



EPA
VICTORIA

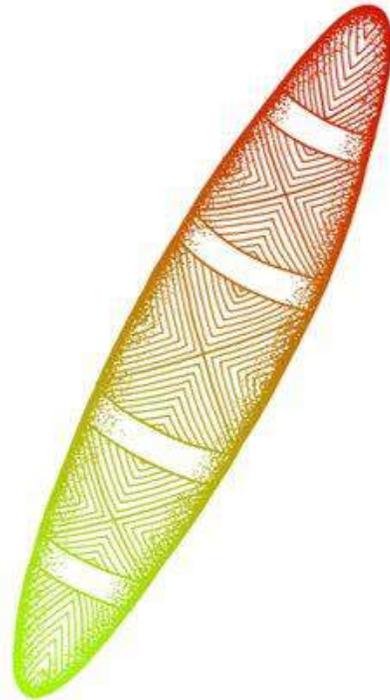


Environmental Science Series

Microplastics: Knowledge, measures and solutions

20 October 2021

Welcome



EPA's aboriginal inclusion symbol, the Gayaam Wilam "shield", signifying protection.

The image was commissioned by EPA in 2017 from Wurundjeri artist, Mandy Nicholson.

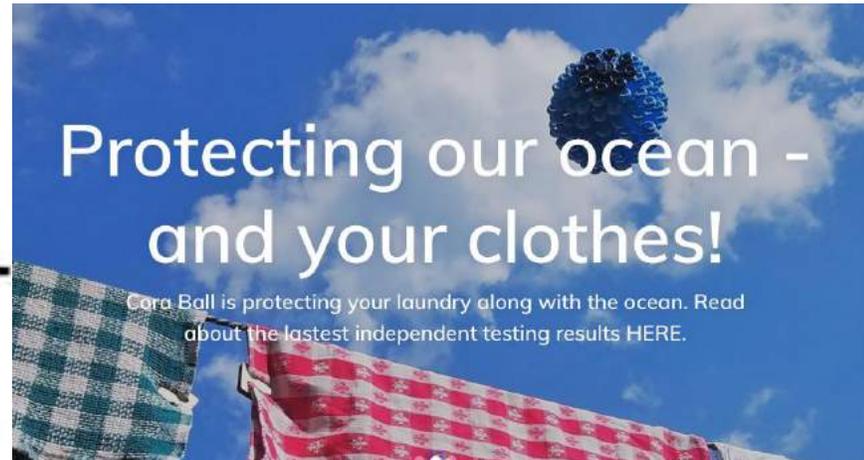


Microplastics

Dr Mark Browne

Senior Lecturer, University of New South Wales
20 October 2021

Sources, fate and impacts of textile fibres to the ecosystem and methods to mitigate these problems



Mark Anthony Browne

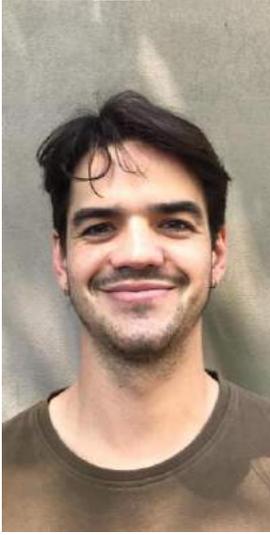
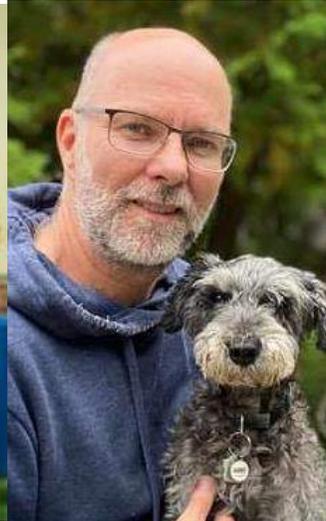


UNSW
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COLLABORATORS



PARTNERS



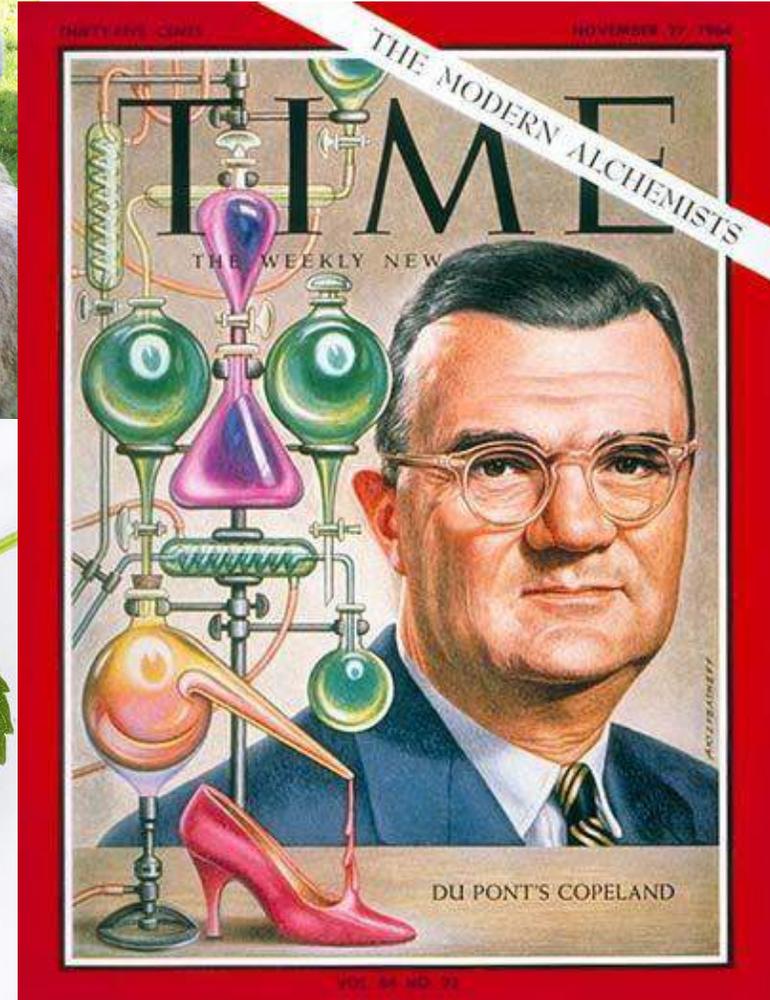
Australian Government
Australian Research Council



**EILEEN
FISHER**



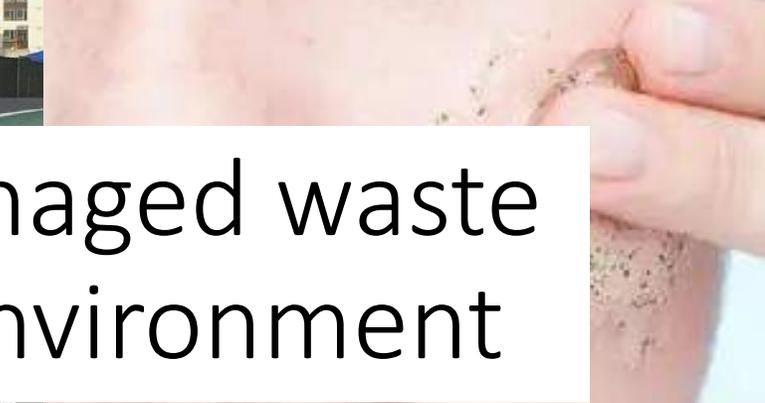
HUMANS ENGINEER PRODUCTS FROM POLYMERS



Vegetable

Animal

Petrochemical



Poorly designed products and managed waste allow polymers to contaminate environment





poles equator

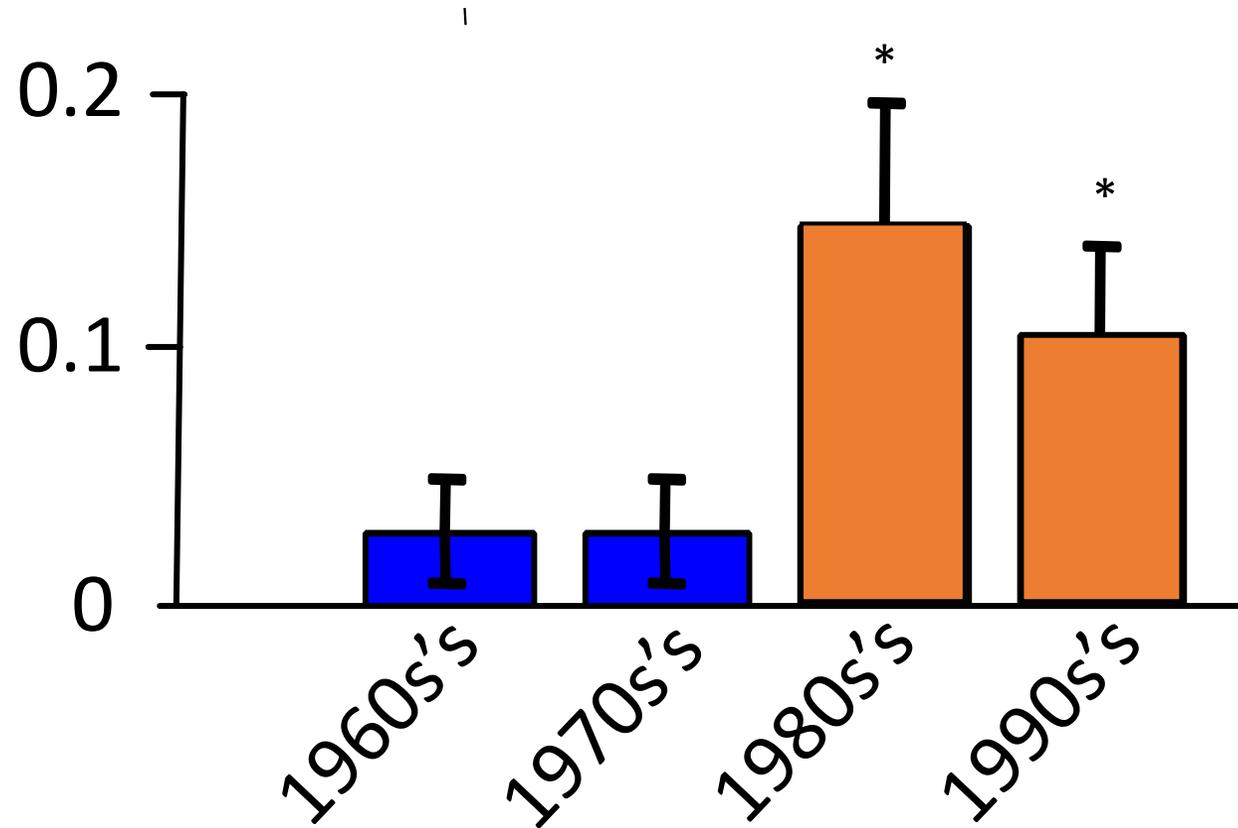


mountain

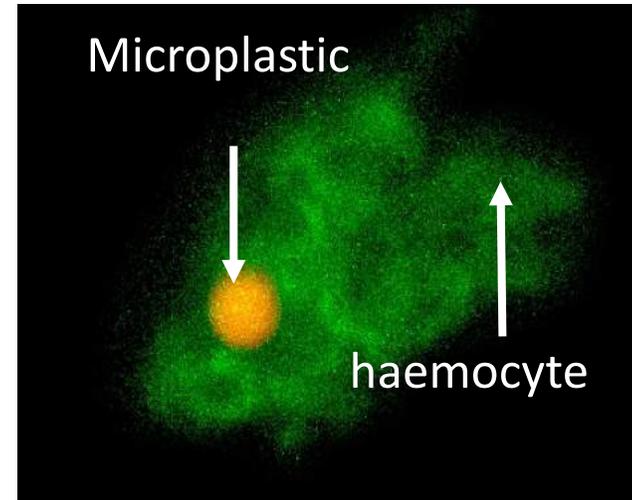
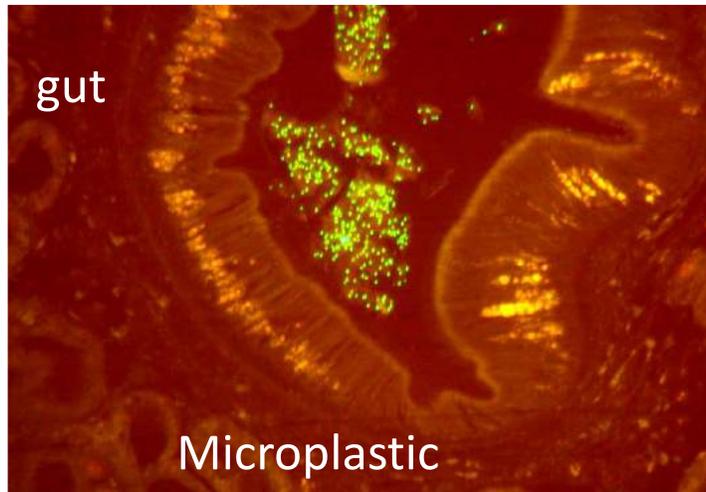
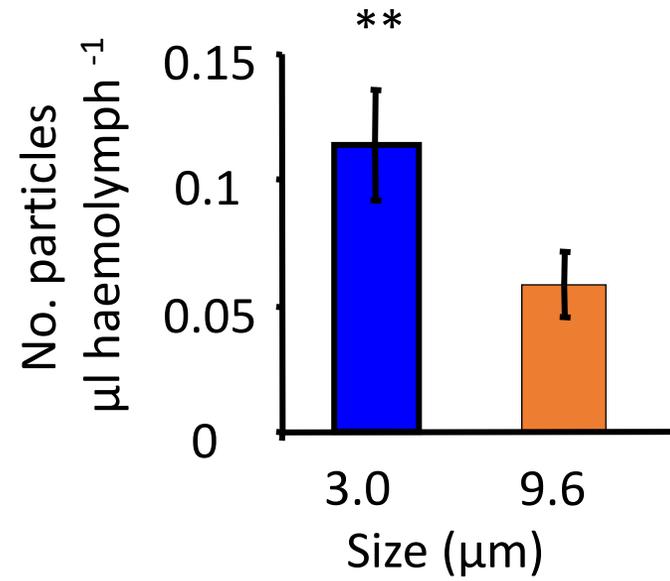


oceanic depths

450% INCREASE IN OCEANIC MICROPLASTIC



MICROPLASTIC CAN BIOACCUMULATE



MICROPLASTIC AS A CHEMICAL VECTOR

Priority pollutants

- 78% US
- 61% EU

Plastics sorb pollutants at concentrations:

