MARINE PLASTIC POLLUTION RESEARCH

Schmidt Ocean Institute Planning Workshop – Aug. 2014, Hawaii

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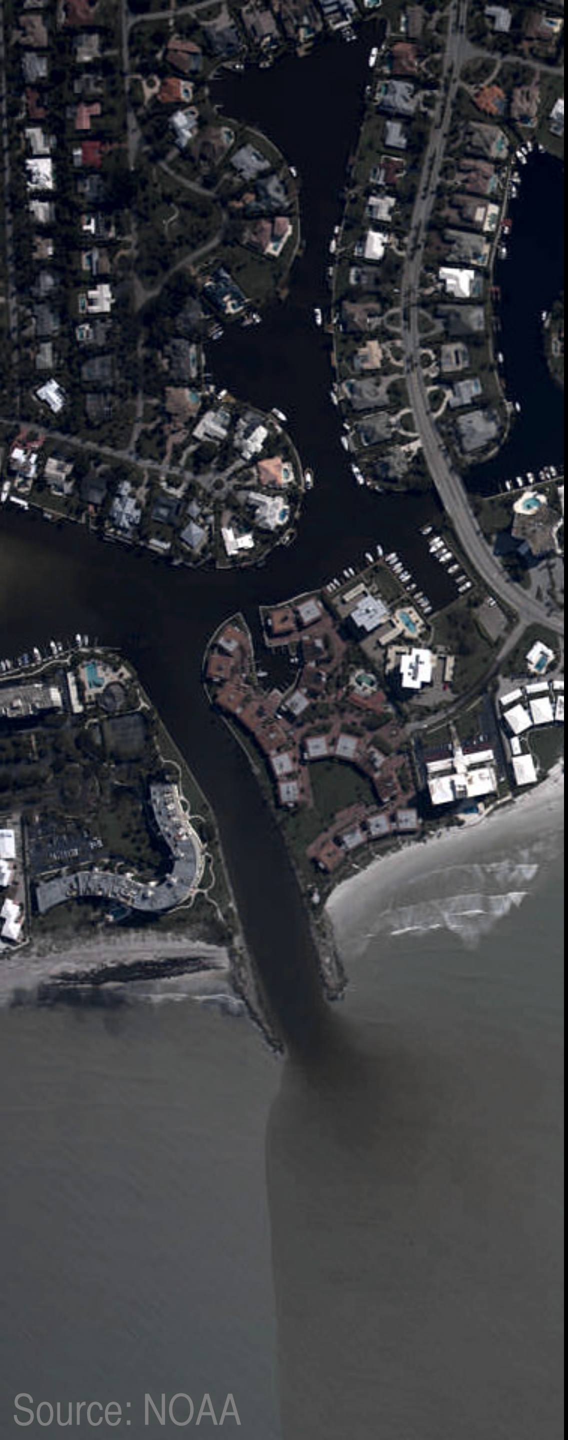
MARINE POLLUTION

“Fashions change in all subjects, but in marine pollution, fashions are largely determined by public perceptions which are notoriously capricious.”

