



# Parachute science through a regional lens: Marine litter research in the Caribbean Small Island Developing States and the challenge of extra-regional research

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## ABSTRACT

The Wider Caribbean (WC) comprises numerous diverse developing states and territories including Small Island Developing States (SIDS). In particular, the Eastern part of the WC with its 16 SIDS receives a disproportionate amount of marine litter. Addressing this serious and urgent environmental problem requires scientific evidence to support and inform policy formation and decision making. Yet, as this study demonstrates, marine scientific research on the issue of marine litter in the Caribbean SIDS is predominantly undertaken by extra-regional scientists and organisations which might weaken the science-policy transfer to develop suitable and tailor-made solutions. The view point paper highlights issues and the problems associated with parachute science for the Caribbean SIDS before offering a series of potential policy-ready response options to address the identified challenges.

## 1. Introduction

The Wider Caribbean (WC) is a region of more than three dozen diverse states and territories, with varying ecological and socio-economic priorities (Barnett, 1997; Kumar and Mishra, 2015). The Small Island Developing States (SIDS) of the WC, in particular, share certain common features and challenges, as they have a high dependency on tourism, limited land resources and high population densities (Wong, 2015). Importantly, SIDS are highly dependent on the surrounding oceans and ecosystem services from the ocean such as seafood for human consumption, pristine beaches for recreation and a thriving marine life which attracts cruise and dive tourism and contributes to livelihoods through fishing (Pelling and Uitto, 2001; Briguglio, 1995). This interdependence and close connection with nature makes SIDS ideally positioned to act as a “global barometer of change” (Kelman and West, 2009). Pollution of the marine environment by plastic waste stemming from oceanic currents and localized sources is only one of many pressures which impact the long-term environmental and economic prosperity of SIDS (Lachmann et al., 2017). Therefore, it can be argued that specific and tailor-made research addressing the challenges associated with marine litter has to be conducted for and in

the region in order to meet their needs. However, this is not always the case and the phenomena of parachute science may occur. Parachute science for the purpose of this paper refers to a phenomenon whereby there is a preponderance of research conducted by scientists based predominantly outside the target geographical region without the input or involvement of local experts. However, the authors acknowledge that a discussion on parachute science is a high value-based issue which is closely interlinked to societal norms, academic traditions and access to resources in a region and may also change over time and within differing contexts.

The viewpoint paper aims to explore the issue of parachute science in the SIDS of the WC and analyses the means by which marine plastic pollution measures are developed. Based on this analysis, the paper provides the viewpoints of the authors on how to effectively increase research on marine litter in the region by researchers from the region.

## 2. Addressing marine litter pollution in the Caribbean Region

The Caribbean region is host to 16 SIDS (United Nations (UN), 2021). These are Antigua and Barbuda, The Bahamas, Barbados, Belize, Cuba, Dominica, Dominican Republic, Grenada, Guyana, Haiti, Jamaica, St.

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Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname and Trinidad and Tobago (see Fig. 1).

Due to the geographic location of most of these SIDS at the outer rim of ocean gyres and wind belts, they are heavily impacted by anthropogenic pressures from marine pollution, in particular marine litter (Ambrose, 2021; Clayton et al., 2020; Diez et al., 2019). Consequently, marine litter density in the Caribbean has been estimated to be three times higher than the global average (Diez et al., 2019). There is a certain understanding that waste management and mismanaged terrestrial waste is a significant source of marine litter in the Eastern Caribbean region (Clayton et al., 2020). Among the many complex questions posed by marine litter management in the region, it remains yet to be seen how specific measures and responses should be guided by science and scientific advice (Chen, 2015; Rochman, 2016).

### 2.1. Marine litter research in Caribbean SIDS

A variety of efforts to identify marine litter related research priorities have been undertaken in the past at national and regional levels, often through agency-led approaches that draw on eminent scientists for advice. Yet, this vital requirement has many complex facets (MacDonald et al., 2016) including the need for an understanding of governmental and scientific needs and priorities, as well as those of the broader public relating to agenda-setting and framing a science-policy approach involving several stakeholders within a given context (Rudd, 2015). This also relates to understanding the effects of pollution and cumulative impacts from other types of anthropogenic pressures in the Caribbean, as well as those related to climate change and extreme weather events.

