Efficiency of beach clean-ups and deposit refund schemes (DRS) to avoid damages from plastic pollution on the tourism sector

in Cape Town, South Africa

Authors: Jain, A., Raes, L., Manyara, P.
May 2021

GLOBAL MARINE AND POLAR PROGRAMME

About IUCN

IUCN is a membership Union uniquely composed of both government and civil society organisations. It provides public, private and non-governmental organisations with the knowledge and tools that enable human progress, economic development and nature conservation to take place together.

Created in 1948, IUCN is now the world's largest and most diverse environmental network, harnessing the knowledge, resources and reach of more than 1,400 Member organisations and some 18,000 experts. It is a leading provider of conservation data, assessments and analysis. Its broad membership enables IUCN to fill the role of incubator and trusted repository of best practices, tools and international standards.

IUCN provides a neutral space in which diverse stakeholders including governments, NGOs, scientists, businesses, local communities, indigenous peoples organisations and others can work together to forge and implement solutions to environmental challenges and achieve sustainable development.

www.iucn.org
twitter.com/IUCN/

Efficiency of beach clean-ups and deposit refund schemes (DRS) to avoid damages from plastic pollution on the tourism sector

in Cape Town, South Africa

Authors: Jain, A., Raes, L., Manyara, P.

This policy brief is the summary of the Master's thesis for University of Nantes, 2019-2020. The thesis was completed at IUCN, Switzerland as part of the Marine Plastics and Coastal Communities (MARPLASTICs) project. The following report is an analysis of the costs and benefits of current beach clean-ups in Cape Town, and it aims to estimate the cost efficiency of implementing a Deposit Refund Scheme (DRS) in conjunction with beach clean-ups. (Full Thesis).

 IUCN is pleased to acknowledge the support of its Framework Partners who provide core funding: Ministry for Foreign Affairs of Finland; Government of France and the French Development Agency (AFD); the Ministry of Environment, Republic of Korea; the Norwegian Agency for Development Cooperation (Norad); the Swedish International Development Cooperation Agency (Sida); the Swiss Agency for Development and Cooperation (SDC) and the United States Department of State.

This publication has been made possible by funding from the Swedish International Development Cooperation Agency (Sida) from the Marine Plastics and Coastal Communities (MARPLASTICCs) project in Kenya, Mozambique, South Africa, Thailand and Viet Nam.

Published by: IUCN, Gland, Switzerland, Global Marine and Polar Programme

Citation: Jain, A., Raes, L., Manyara, P., *Efficiency of beach clean-ups and deposit refund schemes (DRS) to avoid damages from plastic pollution on the tourism sector in Cape Town, South Africa*. Switzerland: IUCN. 10 pp.

Authors: Aanchal Jain, Leander Raes (Economic Knowledge Unit, IUCN), Peter Manyara (IUCN ESARO)

Editors: Jennifer Ross-Jones, Lynn Sorrentino (Publication Coordinator)

Reviewers IUCN: Janaka de Silva, Lynn Sorrentino

Cover Photo: Beach in Kenya, White Rhino Films.

Design and layout: Imre Sebestyén, jr / Unit Graphics

Available from: IUCN (International Union for Conservation of Nature)
Global Marine and Polar Programme (GMPP)
Rue Mauverney 28
1196 Gland
Switzerland
Tel +41 22 999 0000
Fax +41 22 999 0002
www.iucn.org/theme/marine-and-polar/our-work/close-plastic-tap-programme/reports

Table of contents

Introduction

Impacts of beach litter on tourism and its economic cost

Plastic debris is commonly found on many beaches (Hammer, 2012). The quantities of plastic debris items found vary greatly over the course of any year and differ by location (Thompson et al., 2009a). Accumulation of plastic debris is greater near densely populated areas and on more frequently visited beaches. Plastic litter on beaches is primarily sourced from adjoining land areas (Hammer, 2012). The build-up of plastic litter on beaches can have a large impact on a country's economy, wildlife, and the physical and psychological wellbeing of individuals (Moore et al., 2001; Donohue et al., 2001).

