

# Mapping the global distribution of terrestrial microplastics

C. Lauren Mills

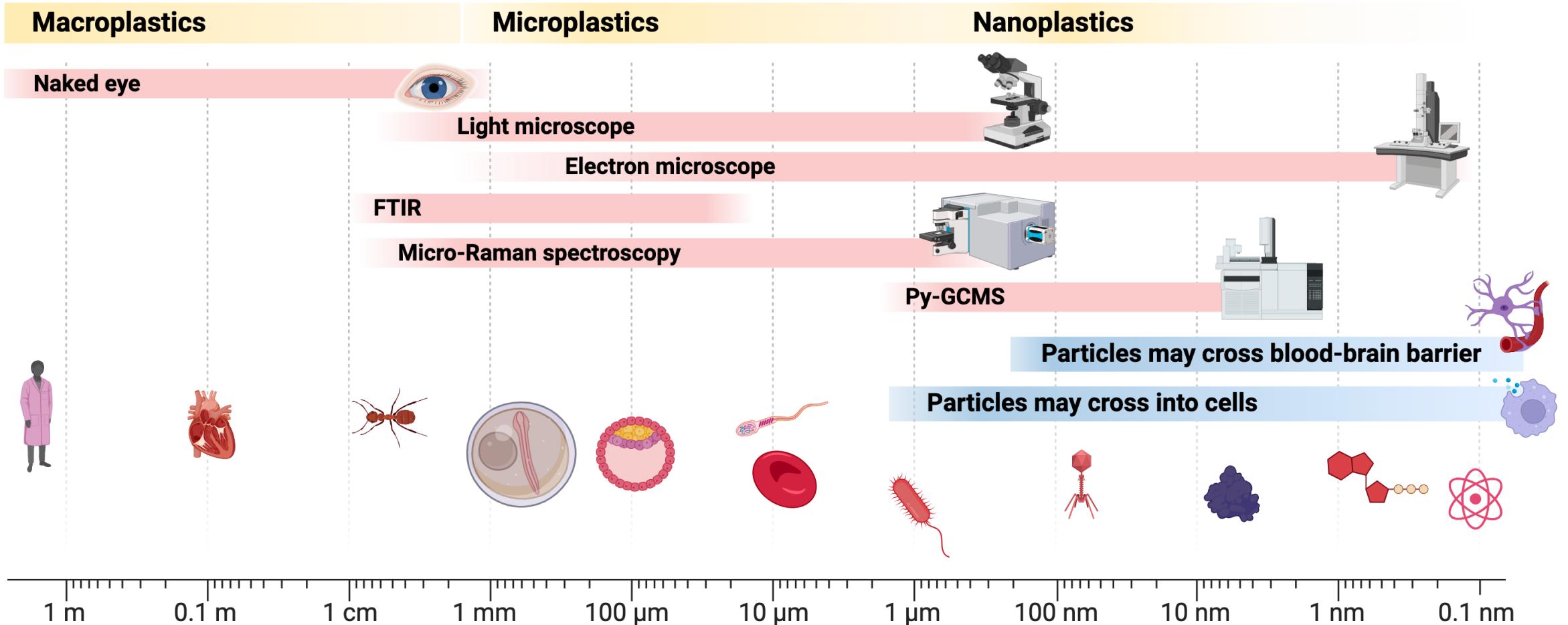
*University of British Columbia, Okanagan  
Department of Biology*

# Plastic pollution crisis

Globally, > 350 million tons of plastic produced per year<sup>[1,2]</sup>

Plastics break down into microplastics

# Size of microplastics

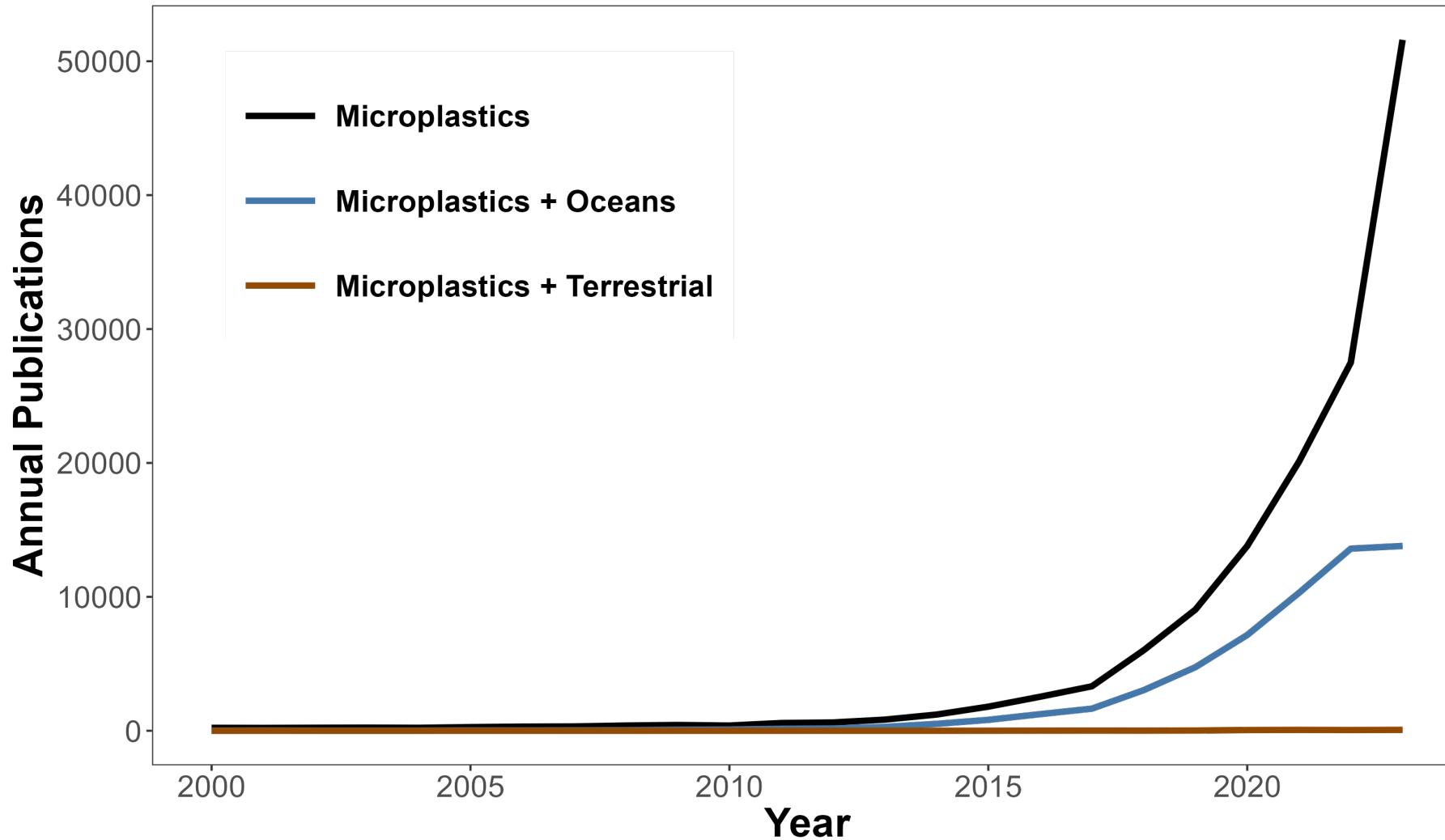


# **Microplastics are everywhere**

Microplastics are  
dispersed across  
the environment

Little known  
about  
microplastics on  
land

# Trends in microplastic publications



**Figure 1.** Number of annual peer-reviewed publications related to MPs. Data were collected from a Google Scholar search for the term “microplastics” alone or in combination with “health”, “ocean”, or “terrestrial” and “fertility”.



[3]



[4]



# Reproductive toxicity of polystyrene microplastics: In vivo experimental study on testicular toxicity in mice

Baolian Hou<sup>1</sup>  , Fangyi Wang  , Tao Liu  , Zhiping Wang  



# Reproductive toxicity of polystyrene microplastics: In vivo experimental study on testicular toxicity in mice

Baolian Hou<sup>1</sup>✉, Fangyi Wang✉, Tao Liu✉, Zhiping Wang✉

## Chronic toxic effects of polystyrene microplastics on reproductive parameters of male rats

Ifenna Ilechukwu<sup>1, 2</sup>✉, Ben Enoluomen Ehigotor<sup>3</sup>, Inemesit Okon Ben<sup>4</sup>, \* Chinedu Joseph Okonkwo<sup>5</sup>, Oluwakemi S. Olorunfemi<sup>3</sup>, Uchechukwu Emmanuel Modo<sup>6</sup>, Chibuumam Ezinwanneamaka Ilechukwu<sup>7</sup>, Ngozika Juliet Ohagwa<sup>5</sup>

<sup>1</sup>Graduate School of Engineering and Science, Department of Marine and Environmental Science, University of the Ryukyus, Nishihara, Okinawa, Japan

<sup>2</sup>Environmental Chemistry Unit, Department of Industrial Chemistry, Madonna University, Elele Campus, Rivers State, Nigeria

<sup>3</sup>Department of Pharmacology and Toxicology, Madonna University, Elele Campus, Rivers State, Nigeria

<sup>4</sup>Department of Pharmacology and Toxicology, School of Pharmacy, University of Health and Allied Sciences, Ho, Ghana

<sup>5</sup>Department of Biochemistry, University of Port Harcourt, Choba, Rivers State, Nigeria

<sup>6</sup>Department of Biochemistry, PAMO University of Medical Sciences, Port Harcourt, Rivers State, Nigeria

<sup>7</sup>Faculty of Pharmacy, University of Ibadan, Ibadan, Oyo State, Nigeria

\*Correspondence: ioben@uhas.edu.gh

Received March 23, 2022 Accepted May 26, 2022

Copyright © 2022 The Korean Society of Environmental Health and Toxicology & Korea Society for Environmental Analysis

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<https://creativecommons.org/licenses/by-nc/4.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.



# Reproductive toxicity of polystyrene microplastics: In vivo experimental study on testicular toxicity in mice

Baolian Hou<sup>1</sup> , Fangyi Wang , Tao Liu , Zhiping Wang



## Polystyrene microplastics lead to pyroptosis and apoptosis of ovarian granulosa cells via NLRP3/Caspase-1 signaling pathway in rats

Junyu Hou<sup>a</sup>, Zhimin Lei<sup>a</sup>, Linlu Cui<sup>b c</sup>, Yun Hou<sup>b c</sup>, Long Yang<sup>a</sup>, Ru An<sup>a</sup>,  
Qimeng Wang<sup>a</sup>, Shengda Li<sup>a</sup>, Hongqin Zhang<sup>b c</sup>,  
Lianshuang Zhang<sup>b c</sup>

### Chronic toxic effects of polystyrene microplastics on reproductive parameters of male rats

Ifenna Ilechukwu<sup>1, 2</sup> , Ben Enoluomen Ehigotor<sup>3</sup> , Inemesit Okon Ben<sup>4,\*</sup> , Chinedu Joseph Okonkwo<sup>5</sup>, Oluwakemi S. Olorunfemi<sup>3</sup>, Uchechukwu Emmanuel Modo<sup>6</sup> , Chibuumam Ezinwanneamaka Ilechukwu<sup>7</sup>, Ngozika Juliet Ohagwa<sup>5</sup>

<sup>1</sup>Graduate School of Engineering and Science, Department of Marine and Environmental Science, University of the Ryukyus, Nishihara, Okinawa, Japan

<sup>2</sup>Environmental Chemistry Unit, Department of Industrial Chemistry, Madonna University, Elele Campus, Rivers State, Nigeria

<sup>3</sup>Department of Pharmacology and Toxicology, Madonna University, Elele Campus, Rivers State, Nigeria

<sup>4</sup>Department of Pharmacology and Toxicology, School of Pharmacy, University of Health and Allied Sciences, Ho, Ghana

<sup>5</sup>Department of Biochemistry, University of Port Harcourt, Choba, Rivers State, Nigeria

<sup>6</sup>Department of Biochemistry, PAMO University of Medical Sciences, Port Harcourt, Rivers State, Nigeria

<sup>7</sup>Faculty of Pharmacy, University of Ibadan, Ibadan, Oyo State, Nigeria

\*Correspondence: ioben@uhas.edu.gh

Received March 23, 2022 Accepted May 26, 2022

Copyright © 2022 The Korean Society of Environmental Health and Toxicology & Korea Society for Environmental Analysis

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<https://creativecommons.org/licenses/by-nc/4.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.