Whereas a considerable volume of research has been conducted in certain areas of the world [e.g. in the European Union: Galgani et al., 2013; UN World Ocean Assessment, 2021] and a certain understanding

of sources and distribution of marine litter is prevalent or at least emerging; sparse research has been conducted in the Caribbean region to date meaning that significant knowledge gaps persist, relating to sources and pathways of marine litter. Several international and regional organisations are increasingly working in the region and have contributed to policy coordination and the preparation of guidance documents on scientific monitoring and assessment. This includes the UN Environment Caribbean Programme (UNEP CEP), Global Partnership for Marine Litter-Caribbean (GPML-Caribe), the Gulf and Caribbean Fisheries Institute (GCFI) and the IUCN's Plastic Waste Free Islands Initiative (IUCN, 2021).

A distinction between monitoring of marine litter and research relating to the sources and impacts of marine litter in the region must also be considered. Monitoring for marine plastic litter on beaches in the region occurs only sporadically and independently by volunteers or citizen science, non-governmental organisation (NGO) initiatives (Ambrose, 2021). Monitoring of the marine environment for marine litter may be established formally via government programs that maintain a hybrid approach using citizen science (Zorzo et al., 2021), whereas, formal research may expand into biological, ecological and economic impacts of marine litter through assessments or experiments. Further, there is a tendency to draw on the results of volunteer clean-up activities to gain an understanding of the amount and distribution of marine litter in the Caribbean Region (Ocean Conservancy, 2017; Diez et al., 2019). This is in no way intended to detract from the importance of clean-up activities, in particular with regard to awareness raising. Such actions, while they serve to deepen the understanding of the extent of the problem of marine litter and frequently produce significant findings, might undermine reaching an evidence-based understanding of the state of pollution by marine litter on the marine and coastal environment and its sources due to the absence of structured and continuous



Fig. 1. Map of the Wider Caribbean Region including all Caribbean SIDS (highlighted in blue). Eastern Caribbean countries are highlighted in the inset map. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

monitoring and/or research activities in place.

Increasingly, a number of reports have been published and measures taken with regard to marine litter in the Caribbean region (see Table S2). An assessment of the knowledge base for the region makes apparent that the knowledge created with regard to the multifaceted challenges of marine litter is not equally distributed. Knowledge on distribution and sources of litter is limited in respect of several countries (Smail et al., 2020).

In particular, we argue that SIDS are not often the subject of peer-reviewed papers or are written by researchers from these countries. By way of example, Ivar-do-Sul and Costa reviewed 70 documents on marine litter in Latin America and the Caribbean region and merely two peer-reviewed papers were from the insular Caribbean (Ivar-do-Sul and Costa, 2007).

It is generally understood that peer-reviewed papers are seen as providing a robust and accessible source of information which are reviewed for their validity, significance and originality (Kelly et al., 2014). This makes them a suitable source for decision-makers to address specific point sources of litter, by way of example, or risk factors relating to infrastructure challenges and consumption and production patterns which might lead to marine litter (Nurse-Bray et al., 2014; Tengö et al., 2014). They can therefore be used to develop targeted measures in line with international and regional objectives (UNEP/NOAA, 2011). It has been established that a majority of research in the Wider Caribbean Region is documented in institutional reports, which are difficult to find and oftentimes not published for external users (Acosta et al., 2020).

