

Microfiber Pollution & the Apparel Industry

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INTRODUCTION

Microfibers, synthetic fibers less than 5 mm in length, are an emerging pollutant with widespread distribution in the environment. In marine ecosystems, they are bioaccumulating in the food chain and causing ecological harm. There is a knowledge gap in scientific literature on how much synthetic clothing shed and the amount of fibers that enter the environment. This project aims to fill this gap by quantifying and contextualizing microfiber pollution from the household laundering of synthetic clothing.



Objectives

1. Quantify the microfibers shed from synthetic jackets
2. Explore the potential impacts on the environment

Key Questions

- What factors significantly impact shedding?
- Where are the fibers present in the environment?
- What are the ecological impacts?

RESULTS OF WASH EXPERIMENT

Shedding ranged from 0.16 g to 2.7 g per jacket per wash (A).

Both the type of washing machine (B) and "age" of jacket (C) significantly impacted shedding.

A combination of top load, "aged", and budget jacket resulted in the highest shedding.

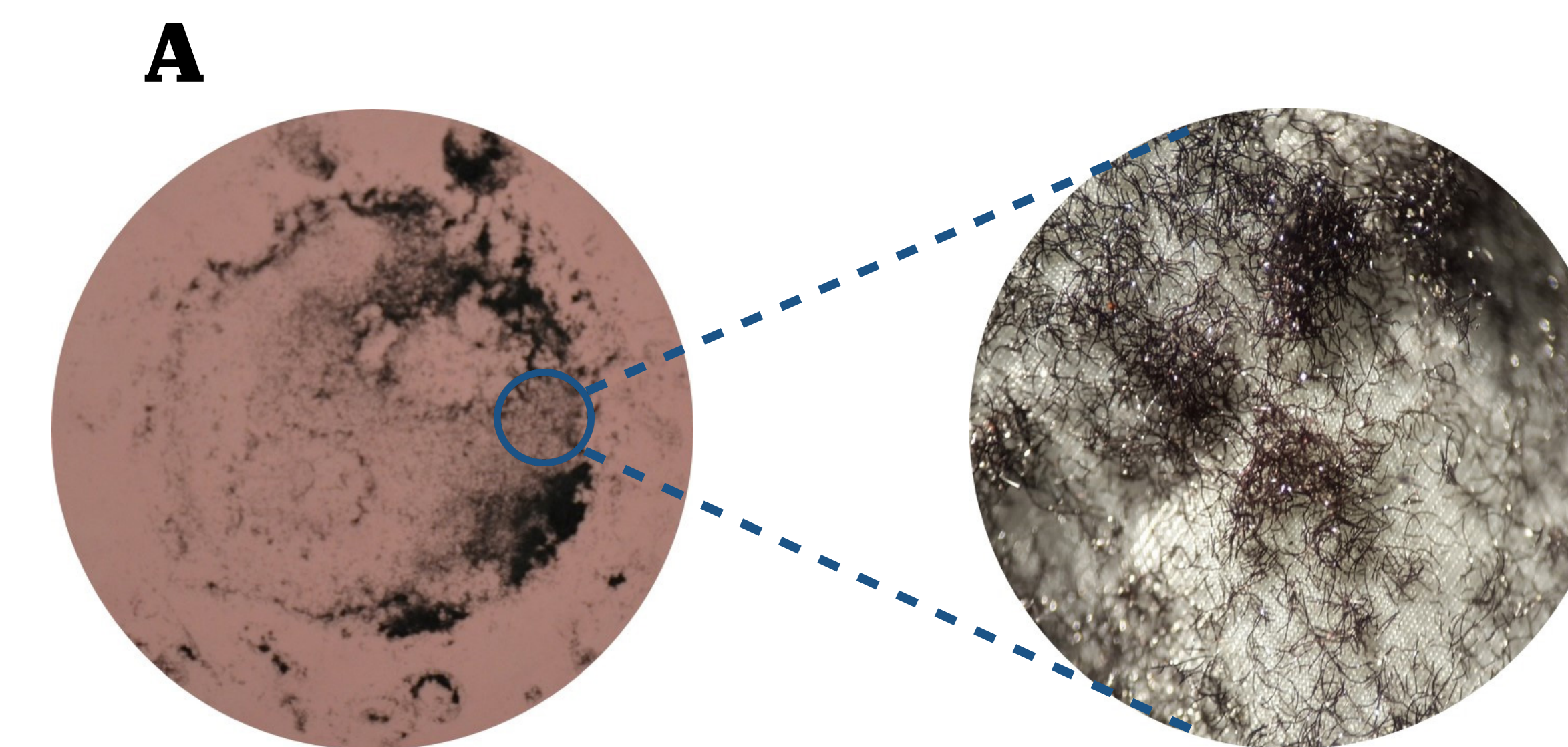


Image of a filter (left) and the magnification of fibers (right)

DISTRIBUTION

Microfibers are globally prevalent in terrestrial, aquatic, and atmospheric ecosystems.