# Reproductive toxicity of polystyrene microplastics: In vivo experimental study on testicular toxicity in mice

Baolian Hou<sup>1</sup>  , Fangyi Wang  , Tao Liu  , Zhiping Wang  



# Polystyrene microplastics lead to pyroptosis and apoptosis of ovarian granulosa cells via NLRP3/Caspase-1 signaling pathway in rats

Junyu Hou<sup>a</sup>, Zhimin Lei<sup>a</sup>, Linlu Cui<sup>b c</sup>, Yun Hou<sup>b c</sup>, Long Yang<sup>a</sup>, Ru An<sup>a</sup>, Qimeng Wang<sup>a</sup>, Shengda Li<sup>a</sup>, Hongqin Zhang<sup>b c</sup>, Lianshuang Zhang<sup>b c</sup>  



# Proinflammatory properties and lipid disturbance of polystyrene microplastics in the livers of mice with acute colitis

Haibin Zheng, Jun Wang, Xuanyi Wei, Le Chang, Su Liu  

## Chronic toxic effects of polystyrene microplastics on reproductive parameters of male rats

Ifenna Ilechukwu<sup>1, 2</sup>  , Ben Enoluomen Ehigotor<sup>3</sup>  , Inemesit Okon Ben<sup>4,\*</sup>  , Chinedu Joseph Okonkwo<sup>5</sup>, Oluwakemi S. Olorunfemi<sup>3</sup>, Uchechukwu Emmanuel Modo<sup>6</sup>  , Chibuamam Ezinwanneamaka Ilechukwu<sup>7</sup>, Ngozika Juliet Ohagwa<sup>5</sup>

<sup>1</sup>Graduate School of Engineering and Science, Department of Marine and Environmental Science, University of the Ryukyus, Nishihara, Okinawa, Japan

<sup>2</sup>Environmental Chemistry Unit, Department of Industrial Chemistry, Madonna University, Elele Campus, Rivers State, Nigeria

<sup>3</sup>Department of Pharmacology and Toxicology, Madonna University, Elele Campus, Rivers State, Nigeria

<sup>4</sup>Department of Pharmacology and Toxicology, School of Pharmacy, University of Health and Allied Sciences, Ho, Ghana

<sup>5</sup>Department of Biochemistry, University of Port Harcourt, Choba, Rivers State, Nigeria

<sup>6</sup>Department of Biochemistry, PAMO University of Medical Sciences, Port Harcourt, Rivers State, Nigeria

<sup>7</sup>Faculty of Pharmacy, University of Ibadan, Ibadan, Oyo State, Nigeria

\*Correspondence: ioben@uhas.edu.gh

Received March 23, 2022 Accepted May 26, 2022

Copyright © 2022 The Korean Society of Environmental Health and Toxicology & Korea Society for Environmental Analysis

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<https://creativecommons.org/licenses/by-nc/4.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.



Reproductive toxicity of polystyrene microplastics: An experimental study on toxicity in

# Maternal Polystyrene Microplastic Exposure during Gestation and Lactation Altered Metabolic Homeostasis in the Dams and Their F1 and F2 Offspring

Ting Luo, Caiyun Wang, Zihong Pan, Cuiyuan Jin, Zhengwei Fu, and Yuanxiang Jin\*

Published online August 26, 2019  
DOI 10.1021/acs.est.9b03191  
Copyright © 2019 American Chemical Society  
Request reuse permissions

Junyu Hou, Lumin Lei<sup>a</sup>, Linlu Cui<sup>b,c</sup>, Yun Hou<sup>b,c</sup>, Long Yang<sup>a</sup>, Ru An<sup>a</sup>,  
Qimeng Wang<sup>a</sup>, Shengda Li<sup>a</sup>, Hongqin Zhang<sup>b,c</sup>,  
Lianshuang Zhang<sup>b,c</sup>  



...emi S. Olorunfemi<sup>3</sup>, Uchechukwu Emmanuel

...and Environmental Science, University of the Ryukyus, Nishihara,

...or Industrial Chemistry, Madonna University, Elele Campus, Rivers State, Nigeria

...and Toxicology, Madonna University, Elele Campus, Rivers State, Nigeria

...armacology and Toxicology, School of Pharmacy, University of Health and Allied Sciences, Ho, Ghana

...partment of Biochemistry, University of Port Harcourt, Choba, Rivers State, Nigeria

<sup>6</sup>Department of Biochemistry, PAMO University of Medical Sciences, Port Harcourt, Rivers State, Nigeria

<sup>7</sup>Faculty of Pharmacy, University of Ibadan, Ibadan, Oyo State, Nigeria

\*Correspondence: ioben@uhas.edu.gh

Received March 23, 2022 Accepted May 26, 2022

Copyright © 2022 The Korean Society of Environmental Health and Toxicology & Korea Society for Environmental Analysis

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<https://creativecommons.org/licenses/by-nc/4.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

# Gestation and Microplastics in ICR M

Volume 750, 1 January 2021



Volume 750, 1 Jan

# Gestation and Their F1 Evaluation of Polyethylene Microplastics in ICR Mice

Polymers 2022, 14(3), 402; <https://doi.org/10.3390/polym1403040>  
Submission received: 22 December 2021 / Revised: 14 January 2022 / Accepted: 14 January 2022  
Editorial handling: Caiyun Wang

Received: 22 December 2021  
and F  
Ting Luo, Caiyun  
Environ. Sci. Tech.

P  Cite this: Environ. Sci. Technol., 2019, 53, 10992  
py 10992 Publication Date: August 26, 2019   
gra <https://doi.org/10.1021/acs.est.9b03191> © 2019 American Chemical Society  
ight © 2019 American Chemical Society  
issions  CrossMark

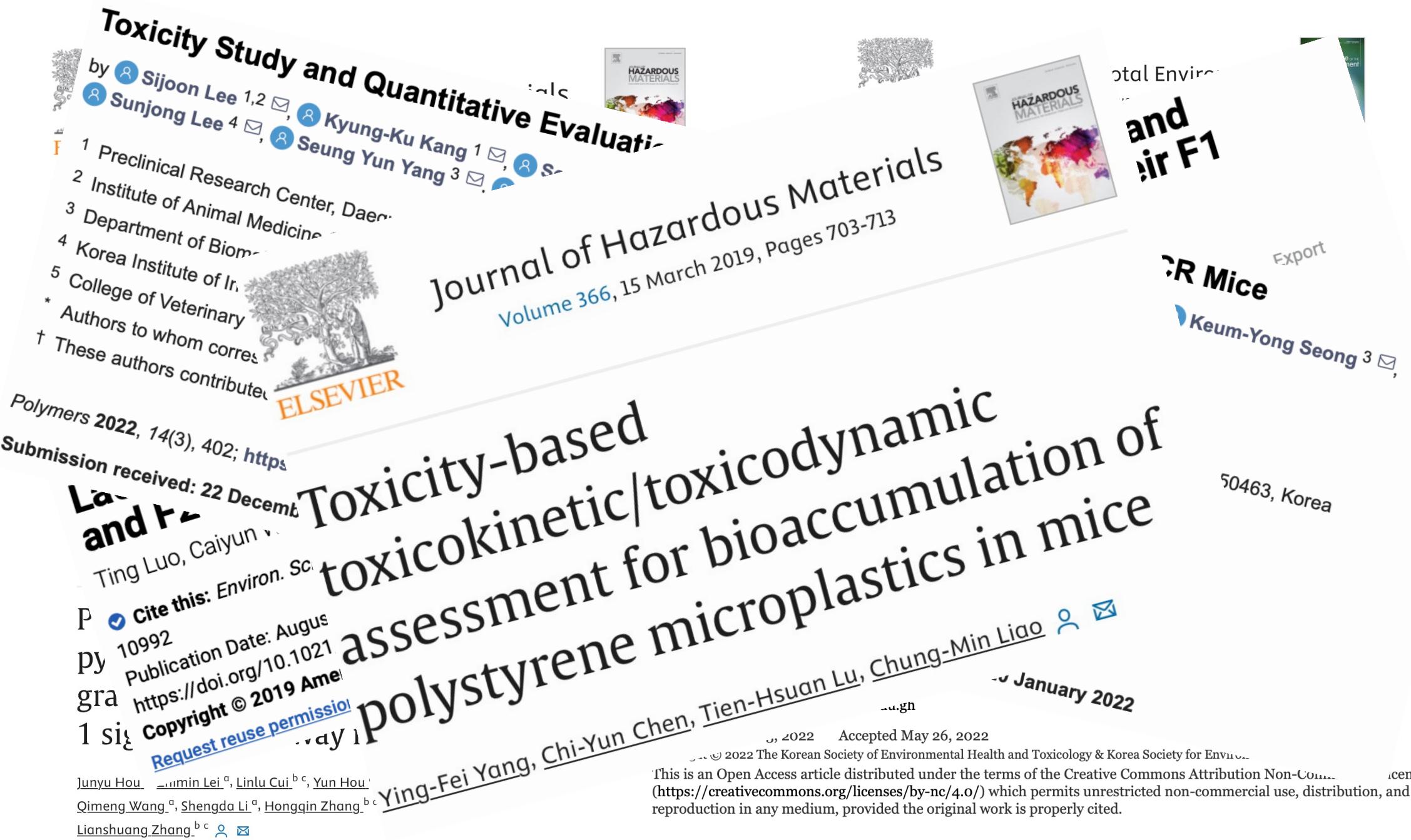
gra https://doi.org/10.1186/s13021-019-0621-1  
1 sig Copyright © 2019 The Author(s). This article is an open access publication  
Request reuse permissions → day in rats

Junyu Hou, Yiimin Lei<sup>a</sup>, Linlu Cui<sup>b c</sup>, Yun Hou<sup>b c</sup>, Long Yang<sup>a</sup>, Ru An,  
Qimeng Wang<sup>a</sup>, Shengda Li<sup>a</sup>, Hongqin Zhang<sup>b c</sup>,  
Lianshuang Zhang<sup>b c</sup>  

Received March 23, 2022 Accepted May 26, 2022

Copyright © 2022 The Korean Society of Environmental Health and Toxicology & Korea Society for Envir.

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<https://creativecommons.org/licenses/by-nc/4.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.



