Advances in cumulative effects assessment and application in marine and coastal management (Willsteed et al., in review)

# Extended methodology statement

From abstract of James et al. (2016):

“Evidence synthesis in environmental sciences faces similar challenges to those found in social sciences. Here we describe the translation of systematic mapping methodology from social sciences for use in environmental sciences. We provide the first process-based methodology for systematic maps, describing the stages involved: establishing the review team and engaging stakeholders; setting the scope and question; setting inclusion criteria for studies; scoping stage; protocol development and publication; searching for evidence; screening evidence; coding; production of a systematic map database; critical appraisal (optional); describing and visualising the findings; report production and supporting information.”

We applied a simplified version of the James et al. (2016) process, which was modified to accommodate time and resource constraints. The modifications were to streamline and reduce the set-up steps, to remove the coding step, and to limit the extent of the search to the Scopus database supplemented by the authors’ knowledge of relevant CEA papers. Critical appraisal to an extent will be carried out by peer review.

## Process applied in this paper:

(**step** / description of step from James et al. (2016) / **applied approach**)

i) **establishing the review team and engaging stakeholders** / The review team should ensure that they have adequate means of searching multiple sources for relevant published and unpublished literature (e.g. access to relevant bibliographic literature databases, web-based search engines, websites of specialist organisations) and accessing full texts (e.g. subscriptions to relevant journals, adequate funds for interlibrary loans), as a comprehensive and unbiased search is essential to the systematic mapping process. / **Review team established that comprises the group of authors attributed to this paper, which includes authors with access to published academic literature and databases and ability to access full texts. Review team comprises people with active research, consulting, and delivery interests and experience, providing a depth of relevant knowledge for the review. We omitted stakeholder engagement from the review, though this could be a useful future research step.**

ii) **setting the scope and question** / Firstly, the review team must consider the scope of the topic and the aim of the question to decide whether systematic mapping is the most appropriate approach. Question formulation follows a similar procedure as for systematic reviews (PICO, PECO, PIT or PO formulae) alternatively the question may be more open-framed where, for example, it is not known what interventions or outcomes have been studied or how the studies have been undertaken / **Systematic mapping was judged to be appropriate for the review. An open framed question was set: *what is the current state of knowledge regarding cumulative effects assessment in marine and coastal environments?***

iii) **setting inclusion criteria for studies** / Criteria should be set in consultation with stakeholders where possible and considerable effort should be expended in ensuring they are appropriate and well-defined, since they form the backbone of the systematic map. Systematic maps can include a wide range of research (e.g. primary, secondary, theoretical, economic) and study designs (e.g. experimental, quasi-experimental or observational). The chosen approach for inclusion of studies should be detailed in the protocol and the type of evidence clearly documented in the map database / **Due to time constraints, the authors set their own criteria and limited the search for literature to the Scopus database and including publications known to the authors to be relevant to the question, but which fell outside the literature search term parameters.**

iv) **scoping stage** / The scoping stage helps to shape the planned method for the review and inform development of the protocol. In scoping, the search strategy is tried and tested, the number of results found is recorded (typically from searches in just one academic database), and screening is undertaken on a subset of search results to assess proportional relevance at title, abstract and full text levels / Scoping involved testing a pilot search term: TITLE-ABS-KEY (“cumulative effect” OR “cumulative impact”) AND TITLE-ABS-KEY (marine OR sea OR coast\*) AND TITLE-ABS-KEY (assessment) AND DOCTYPE (ar OR cp OR re) AND PUBYEAR > 2014 . However, results were too numerous and included a large number of papers beyond the scope of this review. We devised a narrower search term: TITLE-ABS-KEY (“cumulative effect assessment” OR “cumulative impact assessment”) AND TITLE-ABS-KEY (marine OR sea OR coast\*) AND DOCTYPE (ar OR cp OR re) AND PUBYEAR > 2014.

