

Ocean Plastics Pollution from Quissett Harbor to the “Garbage Patches”: Sources, Impacts and Solutions

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www.sea.edu

“Great Pacific Garbage Patch”





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Subtropical Ocean aka "Garbage Patches"



Images from Sea Education Association



Subtropical Ocean

aka "Garbage Patches"



Images from Sea Education Association

North Pacific Ocean, Oct. 2012

aka "Great Pacific Garbage Patch"





Microplastics



Sea Education Association

Trash on the beach is marine debris

TOP 10 ITEMS COLLECTED



1 Cigarette Butts
2,248,065



6 Other Plastic Bags
489,968



2 Food Wrappers
(Candy, chips, etc.)
1,376,133



7 Grocery Bags
(Plastic)
485,204



3 Beverage Bottles
(Plastic)
988,965



8 Beverage
Bottles (Glass)
396,121



4 Bottle Caps (Plastic)
811,871



9 Beverage Cans
382,608



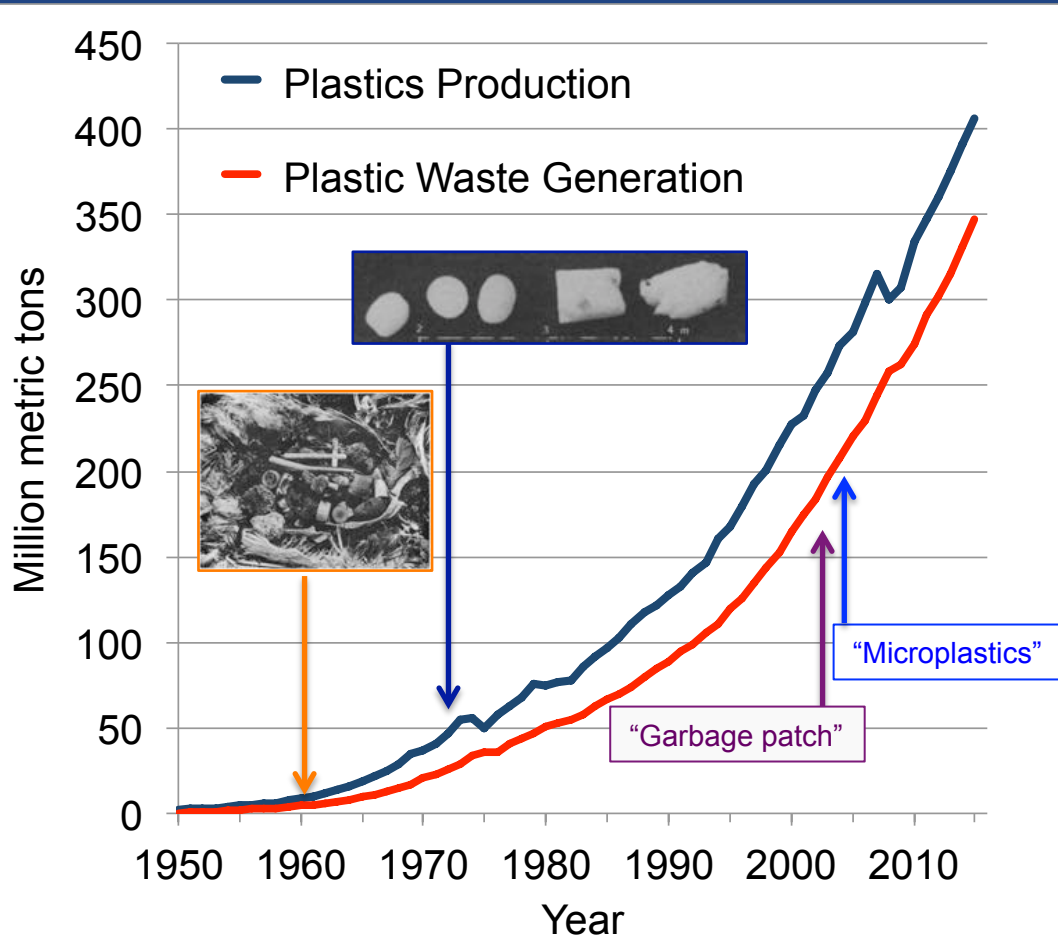
5 Straws, Stirrers
519,911



10 Cups & Plates
(Plastic)
376,479



The rapid rise of plastics



- 8.3 Bt produced
- 90% still in existence

Kenyon and Kridler (1969)
Carpenter et al. (1972)
Moore (2003)
Thompson et al. (2004)

Impacts of plastic debris: Entanglement



“Blonde Bomber”
The Marine Mammal Center, Sausalito, CA



Provincetown Center for Coastal Studies



Impacts of plastic debris: Species transport



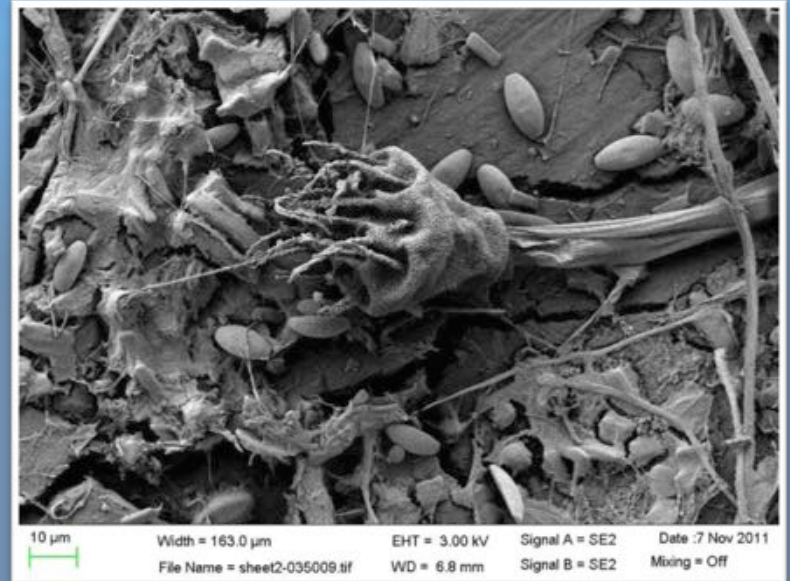
Sea Education Association (SEA)



Skye Morét-Ferguson/SEA



Matt Ecklund/SEA

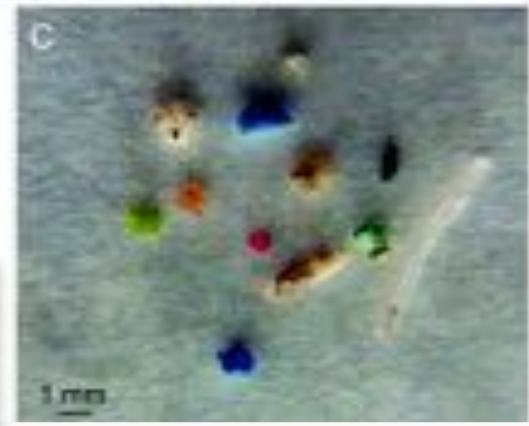


Zettler *et al.* (2013)

Impacts of plastic debris: Ingestion



www.chrisjordan.com



Goldstein and Goodwin (2013)