The major economic cost of this plastic debris is the reduced aesthetic appeal of coastal areas. This adversely affects the tourism industry, leading to a loss of output, revenue, and employment (Jang, 2011). According to a survey conducted in Cape Town, South Africa, clean beaches are one of the most important factors for tourists; plastic litter can dissuade them from coming to the beaches (Ballance, 1996). For instance, €25 and €40 million represent the estimated loss in tourism revenue due to coastal litter in South Korea and California, respectively (Jang et al., 2014; Leggett et al., 2014). Dirty beaches also increase the costs for governments, local municipalities, and NGOs to ensure clean, attractive, and safe beaches for tourists. These costs include the collection, transportation and disposal of litter, and the associated administrative costs. In most cases, the costs spent on cleaning are justifiable; the benefits harvested from doing so are generally much higher (Ryan, 2000).

Measures to remove plastic litter from the coastlines

There are several solutions to address the coastal litter problem. Preventative measures include strengthening producers' extended responsibility, implementing a 'Deposit Refund Scheme' (DRS), and/or improving waste management practices. Removal measures involve the direct removal of litter from the coastlines. Lastly, addressing consumer behaviours (such as implementing taxes on plastic bottles) can also reduce plastic littering by discouraging the consumption of plastic materials in the first place. This study focuses on the costs and benefits of implementing DRS in conjunction with beach-clean up actions.

Study area

This study focuses on Cape Town City, one of the most touristic regions in South Africa, where beaches are a natural, focal attraction (Sowman, 1990). Cape Town is one of the most visited cities in South Africa with 49% of international tourists and 20% of domestic tourists (City of Cape Town, 2019). Tourism in Cape Town not only contributes significantly to the region's GDP, but also generates employment. For instance, the tourism sector directly employed 43,566 people in 2018. Total employment in the tourism sector in Cape Town has grown over 2.6% over the last decade (City of Cape Town, 2019).

A large number of tourists visit Cape Town, which is known for its **coastline that stretches for approximately 307 km hosting 73**

beaches (Figure 1). However, a rapidly growing economy, touristic pressures, and waste streams associated with development and population growth pose an increasing threat to Cape Town's valuable beaches by increasing the number of pollutants and litter on the coastline (Newman, 2019). Plastic accounts for 94-98% of all the litter on Cape Town beaches (Takunda, 2019). **Continued degradation of beaches could significantly impact Cape Town's economy. According to a study on Cape Town, foreign tourists stated that a drop in cleanliness standards could influence the choice of beaches frequented; up to 97% of tourists would not be willing to come to beaches with more than ten large items of debris per metre. This reduced expenditure on travel to beaches would correspond to a considerable decrease in the total recreational value of beaches and a reduction in the regional economy (Ballance, 1996).**

To target this problem, **Cape Town has implemented a variety of beach clean-up programs, organised at three different levels.** First are those organised by the government, which comprise a majority (90%) of all clean-ups. The Department of Environment, Forestry and Fisheries (DEEF) of South Africa has launched various projects to ensure a clean South African coastline, such as 'Work for the Coast (WFTC)' and 'International Coastal Clean-up (ICC)'. Second, the City of Cape Town Metropolitan Municipality also takes care of regular cleaning of the coastline and residential areas through its waste management department. Third, select NGOs are engaged in beach cleaning through their own or sponsors' funding. In addition, a few other local NGOs and individual volunteers are also engaged in conducting clean-ups.

Study objective

This study aims to: **(1) estimate if current beach clean-up efforts in Cape Town, South Africa are efficient in avoiding losses in the tourism revenue sector;** and **(2) to analyse how the efficiency of beach cleaning changes with the implementation of a Deposit Refund Scheme[1](DRS).** To estimate the efficiency of a DRS, five scenarios are considered with different return rates of bottles by consumers (i.e. 74%, 86%, 94%, and 100%).[2] Lastly, a sensitivity analysis is carried out verify whether efficiency results are consistent if beach tourism is less impacted by beach litter than originally assumed. Nine different scenarios are considered for the sensitivity analysis, ranging from a 90% reduction in tourism numbers if coastal litter is not cleaned up, to only a 10% reduction in tourism numbers.

1 When purchasing a product, an individual will pay a deposit for the packing, which is reimbursed when the packaging is returned. This encourages return and reuse by consumers, and therefore reduces the number of such items ending up as litter (Numata, 2005).

2 74% is considered as the defining threshold; below this return rate, the deposit rate will go below R 0.1, which is practically impossible to achieve. The return rates (86%, 94% and 100%) were randomly selected to analyse what happens when the return rate is increased by 10%.