# Toxicity Study and Quantitative Evaluation

by

Sijoon Lee<sup>1,2</sup>✉, Kyung-Ku Kang<sup>1</sup>✉, Seung

Sunjong Lee<sup>4</sup>✉,

Seung

<sup>1</sup> Preclinical Research Center, C

<sup>2</sup> Institute of Animal Medicine

<sup>3</sup> Department of Biomed

<sup>4</sup> Korea Institute of In

<sup>5</sup> College of Veterinary

\* Authors to whom corre

† These authors contribut



Total Enviro  
and  
air F1

CR Mice



Export

Seong 3✉,

Korea

Materials

103-713

Environmental Pollution  
Volume 265, Part A, October 2020, 115025

Polystyrene microplastics cause cardiac fibrosis by activating Wnt/β-catenin signaling pathway and promoting cardiomyocyte apoptosis in rats ☆

Zekang Li<sup>a</sup>, Shuxiang Zhu<sup>a</sup>, Qian Liu<sup>a</sup>, Jiali Wei<sup>b</sup>, Yinchuan Jin<sup>c</sup>, Xifeng Wang<sup>d</sup>, Lianshuang Zhang<sup>e</sup>✉

Cite this: Environ.

py 10992

Publication Date: 1

gra https://doi.org/1/

1 sig Copyright © 2019

Request reuse permission

Junyu Hou<sup>a</sup>, Junmin Lei<sup>a</sup>, Linlu Cui<sup>b c</sup>, Yun Hou<sup>a</sup>

Qimeng Wang<sup>a</sup>, Shengda Li<sup>a</sup>, Hongqin Zhang<sup>b c</sup>

Lianshuang Zhang<sup>b c</sup>✉

Ying-Fei Yang, Chi-Yun

This is an Open Access article  
(https://creativecommons.org/licenses/by-nd/4.0/),  
reproduction in any medium, provided the original work is pro

tribution Non-Commercial license  
ommmercial use, distribution, and

# Toxicity Study and Quantitative Evaluation

by

Sijoon Lee<sup>1,2</sup>✉, Kyung-Ku Kang<sup>1</sup>✉, Seung

Sunjong Lee<sup>4</sup>✉, Seung

<sup>1</sup> Preclinical Research Center, C

<sup>2</sup> Institute of Animal Medicine

<sup>3</sup> Department of Biom

<sup>4</sup> Korea Institute of In

<sup>5</sup> College of Veteri

\* Authors +

+ Th

Polymers

Submission

ELSEVIER



Chemosphere

Volume 307, Part 4, November 2022, 136093

Lc Toxicity of micro(nano)plastics with  
air different size and surface charge on human  
P nasal epithelial cells and rats via intranasal  
py exposure

gra h  
1 sig c Jiayu Huang<sup>a,c,1</sup>, Guangyuan Dong<sup>c,a,1</sup>, Miaoqing Liang<sup>b,1</sup>, Xidong Wu<sup>d</sup>, Mingjian Xian<sup>e</sup>,  
Yunsong An<sup>a</sup>, Jiandong Zhan<sup>a</sup>, Lingling Xu<sup>a,f</sup>, Jindong Xu<sup>g,f</sup>, Weimin Sun<sup>h</sup>, Shaohua Chen<sup>a</sup>,

Junyu Hou<sup>b</sup>, Chengyu Chen<sup>b</sup>, Tao Liu<sup>a,f</sup>  
Qimeng Wang<sup>a</sup>, Hongqin Zhang<sup>b,c</sup>, Lianshuang Zhang<sup>b,c</sup>

Ying-Fei Yang, Chi-Yuu



713

pollution  
20, 115025

total Enviro  
and  
air F1

CR Mice



ig Seong 3✉,

Korea

use cardiac  
attenin  
ng



This is an Open Access article  
(<https://creativecommons.org/licenses/by-nd/4.0/>)  
reproduction in any medium, provided the original work is pre

tribution Non-Commercial license  
ommercial use, distribution, and

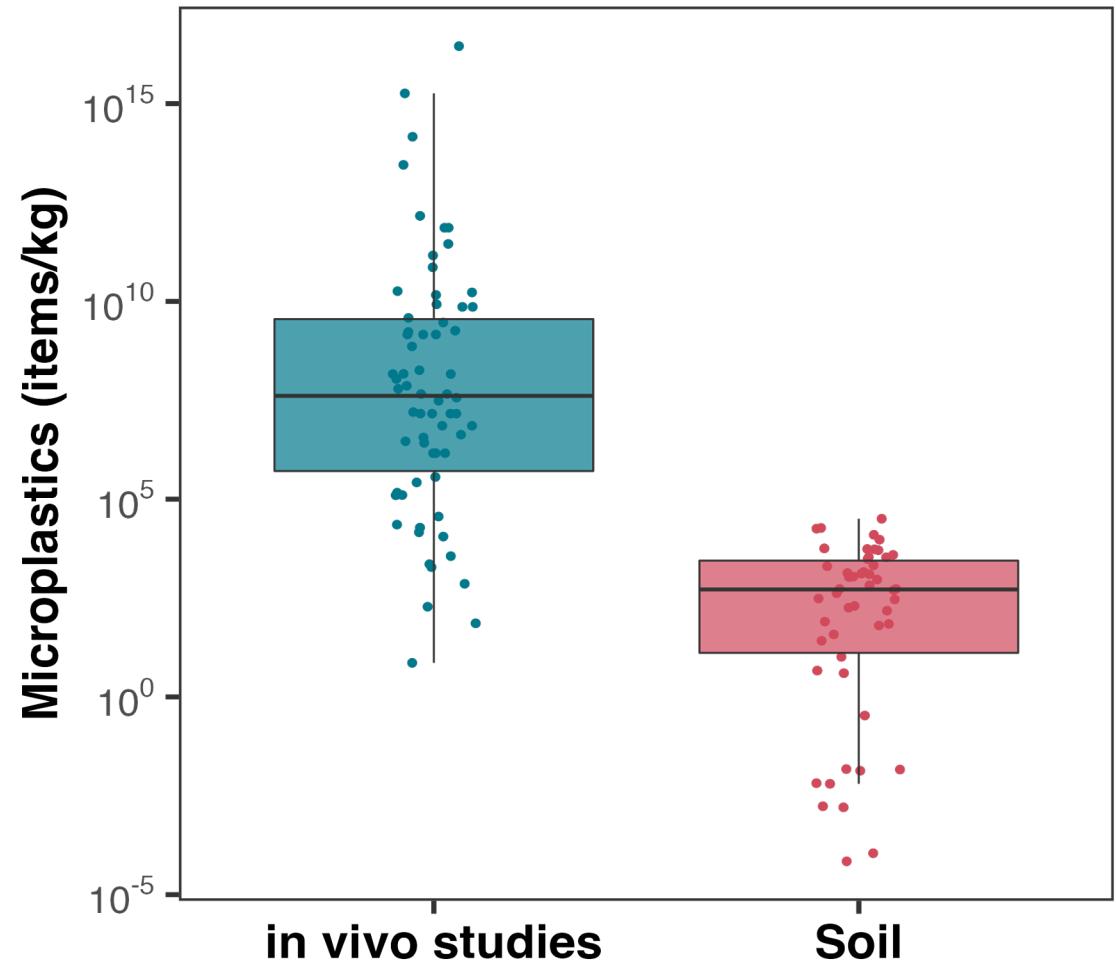


# The problem...

---



## *In vivo* lab vs. soil studies



**Figure 2.** Boxplots showing the concentrations of MPs fed to rodents in *in vitro* lab studies, compared to those of MPs found in soils. Data were compiled from 93 peer-reviewed studies; 38 on MPs in soil and 55 on the health effects of MPs (11 focused on reproduction).



So, what about wildlife?



[5]

---

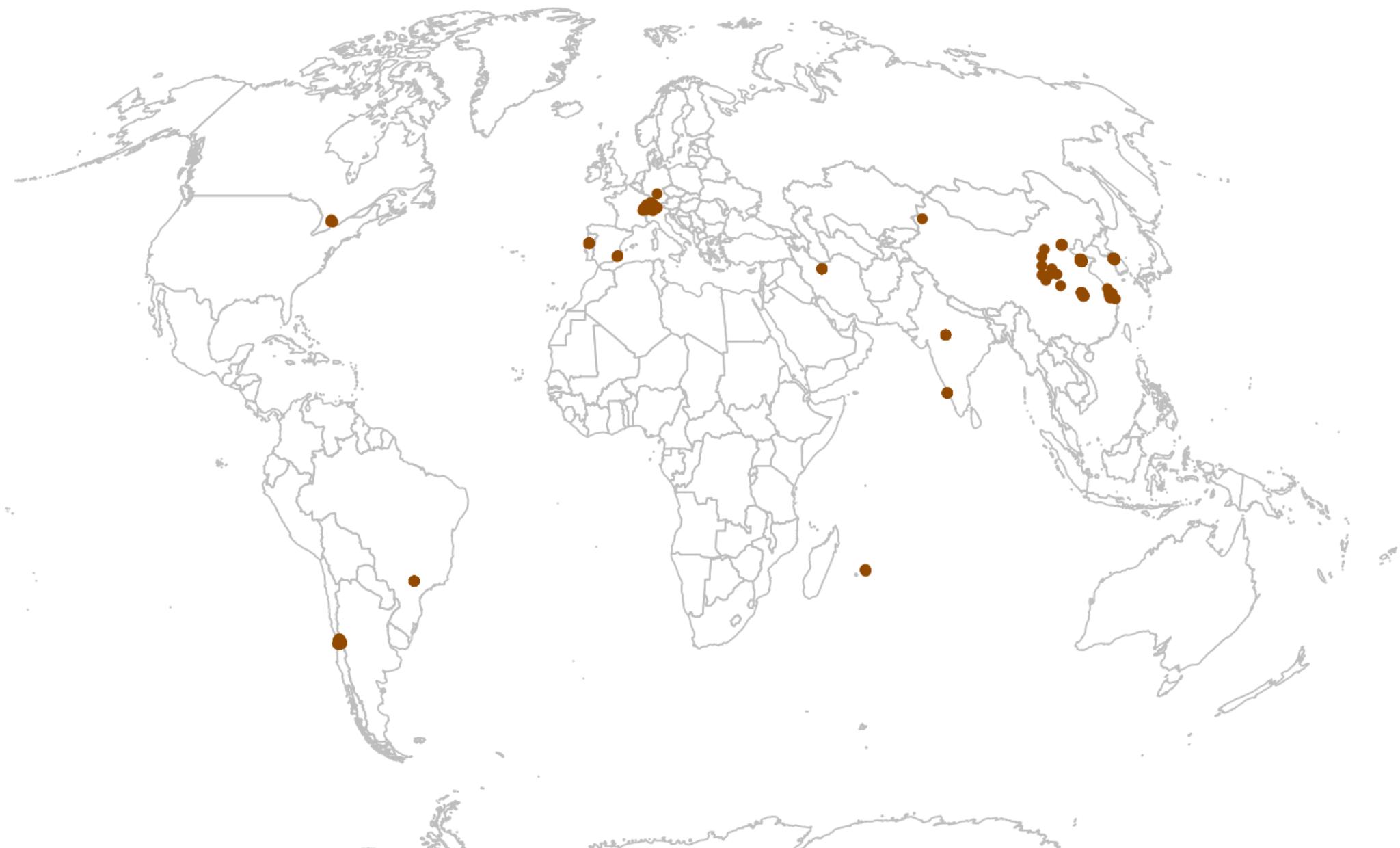
A better understanding of  
terrestrial microplastic  
exposure levels are needed