Higher density of synthetic fibers results in sinking and settling in shoreline and deep sea sediments.

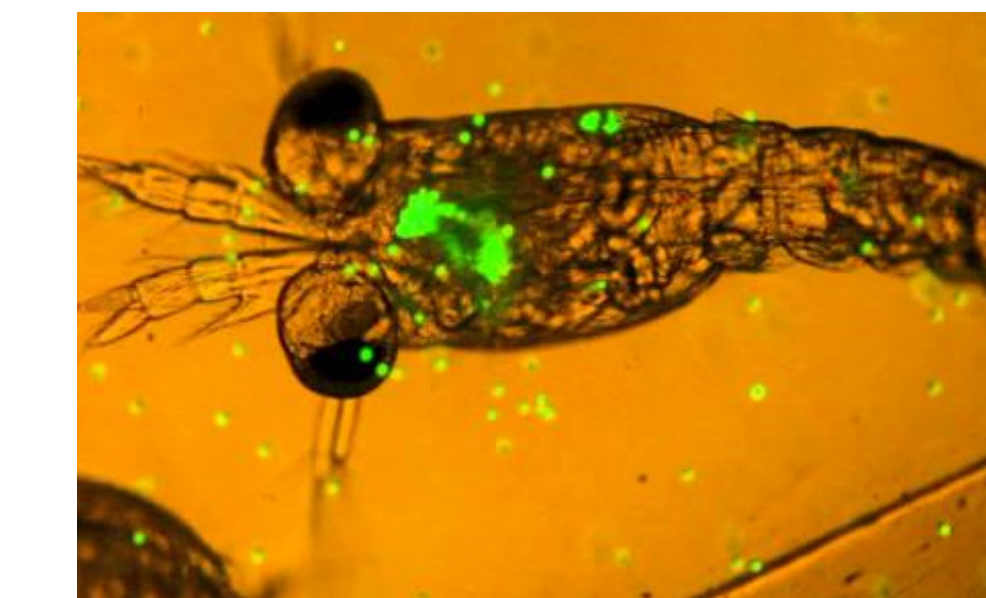
Due to the release of fibers from WWTPs, marine systems are an especially substantial receptor.

It's increasingly common to apply sewage sludge to agricultural fields so more fibers are being found on land.

ECOLOGICAL IMPACTS

Microfibers act as sponges, carrying invasive bacteria that can be harmful to humans.

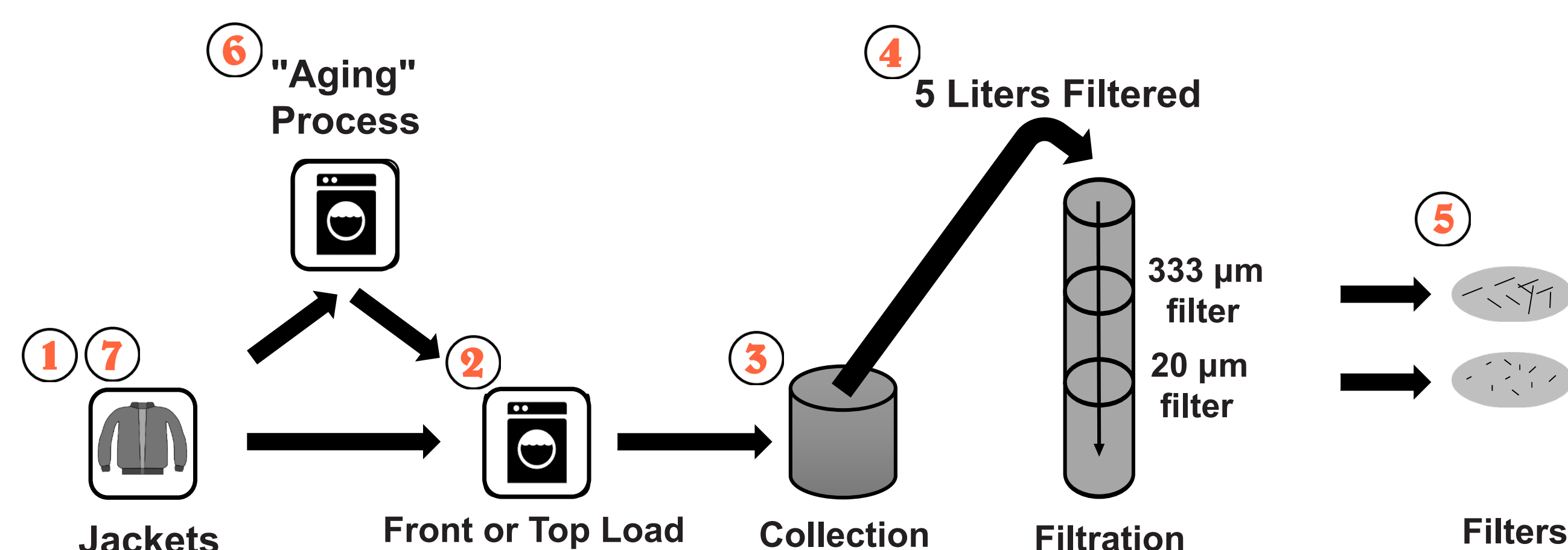
Microfiber consumption reduces reproductive rates in oysters.



