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REGISTERED REPORT STAGE 1

Mapping literature reviews on coral health: Protocol for a review map, critical appraisal and bibliometric analysis

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Abstract

1. The health of coral reef ecosystems is declining. As research examining this decline has grown, review articles (secondary literature) have emerged. Secondary literature can include narrative reviews, systematic reviews, and bibliometric analyses. Synthesizing secondary literature can influence research directions, as syntheses visualize both the current state of knowledge and trends in research. Therefore, we propose to use the combination of bibliometric mapping and systematic mapping techniques to synthesize the secondary literature on coral health and coral reef decline.
2. We will examine secondary literature on coral health published in peer-reviewed journals and indexed in Scopus or Web of Science databases. After screening the title, abstract, and keywords of each paper, we will extract information that encompasses the type and purpose of the review, the identified factors affecting coral health, and the health-related outcomes on coral reefs. We will also conduct a critical appraisal using the Collaboration for Environmental Evidence Synthesis Assessment Tool (CEESAT) criteria for papers that are self-reported to be systematic reviews. We will also extract bibliometric data to identify author affiliations, collaboration networks, and journals. We will communicate our results from systematic and bibliometric mapping using visualizations and tabulations.
3. Our systematic map aims to reveal gaps and clusters of topics in review articles on coral health. These findings can guide future research into coral health in both primary and secondary literature. Our critical appraisal will evaluate the robustness of systematic reviews, informing researchers on how to identify and conduct high-quality reviews. Our bibliometric map will uncover the extent and connectivity of researchers synthesizing evidence on coral health, highlighting the diversity (or lack thereof) of those engaging in coral health research.

KEYWORDS
coral bleaching, coral disease, coral recovery, coral reefs, critical assessment, research weaving, second-order synthesis, systematic map

1 | INTRODUCTION

1.1 | Background

Coral reefs are iconic and critical ecosystems of our living planet. Reefs build highly productive ecosystems which support high levels of marine biodiversity (e.g. approximately 30% of fish species) and provide natural storm barriers to protect coastlines (Bowen et al., 2013; Cesar & van Beukering, 2004). Coral reefs are also vital to human fishing and tourism industries (Cesar & van Beukering, 2004). However, the health and abundance of coral reefs have been decreasing worldwide (Harvell et al., 2007; Hoegh-Guldberg et al., 2007; Rogers, 2010; Tracy et al., 2019). Given the ecological and economic importance of coral reefs, research over the past four decades has aimed to identify the strongest drivers of declining coral health and how different aspects of coral health are impacted (e.g. Heron et al., 2010; Maynard et al., 2015; Prada et al., 2017). As we intend to demonstrate, there are a variety of factors identified that contribute to coral health decline, some of which remain poorly understood and many remain understudied.

Coral health empirical research (the primary literature) has rapidly accumulated in recent years. At the same time, many syntheses and review articles (the secondary literature) summarizing the primary literature have also emerged. The growing availability of secondary literature within this field provides a great opportunity to apply methods of second-order synthesis. Second-order syntheses are qualitative and/or quantitative reviews focusing on secondary literature (Hofmeyr & Cochrane Collaboration, 2008; Ioannidis, 2009; Nakagawa et al., 2019). Second-order syntheses use similar or the same methodologies as 'first-order' synthesis (e.g. systematic reviews, systematic maps, meta-analysis, and bibliometric mapping), but such methods are applied to the secondary literature instead. These syntheses allow one to gain a high-level view of research from which to identify common themes, gaps, biases, and research evidence available (Hofmeyr & Cochrane Collaboration, 2008; Ioannidis, 2009; Nakagawa et al., 2019). While first-order syntheses allow researchers to analyse these themes and trends within the data, second-order syntheses analyse broader patterns, such as what topics are most studied, from a wider perspective.

Recently, it has been suggested that one can combine systematic mapping and bibliometric mapping in both first-order and second-order syntheses, an approach termed 'research weaving' (Nakagawa et al., 2019). Systematic maps are key for identifying the state of research (both primary and secondary), allowing us to find trends in research content and discover what topics still need exploring (Nakagawa et al., 2019). Systematic maps can also include a critical appraisal which assesses the quality of both primary and secondary literature, providing a standard to which research can be compared (Woodcock et al., 2014). Bibliometric mapping reveals crucial information on the diversity and connectivity of researchers and topics in a field. In general, combining systematic and bibliometric mapping through research weaving allows for thorough and broad analyses of the literature and presents the results in a clear, highly visual way. Research weaving is also an effective way of directly identifying biases in research. Clearly defined biases and gaps can direct funders, decision-makers, and other shareholders to research areas requiring urgent attention.

