Journal of Environmental Management 197 (2017) 114–116

Contents lists available at ScienceDirect

Journal of Environmental Management

journal homepage: www.elsevier.com/locate/jenvman

Short communication

The author's reply to N.R. Haddaway

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ARTICLE INFO

Article history:
Received 23 February 2017
Received in revised form
7 March 2017
Accepted 15 March 2017
Available online 23 March 2017

Keywords:
Tailoring
Comprehensiveness
Transparency
Repeatability
Minimum requirement
Systematic map

ABSTRACT

In this reply we respond to the commentary of Dr. Haddaway addressed in searching for pitfalls in our systematic mapping exercise "Collating science-based evidence to inform public opinion on the environmental effects of marine drilling platforms in the Mediterranean Sea" recently published in Journal of Environmental Management (Mangano, M.C. and Sarà, G. 2017. Journal of Environmental Management 188: 195–202). We discussed each so called "pitfalls" and, in our opinion, the main cornerstones of systematic map – SM (repeatability, comprehensiveness, transparency, traceability, quality, generalizability) are safe guaranteeing the "gold standard" required by this technique. Where needed we explain our position in doing a "tailoring" of some steps, and we stressed the differences among our approach and a SM protocol. We also stressed the importance of our main message, to select the most rigorous approach (evidence-based), to create a credible, salient and effective knowledge baseline to inform end users and guarantee the creation of a solid science-policy nexus (here specifically we provided a final review product, an easy to follow up graphical evidence).

1. Commentary

In our recent paper "Collating science-based evidence to inform public opinion on the environmental effects of marine drilling platforms in the Mediterranean Sea" (Mangano and Sarà, 2017), we assessed the amount of evidence in the literature dealing with the potential impacts of marine drilling platforms in the Mediterranean Sea. The main purpose of our paper was to scope the amount of evidence existing on the effects of drilling platforms on components of the Mediterranean marine ecosystem to create an evidence-based baseline to inform end users. For this purpose, we decided to exploit the power of a recently proposed approach, the systematic map (SM) (McKinnon et al., 2016; Haddaway et al., 2016 and references therein), which was primarily based on Guidelines for Systematic Review in Environmental Management proposed by the Collaboration for Environmental Evidence (CEE, 2013; http://www.environmentalevidence.org/). Specifically, we embraced the CEE approach, based on robustness and transparency, tailoring some steps to fit the question. However, in a commentary note, Haddaway (this issue) criticised our systematic mapping exercise and specifically highlighted some pitfalls dealing with: 1) question framing, 2) search engine, 3) grey literature selection criteria, 4) SM key output, 5) "vote-counting" approach. While we are happy to receive valid criticism from a prominent leading scientist in the field, we believe in this instance his criticism is not fully justified. We fully appreciated Haddaway's point-by-point examination of our systematic mapping process which allowed us to further explore the importance of comprehensiveness, transparency and repeatability as foundational pillars to ensure the "gold standard" in reviewing methods when building evidence-informed policy and practice (Pullin and Stewart, 2006; Haddaway and Bilotta, 2016). Indeed, we believe that a fully open approach of providing arguments *pro et contra* is the chief strength of the scientific approach.

As authors who are very familiar with systematic review and the use of meta-analytical tools to answer various environmental questions (Sarà, 2007a, 2007b, 2007c; Mangano et al., 2015, 2017) - we felt the need to correct errors of judgement relating to i) our application of methods and ii) the presentation of key outputs in our review. Thus, we have systematically replied to each "pitfall". We clearly demonstrate that we met the minimal threshold of the standard requirements for a SM (Randall and James, 2012; Haddaway and Bilotta, 2016; Haddaway et al., 2016), however, as in most experimental practices, justified deviations from standard well-accepted protocols (e.g. CEE) are commonly adopted in all

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http://dx.doi.org/10.1016/j.jenvman.2017.03.044
0301-4797/