# Data collection

No standardized measurements across studies

Few published papers had readily available data

# Sampled locations to date



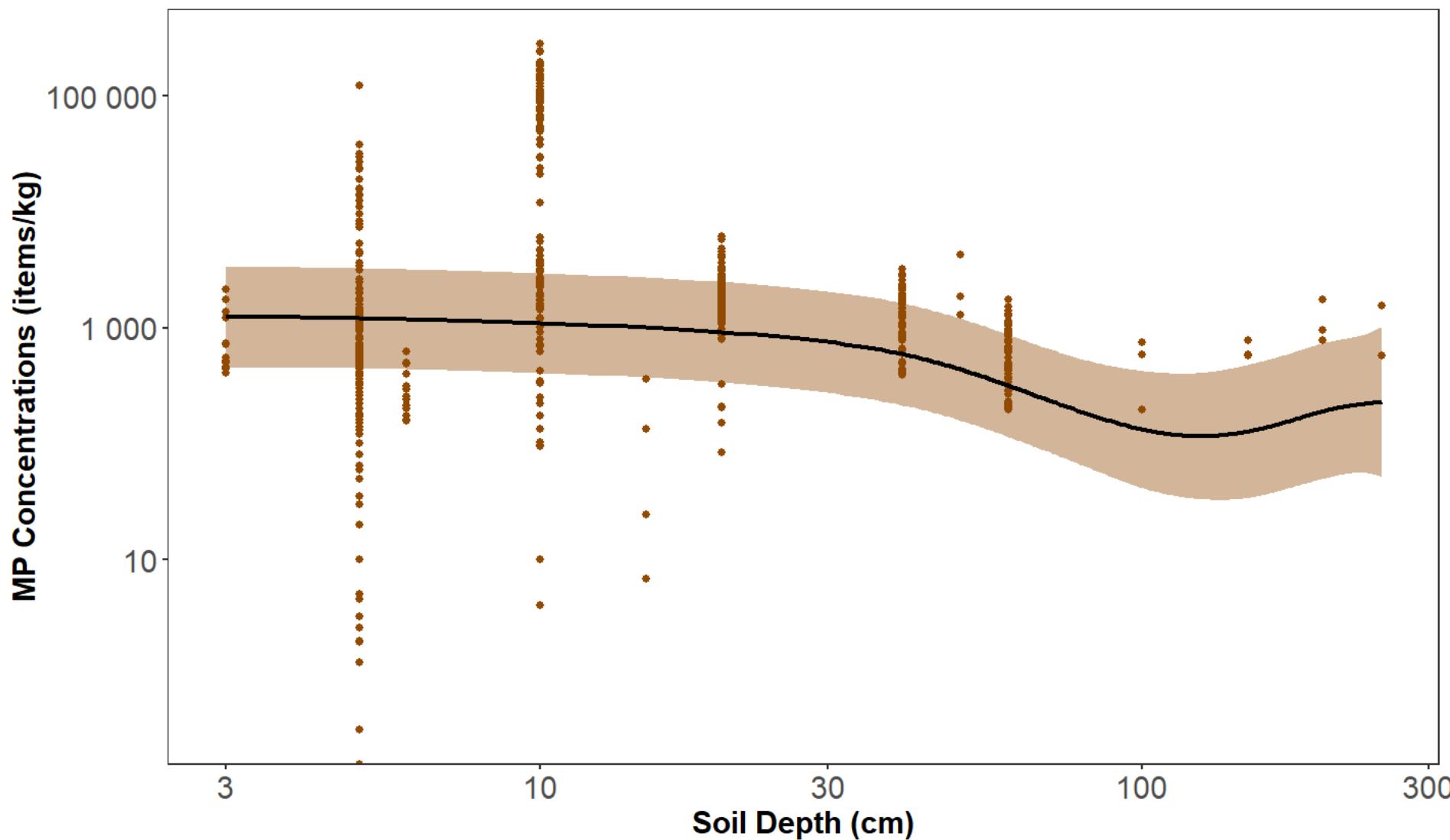
# Predictor variables

Soil  
Depth

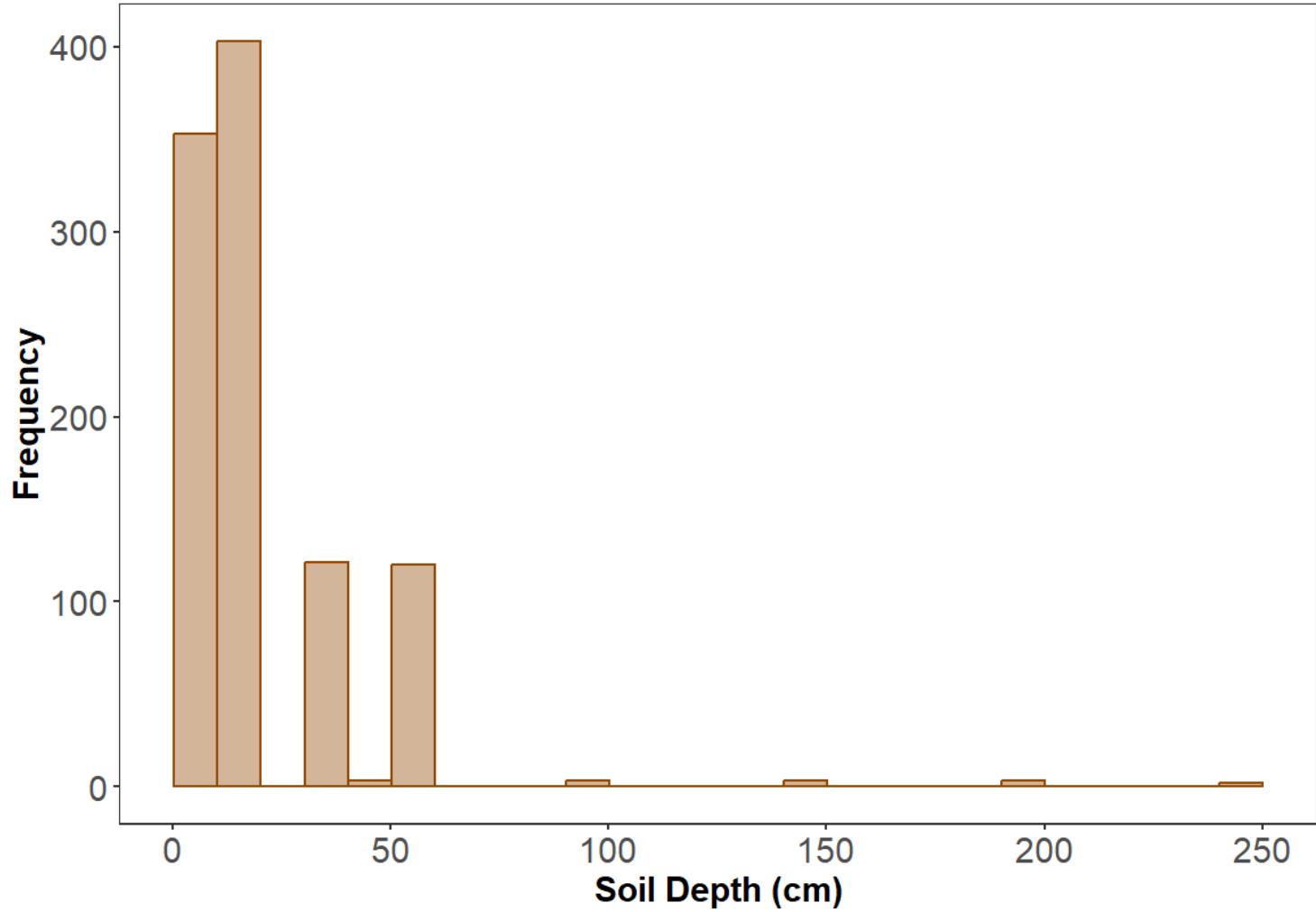
Elevation

HFI

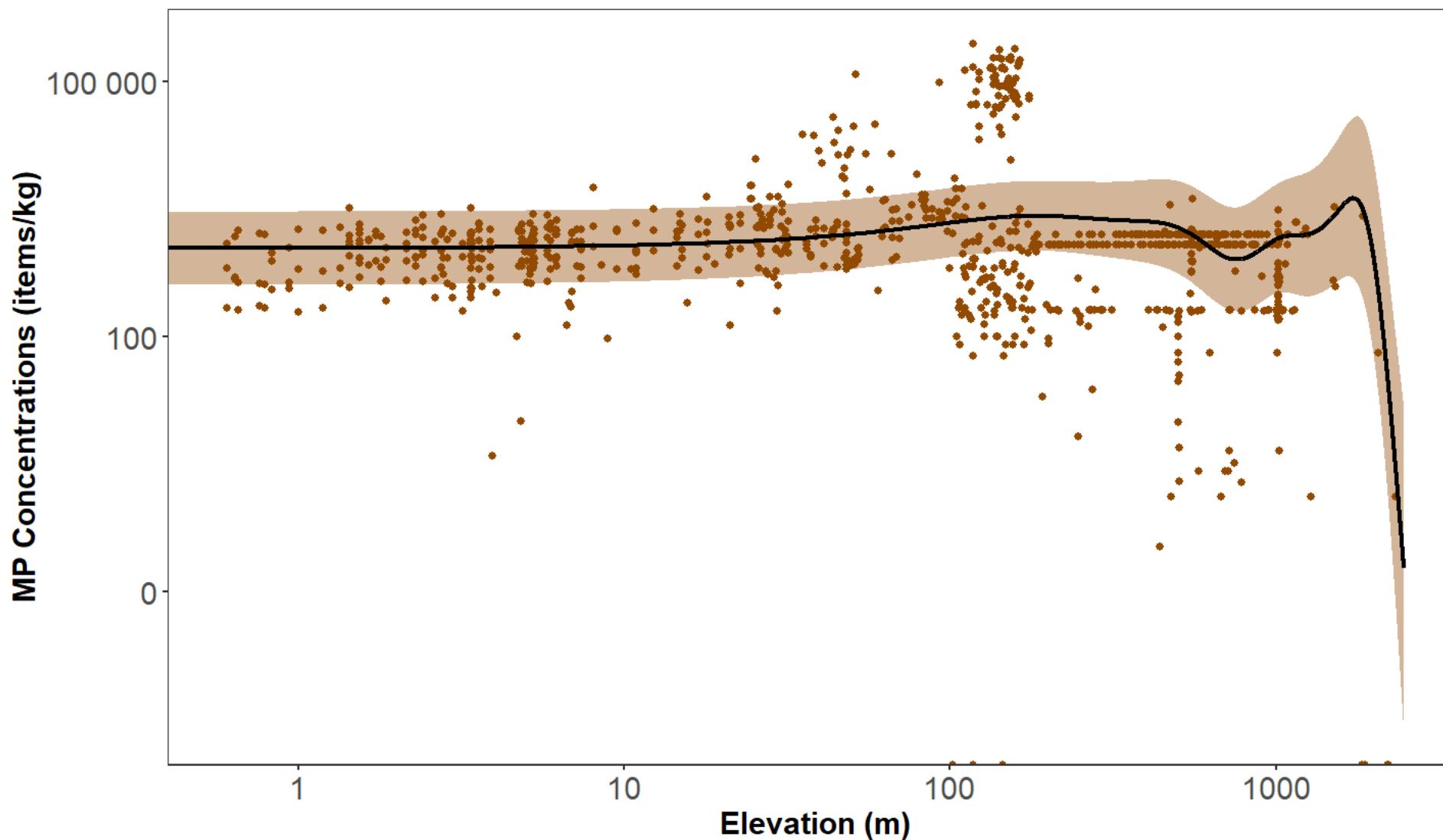
