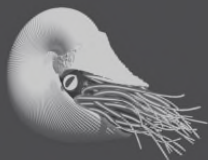


Impact of marine debris on marine ecosystems

APEC Workshop, 18-20 February 2020

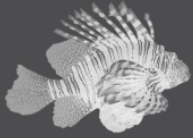
Capacity building on global marine debris monitoring and
modeling: Support protection of the marine environment



IRD AT A GLANCE

- ◊ French public organization for Science and Technology
- ◊ Under the dual authority of
 - ◊ French Ministry for Europe and Foreign Affairs
 - ◊ French Ministry for Higher Education, Research, and Innovation
- ◊ Key French player on the international development agenda
- ◊ Inter-tropical regions & Mediterranean area
- ◊ Equitable scientific partnership with local research bodies
- ◊ Scientific evidence-based solutions to tackle global challenges





SCIENCE POLE AT IRD: 5 SCIENTIFIC DEPARTMENTS

- ◊ Internal and surface dynamics of continents
- ◊ Ecology, biodiversity, and functioning of continental ecosystems
- ◊ Health and societies
- ◊ Societies and globalization
- ◊ Oceans, climate and resources (OCEANS)

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9 RESEARCH UNITS WITHIN OCEANS

- ◊ Tropical marine ecology of Pacific and Indian oceans (ENTROPIE)
- ◊ Marine biodiversity, exploitation and conservation (MARBEC)
- ◊ Oceanian insular ecosystems (EIO)
- ◊ Laboratory of environmental marine science (LEMAR)
- ◊ Instrumentation, analytic tools, observatories in geophysics and oceanography (IMAGO)
- ◊ Laboratory of physical and spatial oceanography (LOPS)
- ◊ Laboratory of studies on geophysics and spatial oceanography (LEGOS)
- ◊ Mediterranean Institute of Oceanography (MIO)
- ◊ Laboratory of oceanography and climate (LOCEAN)



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APEC COUNTRIES IN WHICH IRD WORKS



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WHAT ARE MARINE DEBRIS?

Industrial-agricultural-mining-nuclear chemical effluents not included



Paper



Textiles



Glass



Rubber



Cigarette butts



Fishing gear



Food containers



Wood



Metal



Ceramics



Plastics
60 to 90%



Plastic bags

etc.

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SIZE AND ORIGINS OF MARINE DEBRIS

- ◊ Land runoff
- ◊ Direct discharge
- ◊ Deep sea mining
- ◊ Ship pollution
- ◊ Atmospheric pollution

◊ LARGE



53%
Mega-P

26%
Macro-P

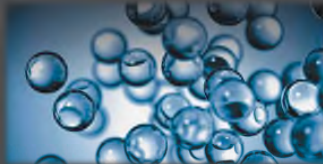
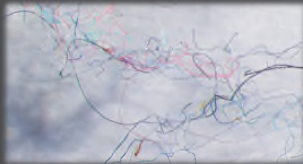
◊ MEDIUM



13%
Meso -P

8%
micro -P
nano-P

◊ SMALL



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ECONOMIC ACTIVITIES IMPACTED BY MARINE DEBRIS



Shipping



Fishing



Aquaculture



Tourism



Recreation

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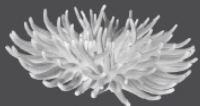


COSTS OF MARINE DEBRIS

- ◊ \$ 8 billion/year (fisheries, aquaculture, marine tourism, cleanups)
- ◊ Loss in tourism: \$622 million/year
- ◊ Loss for EU fishing fleet: \$81.7 million/year

◊ Produced plastic: 1.5 million tons in 1950
300 million tons in 2014
33 000 million tons in 2050