R. B. Clark



. Oxygen-demanding Waste

. Oil Pollution

. Metals

. Halogenated Hydrocarbons

. Radioactivity

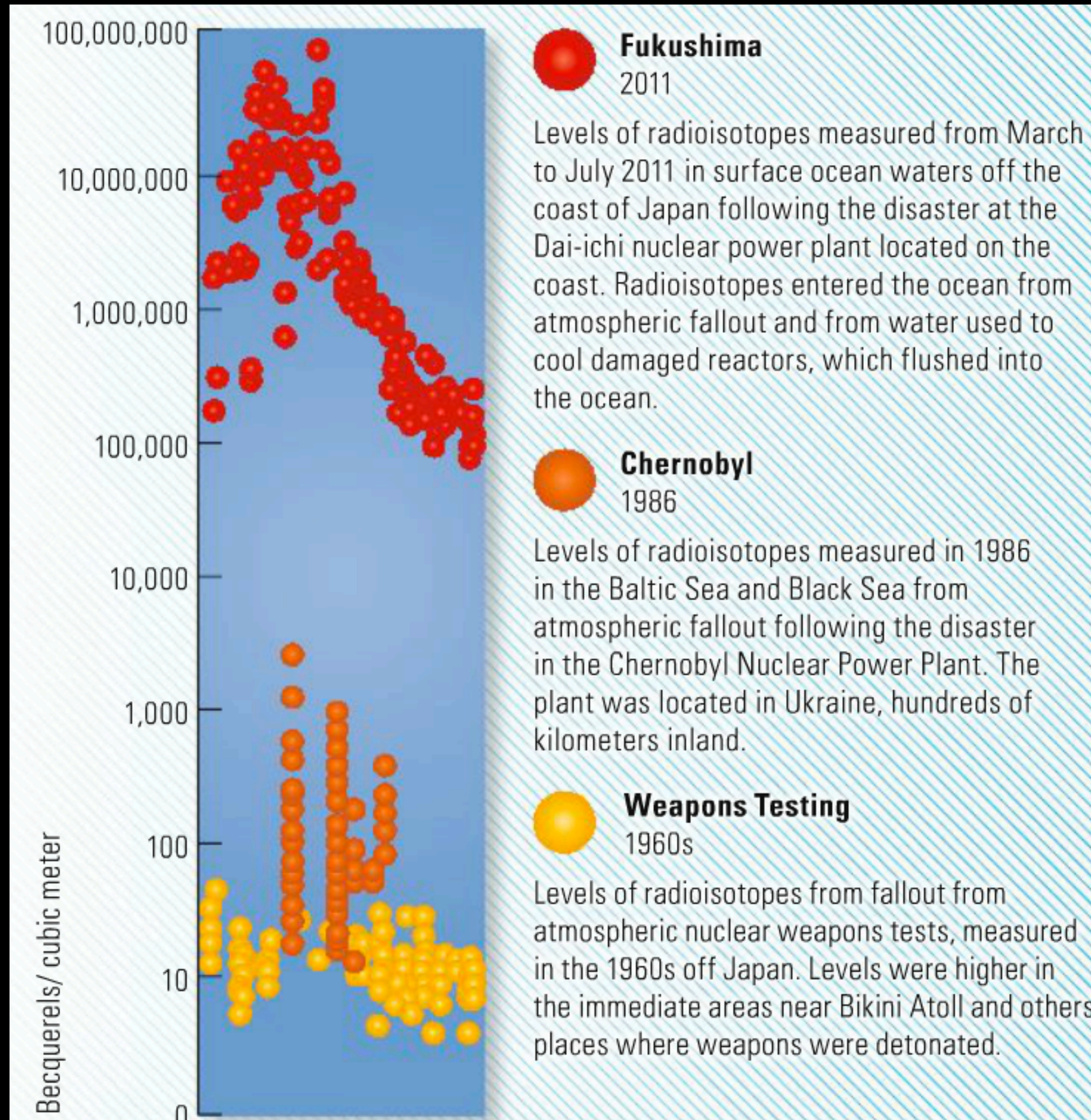
. Dredgings, solids

. Heat, sound, light

Radioactive contamination

“Uncertainty is a key factor in fear of people”