Source : Strategic tourism Infrastructure Development, Cape Town, tourism department Cape Town

Realization : Aanchal Jain

Figure 1: Map of beaches in Cape Town City, South Africa

Results

Impacts on tourism revenue

Approximately R 7.8 billion could potentially be lost if international tourists are unwilling to visit Cape Town's beaches, and R 591 million in the case of domestic tourists.[3] Overall, if there is plastic litter on the beaches, Cape Town could lose up to R 8.5 billion in total coastal tourism revenue, representing 91% of total coastal tourism revenue and 67% of overall tourism revenue. An estimated 1.5% of the GDP of Cape Town could be impacted by the presence of plastic litter that is not cleaned up (City of Cape Town, 2019).

Impact on tourism employment

The revenue which could have been lost in the absence of beach clean-ups could employ approximately 29,258 people in the tourism sector. According to the calculation in this study, 67.8% of total employment in the total tourism sector and 91% of total employment in coastal tourism in Cape Town would lose their job due to the plastic litter on beaches.

Beach cleaning efficiency for all coastal plastic litter

Due to the regular organisation of beach clean-ups, Cape Town is avoiding a loss of R 8.5 billion. If the cost of conducting clean-ups (R 13 million per year), is compared to the benefit (i.e. the avoided damage), beach clean-ups are a very efficient intervention. For every Rand spent on the beach clean-ups, 1.9 g of plastic litter is collected, and R 665 tourism revenue is saved.

Beach cleaning efficiency for plastic bottles

Out of all the waste, plastic bottles were found to be the most abundant, making up 14% of all plastic litter found on the beaches. From an efficiency perspective, the cost of cleaning one single bottle from the coastline is on average R 9.6, whereas cleaning a single plastic bottle can save an estimated R 6,249. This indicates that every Rand spent on cleaning up plastic bottles will save R 654 (See Table 3).

Impact on plastic bottle collection with the implementation of a DRS

In addition to beach clean-ups, other instruments can be employed to reduce plastic waste by preventing it from ending up on the beach in the first place. One such instrument is a DRS. This study focuses on the joint implementation of a DRS system for plastic bottles alongside beach clean-ups, the latter to remove the remaining litter from beaches.

3 R = South African Rand currency sign.

It is estimated that 635 million bottles are consumed annually in Cape Town. 245,265 bottles end up as litter without a DRS system in place (See Baseline, Table I). However, by implementing a DRS - with a 74% of return rate (DRS 74%)[4] - only 66,054 bottles are littered and will need to be cleaned through beach clean ups (Table 1). This reduces the beach cleaning cost for bottles from R 2,345,290 to R 631,630.

In the second DRS scenario, 87% of bottles are collected, which means that only 33,027 bottles are littered on the coastline. This reduces beach clean-up costs for bottles to R 315,815.

In the last scenario - with a 100% return rate - no more plastic bottles need to be cleaned from the beach; only the remaining litter is cleaned so as not to negatively impact coastal tourism. This said, achieving a 100% return rate of plastic bottles is difficult to achieve.

Overall, the presence of a DRS can significantly reduce the number of bottles littered on beaches from 245,000 to 15,000 (in scenario DRS 94%).

Table 1: Bottles collected through DRS and beach clean-ups with different return rates

	Impact on DRS system					Impact on beach clean-ups	
Scenarios	**Return Rate**	**Deposit rate (ZAR)[5]**	**Bottles returned**	**Bottles not returned**	**Cost of DRS (ZAR)**	**Bottles littered on beaches**	**Cost cleaning bottles from beaches (ZAR)**
Without DRS	-	-	-	-	-	245,264	2,345,290
DRS 74%	74%	0.1	470,000,116	165,135,176	128,927,191	66,054	631,630
DRS 87%	87%	2.3	552,567,704	82,567,588	136,097,546	33,027	315,815
DRS 94%	94%	11.6	597,027,174	38,108,117	139,638,422	15,243	145,761
DRS 100%	100%	46.5[6]	635,135,291	0	142,851,791	0	0

Total cost of clean beaches (with beach clean-ups and DRS)

Jointly implementing a DRS and beach clean-ups decreases the total costs to clean the coastline. For example, in Scenario 2 (DRS 74%), the total cost to clean beaches decreases from R 13 million to 11 million. This is because an increased DRS cost decreases the bottles littered on beaches, which reduces beach clean-up costs by at least 14%. If 100% of bottles are returned, the beach clean-up cost will further decrease by R 1 million. As the number of bottles returned to DRS increases, fewer bottles are littered on the beaches. As a result, this reduces the overall beach clean-up costs.

