

Ecosystem service and economic impacts of marine plastic litter: State of South African research

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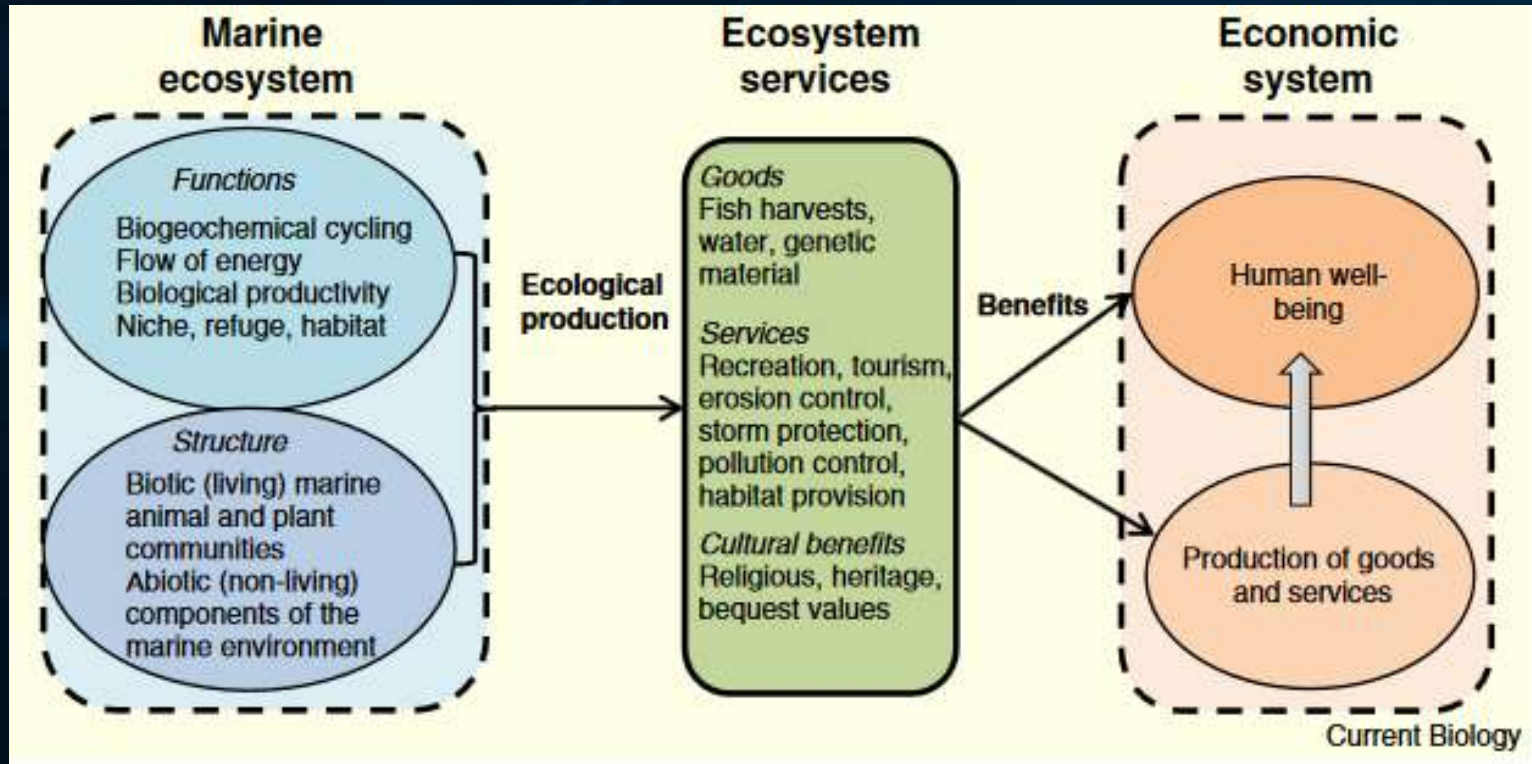
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Introduction

- Marine plastic litter - impacts not only on marine ecology and biota, but on ecosystem services, human well-being, society and economy.
- Ecosystem services: Valuable goods and services provided by well-functioning ecosystems to human societies.
 - Supporting services - e.g. habitat provision, biodiversity
 - Provisioning services - e.g. food, water, other resources
 - Regulating services - e.g. climate, clean air, water purification
 - Cultural services - e.g. recreation, aesthetics, education
- These are vital to human livelihoods & sustained economic activity
- Therefore have an intrinsic (though typically unaccounted for) economic value.