# Predicted microplastic concentrations



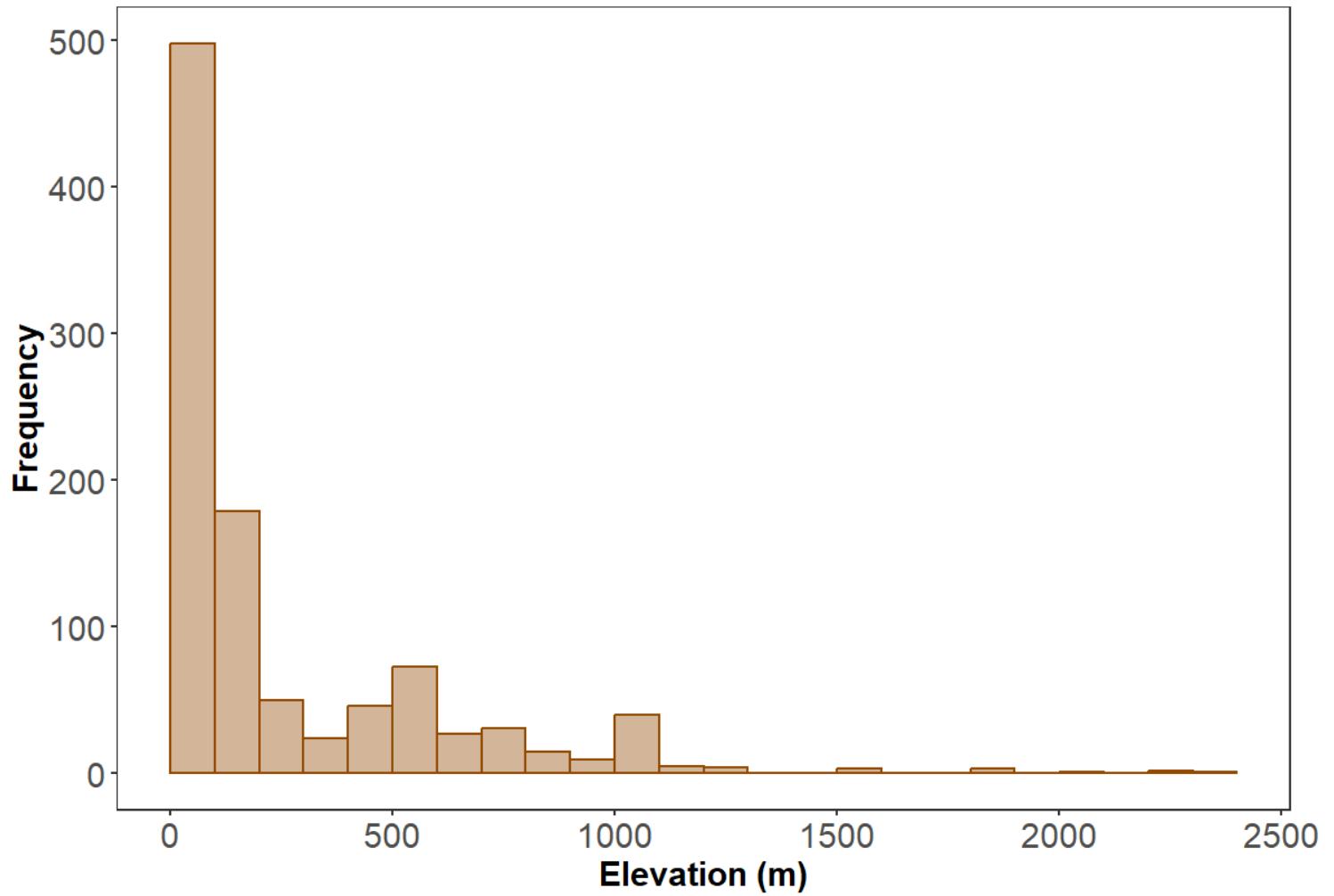
# Existing data



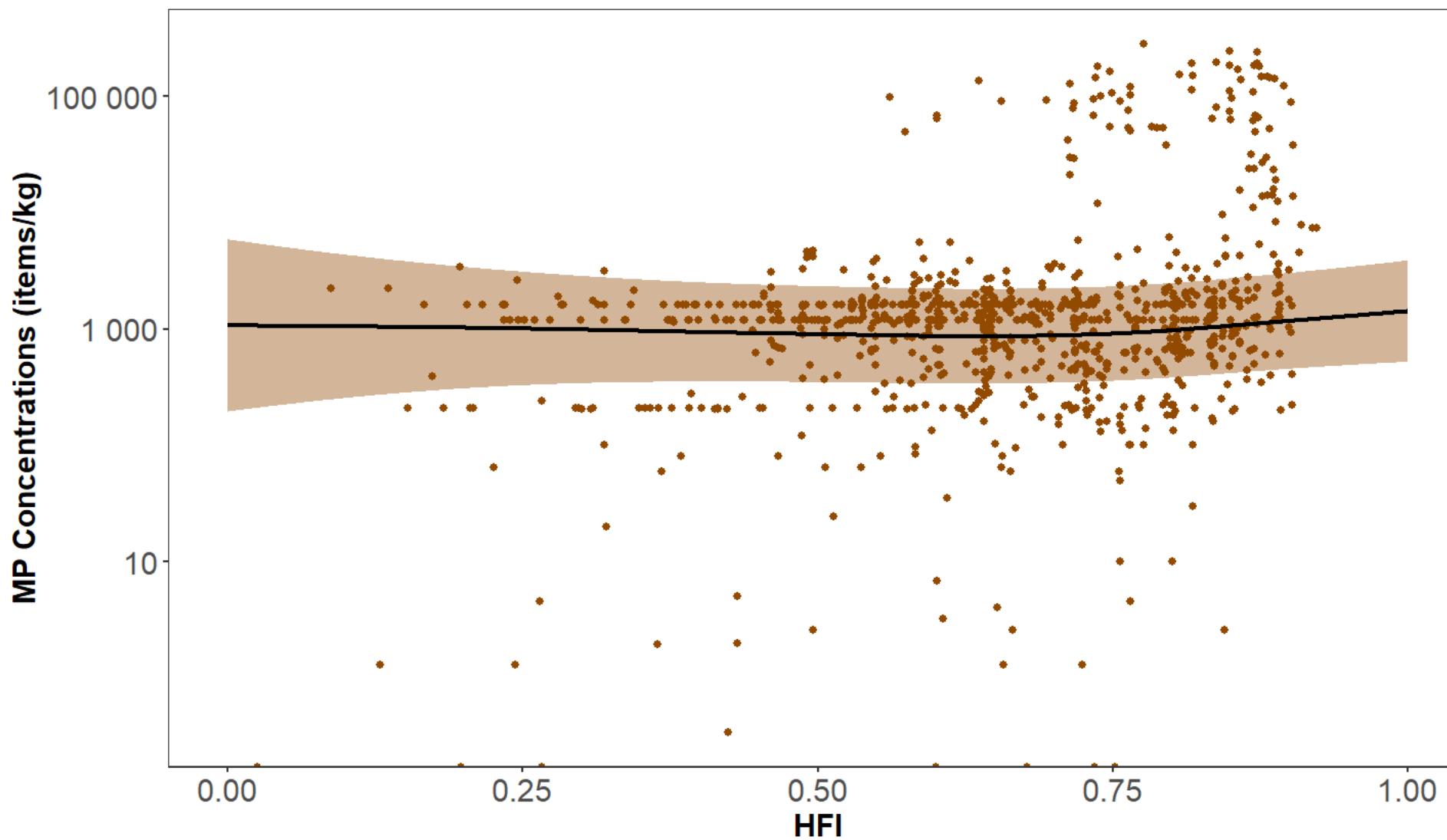
# Predicted microplastic concentrations



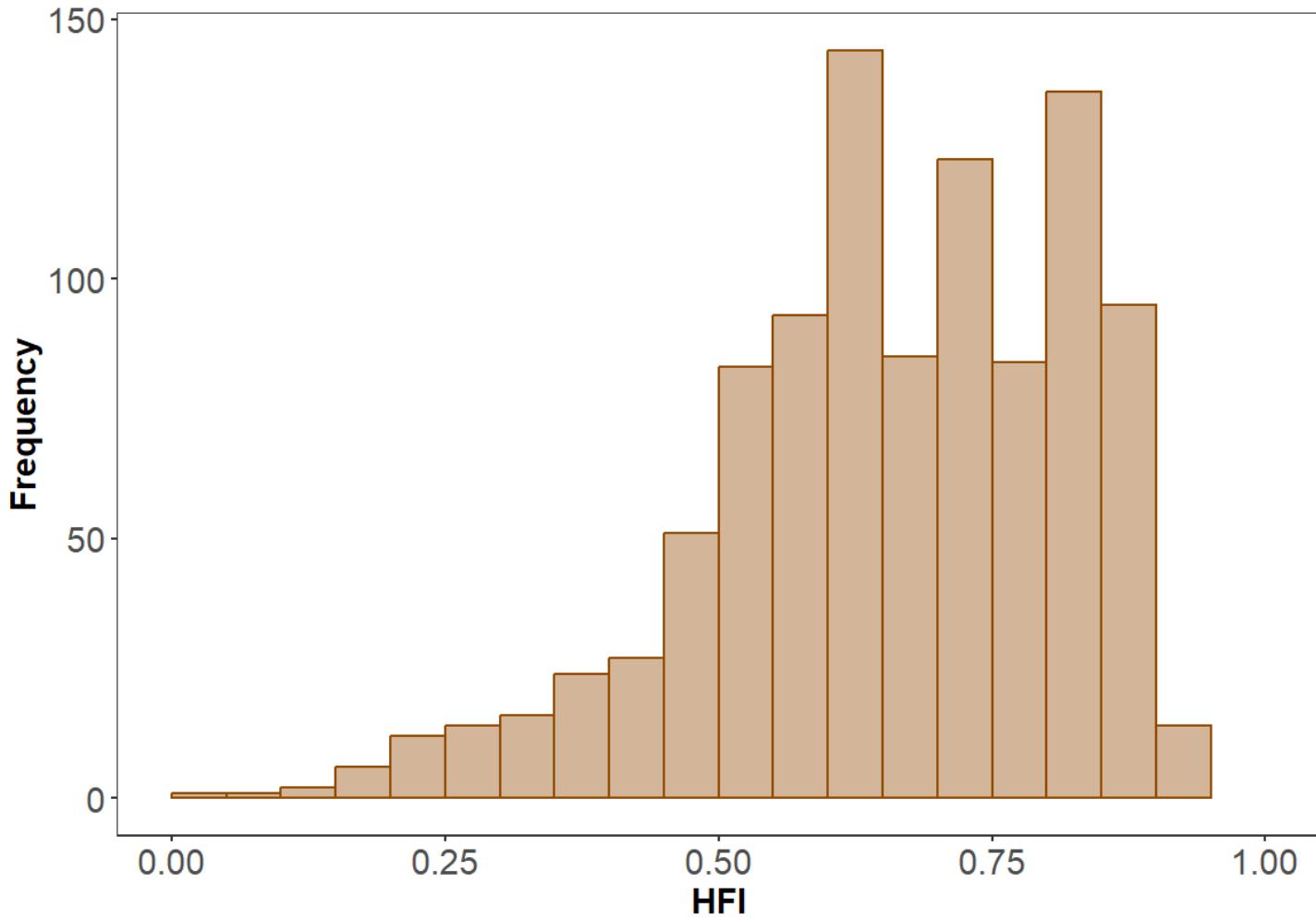
# Existing data



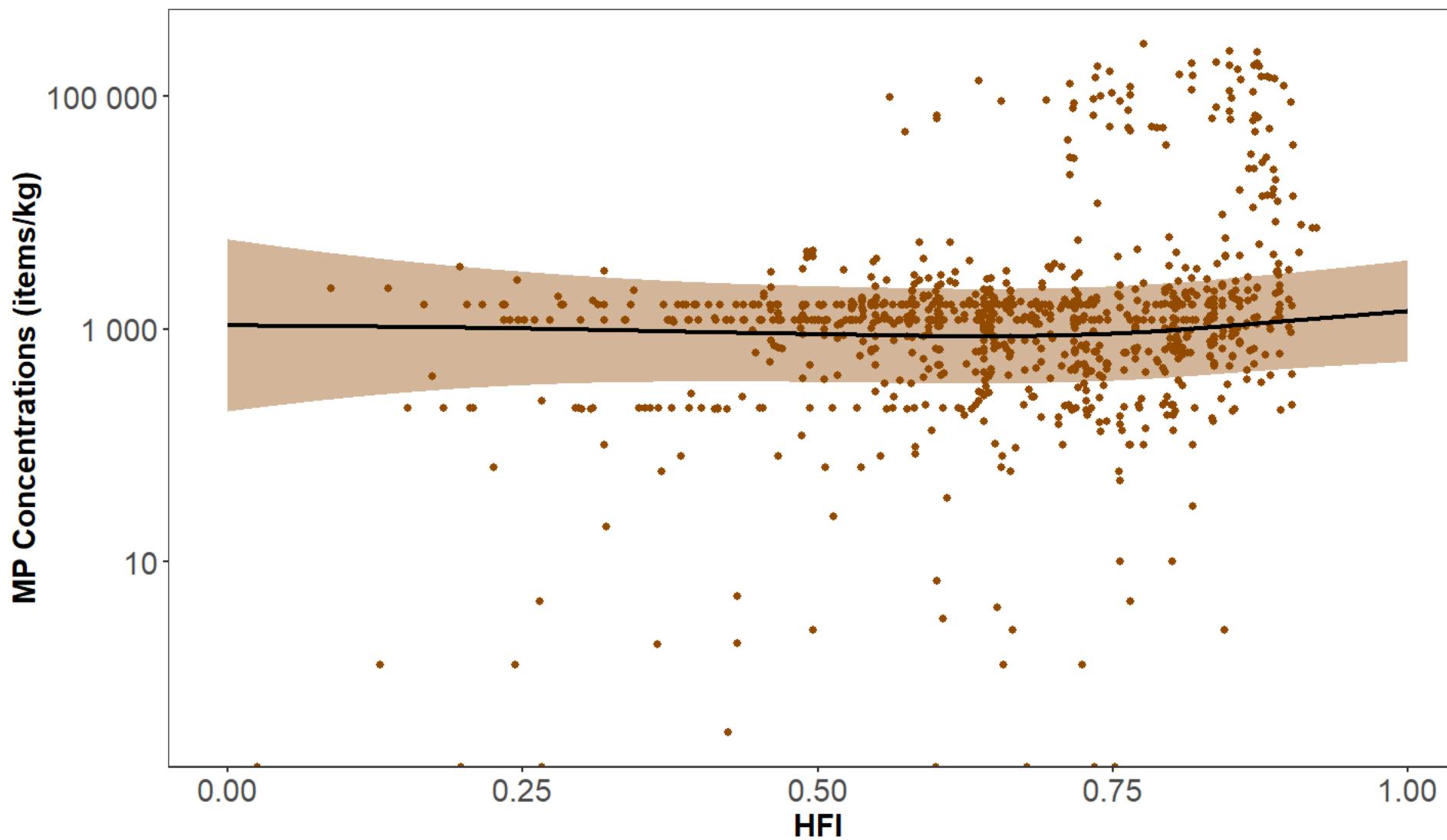
# Predicted microplastic concentrations



# Existing data

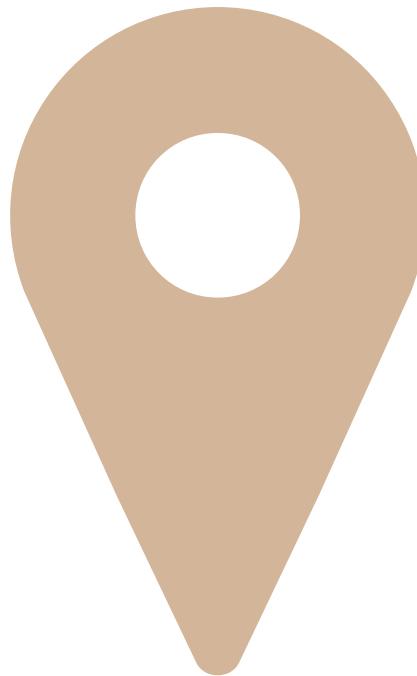


