COMMENTARY

The Microplastics and Shellfish Media Frenzy - Stop the Train, We Want to Get Off!

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Plastics are pervasive, persistent, and perpetual components of the marine environment, and this has been well documented. The impacts of macroplastics (plastic bags, chairs, bottles, and other items) are highly visible, often dramatically, e.g., general pollution, bags smothering coral reefs, choking sea turtles, and starving sea birds. More recently microplastics – the breakdown by-products of macroplastics, components of personal care products, synthetic fibers, and others – have become a major focal point. While microplastics have been a curse of the marine environment for decades, recent publicity and campaign efforts have brought the plight to the forefront and the topic has become the latest scientific bandwagon, driven unfortunately, as are many scientific bandwagons, by the international desire to claim one's territory in the quest for research funding and notoriety.

Microplastics have become the latest scientific bandwagon, driven unfortunately by the international desire to claim one's territory in the quest for research funding and notoriety. Researchers need to design and carry out experiments using proper and accepted methodologies, read past literature, and not rush to publish prematurely. Sloppy efforts will inevitably cause more harm than good and overcoming bad publicity and stigma is never an easy or even possible task.

Scientific research takes time, careful experimentation, and expertise. Far too often, in the rush to publish and stake one's claim within the field, the scientific literature becomes littered with unreliable, dubious and incorrect information. It is entirely irresponsible for scientists and scientific journals to publish questionable data derived from questionable methods. Once published, be it in scientific journals or the internet, it is difficult, if not impossible, for the general reader to distinguish between what is reliable and true versus what is mere hyperbole. And it cannot be unpublished. Much of what is currently available has not been carefully peer-reviewed or vetted and has done nothing more than confuse the entire field. Indeed, one recent supposed review paper included the statement "the literature review process did not include assessment of the reliability of each report" – they simply listed some of the available literature.

The methodologies alone for the determination and characterization of microplastics are difficult and expensive and the majority of studies published have not used them. Simple microscopic examination is not sufficient. Experimental protocols used for uptake and depuration studies are severely lacking in scientific rigor or suitable animal husbandry.

Microplastic sampling and extraction protocols are inconsistent across studies. The use of muffled glassware, metal equipment and filtered liquid reagents (e.g., Milli-Q water and ethanol) are necessary for field collection quality control. Studies need to report relevant quality control efforts and eliminate avoidable plastics including collection bottles and ropes. Preservation methods and details like microplastic recovery rates should be reported to determine the validity of the extraction methods used.

To extract microplastics efficiently, samples are digested before a density separation. Digestion with hydrogen peroxide has been demonstrated as time-efficient and non-damaging to plastic polymer composition. Alternative digestions using acid, enzymes and alkaline solutions have been used, but little is known about the effect of enzymatic and alkaline digestions on polymer composition. Acids can melt plastics in the sample and therefore should be avoided. Hypersaline sodium chloride solutions or denser salts, like sodium iodide or zinc bromide, are recommended for density separations. Methanol or ethanol can be added secondarily to extract any remaining microplastics.

The most important and often most neglected part of the methodology is proper identification of microplastics with Fourier transform infrared spectroscopy (FT-IR) or Raman spectroscopy. Visual sorting with a dissecting microscope can be used for imaging and characterization of the particles' physical properties, but FT-IR or Raman spectroscopy are needed to validate polymer composition, particularly for particles <500 μm. Many studies claim to have identified microplastics visually but, without spectroscopic analysis, the results are likely biased. The current literature on the presence and impacts of microplastics on marine organisms is seriously flawed. In short, microplastics are difficult to identify and quantify.

Many studies have used incorrect or insufficient methodology for identification of microplastics, poor animal husbandry in experiments with shellfish, and some investigators lack any understanding of feeding processes in bivalve molluscs. Microplastics is a sweeping term as it includes particles < 5 mm. This is a very wide spectrum and bivalve molluscs will only be consuming particles in the 1 - 500 μm range, more commonly in the 5 - 150 μm range. It is well-established that filter-feeding shellfish consume microplastics; there is nothing newsworthy there. Indeed, the fact that filter-feeding bivalves consume particles readily and excrete them just as readily made it possible to use them as test particles and markers. We have been using microplastic beads in our research for over 30 years.

There is no question that microplastics occur within marine animals. These particles are ubiquitous and it is to be expected that wherever one looks they will be found but every discovery does not warrant a new publication. What is in question is the extent of impacts (if any) on these marine animals. Identifying detrimental impacts quickly garners the attention of funding agencies as well as the public.

Just as important are findings that demonstrate no impacts but these results rarely make the news. Recent efforts to raise a public scare by noting that humans may be consuming microplastics are both premature and irresponsible. One microparticle (or even 5 or 10) cannot be extracted reliably from an entire mussel or oyster with any degree of confidence. And even if it can, is that really of any consequence for the shellfish or, as some have suggested, human health? Most likely not on either point. Experiments are currently underway in our laboratory to address this.

There are very few studies that clearly and reliably demonstrate any negative impacts of microplastics on bivalve molluscs and none have demonstrated any adverse human health impacts of eating shellfish purportedly contaminated with microplastics. There are conflicting reports on the actual versus potential role of microplastics as vectors for transfer of drugs and pollutants that adhere to particles. There is currently no clear evidence that accumulated microplastics are a hazard in this regard in bivalve molluscs. A recent article realistically noted that one is exposed to more plastic fiber during a meal via dust fallout in a household (13,000 - 68,000 particles/yr/capita) than from the shellfish on their plate (perhaps 1-10 particles/shellfish). More data are needed to confirm potential impacts but current media hype and scare tactics with regard to 'potential' impacts are irresponsible, unwarranted and dangerous.

All of this is not to say that there are not some very well-done studies available, but they are difficult to discern among the myriad of mediocre or simply flawed efforts. As in other fields, e.g. global warming and ocean acidification, as the field matures, the best works will distinguish themselves, but this will take time. In the interim, researchers need to step back, take a breath, design and carry out experiments using proper and accepted methodologies, read past literature, and not rush to publish prematurely, either in scientific journals, the popular press or on the internet. Sloppy efforts will inevitably cause more harm than good and overcoming bad publicity and stigma is never an easy or even possible task.

The plastic will still be there!

Notes

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