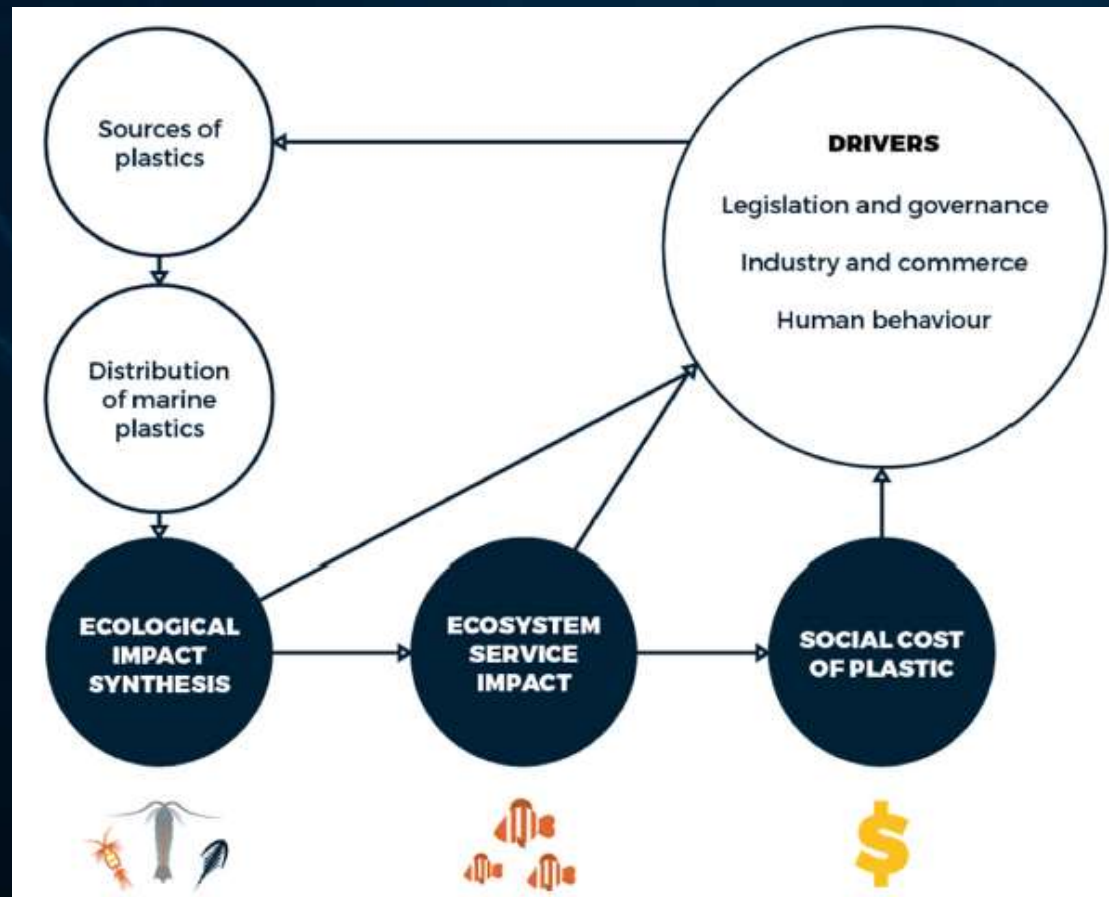
Marine ecosystem services



Barbier, 2017

Introduction (cont)

- By-products of human activities (e.g. pollution and waste) have negative impact on ecosystem structure & functioning, and therefore on ability of ecosystems to provide these services
- This in turn can have a negative impact on the economic value derived from such services.
- E.g: If marine plastic pollution has negative impact on marine habitats and biodiversity, fishing stocks for commercial and recreational fishers can be negatively affected, which in turn has a negative economic impact



