Ecological impacts of marine plastic litter: A South African perspective

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Plastic soup

- Water column and benthic environments – becoming increasingly polluted
- Macroplastics > 20 mm, mesoplastics < 20 mm

Plastic soup. Photo: Charles Moore

Seabed Pollution. Photo Source: Bouteilles à la mer org.

Microplastics < 5mm Arthur et al. (2009)

- Primary sources:
  - microplastics are precursors of various products
  - spillage

Pre-production pellets

Airblast media

Cosmetic exfoliants

- *Secondary sources*:
  - products of fragmentation of larger plastics
  - fragmentation rate depends on the physical characteristics of the environment and the chemical properties of the plastic material

Discarded plastic litter is a global problem

Indonesia

India

Philippines

North America

Iceland

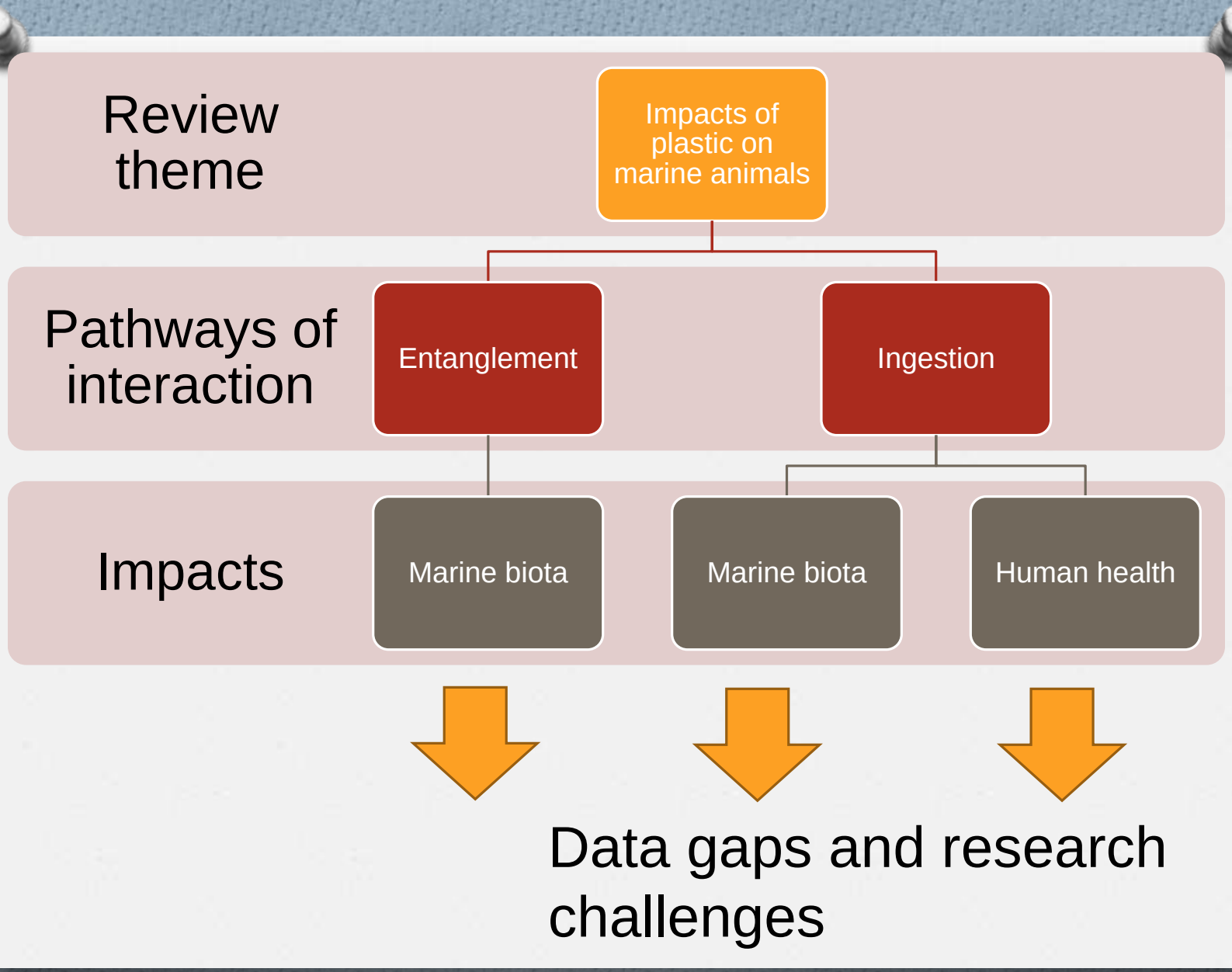
African coast

South Africa (SA),
Durban Bay

Focus review: impacts of plastic litter

Review objectives

- Review the literature - impacts of plastics, specifically entanglement and ingestion in a South African context
- Determine the potential for transfer of microplastics from marine biota to humans and possible impacts on human health
- Determine the gaps in our understanding of the impacts of marine litter on South African biota
- Identify research challenges
- Where there is deficiencies and challenges in a South African context - draw parallels with global literature


