Commentary

The Microplastics and Shellfish Media Frenzy: Stop The Train, We Want To Get Off!

by Sandra E. Shumway, J. Evan Ward, and Kayla Mladinich,
Dept. of Marine Sciences, University of Connecticut

It has been well documented that plastics are pervasive, persistent, and perpetual components of the marine environment. The impacts of macroplastics (large items like plastic bags, bottles, etc.) are obvious as general pollution — the ubiquitous plastic bags smothering coral reefs and choking sea turtles, the bottle caps and other plastic detritus causing sea birds to starve. Recently though, microplastics have become a major focal point. These are the tiny bits (smaller than 5mm) formed by the breakdown of microplastics and synthetic fibers, and also include the tiny plastic beads added to personal care products, detergents, and other household items.

While microplastics have plagued the marine environment for decades, recent publicity and campaign efforts have brought the blight to the forefront. Microplastics pollution is now the latest scientific bandwagon — driven unfortunately, by some scientists' desire to establish their territory in the quest for research funding and fame. Scientific research takes time, careful experimentation and expertise. Far too often, in the rush to publish and stake claims within the field, researchers litter the scientific literature 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 it is difficult, if not impossible, for the general reader to distinguish between what is reliable and true *vs.* what is mere hyperbole. And it cannot be unpublished. Much of the currently available research on microplastics has not been carefully peer–reviewed or vetted, and has done nothing but sow confusion. Indeed, one recent purported "review paper" actually included the statement, "The literature review process did not include assessment of the reliability of each report." The authors simply listed some of the published literature.

The methodologies used in identifying and characterizing microplastics are difficult and expensive. Most of the published studies rely on simple micoscopic examination, which is not sufficient. Futhermore, experimental protocols used for animal uptake and depuration studies are severly lacking in scientific rigor and even acceptable methods of animal husbandry.

To make matters worse, microplastic sampling and extraction protocols are inconsistent across studies. To ensure field–collection quality control, it's important to use metal equipment, glassware that has been heated in a muffle furnace, and filtered liquid reagents (such as Milli–Q® purified water and ethanol), but these are not always

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Microplastics are smaller than 5 mm and come from the breakdown of larger plastic items and synthetic fibers, and from microbeads added to a variety of household products.

used. Studies need to report relevant quality–control efforts and must eliminate extraneous plastics such as collection bottles and ropes. Preservation methods and microplastic recovery rates should be reported to determine the validity of the extraction methods used.

To extract microplastics efficiently, samples are first digested (preferably in hydrogen peroxide), then undergo a density separation. 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. It has been established, however, that 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 microplastics remaining in the sample.

The most important step, and often the most neglected, is the 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 characterizing the particles' physical properties, but FT–IR or Raman spectroscopy is needed to validate polymer composition, particularly for particles smaller than 500μm. Many studies claim to have identified microplastics visually, but without a spectroscopic analysis the results are likely biased. In short, microplastics are hard to identify and quantify, and the current literature on the presense and impacts of microplastics on marine organisms is seriously flawed.

Many studies have used incorrect identification methodologies, as well as poor animal husbandry in their experiments with shellfish — some investigators lack any understanding of the feeding process in bivalve molluscs. Microplastics is a sweeping term, as it includes particles smaller than 5mm (5,000μm). This is a very wide spectrum, and bivalve molluscs only consume 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; nothing newsworthy there. Indeed, because filter–feeding bivalves consume the particles readily and excrete them just as readily, they make ideal test particles and markers; we have been using microplastic beads in our research for over 30 years.

There is no question that microplastics can be found within marine animals. These particles are ubiquitous and can be found almost everywhere you look, but every discovery does not warrant a new publication. **What is in question is the extent of the impacts (if any) on marine animals.** Identifying detrimental impacts quickly garners the attention of both funding agencies and the public. Just as important are findings that demonstrate no impacts, but these results rarely make the news.

Recent efforts to frighten the public by noting that humans may be consuming microplastics are both premature and irresponsible. One (or even five or 10) microparticles cannot be extracted reliably from an entire mussel or oyster with any degree of confidence. And even if it could be, is that really of any consequence for the shellfish or, as some have suggested, human health? The answer is most likely *No* on both points, but experiments are currently underway in our laboratory to address this question.

Very few studies clearly and reliably demonstrate any negative impacts of microplastics on bivalve molluscs.

A recent article realistically noted that people are exposed to more plastic fiber during a typical meal via household dust fallout (adding up to 13,000 – 68,000 particles per person every year) than from the shellfish on their plates (perhaps 1–10 particles per shellfish). Although more data are needed to confirm potential impacts, the current media hype and scare tactics with regard to "potential" impacts is irresponsible, unwarranted, and dangerous.

All of this is not to say that no well–executed studies have been conducted, but they are difficult to find among the myriad of mediocre or simply flawed efforts. As in other fields, such as global warming and ocean acidification, as the field matures, the best works will distinguish themselves, but this will take time. Meanwhile, researchers need to step back, take a breath, design and carry out experiments using proper and accepted methodologies, read the past literature, and refrain from rushing to publish prematurely — either in scientific journals, in the popular press, or on the internet. Sloppy efforts will inevitably cause more harm than good, and overcoming bad publicity and stigma is never easy or even possible.

The plastic will still be there!

Microplastics are ubiquitous in the marine environment, but very few studies clearly and reliably demonstrate their negative impacts on bivalve shellfish, much less on the humans who eat them.