1.2 | Objectives

To better understand the state of the currently available coral health research, we propose to conduct a second-order synthesis of reviews, using research weaving—that is systematic and bibliometric mapping. First, we will construct a systematic map to determine how the coral health secondary literature has changed over time and to identify what outcomes are examined in relation to coral health status, what drivers are most explored, and if there are any emerging or niche topics being reviewed. As a supplement to the systematic map, we will conduct a critical appraisal of systematic reviews to evaluate the robustness and reporting transparency of coral health systematic reviews. Second, we will carry out a set of bibliometric analyses to identify, for example, influential reviews, locations of review authors, collaborative networks within the secondary literature, and who the intended audiences are. More specifically, we ask the following questions:

- What types of reviews are used most (e.g. narrative, systematic reviews, or meta-analyses)?
- What are the common and newly emerging topics?
- How robust (e.g. quality of reporting) are the available systematic reviews?
- How are the collaboration networks structured?
- Which countries do review authors come from?
- What type of journals (i.e. specialized or interdisciplinary) do reviews of coral health get published in?

2 | MATERIALS AND METHODS

For protocol methods, we adhered to the RepOrting standards for Systematic Evidence Syntheses (ROSES) for systematic map protocols (Haddaway et al., 2018). Our ROSES checklist for systematic map protocols is available as the Supporting Information.

We defined our primary question using the PECO framework (as described in Haddaway et al. [2018] and Morgan et al. [2018]):

Population: Reviews and syntheses focusing on primary empirical coral health research.

Exposure: Reviews and syntheses addressing impacts of factors that have the potential to affect coral health or address closely related topics including, but not limited to, research methodologies, restoration approaches, data availability, or analyses of global datasets.

Comparator: This part of the framework is not applicable given the diversity of primary evidence types reviewed by studies included in this second-order synthesis.

Outcomes: Reviews and syntheses concerning any outcomes related to coral health research including, but not limited to, bleaching rates, disease prevalence or severity, changes to assemblages of symbionts, changes to research methodology or data availability, or changes in coral cover and diversity in response to environmental drivers.

2.1 | Searches

Literature searches will be conducted using two interdisciplinary databases with broad coverage—Web of Science (Core Collection) and Scopus. These databases are recommended for conducting searches in ecological sciences (Gusenbauer & Haddaway, 2020).

Through piloting, we developed a search string to capture secondary literature on the health of common corals (Table S1). The search string in SCOPUS format is as follows:

> TITLE-ABS-KEY ((coral* OR reef*) AND (disease* OR health* OR bleach* OR band* OR plague OR pox OR spot* OR necro* OR syndrome* OR anomal* OR lesion* OR trematodias* OR 'white patch' OR 'cyanobacterial infection*' OR 'pigmentation response*' OR 'compromised tissue*' OR 'tissue loss' OR 'ciliate* infect*' OR rehabilit* OR recover* OR restorat* OR resilien* OR toleran* OR 'adaptability' OR declin* OR mortalit* OR death* OR 'die-off') AND (review* OR map* OR meta-analy* OR metaanaly* OR meta-regress* OR metaregress* OR (meta AND analy*) OR (meta AND regress*) OR map* OR overview*)).

We benchmarked this search string against 10 test papers (Table S2). Further, we piloted the search string in both Scopus and Web of Science on 17 October 2022. In a pilot search, the search string yielded 3084 papers in Scopus and 2734 papers in Web of Science, representing a total of 4068 unique papers for screening. The piloted search string retrieved all 10 benchmark papers.

When performing the database searches, we will not limit our search results by publication year, discipline or language. However, we will limit the results to papers classified as 'Reviews' or 'Articles' post-search to reduce the capture of conference proceedings, opinions, book sections, and editorials, which are not included in the scope of our synthesis. While we have not used keywords in languages other than English in the search string, we will include papers in other languages that we are able to understand (French, Japanese, Polish, Russian, and Spanish). While this may potentially bias our results, we will acknowledge this limitation in the main text of our report.