Review theme
Impacts of plastic on marine animals
Pathways of interaction
Entanglement
Ingestion
Impacts
Marine biota
Marine biota
Human health
Data gaps and research challenges

SA : Entanglement

Sharks (Cliff et al., 2002)

Turtles (Ryan, 1990)

Birds (Ryan, 2018)

Cape fur seals (Shaughnessy, 1980)

Entanglement

- Conspicuous cases affecting marine biota receives wide media coverage
- Global assessment of Laist (1997) lists 90 entangled species of vertebrates
- SA assessment of Ryan (1990):
  - : 6 shark
  - : 2 turtle
  - : 13 seabird
  - : 5 marine mammal species
- Entangled bird species increased (Ryan, 2018) - most species at risk
- Limited information on impacts to invertebrates/smothering of substrata

SA: Ingestion

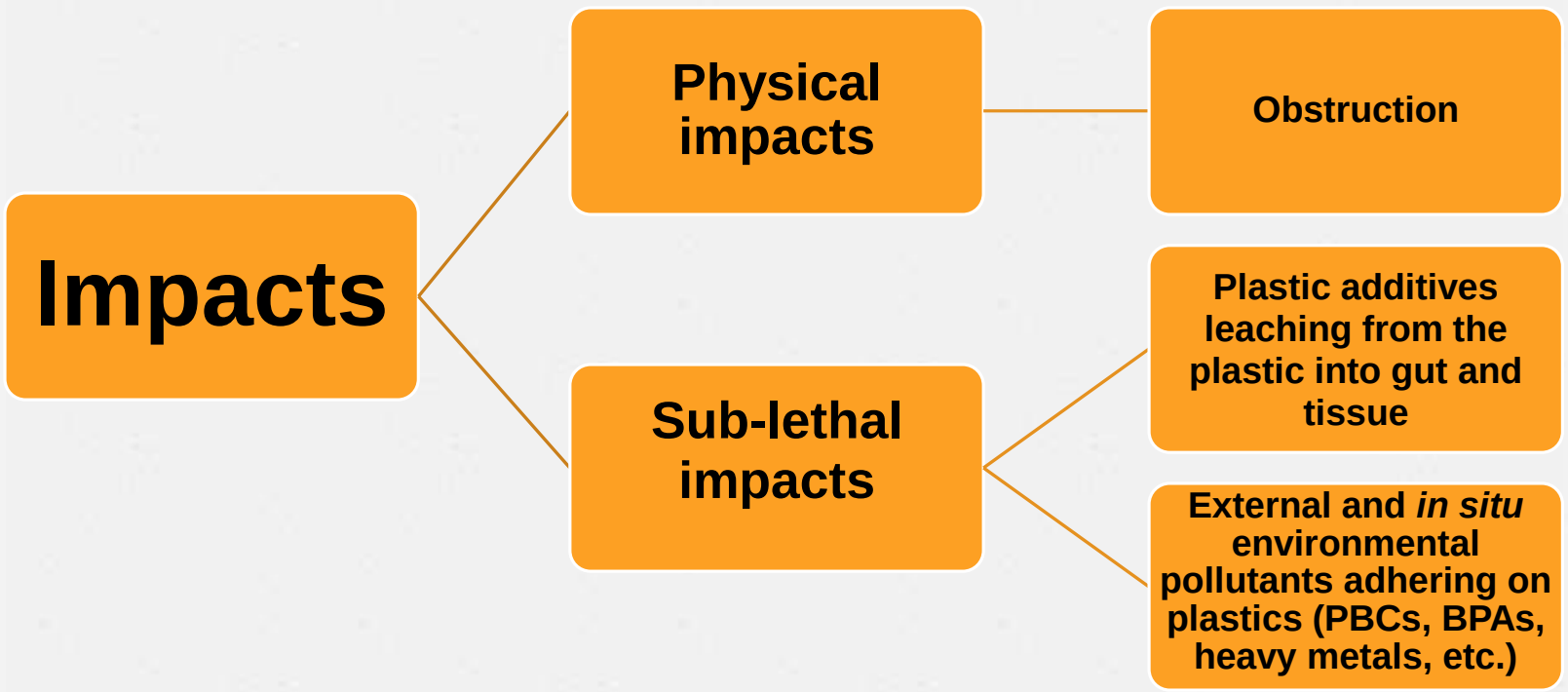
- South African research has focused on seabirds (Ryan 1987, 2008), post-hatchling loggerhead turtles (Ryan et al., 2016), sharks (Cliff et al., 2002) and estuarine fish (Naidoo et al., 2016)
- Particle selection based on feeding strategy, size, shape and colour
- Paucity of SA studies – growing need for more information on microplastic ingestion
- There are on going, but unpublished studies investigating invertebrates e.g. sea cucumbers and corals

