

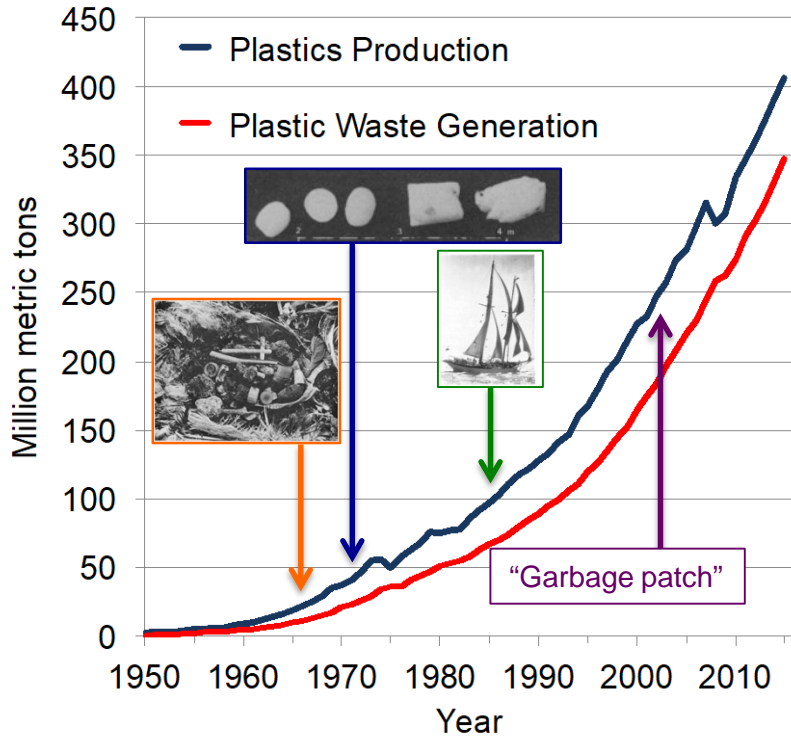
# The state of knowledge on microplastics and their impact on environmental health

Kara Lavender Law, PhD

Sea Education Association  
Woods Hole, MA



# The rapid rise of plastics



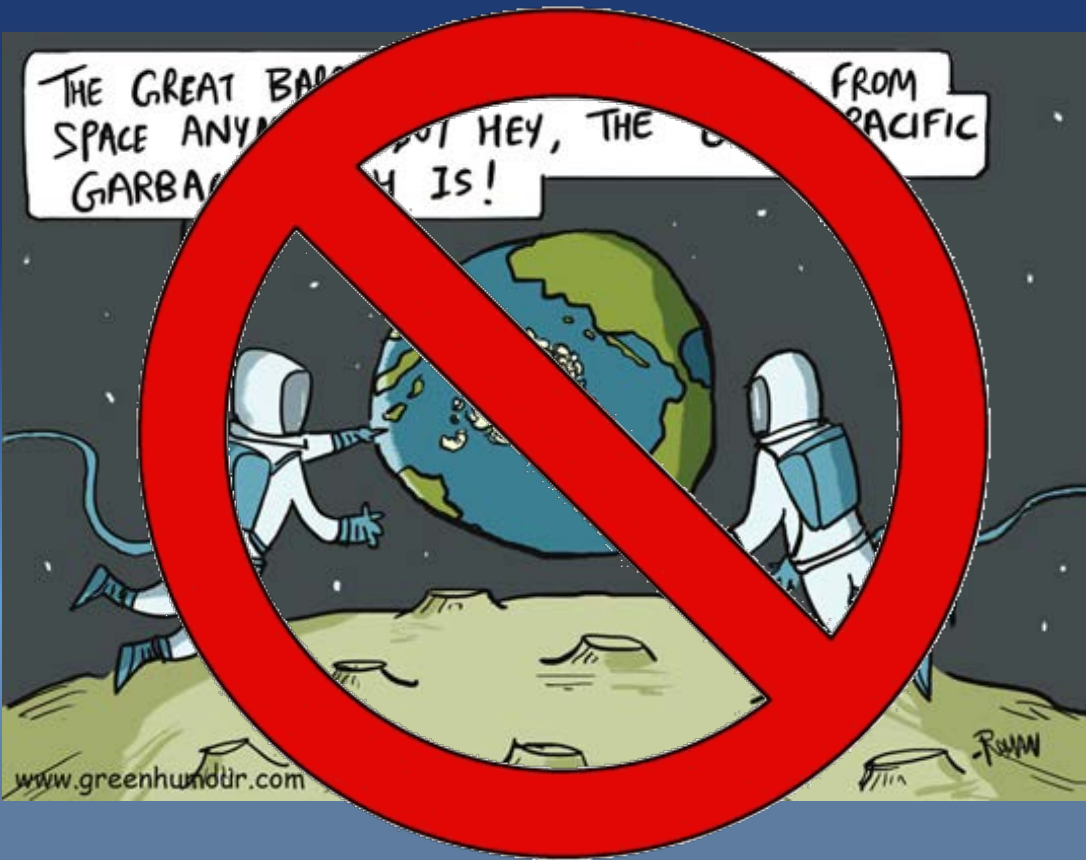
- 8.3 B tonnes produced
- 90% still in existence