Table 2 provides the total beach clean-up costs (not limited to plastic bottles), and the proportion of DRS costs spent on the collection of bottles (which could have otherwise ended up on beaches). Contrary to Table 1, which shows the total costs of the DRS, Table 2 only shows the proportional DRS costs for bottles that would have otherwise ended up on the beach. The purpose here is not to show the costs incurred to collect plastic, but to show the costs incurred to clean beaches.

Figure 2 depicts two types of data: (1) DRS costs limited to beaches (which are 4% of the total DRS set-up costs, and 96% lower than the beach clean-up costs); and (2) beach clean-up costs (which decrease with the introduction of a DRS).

4 DRS74% represents the scenario where only 74% of bottles are returned back to the system.

Table 2: Total costs to clean beaches through beach clean-ups and DRS

Scenarios	Cost of cleaning beaches with DRS (ZAR)	Cost of beach clean-ups (ZAR)	Total cost to clean beaches with both interventions (ZAR)
Without DRS		13,029,387	13,029,387
DRS 74%	51,571	11,367,299	11,315,728
DRS 87%	54,439	11,054,352	10,999,913
DRS 94%	55,855	10,885,713	10,829,858
DRS 100%	57,141	10,741,238	10,684,097

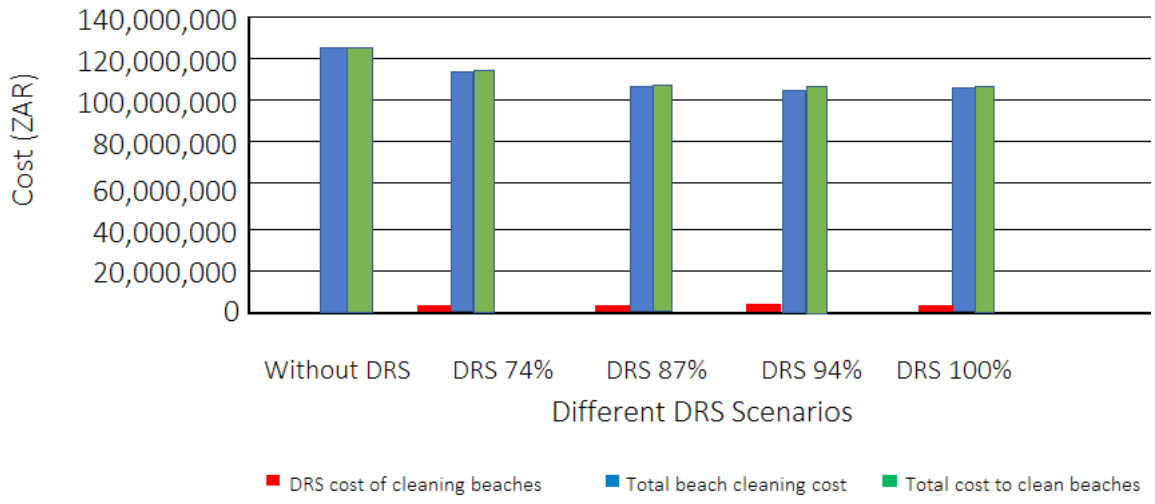


Figure 2: Different DRS scenarios

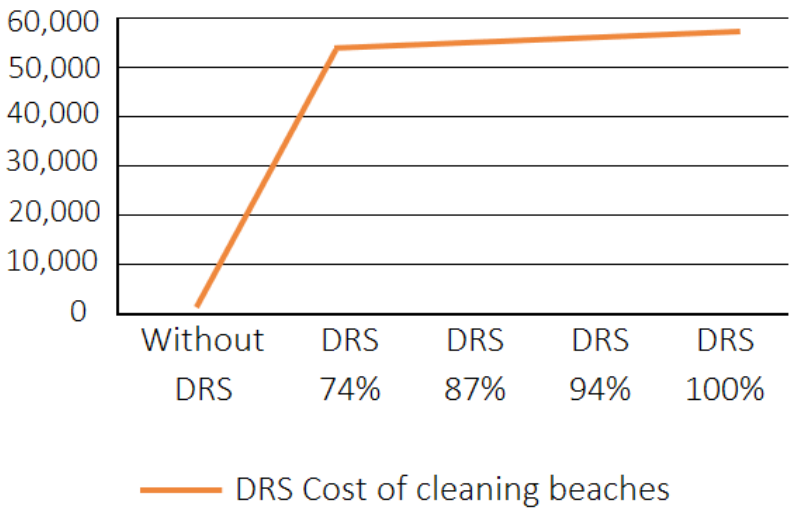


Figure 3: DRS related costs to clean-up the bottles from the beaches

Cost efficiency of clean beaches

Table 3 shows the efficiency of combining the different systems, with the efficiency being calculated as 'benefits/costs' or 'avoided loss for the tourism sector/costs of the system'. The efficiency increases when the two systems are operated together.

