Microplastics – an introduction

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U of T Trash Team

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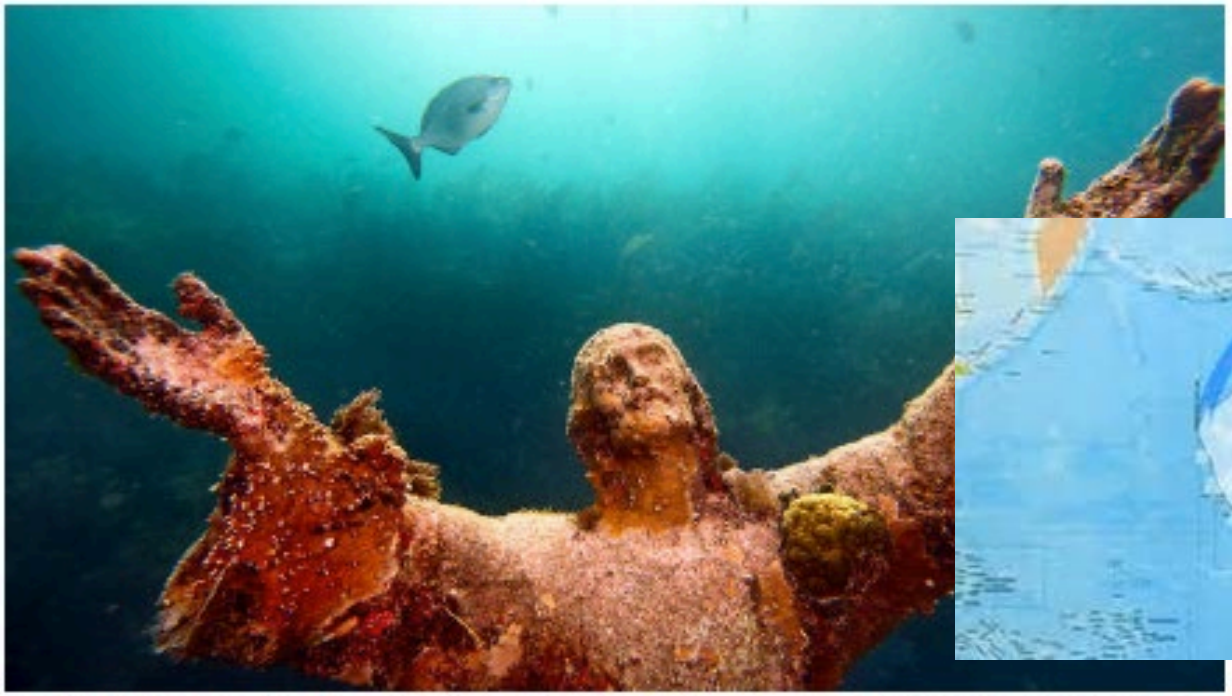
Altered Oceans Part Four: Plague of Plastic Chokes the Seas



This five-part series on the crisis in the world's oceans was published in July and August of 2006. The series — by reporters Kenneth R. Weiss and Usha Lee McFarling and photographer Rick Loomis — won the 2007 Pulitzer Prize for explanatory reporting.