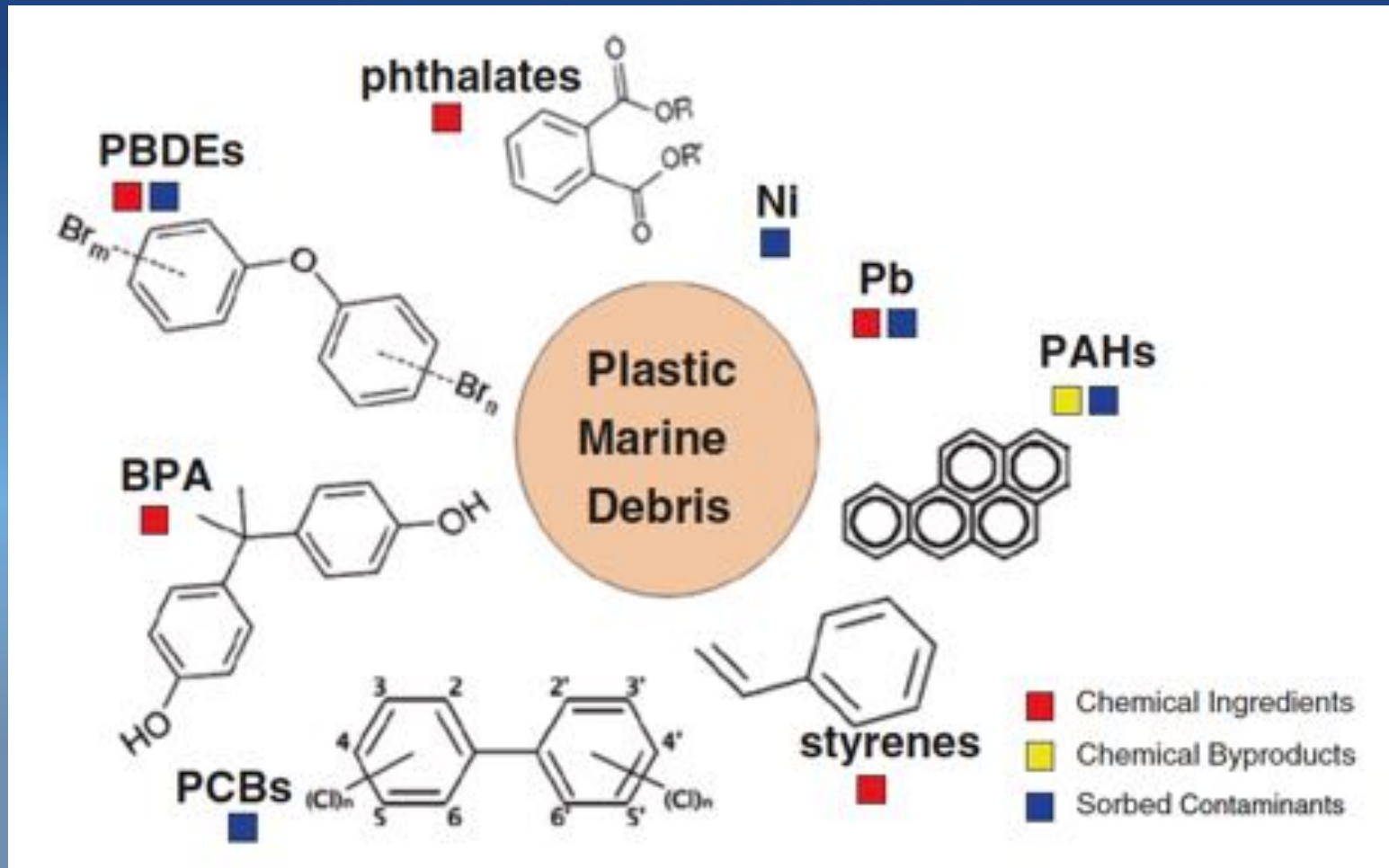


David M. Lawrence/SEA



J.P. Skinner/BIOS

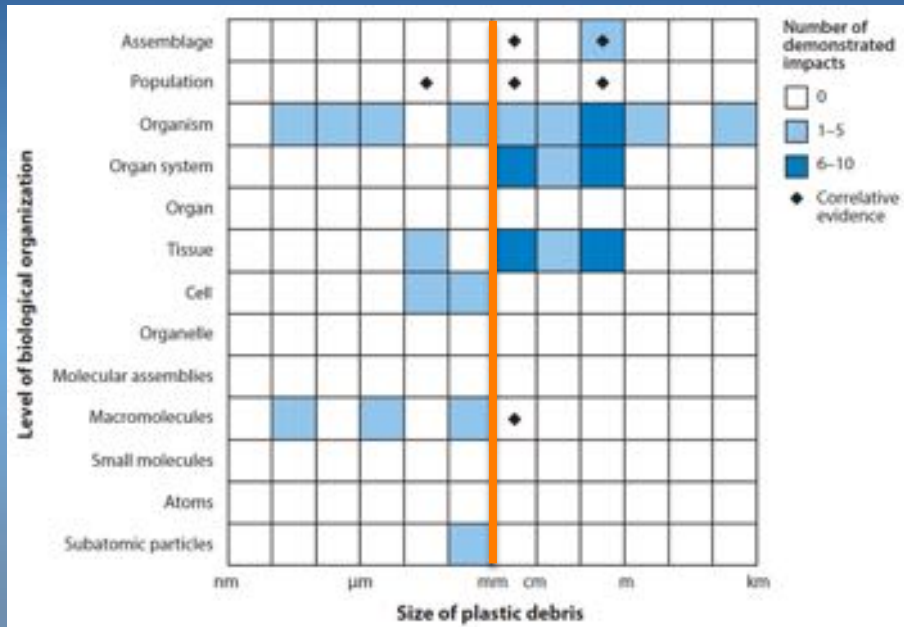
Impacts of plastic debris: Toxic chemicals



Rochman (2015)

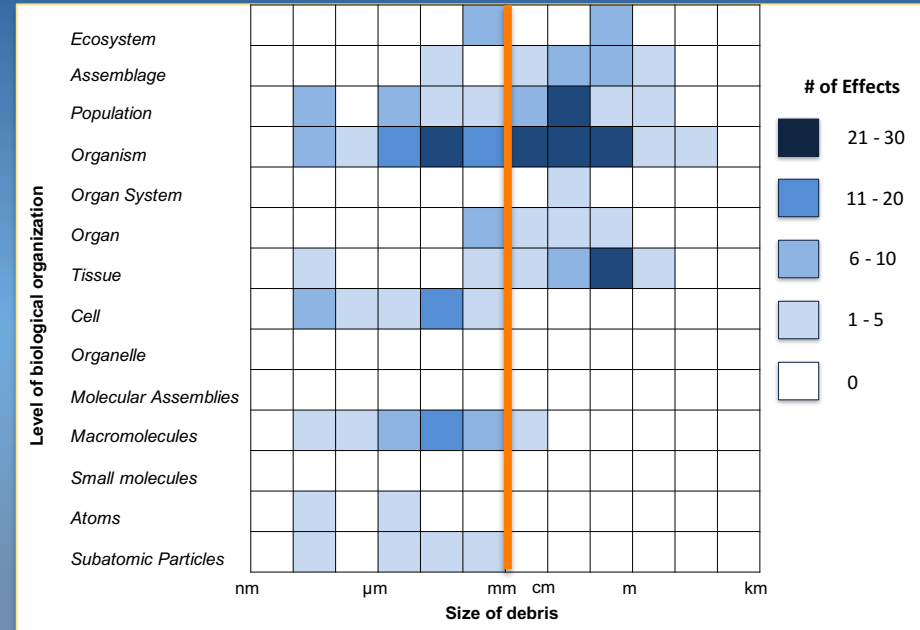
Contamination → Impact?