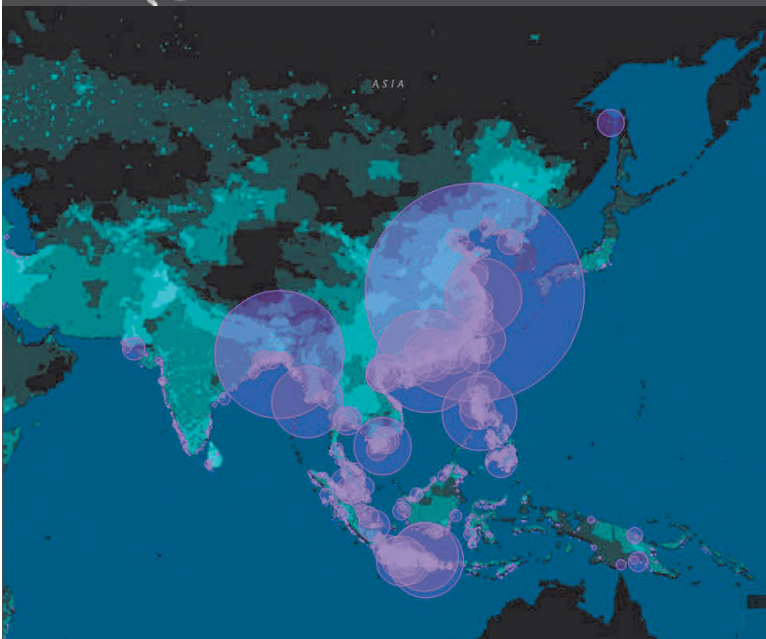
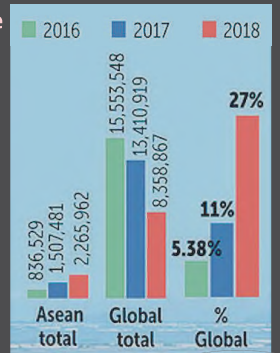
◊ Mismanaged plastic: 32 million tons in 2014
250 million tons in 2025



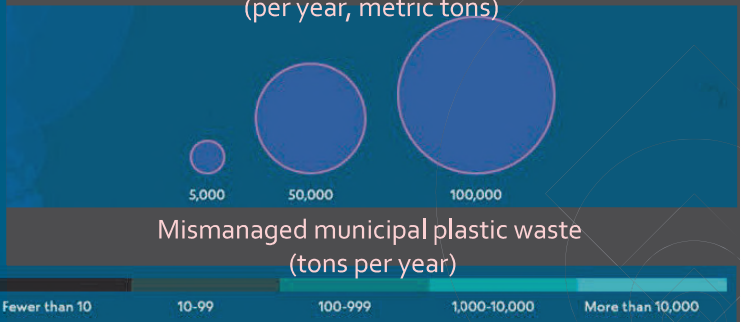
ASIA AS A SOURCE... AND A DESTINATION

Increasing plastic waste imports in Asean countries

© Greenpeace



Mid-range plastic waste entering the ocean from rivers (per year, metric tons)





IMPACT ON MARINE ECOSYSTEMS

Marine debris impact:

Habitat



Biodiversity

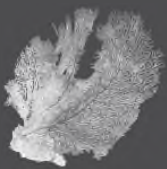


Food web



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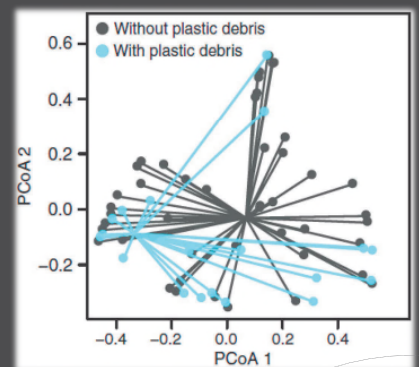
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IMPACT ON MARINE ECOSYSTEMS

Damage of coral reefs

- ◊ **Mechanic destruction of reefs: 11.1 billion plastic items entangled on coral reefs across Asia-Pacific**
- ◊ **Reef-building corals with plastic debris have different disease assemblages than corals without plastic debris**
- ◊ **Plastic waste influences disease susceptibility of reef-building corals**



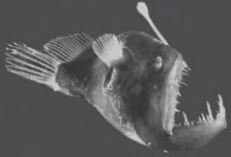
Lamb *et al.* 2018



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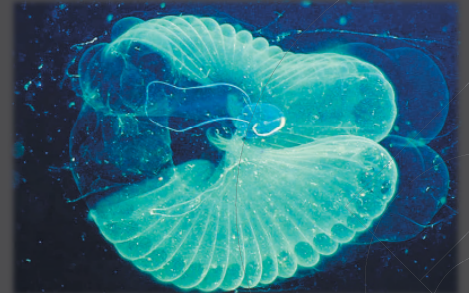




IMPACT ON MARINE ECOSYSTEMS

Pollution of the unseen and unknown

- ◊ Marine debris sediment in deep seafloor
- ◊ Filter feeder larvaceans introduce the particles into food webs from near-surface waters to the deep seafloor
- ◊ As deep sea ecosystems are poorly known, precise impact remains inestimable...



