## MARINE

# PLASTIC POLLUTION

# RESEARCH

Schmidt Ocean Institute Planning Workshop – Aug. 2014, Hawaii Julia Reisser – PhD candidate, University of Western Australia

# **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





Levels of radioisotopes measured from March to July 2011 in surface ocean waters off the coast of Japan following the disaster at the Dai-ichi nuclear power plant located on the coast. Radioisotopes entered the ocean from atmospheric fallout and from water used to cool damaged reactors, which flushed into the ocean.

#### Chernobyl 1986

Levels of radioisotopes measured in 1986 in the Baltic Sea and Black Sea from atmospheric fallout following the disaster in the Chernobyl Nuclear Power Plant. The plant was located in Ukraine, hundreds of kilometers inland.

#### Weapons Testing 1960s

Levels of radioisotopes from fallout from atmospheric nuclear weapons tests, measured in the 1960s off Japan. Levels were higher in the immediate areas near Bikini Atoll and others places where weapons were detonated.



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





Life Magazine (1955)



### 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



Rivers Wind Tides Sewage Disposal Flood Events

Vessels (fishing) Offshore platforms

Wikipedia

### 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





A.Slotwinski/TAFI/UTAS

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)



#### WHAT GOES IN THE OCEAN GOES IN YOU.

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



## 3D survey: pollutants loads

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



EMERGING ISSUES ON OUR GLOBAL ENVIRONMENT

### 3D survey: metagenomics plastic biofilm Hydrocarbon-degrading genes?

C556 C27 AW/X C297 C323 C134 Cyanobacteria Phormidium C268 C2094 -C3284 Bacteria Hyphomonas C300 C3528 C1514 C3363 20µm CO C36 Bacteria Chloroflexi C75 C292 C131 Bacteria *Myxococcales* C275 C1159

C117 C19

C126 C133

C42

C433 C143

K C211

C3390

C1515

C26

C1799 C39 C121



Reisser et al. 2014

Zettler et al. 2013



## Shallow-water drifter deployment

Improve ocean plastic connectivity studies

Maximenko et al. 2011

#### At-sea feeding experiments

Does size matter? Current assumption: particle smaller than organism



Cole et al 2013

Michels et al 2012

#### For discussion

- . Efficient 3D survey (sensor for particles?)
- . Metagenomics biofilm
- . Shallow-water drifters
- . At-sea feeding experiments