### 3. Methodology

Using SCOPUS, LITTERBASE and Google Scholar, peer-reviewed journal articles which address or target all of the 16 SIDS in the Caribbean were identified (see Fig. 1, Table S1 and Fig. S2 Supplementary material). This was done by standardized keywords: “Marine Debris and Caribbean”, “Marine Litter and Caribbean”, “Marine Plastic and Caribbean” and “Marine Debris/Marine Litter” followed by each of the 16 Caribbean SIDS (see Table S1). The reference list of all relevant papers was then searched for additional articles. The country affiliation of the lead authorship and senior authorship of the articles at time of publication as indicated in the author affiliation information provided to the journal was analysed (see Table S2). It is acknowledged that researchers may move and that an affiliation to a certain university does not account for the actual citizenship of the individual researcher, thus country affiliation can only be used as an approximation on where the researcher may come from. For this reason, further investigations into the university webpages of each author was made to attempt to determine the origin country of each author within a reasonable degree. In addition, the gender of lead and senior authors was identified, where possible.

### 4. Results and discussion

Out of the 23 identified papers addressing any of these SIDS, 65% of the papers were not authored by lead authors affiliated to countries from the region at time of writing the papers in question. With regard to senior authors in case of multiple authorships, 85% of the authors did not come from the region. Females represented 57% of the lead authorship, with males representing 43%. Overall, these findings raise questions relating to the applicability of information provided and the knowledge on which decision makers may act to address the issue of marine litter in the region. In order to find adequate and appropriate solutions tailored to the specific governance structure, both in terms of level of decision-making (municipal, national and/or regional) as well as with regard to specific sources and pathways, the knowledge and information provided should ideally be based on the expertise of researchers already in situ in the region. In a recent paper on parachute science, Stefanoudis et al. (2021), provided insights into the concept which they frame as a practice in which international scientists, usually from higher-income

countries conduct research in lower-income countries without necessarily engaging with local considerations and suggestions for suitable recommendations (Stefanoudis et al., 2021). Similar approaches to the marine litter research in the SIDS of the Eastern Caribbean can be therefore also categorized as being subject to parachute science or hegemonic research.

#### 4.1. Understanding the research agenda for marine pollution/litter in Caribbean SIDS

Science is a key source for decision-makers when developing and creating policy (Polejack, 2021; Pielke, 2007). It is well known that conducting research is the basis of advancement in science (Acharya and Pathak, 2019). Research output and of course monitoring and assessment for marine litter can be costly when integrated in a national or regional monitoring strategy/framework and when several compartments of the marine environment are being monitored (e.g. beach litter, litter in the water column and litter in biota and sediments) (Smail et al., 2020). Given the efforts required to monitor and assess various aspects of marine litter, uptake of the best available research by decision makers is the ultimate goal. Within the context of the WC the mechanism that facilitates the uptake of research by policy/decision makers involves ‘research providers’ and ‘research users’. Research users within the region have diverse backgrounds and work within several institutions such as: universities, marine laboratories, NGOs, private sectors and regional and national agencies. Research conducted by research providers is primarily taken up by advisors (e.g., Cabinet, Fishery Advisory Committees, National Coordination Committees and Ministerial Councils) who then engage with decision makers (Acosta et al., 2020). In order for the science-policy interface to be effective, the process needs to be iterative with research providers conducting science that is responsive to the needs of policy and research users basing their decisions on the best available science, however this is not always achieved (Acosta et al., 2020). The research agenda of scientists can be driven by several factors. This can include political commitments and obligations stemming from international, regional or national regulatory or policy frameworks. The UN 2030 Sustainable Agenda (UN, 2015) follows a universal approach which requires that every country possesses the necessary science and technology to develop responses to its specific characteristics, needs and priorities (van der Heijden et al., 2014 and O'Connor and Mackie, 2016). UN Sustainable Development Goal 14.a calls for an increase of scientific knowledge and the development of research capacities in order to improve ocean health to the benefit of developing countries, in particular SIDS and least developed countries (UN, 2015). Moreover, the UN Decade of Ocean Science for Sustainable Development, which runs from 2021 to 2030, aims, among other objectives, to understand the impacts of cumulative stressors and seeks sustainable solutions for benefits from the oceans and to share knowledge and enhance interdisciplinary marine research capacities leading to benefits [...] particularly for SIDS and least developed countries (UNESCO IOC, 2017). These two policy objectives frame the understanding that SIDS are a particular subject in ocean governance and that the science-policy approaches should be targeted to meet their needs and address capacity gaps. This is somewhat juxtaposed with the fact that over 60% of the total scientific literature emanates from high-income countries (UN, 2019a, 2019b).