THEN



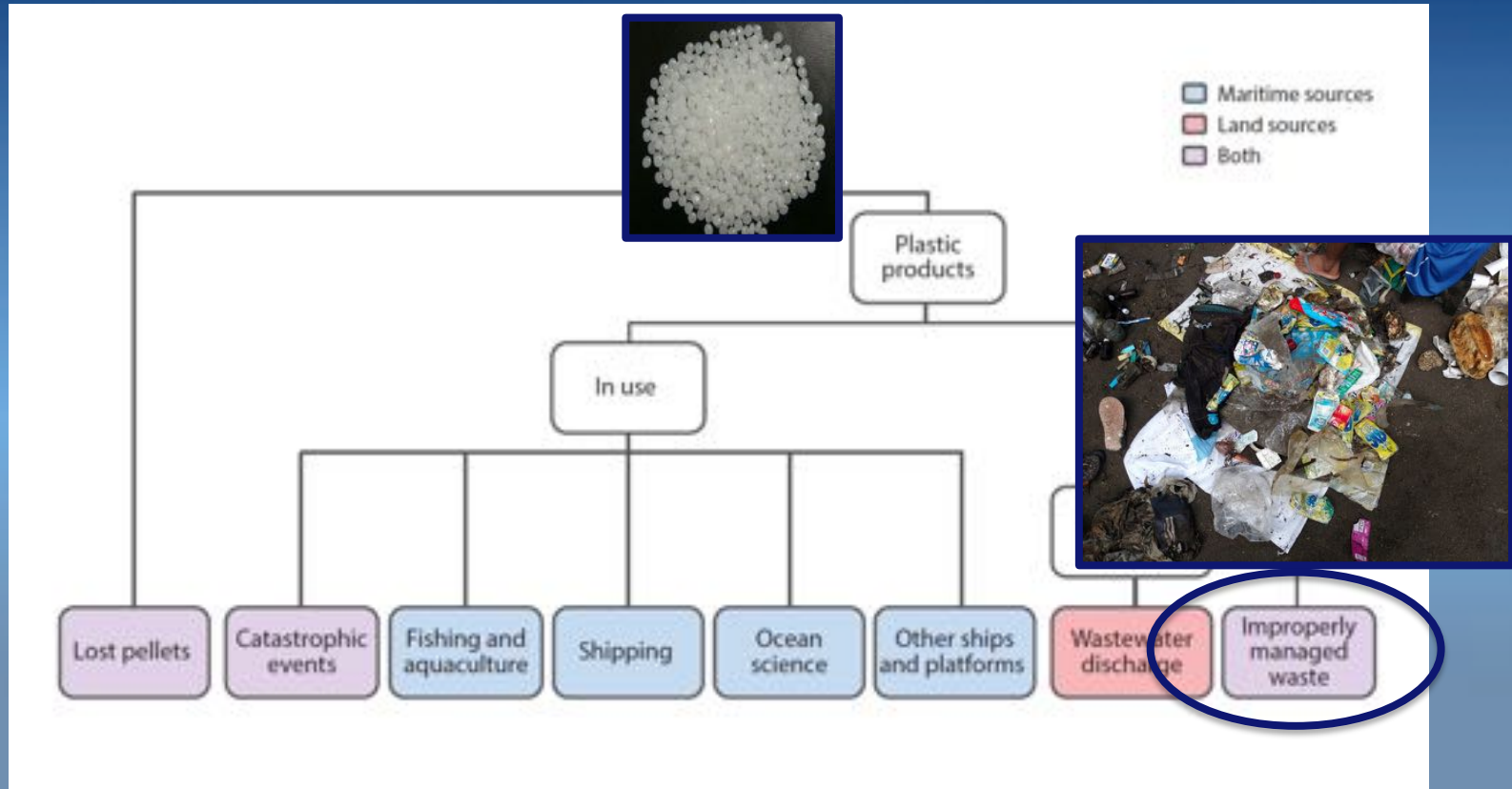
Law, *Ann. Rev. Mar. Sci.* 2017,
 adapted from Rochman *et al.*, *Ecology* 2015

