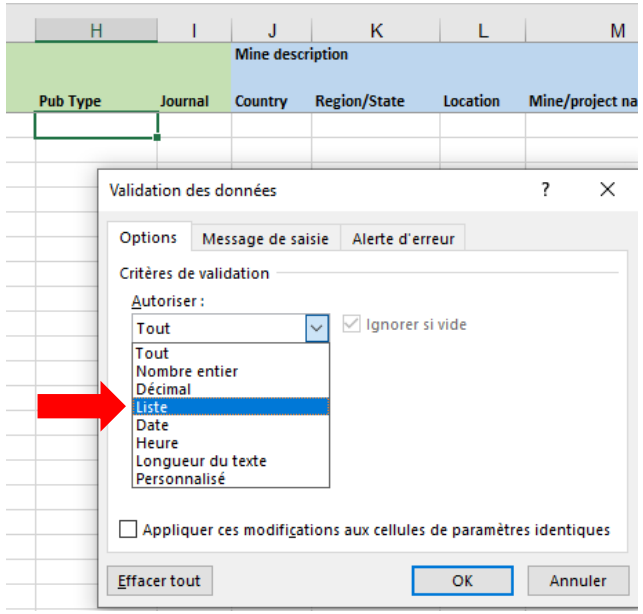


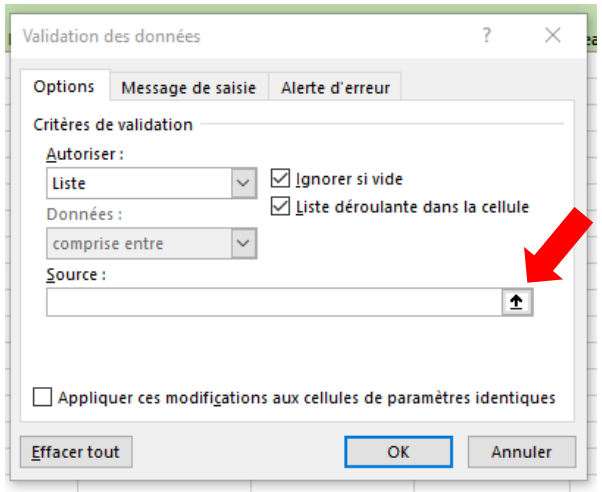


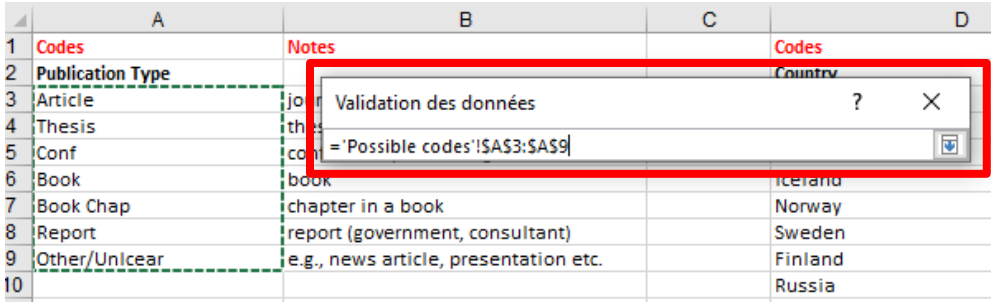
Coding: in practice with Excel

Defining constrained cells / drop-down lists



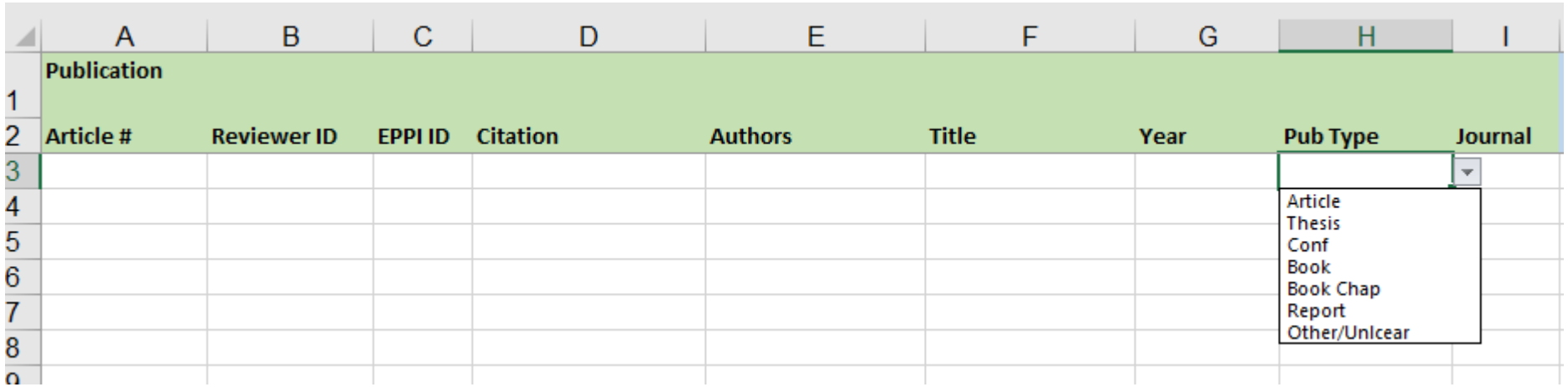


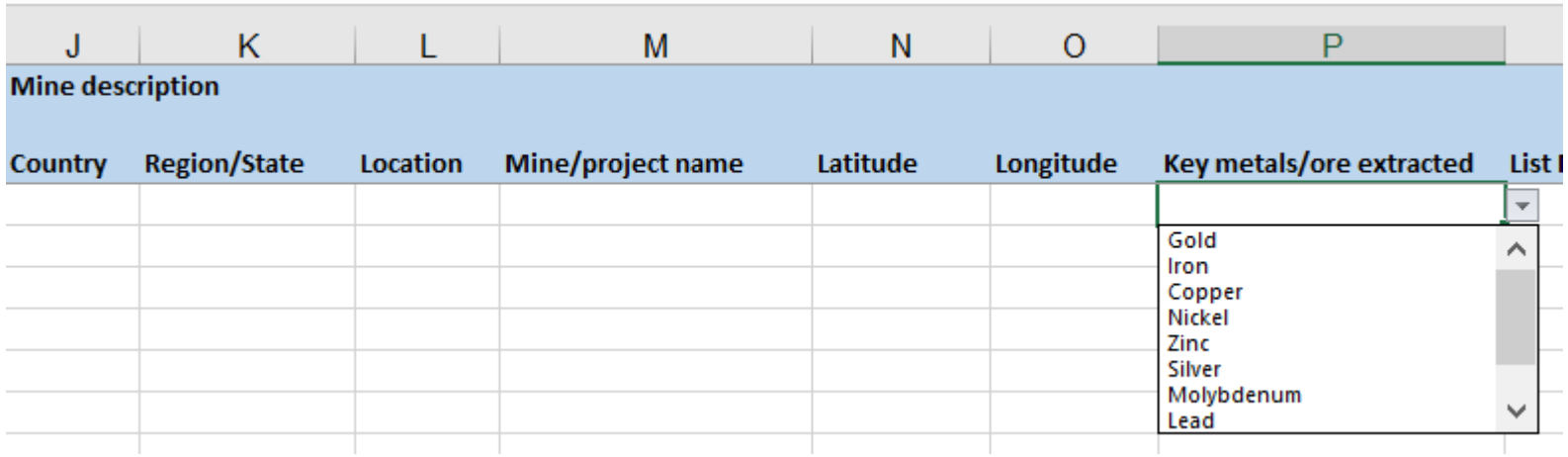




Coding: in practice with Excel

Defining constrained cells / drop-down lists





Coding with other tools than Excel

Colandr

https://www.colandrcommunity.com/how-to--guidance.html

Apriyani *et al. Environmental Evidence* (2024) 13:17
https://doi.org/10.1186/s13750-024-00339-0

