Environmental impacts of plastic debris on marine ecosystems





Wider impacts?



Wider impacts?



Alternative plastics

Bioplastics, that are also biodegradable, may become more important in the future in some sectors, especially packaging.

It is important, therefore, to also assess their potential effects as litter.



Global production capacity of bioplastics (2016) Source European Bioplastics, nova-Institute (2016).



Biodegradable plastics



European Bioplastics, 2016

Effects of biodegradable plastic

Journal of Polymers and the Environment Journal of environmental polymer degradation October 1994, Volume 2, <u>Issue 4</u>, pp 271–275 | <u>Cite as</u>

Effects of biodegradable plastic components on metabolism of an estuarine benthos

Authors

Authors and affiliations

Peter H. Doering, Barbara K. Sullivan, Heeseon Jeon

Doering et al. 1994: "the high biological oxygen demand... and resulting disturbance of normal nutrient regeneration patterns of the benthos... must be considered in developing strategies for their disposal."

Effects of HDPE vs PLA bags



Biodegradable plastics

PLA bag after 15 months in an Irish marsh.

Studies on impacts of biodegradables



Science of The Total Environment Volumes 605–606, 15 December 2017, Pages 755-763



Biodegradable plastic bags on the seafloor: A future threat for seagrass meadows?

Elena Balestri 🙁 🖾, Virginia Menicagli, Flavia Vallerini 🖾, Claudio Lardicci 🖾

Public



Int J Environ Res Public Health. 2017 July; 14(7): 774. Published online 2017 July 13. doi: <u>10.3390/ijerph14070774</u>

PMCID: PMC5551212

Biodegradable and Petroleum-Based Microplastics Do Not Differ in Their Ingestion and Excretion but in Their Biological Effects in a Freshwater Invertebrate *Gammarus fossarum*

Sandrine Straub, Philipp E. Hirsch, and Patricia Burkhardt-Holm*

A. Dick Vethaak, Academic Editor

Author information ► Article notes ► Copyright and License information ►



Arenicola marina



Arenicola marina



Current Biology

Wright et al. 2013: Reduced energy reserves and reduced bioturbation.

Besseling et al. 2013: Reduced weight and bioturbation.



activity







Lugworms and microplastics

A CORE YOUR



Outdoor mesocosm system



Bioturbation



Green et al. 2016

Chlorophyll-a



Diatoms



Green et al. 2016

Microplastics: effects on primary productivity

25 mg PS/I



Bhattacharya et al. 2010: Reduced photosynthesis in response to 1.8 mg L⁻¹ of nano PS.

> Sjollema et al. 2016: Decrease in microalgal growth after 72 hrs in response to 250 mg L⁻¹ of PS.









Muddy habitats and microplastics



Outdoor mesocosm system



Results - assemblages



Green et al. 2017

Results – more oligochaetes

400 *High > Control

control



2 Att

HOPEN HOPEN Green et al. 2017



Results – less polychaetes



Results – primary producers



Effects on nutrient cycling

All mesocosms with microplastics had less storage and flux of inorganic nitrogen (Green et al. 2017).

Environmental Contamination Taxicology

Internet Grannet für ben Internet Grannet für ben Archives of Environmental Contamination and Toxicology Control Contamination and Toxicology Cite as

Intertidal Concentrations of Microplastics and Their Influence on Ammonium Cycling as Related to the Shellfish Industry

Authors

Authors and affiliations

Melanie Cluzard, Tamara N. Kazmiruk, Vasily D. Kazmiruk, L. I. Bendell 🖂

Microbial life is a key driver of biogeochemical processes... More research needed.

Summary of results



Green et al. 2017

Oysters in sandy habitat



Results – less animals and species



Results – less juveniles



Green 2016

Effects on reproduction

The Impact of Polystyrene Microplastics on Feeding, Function and Fecundity in the Marine Copepod Calanus helgolandicus

Matthew Cole*1[‡], Pennie Lindeque[†], Elaine Fileman[†], Claudia Halsband[§], and Tamara S. Galloway[‡] [†] Marine Life Support Systems, Plymouth Marine Laboratory, Prospect Place, The Hoe, Plymouth PL1 3DH, U.K. [‡] College of Life, Environmental Sciences: Biosciences, Geoffrey Pope Building, University of Exeter, Stocker Road, Exeter EX4 4QD, U.K.

§ Akvaplan-niva AS, FRAM – High North Research Centre for Climate and the Environment, N-9296 Tromsø, Norway

Oyster reproduction is affected by exposure to polystyrene microplastics

Rossana Sussarellu^{a,1}, Marc Suquet^a, Yoann Thomas^a, Christophe Lambert^a, Caroline Fabioux^a, Marie Eve Julie Pernet^a, Nelly Le Goïc^a, Virgile Quillien^a, Christian Mingant^a, Yanouk Epelboin^a, Charlotte Corporeau^a, Julien Guyomarch^b, Johan Robbens^c, Ika Paul-Pont^a, Philippe Soudant^a, and Arnaud Huvet^{a,2}

Environmental Toxicology

Responses of *Hyalella azteca* to acute and chronic microplastic exposures

Sarah Y. Au 🗠, Terri F. Bruce, William C. Bridges, Stephen J. Klaine

First published: 23 September 2015 Full publication history

DOI: 10.1002/etc.3093 View/save citation

Community effects?

Similar habitats are already contaminated with microplastics.

Lourenco et al. 2017: Contamination of all compartments of benthic sedimentary habitat with microplastics.



Wider effects of microplastic pollution

- Beyond individual-level effects: wider impacts on biodiversity and ecosystem functioning are possible.
- The flux and pool of ammonium and the biomass of primary producers on sedimentary shores may be reduced by microplastics.
- Communities in oyster dominated habitats could be altered less species, abundance and biomass.
- Some biodegradable plastics have the same effect as conventional types more research is needed to assess the potential impact of alternatives BEFORE mass production and replacement takes place.
- Environmentally relevant? The concentrations of microplastics used in Green et al. 2017 (2.5 and 25µg L⁻¹) are among the lowest used in an exposure experiment to date, but are at least 1 order of magnitude greater than current levels of contamination in marine habitats. Future studies should assess impacts at lower doses.

Thank you!

Staff at Portaferry
Marine Laboratory
Fieldwork helpers
Richard Thompson,

Carlos Rocha, Bas Boots





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