

Microplastics in the environment: much ado about nothing? A debate

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Tab. S1: Word-by-word transcript of our debate on Twitter, conducted on Nov 21, 2017. As there were multiple threads, this table is not necessarily in the correct chronological order.

Martin Wagner (@MartiWag)

Okay, I am also sometimes annoyed by #microplastics hype bc I belief it seriously conflicts with scientific rigour. But the view Allen Burton presents on env. risks in @EnvSciTech is clearly too simplistic.



I/II: In 280 chars: In his piece, Burton
- assumes low exposure based on studies of very large MP not covering relevant sizes
- assumes no hazard based on handful of tox studies conducted mainly with

Thomas Backhaus (@ThoBaSwe)

I have to admit that I tend to agree with Allen. Where is his argumentation too simplistic? I certainly might be overlooking something...

Martin Wagner (@MartiWag)

PS beads

Bottom line: Does risk assessment in absence of required knowledge

Well, he claims no risk throughout the piece. Leaving this aside, #microplastics are just another aspect of #globalchange that we need to look out for. When, where and if there will be risk I cannot even best guess today. Does that mean we should stop investigating? #Idontthinkso

stated in ~500 AD a currently held, toxicological truth: *All things are poisons at the right dose*. My concern that microplastics in marine and freshwater ecosystems aquatic environment are not a risk due to LOW concentrations (i.e., low exposures) is slowly being realized and certainly applies to other contami-

Otherwise, I agree with him that authors, reviewers and editors need to raise the bar, resist the hype and significantly increase quality of [#microplastics](#) research.

Indeed, waiting for "final proof" (which does not exist anyway) may be missing the last bus. Plus: Societies and politics have decided to act on

Thomas Backhaus (@ThoBaSwe)

Well, he does not really do a risk assessment. But he argues that we know that there are massive ecosystem-wide risks, which we should study first. Unless we have at least an idea when/how/where MP could actually have env. impacts. Do we have that (honest question)?

That's an interesting question... In a world with sufficient resources for env research: certainly not. In the current situation: maybe we should focus our time, effort and resources on more pressing matters?

The statement that I actually don't agree with, is the notion that we should not bother to limit unnecessary env. exposures, unless we already know they're causing harm (and not a minute earlier). [#precautionaryprinciple](#)

Martin Wagner (@MartiWag)

[#plasticpollution](#) already. W/o consulting us. May be blow to scientist's ego but we need to accept and work on what they task us with.

No either or here: [#plasticpollution](#) and [#microplastics](#) are the same. Just different in size. Problem is that we cannot dump [#macroplastics](#) on whales in the lab. And different in numbers (I expect exponentially more nano than micro than macro).

II/II: What I find simplistic is that Burton treats MP as one entity whereas in fact it is a huge group of potential stressors. Furthermore, his view is solely thru ecotox lens, ignoring wider ecological & societal implications of [#plasticpollution](#). We must be more holistic here.

Sure. Big issues are [#consumerism](#) and linear economy. Unfamiliar deckchairs for ecotoxicologist to sit on, I admit. But either we can stay seated

Thomas Backhaus (@ThoBaSwe)

[#plasticpollution](#) is an absolutely critical environmental issue, no doubt. I think we completely agree on that. But are [#microplastics](#) ?

Btw, I hope you're right in your assessment that society and politics actually DO start to act.

But I actually beg to differ. There's clearly proven harm caused by macroplastics to macrofauna. And it's completely reshaping ecosystems (an effect of which we know far too little).

In all fairness, Allen doesn't touch upon the general issue of [#plasticpollution](#) Which might be a shortcoming of the paper, indeed. But being holistic would also imply to realize where the big issues are, not re-arranging deckchairs on the Titanic.

Martin Wagner (@MartiWag)

or help to redesign...

First, I'm not convinced our discipline has managed to prioritize very well. Second, I believe everybody going after the one ring is not how we should approach #globalchange. Third, this is especially true for #microplastics. Diversification needed. Hampered by funding practice.

At this point: Start determining env. conc. of #microplastics < 300 μm (preferably down to 2 μm , which is technically feasible) and you will find tons.