Kenyon and Kridler (1969)

Carpenter *et al.* (1972)

Wilber (1987)

Moore (2003)





www.sea.edu

# Sea Education Association

## Measuring floating plastics since the 1980s







[www.sea.edu](http://www.sea.edu)

# Microplastics



# What are “microplastics”?

Size

Shape

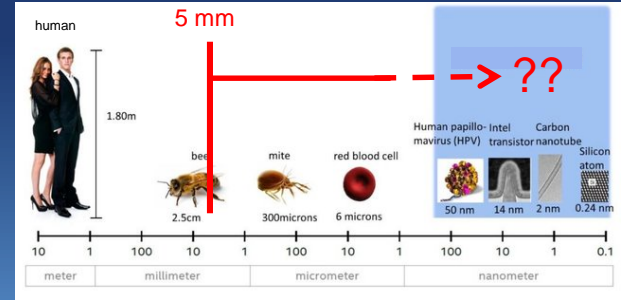
Source

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



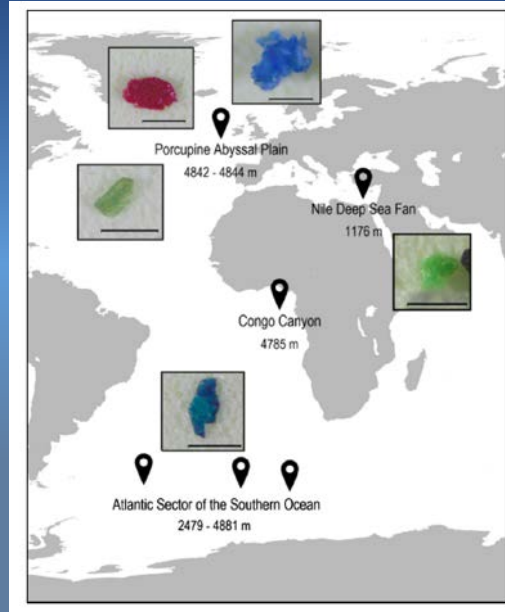