- Review will provide summaries of invertebrate, shark, fish and turtle species from South Africa *in situ*

- Class Aves are reviewed by Ryan 1987 - excluded here (2)

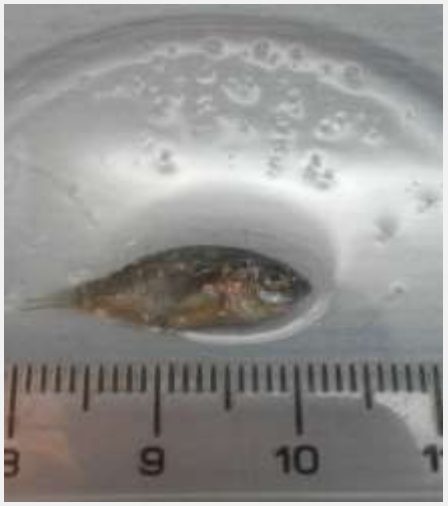
698 Table 1. A summary of invertebrates, fish and turtles species from South Africa which have been recorded to ingest plastic litter *in situ*.
699 Members of the class Aves are reviewed by Ryan 1987 and thus are excluded here.
700

Taxon	Species	Feeding	Type	Size (mm)	Region	Location	Enviro.	% Incidence	Items per ind.	Source
Invertebrate										
Chironomid larvae	*Chironomus* spp.	Deposit feeding	F,Fb	0.05	WC	Bloukrans River	FW	75% of 1680	0.37 ± 0.44/mg	Nel et al 2018
Brown mussel	*Perna perna*	Filter-feeding	F,Fb	0.02 - <1		Durban, South Coast	C	100% of 90	2.2 ± 0.8/g.	Gerber et al 2017
Fish										
Razorbelly	*Hilsa kelee*	Zoobenthivorous	Fb	< 1		Durban Harbour	C		9 ± 3.5	
Silver silago	*Sillago sihama*	Zoobenthivorous	Fb	< 1		Durban Harbour	C		6 ± 5.2	Naidoo et al 2017.
Pursemouth	*Gerres filamentosus*	Zoobenthivorous	Fb	< 1	KZN	Durban Harbour	C		8 ± 4.7	
Juvenile glassfish	*A.dussumieri*	Zoobenthivorous	Fb,F	0.76 ± 0.77		Durban Harbour	C	69% of 29	0.93 ± 0.75	
Juvenile tilapia	*O. mossambicus*	Zoobenthivorous	Fb,F	0.64 ± 0.46		St. Lucia Estuary	C	38% of 29	0.41 ± 0.57	Trishan et al. In review
Juvenile thornfish	*T. jarbua*	Zoobenthivorous	Fb,F	0.94 ± 0.81		Umgeni Estuary	C	48% of 29	0.66 ± 0.81	
Juvenile mullet	*Mugil* sp.	Microphytobenthos	Fb,F	1.09 ± 0.77		Durban Harbour	C	55% of 29	1.00 ± 1.46	
Sub-adult mullet	*Mugel cephalus*	Microphytobenthos	F,Fb,Fl,PS	0.2-15		Durban Harbour	C	73% of 70	3.8 ± 4.7	Naidoo et al. 2016
Turtles										
Loggerhead	*Caretta caretta*	Benthic carnivorous	F,P,Fl	< 30	WC	Cape Town	C	60% of 40	7.7 ± 13.9	Ryan et al 2016


Impacts
Physical impacts
Obstruction
Sub-lethal impacts
Plastic additives leaching from the plastic into gut and tissue
External and *in situ* environmental pollutants adhering on plastics (PBCs, BPAs, heavy metals, etc.)