# Predicted microplastic concentrations



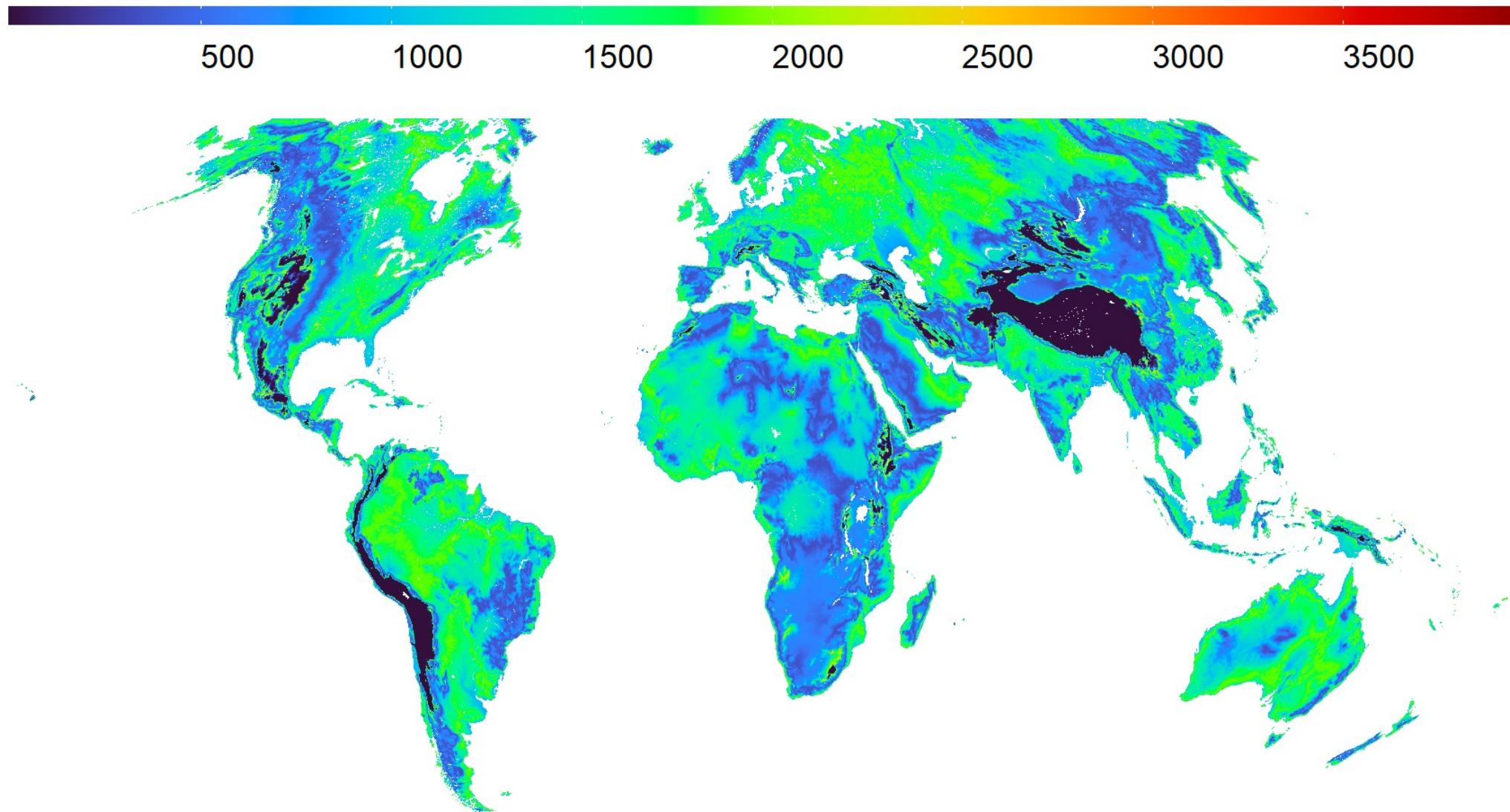
---

# Predicting microplastic concentrations at unsampled locations

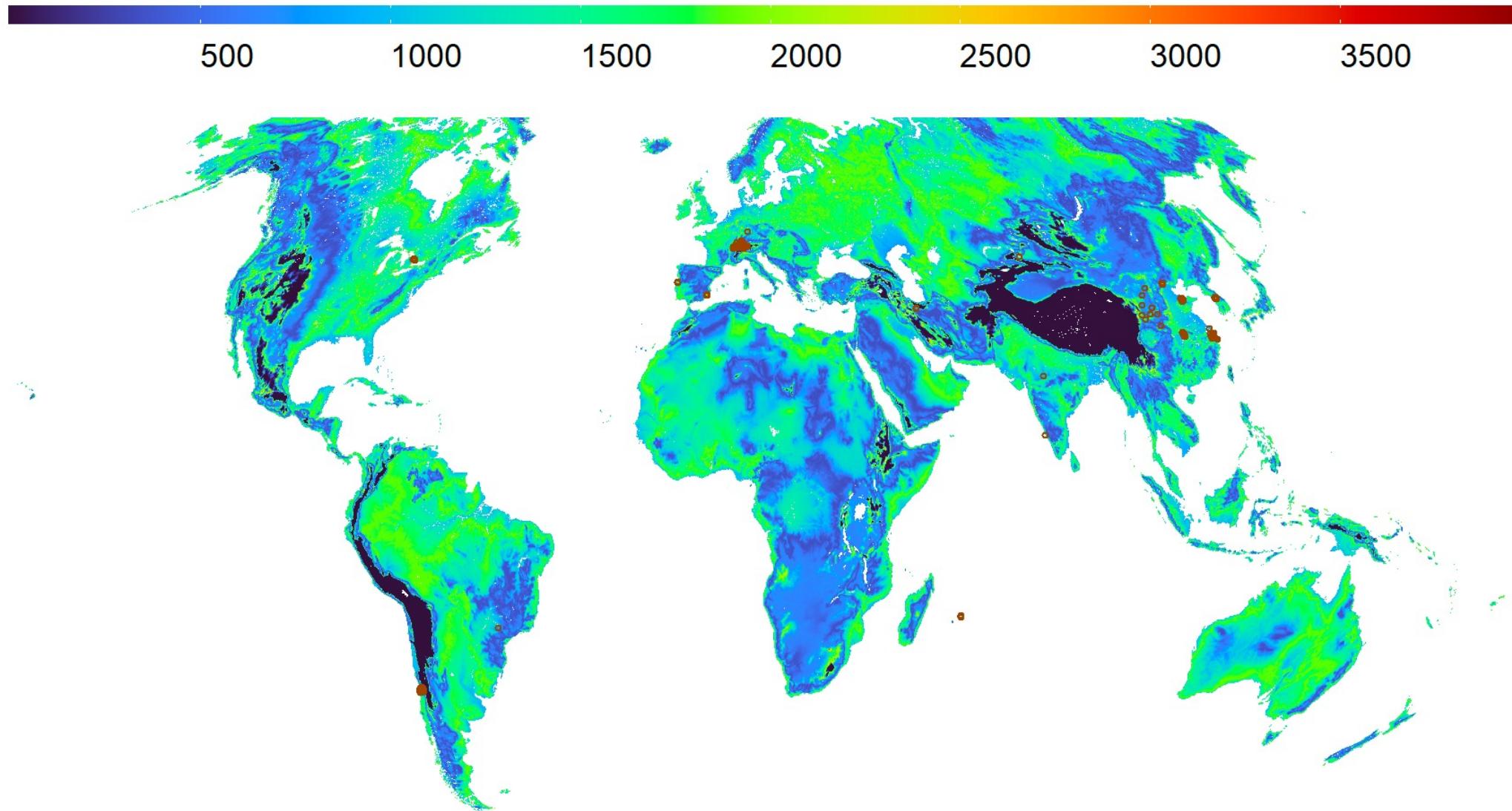


# Kriging

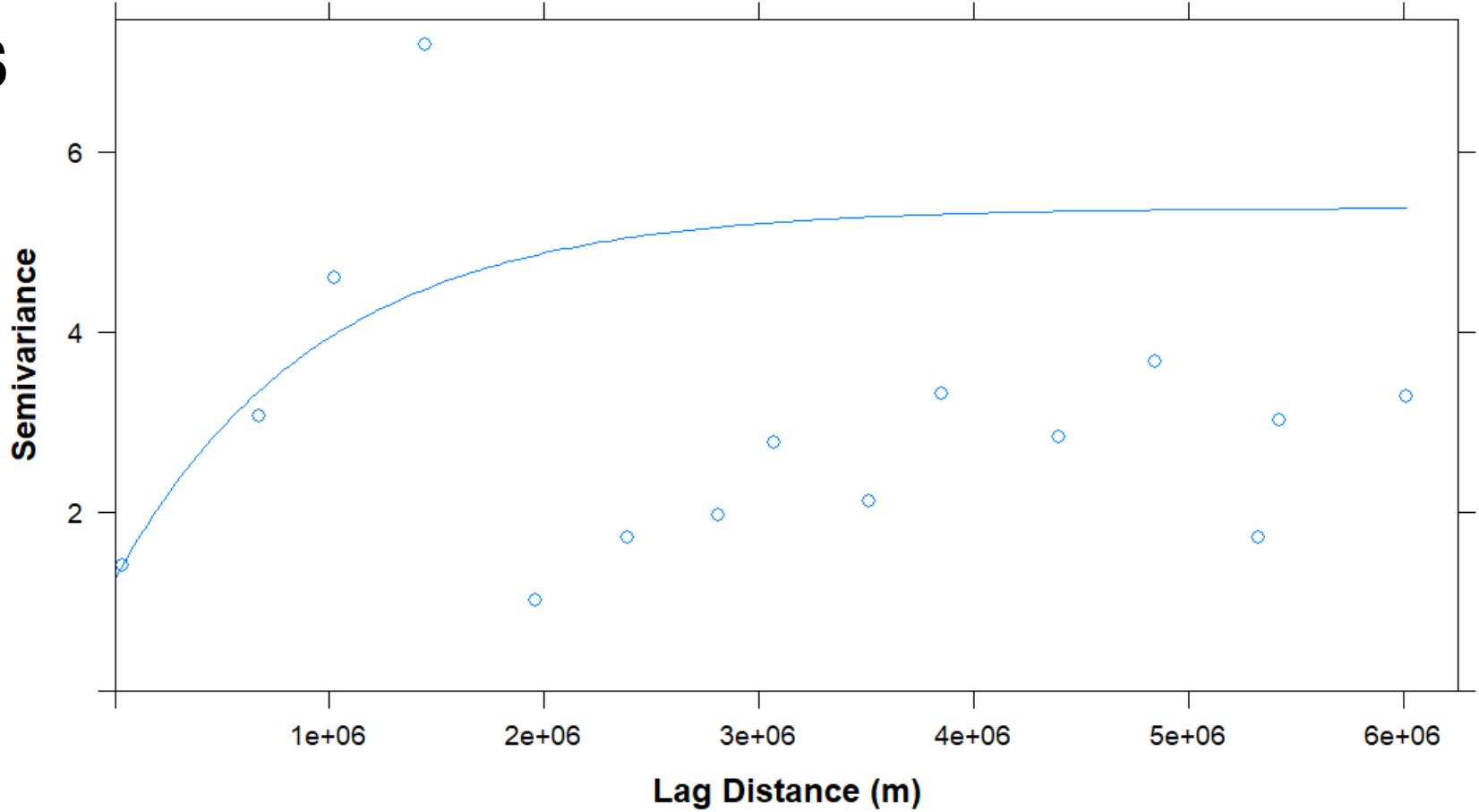
# Microplastic predictions based off model