Environmental Evidence

SYSTEMATIC MAP **Open Access**

A systematic map of evidence on the relationship between agricultural production and biodiversity in tropical rainforest areas

Via Apriyani[1*], Mukhlish JM Holle[1,2] and Sonny Mumbunan[1,3]

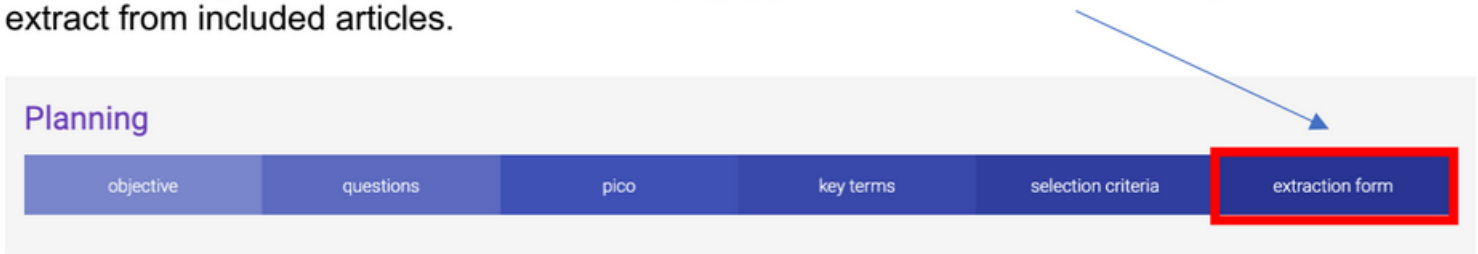
Coding with other tools than Excel

Colandr

https://www.colandrcommunity.com/how-to--guidance.html

Planning data extraction scheme

In the planning section of your review homepage, you can define fields of data you would like to extract from included articles.