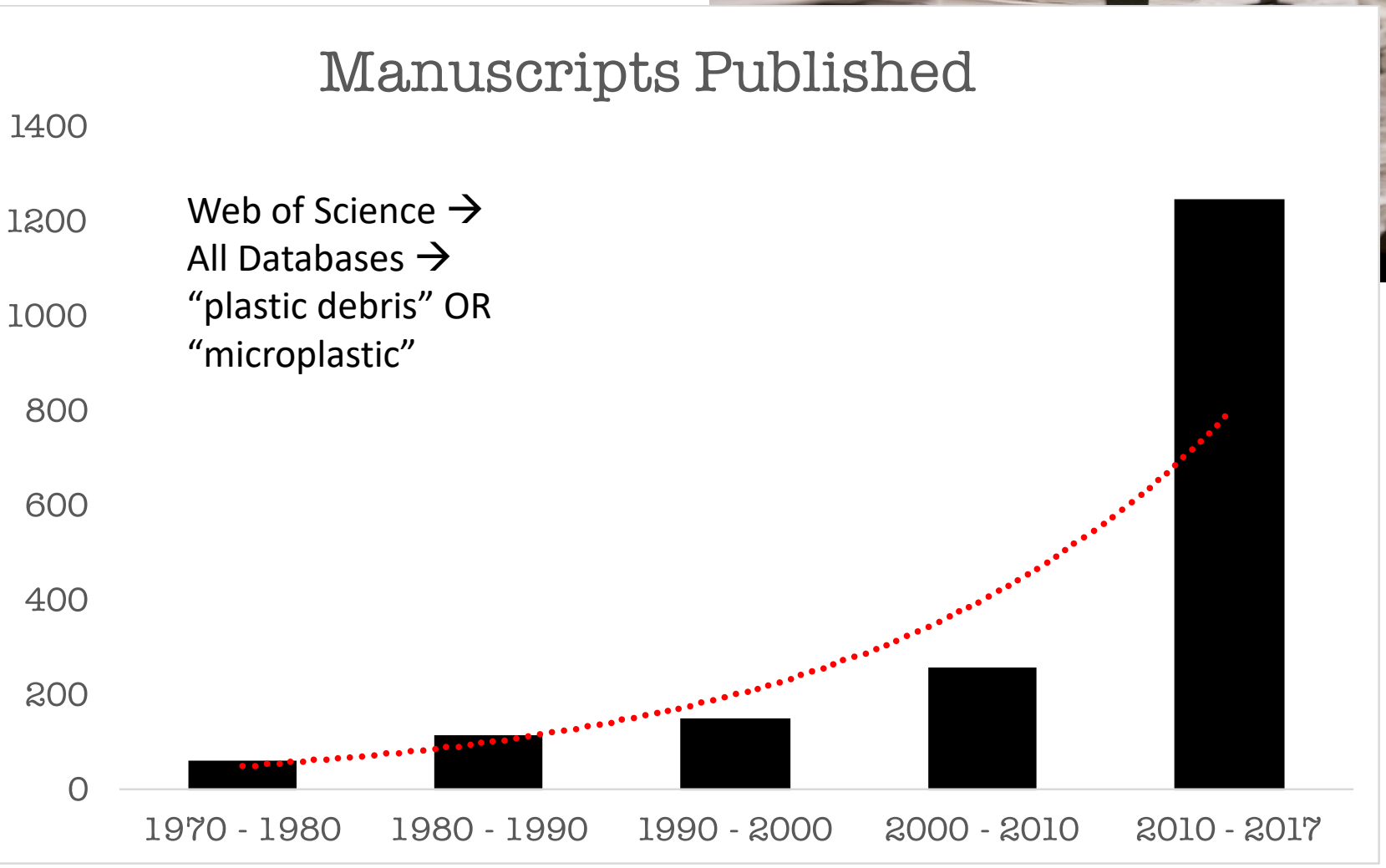
By **Kenneth R. Weiss**

AUGUST 2, 2006 | REPORTING FROM MIDWAY ATOLL

The albatross chick jumped to its feet, eyes alert and focused. At 5 months, it stood 18 inches tall and was fully feathered except for the fuzz that fringed its head.

All attitude, the chick straightened up and clacked its beak at a visitor, then rocked back and dangled webbed feet in the air to cool them in the afternoon breeze.