Introduction (cont)

- Important to be able to quantify these impacts in economic terms - provides evidence for determining an appropriate policy response
- E.g. McIlgorm et al. 2008 - direct economic cost of marine debris in APEC region - \$1.265 billion in 2008
- Beaumont et al. 2019 :
 - 1 – 5% decline in ecosystem services as a result of marine plastics per year
 - Translates to loss of \$0.5 – 2.5 trillion in the value of global marine ecosystem services annually
 - I.e. \$3 300 - \$33 000 per tonne of marine plastic

Aim and approach

- This paper assesses current state of SA literature re: impacts of marine plastic pollution on ecosystem services and on the economy, in order to be able to identify gaps.
- Research on ecological impacts is specifically excluded – refer to Dr Naidoo’s paper
- Approach:
 - Brief overview of international literature to identify typical types of impacts - provides a framework/basis of comparison to identify gaps in SA research
 - We then review the SA research and map this against the framework, to identify gaps

International literature: Impacts on ecosystem services

- **Provisioning services**
 - **Fisheries and aquaculture**
 - Direct damage to fish stocks and reduced reproductive success, negatively affecting population growth, e.g. through
 - Entanglement
 - Ingestion
 - Contamination of food chain
 - Damage to ecosystems
 - Negative impact on the fisheries & aquaculture sectors
 - Ingestion of contaminated organisms – impacts on human health

International literature: Impacts on ecosystem services

- **Cultural services**
 - **Recreation & aesthetics**
 - Presence of litter - impacts on physical & mental health
 - cuts, entanglement, exposure to unsanitary items etc.
 - Impacts individuals' well-being and mood
 - Avoiding beaches – reduced options for physical activities & social interactions, negatively impacting health & well-being
 - Reduced aesthetic appeal - reduced quality of life
 - Impacts on tourism
 - **Heritage**
 - Emotional/cultural attachment to marine organisms
 - Their continued existence is important for wellbeing of humans
 - Loss of these animals – negative impact on human well-being

International literature: Impacts on ecosystem services

- **Supporting services**

- **Habitat provision**

- Physical damage to benthic habitats through abrasion, scouring, and breaking
 - Derelict fishing gear - translocate organisms & sea-bed features

- **Biodiversity**

- Prevents gas exchanges & oxygen in ocean floor sediment - impacts negatively on ecosystem functioning, benthic organisms and composition of biota
 - Impacts on marine ecology & biodiversity could reduce ecosystem resilience in the face of global change.
 - Lack of understanding regarding long term impacts on marine ecosystems

- **Invasive species transport**

- provides substrate for invasive species to be transported over long distances

International literature: Economic impacts

- **Direct economic costs**
 - Arise from damage to an industry or economic activity
 - E.g. impacts on the fishing, shipping, and tourism industries
 - Relatively straightforward to quantify
- **Indirect economic costs**
 - Arise indirectly (not from direct damage to an industry)
 - E.g. impacts on human health
 - More difficult to quantify
- **Non-market costs**
 - Impacts on the value that humans place on the marine environment over and above the value associated with the actual use of marine resources
 - E.g. scenic value, cultural value, spiritual value, etc.
 - Most difficult to quantify

International literature: Economic impacts

- **Direct economic costs**
 - **Fishing industry**
 - Impacts on catch and therefore revenues
 - **Transportation (shipping) industry**
 - Damage to craft - increasing maintenance and repair costs
 - Ports incur costs to clean up debris to avoid these damages
 - **Tourism industry**
 - Litter on beaches undesirable for tourists - presence of plastics on the coast affects tourism, leading to a loss of revenue
 - Municipalities incur high costs for litter clean-ups so as to avoid losses in tourism revenue
 - Also has economic impact on residents – incur additional costs to travel further to avoid degraded areas