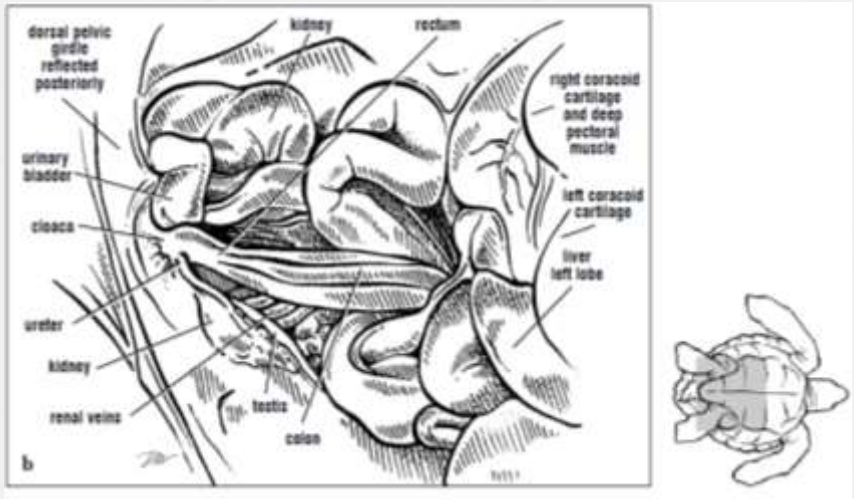
Negative health effects:

- Transfer to organs (Browne et al., 2008)
- Inflammation (Wright et al., 2013)
- Decreased growth (Naidoo et al., 2019)
- Decreased feeding and/or weight loss (Besseling et al., 2013; de Sá et al., 2015)
- Liver toxicity and pathology (Rochman et al., 2013)
- Endocrine disruption (Rochman et al., 2014)
- Decreased reproductive output (Sussarellu et al., 2016)



Turtles

Turtle eats plastic. Photo Source: Greenhouse Carbon Neutral Fdn



Seabirds

Albatross, victim of plastic ingestion. Photo: Unknown.

Midway atoll, bird corpse. Photo: Chris Jordan

Midway atoll, bird corpse. Photo: Chris Jordan

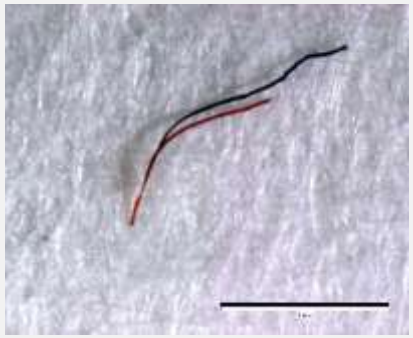
Fish

Tilapia

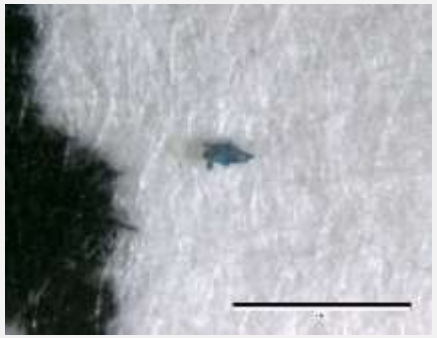
Thornfish

Mullet

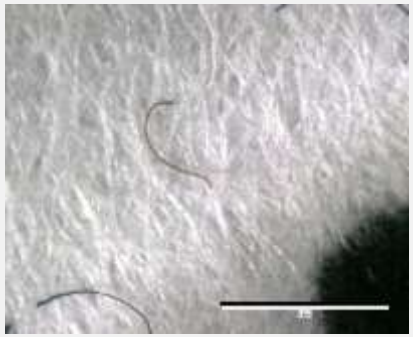
Glassfish



Blue and Red fibre - Rayon

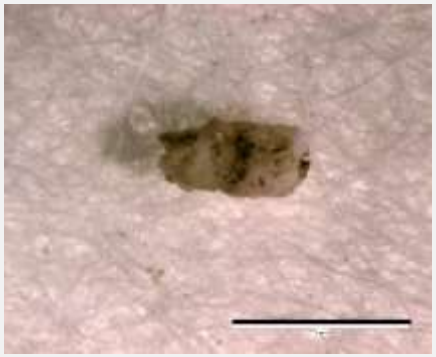


Blue Frag of PVC – Mullet DBN



Polyester – Mullet DBN

Blue and Red fibre - Rayon



PVC – Mullet DBN

Polyethylene frag – Thornfish S6 UMG

Human impact

- Consumption of seafood with microplastics - unknown threat to human health in SA

- Possibility for transferal of microplastics, associated chemicals and microbes

- Two studies show microplastic uptake in consumed species: *Perna perna* Gerber (2017) and juvenile estuarine fish (Trishan et al., In review).