Manuscripts Published



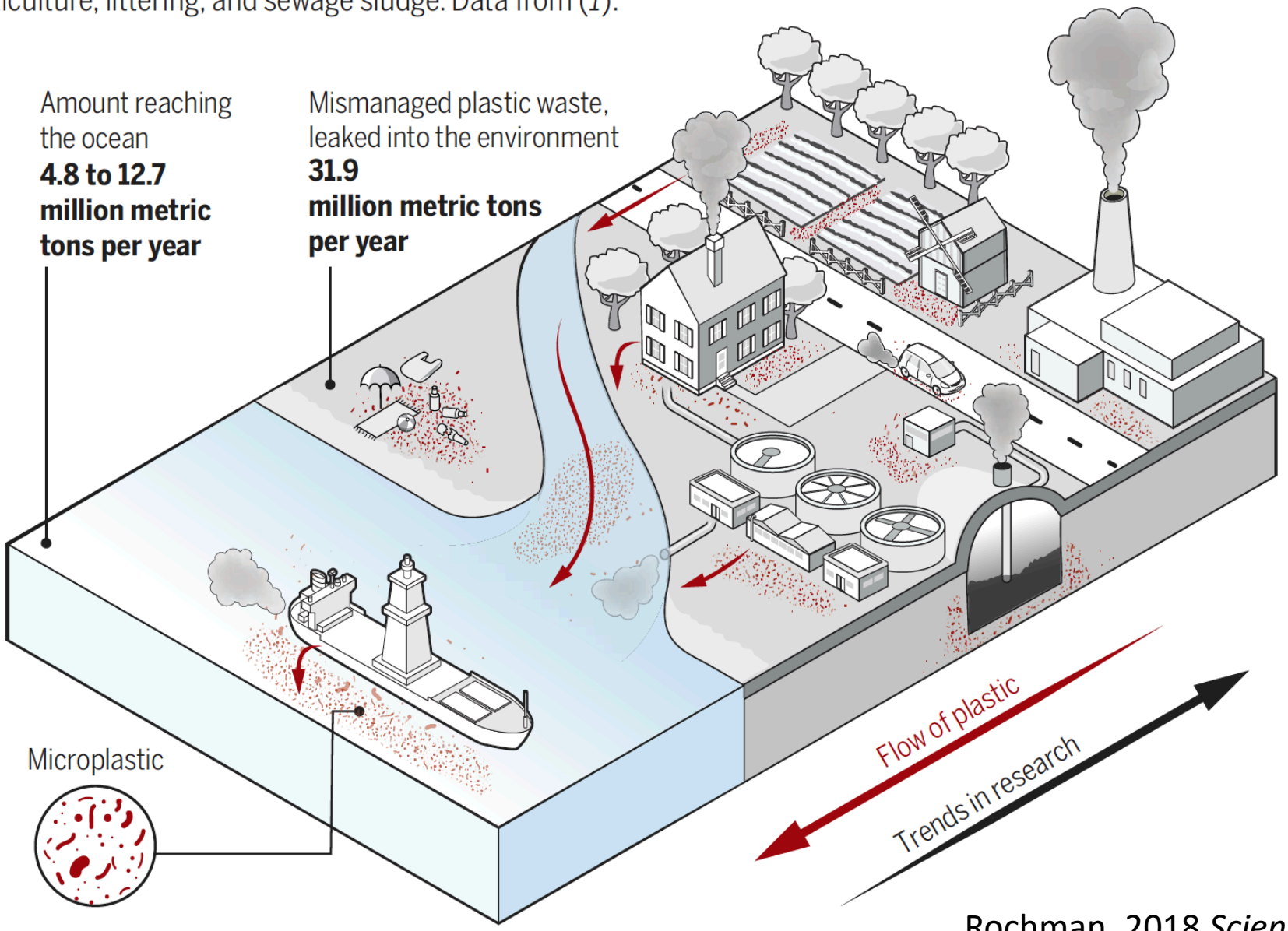
Contamination

Macroplastics (>5 mm)