When you first begin, your data extraction form will be blank. You can add items using the “add item” button. Remember to save your data extraction form. You can add as many data extraction fields as you like.

Coding with other tools than Excel

Colandr

https://www.colandrcommunity.com/how-to--guidance.html

There are seven different data types that can be coded in colandr, however, note that colandr will only provide predictive labels for data fields that are “select one” or “select many.”

Type	***Definition***	***How to use***	***Predictive labeling?***
Text	Character text	Allows for any type of character input (including numbers)	No
Integer	A number without a decimal point	Allows only for whole numbers	No
Float	A floating point number	Allows for numbers with a decimal place	No
Date	Month-Day-Year date	Allows for mm/dd/yyyy input	No
Boolean	True or false	Dropdown choice of true, false	No
Select one	One categorical value	Dropdown choice of one out of a user-defined set of allowed values	Yes
Select many	Many categorical values	Dropdown choice of many out of a user-defined set of allowed values	Yes

Changing data types and allowed values, and removing fields is possible, but can introduce errors into the system if you have already begun data extraction. Thus, **we recommend that users develop, refine, and finalize their data extraction form PRIOR to inputting it into colandr.**

Coding with other tools than Excel

Google form

Collaboration for Environmental Evidence

PROCEED
WWW.PROCEEDEVIDENCE.INFO

Systematic Map Protocol

Title
What is the evidence for the impact of ocean warming on subtropical and temperate corals and coral reefs?

Citation:
Man Lim Ho, Malgorzata Lagisz, Shinichi Nakagawa, Sarah Perkins-Kirkpatrick, Paige Sawyer, Bill Leggat, Troy Gaston, Alistair Hobday, Zoe Richards, Tracy Ainsworth. What is the evidence for the impact of ocean warming on subtropical and temperate corals and coral reefs?: a Systematic Map Protocol. PROCEED-23-00108 Available from:
https://www.proceedevidence.info/protocol/view-result?id=108
https://doi.org/10.57808/proceed.2023.9

Data Extraction Form Version 3 (08 Mar 2023)

Please use comma (,) as a separator so data collection on excel will be tidier:)

* Indique une question obligatoire

Title of Article *

Votre réponse

First Author, Last Author (Last name only, e.g. Doe, Doe) *

Votre réponse

Corresponding or First Author Location (Institution and country, e.g. University of New South Wales, Australia)

Votre réponse

Year of Publication (YYYY) *

Votre réponse

DOI (10.XXXX/xxxxxx)

Votre réponse

Coding with other tools than Excel

Google form

- Title of Article **(Short answer text)**
- First Author, Last Author (Last name only, e.g. Doe, Doe) **(Short answer text)**
- Corresponding or First Author Location (Institution and country, e.g. University of New South Wales, Australia) **(Long answer text)**
- Year of Publication (YYYY) **(Short answer text)**
- DOI (10.XXXX/xxxxxx) **(Short answer text)**
- Reason for exclusion **(Checkboxes)**
- Comments on Exclusion (If article is excluded, no further questions are needed to be answered. **(Short answer text)**
- Is the article included for screening? **(Yes/No)**
- Study type **(Checkboxes)**
- Comment on study type **(Short answer text)**
- Keywords used in this literature **(Checkboxes)**
- Location of Study (Location Name only)
  You can download the .html map with pop up at the following link:
  Ecoregion Popup File **(Short answer text)**
- Coastal/Offshore/Island? **(Checkboxes)**
- Is it in proximity to a exclusive economic zone that is a tourist attraction or urbanisation region? **(Yes/No)**
- If yes, please specify the area: **(Short answer text)**
- What is the proximity of the site in relation to the mentioned area? (United Nations Conference on the Law of the Sea, 1982). Select multiple if applicable. **(Checkboxes)**
- Approximate Latitude, Longitude, minimum 2 decimal places (e.g. 22.3193N, 114.1694E) **(Short answer text)**
- Development Status of Country (Use UN definition: https://www.un.org/en/development/desa/policy/wesp/wesp_current/2014wesp_country_classification.pdf) **(Multiple choices)**
- Did the study take place at a protected area (E.g. marine park, etc.)? **(Yes/No)**
- If the study took place at a protected area, please specify: **(Short answer text)**
- Did the author refer to the event taking place in an ocean current or other water bodies? **(Checkboxes)**
- When did the event start? (e.g. Sep 2022) **(Short answer text)**
- When did the event end? (e.g. Feb 2023) **(Short answer text)**
- When did the study start? (e.g. Sep 2022) **(Short answer text)**
- When did the study end? (e.g. Feb 2023) **(Short answer text)**
- Did the study take place at the same time as the event? **(Yes/No)**
- Temperature data categorisation **(Checkboxes)**
- If in-situ, from what depth was the data taken? N/A if satellite-derived or did not specify in paper. (Unit in metres, e.g. 10) **(Short answer text)**
- If in-situ, which data source is it from? (E.g. IMOS, etc.)? N/A if not specified in paper. **(Short answer text)**
- What organisms are studied? **(Checkboxes)**
- What species are studied? If more than one species, please separate each specie name by coma (,) **(Short answer text)**
- What are other environmental variables recorded? **(e.g. Chlorophyll a concentration, etc.) (Short answer text)**
- Is there an outcome/prediction provided in the study? **(Checkboxes)**
- If an outcome is provided, please provide a short description of the outcome **(Short answer text)**
- If a prediction is provided, please provide a short description of the prediction **(Long answer text)**
- Is the studied site classified as phase shifted/tropicalised/refugia/degraded, etc.? **(Checkboxes)**
- Is there a causality in the study? **(Yes/No)**
- Stressor used **(Checkboxes)**
- Severity of event based on DHWs/MHWs definition **(Short answer text)**
- Main Finding of this publication **(Long answer text)**
- Remark **(Long answer text)**

