Collaboration for Environmental Evidence

CEE is an independent, not-for-profit, global network of researchers and stakeholders that publishes evidence syntheses to inform environmental policy and practice

Plain Language Summary
September 2021

Systematic Map
CEE 20-017

Evidence for impacts of individual chemicals on tropical reef-building corals is generally available but experimental studies on combined effects of more than two chemical categories are completely absent.

Dakis-Yaoba Ouédraogo, Mathilde Delaunay, Romain Sordello, Laetitia Hédouin, Magalie Castelin, Olivier Perceval, Isabelle Domart-Coulon, Karen Burga, Christine Ferrier-Pagès, Romane Multon, Mireille M.M. Guillaume, Clément Léger, Christophe Calvayrac, Pascale Joannot & Yorick Reyjol


Photo: Quod Jean-Pascal

This systematic map revealed a large volume of literature (908 articles corresponding to 7,937 studies), which highlighted the many chemical classes that tropical reef corals are exposed to, and the varied impacts recorded. We highlight four knowledge clusters as subtopics for further focused review. We also identified knowledge gaps, which indicate areas meriting further resources and research. Of particular concern is the complete gap in experimental research on the combined effects of more than two categories of chemicals, although observational studies have found that corals are indeed exposed to combinations of chemicals.

Why is this Evidence Synthesis Needed?

Tropical coral reefs provide important ecosystem services to millions of coastal and island people but 75% of these reefs are currently threatened by both climate change and local stressors, the latter including chemical pollution arising from poor land management, agriculture, and industry. While countries cannot tackle climate change alone, they can seek to reduce local stressors such as chemical pollution, which may be exacerbating impacts of climate change on corals. To do this, decision-makers need evidence on what chemicals the reefs are exposed to, and what impact they are having. We therefore systematically mapped the evidence on impacts of chemicals arising from human activities on tropical reef-building corals, which are the main engineer species of reef ecosystems. We mapped different categories of chemicals, impacts studied, taxa studied, geographical location, and date.

This Collaboration for Environmental Evidence systematic map evaluates the evidence on the impacts of chemicals on tropical reef-building corals. The map summarizes 7,937 studies from 908 articles.

Main Findings

What studies are included?

This map includes 7,937 studies that evaluate the impact of chemicals arising from human activities on tropical reef-building corals. These studies come from 908 articles dating from 1971 to 2020. The scope was global, but studies were mainly from Australia and the United States of America (primarily Hawaii and the Florida Keys). Nutrients (e.g. nitrate, phosphate) were the most commonly studied chemical category, while the most studied coral response was bioaccumulation (i.e. the process of accumulation of chemicals in an organism, the entry of contaminants into the cells of organisms is the first step for potential subsequent toxic effects). About half of the studies were experimental (i.e. exposure was controlled by the researchers), and half were observational.

What evidence exists on the impacts of chemicals arising from human activities on tropical reef-building corals?

We found evidence for at least 10 categories of chemicals, including nutrients, metals, pesticides, hydrocarbons, oil dispersants, detergents, microplastics, nanoparticles, pharmaceuticals such as antibiotics, and ultraviolet filters. We found a wide range of effects had been recorded from experimental or observational research: from molecular aspects such as genetic expression and enzyme activity, through physiological impacts including growth, disease and mortality, to community-level impacts such as coral cover and species richness. We found many studies (knowledge clusters) about bioaccumulation, nutrient enrichment effects, human activity effects (although chemicals were not identified), and ecotoxicology, and we suggest how these could be subtopics for focused systematic reviews. We also identified gaps in knowledge for geographical regions, taxonomic groups, and chemical categories. For example, there was some mismatch between the number of studies on corals from a specific country and the coral reef area of that country. There is also a relative paucity of studies on some chemical categories (e.g. microplastics), which is likely to be temporary because they have only begun to be studied in recent years. There is, however, a complete gap in experimental research on the combined effects of three or four chemical categories, although observational studies confirm that such exposure is a reality in the natural environment of tropical corals.

What are the Implications of the Review Findings?

Decision-makers and researchers can use this systematic map in a number of ways, including providing a way to identify literature most relevant to the country/topic of interest. This allows strengths and gaps in evidence to be identified, which can help policy-/decision-makers decide on priority research topics to support and focus on in the future. The systematic map can also help in the risk assessment process, which requires an evaluation of toxicity and exposure to chemicals. It will indeed be possible to extract evidence of toxicity from experimental studies presented in the map.

This systematic map can also provide valuable support to local stakeholders who need to identify the body of literature that is relevant to their particular concern. For example, if local stakeholders are concerned with the impact of nickel mining on corals, they will be able to easily search the map database under the metal exposure category and select studies relevant to their issue. Or, if local stakeholders want to identify research projects already being conducted in their area, they can select studies from the database that correspond to the geographical area of their interest.

Photo:: Eggy Febryano

Synthesis Time Frame

The review authors conducted their searches between March and September 2020, with no time restriction applied. This CEE Systematic Map was published in September 2021.

Full Citation

Ouédraogo, D.-Y., Delaunay, M., Sordello, R., Hédouin, L., Castelin, M., Perceval, O., Domart-Coulon, I., Burga, K., Ferrier-Pagès, C., Multon, R., Guillaume, M. M. M., Léger, C., Calvayrac, C., Joannot, P., & Reyjol, Y. (2021). Evidence on the impacts of chemicals arising from human activity on tropical reef-building corals; a systematic map. Environmental Evidence, 10(22), 1-18. https://doi.org/10.1186/s13750-021-00237-9

Link to Publication

https://environmentalevidencejournal.biomedcentral.com/articles/10.1186/s13750-021-00237-9

Funding

This map was funded by the French Office for Biodiversity and the French National Museum of Natural History.