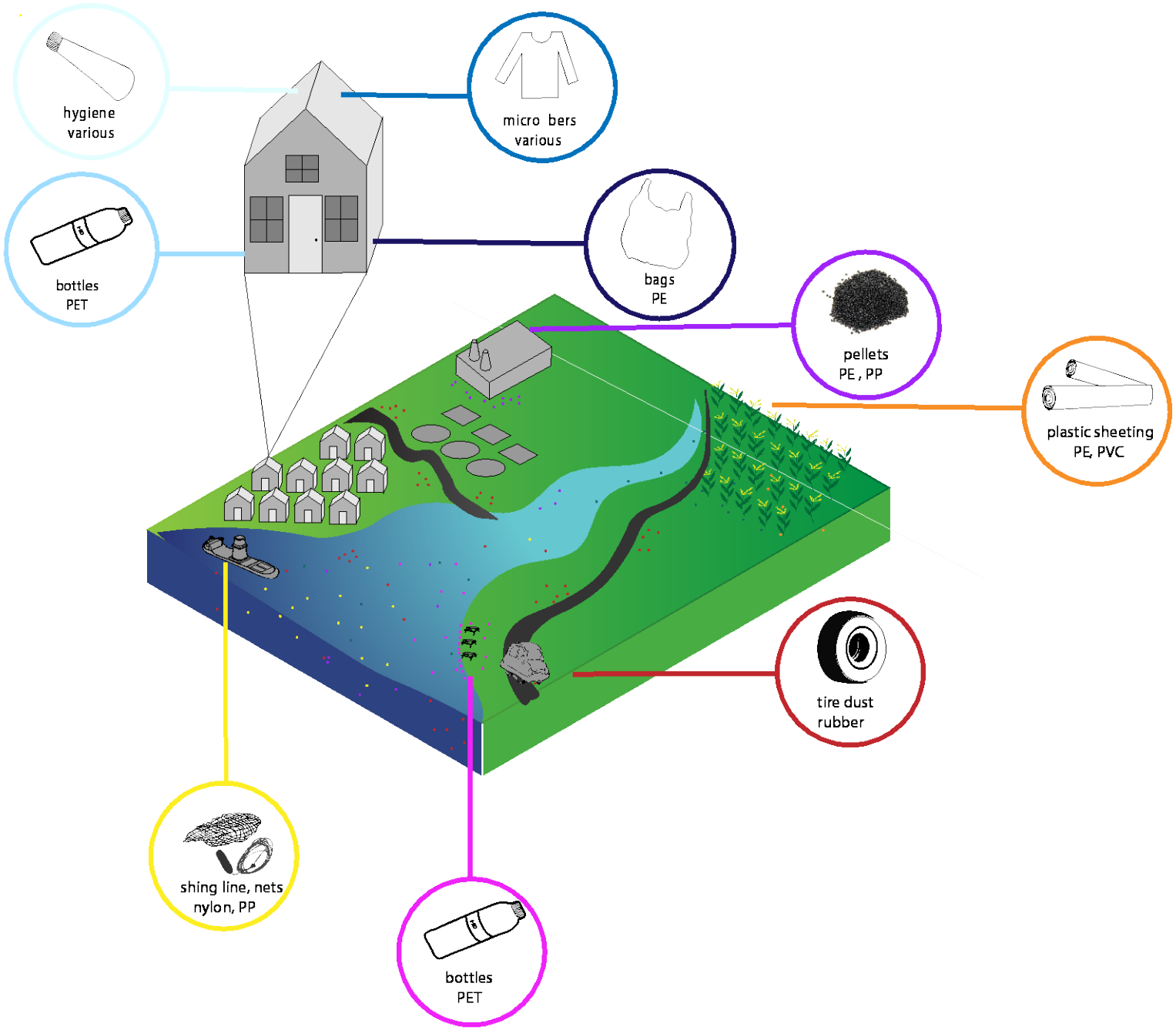
Microplastics (< 5mm)

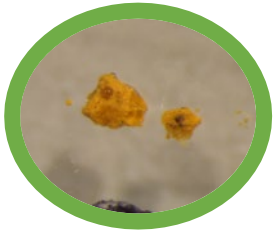
Microplastics everywhere

High amounts of microplastics have been found not just in the sea and on beaches, but also in rivers and soils around the world, demonstrating how pervasive this modern pollution is. Sources include leakage from landfills, plasticulture, littering, and sewage sludge. Data from (*1*).



Rochman, 2018 *Science*


hygiene
various
micro bers
various
bottles
PET
bags
PE
pellets
PE , PP
plastic sheeting
PE, PVC
tire dust
rubber
shing line, nets
nylon, PP
bottles
PET



Polymer

- PP
- LDPE
- HDPE
- PVC
- PU
- PET
- PS
- ABS
- PMMA
- POM
- PBT
- PC
- PA
- SAN
- PEEK
- PSU
- PU
- ...

Additives

- Plasticizers
- Colorants
- Reinforcements
- Fillers
- Flame retardants
- Stabilizers
- ...

Product types

Primary

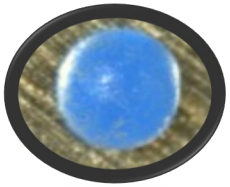
- Pre-production pellets
- Personal care products
- Industrial abrasives...

Secondary

- Agricultural materials
- Beverage bottles
- Carry bags
- Construction materials
- Containers
- Clothing
- Cutlery
- Electronics
- Food packaging
- Film
- Furniture
- Insulation
- Mattresses
- Medical
- Pillows
- Pipes
- Textiles
- Toys
- Tires
- ...