Microfibers are easily entangled in the stomach lining of smaller organisms, reducing feeding activity.

Sediments with plastic warm slower which would affect the sex determination of sea turtles.

METHODOLOGY



Wash Experiment Methods:

1. One jacket chosen (see table below)
2. Jacket is washed in front or top load washing machine
3. Water from wash cycle is collected
4. Five Liters is filtered through filtration column
5. Filters are collected and massed
6. Each jacket is "aged" via a 24-hour intensive wash cycle
7. Steps 1 through 5 are repeated for all "aged" jackets

Wastewater Treatment Plant Model Methods:

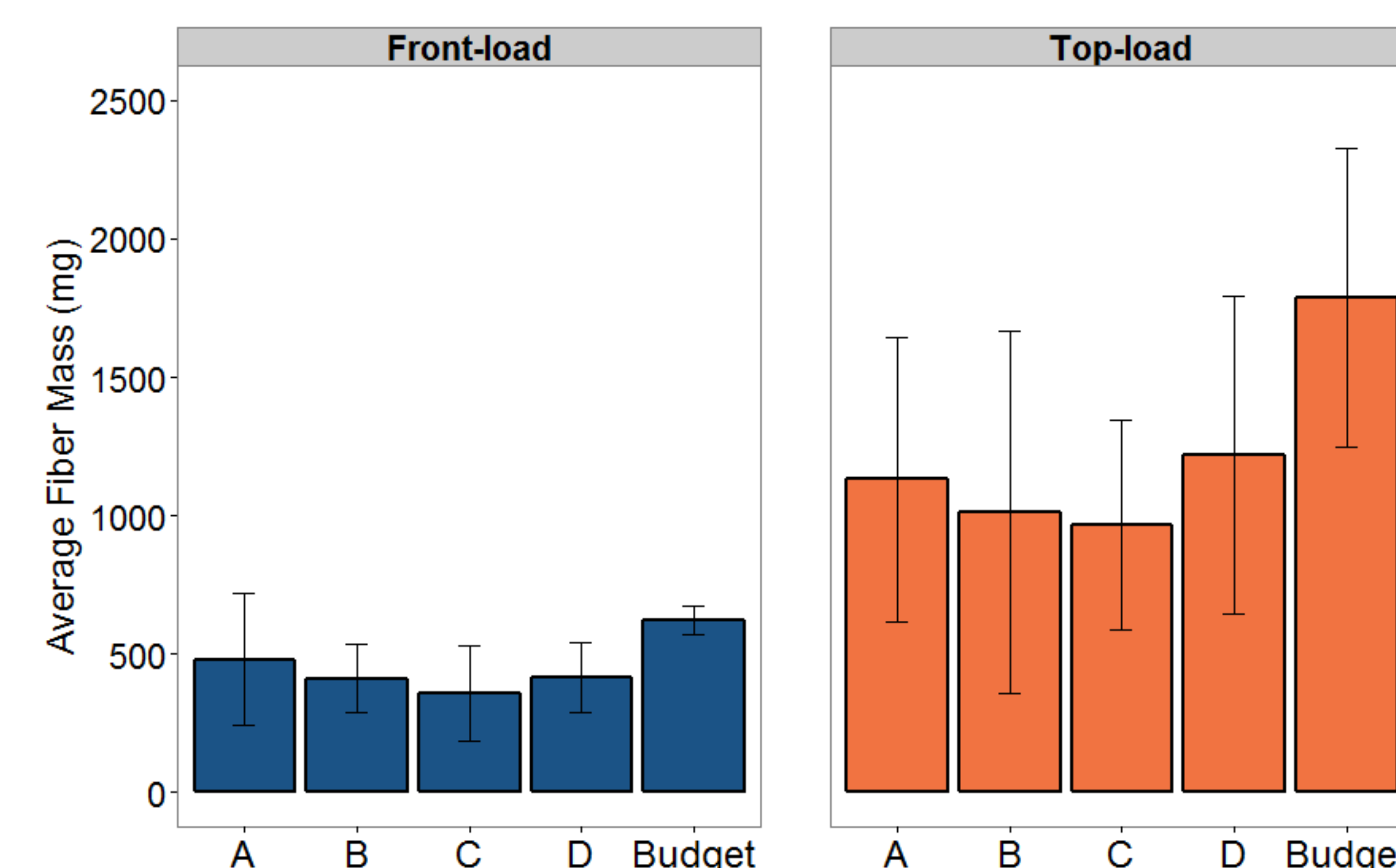
Based on a literature review of numerous wastewater treatment plants, we created a model to estimate the count and mass of microfibers entering local water bodies using a microfiber removal rate between 65 and 92%. We then scaled this up for two scenarios:

1. A city of 100,000 people with a range of synthetic jackets washed once
2. 100,000 Patagonia jackets washed once

Jacket	Description
Patagonia A	Technical non-fleece synthetic jacket
Patagonia B	Synthetic fleece pullover
Patagonia C	Synthetic fleece midlayer jacket
Patagonia D	Synthetic sweater fleece jacket
Budget	Budget version of Patagonia D

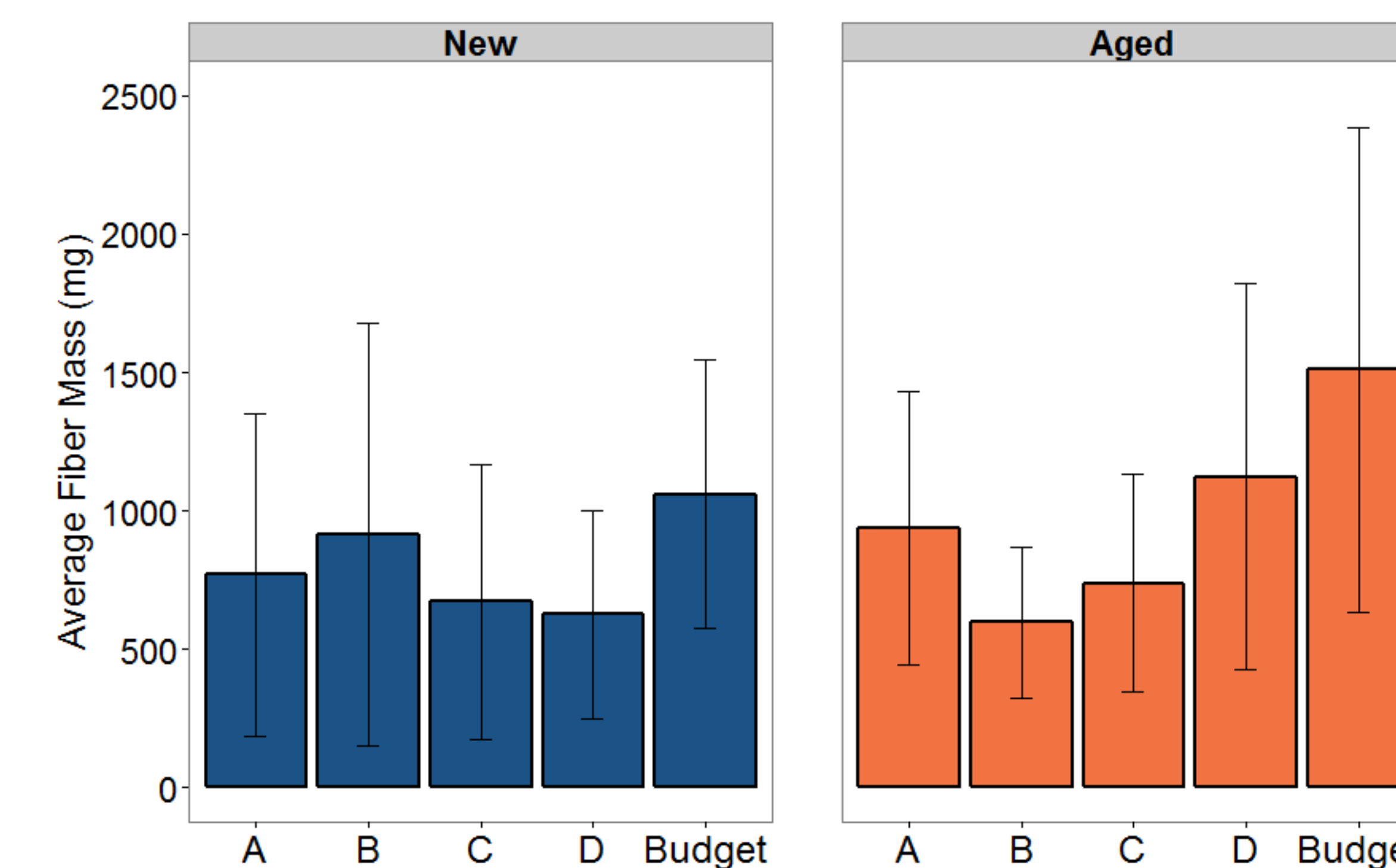
EFFECT OF WASHING MACHINE TYPE

2.7 X more shedding from top load machines



EFFECT OF "AGING"

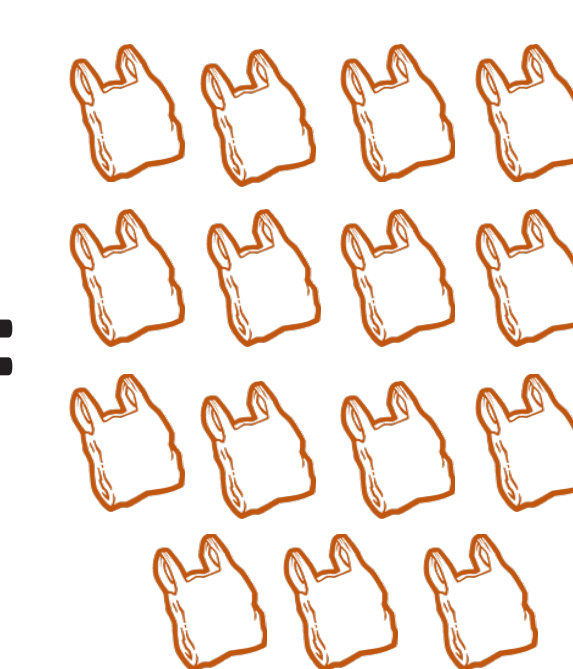
1.6 X more shedding from aged jackets



WASTEWATER TREATMENT PLANT MODEL

City with 100,000 People

9 - 110 kg of microfibers would be released per day into local waterbodies

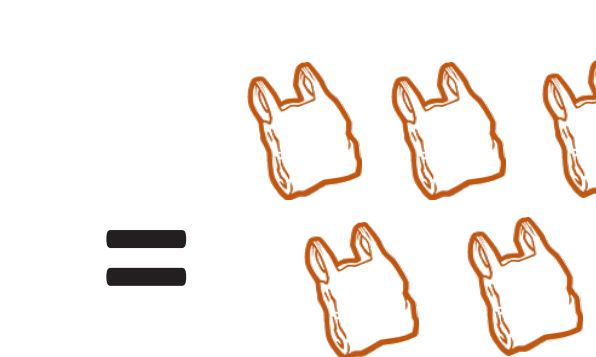


= Mass of 1,000 Plastic Bags



100,000 Patagonia Jackets

6 - 30 kg of microfibers would be released after a single wash into local waterbodies



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ACKNOWLEDGEMENTS

We could not have done this project without Patricia Holden's expertise, insights, and encouragements; Jessica Perkin's input and LCA-thinking; Elissa Loughman and Patagonia's support and encouragement. We'd also like to thank the following for their collaboration and expertise:

Roland Geyer, the Bren School
 Anna-Marie Cook, E.P.A.
 John Kester, Sustainability Consortium

Nick Mallos, the Ocean Conservancy
 Sherri Mason, State University of N.Y.
 Blake Kopcho, 5 Gyres

Chelsea Rochman, UC Davis
 Rebecca Sutton, San Francisco Estuary Institute
 Abby Barrows, Adventures & Scientists for Conservation