Consistency check

To be sure that the metacoding is objective / robust:

- metacoding of each study carried out independently by 2 people

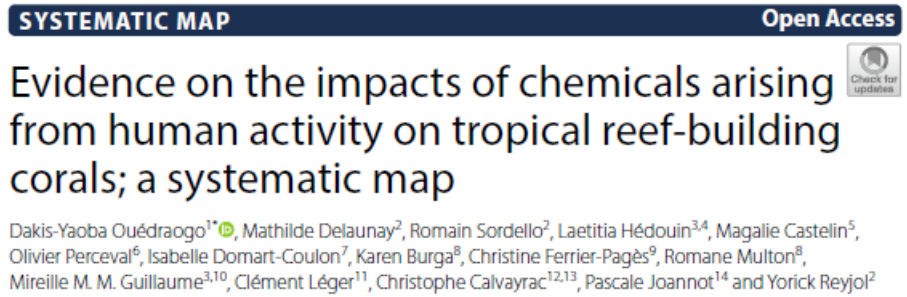
- if several coders share the work, check the consistency of the coding between coders on a sample before starting the actual coding (and discuss any disagreements)

- if only 1 coder, have someone to check a sample of the coding at the start of the work (and discuss any disagreements)

TD

Ouédraogo et al. Environ Evid (2021) 10:22
https://doi.org/10.1186/s13750-021-00237-9

Environmental Evidence


SYSTEMATIC MAP Open Access

Evidence on the impacts of chemicals arising from human activity on tropical reef-building corals; a systematic map

Dakis-Yaoba Ouédraogo[1*], Mathilde Delaunay[2], Romain Sordello[2], Laetitia Hédouin[3,4], Magalie Castelin[5], Olivier Perceval[6], Isabelle Domart-Coulon[7], Karen Burga[8], Christine Ferrier-Pagès[9], Romane Multon[8], Mireille M. M. Guillaume[3,10], Clément Léger[11], Christophe Calvayrac[12,13], Pascale Joannot[14] and Yorick Reyjol[2]

Question: What evidence exists on the impacts of chemicals on tropical reef-building corals?

P : all tropical reef-building coral species

E : all chemicals

C : comparison exposed / not exposed; before/after exposure; range of exposure

0 : all outcomes at all levels of organisation (molecular, colony, community)

A **study** = **a taxon × an exposure × an outcome**

Total amount of literature to code: 908 documents

TD

Files:

data_TD.xlsx (sheets 2, 3 and 4)

Hedouin2016_Improving.pdf (read only methods and results)

Exercise: code the article (15-20 min)