Nicholas Mallos/Ocean Conservancy

## Water column



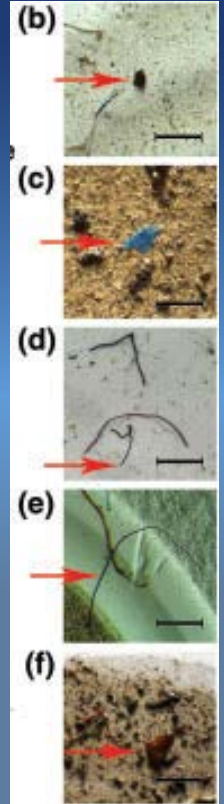
Giora Proskurowski/SEA

## Deep-sea sediments



Van Cauwenberghe *et al.*, 2013

## Arctic sea ice



Obbard *et al.*, 2014

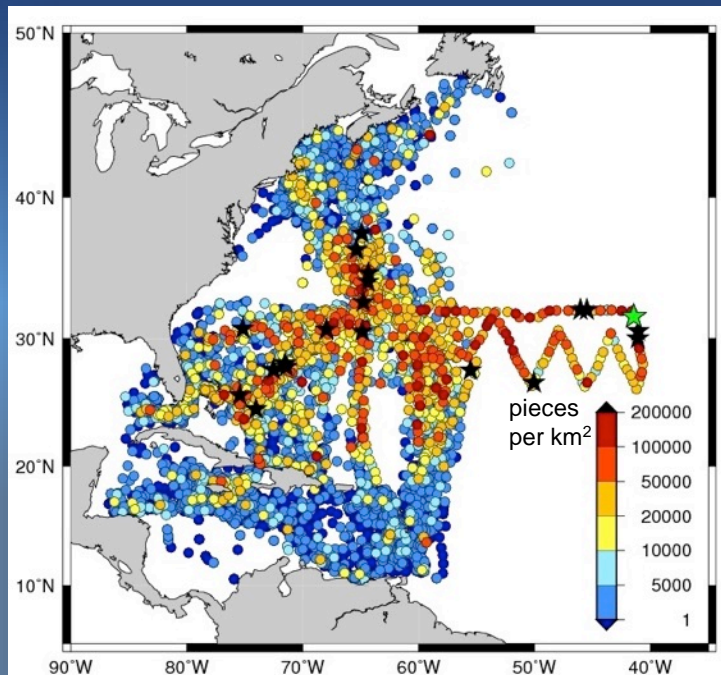


www.sea.edu

# Open ocean microplastics

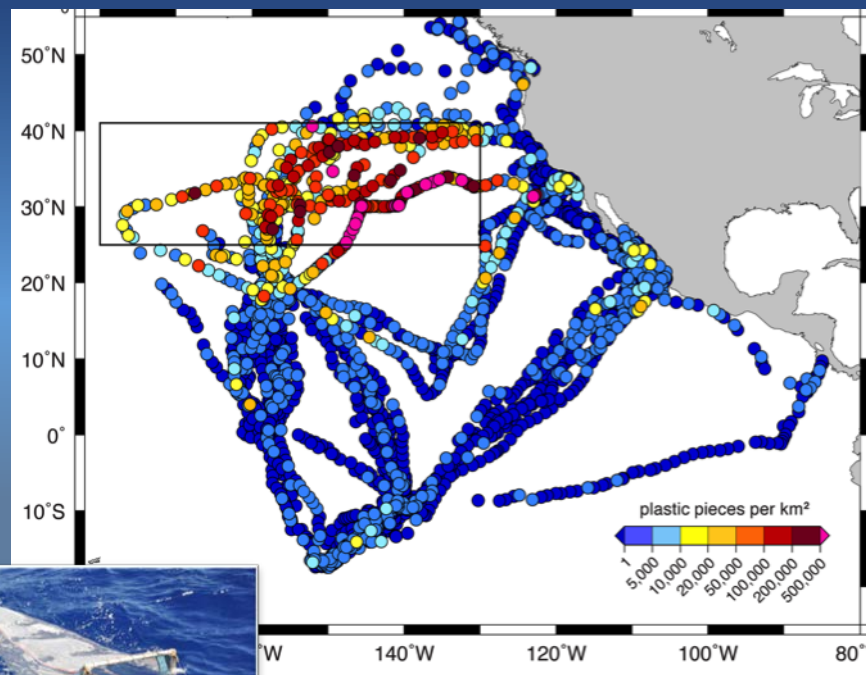
Plankton net tows: particle sizes  $\sim 0.35$ -10 mm