- 100 times: sediments
- 1 million times: water



Nonylphenol



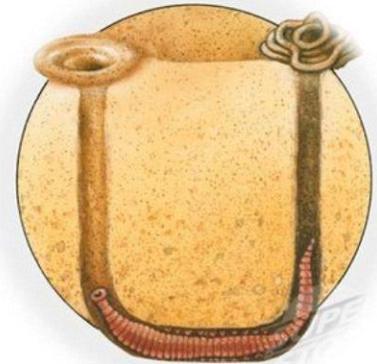
Phenanthrene



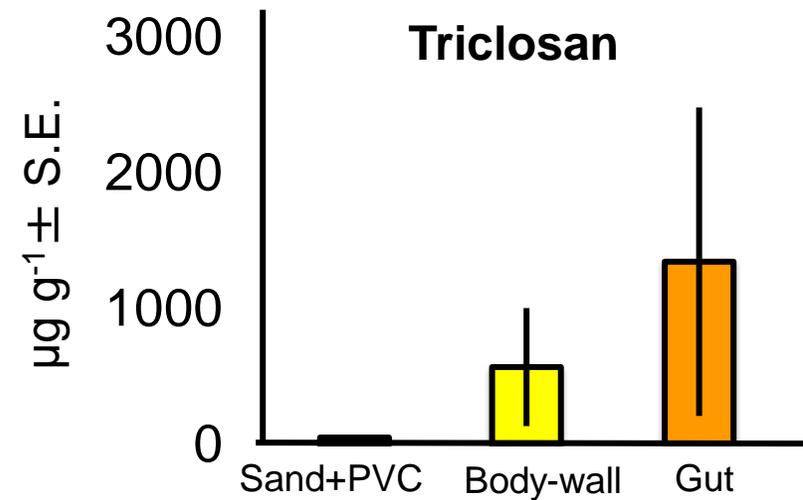
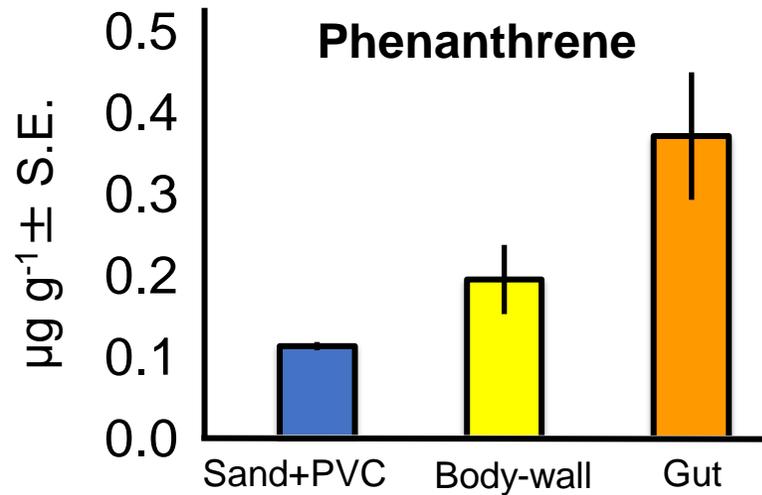
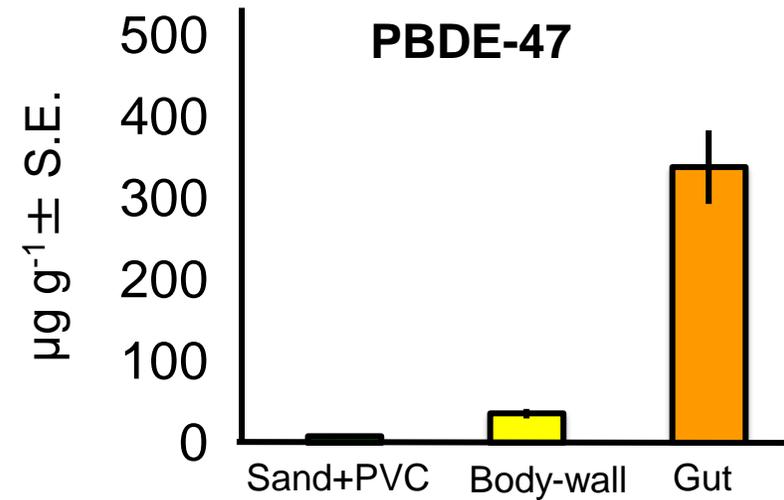
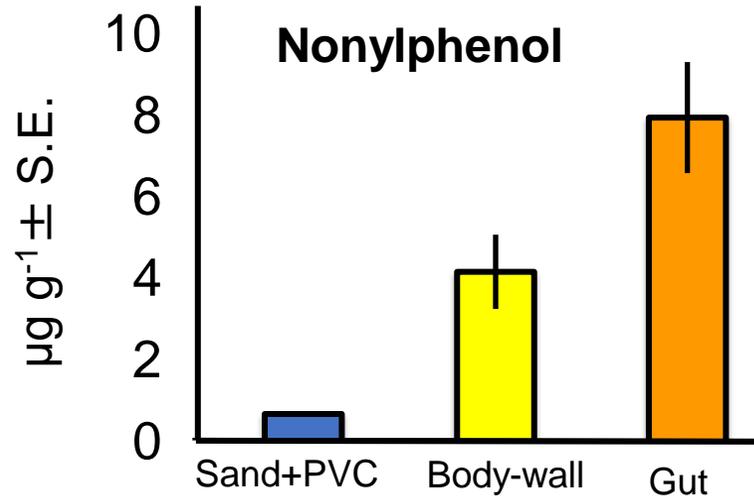
PBDE-47



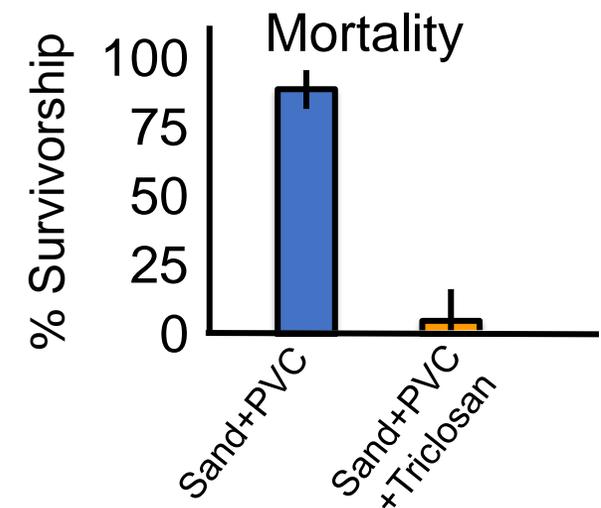
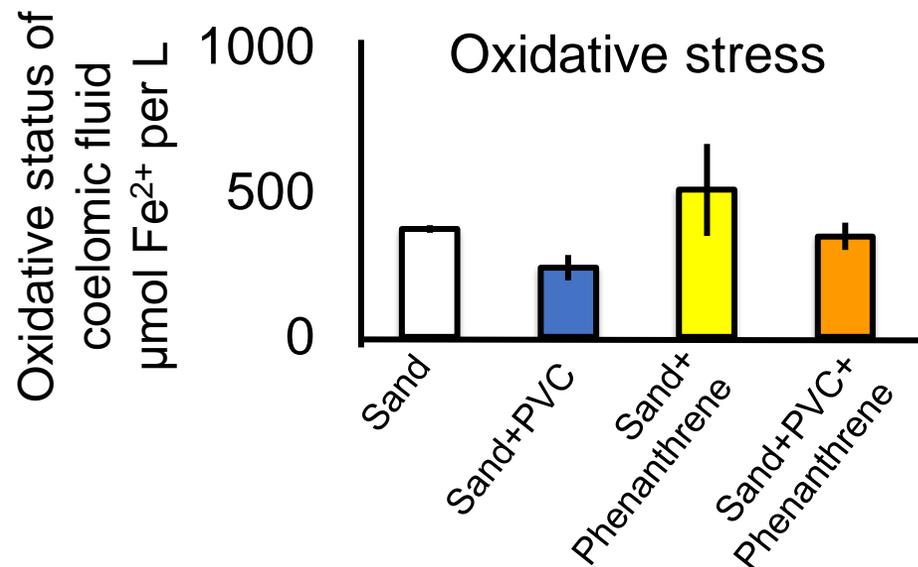
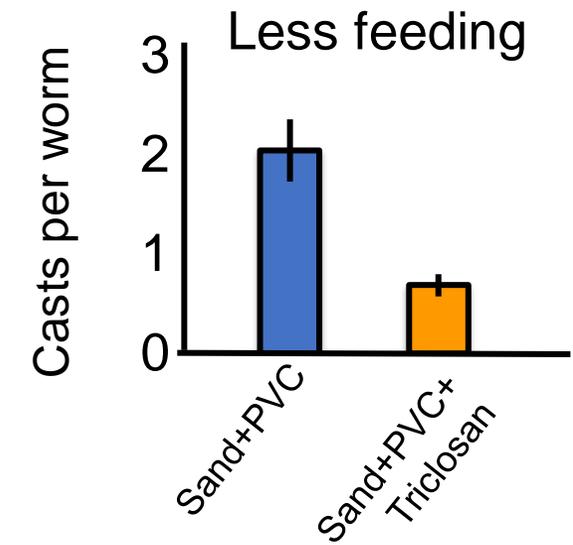
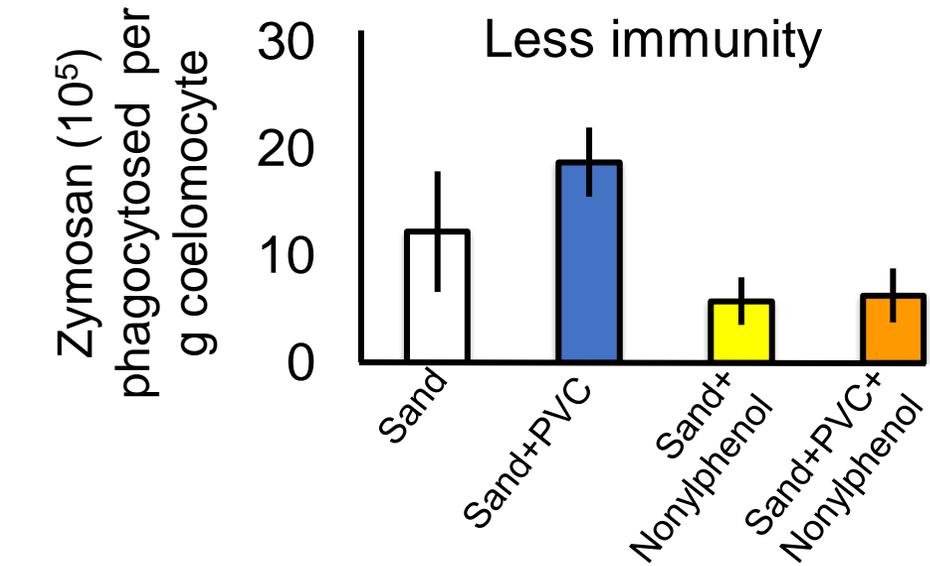
Triclosan