scientific fields (O'Leary et al., 2016; see also studies criticised by Haddaway et al., 2017). Such deviations generate choices and compromises not directly dependent on the conduct of the researcher *per se*, but on many other factors: the nature of the question and formal structure and components of hypothesis, external conditions often not controllable (*sensu* Hulbert, 1984) such as some field limitations (e.g. investigations under difficult conditions such as deep-sea or polar environments) and laboratory restrictions (e.g. practices subjected to the animal care) and on possible literature data source limitations (e.g. all practices analysing secondary data - systematic review, meta-analyses). In dealing with such limitations and restrictions, scientists may adopt tailored solutions to render their questions remaining answerable and facilitate the translation of the scientific message to a broad audience concerned with the science-policy nexus. The building of a credible, salient, legitimate science-policy nexus baseline (*sensu* Cash et al., 2003) is a welcome step in environmental science in order to correctly inform and increase the interest of practitioners and end users (including academics, environmental managers, stakeholders, policy makers and public opinion). Thus scientists should recognise possible bottlenecks, pitfalls and shortcomings in any approach without *a priori* prejudices, but with an open-mind in order to identify possible improvements address experimental limitations, including rare and poorly prepared sources of data in the existing. Here, we demonstrate that our "tailored" SM exercise aligned well with the final aim of our question, i.e. "to provide inform public opinion and policy makers by offering a relevant set of objective scientific evidence as an effective and active information, translation and mediation tool to apply to human-environmental systems" (Mangano and Sarà, 2017).

The question framing: the need to feed a science-policy nexus dialogue. We recognise the importance of setting a valid primary question, reporting in the Introduction, "We decided to create an evidence map (systematic map based on evidence from the literature *sensu* McKinnon et al., 2016) to scope and quantify the existing evidence on the effects of off-shore extraction platforms on Mediterranean marine ecosystem components". The construction of this phrase seems to us to coincide with that of "what evidence exists on …" rather "what are the effects of …" which is exactly the contrary that Haddaway criticised. In doing so, the search was intended to evaluate the amount of information (evidence) that could effectively test whether it was possible that the drilling activity could elicit a change in a natural system. Later, in the paper, we used the sentence: "What effects do offshore extraction platforms have on Mediterranean marine ecosystem components?" We translated the formal meaning of the technical sentence reported above, with a simple and easily-understandable phrase for practitioners, the final end users of that review. Such translation is required if the evidence-based research is to be accessible to policy-makers and to feed into the science policy-nexus dialogue (Adams and Sandbrook, 2013; Hickey et al., 2013).

Searching for evidence. Most scientists performing reviews in ecology and environmental science are experimental biologists and ecologists who appreciate the role and the importance of meeting the criterion of Galilean repeatability (*sensu* Underwood, 1997) to build the basic framework to test scientific hypotheses (Popper, 1968). We recognise that the adoption of comprehensiveness in designing the search strategy is a cornerstone when undertaking systematic reviews, as demonstrated for example by a companion protocol published recently in Environmental Evidence Journal (Mangano et al., 2015). The search of relevant information for the "drilling platform" review (Mangano and Sarà, 2017) was performed on exactly the same collection of databases as most of the reviews we carried out over the last 10 years. Haddaway was right in counting details provided about the database list, but we believe that this aspect does not impair the validity of the outcome *per se* or violate the repeatability principle, but highlights an important concern that theoreticians should solve soon. Indeed an important question is about how to standardise the search in scientific fields when, for example, Palermo University or the Italian Research Council can rely on more databases included in their collections than Stockholm University[1] as suggested by Haddaway's commentary and other authors doing similar consideration on the value of search engine (O'Leary et al., 2015). Thus, we appreciated this criticism and believe it should cause the scientific community to reflect not only on the value of search engines *per se*, but also on the role played by differential accessibility to information on the outcomes of research. While a possible solution would be to limit such research to the more powerful private or public institutions, this would obviously be undesirable and indeed could violate the principle of freedom of expression. In Mangano and Sarà (2017), the search engine on academic databases essentially followed Pullin and Stewart (2006) and Haddaway and Bayliss (2015), combining searches for unpublished scientific studies through Google Scholar and Google, extending to several catalogues of academic theses, databases including conference proceedings and pre-print servers (e.g. biorxiv.org; http://www.opengray.eu) and involving a check for duplicates. We believe that the details provided were comprehensive. Surprisingly, and in contrast to Haddaway's note (this issue), all essential elements which made the search strategy sufficiently sensitive and transparent to capture most of the evidence pertinent to the original review (Pullin and Stewart, 2006; Haddaway and Bayliss, 2015; Haddaway et al., 2017) were correctly reported in the original paper (e.g. all keywords for each of the PICO elements chosen during an initial inception meeting among the review team and steering group; the search strings built and successively tested; of course the search date was also reported; see Tables 1 and 2 Mangano and Sarà, 2017).