We will update our literature searches every 6 months until approval for publication to ensure new publications are included in our final synthesis. Literature collections will be stored in the reference manager Zotero and archived as bibliographic files (.ris, .bib).

2.2 | Study inclusion criteria and article screening process

Our inclusion and exclusion criteria are presented in Figure 1. These criteria reflect our PECO framework (Haddaway et al., 2018; Morgan et al., 2018) as we aim to only include peer-reviewed secondary literature which explores some aspects of coral health.

We will screen articles for eligibility using Rayyan QCRI (Ouzzani et al., 2016). The screening will be conducted by two reviewers: PP and SB. The first 10% of papers will be independently screened to ensure unified screening decisions. If the conflict rate between reviewers rises above 5%, another 10% of papers will be independently screened and cross-checked until the conflict rate is below the 5% threshold. The remaining papers will be divided between the reviewers for the full screening process. Inclusion decisions will be mostly based on the abstract, title, and keywords of the papers, as our pilot screening round indicated that most screening criteria could be reliably assessed against the information in the bibliographic records. In unclear cases, reviewers will consult the full text of the paper to clarify whether a study fulfils all inclusion criteria. A list of examined full-text articles that were excluded will be provided in the Supporting Information.

We conducted a pilot of the screening process on 14 February 2022, using 100 random papers from the pilot literature search described in Section 2.1. Based on the results of the pilot screening, we expect a 15%–20% inclusion rate in the full study. This will yield a dataset of 300–500 papers for data extraction, if our pilot is representative of the final literature sample. Between the two reviewers, there was a 3% conflict in screening decisions during this pilot round.

2.3 | Data extraction

We will extract data from included papers in two steps. Firstly, we will extract basic bibliographic information identifying each paper. This information will include the title, publication year, and name of the first author. The next step will involve extracting data specific to each aim of our synthesis.

2.3.1 | Systematic map

During data collection, we will code which topics related to coral health research are present in the title, abstract, or keywords of the