1 – read the code book

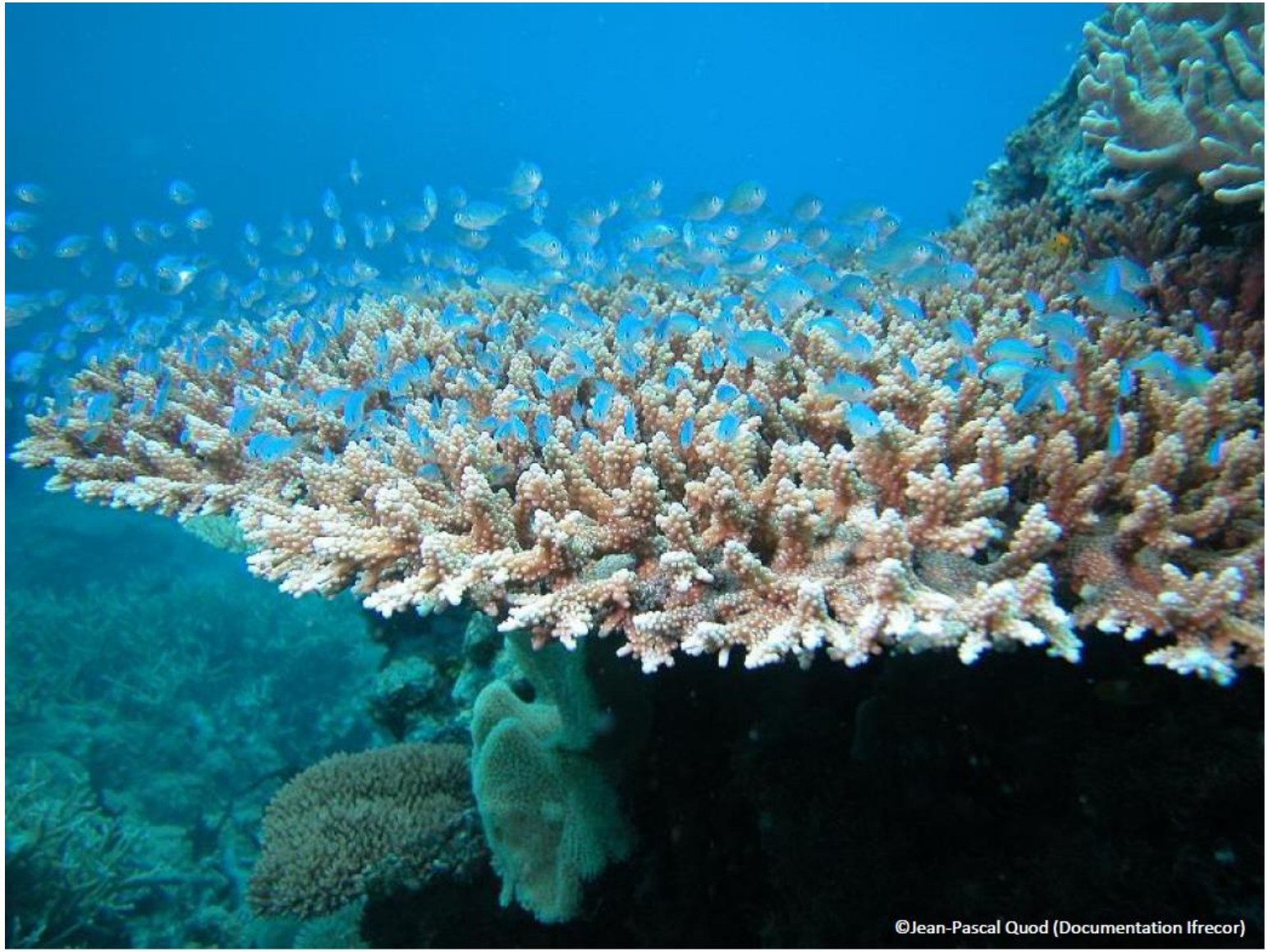
2 – define constrained fields (drop-down lists) for the columns « country », « study_type » and « exposure »

3 – extract and code the information from the article

! Note that a **study** = combination of **a taxon × an exposure × an outcome**

The article has several studies -> 1 line for each study

TD



TD

Hédouin et al. 2016

Location

1 species: *Pocillopora damicornis*

2 exposures: Cu and Pb

Type of study

2. Materials and methods

2.1. Experimental design of the toxicity tests for adults and larvae

Toxicity tests with Cu and Pb were performed on adult and larvae of the coral *P. damicornis*. For each experiment, 10 adult colonies of *P. damicornis* were collected adjacent to Coconut Island (21°26′1.97″N, 157°47′20.10″W), Oahu, Hawaii, in January–February (Winter season) and July–August (Summer season) 2009. Each colony was split into multiple fragments (18 nubbins per colony, 2–4 cm length), and maintained in a common garden tank under natural light and flowing seawater aquaria (24.1 ± 0.7 °C and 26.7 ± 0.8 °C for winter and summer seasons, respectively) to allow them to recover for a month. In order to simulate light condition similar to those experienced by corals at collection site (Padilla-Gamiño et al., 2014), shade cloths were placed above tanks.

study_type	country	latitude	longitude	location	taxon_init
Laboratory_experiment	United States of America	21°26'1.97''N	157°47'20.10''W	Coconut Island, Oahu, Hawaii	*Pocillopora damicornis*

