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The 80:20 estimate of land vs. ocean sources of marine pollution: fit for purpose?

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1 Introduction

An estimation that 80% of ocean pollution comes from land-based sources while 20% comes from ocean-based sources (the “80:20 estimate”) has been oft-quoted in the scientific literature, across various media platforms, and in policy documents for decades. The estimation most likely derives from a study published by the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP), which provides authoritative, independent, interdisciplinary scientific information to United Nations (UN) sponsoring organisations with substantial maritime and ocean interests to support the protection, sustainable use and governance of the ocean. In the report (GESAMP, 1990), GESAMP provided a rough estimation of relative contributions of all potential pollutants resulting from human activities and entering the ocean, positing that 44% was from land-based discharges and run-off, 33% from atmospheric inputs; 12% from maritime transportation, 10% from ocean dumping, and 1% from offshore production. These estimates represented an educated approximation based on review of select published studies and reports and suggested that ocean pollution derived mainly from land-based sources, while shipping and ocean dumping were lesser sources at that time.

2 An oft-cited ‘statistic’

Since publication of the 1990 GESAMP study, a large amount of data has been generated on the sources and fluxes into the ocean of a wide range of marine pollutants, from untreated sewage to plastic to nutrients to other chemicals. Use of any search engine to identify scientific papers on the sources of pollution entering the ocean invariably lists publications that quote the 80% estimation for land-based sources, without any reference or citation for that figure. Where citations for the 80:20 estimate exist, these are usually UN

reports that have themselves used the figures without citation. In essence, an unsubstantiated figure stemming from one very rough estimate produced more than 30 years ago has become apocryphal in the scientific and popular literature as an adopted ‘fact’. However, as more data and information on marine pollution in its many forms and from numerous sources are generated, and with reductions through regulatory actions for some substances (wastes) permitted to enter the marine environment since 1990, it is prudent and timely to review the accuracy and the utility of the 80:20 estimate.

From a scientific perspective, the problems with the 80:20 estimate are two-fold. First, any statement of the global proportion of land- versus ocean-based pollution needs to define the specific pollutant being considered in order to be meaningful. Reference to ‘pollution’ generically, rather than to specific types of pollutants, fails to acknowledge the many orders of magnitude differences in pollutant quantities entering the ocean – figures that range from the tens of millions of metric tons per year for plastic and nitrogen (Jambeck et al., 2015; Tivig et al., 2021) to a few thousand metric tons per year for trace metals such as mercury (Zhang et al., 2023). Some marine pollutants, such as sewage, are clearly nearly entirely from land-based sources, whereas in some locales (such as the North Pacific gyre), at least half the plastic derives from abandoned, lost and otherwise discarded fishing gear, an ocean-based source (LeBreton et al., 2018). Quite simply, the distinct and unrelated nature of pollutants and their potentially harmful effects diminishes the rationale for considering them as an integrated whole.

Second, while the 80:20 estimate was perhaps useful in setting a global context and encouraging a global perspective on ocean pollution, from a policy standpoint pollution data are far more meaningful and useful on a scale of smaller geographies. At the level of seas, coastal regions, bays and estuaries is where pollution threats need to be identified through measurement (fluxes, concentrations, trends) and various policy, regulatory and other actions that may be taken to reduce such pollution to environmentally safe levels, regardless of their origins.

In an era in which the veracity of data and the value of science are increasingly called into question or totally refuted, it is critical to clearly articulate the factual bases of our knowledge and understanding, and to acknowledge what is not based in science. Without equivocation, the estimation of 80% of marine pollutants coming from land-based sources and 20% coming from ocean-based activities is not based on a scientifically rigorous global assessment of data and should not be invoked in those terms.

3 Discussion

GESAMP has considered revisiting and revising the 80:20 estimate by conducting a comprehensive global meta-analysis of available data for specific pollutants (e.g. plastics, nitrogen).

However, as stated above, given the questionable utility of such a global examination from a policy and action standpoint, it would be an academic exercise at best. Rather, it would be more valuable to strengthen scientific information on a selected suite of key marine pollutants at the regional, national and local levels (see Hatje et al., 2024), to identify:

1. Accurate data (concentrations, fluxes) on select pollutants from different sources in defined areas and/or over defined time periods;
2. Most concerning pollutants due to their actual or potential environmental, and/or human and/or animal health impacts;
3. Gaps and emerging concerns regarding sources and impacts of marine pollutants;
4. Trends (temporal, geographic) in sources and impacts of pollutants; and
5. Root causes (governance/market failure) of select pollutants.

It is acknowledged that the 80:20 estimate has served a general purpose in helping translate science into policy. It crystallizes the ever-growing body of scientific data on sources of marine pollution into a generalization that has served to raise public awareness and galvanize change, regardless of its accuracy. However, while the 80:20 estimate has likely contributed to informing some level of awareness, policymaking and action *vis a vis* addressing marine pollution, it needs to be acknowledged that the generic terminology (‘pollution’, covering the whole range of types and volumes) and geographic scale (global) of the estimate is of limited meaning and utility from a scientific or management perspective.

In conclusion, the 80:20 estimate should be retired from scientific use and efforts to address the environmental and human health effects of marine pollution through the collection and analyses of data and associated policy action should rather focus on sources and impacts of priority and emerging pollutants in contaminated areas at smaller geographic scales including regional, national and local.

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Conflict of interest

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