Improving the science-policy interface requires an in-depth understanding of both research agendas of scientists and the research agendas of decision makers. In a recently published GCFI Technical Report (Acosta et al., 2020), research agendas for pollution were identified from the perspective of decision makers who are responsible for implementing policies. To identify priority research areas, decision makers were presented with five crosscutting research topics: science, governance, monitoring, economic and communications. With regards to economic research needs, decision makers highlighted the need for improved solid waste management approaches to accompany the expansion of tourism since many SIDS within the WC are highly dependent on tourism (Wong,

2015). Under the communication research needs, decision makers felt that research is needed to develop effective advocacy approaches that result in decreased marine pollution (Acosta et al., 2020).

The Regional Action Plan on Marine Litter (RAP MaLi) adopted by the Contracting Parties of UNEP CEP (UNEP CEP, 2014) also provides incentives to dedicate research to aspects of the Plan. The geographic scope of the RAP MaLi also includes SIDS in the Caribbean region. Similarly, a recently published report by UN Environment (UN Environment, 2021) identified research priorities must also address gender and intersectionality, which may be factors such as age, marginalized and vulnerable groups, especially in relation to exposure, health effects, attitudes to new innovative technologies and ocean literacy, among others. Acosta et al. (2020) identified that beyond developing research needs from on-going processes and institutional agenda, the uptake of the research outcome and a strategy for linking the science to policy should be in place to secure effective management strategies. It would be important to understand what mechanisms can on the one hand provide for a framework to disseminate information and provide research funding and drive the research agenda by regional scientists.

#### 4.2. Funding marine litter research

Acharya and Pathak (2019) identify the primary root causes for lower productivity in terms of research output in low-income countries as the high cost for necessary equipment, research infrastructure and strategic political planning. The Caribbean Region has limited access to investment in research and development (0.75% of GDP for research and development, world average 2.2.7% of GDP in 2017) as well as limited strategic political planning (World Bank, 2017). The high debt to GDP ratio of many Caribbean islands might also impact the ability to invest in research and development (OECD, 2019). Overall, a fundamental deterrent to proper advancement of science and research in the WC, is the level of poverty and lack of scientists in the region (IADB, 2007). Latin America and the Caribbean represent 8.42% of the world's population, however only 2.5% of the world's scientists come from this region (IADB, 2007). This 2.5% represents scientists from a broad field of scientific research and does not account for the number of scientists from SIDS who dedicate their efforts to marine related issues or even marine litter in the region.

One of the major criticisms of parachute science is the tendency for outside researchers to come into an area, conduct research and leave without engaging with local experts or acknowledging their input into the research. However, there are instances of extra regional led research that takes place within the region that engages locals while also providing a funding source. For instance, the ongoing work being undertaken in projects funded by the Norwegian government involving key regional and national players such as the Organisation of Eastern Caribbean States (OECS) Secretariat and national environmental agencies. The OECS's RemLit Project (OECS, 2020) aims to reduce and control marine litter in participating member states of the OECS. The project has received funding support from the Government of Norway and includes activities aimed at awareness raising on the issue of marine litter, enhancing public policy as well as legislative and fiscal insensitive frameworks, and the development of strategies for improving the transnational movement of plastic waste in the OECS. While at its core RemLit does not include specific objectives related to the advancement of scientific knowledge, the ongoing initiatives may provide useful information. Similarly, the Plastic Waste Free Islands Project (IUCN, 2021), also funded by Norway through the Norwegian Agency for International Development (Norad) and being implemented by the IUCN, includes a number of Caribbean SIDS as well as small island countries in the Pacific region. The project has adopted a knowledge-based approach to the development of practical solutions for increasing policy effectiveness, reducing plastic leakage and the creation of new value chains. This is being done with the input and involvement of key agencies from the partner countries and local knowledge. As in the case of the RemLit

Project, the Plastic Waste Free Islands Project is not expressly centred on scientific research, however in both cases there exists the opportunity to advance knowledge on the challenge of marine litter within the participating countries.