Hédouin et al. 2016

9 outcomes measured for Cu and Pb

exposure_raw	exposure	combined	outcome_raw
Copper (Cu)	Metal	No	Polyp contraction
Copper (Cu)	Metal	No	Expulsion larvae
Copper (Cu)	Metal	No	Change in colour
Copper (Cu)	Metal	No	Survival rate (adult, larvae)
Copper (Cu)	Metal	No	Cu concentration in tissue
Copper (Cu)	Metal	No	Cu concentration in skeleton
Copper (Cu)	Metal	No	Symbiodinium density
Copper (Cu)	Metal	No	Chlorophyll a+c2 content
Copper (Cu)	Metal	No	Fv/Fm (Maximum dark-adapted quantum yield of the photosystem II)
Lead (Pb)	Metal	No	Polyp contraction
Lead (Pb)	Metal	No	Expulsion larvae
Lead (Pb)	Metal	No	Change in colour
Lead (Pb)	Metal	No	Survival rate (adult, larvae)
Lead (Pb)	Metal	No	Cu concentration in tissue
Lead (Pb)	Metal	No	Cu concentration in skeleton
Lead (Pb)	Metal	No	Symbiodinium density
Lead (Pb)	Metal	No	Chlorophyll a+c2 content
Lead (Pb)	Metal	No	Fv/Fm (Maximum dark-adapted quantum yield of the photosystem II)

seawater samples collected at 24, 48, and 72 h (before and after each spike) were pooled. Coral survival rates and signs of stress (tissue loss, polyp retraction, mucus overproduction) were recorded daily. After 96 h the experiment was terminated and the coral

3. Results

3.1. Mortality

Visual assessment of coral nubbins indicated that contraction of coral polyps was the first sign of stress to metal exposure and was observed after 24 h exposure to Cu at > 10 μg L^{-1} or Pb at >160 μg L^{-1}. With increasing time and metal concentration, the first sign of stress was loss of pigmentation; this was followed by rapid ressession of coenosarcs tissue, which isolated the polyps from one another and then rapid tissue loss, and death (Fig. 1). Coral larvae were expelled when adults were exposed to 10 and 50 μg L^{-1} of Cu and 160–640 μg L^{-1} of Pb.

2.2.1. Metal analysis in coral tissues and skeletons

2.2.2. Symbiodinium density and chlorophyll content measurements

2.2.3. Dark-adapted quantum yield (Fv/Fm)

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Hédouin et al. 2016

1 species x 2 exposures x 9 outcomes = **18 studies**

	A	B	C	D	E	F	G	H	I	J	K
1	**article_ID**	**source**	**author**	**title**	**year**	**journal**	**doi**	**language**	**document_type**	**metacod_name**	**study_ID**
2	ScreenTA_6754	Scopus	Hédouin, L.S. and \	Improving the ecol	2016	Environmental Poll	10.1016/j.envpol.2	English	Journal_article	DYO	1
3	ScreenTA_6754	Scopus	Hédouin, L.S. and \	Improving the ecol	2016	Environmental Poll	10.1016/j.envpol.2	English	Journal_article	DYO	2
4	ScreenTA_6754	Scopus	Hédouin, L.S. and \	Improving the ecol	2016	Environmental Poll	10.1016/j.envpol.2	English	Journal_article	DYO	3
5	ScreenTA_6754	Scopus	Hédouin, L.S. and \	Improving the ecol	2016	Environmental Poll	10.1016/j.envpol.2	English	Journal_article	DYO	4
6	ScreenTA_6754	Scopus	Hédouin, L.S. and \	Improving the ecol	2016	Environmental Poll	10.1016/j.envpol.2	English	Journal_article	DYO	5
7	ScreenTA_6754	Scopus	Hédouin, L.S. and \	Improving the ecol	2016	Environmental Poll	10.1016/j.envpol.2	English	Journal_article	DYO	6
8	ScreenTA_6754	Scopus	Hédouin, L.S. and \	Improving the ecol	2016	Environmental Poll	10.1016/j.envpol.2	English	Journal_article	DYO	7
9	ScreenTA_6754	Scopus	Hédouin, L.S. and \	Improving the ecol	2016	Environmental Poll	10.1016/j.envpol.2	English	Journal_article	DYO	8
10	ScreenTA_6754	Scopus	Hédouin, L.S. and \	Improving the ecol	2016	Environmental Poll	10.1016/j.envpol.2	English	Journal_article	DYO	9
11	ScreenTA_6754	Scopus	Hédouin, L.S. and \	Improving the ecol	2016	Environmental Poll	10.1016/j.envpol.2	English	Journal_article	DYO	10
12	ScreenTA_6754	Scopus	Hédouin, L.S. and \	Improving the ecol	2016	Environmental Poll	10.1016/j.envpol.2	English	Journal_article	DYO	11
13	ScreenTA_6754	Scopus	Hédouin, L.S. and \	Improving the ecol	2016	Environmental Poll	10.1016/j.envpol.2	English	Journal_article	DYO	12
14	ScreenTA_6754	Scopus	Hédouin, L.S. and \	Improving the ecol	2016	Environmental Poll	10.1016/j.envpol.2	English	Journal_article	DYO	13
15	ScreenTA_6754	Scopus	Hédouin, L.S. and \	Improving the ecol	2016	Environmental Poll	10.1016/j.envpol.2	English	Journal_article	DYO	14
16	ScreenTA_6754	Scopus	Hédouin, L.S. and \	Improving the ecol	2016	Environmental Poll	10.1016/j.envpol.2	English	Journal_article	DYO	15
17	ScreenTA_6754	Scopus	Hédouin, L.S. and \	Improving the ecol	2016	Environmental Poll	10.1016/j.envpol.2	English	Journal_article	DYO	16
18	ScreenTA_6754	Scopus	Hédouin, L.S. and \	Improving the ecol	2016	Environmental Poll	10.1016/j.envpol.2	English	Journal_article	DYO	17
19	ScreenTA_6754	Scopus	Hédouin, L.S. and \	Improving the ecol	2016	Environmental Poll	10.1016/j.envpol.2	English	Journal_article	DYO	18

