

# The Evolving Knowledge about Plastics as a Contaminant

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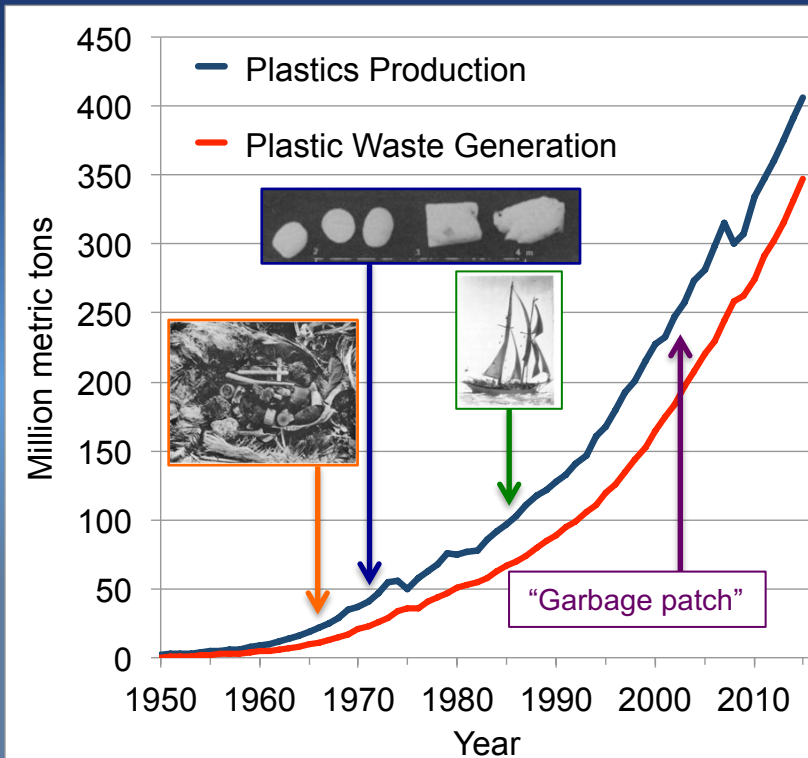
NASEM Food Forum  
8 December 2021

## **Disclosure**

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I have NO financial disclosure or conflicts of interests to disclose.

# The rapid rise of plastics



- 8.3 B tonnes produced
- 90% still in existence

Kenyon and Kridler (1969)

Carpenter *et al.* (1972)

Wilber (1987)