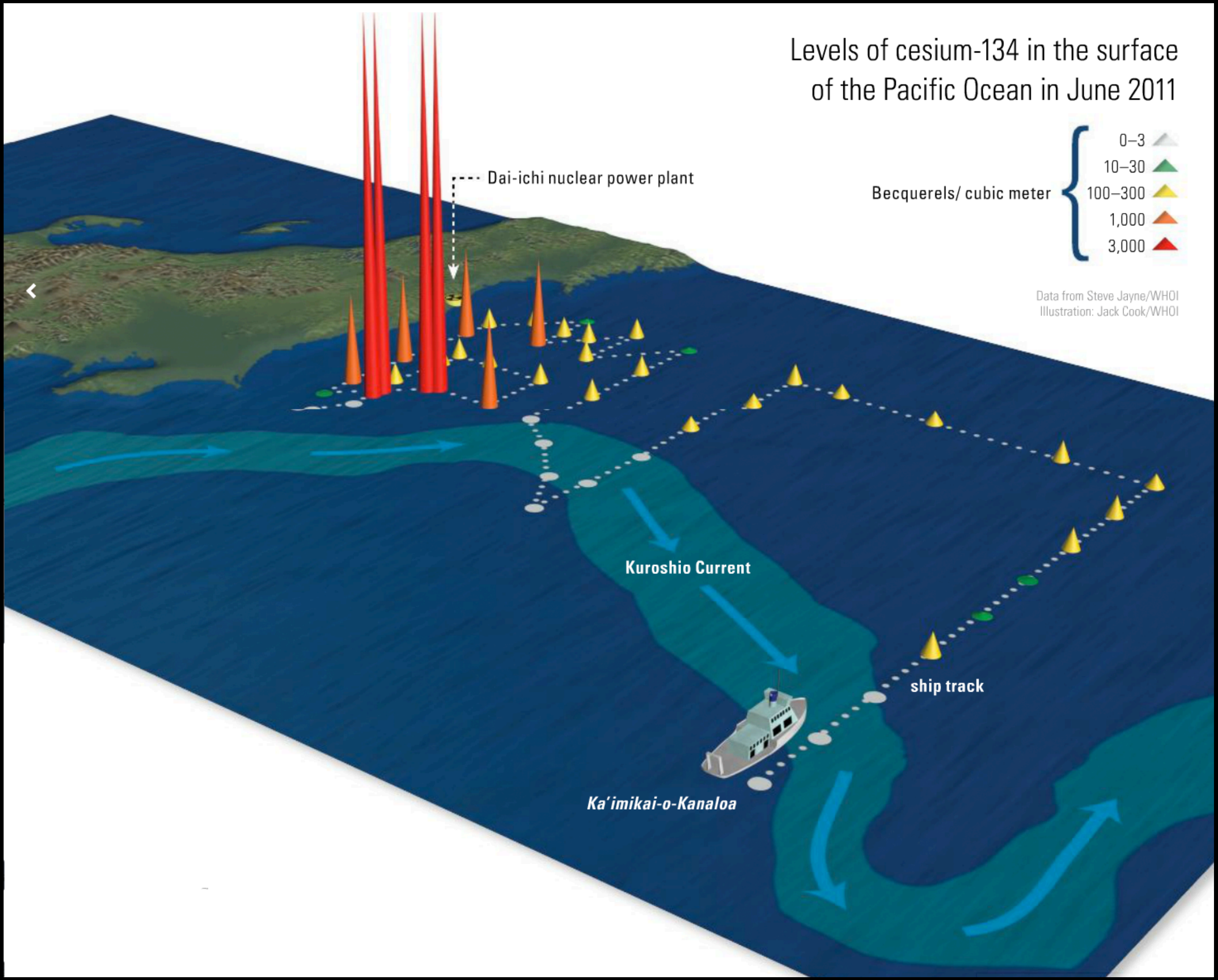
Mitsuyoshi Urashima



Source: Oceanus Magazine

by Steve Hall

Buesseler 2014



Source: Oceanus Magazine

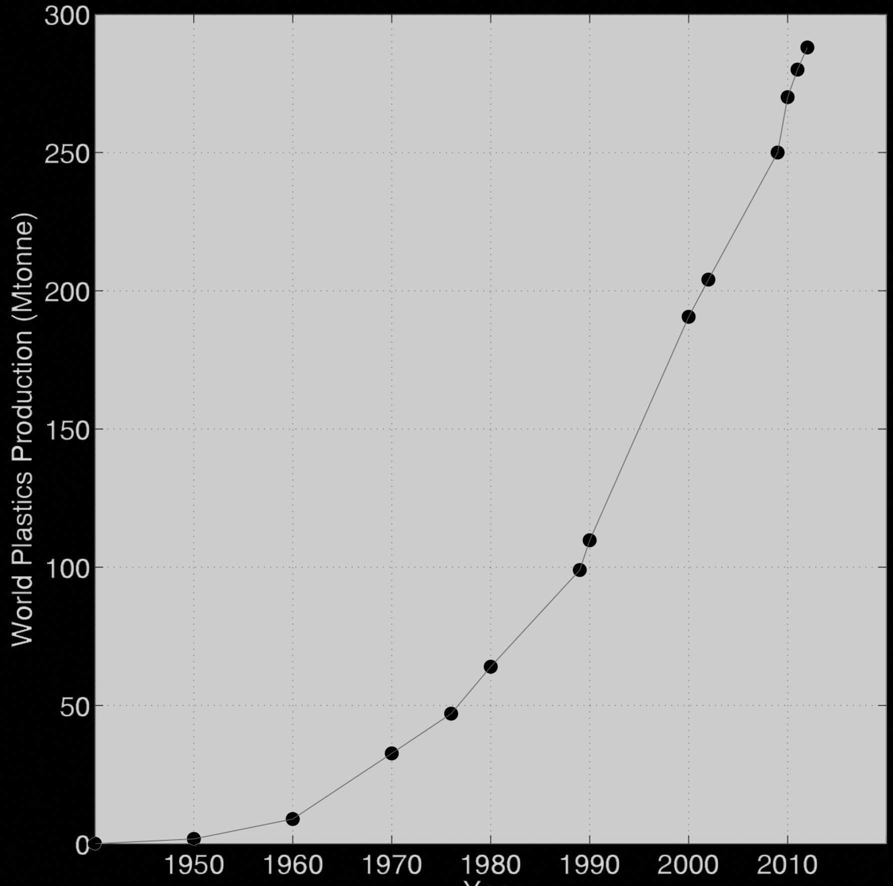
PLASTIC POLLUTION

“Why make something that is used for minutes out of a material that last forever?”

Jeb Berrier

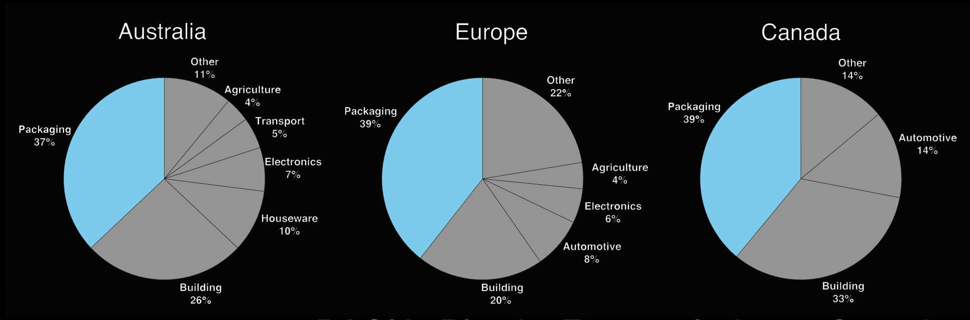
Global Plastic Production

Plastic is made of petrochemicals



PlasticsEurope

Life Magazine (1955)



PACIA, PlasticsEurope, Industry Canada

Plastic Waste

The “throw away” is usually not recycled

Seppo Leinonen, Flickr

US
8% is recycled
EPA (2010)

Australia
20% is recycled
PACIA (2011)

Japan
26% is recycled
PWMI (2012)

Ocean: the ultimate receiver

Land- and ocean-based sources

Wikipedia

Rivers

Wind

Tides

Sewage Disposal

Flood Events

Vessels (fishing)