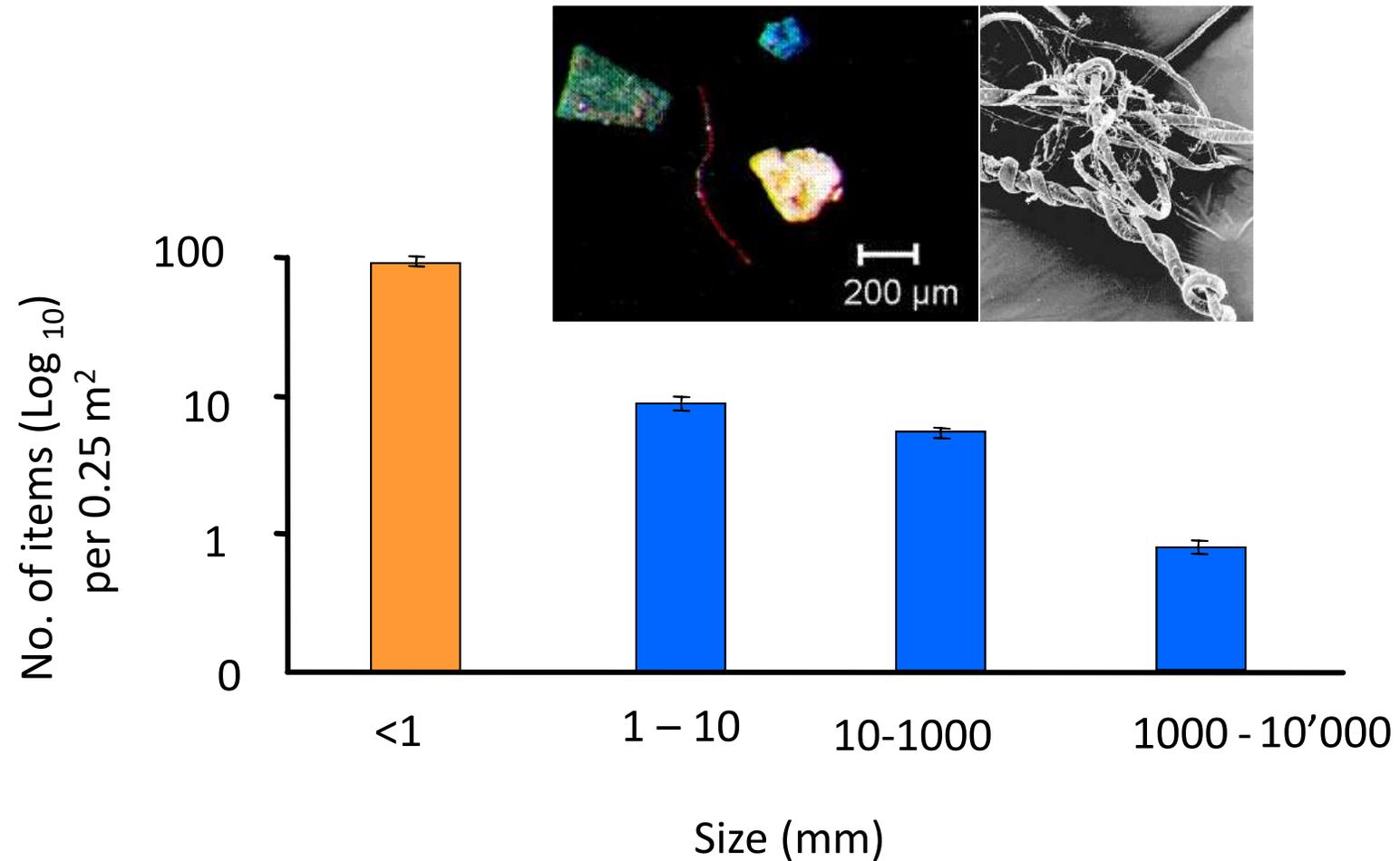
INGESTING MICROPLASTIC CAN MOVE CHEMICALS INTO TISSUES



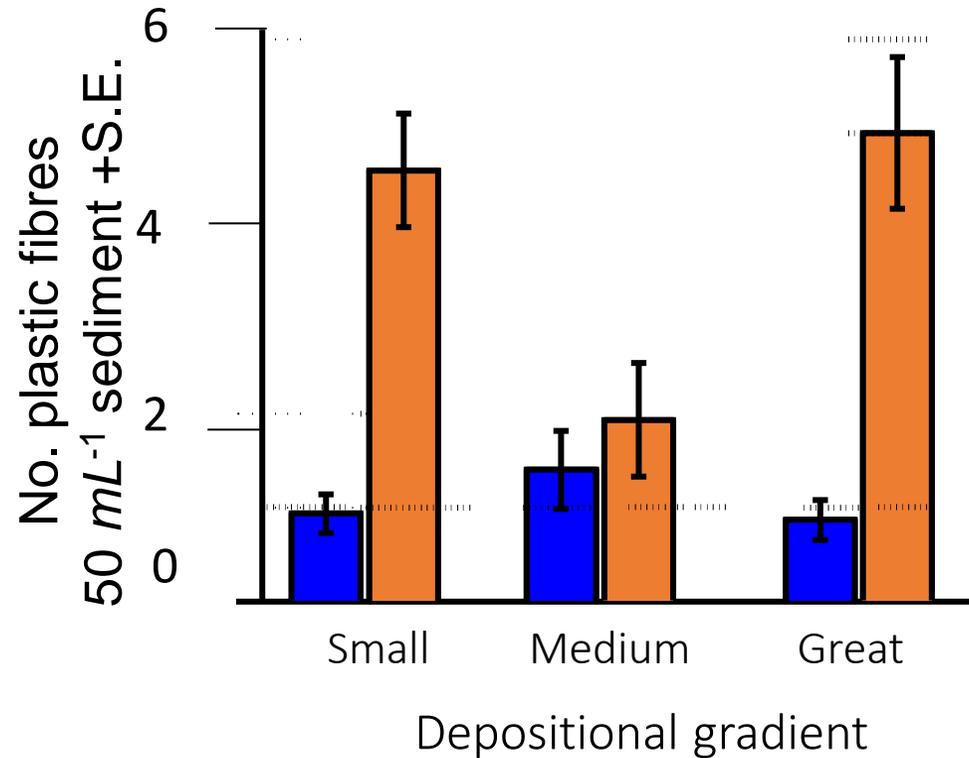
MICROPLASTIC AND/OR SORBED CHEMICALS CAUSE BIOLOGICAL IMPACTS



OVER 65% PLASTIC IS COMPOSED OF MICROPLASTIC, MOSTLY FIBRES



>500% MORE PLASTIC FIBRES: DOWN-WIND HABITATS



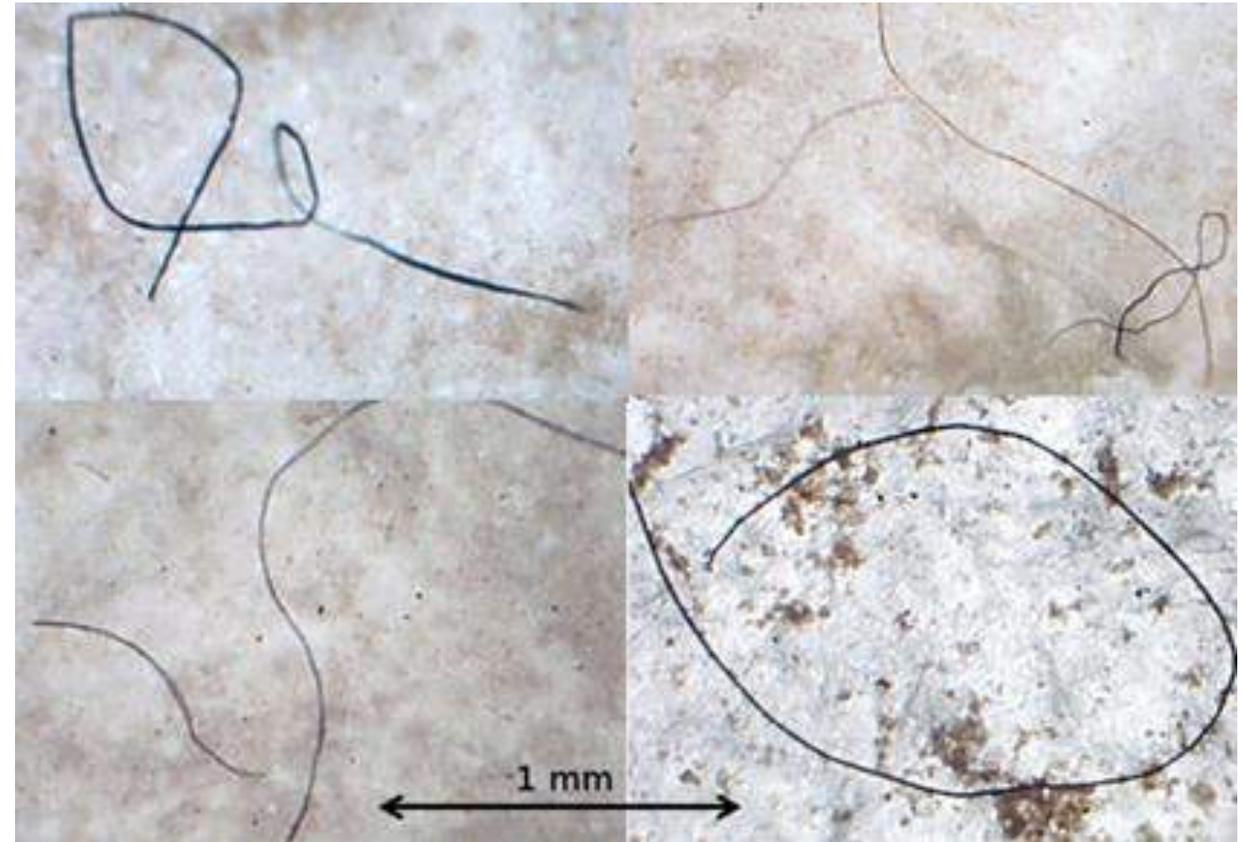
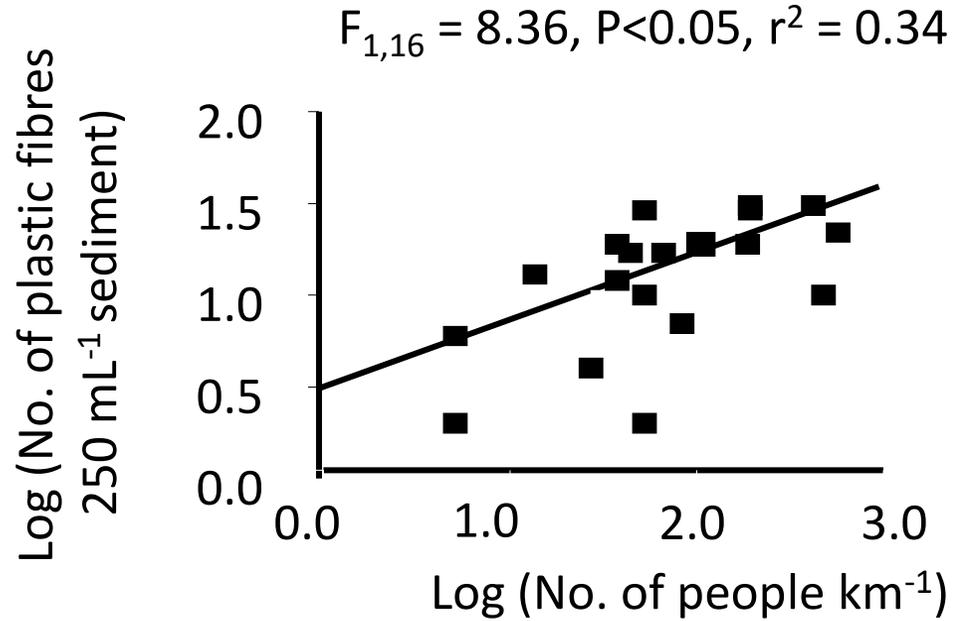
PLASTIC FIBRES CAN CAUSE LETHAL AND SUB-LETHAL BIOLOGICAL IMPACTS TO TERRESTRIAL AND AQUATIC FAUNA



Browne, Charlesworth et al. (in prep.)

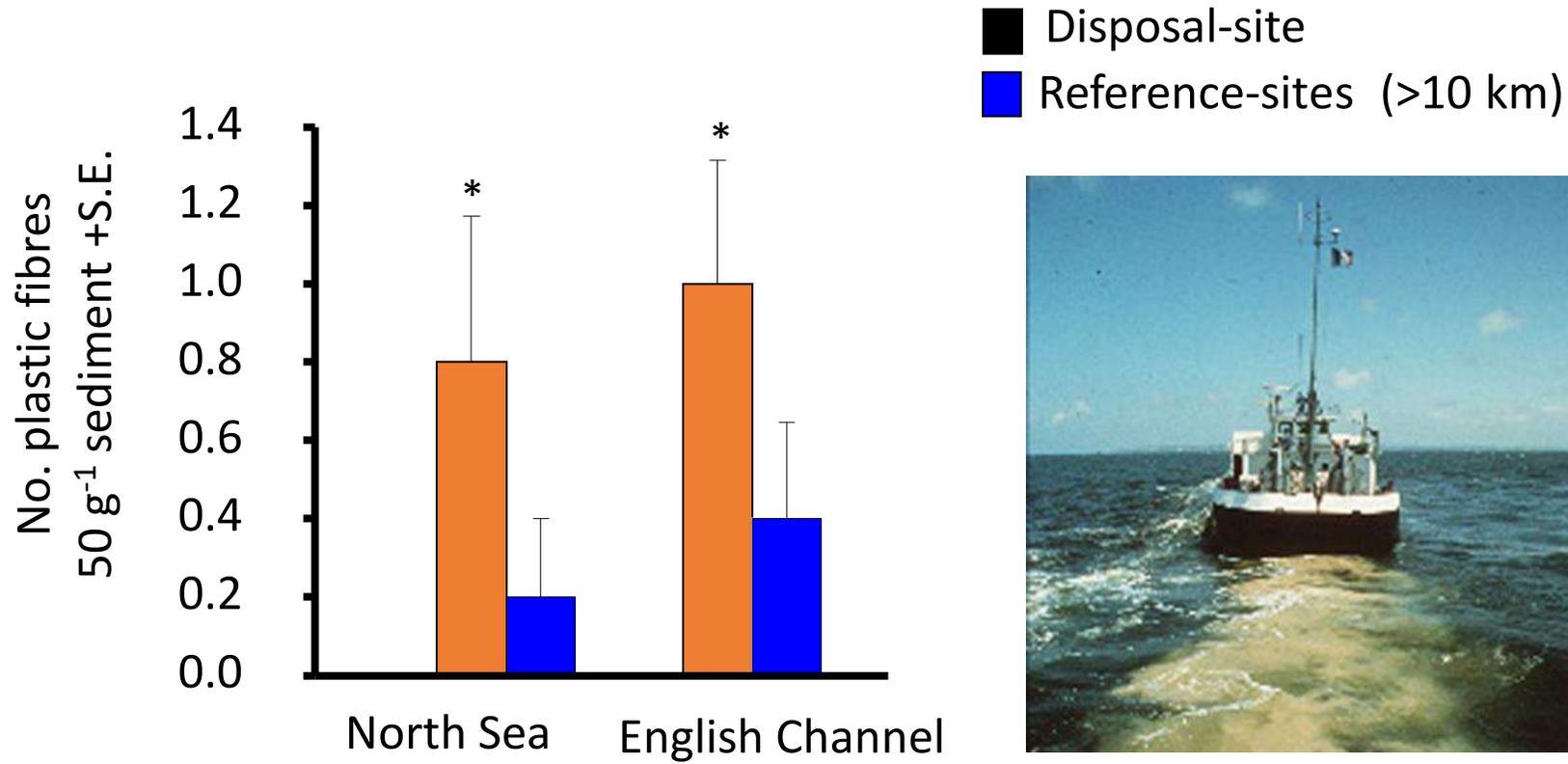


MORE PLASTIC FIBRES WHERE THERE ARE MORE PEOPLE



MOSTLY POLYESTER, ACRYLIC & NYLON FIBRES

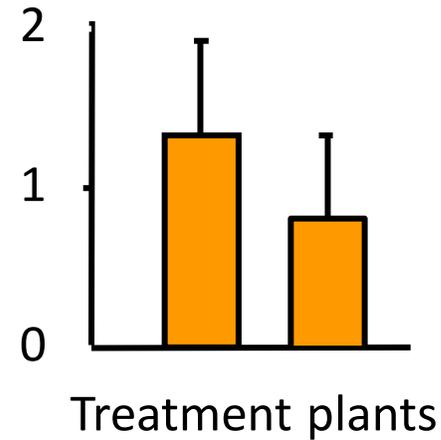
MARINE HABITATS THAT RECEIVE SEWAGE SLUDGE CONTAIN >250% MORE PLASTIC FIBRES



SEWAGE EFFLUENT IS CONTAMINATED WITH PLASTIC FIBRES



No. Plastic fibres
L⁻¹ effluent +S.E.



Australian treatment plants: all fibres

- Polyester (67%)
- Acrylic (17%)
- Nylon (16%)



PROPORTIONS OF POLYMERS MATCH THOSE USED IN CLOTHING

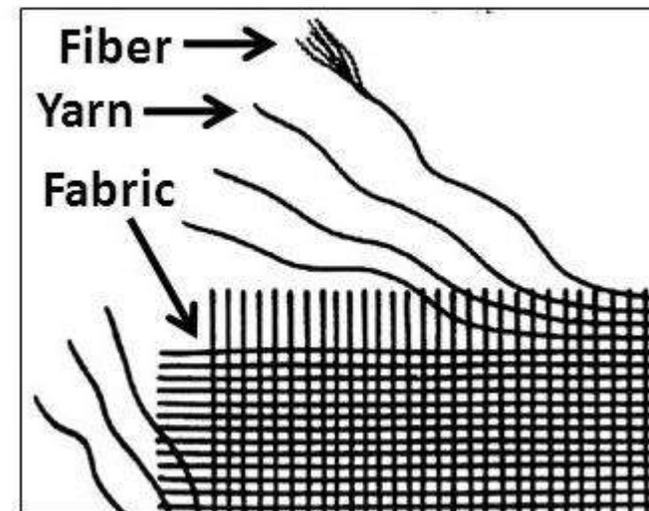
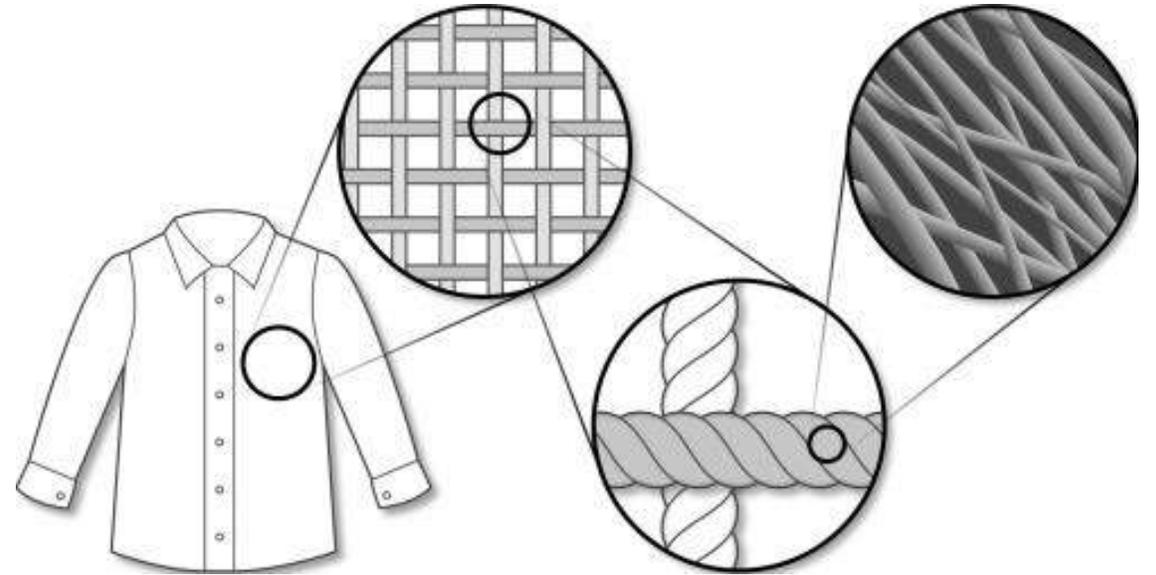


CLOTHES MADE FROM FIBRES, YARNS AND FABRICS

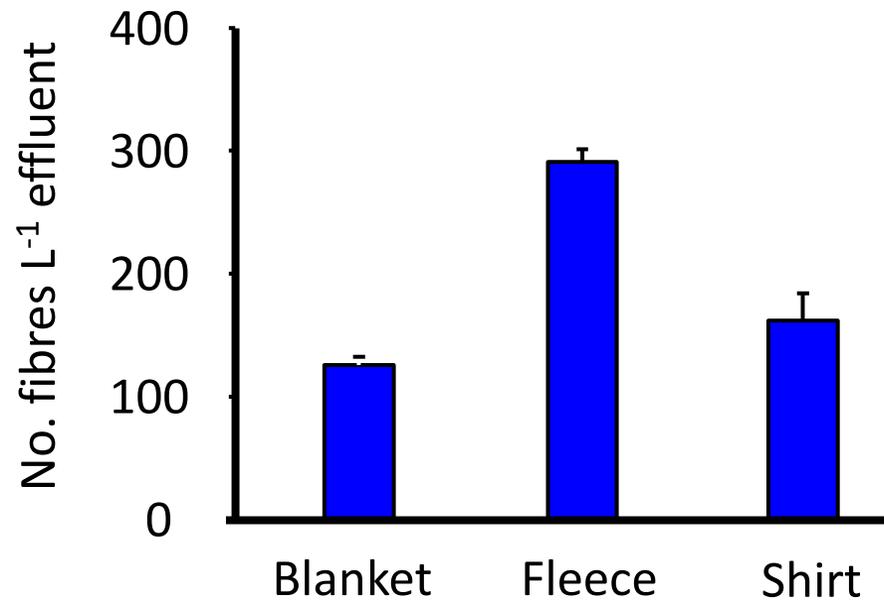
Fibres are are twisted into yarns

Yarns joined to form fabrics

Fabrics stitched together into clothes



COULD FIBRES COME FROM WASHING CLOTHES?