© Monterey Bay Aquarium Research Institute

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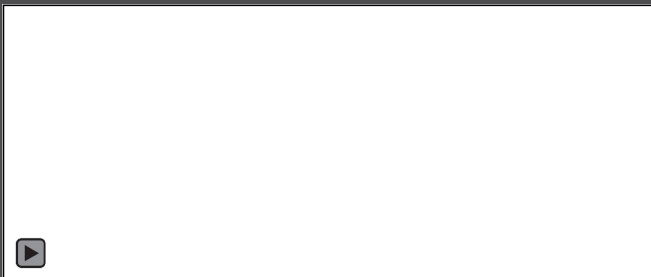


IMPACT ON MARINE ECOSYSTEMS

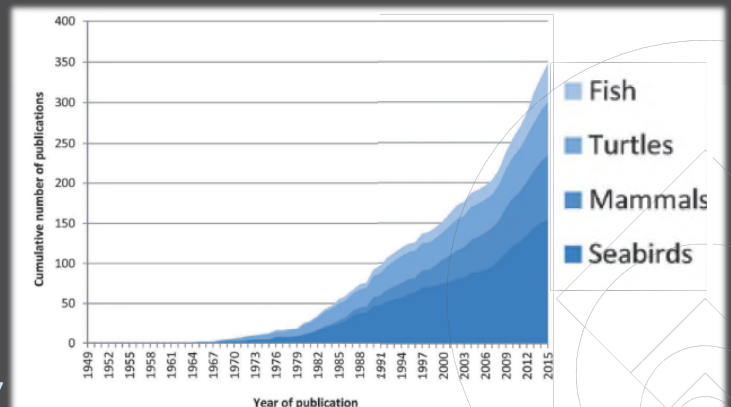
Ghost killings

- ◊ Entanglement, suffocation, congestion, false satiety
- ◊ Lethal ingestion of macro and microplastics by megafauna

© National Geographic



Provencher *et al.* 2017



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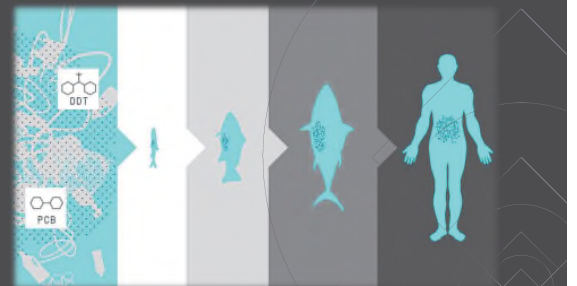
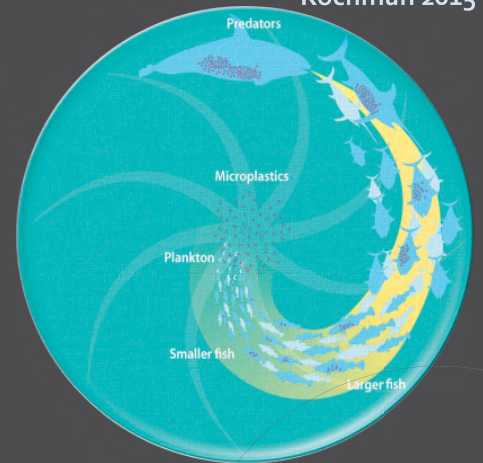