Size

- <5mm
- ...
- Nano
- ...



Morphology

- Fiber
- Fiber bundle
- Fragment
- Sphere
- Pellet
- Film
- Foam
- ...

Color

- Red
- orange
- yellow
- tan
- brown
- off white
- white
- grey
- blue
- green
- ...

Eco-toxins

- PAHs
- PCBs
- DDT
- Heavy metals
- PBDEs
- ...


LIFE

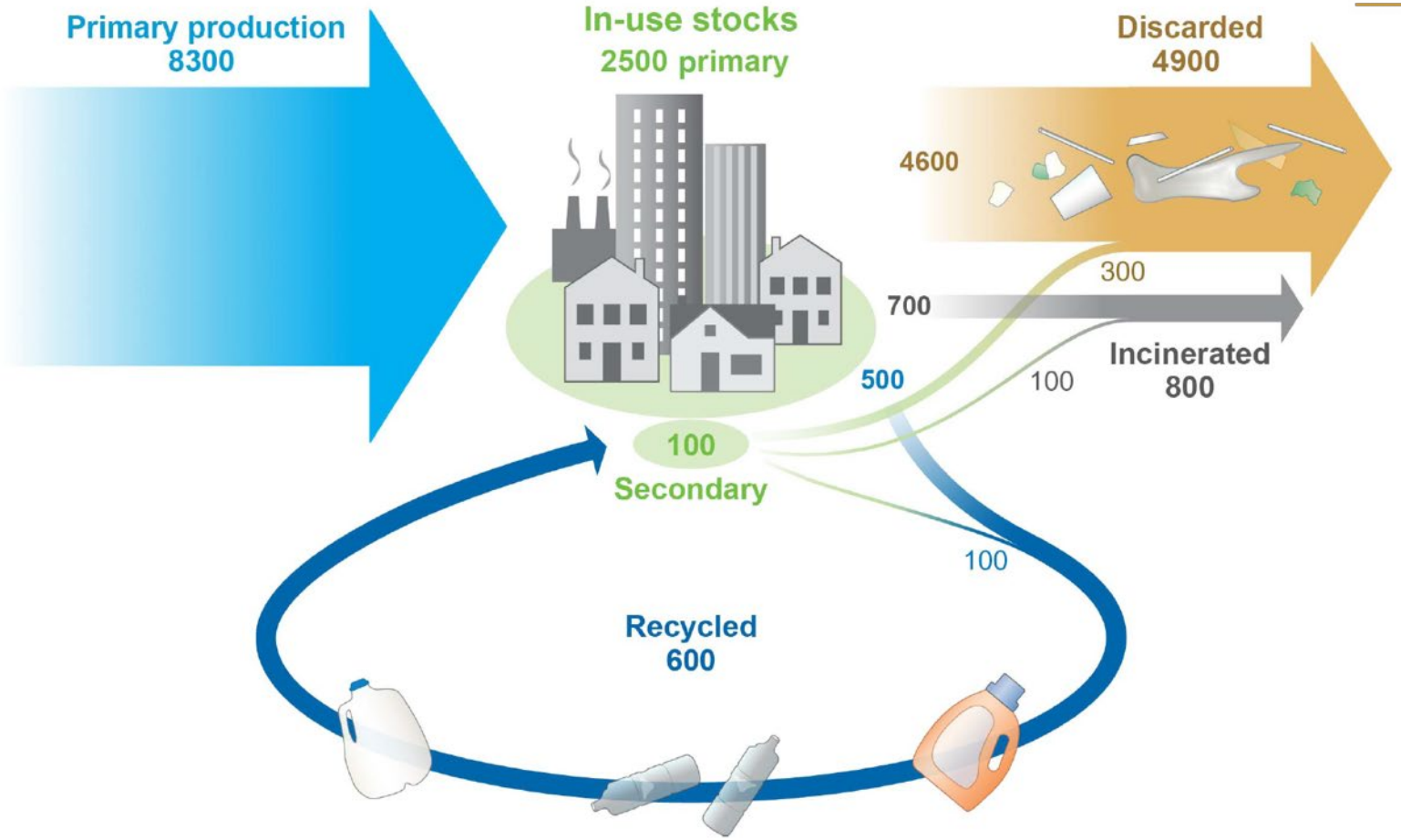


Fig. 2. Global production, use, and fate of polymer resins, synthetic fibers, and additives (1950 to 2015; in million metric tons).