TD

Hédouin et al. 2016

1 species x 2 exposures x 9 outcomes = **18 studies**

L	M	N	O	P	Q
study_type	country	latitude	longitude	location	taxon_init
Laboratory_experiment	United States of America	21°26'1.97"N	157°47'20.10"W	Coconut Island, Oahu, Hawaii	*Pocillopora damicornis*
Laboratory_experiment	United States of America	21°26'1.97"N	157°47'20.10"W	Coconut Island, Oahu, Hawaii	*Pocillopora damicornis*
Laboratory_experiment	United States of America	21°26'1.97"N	157°47'20.10"W	Coconut Island, Oahu, Hawaii	*Pocillopora damicornis*
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Laboratory_experiment	United States of America	21°26'1.97"N	157°47'20.10"W	Coconut Island, Oahu, Hawaii	*Pocillopora damicornis*
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Laboratory_experiment	United States of America	21°26'1.97"N	157°47'20.10"W	Coconut Island, Oahu, Hawaii	*Pocillopora damicornis*
Laboratory_experiment	United States of America	21°26'1.97"N	157°47'20.10"W	Coconut Island, Oahu, Hawaii	*Pocillopora damicornis*
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Laboratory_experiment	United States of America	21°26'1.97"N	157°47'20.10"W	Coconut Island, Oahu, Hawaii	*Pocillopora damicornis*
Laboratory_experiment	United States of America	21°26'1.97"N	157°47'20.10"W	Coconut Island, Oahu, Hawaii	*Pocillopora damicornis*
Laboratory_experiment	United States of America	21°26'1.97"N	157°47'20.10"W	Coconut Island, Oahu, Hawaii	*Pocillopora damicornis*
Laboratory_experiment	United States of America	21°26'1.97"N	157°47'20.10"W	Coconut Island, Oahu, Hawaii	*Pocillopora damicornis*
Laboratory_experiment	United States of America	21°26'1.97"N	157°47'20.10"W	Coconut Island, Oahu, Hawaii	*Pocillopora damicornis*

TD

Hédouin et al. 2016

1 species x 2 exposures x 9 outcomes = **18 studies**

R	S	T	U	V
exposure_raw	**exposure**	**combined**	**outcome_raw**	**metacod_comment**
Copper (Cu)	Metal	No	Polyp contraction	NA
Copper (Cu)	Metal	No	Expulsion larvae	NA
Copper (Cu)	Metal	No	Change in colour	NA
Copper (Cu)	Metal	No	Survival rate (adult, larvae)	NA
Copper (Cu)	Metal	No	Cu concentration in tissue	NA
Copper (Cu)	Metal	No	Cu concentration in skeleton	NA
Copper (Cu)	Metal	No	Symbiodinium density	NA
Copper (Cu)	Metal	No	Chlorophyll a+c2 content	NA
Copper (Cu)	Metal	No	Fv/Fm (Maximum dark-adapted quantum yield of the photosystem II)	NA
Lead (Pb)	Metal	No	Polyp contraction	NA
Lead (Pb)	Metal	No	Expulsion larvae	NA
Lead (Pb)	Metal	No	Change in colour	NA
Lead (Pb)	Metal	No	Survival rate (adult, larvae)	NA
Lead (Pb)	Metal	No	Cu concentration in tissue	NA
Lead (Pb)	Metal	No	Cu concentration in skeleton	NA
Lead (Pb)	Metal	No	Symbiodinium density	NA
Lead (Pb)	Metal	No	Chlorophyll a+c2 content	NA
Lead (Pb)	Metal	No	Fv/Fm (Maximum dark-adapted quantum yield of the photosystem II)	NA

Complete coding

Ouédraogo et al. Environ Evid (2021) 10:22
https://doi.org/10.1186/s13750-021-00237-9