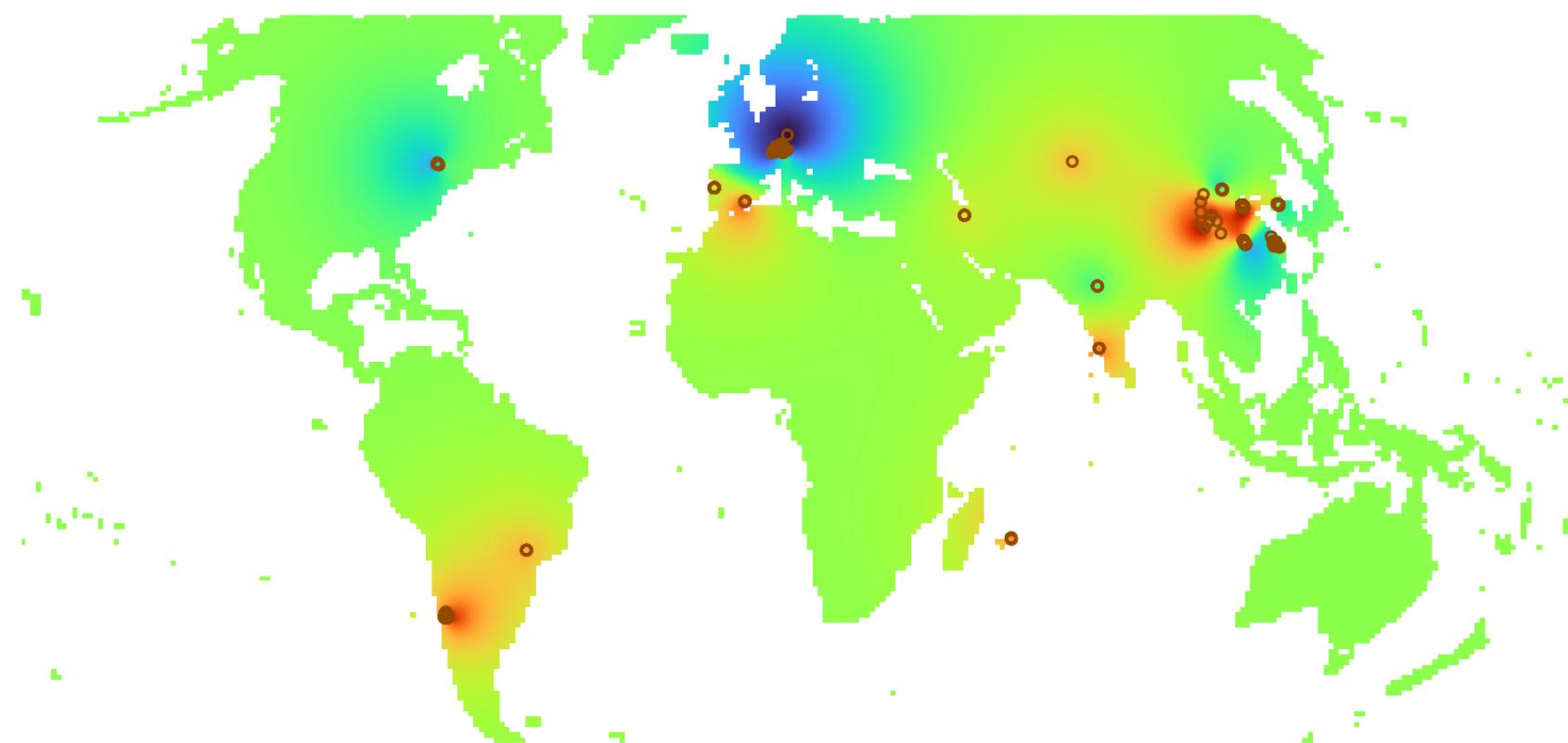
# Microplastic predictions based off model