For which you will burn on a pile of plastic waste, of course. In terms of scepticism I am with you. In terms of closing the case not. Rather want to know more before moving on to the #nextbigthing.

Thomas Backhaus (@ThoBaSwe)

Yeah, let's go down into the engine room! But even from an ecotox perspective... perhaps there are more pressing issues to explore? I'm not saying that #microplastic research is pointless. But more critical distance would sometimes be good.

No, we're lousy at prioritizing. That's basically Allen's point, isn't it? And there are myriads of "rings" out there that need urgent attention... What kind of diversification would you like to see in #microplastic research? Or better: where do you see the critical issues?

...in what volumes of water / sediment? And, even if so, does it matter - or is it just another type of organic particle? Heretical questions, I know. Sorry...

Maybe that's what I'm arguing for: let's limit the hunt for the #nextbigthing a bit. Instead let's do more solid, bread-and-butter, middle-of-the-road research instead. But yeah, that wouldn't sit well with a lot of

Martin Wagner (@MartiWag)

Thomas Backhaus (@ThoBaSwe)

Absolutely, perverse incentives in academia is something that needs addressing as urgent as #plasticpollution.
<http://online.liebertpub.com/doi/10.1089/ees.2016.0223>

funding agencies... Unfortunately.

Yepp, I was just about to send a link to that paper also...!

Are we ready to assess the risk of microplastics? (Martin Wagner)

Let us start with the simple question of why – based on the current state of the science – I believe we are not ready to assess the environmental risks of microplastics. Although not made explicit, Burton (as well as the “all risk” camp) has performed a risk assessment based on expert judgment. Interestingly, both use exposure as main argument, either referring to high and rising emissions (Rochman et al., 2015) or to current and low environmental concentrations (Burton, 2017). Their judgment is premature given the current state of microplastics research.

First, current exposure estimates rely mainly on the analysis of large microplastics, typically > 300 µm. Based on the continuous fragmentation of plastics, it is safe to assume that the environmental concentrations of smaller plastic debris are much higher. Even when taking false positives into account (e.g., by misidentifying natural particles as plastic), current data are very likely to underestimate the actual levels of microplastics. Accordingly, future studies into the abundance of small microplastics will reveal whether the low exposure assumption holds true.

Second, environmental risk is dictated by exposure and hazard. The latter has been – to date – assessed in very few laboratory studies. To give an example, a Web of Science search using the string “microplastic* AND freshwater AND toxic*” (31.01.18) returned 21 publications of which seven were actual toxicological studies. Most of these use spherical beads, acute exposure regimes and high exposure concentrations. This approach can either be criticized as “environmentally unrealistic” or seen as classical point of departure when investigating contaminants of emerging concern. Accordingly, future ecotoxicological studies will reveal whether the low (or high) hazard assumption holds true.

Third, risk assessment is complicated by the fact that “microplastics” is an umbrella terms covering a multitude of synthetic polymers each consisting of a unique chemical mixture (in terms of additives etc.). Further degradation will result in a plethora of physical and chemical properties and diverse toxicological profiles (Lambert et al. 2017). Presenting

microplastics as homogenous entity instead of a heterogeneous group of stressors is too simplistic and may fall short of recognizing the hazard of individual members of that group.

Forth, even if we assume a “null risk” of microplastics based on fragmentary knowledge, demonstrating their “safety” requires at least the same quality and quantity of data as for showing the opposite, especially as scientific proof of safety can epistemologically never be produced. Accordingly, investigating potential “null risk” issues is not futile but relevant as it generates a deeper understanding of the underlying environmental and biological processes that will help us anticipate and tackle future issues of emerging concern.

Tab. S2: Common narrative to communicate why microplastics are a problem.

	Argument/claim	MW's opinion
1	Microplastics are ubiquitous	I agree
2	Microplastics are eaten by a range of species	I agree, although actual encounter rates may be low
3	Microplastics transfer across the food web	I agree, although actual transfer rates may be low
4	Microplastics then end up on our dinner plate	I agree, but the actual concentrations are very low
5a	Microplastics are toxic for biota	I am not certain given the lack of data
5b	Microplastics threaten human health	I am not certain given the lack of data