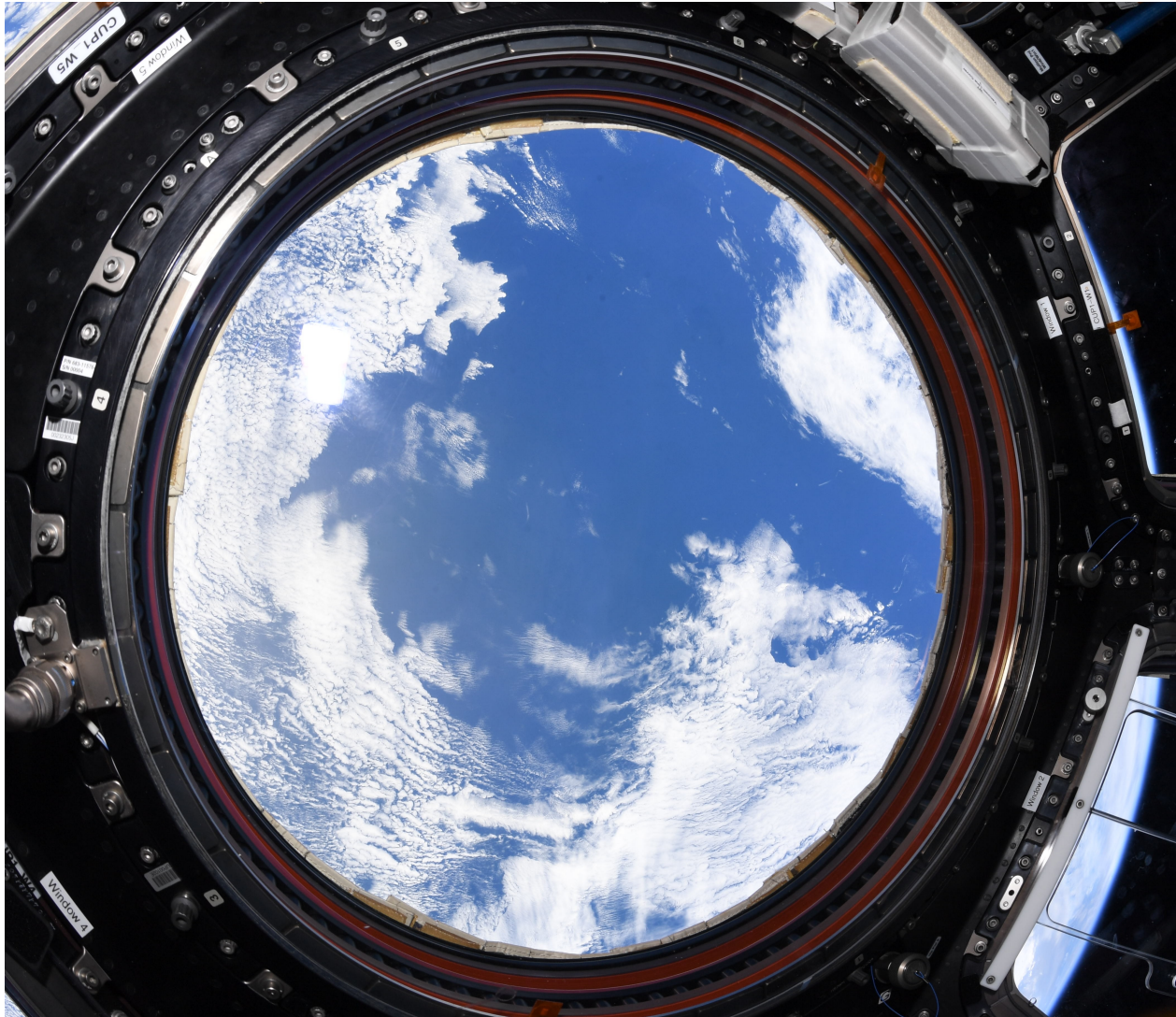
Moore (2003)

# “Garbage Patch”

Fact or Fiction?







# The actual view of the “garbage patch” from space

Photo taken August 5, 2021



Images courtesy of M. McArthur and NASA



**View from a ship in the “garbage patch”**









# Traditional measurements of ocean plastics





# Microplastics



# What are “microplastics”?

Size

Shape

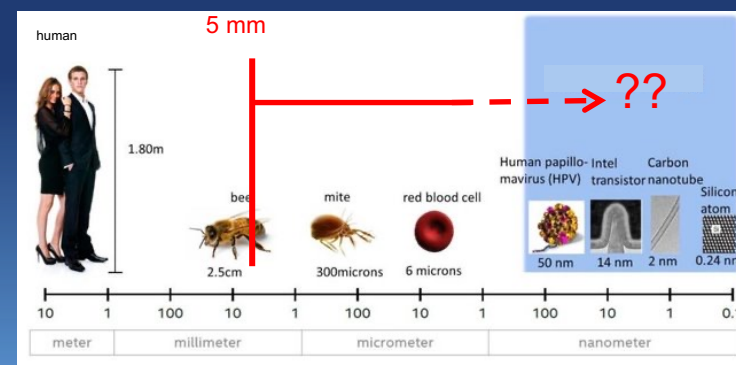
Source

Polymer type

Chemical additives



SEA/Jessica Donohue



Adapted from Ionescu (2016)



*Microplastics are a diverse and complex category of contaminants whose characteristics evolve when exposed in the environment.*