- However, transfer to humans not investigated

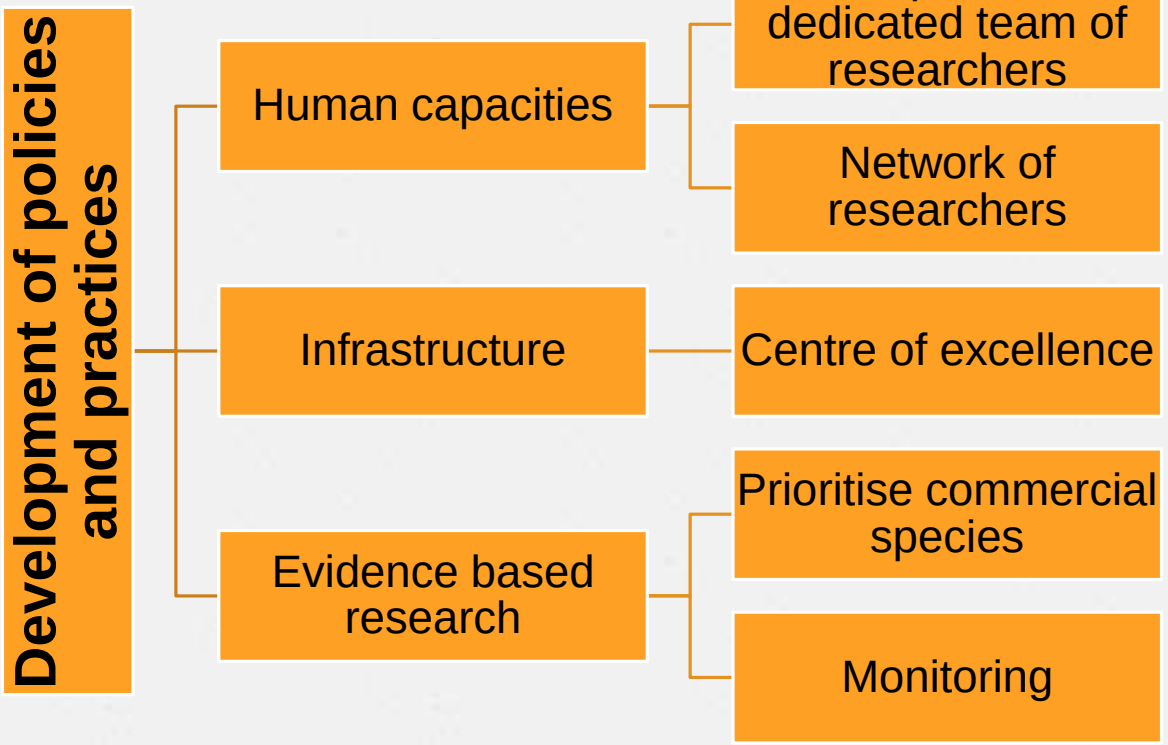
- South Africa to consider commercially important organisms (e.g. prawns, rock lobster, mussels, oysters and abalone) as a priority




Key uncertainties, knowledge gaps and research challenges

- SA relies on marine resources, but ingestion data for commercial species are virtually non-existent
- Unknown - sublethal effects passed on from biota to humans
- Lack of consolidated protocols for the particle isolation from different organisms:
- This is a primary step for efficient monitoring
- Access to critical technology and infrastructure - challenge in developing countries such as SA
- Contamination by airborne microfibres another key issue

If gaps are not addressed:



Where there are gaps can data, from other countries, be applied to SA?

- Essential to draw on international literature to predict possible impacts on organisms (including humans) to design national policies and mitigate effects
- Trialed international protocols but need to optimize for SA organisms and systems
- Infrastructure challenges for contamination control, plastic isolation and chemical diagnosis
- SA may have a unique combination of species and/or interactions which make predictions based on global literature difficult in certain cases
- The levels of pollution and their impact on the environment may also be much higher than in developed parts of the world

Thank you


refuse-disposable-plastic
I will REFUSE disposable plastic
plasticpollutioncoalition

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