Fleeces: > 180% more

Single garment shed millions of fibres per wash

Problem for circular economy of plastic fibres



UNSW
SYDNEY

**Water
Research
Laboratory**



CAN WE MITIGATE POLLUTION BY CLOTHING FIBRES BY AVOIDING, INTERCEPTING OR RE-ENGINEERING?

LAUNDROMAT TO TEST METHODS OF REDUCING EMISSIONS



FILTERS MARKETED WITHOUT SCIENTIFIC EVIDENCE OF EFFICACY DESPITE LEGAL REQUIREMENTS

INHABITAT NEWS DESIGN LIFESTYLE ENVIRONMENT SUBSCRIBE

How To · Lifestyle · Sustainable Living

These are the best tips to help you establish an eco-friendly laundry routine

Written by Dawn Hammon on May 13, 2019

GUPPYFRIEND® SHOP FAQ WASHGUIDE STOPI BLOG ABOUT US

Guppyfriend Washing Bag

The first pragmatic solution to prevent microplastic pollution from washing synthetic clothes

GET YOURS

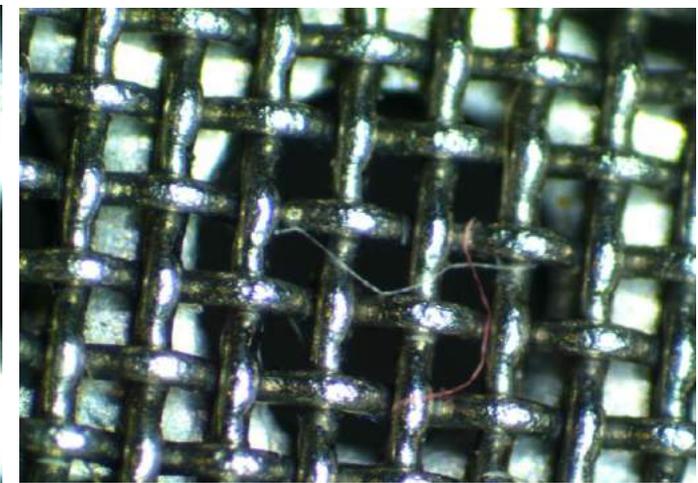
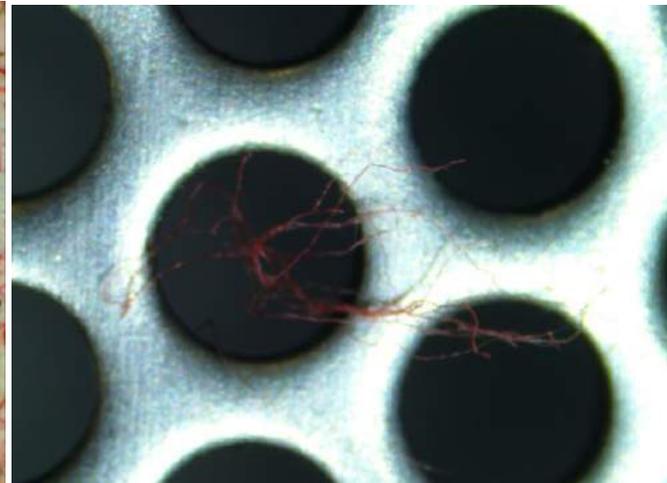
The Cora Ball

Protect the ocean and your clothes with this easy-to-use laundry ball that prevents and catches microfibers shedding off our clothes in the washer.

Protecting our ocean - and your clothes!

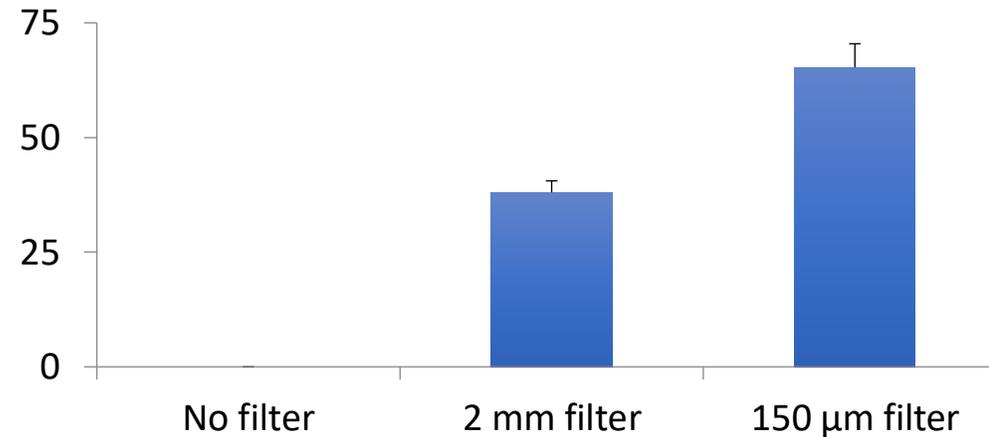
Cora Ball is protecting your laundry along with the ocean. Read about the latest independent testing results [HERE](#).

INTERCEPTION: TESTING AND RE-ENGINEERING FILTERS FOR WASHING MACHINES

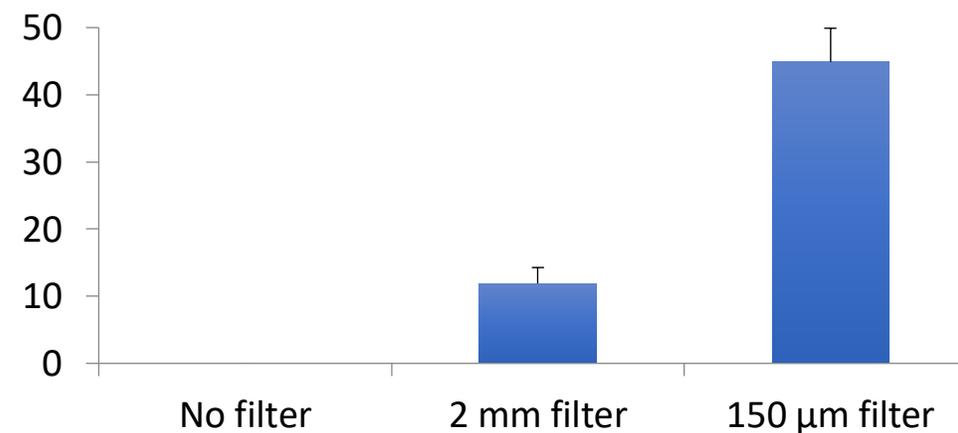


FILTERS REDUCE EMISSIONS OF CLOTHING FIBRES TO SEWAGE BUT EFFICIENCY VARIES WITH PORE-SIZE AND POLYMER

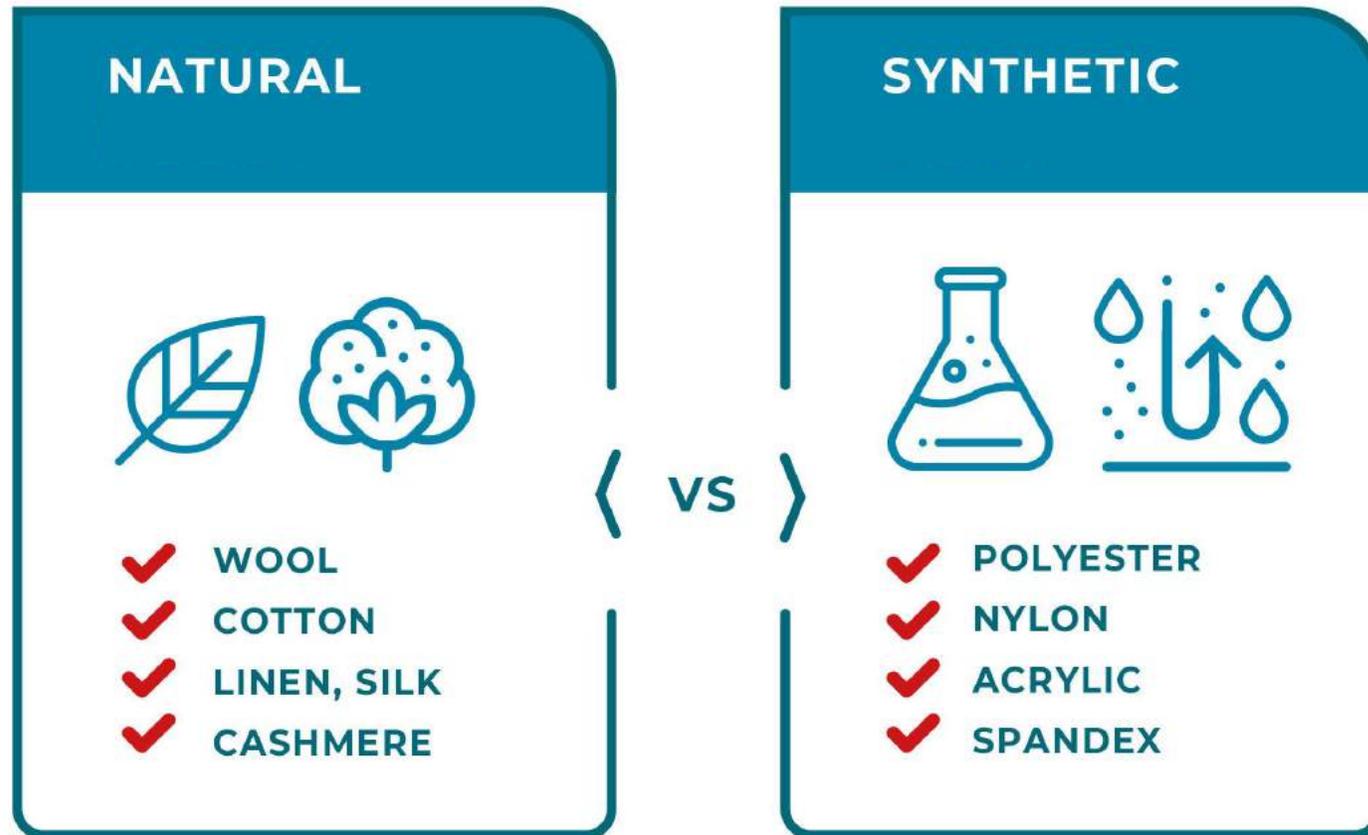
Reduction of cotton fibres emitted to sewage (%)



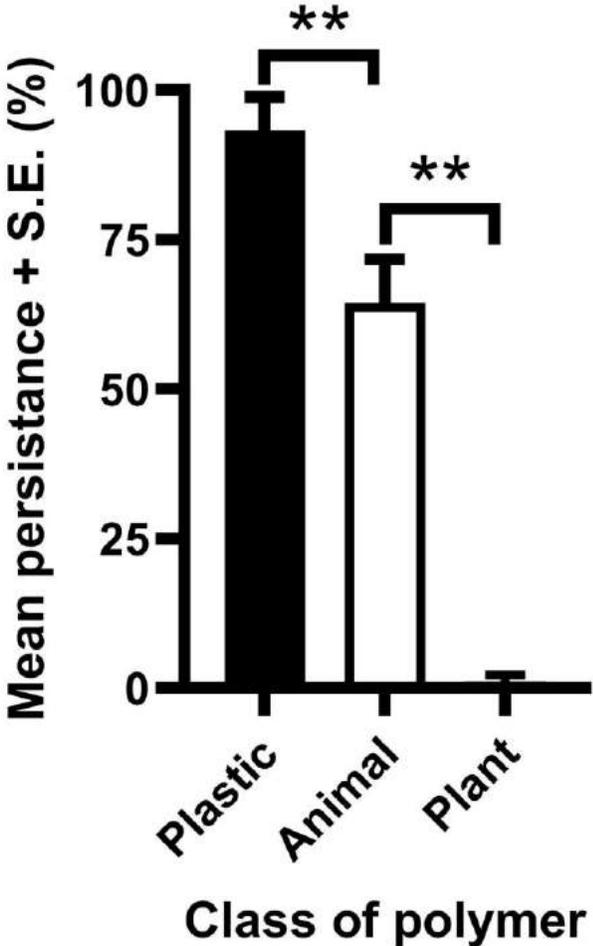
Reduction of polyester debris emitted to sewage (%)



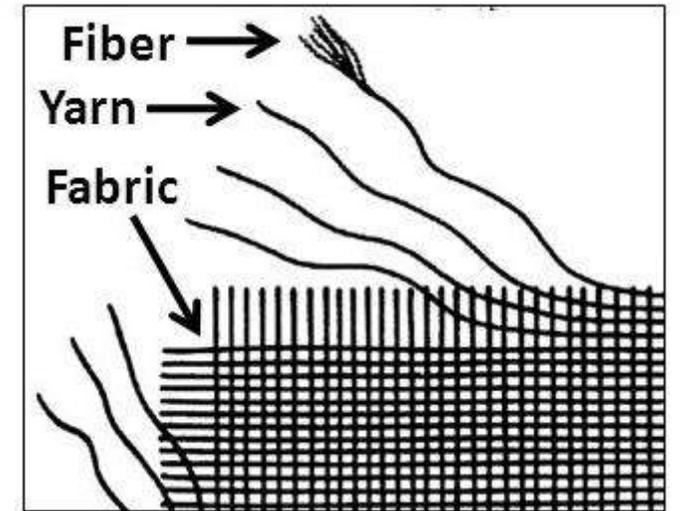
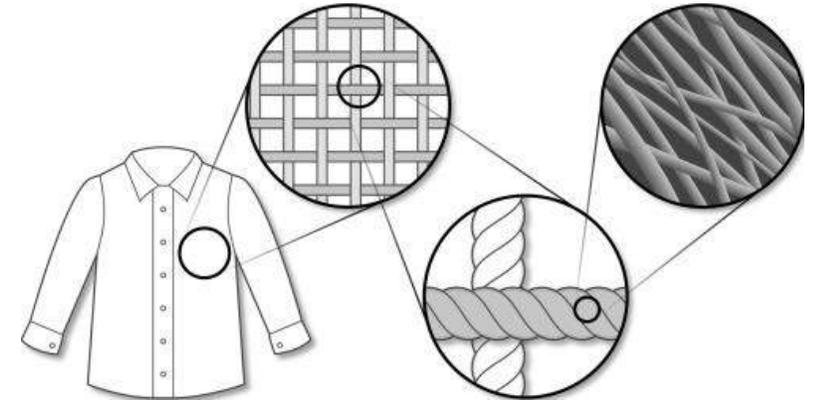
AVOID: NATURAL, PLASTIC & RECYCLED FIBRES?