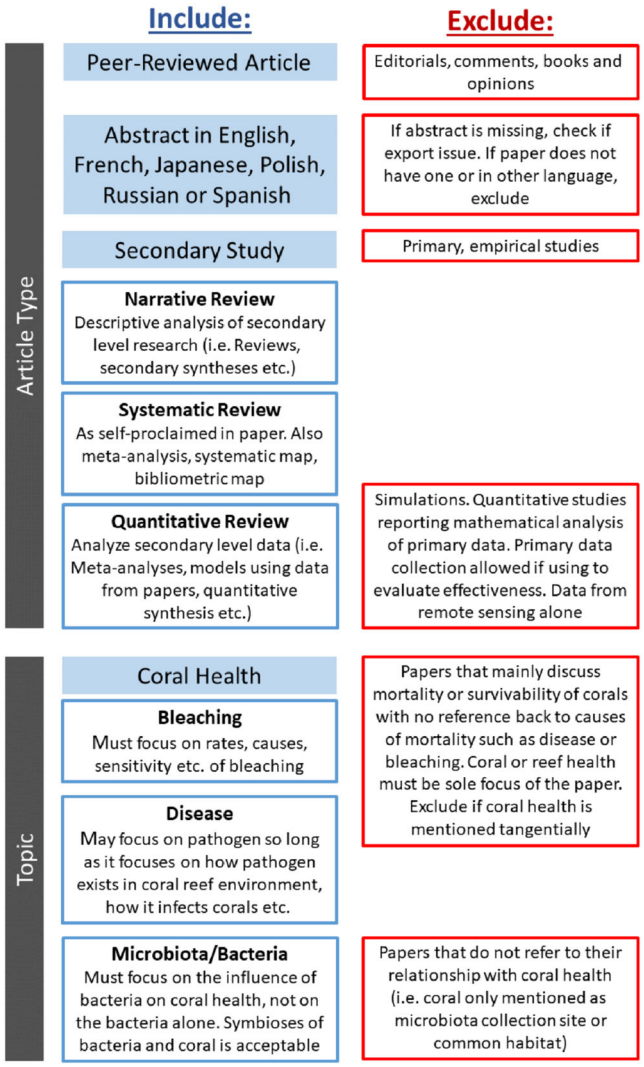

FIGURE 1 Screening decision criteria. Papers must be peer-reviewed journal articles, therefore editorials, comments, book chapters, opinion pieces, conference proceedings, and the like are excluded. Additionally, papers with abstracts written in a language that cannot be understood by at least one author were excluded. In cases where the abstract is missing from the bibliographic record, the full text will be referenced to confirm whether this was an error in uploading the reference to the screening software or if the paper does not have an abstract. If the paper contains no abstract, this paper is excluded as it is then most likely not a peer-reviewed journal article. Included papers must be secondary literature, which includes article types such as narrative reviews, systematic reviews, and quantitative reviews. Quantitative reviews are hard to find in a secondary context, so we define a secondary quantitative review as one that analyses secondary-level data such as a meta-analysis or an analysis of data collected from published studies. This excludes papers that utilize simulated data or data from one directly collected source such as a survey of a particular environment; this would also exclude studies that rely on remote sensing data as it is still an empirical analysis. Primary data are only allowed in a quantitative review if the data are used to evaluate effectiveness of data collection methods. Included papers must also examine some aspect of coral health as the main focus of the study. This can be from a wide variety of perspectives such as coral bleaching/disease, as well as more nuanced studies of health

(Continues)

FIGURE 1 (Continued)
such as understanding the relationship between microbiota and corals. Papers that do not indicate a clear link between their work and coral health will be excluded. Papers where coral or reef health is not the sole focus and is mentioned tangentially, as well as papers that discuss mortality with no mention for how that mortality may have occurred, will also be excluded.

paper. These data will be extracted via a Google Form questionnaire (Figure S1).

For the first aim, we will extract four main categories of information (Figure 2):

1. how are coral health reviews conducted (e.g. narrative or quantitative),
2. why are coral health reviews conducted (e.g. conservation and ecosystem management),
3. which aspects of coral health outcomes are being reviewed (e.g. bleaching, disease, and biodiversity of coral species or microbiota), and
4. what drivers affecting coral health are being reviewed (e.g. increasing temperatures, acidification, pollution, fishing).

A full list of variables we will extract is provided in Table S3. We note that terms and concepts represented by these variables are not exclusive, since many topics in coral research seem to overlap or closely relate (e.g. recovery and resilience—coral recovery is incorporated in the Australian Institute of Marine Science's definition of coral resilience).

When multiple variables apply to a paper, the extraction form allows for multiple to be selected in all categories. To reduce subjectivity between individuals extracting data, we will conduct a conflict analysis as in the article screening process. We set our conflict threshold at no higher than 5% and will cross-check the data should we exceed this threshold.

2.3.2 | Critical appraisal

Due to the high volume of expected included papers, we will conduct critical appraisals for self-proclaimed systematic reviews and meta-analyses only. We expect 50–80 systematic reviews and meta-analyses (1%–2% of the searched literature collection) to undergo critical appraisal. Therefore, to conduct the critical appraisal, we will first need data on what type of review the included papers are (as claimed by the authors) which we collected in the Google Form questionnaire.

We will use the Collaboration for Environmental Evidence Synthesis Assessment Tool (CEESAT; Woodcock et al., 2014) to assess the robustness and quality of coral health systematic reviews and meta-analyses. The CEESAT checklist examines aspects relating to reproducibility and transparency of research. In addition to the 13 CEESAT criteria, we will extract information related to data and code accessibility to further assess coral health systematic reviews against the standards