For the purposes of this study, efficiency was calculated according to the economic benefits for the tourism sector, i.e. the avoidance of losing tourists due to pollution of beaches. All other potential benefits generated from implementing one of the two interventions or a combination of both, are not considered for this study. Other benefits include, for example, positive impacts on marine wildlife and improved marine water quality as less plastic enters the ocean (Moore et al., 2001). A DRS can also benefit the waste management department, leading to increased recycling, and decreased landfill costs.

Table 3: Efficiency of combining DRS and beach clean-ups to avoid losses for the tourism sector

Scenarios	Cost Efficiency estimate
Without DRS	654
DRS 74%	749
DRS 87%	770
DRS 94%	782
DRS 100%	793

Impact on employment after DRS implementation

The implementation of a DRS has the potential to generate many other benefits in addition to avoiding damage to the tourism sector. Most importantly, a DRS can potentially create at least 741 jobs, including employment for collecting the bottles in big stores (2 workers per big retail store) and administrative staff (15 employees). Furthermore, an estimated 350 jobs are created through beach clean-ups. By contrast, the increasing return rate from a DRS will decrease the efforts that have to be placed for beach clean-up; and hence, some of these jobs will be lost. However, even if 100% of bottles are returned, an estimated total of 1,028 jobs (including lost jobs) could be generated by the two interventions being implemented together. This would account for at least 2.34% of the total jobs in the tourism sector. Thus, the implementation of a DRS, with ongoing beach-clean ups could support economic recovery through green job creation.

Sensitivity Analysis

As tourists become less sensitive to plastic pollution, the efficiency of beach cleaning efforts is reduced as well, as less benefit (avoided losses) is generated from the same cost. For example, in the first scenario (without DRS), the cost efficiency decreases from 654 to 72 with a reduction in tourist sensitivity from 90% to 10%. Similarly, in the second scenario (DRS with 74% return rate), the cost efficiency also decreases from 749 to 82 with a reduction in tourist sensitivity from 90% to 10%.

This shows that as the importance of clean beaches decreases for tourists, the impact on avoiding losses in the tourism revenue decreases, as tourists will spend or visit the beaches as usual. This decreases the value of the externality that plastic debris on beaches is causing; the lower the externality value, the lower the efficiency will be. For instance, if 90% of tourists are concerned by littered beaches, every R 1 spend on cleaning beaches will bring R 654 into the economy. If only 30% of tourists are concerned by littered beaches, the efficiency will decrease to R 111 for every R1 spent. However,

even under these scenarios, the beach cleaning solutions are still efficient, as the avoided losses are higher than every rand spent on reducing the number of plastic bottles on beaches.

In summary, to clean beaches, beach clean-ups are more efficient if implemented along with a DRS. The cost efficiency increases as the DRS return rates increase. At the same time, the efficiency will decrease as fewer tourists are affected by beach litter and as the tourists' sensitivity decreases.

Table 4: Total Cost Efficiency of beach clean-ups and DRS with varied tourists' sensitivity

	Change in tourists' sensitivity towards beach litter (%)									
DRS Scenario	**90%**	**80%**	**70%**	**60%**	**50%**	**40%**	**30%**	**20%**	**10%**	**0%**
	Total Cost Efficiency									
Without DRS	654	575	503	431	359	287	215	144	72	0
DRS74%	749	659	576	494	412	329	247	165	82	0
DRS87%	770	677	593	508	423	339	254	169	85	0
DRS94%	782	688	602	516	430	344	258	172	86	0
DRS100%	793	697	610	523	436	348	261	174	87	0

Conclusion

This study shows how the presence of marine plastic pollution on can have a major impact on the tourism sector, potentially reducing tourism revenue and employment by up to 91%. By spending R 13 billion on regular beach clean-ups, Cape Town avoids a damage of an estimated R 8.5 billion.