Peer-reviewed and grey literature: shading the grey. As recognised by Haddaway in his commentary, we have included the grey literature (*sensu* Haddaway and Bayliss, 2015) in our search strategy. Nevertheless, we defined it as "peer-reviewed literature" as most of the grey literature was retained after the quality check step (i.e. but see screening criteria in the original paper) was peer-reviewed (e.g. conference proceedings for which we have checked the presence of a peer review process), apart from seven stakeholder and local manager reports (Fig. 2c in Mangano and Sarà, 2017). We considered these routines steps in conducting a SM and for this reason, details were not listed in the methods section of our paper, where we simply referred to the followed guidelines. We preferred to show a good example of how to propose SM as the most rigorous tool, to organise the best available evidence, and take a step forward from both a SM protocol or SM database to create a solid baseline in a practical and pragmatic sense.

Key outputs from systematic map: theory *vs* practice. Purists of systematic review techniques are correct to indicate the precise difference between "heat" and "systematic map". We adopted another choice in presenting our data because we considered a "searchable database of relevant studies" as claimed

[1] Web of Science package were: Web of Science Core Collection of course (the main Web of Science database, itself consisting of 8 databases; Science Citation Index Expanded, Social Sciences Citation Index, Arts & Humanities Citation Index, Conference Proceedings Citation Index- Science, Conference Proceedings Citation Index- Social Science & Humanities, Book Citation Index– Science, Book Citation Index– Social Sciences & Humanities, and Emerging Sources Citation Index), BIOSIS Citation Index, Chinese Science Citation Database, Current Contents Connect, Data Citation Index, Derwent Innovations Index, KCI-Korean Journal Database, MEDLINE, Russian Science Citation Index, SciELO Citation Index and Zoological Record.

by Haddaway, a difficult tool to be managed by most stakeholders and the general public. We believe that the visualization in our graphical map (Fig. 4, Mangano and Sarà, 2017) reflects the evidence from our databases clearly and is readily understandable by end users. This decision resulted from a public consultation which invited people to express their opinion by voting to change the rules on the length of licence duration and the decommissioning of offshore oil and gas platform drilling licences, followed by our bottom-up process to build a synthesis to meet that need. As a main consequence, we proposed a tool for the immediate consultation that was - in the opinion of the Authors and Journal of Environmental Management referees – a winning choice. That choice did not meet the need of some theoreticians, but it is apparent from our paper how much work has been done on this topic. In this reply, we present the main outcome as a "systematic graphical analysis of the current literature" on a certain topic which meets the basic principles of science-policy nexus more appropriately than a systematic map. Other authors that selected guidelines on how to structure reviews and present their main outcomes adapted their approach to review information in the same spirit (McKinnon et al., 2016).

Dangers of vote-counting. Contrary to Haddaway's suggestion that we were carrying out "vote count analyses", our grouping analysis (Table 4, Mangano and Sarà, 2017) had the simple aim of organising the evidence as a matrix to catalogue science-based knowledge, helping the visualization of a set of knowledge gaps and gluts. We did not violate any principle of comprehensiveness, transparency and repeatability. The objective of our data presentation was simply to grasp the reader's attention.

Summary. In our opinion the hyper-specialised searching for "pitfalls" applied by Haddaway to our paper fits better with the production of a SM protocol than the evidence-based synthesis generated from a SM map and related "heat map" (*sensu* McKinnon et al., 2016) or graphical analysis. The latter is closer to what we had in mind and for the general purpose of our paper. While we stressed the importance of SM for the collation and description of bodies of evidence, our main aim was to arrange the knowledge necessary for end users (e.g. public opinion) in a credible, salient and legitimate way. The simple message communicated by our review was to encourage a more evidence-based approach in environmental science. Being confident of the rigour adopted in planning and perform a SM, we addressed a specific question for our college students and common citizens. Nevertheless, as scientists, we again thank Haddaway for his specialised comments as he offered food for thought, reflecting on the power of a specific tool while acknowledging that this, like most analytical techniques, must meet certain criteria if it is to perform optimally. Without approving of sloppiness, we caution against unnecessarily strict adherence to narrow approaches in science, specifically scientific review and discussion of environmental issues, as suggested by others authors (Adams and Sandbrook, 2013; Dafforn et al., 2015). We would appreciate scientific articles written by theoretical purists in a constructive and open-minded spirit, demonstrating an appreciation of the different ways in which an approach may be applied, while suggesting improvements of necessarily imperfect methodologies.

Acknowledgements

We thank Magnus Johnson (University of Hull, UK), Nova Mieszkowska (Plymouth Marine Lab, Plymouth, UK), Christopher Mc Quaid (Rhodes University, Grahamstown, South Africa) and Ken Sebens (Washington University, Washington, USA) to have encouraged us in replying and for the fine tuning of our writing.