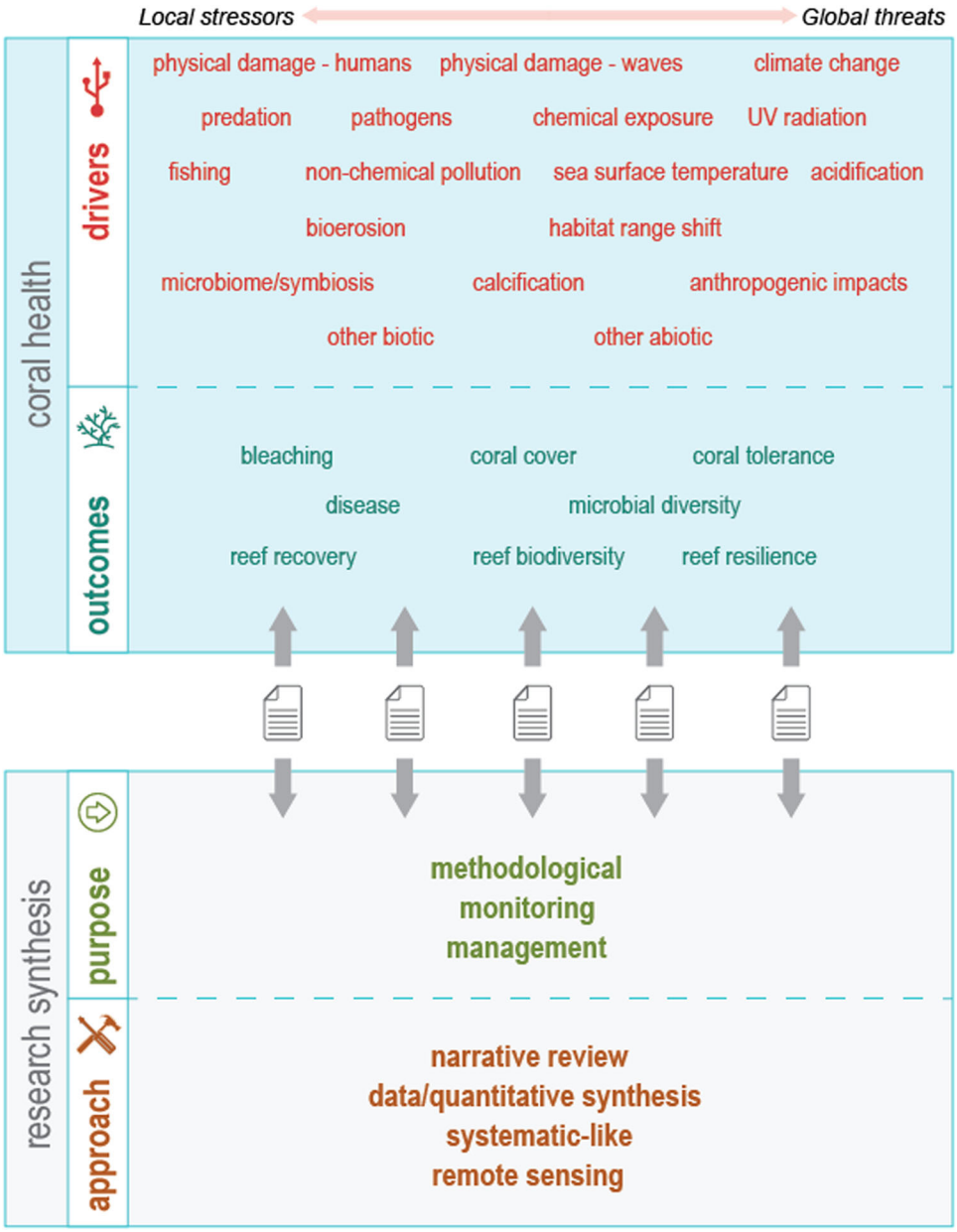

FIGURE 2 Schematic representation of the grouping of variables to be coded during data extraction. The groups represent (from the top): coral health drivers and outcomes, research synthesis purpose and approach. Individual variables will be coded as presence or absence of a given focus or approach in a review. These variables will be complemented by bibliographic information on the included reviews.

for openness in ecological research (O'Dea et al., 2021). Data will be extracted using another Google Form questionnaire which includes both CEESAT criteria and the additional code and data questions (Figure S2). This extraction and CEESAT evaluation will be conducted collaboratively by two researchers and cross-checked by a separate evaluator.

2.3.3 | Bibliometric map

For our bibliometric map of coral health review literature (our second aim), we will need two kinds of data: (i) bibliometric data and (ii) impact metrics. We will extract bibliometric data such as author names, author affiliations (including countries), and publication journals from Scopus records. As bibliometric records from Web of Science and Scopus are incompatible, we can only select one database from which to collect bibliometric data. We select Scopus because, in our experience, relevant bibliometric records can be easier to obtain using articles' DOIs and Scopus often has a better coverage of journals (note that we expect to obtain bibliometric records of almost all selected reviews via this process of using DOIs even though the original search of Scopus would not have all relevant records). We will also collect data on article references, which allows us to conduct citation analysis via bibliometric coupling, co-citation, and direct citation analysis (Nakagawa et al.,