Adopting a Deposit Refund Scheme in combination with the current beach clean-up practices could reduce the cost of beach cleaning by an estimated 14%. The reduction in the number of plastic bottles on beaches and the cost of a DRS will continue decreasing as the bottle return rates increase; in other words, the DRS will become more efficient. Jointly implementing the two interventions increases the overall cost efficiency of keeping the beaches clean. Without a DRS system in place, and considering a potential reduction in beach tourism of 90%, every rand spent on cleaning beaches will help Cape Town avoid a loss of R 654. By contrast, with the implementation of a DRS, every rand spent by Cape Town on cleaning beaches will avoid losses of R 749 to R 793 for the tourism sector.

In addition, the implementation of a DRS system can contribute to the creation of jobs in retail, bottle collection, waste management, as well as administrative staff to ensure the smooth functioning and implementation of the DRS. While not considered for the purposes of this study, other potential benefits are also generated from the implementation of a DRS. These benefits include: a reduction in waste management and collection costs, reduced landfill costs, reduced household waste disposal costs, reduced illegal dumping, increased recycling, and improved marine water quality.

Bibliography

Abalansa, S. (2020). The Marine Plastic Litter Issue: A Social-Economic Analysis, *Sustainability*, 12(20): p. 12, Available at: https://www.researchgate.net/publication/349140134_The_Marine_Plastic_Litter_Issue_A_Social-Economic_Analysis.

Ballance, A. (1996). The Recreational use value of beaches in the Cape Peninsula, South Africa. M.Sc. Thesis, University of Cape Town.

City of Cape Town, Williams S., Crous M., Ryneveldt, L. (2019). Economic Performance Indicators for Cape Town, Available at: http://www.capetown.gov.za/work%20and%20business/doing business in the city/businsssupport and guidance/economic reports/Economic%20resources%20and%20publication.

Derraik, J. (2002). The pollution of the marine environment by plastic debris: a review, *Marine Pollution Bulletin,* 44 (9), Available at: https://doi.org/10.1016/S0025-326X(01)00139-4.

Donohue, M.J., Boland, R.C., Sramek, C.M., and Antonelis, G.A. (2001). Derelict fishing gear in the north western Hawaiian Islands: diving surveys and debris removal in 1999 confirm threat to coral reef ecosystems. *Marine Pollution Bulletin*, 42 (12): p.14, Available at: doi: 10.1016/s0025-326x(01)00139-4.

Galgani, F., Hanke, G., Werner, S., Oosterbaan, L., Nilsson, P., Fleet, D., et al. (2013). Monitoring guidance for marine litter in European Seas, *JRC Scientific and Policy Reports*, Report EUR 26113 EN, p. 120, Available at: https://circabc.europa.eu/w/browse/85264644 ef32 401bb9f1 f640a1c459c2.

Galgani, F., Piha, H., Hanke, G., Werner, S., and MSFD GES Technical group. (2011). Marine litter: Technical recommendations for the implementation of MSFD requirements, Publications Office of the European Union, Available at: http://publications.jrc.ec.europa.eu/repository/handle/111111111/22826

Hess, N.A.; Ribic, C.A., and Vining, I. (1999). Benthic marine debris with an emphasis on fishery related items, surrounding Kodiak Island, Alaska, 1994 1996, *Marine Pollution Bulletin*, 38(10): p.38, Available at: doi: 10.1016/S0025-326X(99)00087-9.

Hidalgo Ruz, V., & Thiel, M. (2015). The contribution of citizen scientists to the monitoring of marine litter, *Marine Anthropogenic Litter*, p. 433, Available at: https://doi.org/10.1007/978-3-319-16510-3_16.

Jang, Y. C., Hong, S., Lee, J., Lee, M. J., & Shim, W. J. (2014). Estimation of lost tourism revenue in Geoje Island from the 2011 marine debris pollution event in South Korea. *Marine Pollution Bulletin*, 81(1): p. 49-54, Available at: https://doi.org/10.1016/j.marpolbul.2014.02.021.

Jones, M.M. (1995). Fishing debris in the Australian marine environment. *Marine Pollution Bulletin*, 30(1): p. 30, Available at: doi: 10.1016/0025-326X(94)00108-L.