Offshore platforms

Ocean sinks for plastic

Vary with biological and physical processes

Coastlines

@GlobalGarbage

Seafloor

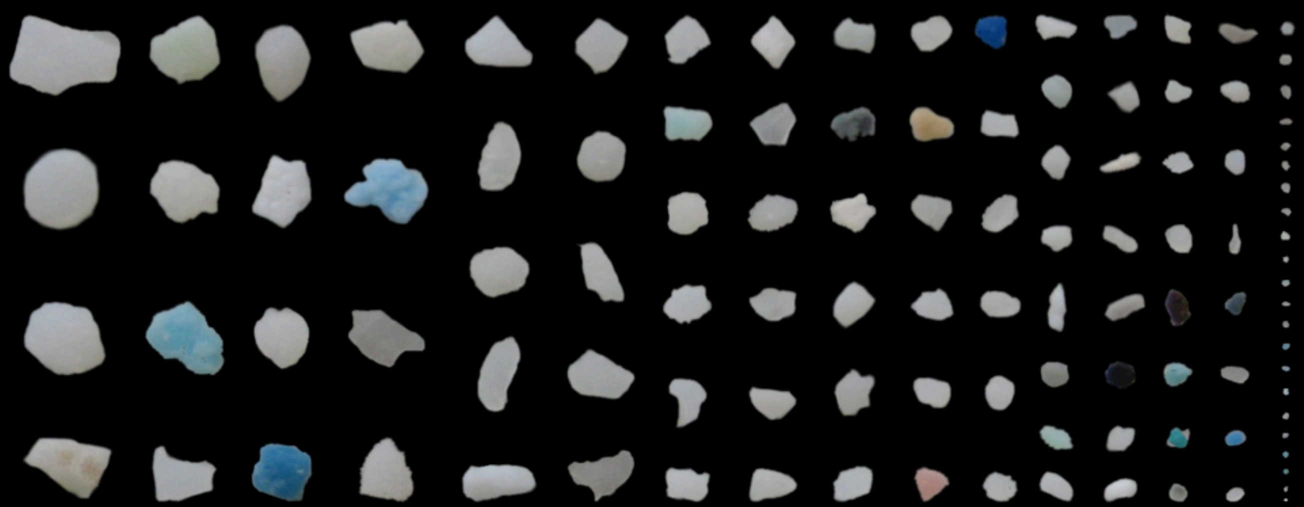
Bouteiles.org

Water Column

Cesar Harada, Flickr

Plastic fragmentation

Microplastics: the most abundant form of human-made debris

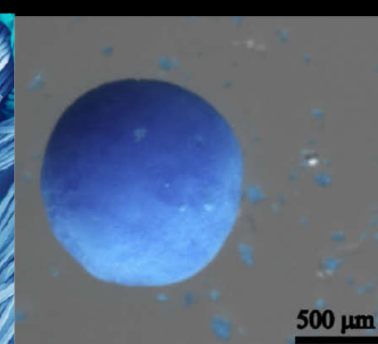


Malaspina Expedition 2010

5 mm

CMORE

Browne et al 2011



Fendall 2009

Song et al 2014

Why does it matter?

Plastic ingestion

The University of Tasmania

National Geographic

Plastic ingestion

Physical & chemical impacts

Campioli et al. 2011

Toxic additives (e.g. flame retardants, BPA)

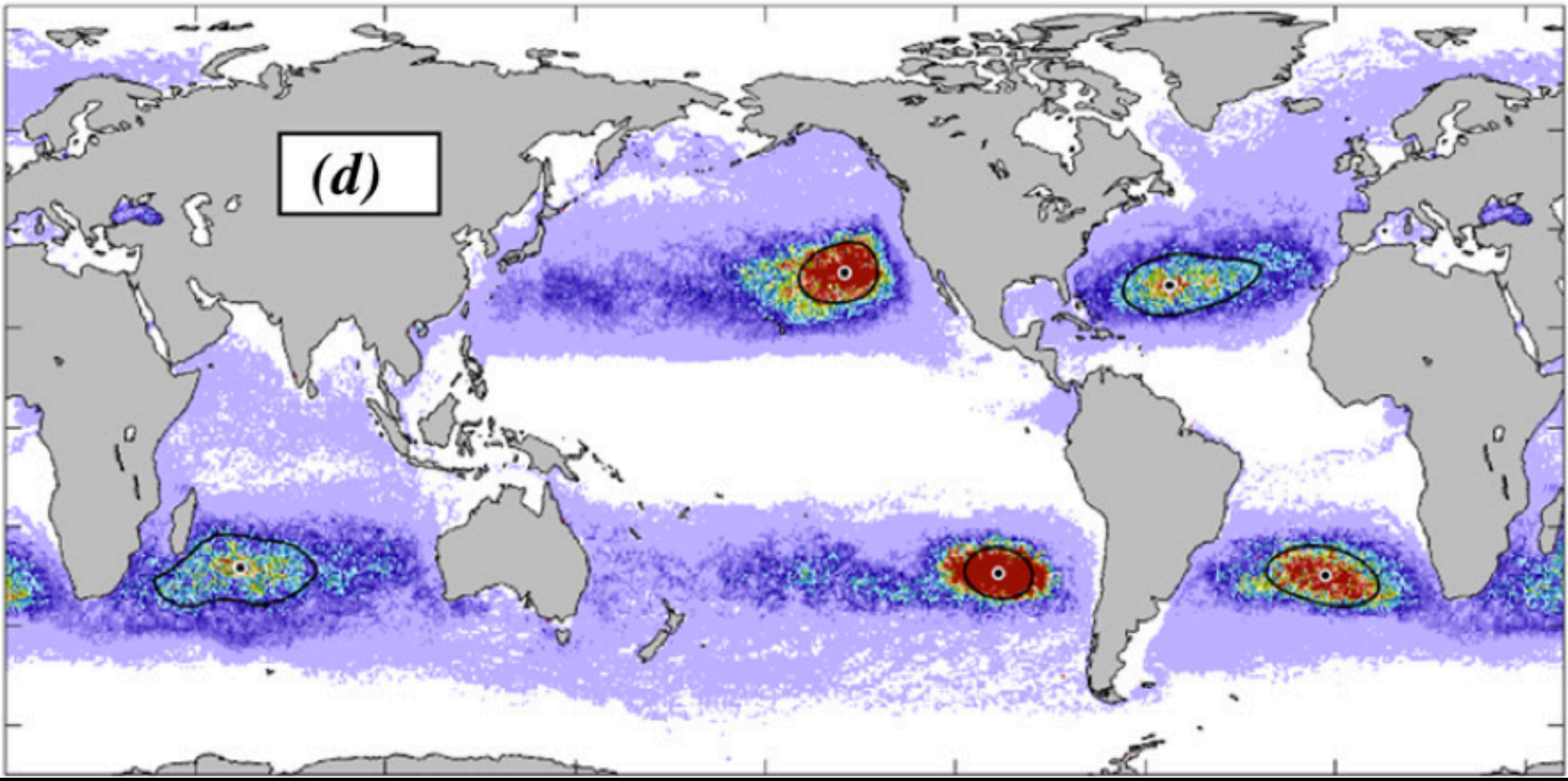
Engler 2012

POPs from seawater (e.g. PAHs, PCBs, DDTs)