### 5. Recommendations on how to strengthen the knowledge base on marine litter in Caribbean SIDS

#### 5.1. Actively seek to engage local researchers and scientific institutions in the region before engaging on research in the region

Establishing a relationship with local/regional researchers prior to conducting field studies can be extremely beneficial for both international and regional scientists. This relationship serves as a mutual knowledge exchange as locals offer insights into the issues they face and how challenges vary over space and time. On the other hand, international scientists can provide solutions based on ongoing global research and work with locals to collect data and build local capacity. Should there be research conducted from scientists from outside the region, it would be strongly advised to ensure that local researchers are informed and indeed actively involved in this kind of research and that any information or results stemming from this research is channeled back to the region and researchers. EXXpedition, a community interest company which runs all-female sailing research expeditions at sea and virtually voyages on land to investigate the causes of and solutions to ocean plastic pollution may be seen as one example which may achieve this cooperation, notwithstanding its limited scope in terms of participants (eXXpedition, 2021). During the research sails in the WC, also local researchers were involved alongside international researchers.

Research directly undertaken in low-income countries is likely to be better suited to the needs and priorities within a society or nation's context and better accounts for the social, economic and governance structures and approaches within a specific society. In this regard, efforts should also be made to translate scientific knowledge into local languages and dialects, which may increase the translation of scientific knowledge into local and regional measures (Ban et al., 2020).

#### 5.2. Research uptake by decision-makers

A possible pathway to ensure an increase of financial support to strengthen research from the region might be the uptake of provided scientific knowledge by decision-makers. Acosta et al. (2020) argue that whereas marine research has a long history in the Caribbean region, this has been mainly opportunistic in nature and not of a strategic nature as the scientists drove the research activities rather than decision-makers. Further, Wisz Mary et al. (2020) argue that the complexities associated with scientific evidence necessitates that this be "distilled to highlight core insights" so that it can be useful to decision makers.

The ongoing work being undertaken through regional initiatives such as RemLit and the Plastic Waste Free Islands Project as well as through regional intergovernmental bodies like UNEP CEP, are often supported by national governments through environmental agencies. Effort needs to be made to capture, synthesize and disseminate the data and information derived from these initiatives into academic writing.

#### 5.3. Explore the opportunities of North-South and South-South knowledge transfer

In order to attain more inclusive and sustainable development in the WC, a renewal of international cooperation is essential (CEPAL, 2021). The cooperation in subject includes entities such as the North-South and South-South cooperation. North-South and South-South cooperation offer a complementary direction to renew and multiply the options to achieving sustainable development goals (IsDB, 2019; CEPAL, 2021). North-South cooperation (NSC) is the most traditional type of cooperation whereby developed countries (north) provide economic support or



other forms of financial aid and resources to the developing countries (south) in socio-economic and environmental domains (United Nations, 2019a, 2019b). Meanwhile, South-South Cooperation (SSC) together with Triangular Cooperation (TrC) are contemporary cooperation gaining more momentum over the last decade. TrC according to the United Nations Office for South-South Cooperation (UNOSSC, 2018) is the “collaboration in which traditional donor countries and multilateral organizations facilitate South-South initiatives through the provision of funding, training, management, and technological systems as well as other forms of support.” It is often described as essential to developing nations as it continues to expand and connect various actors and provides opportunities to share and transfer skills, knowledge and technology in a more cost effective way compared with North-South arrangements (Wang and Banihani, 2015; IsDB, 2019). The 2030 Agenda for Sustainable Development (UN, 2015) calls for enhanced SSC and TrC to enhance policy coordination by particularly making science, technology, innovation and knowledge sharing more readily available. For the case of the Caribbean SIDS, SSC and TrC may support to bridge the challenges relating to the geographically distanced location of the Caribbean SIDS which may slow down the sharing of information concerning emerging concerns, assessments and/or suitable technology.