# Microplastics: abundant & widespread

## Beaches



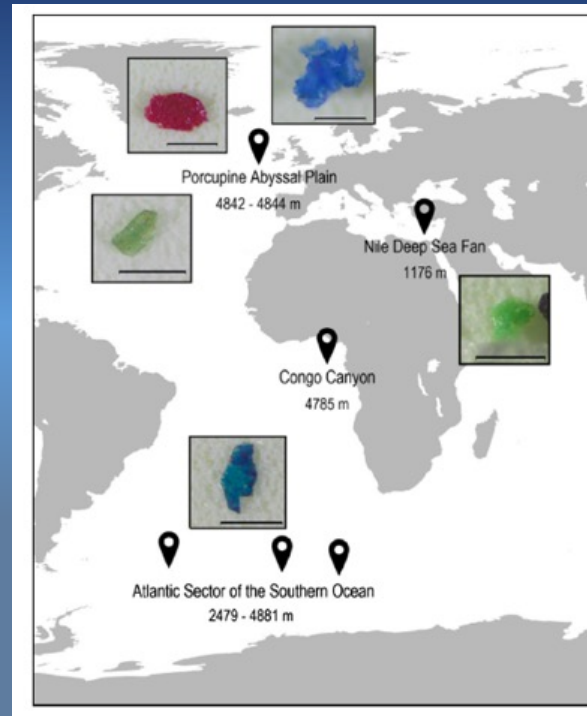
Nicholas Mallos/Ocean Conservancy

## Water column



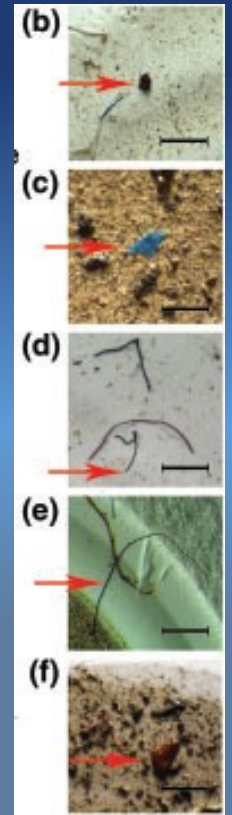
Giora Proskurowski/SEA

## Deep-sea sediments



Van Cauwenberghe *et al.*, 2013

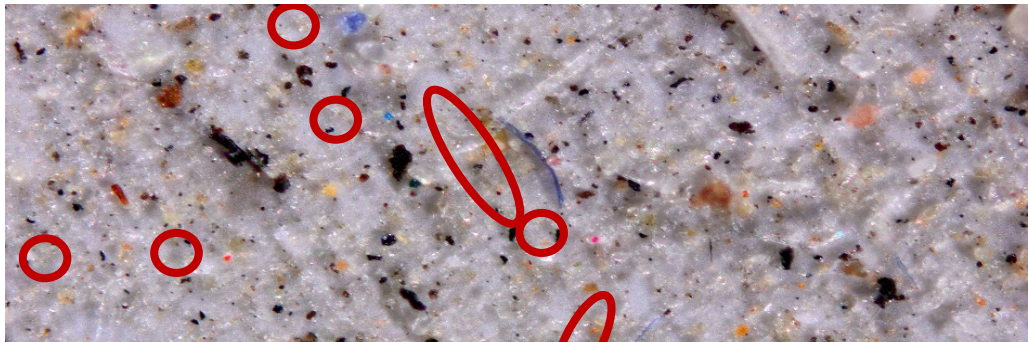
## Arctic sea ice



Obbard *et al.*, 2014



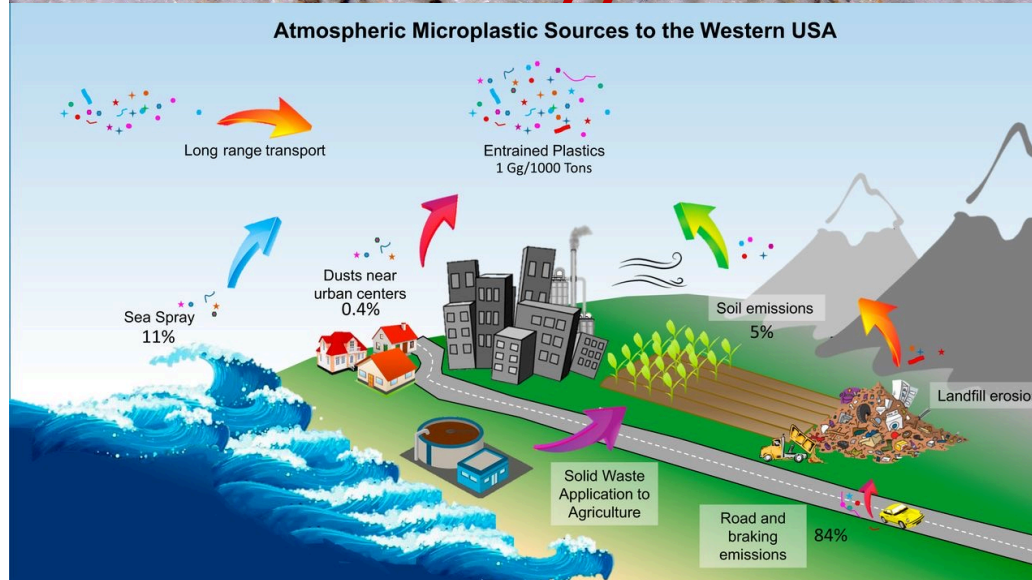
# Microplastics are transported in the atmosphere