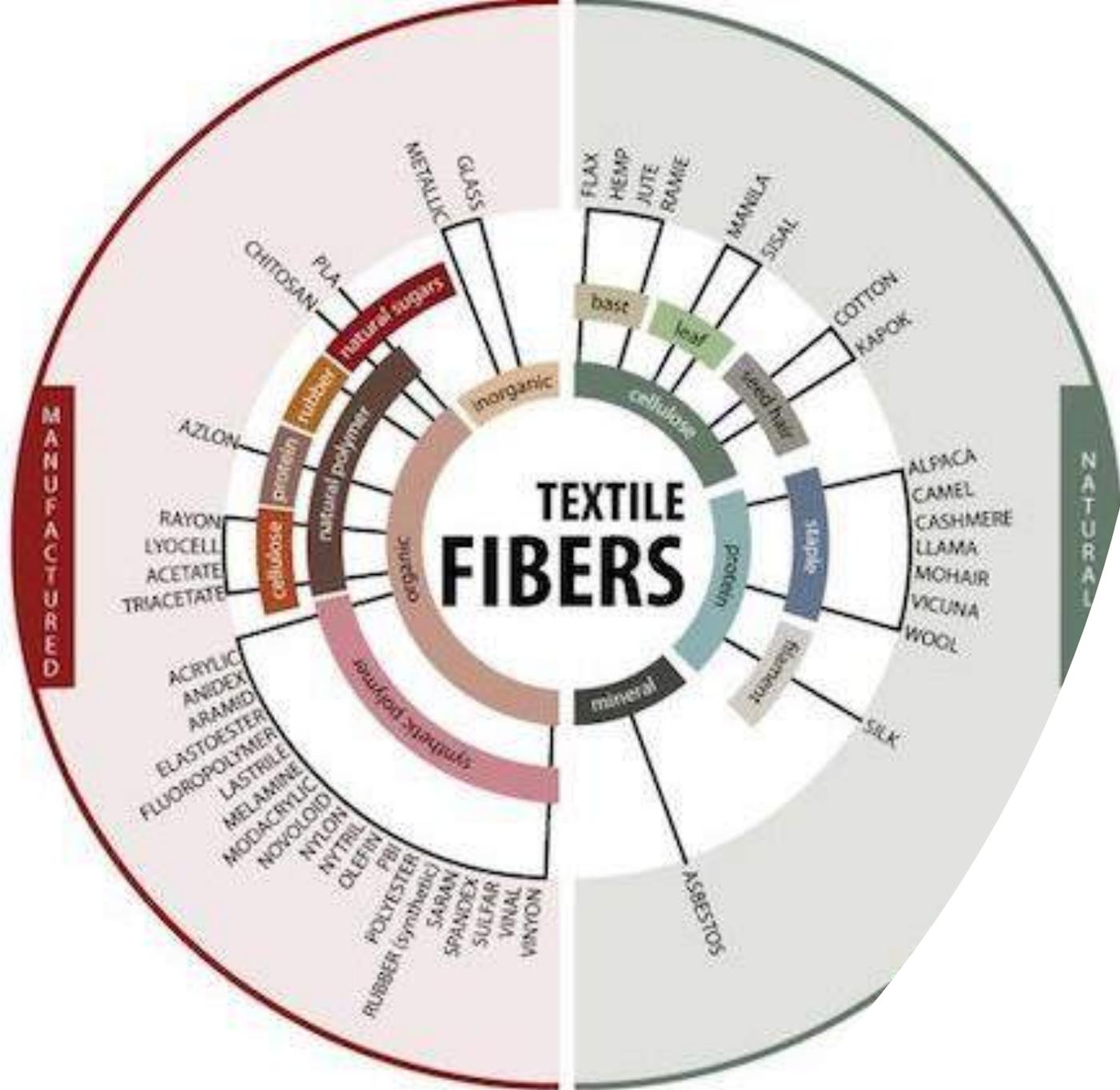


PLASTIC FIBRES PERSIST LONGER THAN ANIMAL AND PLANT FIBRES IN MARINE HABITATS



RE-ENGINEERING GARMENTS

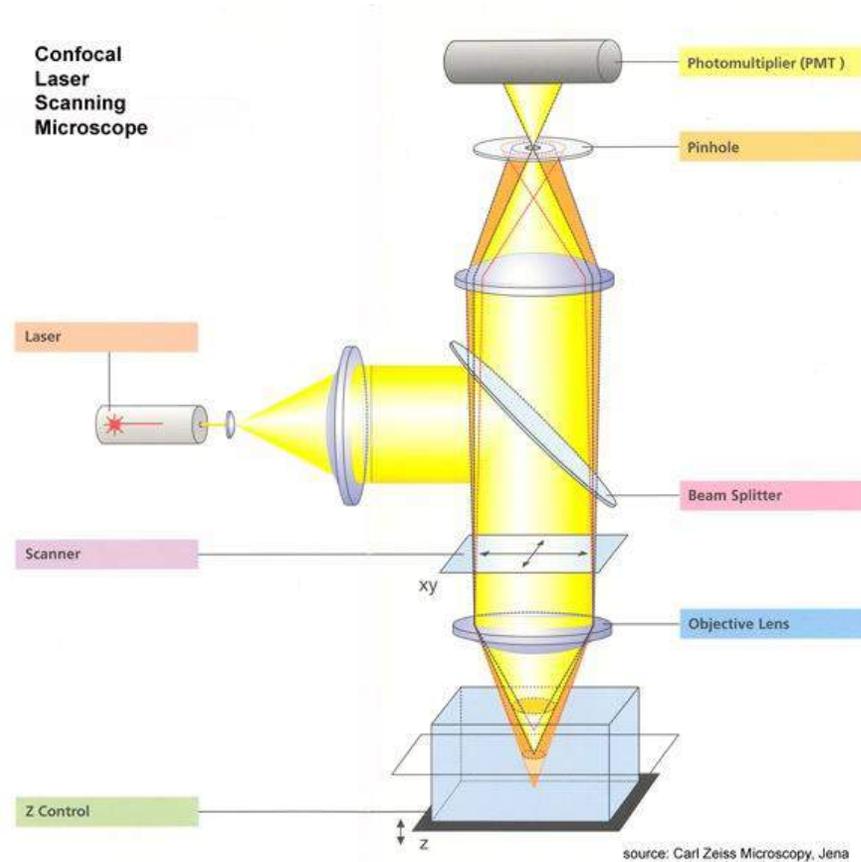
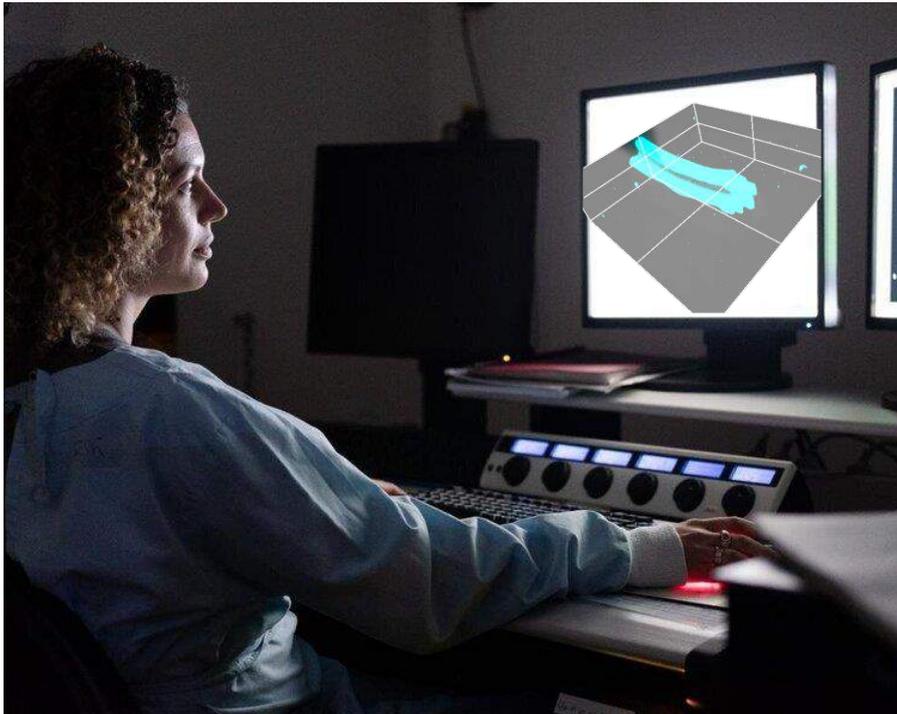




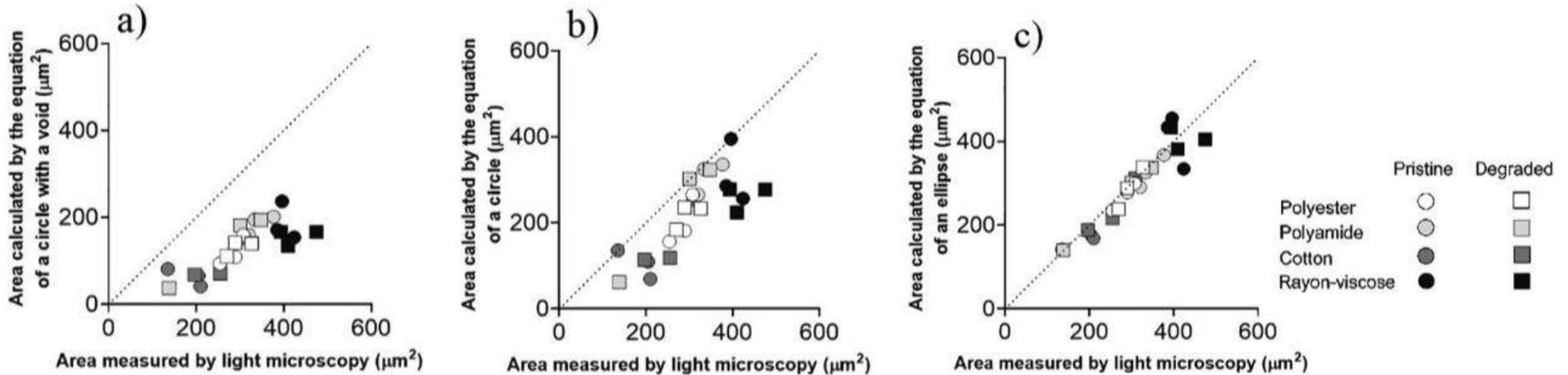
NEW NEWTHODS FOR QUANTIFYING NATURAL AND PLASTIC FIBRES

* Generic classification based on chemical composition

NOVEL CONFOCAL METHOD TO QUANTIFY FIBRES



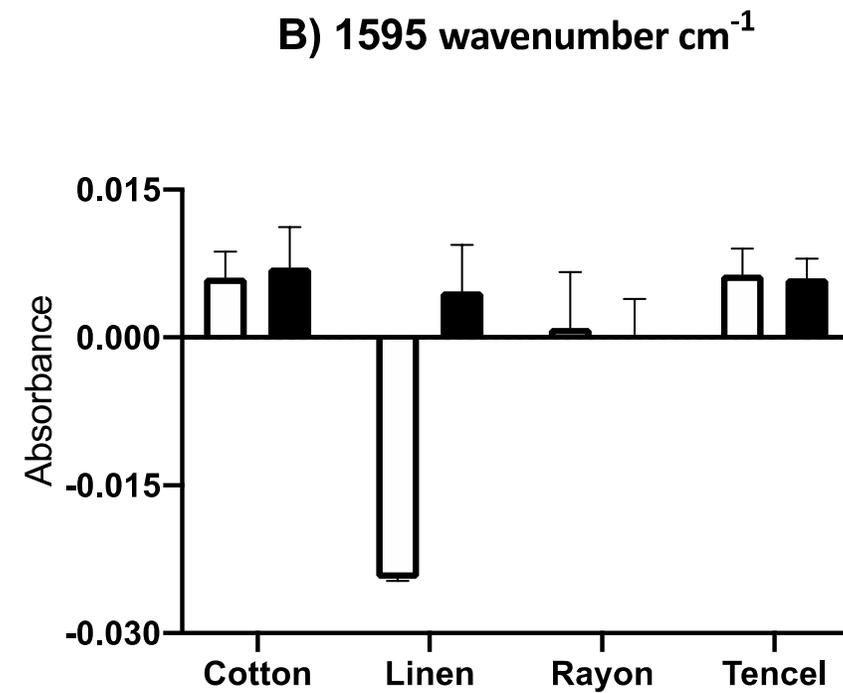
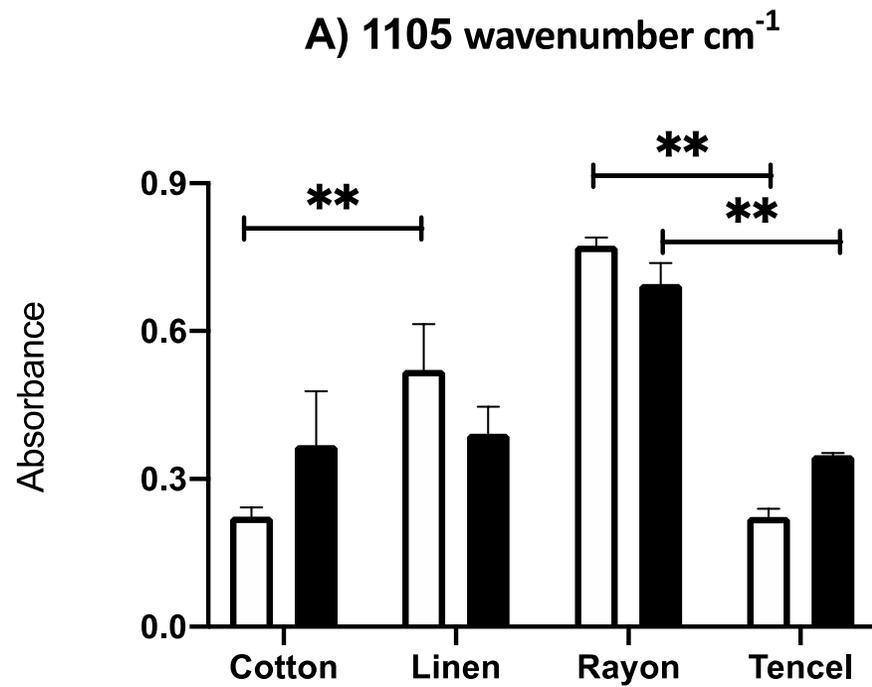
NEW ELLIPSOIDAL METHODS TO ESTIMATE MASS OF FIBRES