## Western North Atlantic Ocean



Law *et al.*, 2010

## Eastern Pacific Ocean



Law *et al.*, 2014



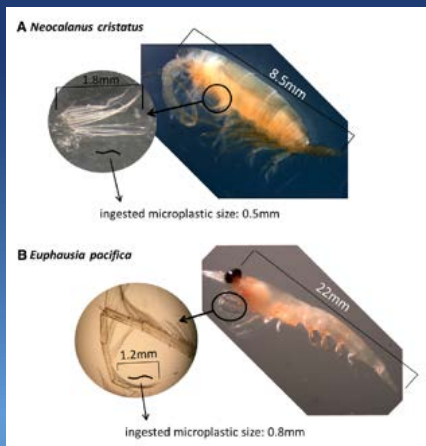


# Global Microplastics Initiative

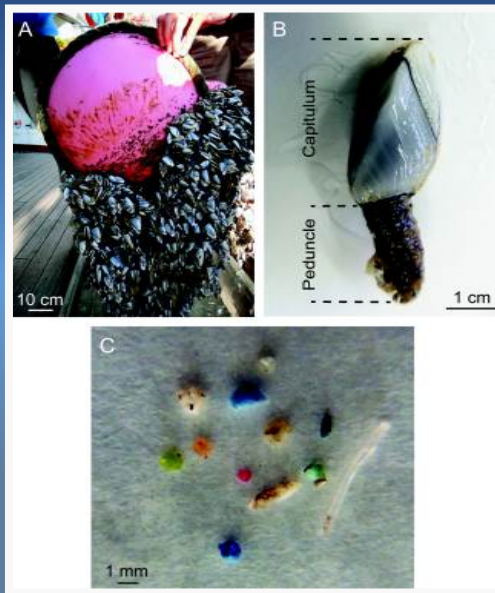
1-L water samples: particle sizes  $> 0.45 \mu\text{m}$