Geyer et al., 2017 *Science Advances*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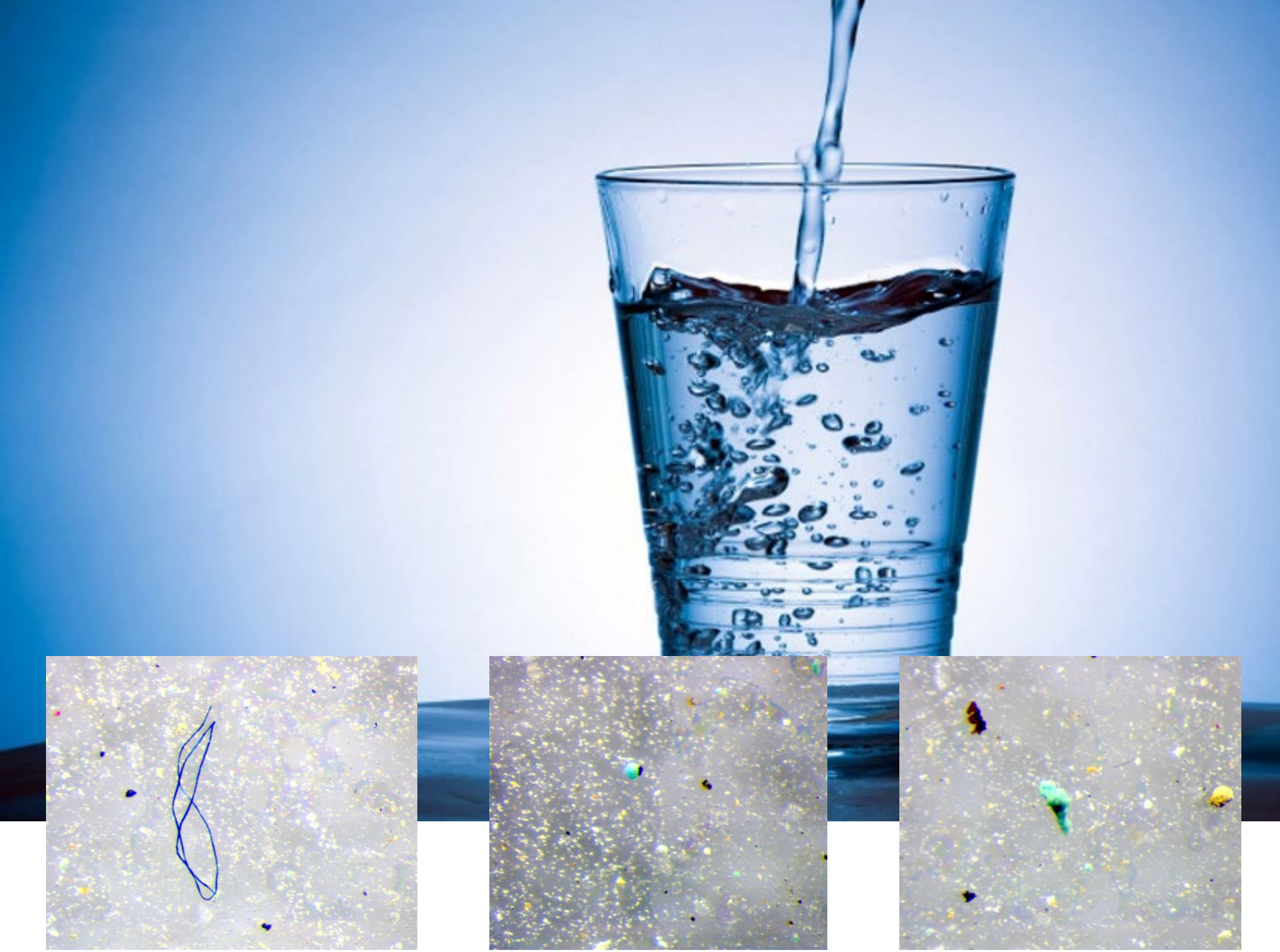
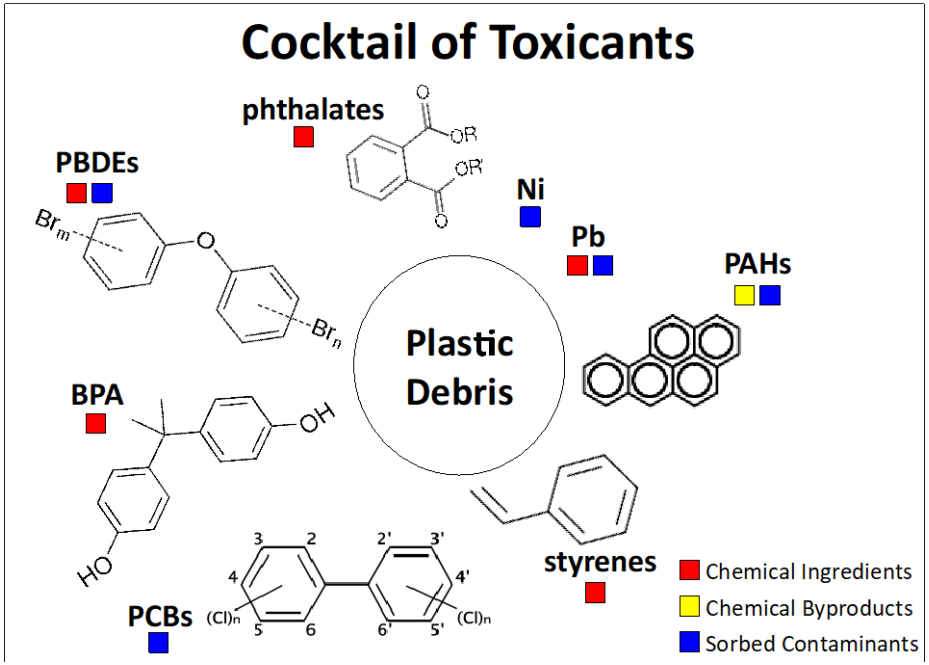
>220 species