Surfrider Foundation

Surface distribution: modelling

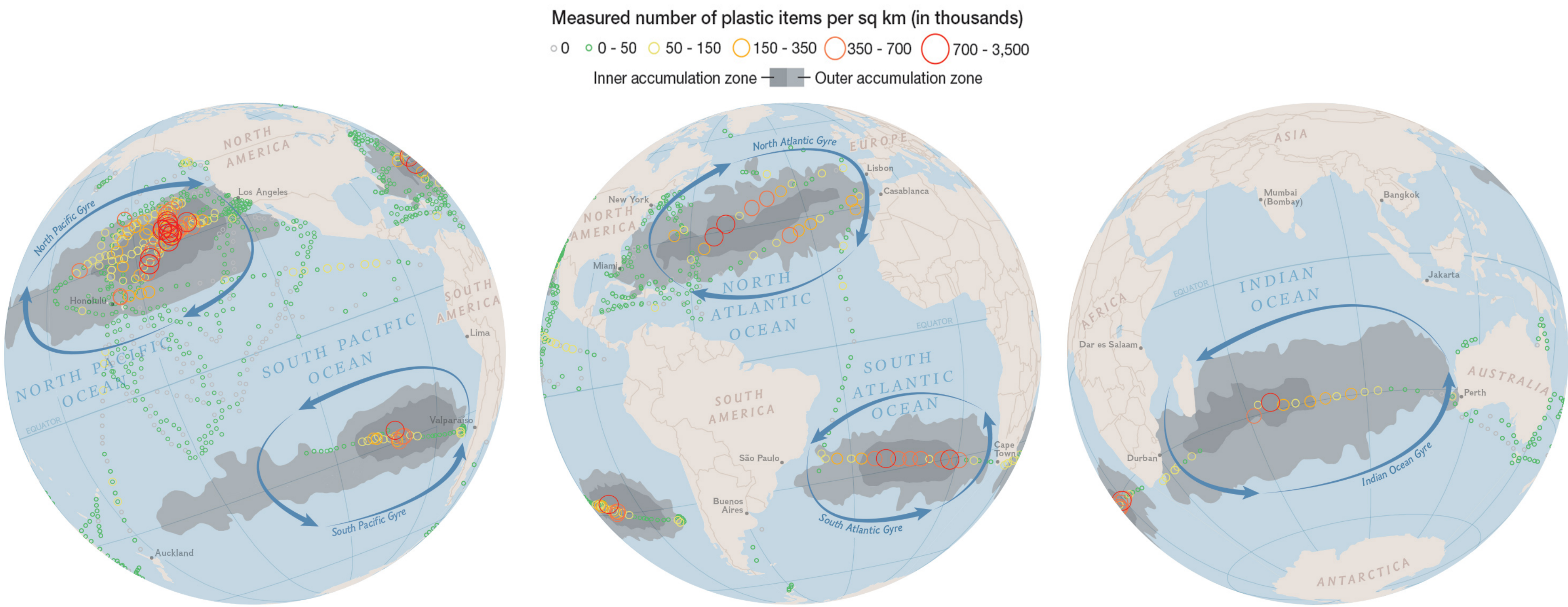
Oceanic plastic hotspots



Maximenko et al. 2011

Surface distribution: net sampling

Lack of data Indian Ocean and Western Pacific



National Geographic, Data from: Cozar et al. 2014

SHIPBOARD RESEARCH

"If curiosity killed the cat, curiosity may be the very thing that saves us, the oceans & planet "