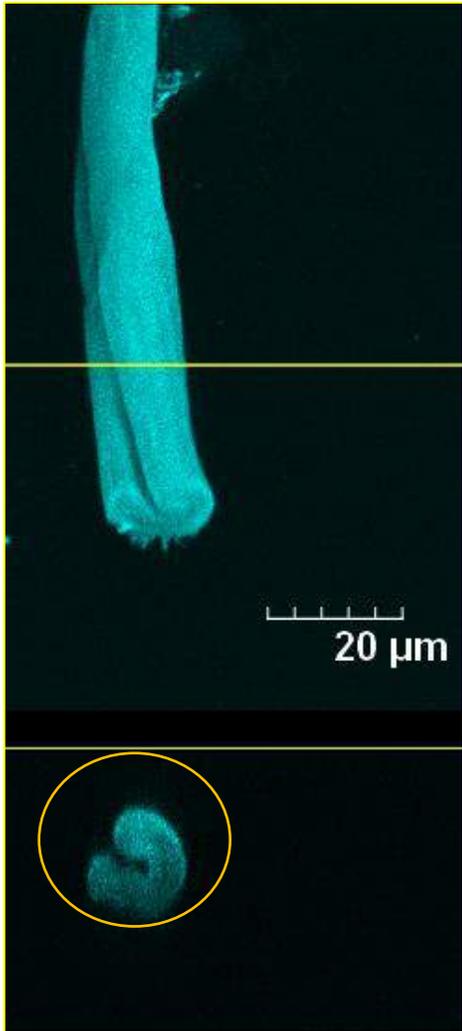


Circle + void ($P < 0.001^{***}$) Solid circle ($P < 0.001^{***}$) Ellipse (ns)

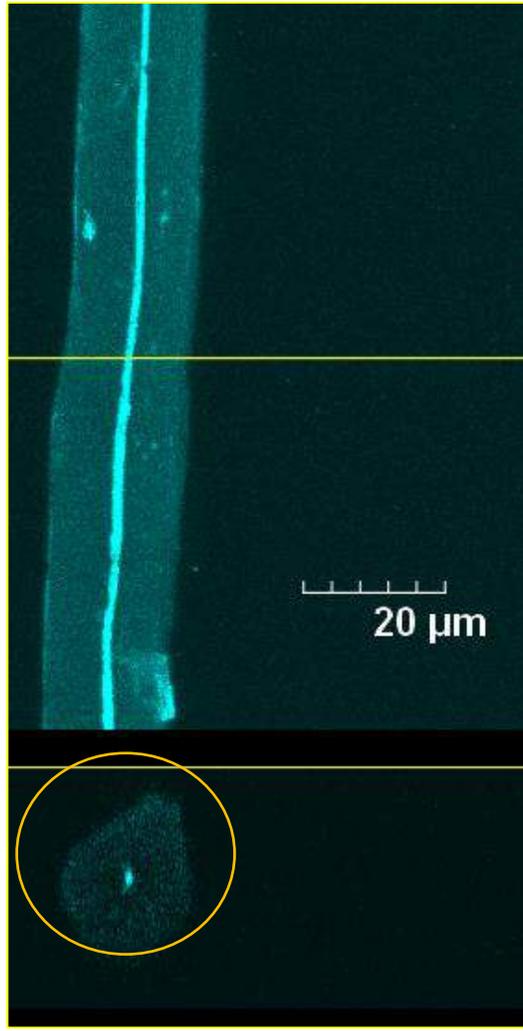
Most authors estimate mass of fibres using circular equation

CURRENT SPECTROSCOPIC METHODS FOR IDENTIFYING CELLULOSE DO NOT WORK

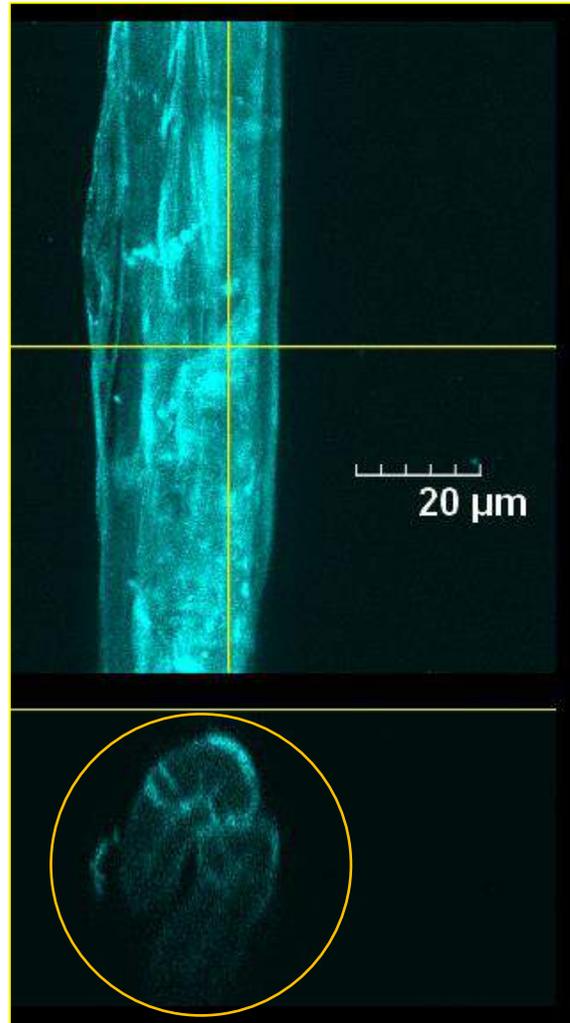




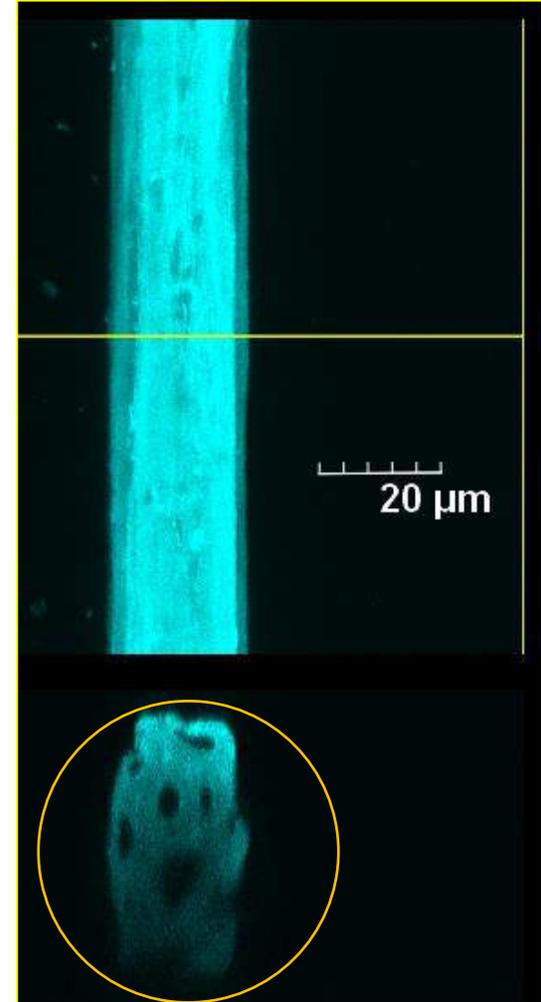
Cotton



Linen



Ramie



Jute

CONCLUSION

- Understanding and managing contamination and pollution by polymers requires linked structured surveys and factorial experiments to determine patterns and processes.
- Most surveys do not provide robust data to allow comparative assessments, examine trends or be sure about the quantities of polymers being encountered.

Analytical
Methods



CRITICAL REVIEW

[View Article Online](#)
[View Journal](#) | [View Issue](#)

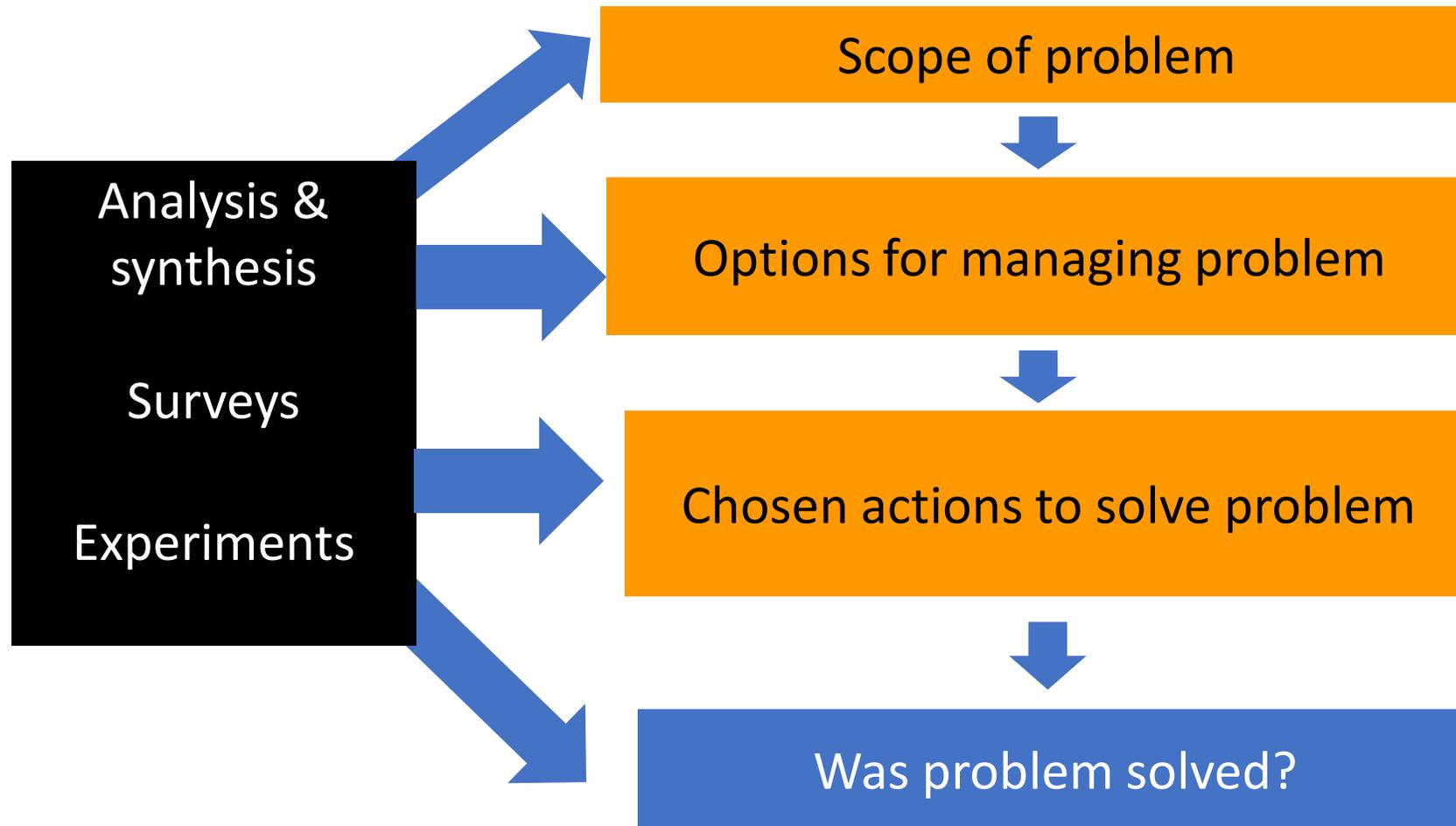


Cite this: *Anal. Methods*, 2017, 9, 1332

Some problems and practicalities in design and interpretation of samples of microplastic waste

A. J. Underwood,^{*a} M. G. Chapman^a and Mark Anthony Browne^b

ROBUST SCIENCE ENABLES PROBLEMS OF POLYMERS TO BE UNDERSTOOD AND MANAGED





Microplastics

Dr Denise Hardesty

Principal Research Scientist, CSIRO Oceans and Atmosphere

20 October 2021





Plastic Waste – Everybody’s business



(Micro) Plastic pollution management, policy and regulation:
Tackling a transboundary problem with multiple approaches

Britta Denise Hardesty | 20 October 2021

Australia’s National Science Agency

The problem

Plastic waste will soon NOT be exported, it is contaminating our lands and seas, and challenging our industries and citizens.

It's everywhere, all the time, increasing.



Governments agree to ban waste exports

Rob Harris

New road projects across the country could be forced to use the recycled plastic from Australian households after the Morrison government clinched a deal with the states to ban waste exports.

Local councils now want the states to mandate the use of recyclables in all infrastructure projects amid a growing regional crisis in the recycling industry after a string of countries refused to accept shipments.

A timeline to ban domestic waste exports, including plastics, paper, glass and tyres, will be put in place following an agreement at yesterday's Council of Australian Governments meeting in Cairns.

Prime Minister Scott Morrison

as part of the hot mix and seals for roads, it would reduce Australia's plastic waste by 52 per cent every year.

"There are a lot of jobs that can be created onshore here in Australia to recycle this material to get it into hot mix, to get into the spray seal, to get it into road base, to create high-value products," he said.

'There are a lot of jobs that can be created to recycle this material.'

David O'Loughlin, Australian Local Government Association

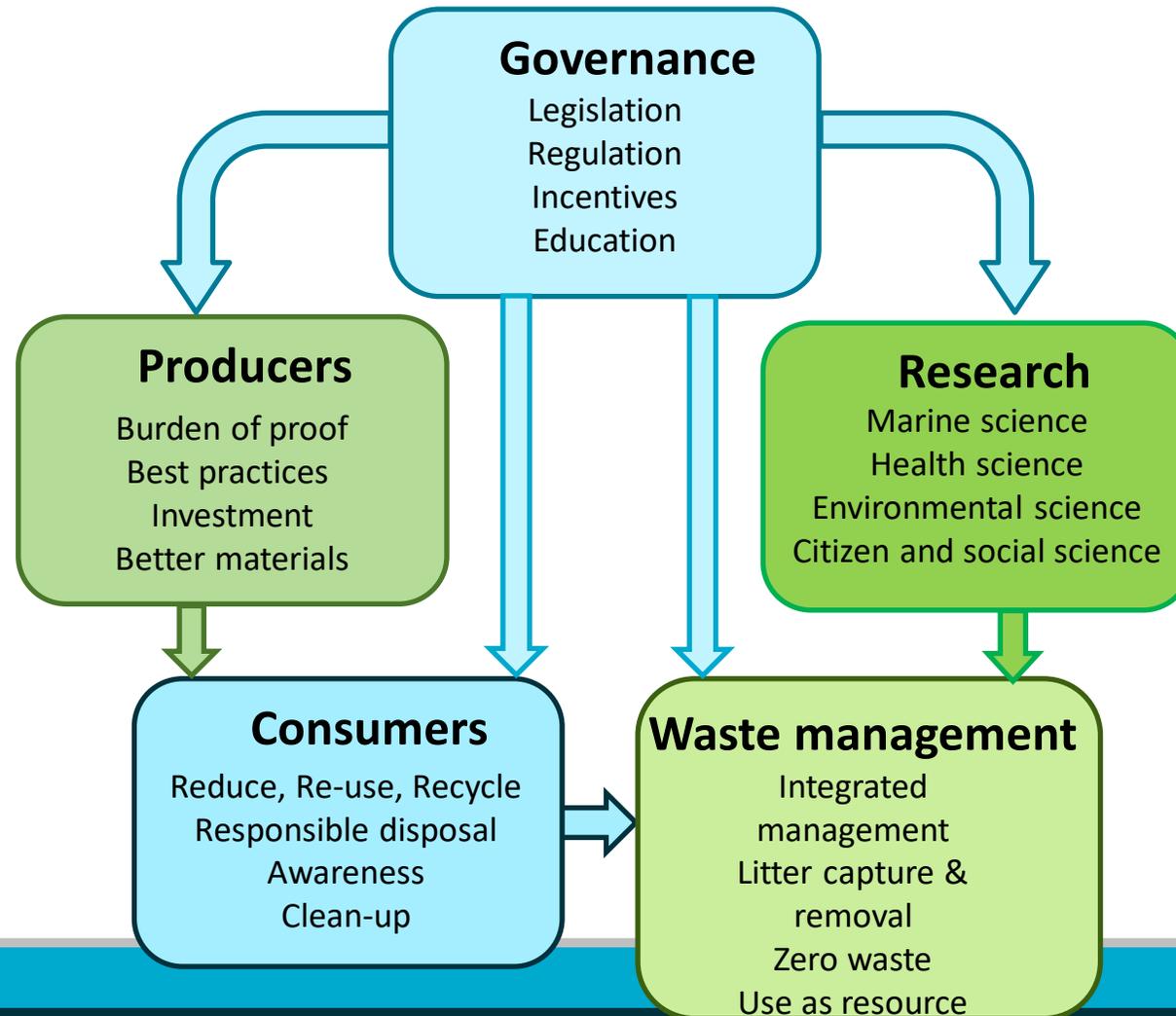
porter of recyclable materials, decided two years ago it would no longer take what it called foreign garbage.