FAO Report 2017

Rochman et al., 2015; van Cauwenberghe and Janssen, 2014; Li et al., 2015; Yang et al., 2015; Davidson and Dudas, 2016



What are the effects?



Rochman 2015 Chapter in *Marine Anthropogenic Litter*

Fate of microplastic and nanoplastics in the body

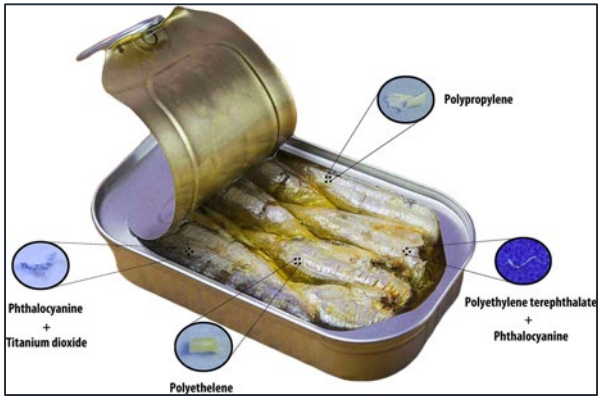
TABLE 6.1

Fate of microplastic and nanoplastics in mammalian bodies as a function of particle size

Microplastics (0.1–5000 µm)		Nanoplastics (1–100 nm)
> 150 µm	no absorption	
< 150 µm	in lymph absorption ≤ 0.3%	
= 110 µm	in portal vein	
≤ 20 µm (≤20000 nm)	access into organs	
		≤ 100 nm access to all organs, translocation of blood-brain and placental barrier
		Absorption up to 7%