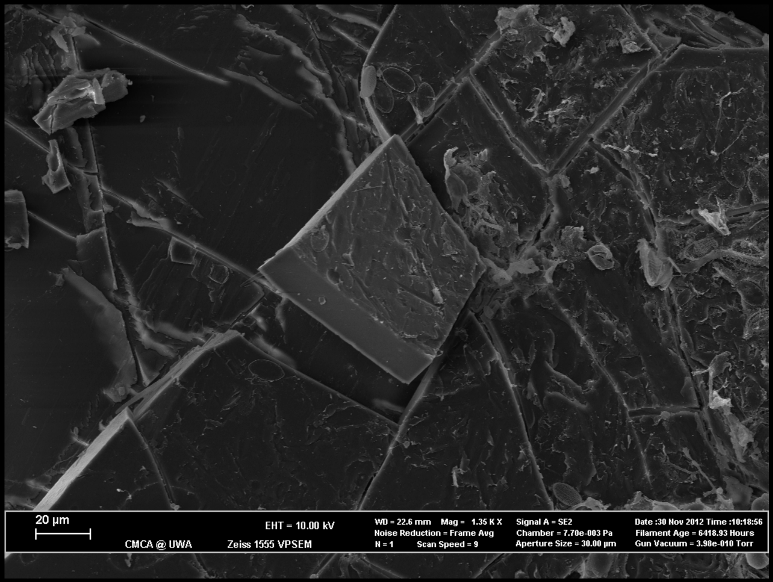
Wendy Schmidt

3D survey: amount and distribution

Wide size ranges; at sea surface, water column, seafloor

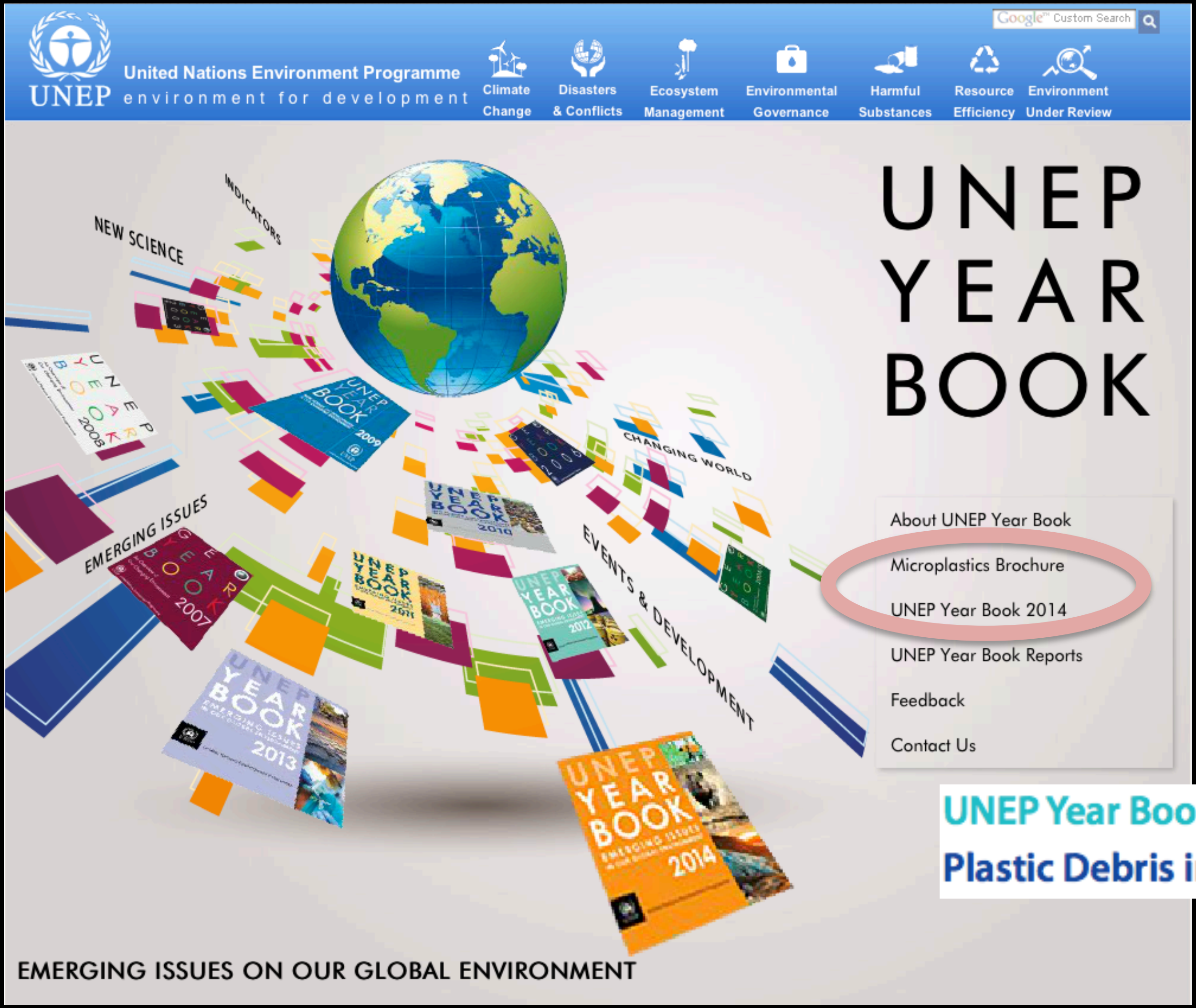
Nanometer——-Micrometer———-Millimeter———-Meter-sized