IMPACT ON MARINE ECOSYSTEMS

Bioaccumulation of ingested microplastics along food chains

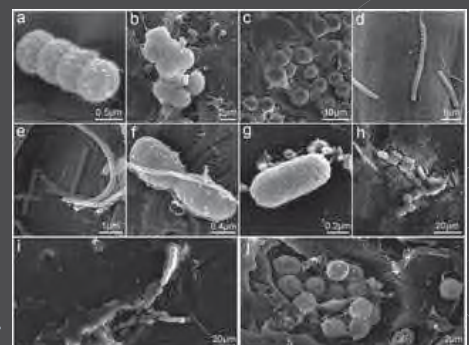
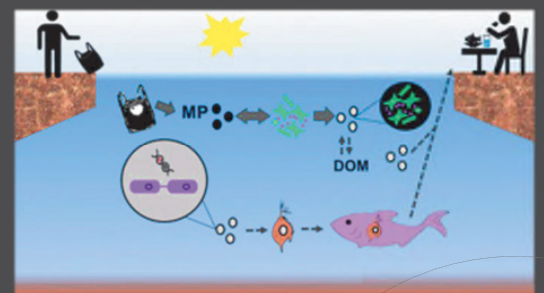
- ◊ Nanoscale fractioning due to UV degradation
- ◊ Translocation into flesh of marine animals
- ◊ Same size + intrinsic toxicity + adsorption of toxic agents (radioactive, pigments...) = Poison pills
- ◊ Eco-toxicity transferred along trophic chains
- ◊ Boomerang effect: back to the polluters



IMPACT ON MARINE ECOSYSTEMS

Plastic hitch-hikers

- ◊ Bacteriological risks: A new niche for the incubation and dispersion of pathogen microorganisms (*Vibrio*, *Arcobacter*, *Ostreopsis*, *Coolia*)
- ◊ Transportation of invasive agents over long distances



Reisser et al. 2014



AFD-PURISKEL-IRD PROJECT (2020-21)

Modeling and monitoring of marine debris in Indonesia

- ◊ Establish a "pilot project" at the Indonesian level to set up a marine debris monitoring system
- ◊ Generate knowledge about impact of marine debris
- ◊ Provide recommendations for the marine debris collection program
- ◊ Implement communication actions
- ◊ Share better understanding on marine debris spreading and its impacts specifically in Indonesia as well as towards global impact



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AFD-PURISKEL-IRD PROJECT (2020-21)



World Bank

1. Ocean modeling requirements
2. Marine Debris data monitoring & services
3. Drift modeling studies and recommendations
4. Marine debris tagging
5. Ocean modelling web portal and analysis in the consultant firm premises

OUTPUT

FEEDING GLOBAL AND INDONESIAN OCEANOGRAPHIC DATABASE

Ocean Modelling and Drifting analysis

OCEANOGRAPHIC DATA ENHANCEMENT IN TERMS OF SPATIAL RESOLUTION AND DEEP ANALYSIS

AFD - France

1. Regional and coastal High-Resolution modeling
2. Global and High-level figures hotspot creation and dispersion modeling
3. Reverse engineering drift study and modeling
4. Marine debris tagging and mammals tagging
5. Ocean modelling web portal and analysis in the MMAF premises

Multiplier value

Vessels

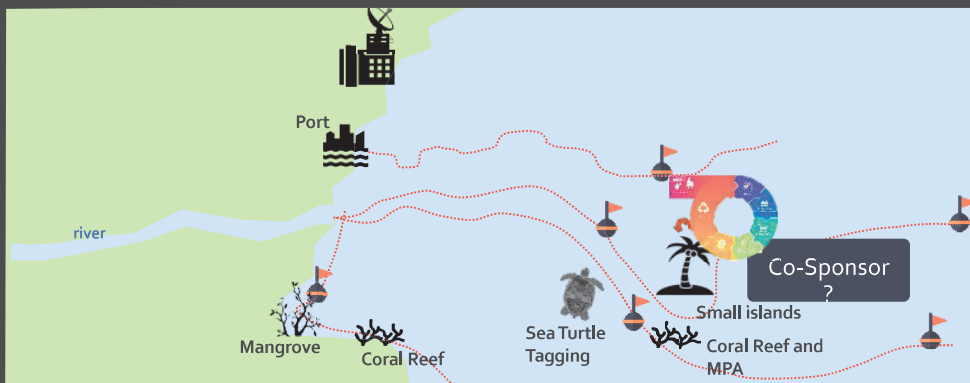


Oil spill

Oil Platform



Oil spill





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Asia-Pacific
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THANK YOU FOR YOUR KIND ATTENTION!