# Why do we care about microplastics?



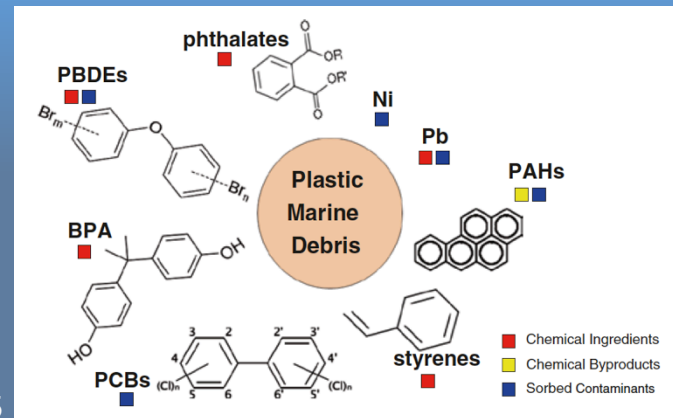
Desforbes *et al.*, 2015



Goldstein & Goodwin, 2013



David M. Lawrence/SEA



Rochman, 2015

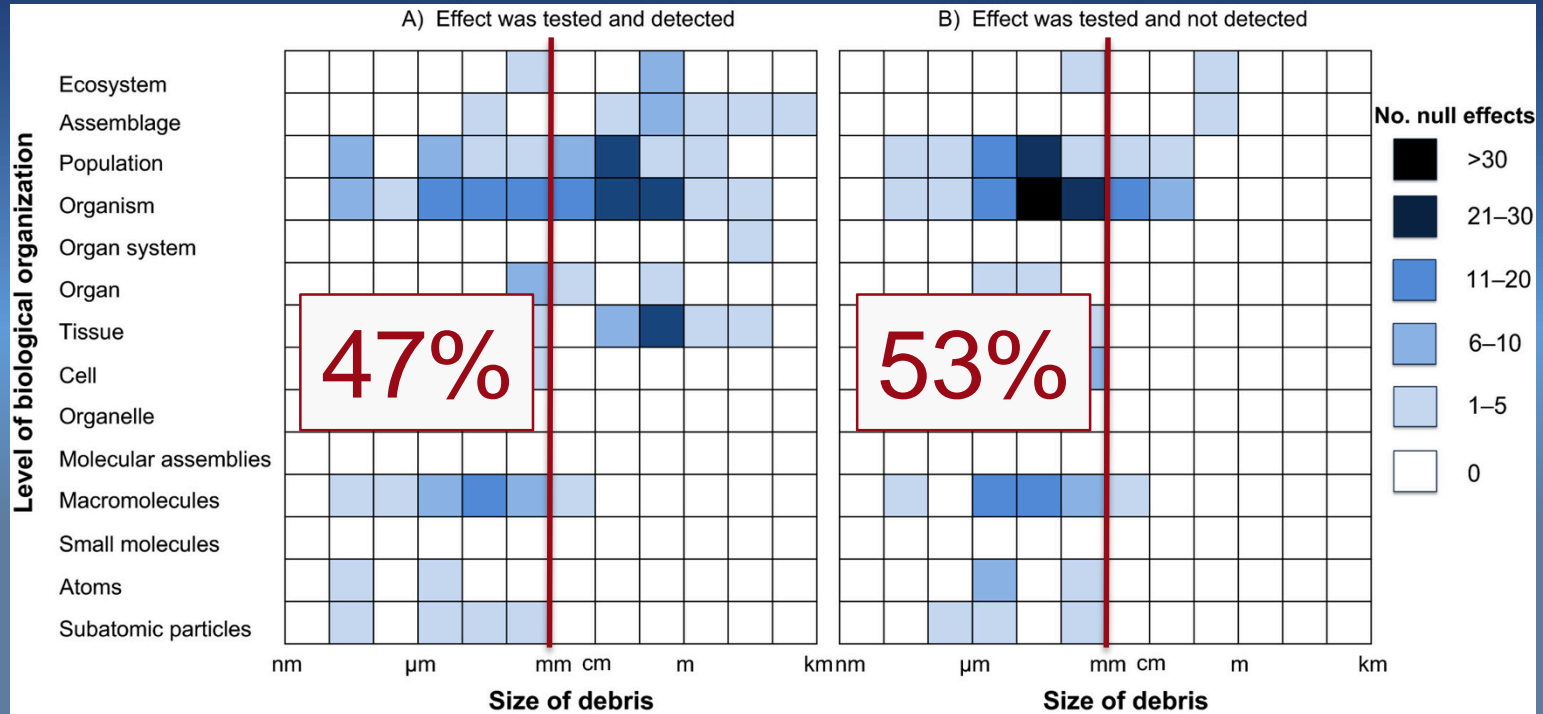
> 220 species

# Demonstrated evidence of impacts

421 effects tested:

Effect

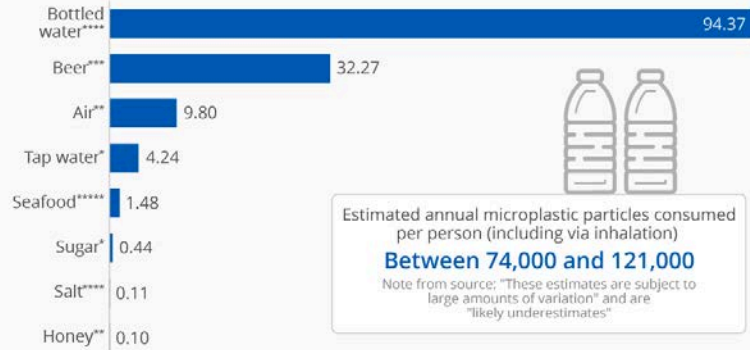
No Effect



# 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)

© StatistaCharts

statista



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



# Why do we care about microplastics?

## Microplastics in drinking-water – World Health Organization, Aug. 2019

*“Based on this limited body of evidence, firm conclusions on the risk associated with ingestion of microplastic particles through drinking water cannot yet be determined; however, health concerns associated with microplastic pollution remain.”*

Are we safe??