7000 – 35000 tons



3D survey: pollutants loads

~ pollutant, polymer, marine region, weathering level, biofouling

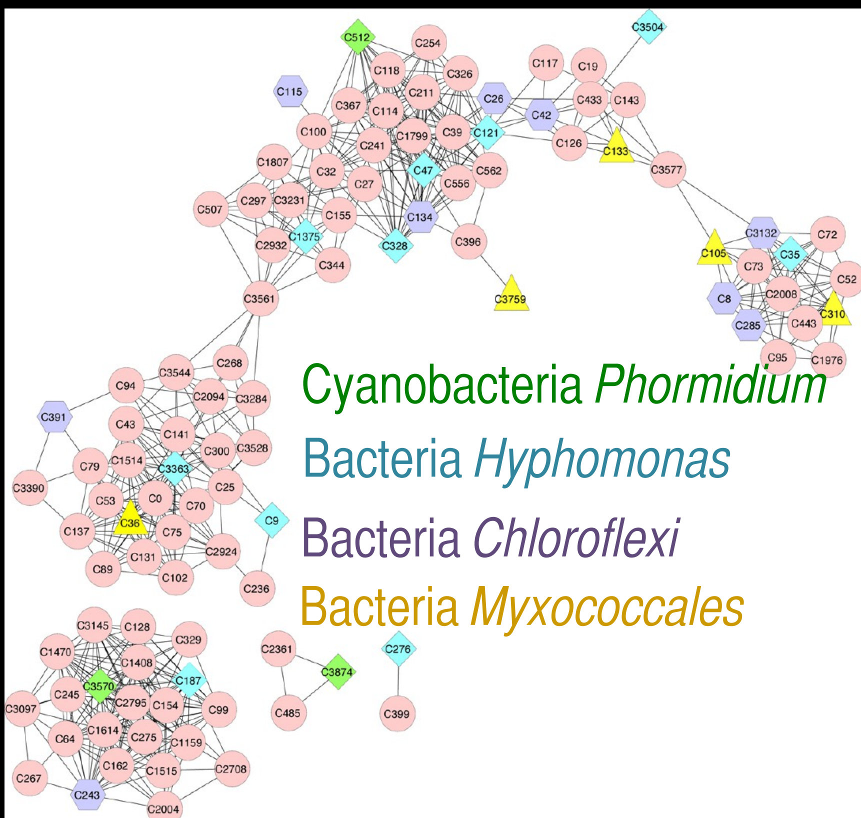


UNEP Year Book 2014 emerging issues update

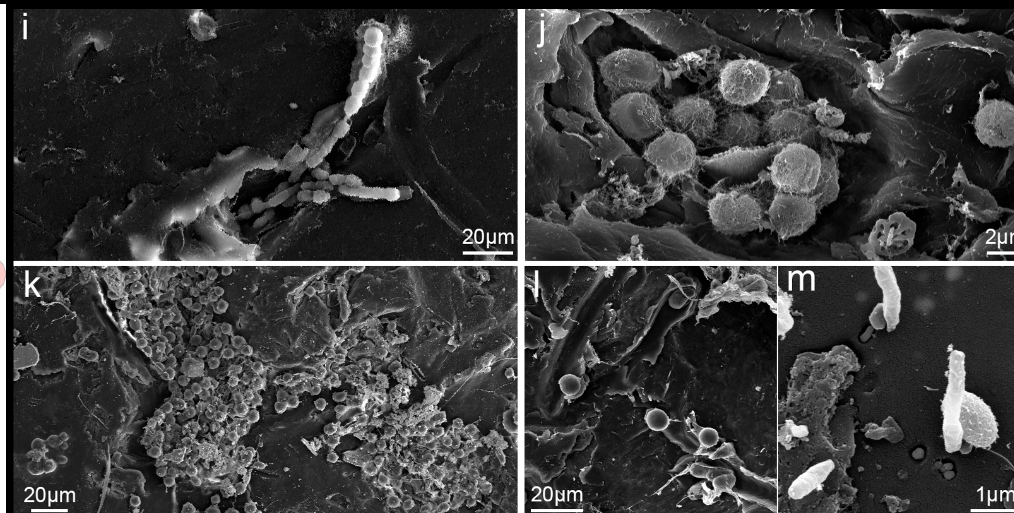
Plastic Debris in the Ocean

3D survey: metagenomics plastic biofilm

Hydrocarbon-degrading genes?