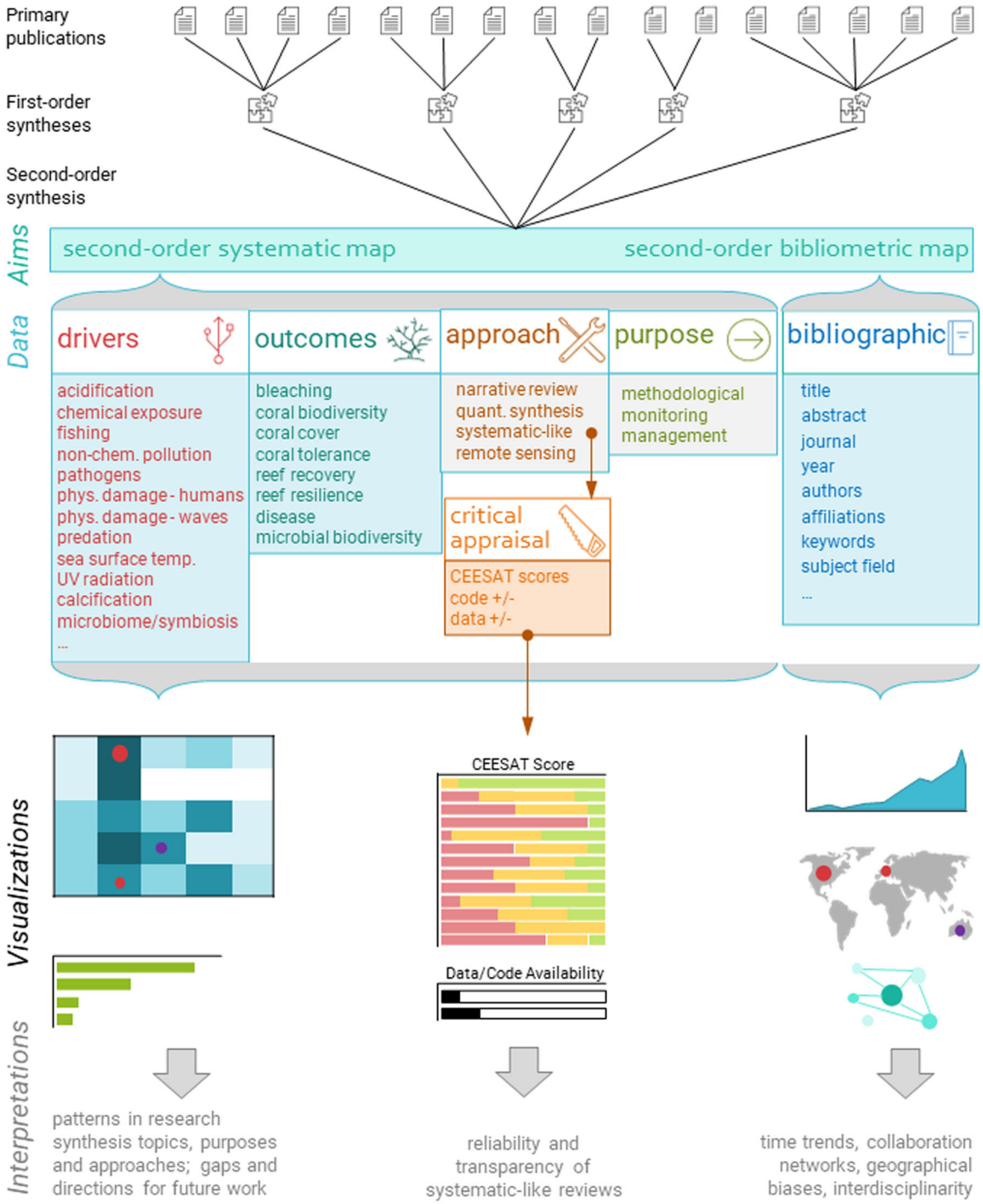

FIGURE 3 Conceptual and workflow diagram of data extraction with example figures based on hypothetical data. The top section summarizes the flow of research as primary literature is compiled into first-order syntheses (i.e. secondary literature) and then first-order syntheses can be further combined into a second-order synthesis. For details of the different aims, see main text. For details of data, see Table S3.

2019). Related to this, we will obtain citation information (e.g. number of times cited) of each paper as an impact metric.

2.4 | Data synthesis and presentation

We will present the data through detailed narrative reviews, descriptive tables, and graphical representation. Any data-generated figures will be created in R (R Core Team, 2021; RStudio Team, 2021); we may use R packages such as ggplot2 (Wickham, 2016), igraph (Csardi & Nepusz, 2006) and bibliometrix (Aria & Cuccurullo, 2017). Examples of visuals are presented in Figure 3.