Environmental Evidence

SYSTEMATIC MAP Open Access

Evidence on the impacts of chemicals arising from human activity on tropical reef-building corals; a systematic map

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	Variable	Description	Value(s)
Bibliographic information	map_ID	Unique identifier given by the review team to each study of the map	A code number
	article_ID	Unique identifier given by the review team to each publication	A combinaison of number and letters
	source	Source of the publication	Scopus | WOS_CC | GS | CORE | GreenFile | Call_for_litterature | CoralTraitDatabase | ReefBase | Ecotox | IFRECOR | AIMS | IFREMER | ICRS | ICRI | LabexCorail | OATD | theseFR
	author	Author(s) of the publication	Text
	title	Title of the publication	Text
	year	Year of publication	YYYY
	journal	Publication journal	Text
	doi	DOI of the publication	Alphanumeric string of characters
	language	Language of the publication	English | French
	document_type	Publication type	Journal_article | Conf_proceedings | Book_chapter |PhD_thesis | MSc_thesis | BSc_thesis | Report
People who coded	metacod_name	Initials of the names of the people who coded the studies	Text

Complete coding

Study general description	study_ID	Unique identifier given by the review team to each study within an article or a thesis chapter	
	study_type	Type of study	Field_survey | Field_experiment | Laboratory_experiment
	country	Name of the country or territory where the study was conducted for in situ study or where samples were collected for ex situ study	ISO 3166 english short name
	region	Region of the country (according to Spalding et al. 2001)	Text
	latitude	Latitude where the study was conducted for in situ study or where samples were collected for ex situ study	Number or alphanumeric string of characters
	longitude	Longitude where the study was conducted for in situ study or where samples were collected for ex situ study	Number or alphanumeric string of characters
	coord_unit	Units of latitude and longitude	Text
	location	Location where the study was conducted for in situ study or where samples were collected for ex situ study (should be recorded when latitude and longitude are unknown)	Text

Complete coding

Population description	taxon_init	Name of the taxon studied as described by authors	Text
	taxon	Name of the taxon studied as updated by the review team. Taxon names were checked using the World Register of Marine Species (http://www.marinespecies.org/) and additional references. **Please note** that *Dipsastraea** does not fully match *Favia* as some *Favia* species in the Indo-Pacific have been transferred to other genera such as for instance *Goniastrea* . Also, *Pocillopora damicornis* has been split into several species including *Pocillopora acuta* . Thus the name *P. acuta* appears in the database from 2019. The two names have been combined here for analysis purposes, as there were *P. acuta* in the past which were called *P. damicornis* . And, *Fungia** includes other genus than *Fungia* such as *Danafungia* .	Text
	taxonlevel	Level of the taxon studied. When a study is about a community (several species or genera or families studied together as a group), the taxon level encoded is the closest common level (e.g. if several species of the same genus are studied together, the "Genus" level is indicated; if several species of the same family are studied together, the "Family" level is indicated; if several scleractinian species are studied together, the "Order" level is indicated).	Species | Genus | Family | Order | NA

Complete coding

General rules for coding:
If applicable, multiple values were delimited with a pipe |
NA was used as a substitute for missing data ("not available")
N/A means "non applicable"

Exposure description	exposure_raw	Type(s) of exposure as described by authors	Text
	exposure	Type(s) of exposure as defined by the review team	Detergent | Dispersant | Eutrophication | Hydrocarbon | Metal | Microplastic | Nanoparticle | Nutrient | Pesticide | Pharmaceutical | Undefined_pollutants | UV filter | Other
	combined	Is the exposure combined with other exposures (e.g. other chemicals, other pressures)?	Yes | No | Unknown | No/Unknown
Outcome description	outcome_raw	Type(s) of outcome as described by authors	Text
	outcome	Type(s) of outcome as defined by the review team	Bioaccumulation | BioaccumulationF | Bleaching | Calcification | Coral_diversity | Cover | Disease | Distribution | Genetic | Growth | Microbiome | Mortality | Physiology | Recruitment | Reproduction | Other
	outcome_level	Level of organization concerned by the measured outcome	Community | Colony | Individual | Tissue | Cellular | Molecular | Unknown
	chemical_accumulated	For Accumulation and Bioaccumulation outcomes only, type(s) of chemical accumulated or bioaccumulated	Hydrocarbon | Metal | Microplastic | Nanoparticle | Nutrient | Pesticide | Pharmaceutical | UV filter | Other | N/A
Comments	metacod_comment	Comments (e.g. description of other pressures)	Text
Linked studies	linked_study	Is the study linked with another one in the database?	No | unique identifier for linked studies
Knowledge cluster	cluster	Number of the knowledge cluster(s) to which the study belongs (see Figure	1 | 2 | 3 | 4 | 2&4 | N/A