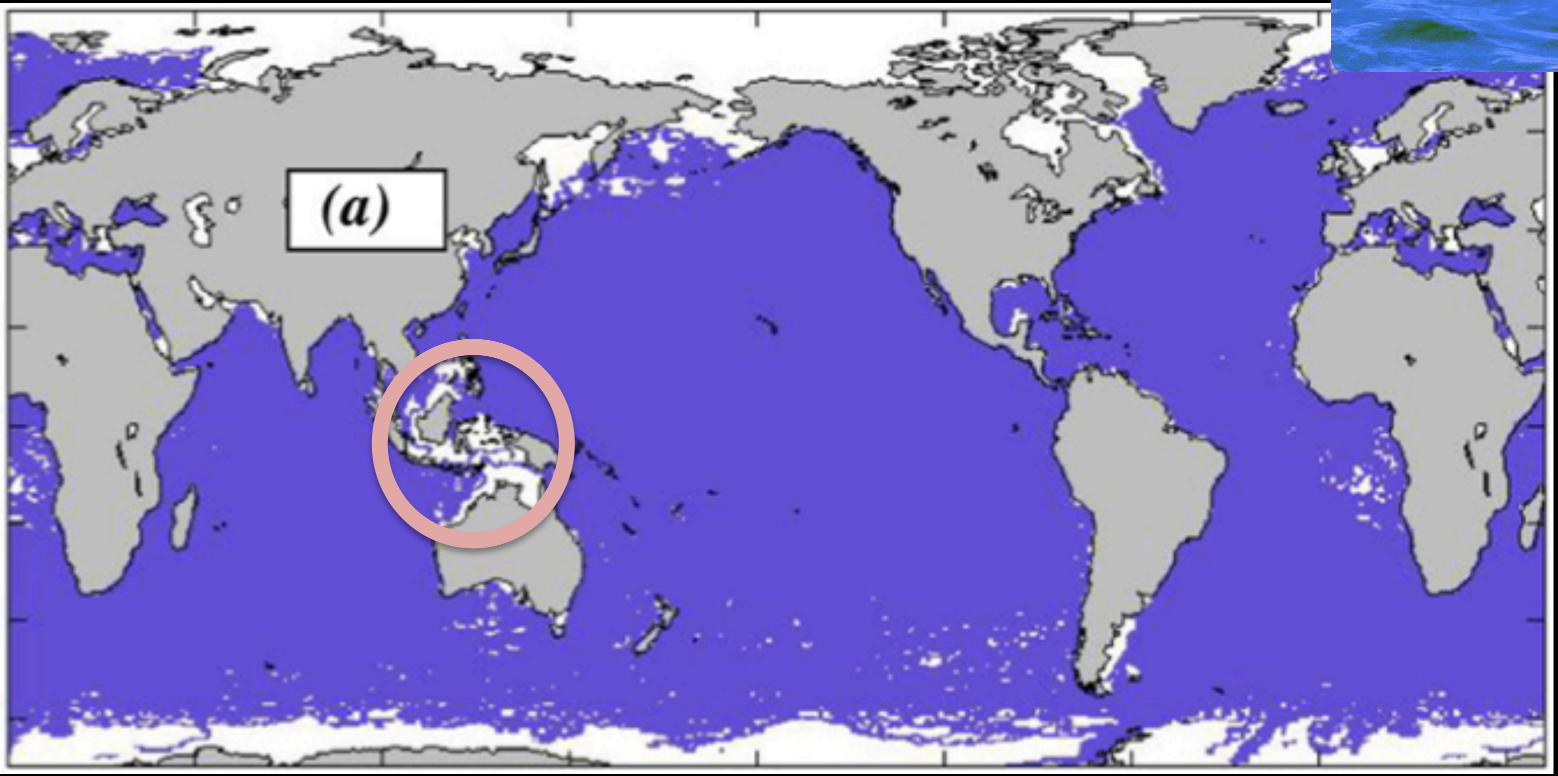
Zettler et al. 2013



Reisser et al. 2014

Shallow-water drifter deployment

Improve ocean plastic connectivity studies

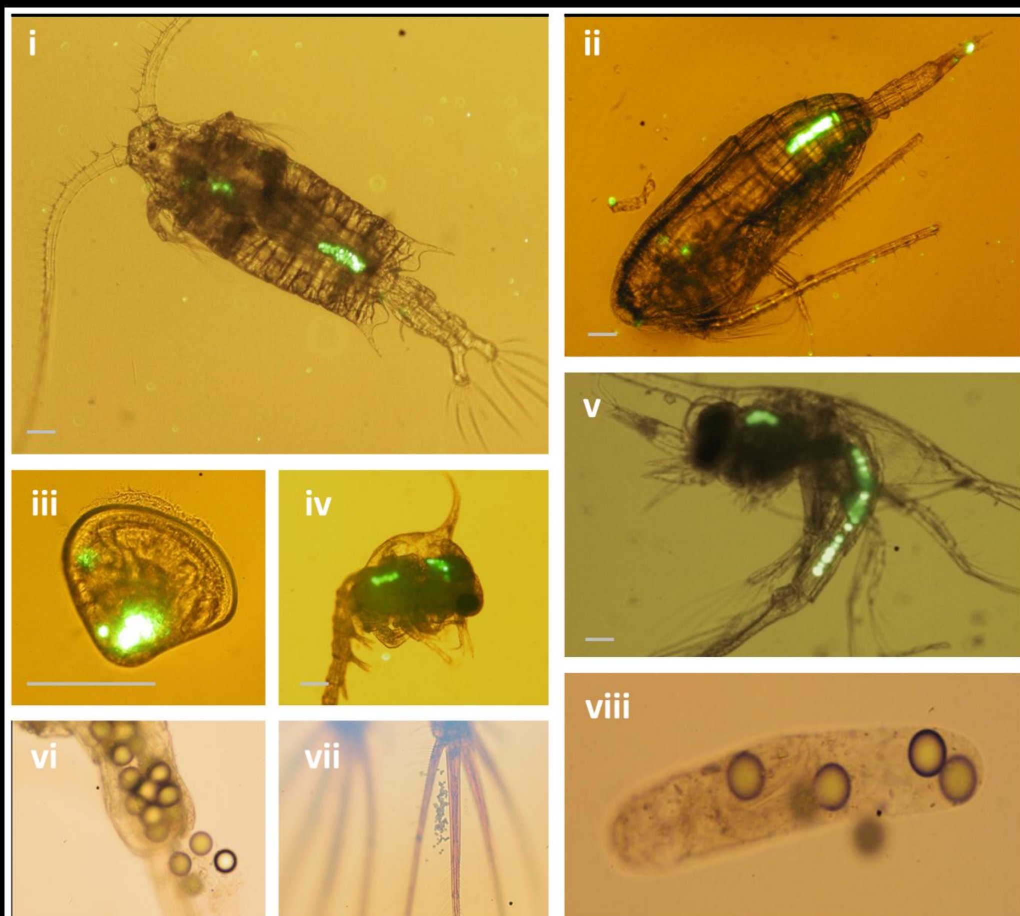


Maximenko et al. 2011

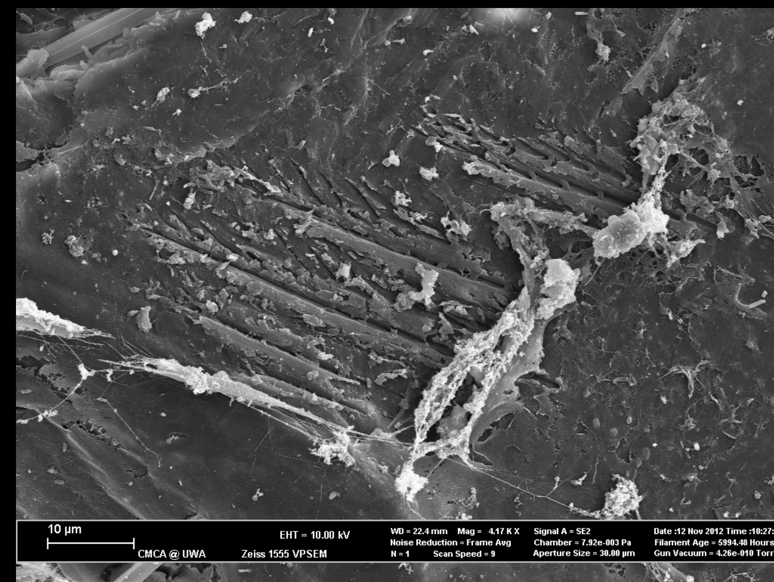
Pacific Gyre

At-sea feeding experiments

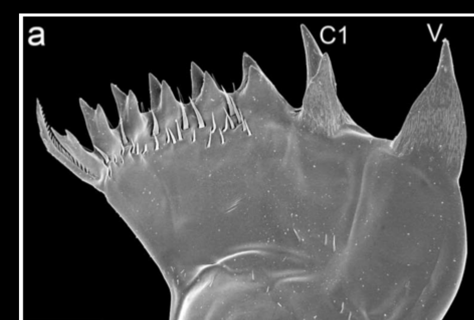
Does size matter? Current assumption: particle smaller than organism



Cole et al 2013



Reisser et al 2014



Michels et al 2012

For discussion

. Efficient 3D survey (sensor for particles?)

. Metagenomics biofilm

. Shallow-water drifters

. At-sea feeding experiments