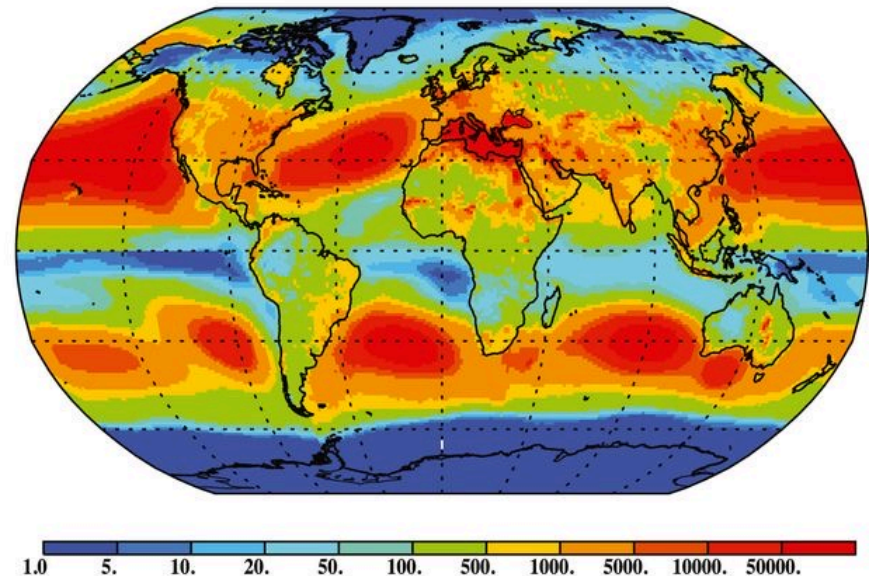
**\*\* 2-6% of particulate aerosols are composed of plastics**

Brahney *et al.* *Science* 2021

Brahney *et al.* *PNAS* 2021



Total modeled microplastic deposition ( $\mu\text{g}/\text{m}^2/\text{day}$ )