NOW

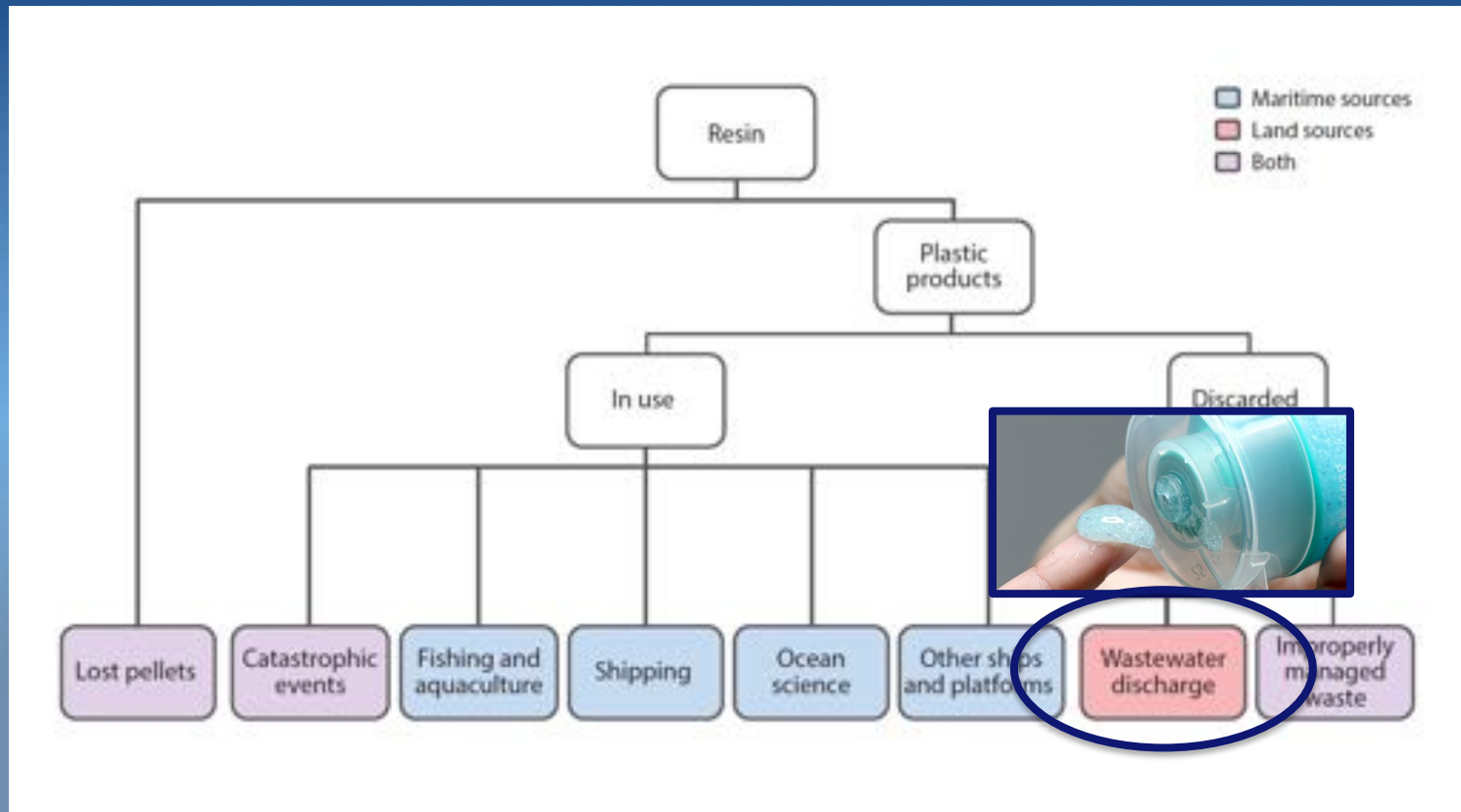


Unpublished results, C. Rochman

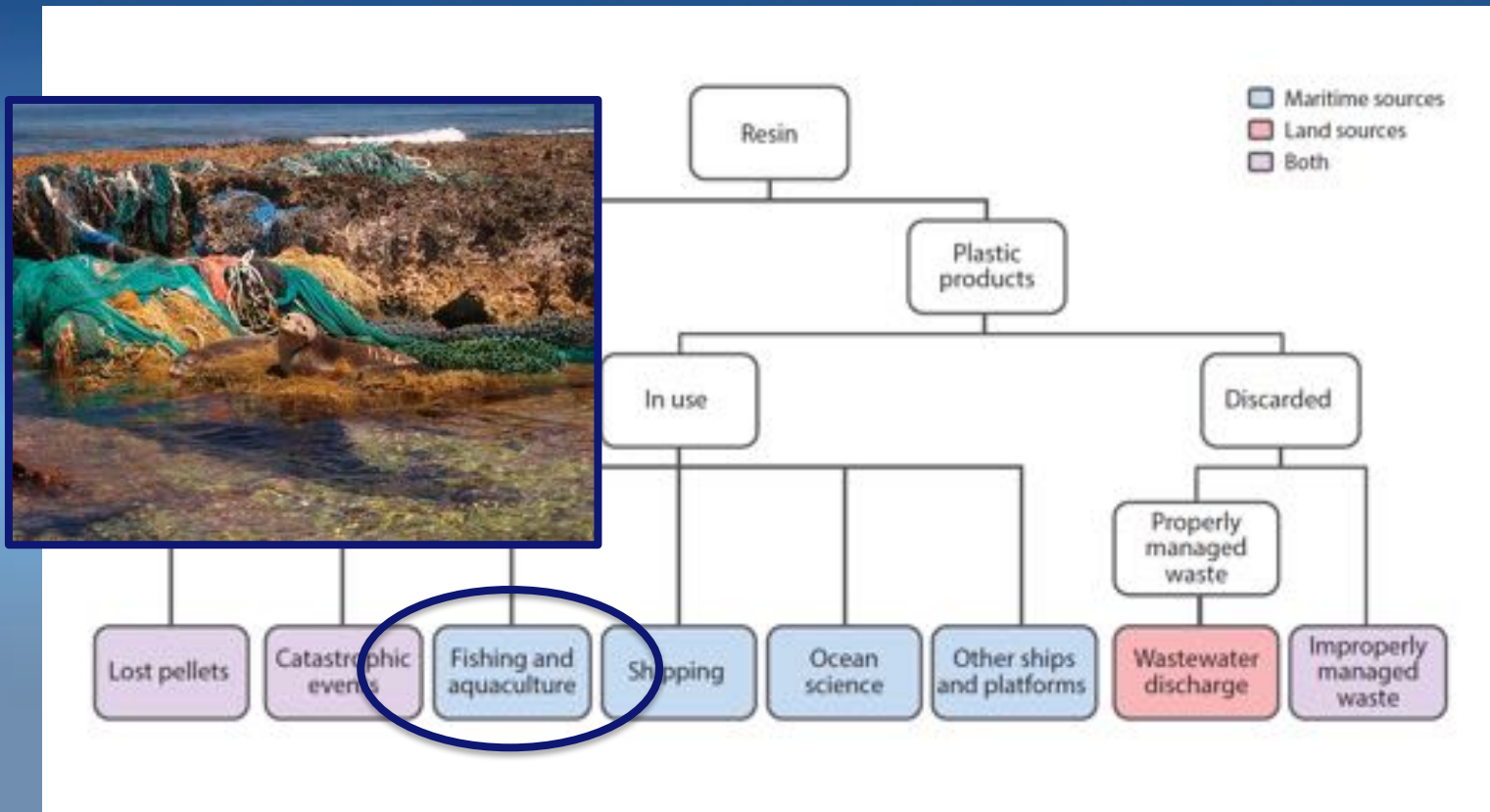
Sources of plastic debris to the ocean



Sources of plastic debris to the ocean

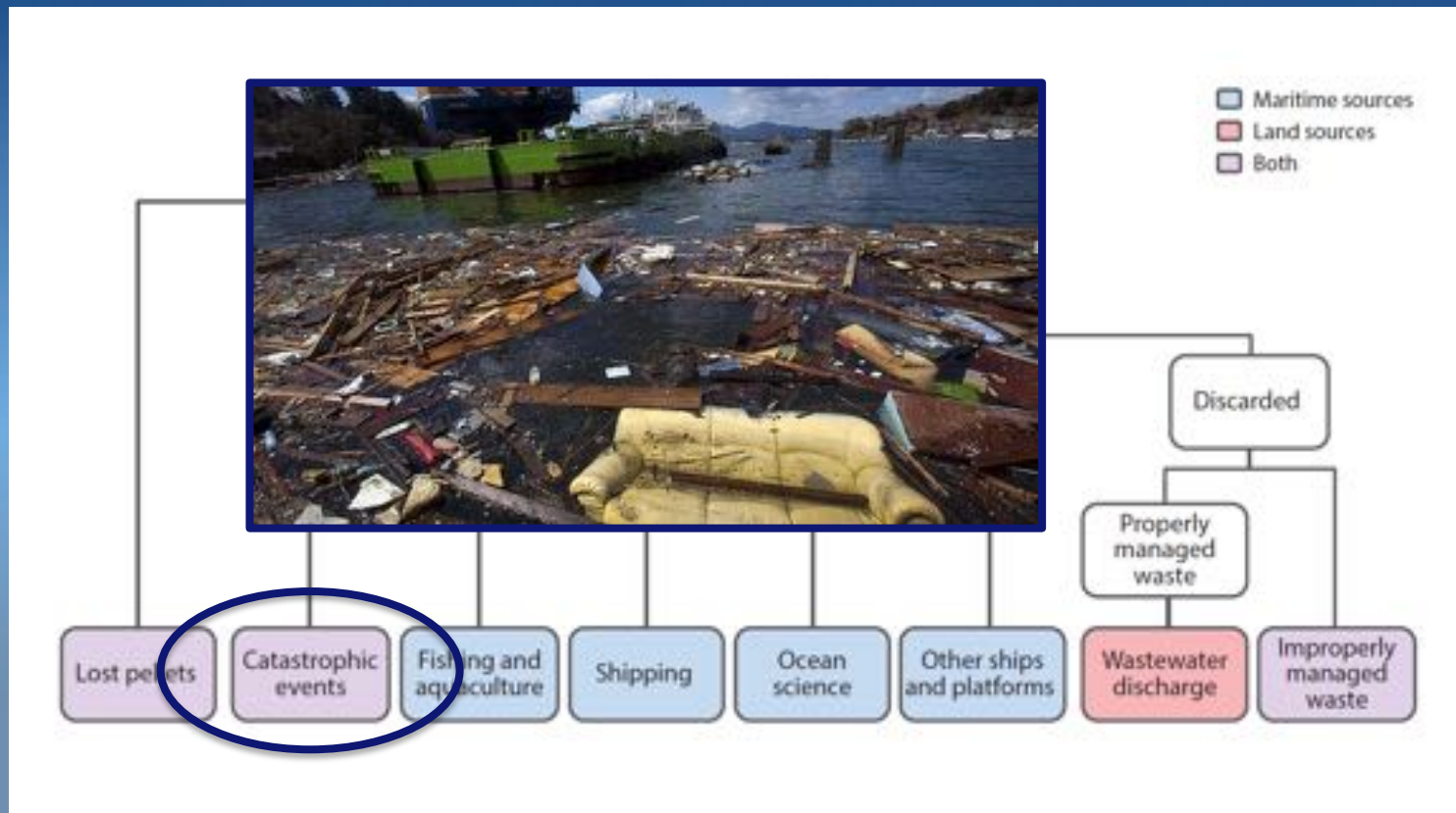


Sources of plastic debris to the ocean



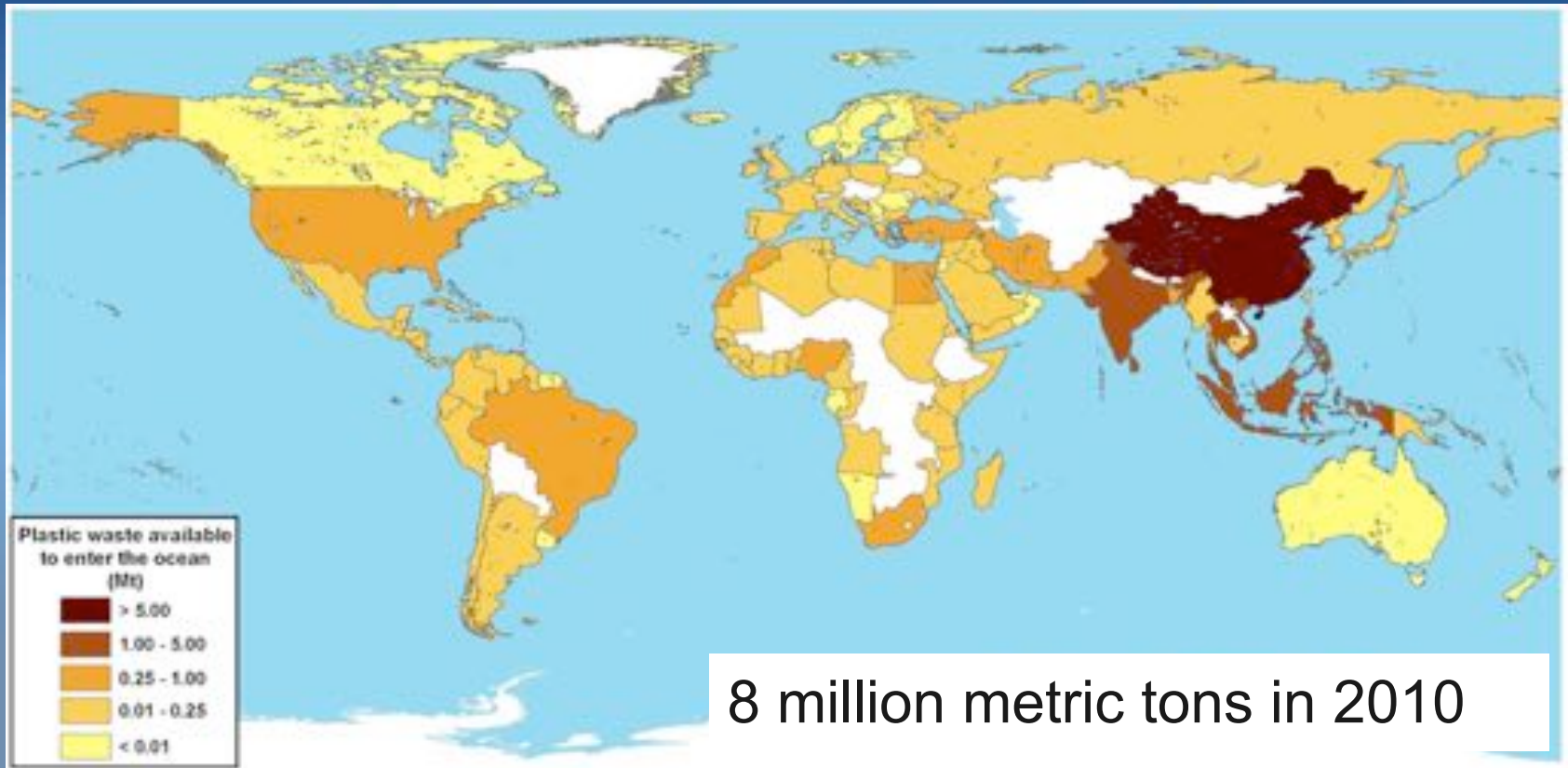