Indonesia recently became the first south-east Asian nation to send contaminated plastic waste back to Australia, while Malaysia has also said it will send plastic waste back.

Local councils across Australia are now sending thousands of tonnes of recycling from kerbside collections to landfill, amid revelations just 12 per cent of household waste is being recycled.

"We've got households right across the nation who do their best to make sure that they sort their waste out at home, put it in the right bin, and their confidence of late has been dented when they found out

Trans-boundary problems need integrated responses



Has anything changed over the last decade?

Critically.... **YES**

Consumers are demanding change

- Social license is shifting

Global Plastic Trends

Global releases of plastic waste into the World's oceans



3% of all plastic on the market will end up in the ocean.



32% of single-use packaging escapes collection systems



Global plastic leakage is estimated at **8 Mt/y** (range: 4.8 - 12.7)

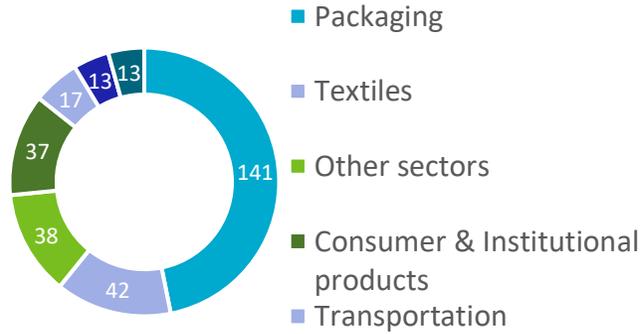


\$13 billion in financial damage to marine ecosystems from plastic waste (yearly estimate)

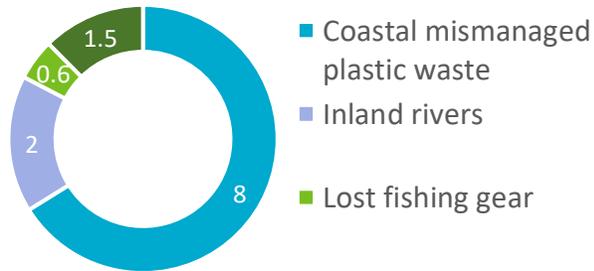


Trends

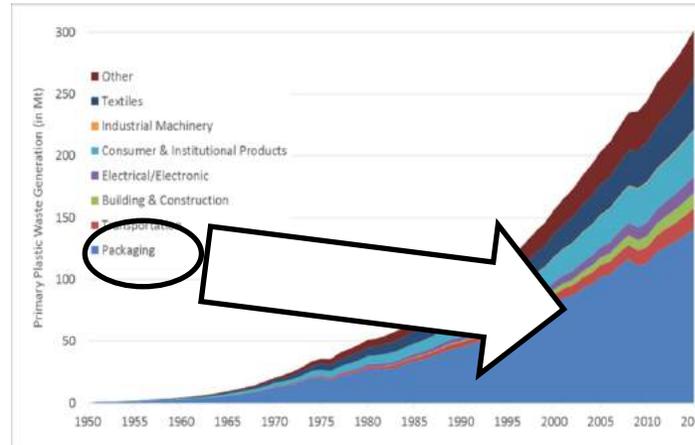
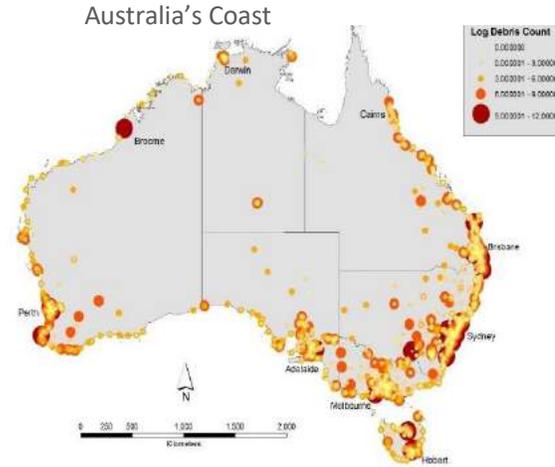
Plastic waste generation by sector Mt/y



Global plastic leakage from four main sources (Mt/y)



Cumulative global plastic production



Plastic production has a doubling time of 11 years

Plastic is increasing in the ocean, ~ 1.5% per year.

Cost of inaction in \$BNs

What do we know about plastic impacts?

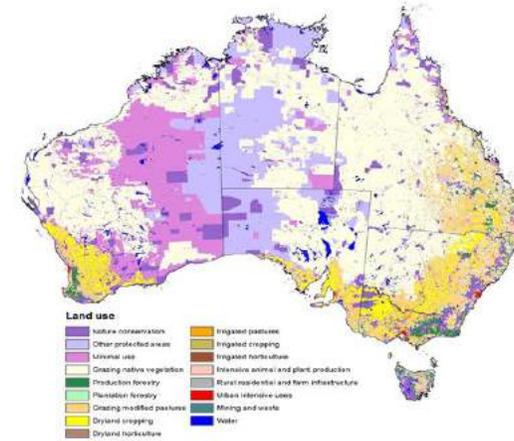
- Economic (tourism & fisheries)
- Navigation hazard
- Invasive species transport
- Wildlife entanglement & ingestion
- Chemical/toxicological effects
- Well-being/community



What drives debris loads?

Urbanization

- Distance to public transport, nearest road
- Regional and local population
- Regional and local road density by type



Land use

- Reserves, Agriculture, Housing, Water, etc.

Socio-economics

- Economic advantage/disadvantage
- Education and employment levels
- Economic resources



What do we know?
What do we need to know?

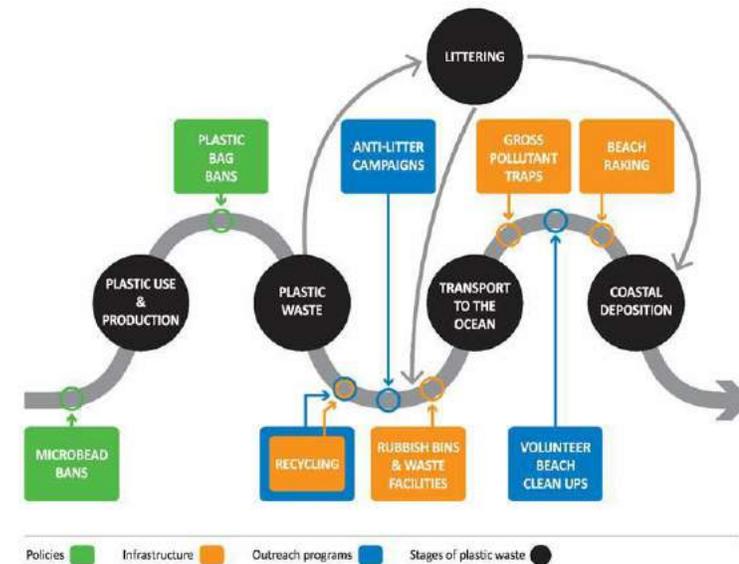
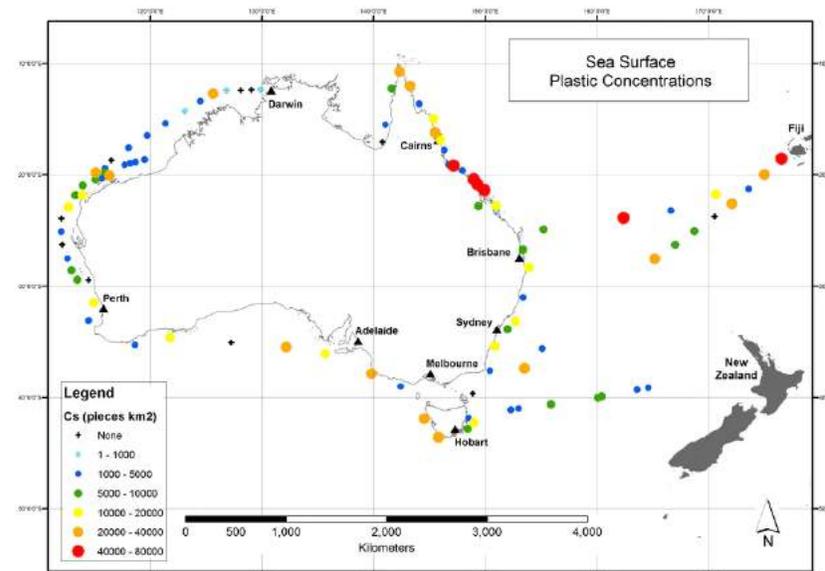
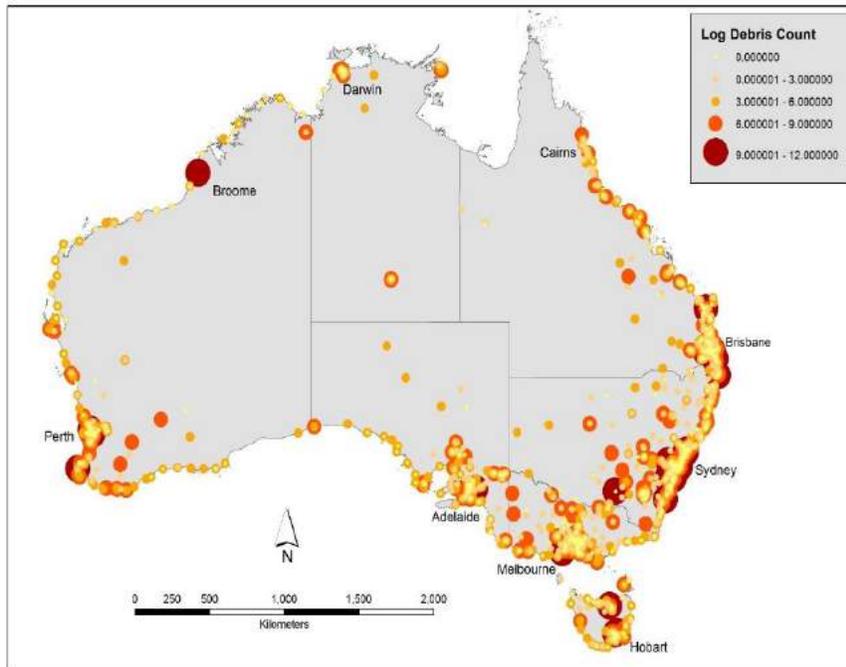


Internat'l Marine Plastics Treaty

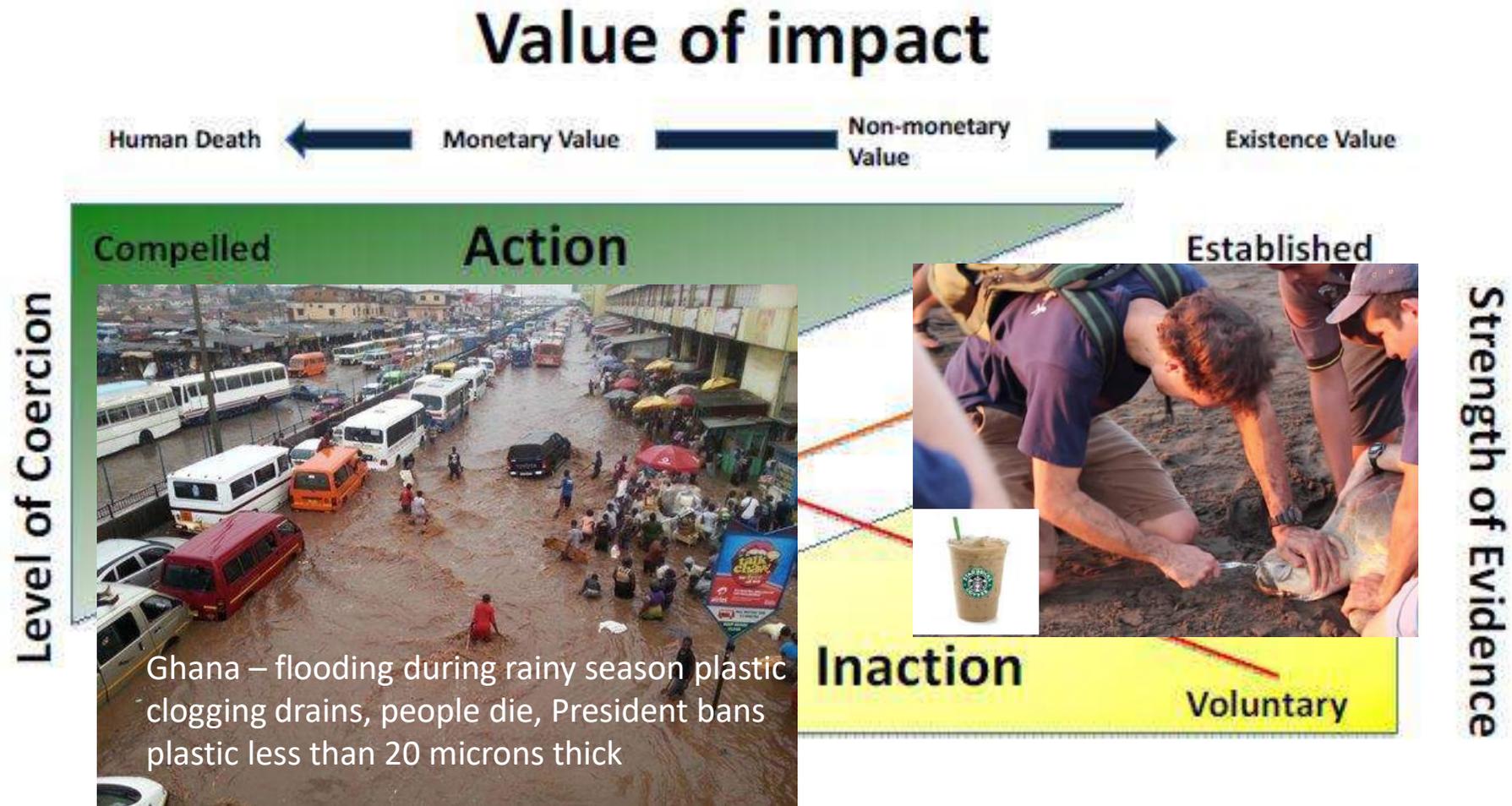


State of Knowledge

- Threat Abatement Plan (TAP)
- National coastal survey
- Risk/threats to marine fauna
- Emerging priorities project(s)



How to decide? When do we act?