Legett, C., Scherer, N., Curry, M. & Bailey, R., and Haab, T. (2014). Assessing the economic benefits of reductions in marine debris: A pilot study of beach recreation in Orange County, California, National Oceanic and Atmospheric Administration, p. 44, Available at: http://marinedebris.noaa.gov/sites/default/files/MarineDebrisEconomicStudy.pdf.

Moore, W.K, Scott, D.L. (1983). Beverage container deposit laws: a survey of the issues and results, *The Journal of Consumer Affairs*, 17(1): p. 57 80, Available at: https://www.jstor.org/stable/23859188?seq=1.

Nelson, C. and Botrill, D. (2002). Evaluating the contribution of beach quality wards to the local tourism industry in Wales the Green Coast Award. Ocean and Coastal Management, *Ocean and Coastal Management*, 45 (2-3): p.45, Available at: doi: 10.1016/S0964-5691(02)00053-4.

Newman, B. & Taaljard S. (2019). Know your Coast, City of Cape Town, p.5, Available at: https://resource.capetown.gov.za/documentcentre/Documents/City%20research%20reports%20and%20review/Know%20Your%20Coast%202019.pdf.

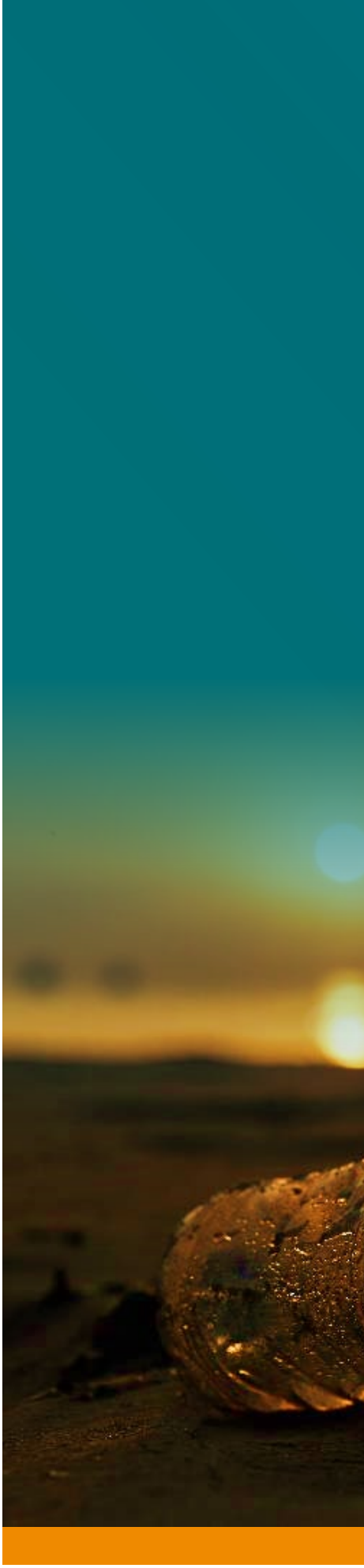
Ryan P.G. (1988). The characteristics and distribution of plastic particles at the sea surface off the southwestern Cape Province, South Africa. *Marine Environmental Research*, 25(4): p. 25, Available at: doi: 10.1016/0141-1136(88)90015-3.

Sowman, M. (1990). The Status of Coastal Zone Management in South Africa, *Coastal Management*, 21(3); p. 21, Available at: doi: 10.1080/08920759309362201.

Takunda Y.C., von Blottnitz, H. (2019). Accumulation and characteristics of plastic debris along five beaches in Cape Town, *Marine Pollution Bulletin*, 138, Available at: doi: 10.1016/j.marpolbul.2018.11.065

Tudor, D. T., Williams, A. T. (2008). Important aspects of beach pollution to managers: Wales and the Bristol Channel, UK. *Journal of Coastal Research*, 243: p. 735 745, Available at: https://doi.org/10.2112/06-0727.1.

Walker, T.R.; Ris, K.; Arnould, J.P.Y., and Croxall, J.P., 1997. Marine debris surveys at Bird Islands, South Georgia 1990 1995, *Marine Pollution Bulletin*, 34(1): p.34, Available at: doi: 10.1016/S0025-326X(96)00053-7.



INTERNATIONAL UNION
FOR CONSERVATION OF NATURE

WORLD HEADQUARTERS
Rue Mauverney 28
1196 Gland
Switzerland
Tel +41 22 999 0000
Fax +41 22 999 0002
www.iucn.org