Law, Ann. Rev. Mar. Sci. 2017

Sources of plastic debris to the ocean



Law, Ann. Rev. Mar. Sci. 2017

Plastic waste input from land

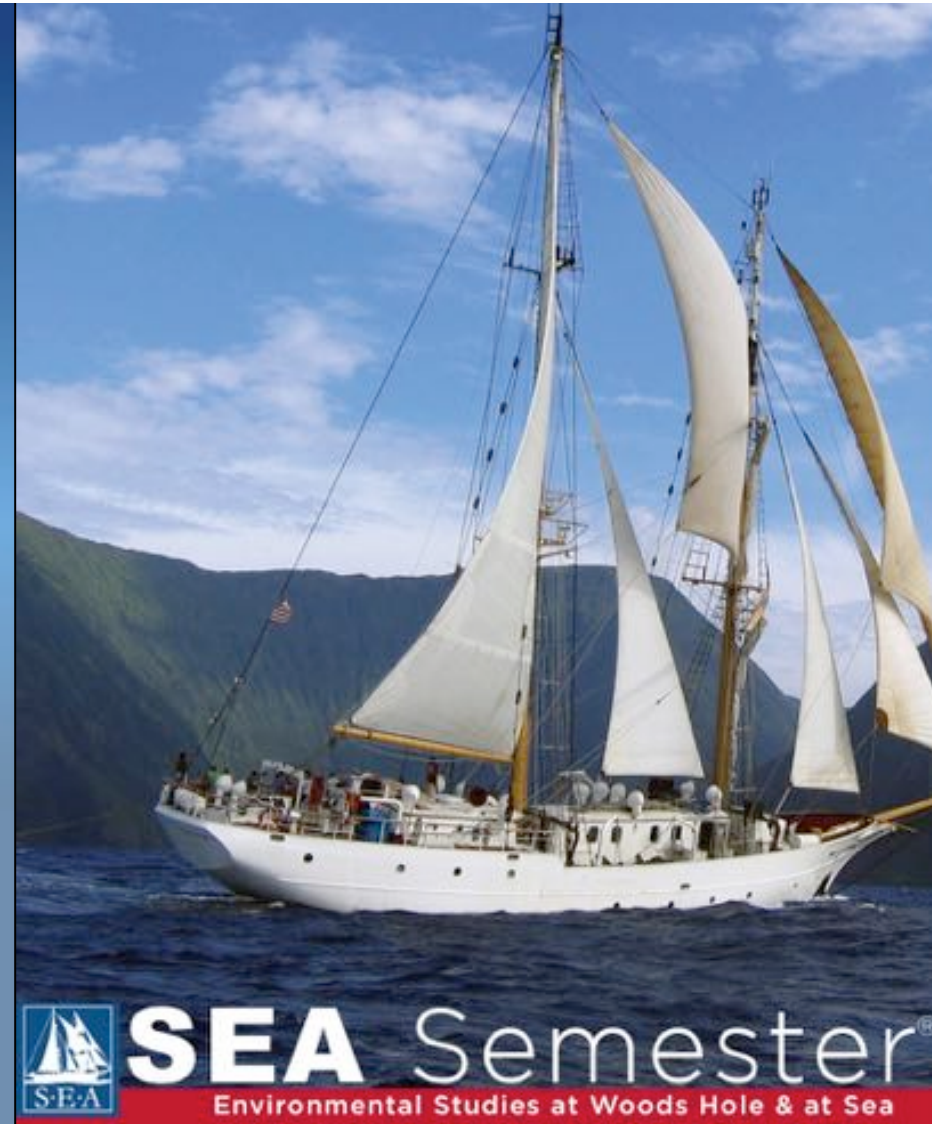


Jambeck *et al.*, *Science*. 2017



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Measuring plastics at the sea surface