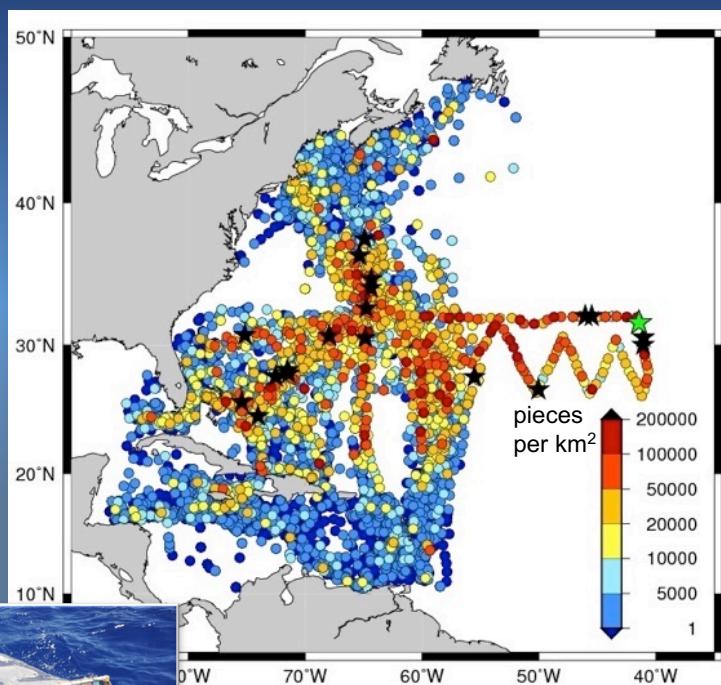




# Open ocean microplastics

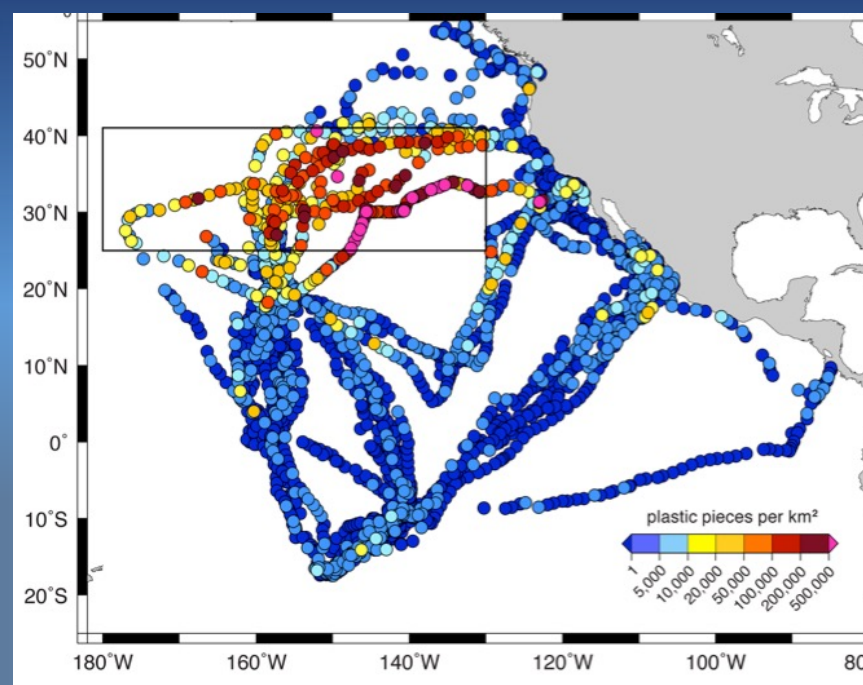
Plankton net tows: particle sizes  $\sim 0.35 - 10$  mm

Western North Atlantic Ocean



Law *et al.*, 2010

Eastern Pacific Ocean



Law *et al.*, 2014

## 1-L water samples: particle sizes > 0.45 $\mu\text{m}$

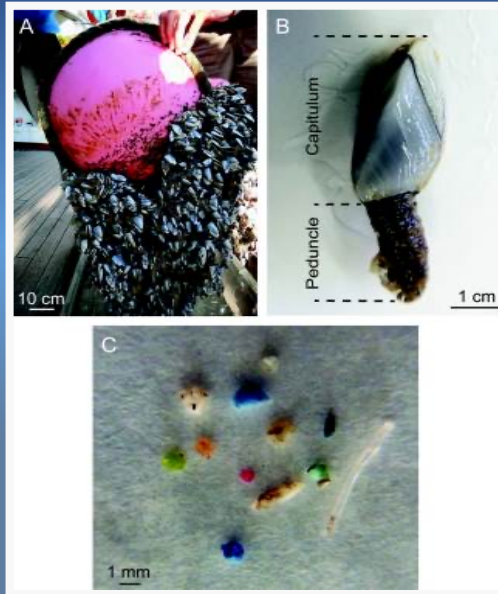
## 1-L water samples: particle sizes > 0.45 $\mu\text{m}$



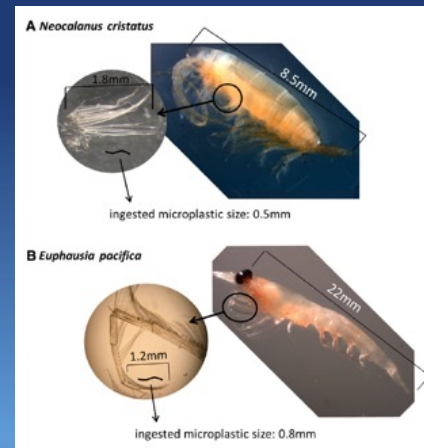
# Why do we care about microplastics?