References

Adams, W.M., Sandbrook, C., 2013. Conservation, evidence and policy. Oryx 47, 329–335.
Cash, D.W., Clark, W.C., Alcock, F., Dickson, N.M., Eckley, N., Guston, D.H., Jager, J., Mitchell, R.B., 2003. Knowledge systems for sustainable development. Proc. Natl. Acad. Sci. 100, 8086–8091.
Collaboration (The) for Environmental Evidence (CEE), 2013. Guidelines for Systematic Reviews in Environmental Management. Centre for Evidence-Based Conservation Bangor University, UK, p. 80. http://www.environmentalevidence.org/.
Dafforn, K.A., Glasby, T.M., Airoldi, L., Rivero, N.K., Pinto, M.M., Johnston, E.L., 2015. The authors' reply. Front. Ecol. Environ. 13, 120–130.
Haddaway, N.R., Bayliss, H.R., 2015. Shades of grey: two forms of grey literature important for reviews in conservation. Biol. Cons. 191, 827–829.
Haddaway, N.R., Bilotta, G.S., 2016. Systematic reviews: separating fact from fiction. Env. Int. 92, 578–584.
Haddaway, N.R., Bernes, C., Jonsson, B.G., Hedlund, K., 2016. The benefits of systematic mapping to evidence-based environmental management. Ambio 45, 613–620.
Haddaway, N.R., Land, M., Macura, B., 2017. A little learning is a dangerous thing": a call for better understanding of the term 'systematic review. Env. Int. 99, 356–360.
Hickey, G.M., Forest, P., Sandall, J.L., Lalor, B.M., Keenan, R.J., 2013. Managing the Environmental Science-policy nexus in government: perspectives from public servants in Canada and Australia. Sci. Public Policy 40 (4), 529–543.
Hulbert, S.H., 1984. Pseudoreplication and the design of ecological field experiments. Ecol. Mon. 54, 187–211.
Mangano, M.C., Sarà, G., 2017. Collating science-based evidence to inform public opinion on the environmental effects of marine drilling platforms in the Mediterranean Sea. J. Environ. Manag. 188, 195–202.
Mangano, M.C., O'Leary, B.C., Mirto, S., Mazzola, A., Sarà, G., 2015. The comparative biological effects of spatial management measures in protecting marine biodiversity: a systematic review protocol. Env. Ev. 4, 21.
Mangano, M.C., Sarà, G., Corsolini, S., 2017. Monitoring of persistent organic pollutants in the polar regions: knowledge gaps & gluts through evidence mapping. Chemosphere 172, 32–45.
McKinnon, M.C., Cheng, S.H., Garside, R., Masuda, Y.J., Miller, D.C., 2016. Sustainability: map the evidence. Nature 528, 185–187.
O'Leary, B.C., Bayliss, H.R., Haddaway, N.R., 2015. Beyond PRISMA: systematic reviews to inform marine science and policy. Mar. Policy 62, 261–263.
O'Leary, B.C., Kvist, K., Bayliss, H.R., Derroire, G., Healey, J.R., Hughes, K., Kleinschroth, F., Sciberras, M., Woodcock, P., Pullin, A.S., 2016. The reliability of evidence review methodology in environmental science and conservation. Env. Sci. Policy 64, 75–82.
Popper, Karl R., 1968. The Logic of Scientific Discovery, 2d ed. Harper & Row, New York.
Pullin, A.S., Stewart, G.B., 2006. Guidelines for systematic review in conservation and environmental management. Conserv. Biol. 20, 1647–1656.
Randall, N.P., James, K.L., 2012. The effectiveness of integrated farm management, organic farming and agri-environment schemes for conserving biodiversity in temperate Europe. A systematic map. Env. Ev. 1, 1.
Sarà, G., 2007a. Aquaculture effects on some physical and chemical properties of the water column: a meta-analysis. Chem. Ecol. 23, 251–262.
Sarà, G., 2007b. Ecological effects of aquaculture on living and non-living suspended fractions of the water column: a meta-analysis. Water Res. 41, 3187–3200.
Sarà, G., 2007c. A meta-analysis on the ecological effects of aquaculture on the water column: dissolved nutrients. Mar. Env. Res. 63, 390–408.
Underwood, A.J., 1997. Experiments in Ecology: Their Logical Design and Interpretation Using Analysis of Variance, xviii. Cambridge University Press, p. 504.