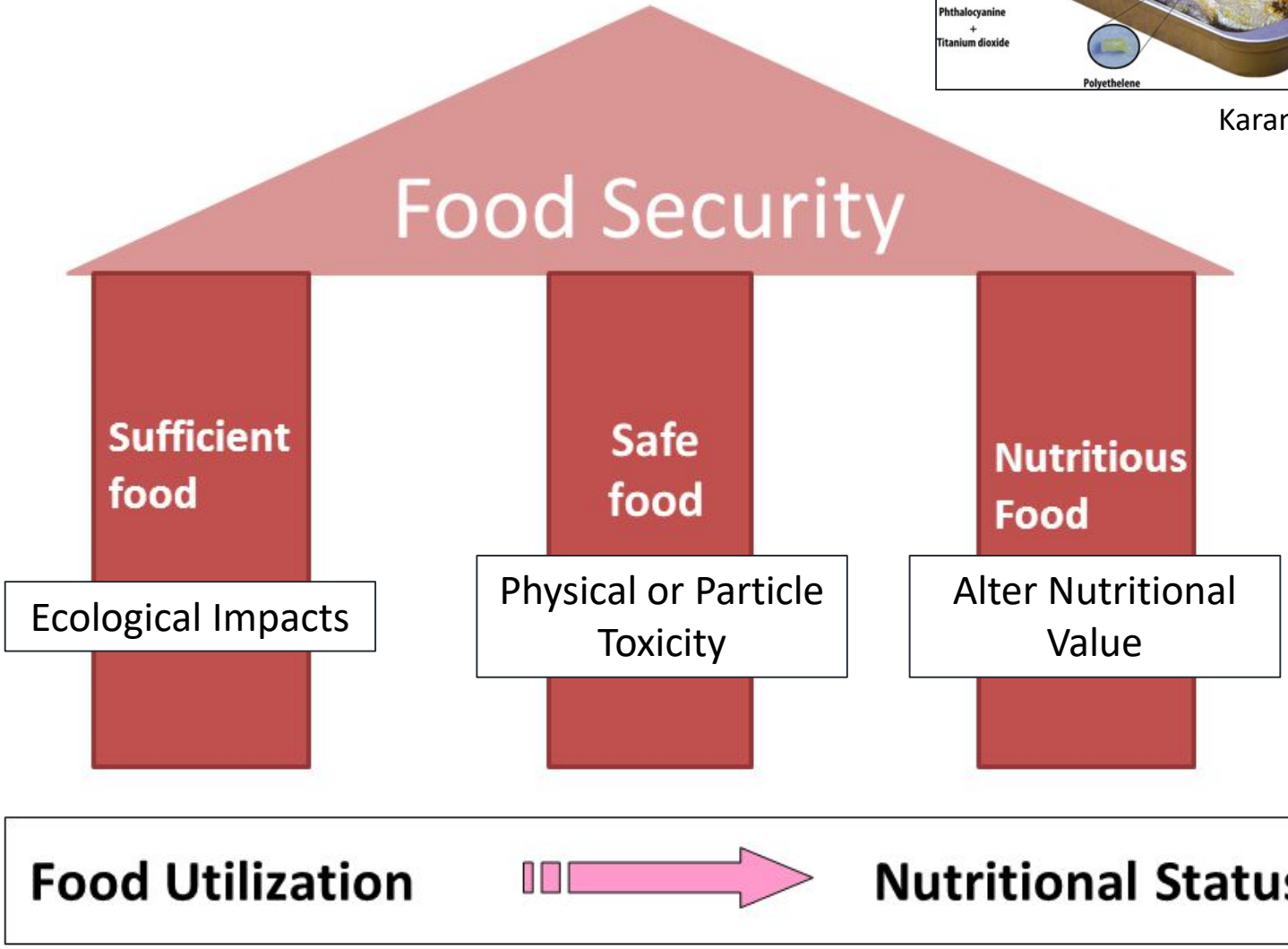
FAO Report 2017

Impacts to Humans



Karami et al., 2018

Pillars of Food Security



Widespread Contamination in habitats and animals – including in sea ice, drinking water, sea salt and seafood.

Evidence of effects – including to laboratory populations and communities.

Continue to aim toward a better understanding of sources, fate and impacts to humans and wildlife populations.

Next Big Questions and Research Needs for Microplastics:

- Identify local entry points for microplastics into the environment
- Identify largest reservoirs for “missing” plastic debris
- Understand the fate of microplastics and associated chemicals in the environment
- Determine ecologically relevant impacts of microplastics:
  - Environmentally relevant laboratory studies, laboratory ecosystem study (mesocosm), field studies, multi-stressor
- Identify impacts to human health and food security
- **Improve methods for quantifying and characterizing microplastics in complex matrices.**

How can we measure risk if we cannot measure contamination?

How can we measure success if we cannot measure contamination?