International literature: Economic impacts

- **Indirect & non-market economic costs**
 - **Human health & safety**
 - consumption of contaminated species, navigational hazards, injuries to recreational users, leaching of poisonous chemicals etc.
 - Current literature does not provide clarity on the health risks associated with marine plastic; therefore difficult to quantify costs
 - **Non-market costs**
 - E.g. impacts on scenic value, heritage value, spiritual value, etc.
 - Have not been assessed in detail based on our brief review

In summary

Category	Sub-category	Impacts
Impacts on ecosystem services	Provisioning services	Impacts on fisheries & aquaculture
	Cultural services	Impacts on recreation & aesthetics
		Impacts on heritage
	Supporting services	Impacts on habitat provision
		Impacts on biodiversity
		Invasive species transport
Economic impacts	Direct costs	Impacts on tourism industry
		Impacts on shipping industry
		Impacts on the fisheries industry
	Indirect and non-market costs	Health costs
		Non-market costs

SA literature: Impacts on ecosystem services

- **Provisioning services**
 - **Fisheries and aquaculture**
 - Over 12 million people engage in the fisheries sector in Africa
 - Impacts of marine plastics could pose a significant problem
 - Could significantly impact on livelihoods of subsistence fishers
 - No research could be found assessing the impacts of marine plastic pollution on fisheries and aquaculture in South Africa

SA literature: Impacts on ecosystem services

- **Cultural services**

- **Recreation & aesthetics**

- Some research on the impacts of marine litter on tourism, incl. aspects related to recreation and aesthetics.
 - Mostly focussed on determining economic impacts on tourism industry, or costs of beach clean-ups to avoid losses in tourism revenue
 - This is therefore discussed in section on economic impacts

- **Heritage**

- No SA research found

SA literature: Impacts on ecosystem services

- **Supporting services**
 - **Habitat provision**
 - No SA research found
 - **Biodiversity**
 - Much research has been done on impacts on marine biota – ingestion, entanglement etc. (see Dr Naidoo's paper)
 - However, no SA research could be found on impacts on biodiversity more broadly
- **Invasive species transport**
 - Whitehead et al. 2011 –
 - All species of goose barnacles found to colonise plastic debris, thereby impacting the abundance and distribution of goose barnacles and their colonisation and distribution along southern Africa

SA literature: Economic impacts

- **Direct economic costs**
 - **Fishing industry**
 - Commercial fisheries sector - R5.8 billion per year (2012)
 - Economic value of recreational fishing R1.6 billion p.a. (2017)
 - Aquaculture contributed 0.8% to SA fish production in 2012
 - Lack of research regarding the impacts of marine plastics on these industries in SA

SA literature: Economic impacts

- **Direct economic costs - continued**
 - **Transportation (shipping) industry**
 - Debris around Port of Durban can become a shipping hazard, particularly after periods of rainfall
 - Little assessment of the associated economic impacts.
 - Port incurs costs in litter clearing operations
 - Are also public volunteer clean-ups of plastic out of the Port, estuaries and beaches in eThekweni
 - Costs of these operations not readily available in published sources.
 - Pers Comm from Port of Durban environmental manager:
 - Harbour clean up following storm in Oct 2017 cost the Port R1.25m
 - Seven clean-up events after storms in April/May 2019 cost a further R4.35m

SA literature: Economic impacts

- **Direct economic costs - continued**
 - **Tourism industry**
 - Tourism contributed R125 billion to SA GDP in 2016 (2.9%) and employed 1.5 million workers (9.8% of total employment).
 - Marine ecotourism contributed approximately R400 million directly, and over R2 billion indirectly in 2014
 - Cape Town - visiting beaches makes up 12% of foreign visitors' activities
 - Some research has been done on impacts of marine litter on tourism in SA
 - Debris impacts on aesthetic value of coast, and decreases the number of visitors to polluted beaches

SA literature: Economic impacts

- **Direct economic costs**

- **Tourism industry - continued**

- Ballance et al. (2000) – Cape Peninsula region - cleanliness the primary factor considered by visitors when choosing a beach, particularly for international tourists.
 - 50% of residents would be prepared to spend more to visit clean beaches further away
 - Litter densities of > 10 large items per metre of beach would deter 40% of foreign tourists, and 60% of domestic tourists, from returning to Cape Town
 - Potential impact on the regional economy of R 'billions per year.
 - >10 large debris items per meter: 97% of visitors would not visit them, leading to decline in total recreational value of R300 000 per year, and a loss of R8 million for the regional economy (1996 values)