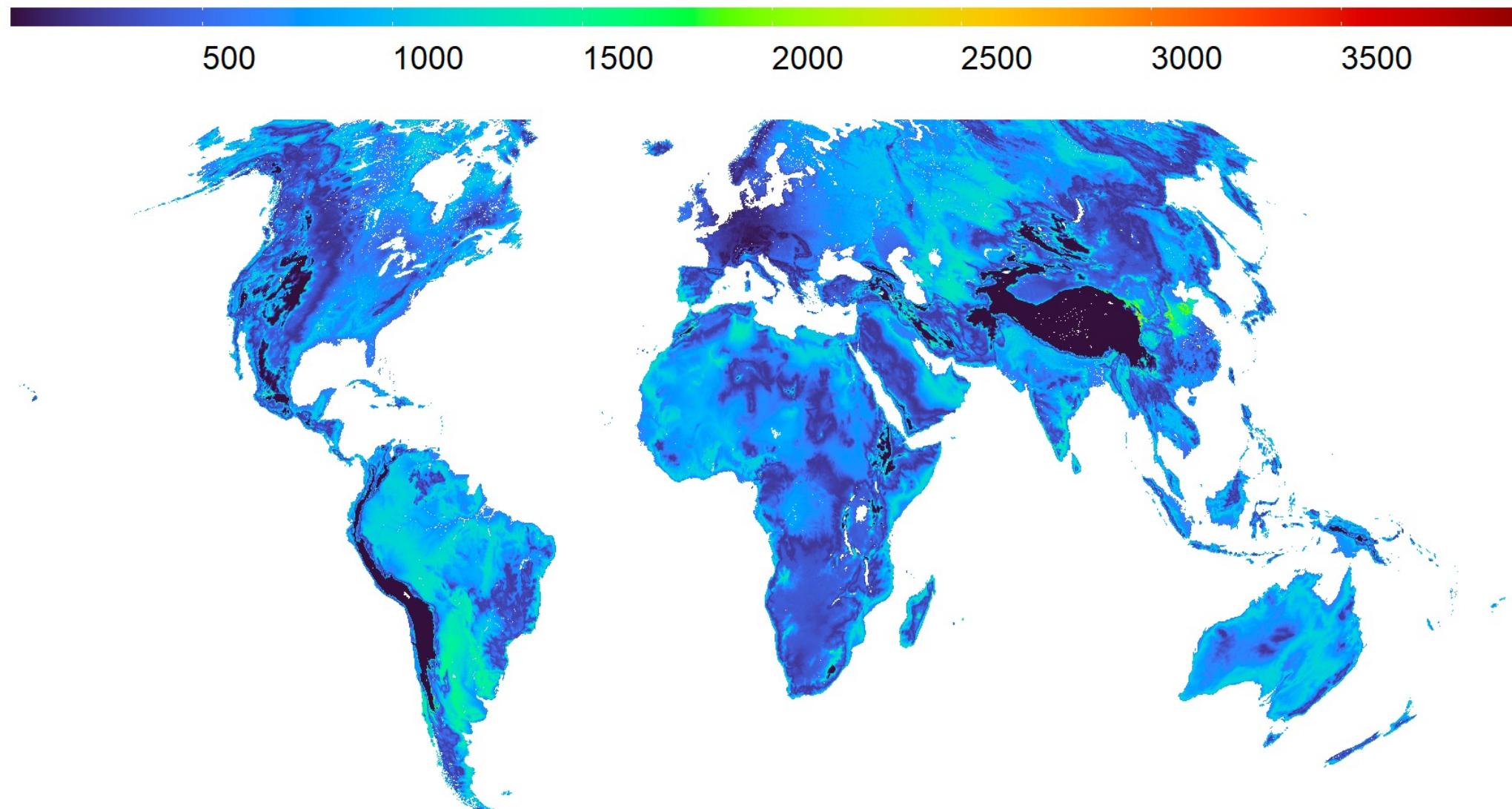
# Conservation implications



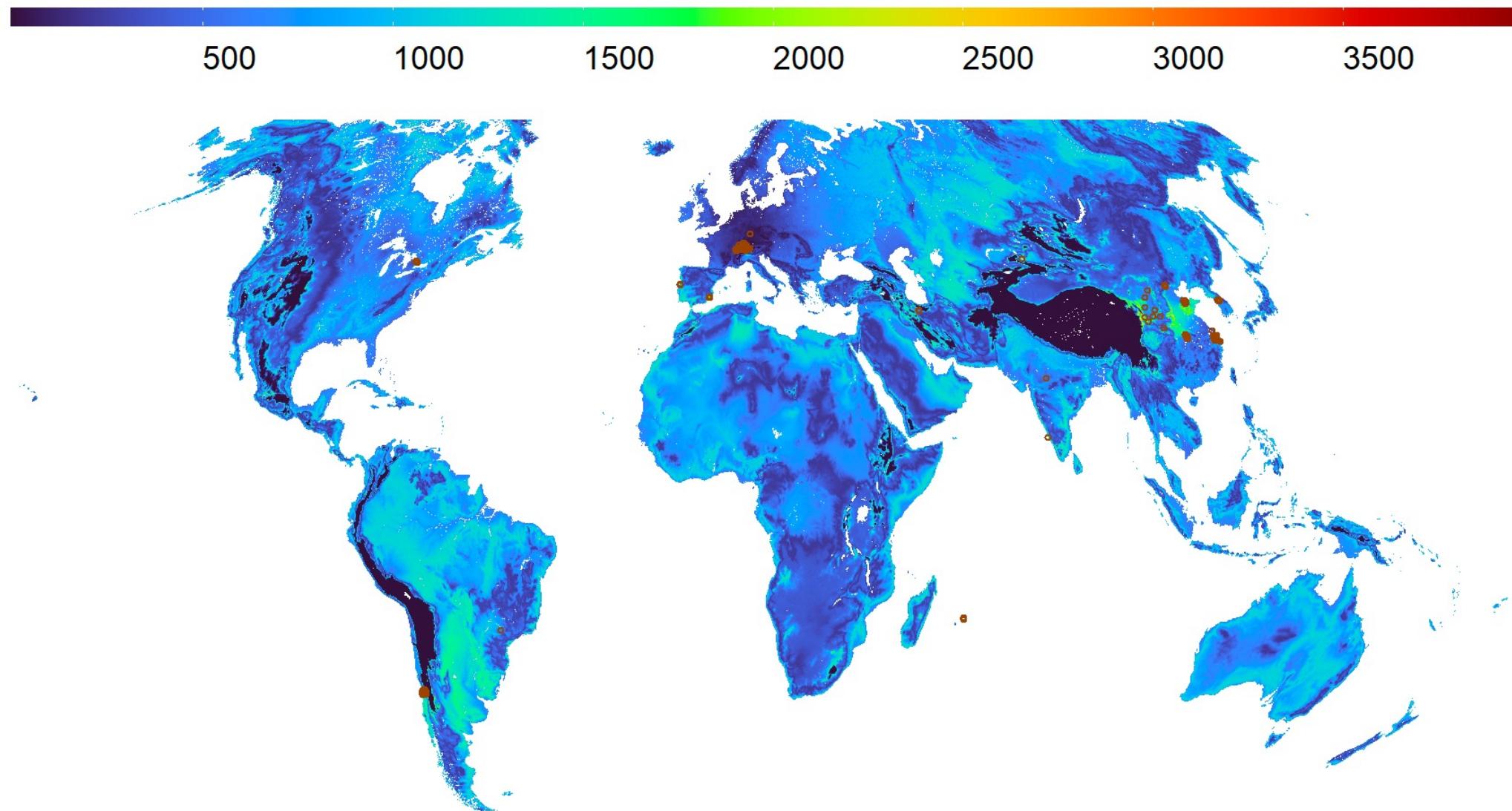
# Kriging model



# Microplastic predictions after kriging



# Microplastic predictions after kriging



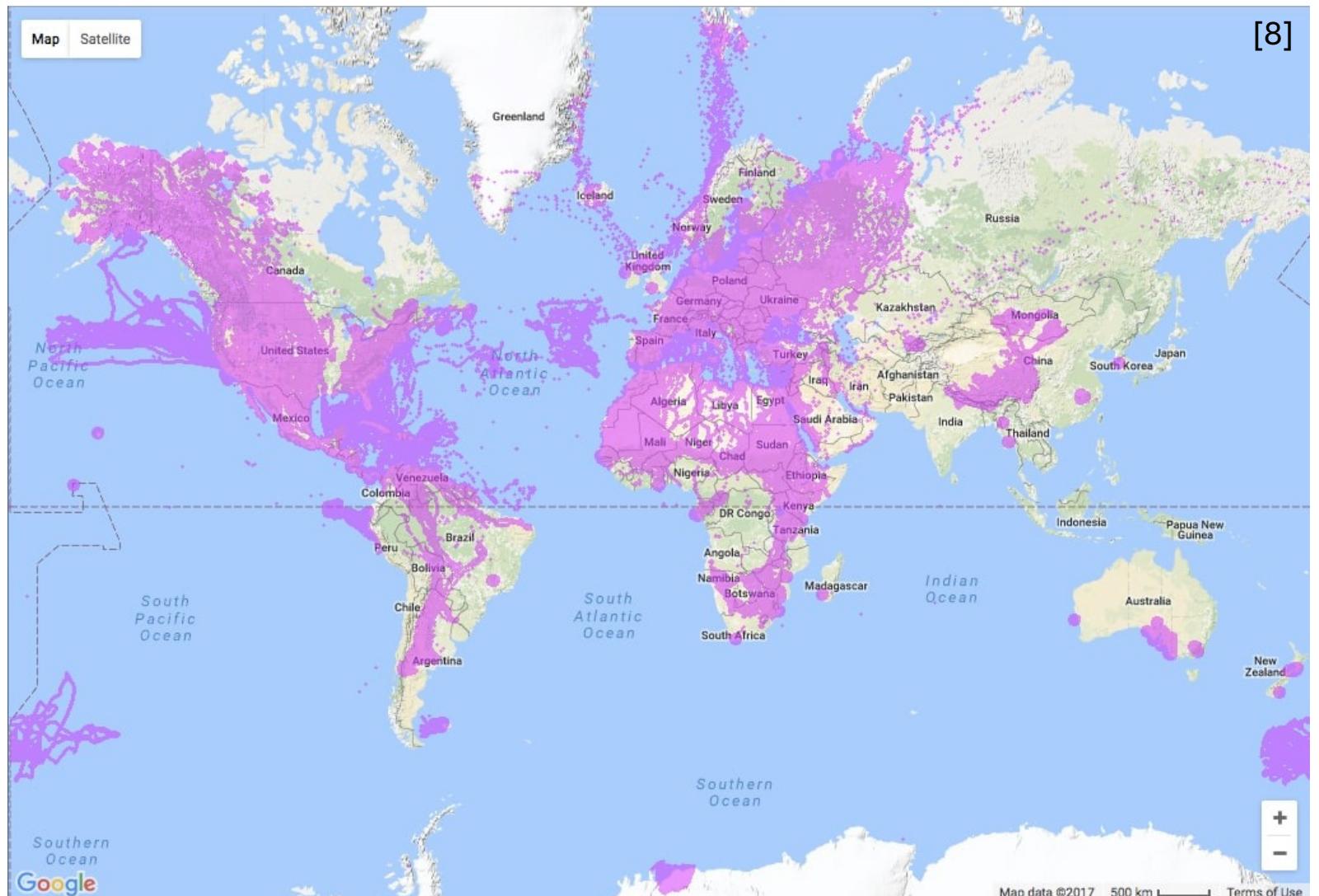


[3]



[4]

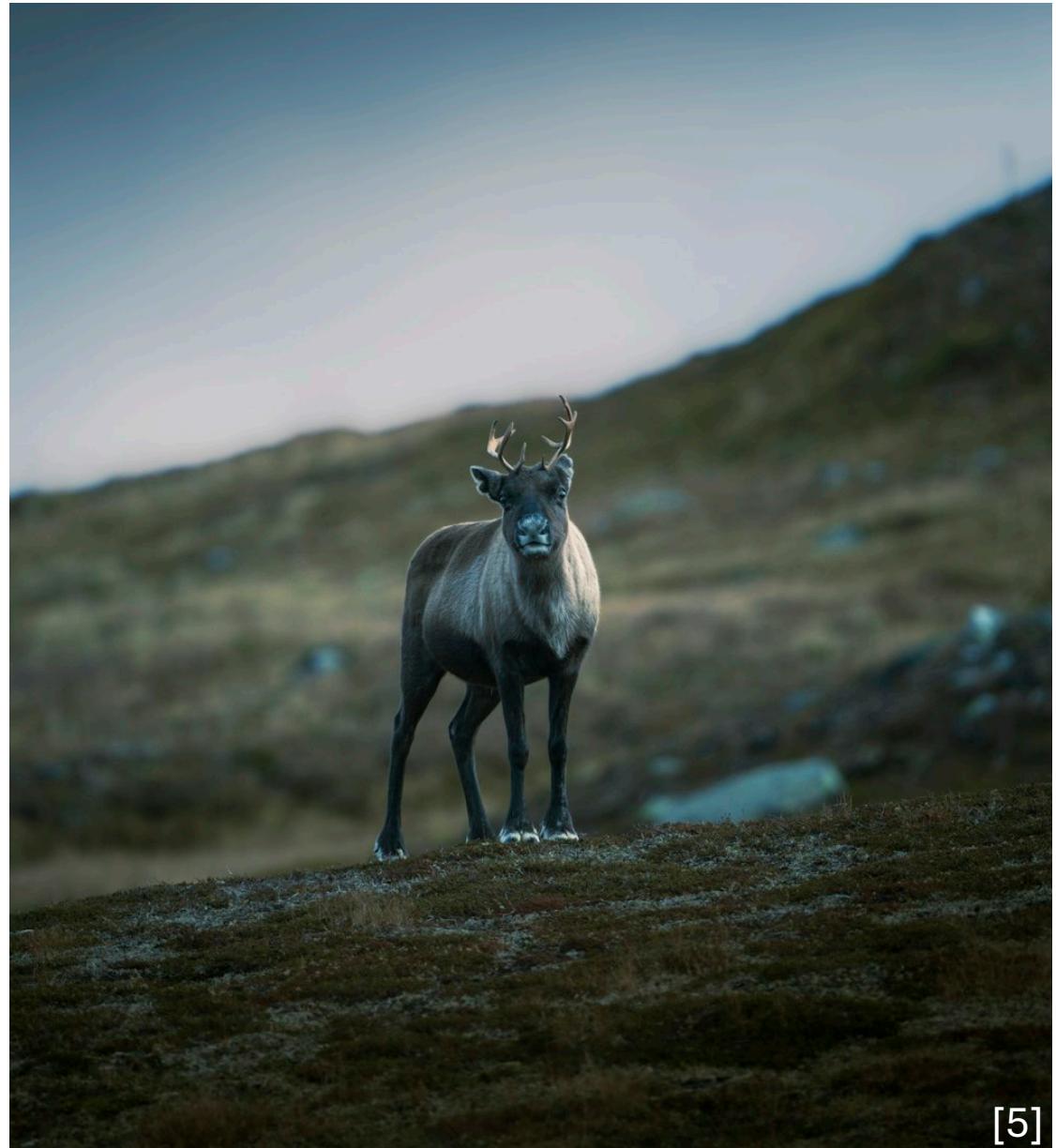
# Wildlife tracking data



# Next steps

More data needed to identify microplastic hotspots

No way of knowing which populations are at risk if hotspots are unknown

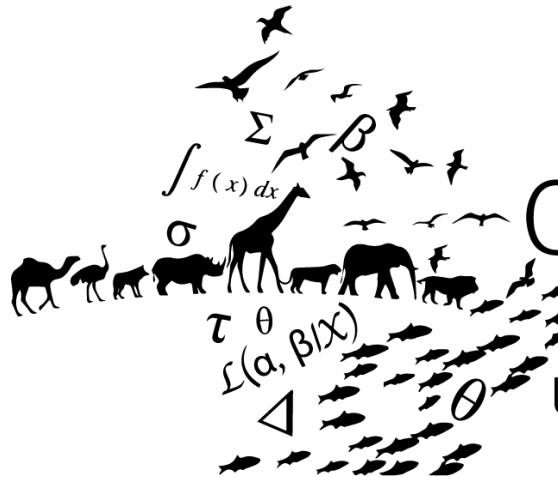


[5]

# References

1. Tournier, V., C. M. Topham, A. Gilles, B. David, C. Folgoas, E. Moya-Leclair, E. Kamionka, M.-L. Desrousseaux, H. Texier, S. Gavalda, M. Cot, E. Guémard, M. Dalibey, J. Nomme, G. Cioci, S. Barbe, M. Chateau, I. André, S. Duquesne, and A. Marty. 2020. An engineered PET depolymerase to break down and recycle plastic bottles. *Nature* 580:216–219.
2. Kazemi, M., S. Faisal Kabir, and E. H. Fini. 2021. State of the art in recycling waste thermoplastics and thermosets and their applications in construction. *Resources, Conservation and Recycling* 174:105776.
3. Renovato, A. (2018). “Two gray bears in green lawn grasses.” Unsplash. Retrieved from: <https://unsplash.com/photos/6HxC-fZjI0> Accessed 4 March 2024.
4. Baber, A. (2017). “Buck eating grass near tall trees.” Unsplash. Retrieved from: <https://unsplash.com/photos/IY4FEvvRpZ4> Accessed 4 March 2024.
5. Notle, C. (2023). “A large animal standing on top of a grass covered field.” Retrieved from: <https://unsplash.com/photos/679B7-70dAA> Access 4 March 2024.
6. Jimenez, G. (2017). “Poor man's garden.” Unsplash. Retrieved from: <https://unsplash.com/photos/jin4W1HqgL4> Accessed 4 March 2024.
7. Wikelski M, Davidson SC, Kays R. [year]. Movebank: archive, analysis and sharing of animal movement data. Hosted by the Max Planck Institute of Animal Behavior. www.movebank.org, accessed on 4 March 2024.

# Thank you to all funders



Quantitative  
Ecology Lab  
UBC Okanagan



THE UNIVERSITY OF BRITISH COLUMBIA  
Library  
Irving K. Barber Learning Centre



**NSERC**  
**CRSNG**

**INNOVATION.CA**  
CANADA FOUNDATION  
FOR INNOVATION | FONDATION CANADIENNE  
POUR L'INNOVATION