SEA Semester[®]

Environmental Studies at Woods Hole & at Sea

Typical plastic debris collected in plankton nets



240 pieces
~ 130,000 pieces per km²



HDPE



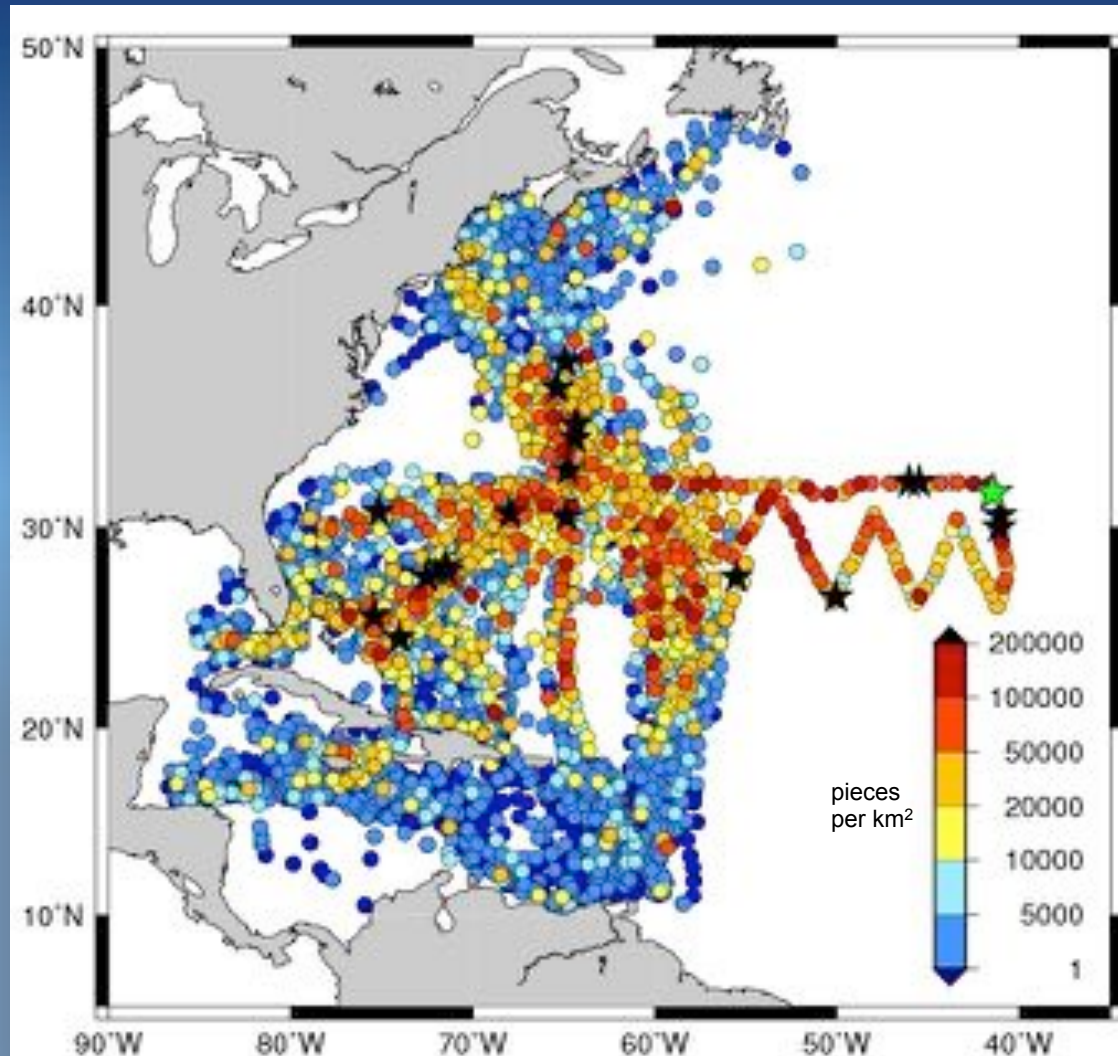
LDPE



PP



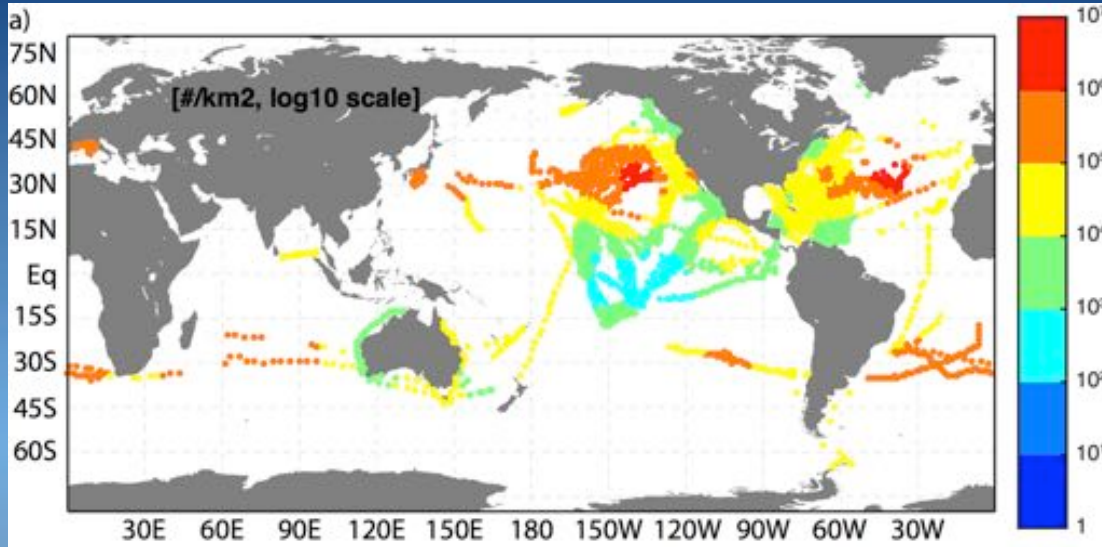
SEA data: North Atlantic Ocean > 6600 net tows since 1986