SA literature: Economic impacts

- **Direct economic costs**
 - **Tourism industry - continued**
 - Number of studies have assessed costs of beach clean-ups aimed at mitigating negative impacts on tourism (mainly in Cape)
 - Swanepoel (1995)
 - C.T. City Council spent R2.7 million on beach clean-ups in 1992-1993 financial year
 - Beach litter removal costs R3 000 / t (v.s. domestic refuse removal - R75 / t)
 - Ballance et al. (2000) – CT spent R3 million during 1994-1995 FY
 - Ryan and Swanepoel (1996) – assessed beach cleaning efforts of 63 coastal authorities in SA.
 - Cape Town spends in excess of R3.5 million annually.
 - Total across the 63 authorities (extrapolated from C.T. figures) - over R8 million p.a.

SA literature: Economic impacts

- **Indirect & non market economic costs**
 - **Human health & safety**
 - No SA research found
 - **Non-market costs**
 - No SA research found

Category	Sub-category	Impacts	State of SA Research
Impacts on ecosystem services	Provisioning services	Impacts on fisheries/aquaculture	-
	Cultural services	Impacts on recreation & aesthetics	Some research on the impacts on tourism (see below)
		Impacts on heritage	-
	Supporting services	Impacts on habitat provision	-
		Impacts on biodiversity	-
		Invasive species transport	One study found on goose barnacles
Economic impacts	Direct costs	Impacts on tourism industry	Some research conducted on the impacts on tourism and on beach clean-up costs; although largely confined to Cape Town
		Impacts on shipping industry	Information on harbour clean-up costs in Durban obtained through personal communication; no other information available
		Impacts on fisheries industry	-
	Indirect and non-market costs	Health costs	-
		Non-market costs	-

Gaps in SA research

- Gaps in SA knowledge re: impacts of marine plastics on ecosystem services and the economy are significant.
- Some research has been conducted in terms of invasive species transport; impacts on recreation, aesthetics and tourism; and the costs of beach and harbour clean-ups
- However, these tend to be very isolated, localised and/or outdated:
 - E.g. invasive species transport – one study on goose barnacles only
 - Tourism impacts (incl. decline in recreational values & cost of beach clean ups) - a few studies in Cape Town only, but outdated
 - Costs of harbour clean ups – No studies; pers. comm. info for Durban only

Gaps in SA research

- Significant lack of research on:
 - Impacts on ecosystem services:
 - Provisioning services - fisheries & aquaculture
 - Cultural services – heritage
 - Supporting services - habitat provision and biodiversity.
 - Economic impacts:
 - direct economic impacts on the transport/shipping and fisheries industries (as well as updated info on tourism)
 - indirect economic impacts (such as costs associated with health-related impacts)
 - non-market costs (e.g. impacts on scenic, cultural and spiritual values).

Implications

- Integral that more research is done in SA to address these gaps, so as to inform policy decisions.
- Without better knowledge of the economic impacts of marine plastic pollution, it is difficult to assess the costs of inaction, and therefore to inform an appropriate policy response
- Need to be able to quantify ecological, social and economic impacts of marine plastic pollution, and compare this with costs of policy responses
- Would not be appropriate for a policy response to be implemented where overall costs of the policy (including economic, social & environmental costs) exceed the overall benefits

Implications

- E.g.: what would be the implications of a total ban; or of alternatives to single use plastics?
- any alternative will also have impacts – so we need to reconsider our overall consumption patterns, rather than simply replace plastic with an alternative
- Also need to change behaviour around how we use, re-use and dispose of plastics
- SA plastics recycling rates relatively high
- Littering a problem – BUT most leakage of plastic waste in SA due to poor waste management & disposal, rather than direct littering – therefore clear need for improved waste management

Thank you