Although the WC has a varied and longstanding experience with SSC and TrC, it is not well-known in other regions and not sufficiently shared with the rest of the world (WHO, 2014). Perhaps because there is a lack of coordination among the multiple regional and global networks and initiatives. According to GEF (2020), there are over eighty regional and global networks and initiatives addressing marine plastics and plastic pollution in the Latin America and Caribbean (LAC) regions. However, there are just a few that are UN institutional agencies (UNOSSC, 2018) which supports South-South cooperation facilitating environmental themed projects including marine litter. UNEP-Regional Office for Latin America and the Caribbean (UNEP/ROLAC) acts as secretariat to the Forum of Ministers of the Environment of Latin America and the Caribbean (CEPAL, 2018). Moreover, the Forum also has an Interagency Technical Committee composed of UNEP, UNDP, ECLAC, IADB and the World Bank. Meanwhile, the Committee on South-South Cooperation is a subsidiary body of ECLAC (CEPAL, 2018).

Essentially, the organisations of the Interagency Technical Committee are individual Clearing House Mechanisms (CHM) (OAS, 1998), which may serve as a forum for the exchange of technologies, expertise, experiences, opportunities, best practices, methodologies, advisory services, and training. They are known to have facilitated a number of projects and programs over the years that are directed to marine litter management. Projects carried out by UNEP-Global Partnership on Marine Litter (GPML)-Caribbean Node, and research conducted by ECLAC (e.g. the Latin America and the Caribbean SDG 14 Implementation Assessment 2020) to name a few, are vital in contributing to the expectation of SSC. Thus, these organisations can benefit by having a joint CHM to achieve efficiency in SSC.

There is also a need for enhanced collaboration with other projects that may not fall directly under SSC directives. For instance, the GloLitter Partnerships Project launched in 2019 by the Food and Agriculture Organization (FAO) and the International Maritime Organization (IMO) and funded by the Government of Norway supports 30 developing countries in preventing and reducing marine litter from the maritime transport and fisheries sectors, which includes plastic litter such as lost or discarded fishing gear (IMO, 2021). Although one may categorize the project as a North-South arrangement, five southern regions are represented in the GloLitter project. According to IMO (2021), these include Asia, Africa, the Caribbean, Latin America and the Pacific. While the project promotes compliance with relevant international instruments (IMO, 2021), there is an opportunity for South-South Cooperation by the participating regions whereby they use this as a platform to allow for the exchange of ideas, technology, innovation and information on research and monitoring specific to marine litter.

To some extent, the perceptions of the added value of NSC and SSC

differ. According to WHO (2014), key informant interviews revealed that developing countries stressed the value of learning, capacity building, solidarity, reciprocity and empowerment, while the informants from International Development Partner (IDP) organisations focused on efficiency, resource use and accountability. Acknowledging this perception while enhancing communication and collaboration among multilateral platforms is crucial to help avoid future fragmentation and confusing or conflicting support entities and to also help reduce the risk of overlapping and duplicating efforts.

## 6. Conclusion

Parachute science is a difficult topic to approach within any given context and relating to any marine environmental problem as it is steeped in a complex set of value-based approaches to research and evidence-based decision-making. Based on our findings, it has become clear that parachute science takes place with regard to the Caribbean SIDS. The root causes may be, among a very complex net of societal factors, a limited funding for monitoring or research and a poor science-policy framework. However, it may be equally challenging to encourage the uptake of decision-makers to make use of the results of research and monitoring and thereby increasing public spending on this. We find that a key to addressing this issue is collaboration and cooperation, among scientists and researchers, government and researchers, countries and donors, as well as international and regional intergovernmental organisations.

### CRedit authorship contribution statement

**Aleke Stöfen-O'Brien:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing. **Kristal Kristene Ambrose:** Writing – original draft, Writing – review & editing. **Kristie S.T. Alleyne:** Writing – original draft, Writing – review & editing. **Tricia Allison Lovell:** Writing – original draft, Writing – review & editing. **Roxanne E.D. Graham:** Writing – original draft, Writing – review & editing.

### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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### Appendix A. Supplementary data

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