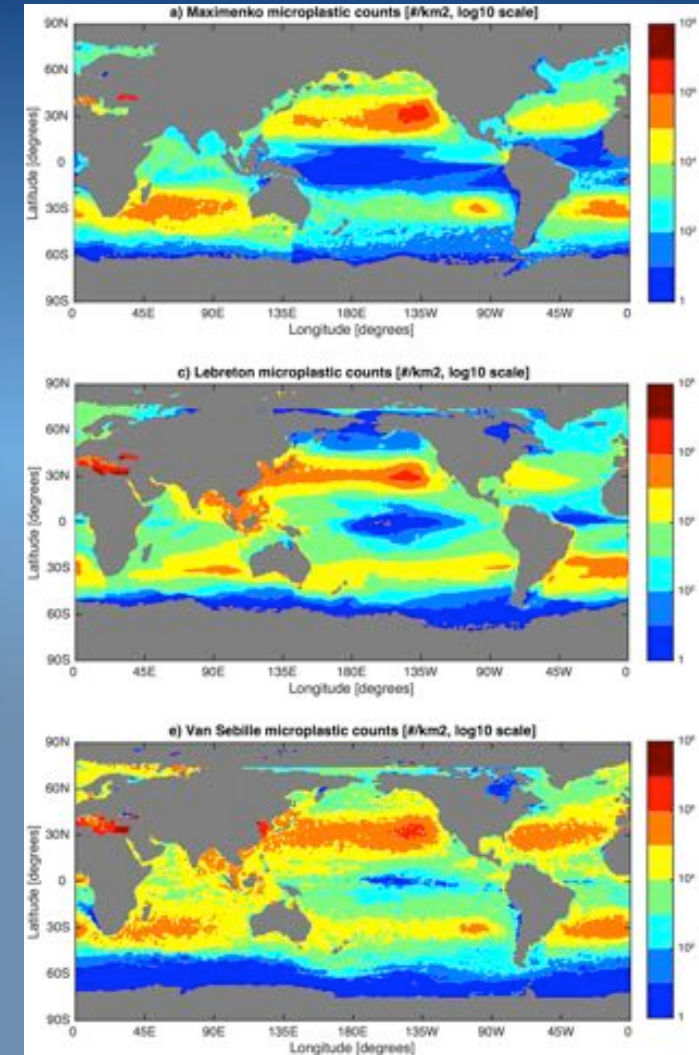
Floating microplastics in all oceans

93,000 – 236,000 metric tons

Plankton net data:



Numerical models:



Where is all the plastic?

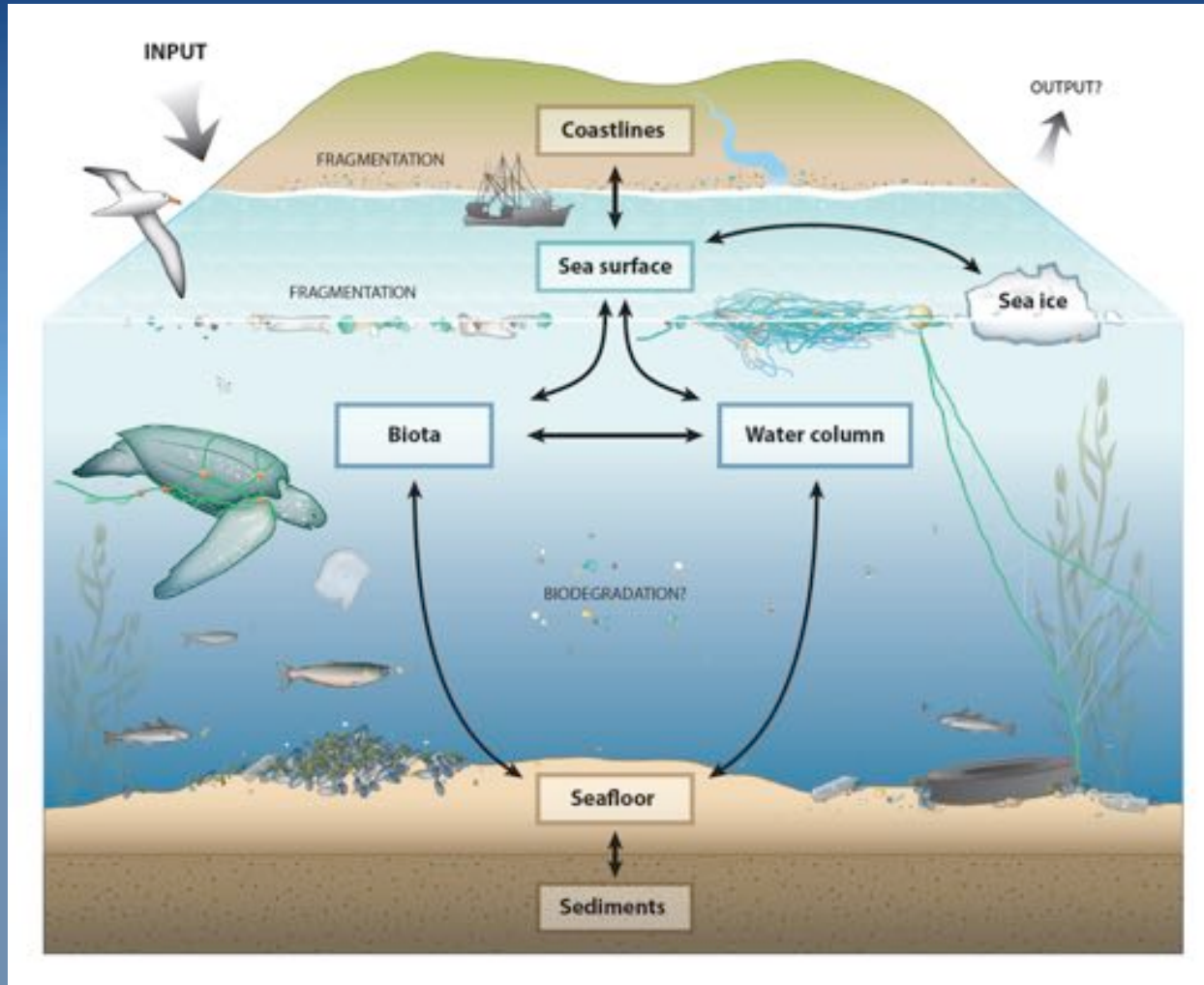
Input from Land:
8 million metric tons per year



Floating at sea surface:
93-236 thousand metric tons



Where is all the plastic?



How are we going to fix this mess?