The collage features a grid of news snippets from various sources, each with a small image and a headline. The sources include NBCNews.com, TODAYonline, NEWS 10, Deutsche Welle, BuzzFeed News, NBC News, WIRED, World Health Organization, Wired.co.uk, and Daily Mail. The headlines generally discuss the WHO's findings on microplastics in water, with some emphasizing that there is no major health worry yet, while others call for more research or a crackdown on plastic pollution. The images show people drinking water, plastic bottles, and microscopic views of plastic particles.

Source	Headline	Image Description
NBCNews.com	Don't worry about drinking microplastics in water, UN says	Person drinking from a bottle
TODAYonline	Plastic particles in drinking water present 'low' risk: WHO	Water being poured from a tap
NEWS 10	Don't Worry About Drinking Micro-plastics in Water, Says UN Report	UN logo
Deutsche Welle	Microplastics in drinking water present 'low' risk: WHO	Microscopic view of plastic particles
BuzzFeed News	Microplastics Are In Most Bottled Water But The WHO Says They're Not A Health Risk – For Now	Person holding a water bottle
NBC News	UN: Microplastics in Water Not a Major Health Worry	Globe with plastic particles
WIRED	You've Been Drinking Microplastics, But Don't Worry—Yet	Microscopic view of plastic particles
World Health Organization	WHO calls for more research into microplastics and a crackdown on plastic pollution	Polluted ground with plastic waste
Wired.co.uk	Thursday briefing: Microplastics in water aren't a significant human health risk	Microscopic view of plastic particles
Daily Mail	UN drinking water report calls for a crackdown on microplastic pollution	Diagram showing microplastic pollution cycle

# Contamination → Impact?



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



By J RAWLS  
[https://commons..](https://commons.wikimedia.org/wiki/File:Blonde_Bomber.jpg)

# Major knowledge gaps

- How much (micro)plastic is in the environment?
- Where in the environment is it?
- What are its characteristics (chemistry, size, shape)?
- How is it transformed in the environment, and what is its ultimate fate?
- What are its impacts on wildlife, and environmental and human health?

# Working towards solutions



G7 GERMANY  
2015 | Schloss Elmau



G20 GERMANY 2017  
HAMBURG



G7 2018  
CHARLEVOIX



GLOBAL PARTNERSHIP  
ON MARINE LITTER



## U.S. Microbead-Free Waters Act of 2015

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.

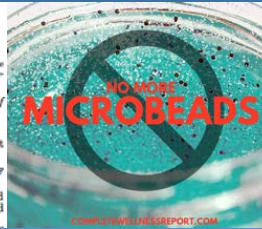
Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

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:



## U.S. Save Our Seas Act of 2018

One Hundred Fifteenth Congress  
of the  
United States of America

AT THE SECOND SESSION

Began and held at the City of Washington on Wednesday,  
the third day of January, two thousand and eighteen

### An Act

To reauthorize and amend the Marine Debris Act to promote international action to reduce marine debris, and for other purposes.

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 "Save Our Seas Act of 2018".

TITLE I—MARINE DEBRIS

SEC. 101. NOAA MARINE DEBRIS PROGRAM.

Section 3 of the Marine Debris Act (33 U.S.C. 1952) is amended—



Falmouth Litter Reduction Team Offers Recommendations For Reducing Trash

By BRAD COLE Jul 26, 2019





# Acknowledgements

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Jan Hafner

> 8,000 SEA students



WHOI  
U. Hawaii  
U. Hawaii



## NCEAS Marine Debris Working Group, including:

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Chris Wilcox	(CSIRO, Australia)	Ramani Narayan	(Mich, State U.)
Roland Geyer	(UC-Santa Barbara)	Anthony Andrady	(NC State U.)



Henry L. and Grace  
Doherty Charitable  
Foundation