v) **protocol development and publication** / The systematic map protocol takes a similar format to that of a systematic review protocol, and should detail the approach that will be taken for all stages of the mapping process / **The protocol applied is detailed in this document, with additional detail in the datafile (supplementary material, worksheet tab “Definitions”.**

vi) **searching for evidence** / Searching for evidence and recording the methods for searching and the numbers of articles captured within a systematic map follows the same procedures as within a systematic review [17]. The methods used for searching for evidence should be documented a priori in the protocol, with any variation recorded in the systematic map report. As with systematic review, the search for literature should aim to be as comprehensive as possible / **We applied the following search term: TITLE-ABS-KEY (“cumulative effect assessment” OR “cumulative impact assessment”) AND TITLE-ABS-KEY (marine OR sea OR coast\*) AND DOCTYPE (ar OR cp OR re) AND PUBYEAR > 2014. The search was limited to the Scopus literature database of peer-reviewed publications.**

vii) **screening evidence** / Screening of search results (also referred to as ‘study inclusion’) against inclusion criteria proceeds in systematic maps in the same way as in systematic reviews: via title, abstract and full text screening stages / **The initial list of literature returned by the search of Scopus was downloaded as a .csv file that was initially refined by a rapid review of titles and abstracts to exclude those that fell outside the remit of the review. We then downloaded and collated retained publications and created a database in Excel to support the systematic mapping exercise. A more detailed review of abstracts and content was completed to further refine the pool of literature to those papers identified as being of direct relevance to understanding the state of CEA research in marine and coastal environments. Reasons for exclusion were noted in the database and subject to review team scrutiny. We added papers known to the authors that were judged to be highly relevant to the review, but which fell outside the search term.**

viii) **coding** / In systematic maps, data extraction may consist only of meta-data. The process of assigning categories to each study for a suite of variables that describe the study setting and design is referred to as coding. Coding is carried out for a combination of generic (e.g. author, title, year of publication, publication type, data source type, data type) and topic-specific (e.g. intervention/s, population/s, length of study, sampling strategy) fields describing the study setting, which will later be collated into a systematic map database. The mapping process is designed to create a useful and structured resource that provides sufficient detail of studies to be of use in future work. / **In addition to coding generic fields the following topic-specific fields were defined and coded for collation into the database:**

**Papers and articles retained for review were distributed among the review team for coding against the following fields:**

* **What geographical region does the research relate to?**
* **Is the research supported by a clear definition of cumulative effects?**
* **Is the research qualitative or quantitative?**
* **Does the research use field data, modelled data, or modelled data that is validated?**
* **What is the primary driver behind the research?**
* **What is/are the VC’s included in the research?**
* **What are the stressors included in the research?**
* **How is the cumulative impact being measured?**
* **What spatial scale is applied?**
* **Is temporal variability considered in the research?**
* **What methodology does the research apply?**
* **What is the output of the research?**
* **What are the key recommendations/observations?**
* **Is there an explicit link to a legislative driver?**
* **Is there evidence that the research has been applied in decision-making or regulation?**

xi) **production of a systematic map database** / The included studies and their meta-data can be presented within one or more databases. Where possible, it is strongly recommended that these databases are searchable. This facilitates interrogation by end-users, who may, for example, want to explore a wider range of questions relating to the map and identify relevant sub-sets of evidence. A database is any organised collation of data. Databases are managed by database management systems (DBMS), such as Microsoft Access and Microsoft Excel. / **We** **created a database in Excel to create the systematic map database (see supplementary material).**

x) **critical appraisal (optional)** / Critical appraisal within systematic mapping is a useful tool to investigating the overall validity of the evidence base or subsets of evidence, something that may be specified by stakeholders commissioning reviews / **Critical appraisal of the database by the authors led to the review paper submitted.**

# Reference

James, K. L., Randall, N. P., & Haddaway, N. R. (2016). A methodology for systematic mapping in environmental sciences. *Environmental Evidence*, *5*(1). https://doi.org/10.1186/s13750-016-0059-6