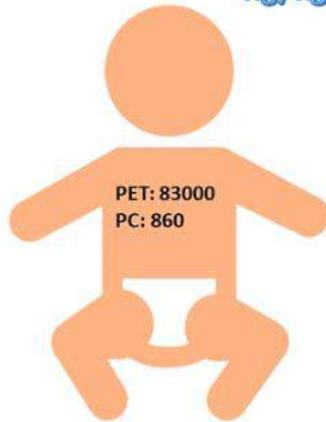


On what do we base policies?

European Union

MICROPLASTICS EXPOSURE

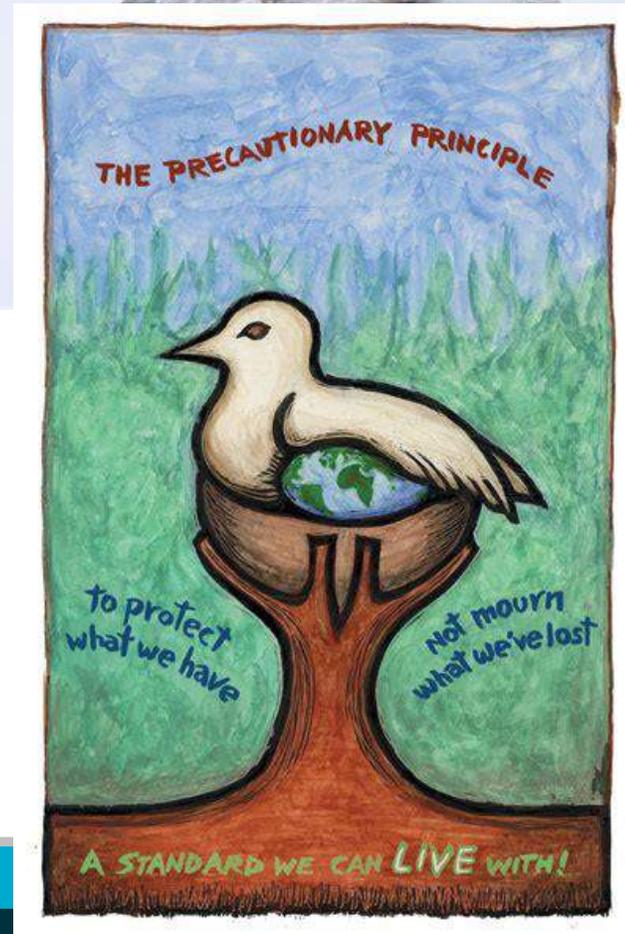
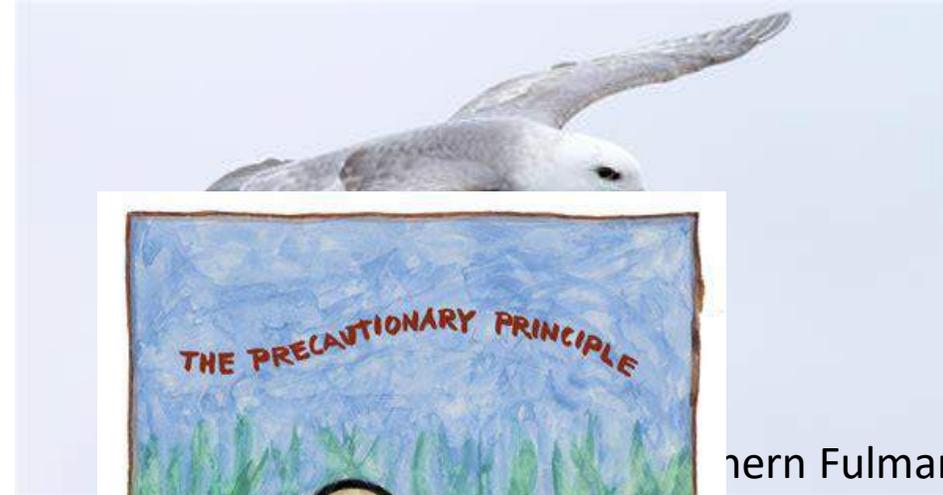
ng/kg-bw/day



How much is a nanogram?
... a billionth of a gram



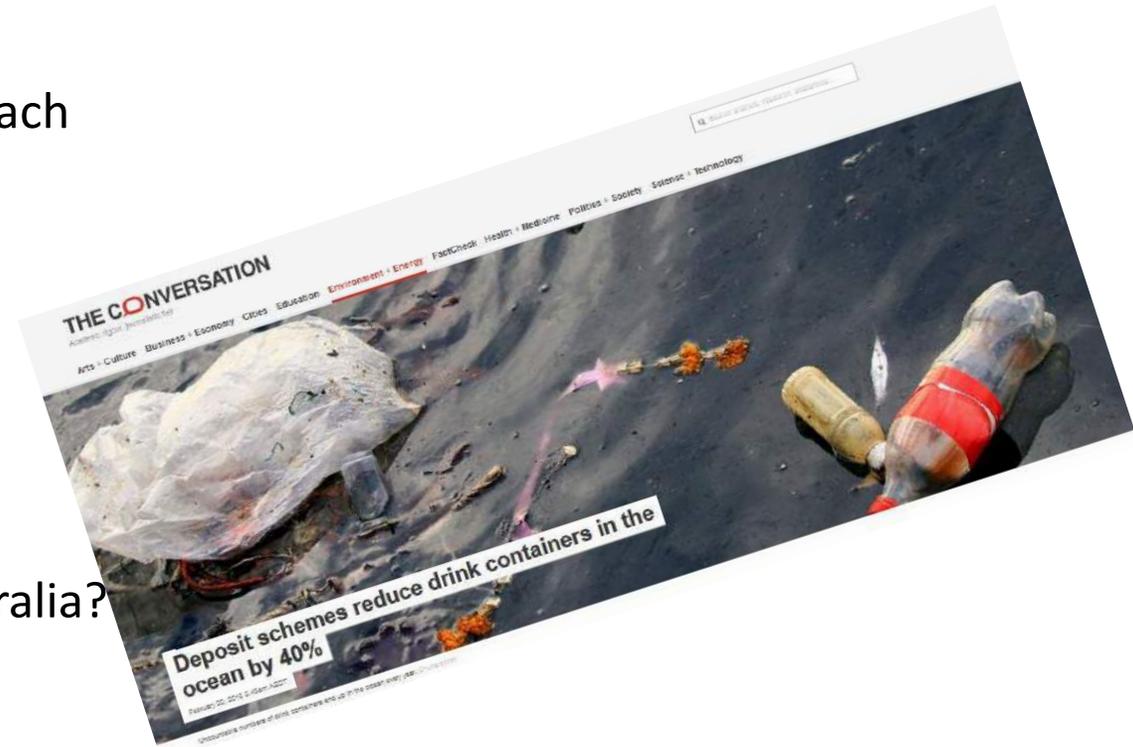
6.6 grams



Northern Fulmar
indicators

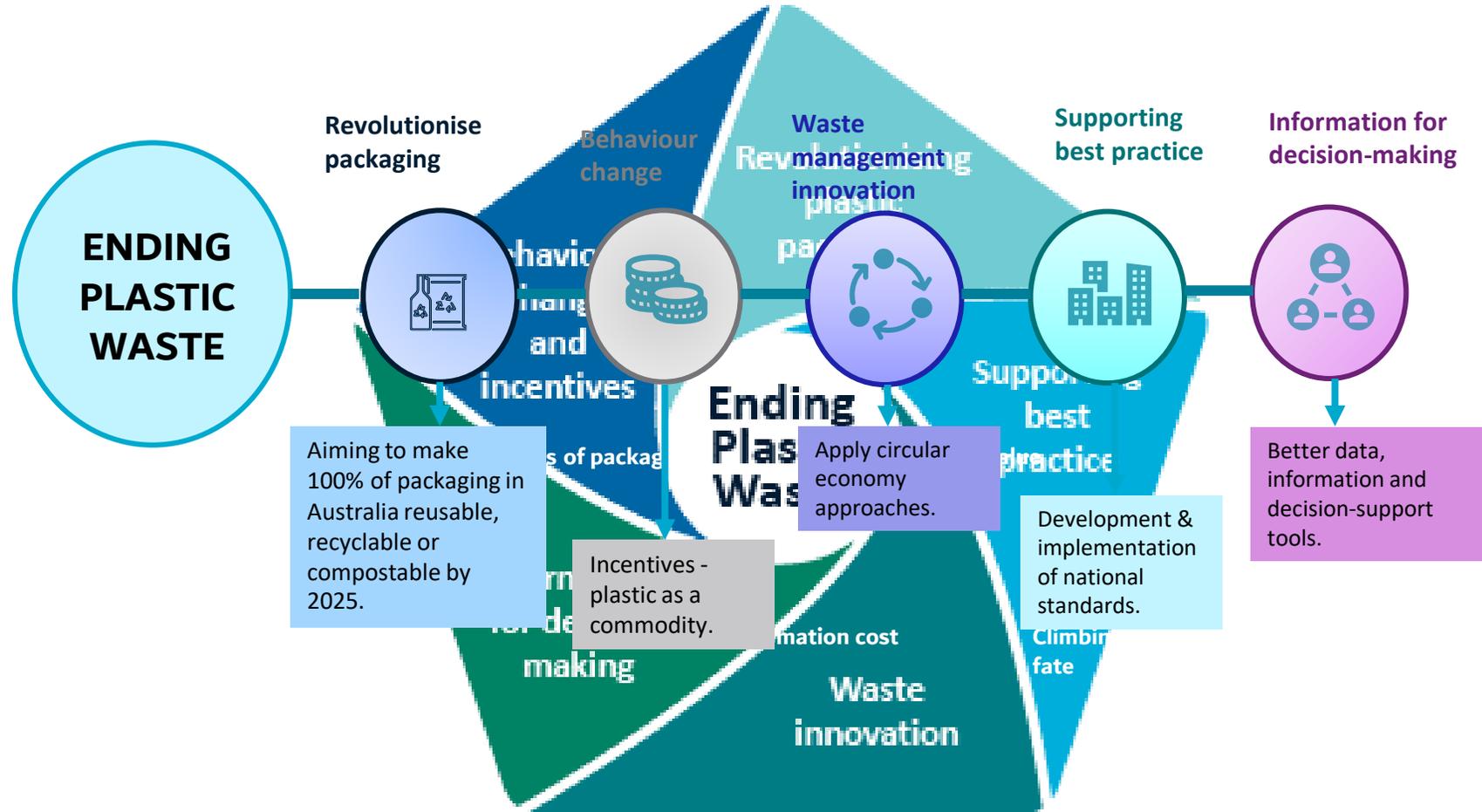
Monitoring waste inputs and evaluating existing and potential responses

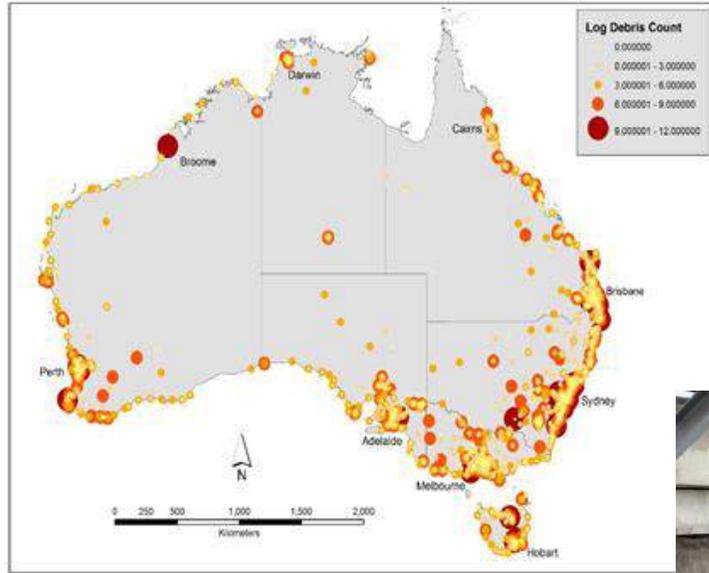
- Where to NOW?
 - Standardization; national, consistent approach
 - Understand policy effectiveness
 - Quantify leakage through waterways
- Emerging issues?
 - GPTs/stormwater drains?
 - Post-covid recovery for Australia?
 - **Waste Export ban**



Timely, relevant, solutions-oriented & scalable

How do we reduce >80% of plastic waste entering the environment by 2025?







Gross pollutant traps | Melbourne Water
melbournwater.com.au

Gross Pollutant Traps (GPT) | City of ...
urbanwater.melbourne.vic.gov.au

Gross Pollutant Traps Clearing - YouTube
youtube.com



Eco Bite™ Gross Pollutant Trap (GPT) ...
smartestwater.com.au



Gross Pollutant Traps | primary ...
okaindustries.com.au



Gross Pollutant Traps protects our ...
petershapperton.com.au



Vortechs™
oceanprotect



Your guide to gross pollutant tr...
globalwatergroup.com.au



Gross Pollutant Traps | Stormwat...
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HumeGuard® Gross Pollutant Trap (...
youtube.com



Gross Pollutant Traps - Cle...
clevertek.com.au



EcoSol In Line GPT Off Line GPT - Urban ...
urbanwaterinstallations.com.au

Related searches

- gross pollutant trap diagram
- malaysia gross pollutant trap
- bioretention basin



Gross Pollutant Traps(GPT) Filtration ...
jacksoninstruments.com.au



Gross Pollutant Trap - LDAM Knowled...
lgam.info



Gross Pollutant Traps | Stormwat...
stormwater360.co.nz



AKS Gross Pollutant Traps (GPT) West...
infobayresearch.com.au



Gross Pollutant Trap ...
clevertek.com.au



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res3seveet/tp.com



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veficatchments.com.au



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okaindustries.com.au



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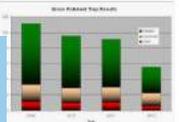
GROSS POLLUTANT TR...
freedatafacts.com.au



Gross Pollutant Traps - Fisher and Fisher
fisherandfisher.com.au



Auditing - Gross Pollu...
optimalstormwater.com.au



Gross Pollutant Traps (GPT) ...
wiseberry-hire.gov.au



Gross Pollutant Trap (GPT) | ...
ecoglobal.com

Opportunities for success:

- Target sites with high debris load sites (hotspots)
- Employ incentives, enforcement, education in areas of socioeconomic disadvantage
- Social context is key for low-cost debris/litter reduction
- Cost-benefit analysis and optimisation of investments (e.g. litter traps in waterways)
- National/international focus on how well policies work



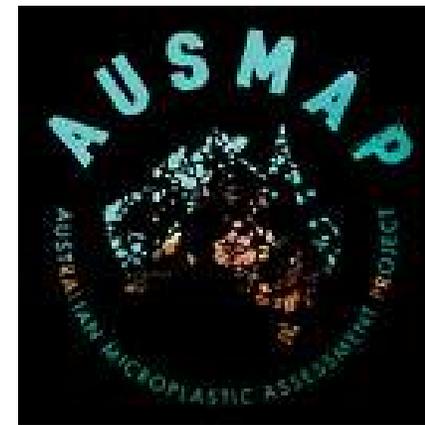
‘If you measure it, you can manage it’

Understand it - Design for it

Participate in it - Influence it

Use it - Circularize it (reuse)





Partnerships

**Springboard for policy development, evaluation
& national monitoring**



Choose our future

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<https://www.csiro.au/showcase/Ending-plastic-waste>

<https://research.csiro.au/marinedebris>





Questions?



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