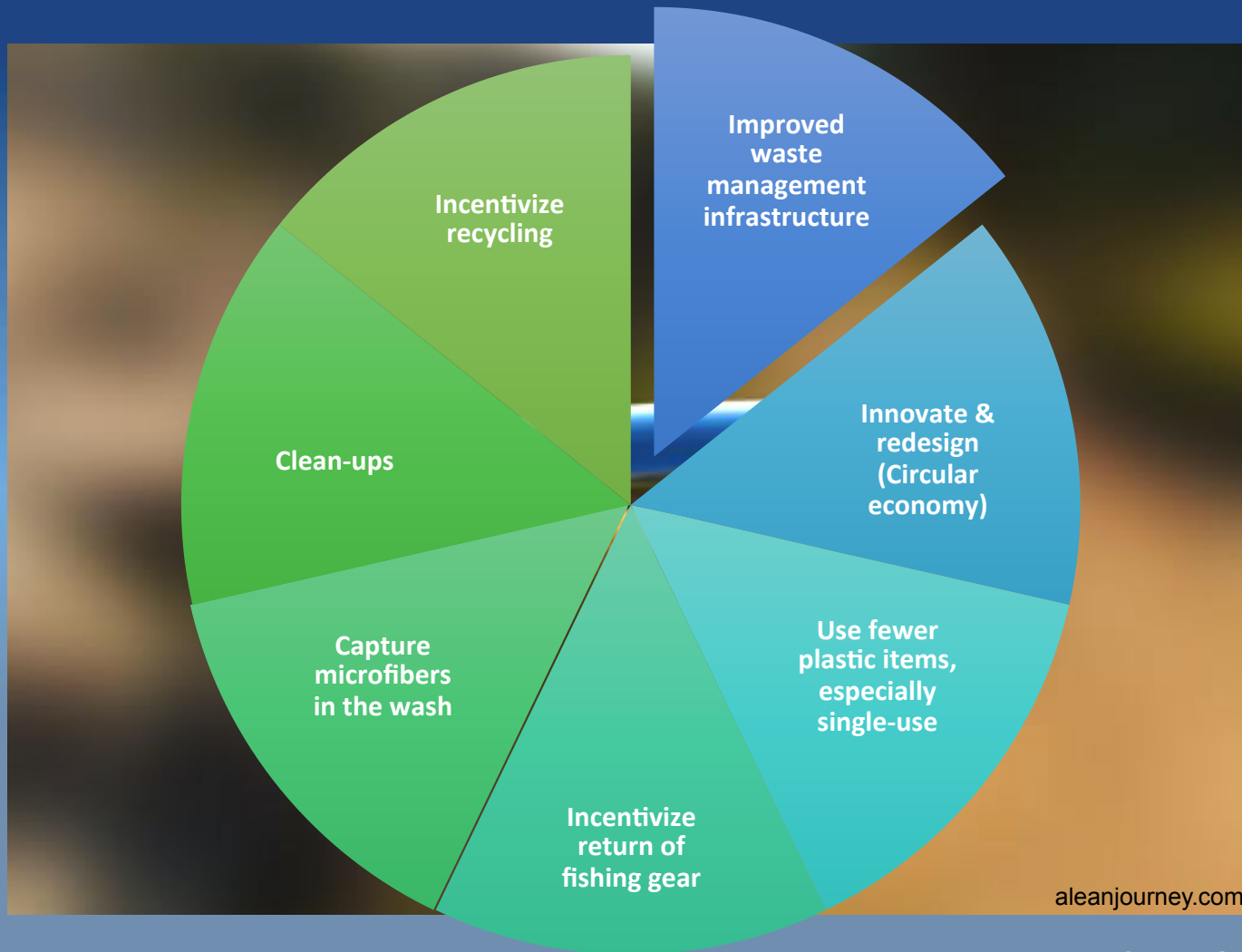


Figure adapted from C. Rochman

High level policy agendas

Why we need an international agreement on marine plastic pollution

Stephanie B. Borrelle^{a,1}, Chelsea M. Rochman^{b,1,2}, Max Liboiron^c, Alexander L. Bond^d, Amy Lusher^e, Hillary Bradshaw^c, and Jennifer F. Provencher^f

Proc. Nat. Acad. Sci. 2017



SUSTAINABLE DEVELOPMENT GOAL 14

Conserve and sustainably use the oceans, seas and marine resources for sustainable development



Public Law 114-114
114th Congress

An Act

To amend the Federal Food, Drug, and Cosmetic Act to prohibit the manufacture and introduction or delivery for introduction into interstate commerce of rinse-off cosmetics containing intentionally-added plastic microbeads.

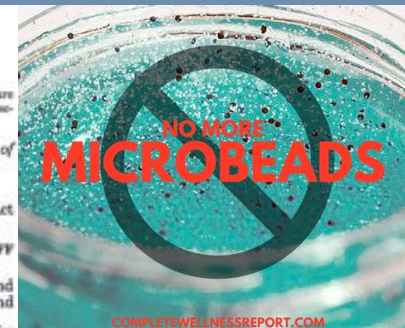
Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "Microbead-Free Waters Act of 2015".

SEC. 2. PROHIBITION AGAINST SALE OR DISTRIBUTION OF RINSE-OFF COSMETICS CONTAINING PLASTIC MICROBEADS.

(a) IN GENERAL.—Section 301 of the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 331) is amended by adding at the end the following:





**KEEP
CALM**

AND

**THINK GLOBALLY
ACT LOCALLY**

Falmouth initiatives

Politics & Government

Falmouth Plastic Bag Ban Goes Into Effect

Falmouth's plastic bag ban is now in effect.

By Jason Claffey, Patch Staff | Aug 6, 2016 11:50 pm ET | Updated Aug 6, 2016 11:50 pm ET

Like 0 Share

FALMOUTH, MA — Falmouth stores are now banned from distributing most types of plastic bags.

The measure, approved by voters in 2014, went into effect Saturday.

"The production and use of single-use bags have significant, negative impacts on the marine and land environment, clogging our storm drains, creating a burden on our solid waste collection and recycling," town officials said in a statement.



What can I do?

1. Make less waste

- REDUCE: “Do I need this?”
- REUSE: Avoid single-use products
- RECYCLE what you can
- Demand end-of-life responsibility from manufacturers



2. “Last Chance Capture”*

- Clean up litter, anywhere and everywhere
- Participate in beach clean-ups

3. Implement **REDUCTION** and **RECYCLING** initiatives in your school/workplace/yacht club

4. Engage with the Town (SWAC, DPW, Selectmen)

Acknowledgements

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> 8,000 SEA students



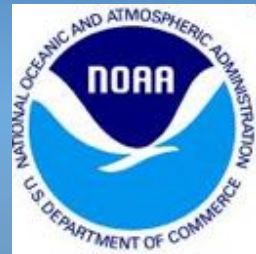
Chris Reddy
Nikolai Maximenko
Jan Hafner

WHOI
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U. Hawaii

NCEAS Marine Debris Working Group, including:

Chelsea Rochman
Jenna Jambeck
Chris Wilcox
Roland Geyer
Erik van Sebille
Ted Siegler
Ramani Narayan
Anthony Andrady

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U. Georgia
CSIRO (Australia)
UC-Santa Barbara
Utrecht U.
DSM Environmental
Michigan State U.
North Carolina State U.



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