For the systematic map of reviews, figures may include graphs such as bar plots of review type and timeline of publication counts per year. Most figures will be created from the extracted terms outlined above.

However, these terms may be expanded or combined post-analysis if we identify from the data available that the terms are too closely linked or vastly distinct. Any derived or modified data will be clearly acknowledged in the resulting manuscript.

For the critical appraisal, CEESAT scores will be represented in a summary plot with the distribution of scores for each assessed questionnaire criteria. Figures depicting data and code availability may be produced to supplement the CEESAT scores plot. The critical appraisal section will be accompanied by a supplementary table of assessed systematic reviews. We will also discuss the quality and transparency of coral health systematic reviews as a whole to identify directions for improvement. We follow Woodcock et al. (2014) to clarify these aspects of papers. Transparency refers to the clear description of methodology such that the audience can precisely replicate the study and evaluate the process used. Quality studies are ones which aim to reduce bias through study design.

We will present the bibliometric data in several ways. For example, we aim to highlight the collaboration network based on the co-authorship of included reviews. We also plan to create a map of countries from which authors are conducting this research. This may allow us to explore if physical proximity to reefs associates with the priority to conduct coral health reviews. Additionally, we plan to create a graphical depiction of journal subject areas to identify if the literature is aimed at interdisciplinary audiences or specialized groups. We will use bar/area plots to identify how many reviews were published across time in different categories of extracted terms, if data permit. In addition, we plan to use bibliometric analysis (e.g. co-word analysis; Callon et al., 1983; Zupic & Čater, 2015) to validate the distinction between the variables extracted in the Google Form (i.e. ensuring they are unique variables).

2.4.1 | Demonstrating procedural independence

T.A. published reviews of coral health that may be included in this study. These reviews will be independently assessed by the other authors of this work.

3 | DISCUSSION

Our review map will produce three main outcomes. Firstly, the systematic map will determine what topics are examined in coral health reviews and how these have changed over time. We will identify the gaps and clusters of topics in review articles on coral health. Identified gaps may indicate a need for synthesis and/or further primary research, guiding both primary and secondary studies. Secondly, the critical appraisal will evaluate the robustness and transparency of published systematic reviews. Not only will this reveal the proportion of systematic reviews conducted to high standards, but our assessment may also guide improvement in the quality of future coral health reviews. Furthermore, researchers and policymakers will be able to determine which systematic reviews are 'reliable, comprehensive and transparent' (Woodcock et al., 2014). Thirdly, the bibliometric analysis will reveal the extent or lack of collaborative networks and interdisciplinarity. These results could lead to improvements in research diversity in terms of inter-institutional, inter-continental and inter-disciplinary collaborations.

AUTHOR CONTRIBUTIONS

Samantha Burke, Shinichi Nakagawa, Patrice Pottier, and Malgorzata Lagisz conceptualized the idea and designed the methodology. Tracy Ainsworth validated the methodology. Samantha Burke and Patrice Pottier conducted screening of papers which was validated by Malgorzata Lagisz. Samantha Burke and Patrice Pottier extracted data from papers. Samantha Burke led the writing of the manuscript with crucial contributions from all authors. Samantha Burke and Malgorzata Lagisz created the figures, and Szymon M. Drobniak and Patrice Pottier contributed in a critical way to their design. The project was supervised by Tracy Ainsworth, Szymon M. Drobniak, and Shinichi Nakagawa. All authors gave final approval for publication.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

As this is a protocol, we do not have data to share at this time. The pilot search results are provided as a part of the Supporting Information. Data compiled during the main study will be made available in a GitHub repository as well as in a Zenodo open repository. Data will be stored in .csv format with a meta-data table in a separate .csv file. Bibliographic data will be available as standard .ris or .bib files. Code generated in the main study will be made available in a GitHub repository as well as in a Zenodo open repository. Code will be provided as .R or .Rmd files. All code will be freely available upon publication of the full manuscript.

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PEER REVIEW

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

Table S1. Literature search string development. The last row presents the final search string to be used in the literature searches.

Table S2. List of papers (test set) used for benchmarking search strings for literature databases.

Table S3. Variables to be extracted using a Google Form and their definitions.

Figure S1. Screenshots of Google Form used to extract non-bibliometric data described in Table S3.

Figure S2. Screenshots of Google Form used to conduct critical appraisal.

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