David M. Lawrence/SEA



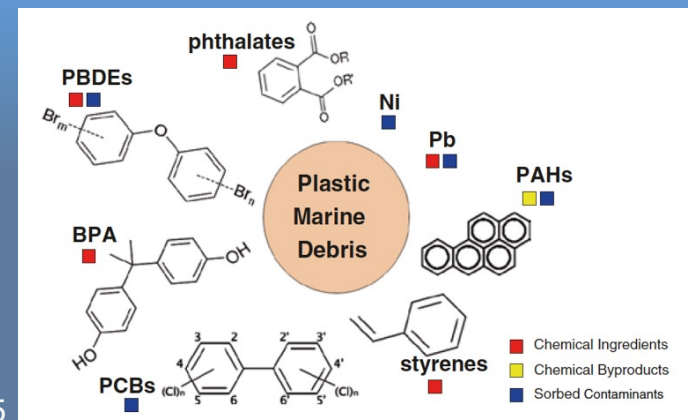
Goldstein & Goodwin, 2013



Desforges *et al.*, 2015

> 700 species

Rochman, 2015



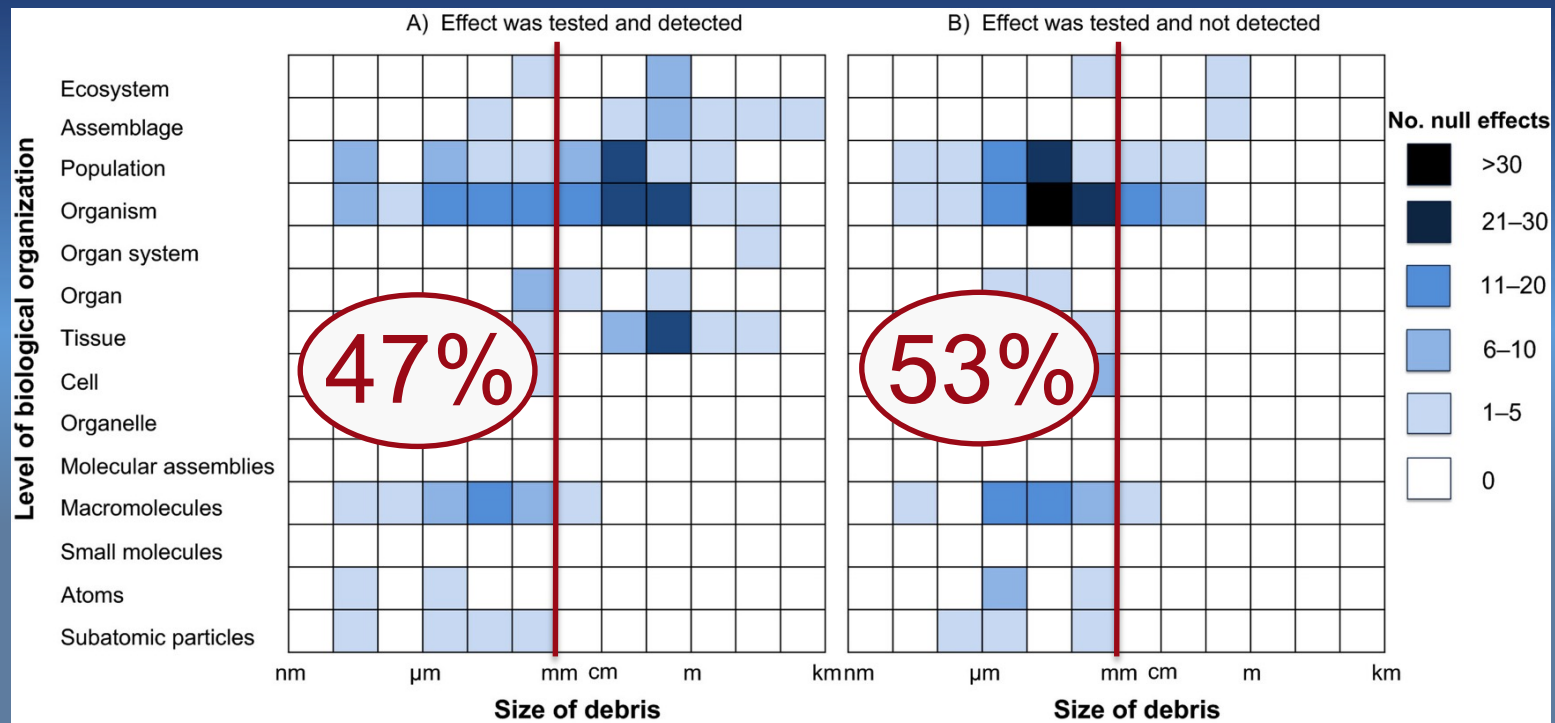


# Demonstrated evidence of impacts

421 effects tested:

Effect

No Effect

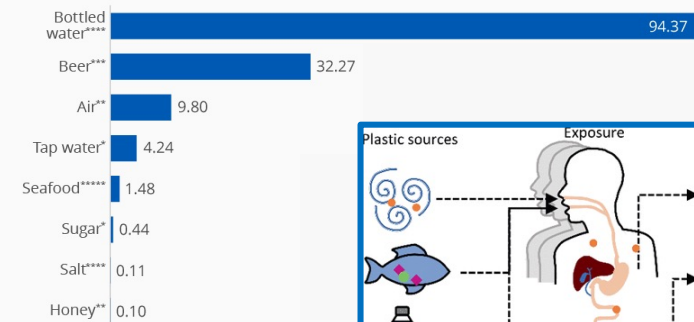


Bucci *et al.* 2019

# Why do we care about microplastics?

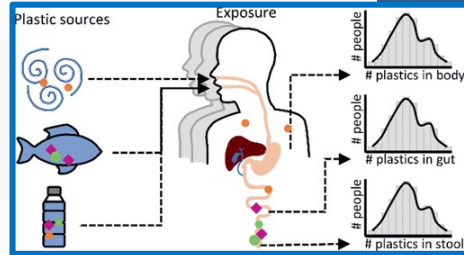
## How We Eat, Drink and Breathe Microplastics

Average number of microplastic particles found per gram/liter/m<sup>3</sup> of selected consumables



\* Based on 1 study  
 \*\* Based on 2 studies  
 \*\*\* Based on 3 studies  
 \*\*\*\* Based on 4 studies  
 \*\*\*\*\* Based on 14 studies

Source: 'Human Consumption of Microplastics', Cox et al. in Environmental Science & Technology (2019)



Nor et al. 2021



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journal homepage: [www.elsevier.com/locate/envint](http://www.elsevier.com/locate/envint)



## Plasticenta: First evidence of microplastics in human placenta

Antonio Ragusa<sup>a</sup>, Alessandro Svelato<sup>a,\*</sup>, Criselda Santacroce<sup>b</sup>, Piera Catalano<sup>b</sup>,  
 Valentina Notarstefano<sup>c</sup>, Oliana Carnevali<sup>c</sup>, Fabrizio Papa<sup>b</sup>, Mauro Ciro Antonio Rongioletti<sup>b</sup>,  
 Federico Baiocco<sup>a</sup>, Simonetta Draghi<sup>a</sup>, Elisabetta D'Amore<sup>a</sup>, Denise Rinaldo<sup>d</sup>, Maria Matta<sup>e</sup>,  
 Elisabetta Giorgini<sup>c</sup>

Annals of Internal Medicine

ORIGINAL RESEARCH

## Detection of Various Microplastics in Human Stool

### A Prospective Case Series

Philipp Schwabl, MD; Sebastian Köppel, Dipl-Ing(FH); Philipp Königshofer, DVM; Theresa Bucsecs, MD; Michael Trauner, MD;  
 Thomas Reiberger, MD; and Bettina Liebmann, PhD

# A word on environmental nanoplastics



+



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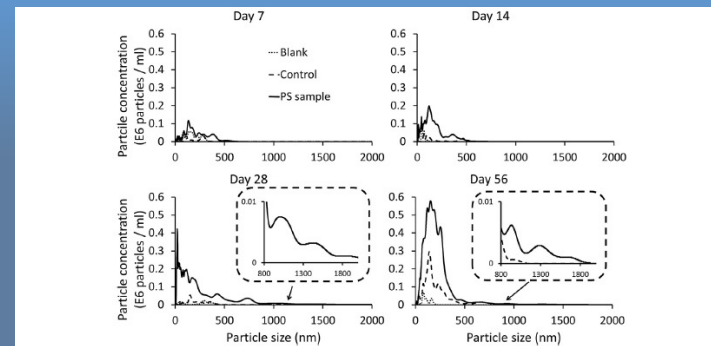


Fig. 2. Size distribution data of particles formed during the degradation of a polystyrene coffee cup lid measured by nanoparticle tracking analysis.

Lambert & Wagner 2016

# Acknowledgements

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Jenna Jambeck

Roland Geyer

Aron Stubbins

NCEAS Marine Debris Working Group

SCOR FLOTSAM Working Group

> 10,000 SEA students



WHOI

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U. Hawaii

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UC-Santa Barbara

Northeastern University



March Marine Initiative