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## Baseline

## Litter assessment on 99 Cuban beaches: A baseline to identify sources of pollution and impacts for tourism and recreation

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## ABSTRACT

Litter presence was assessed on the entire Cuban coastline, and includes 99 beaches from all Cuban regions, during field work carried out in 2012 and 2015. A standard method verified in several countries was applied, which classified beaches for nine types of litter into four grades (A-excellent to D-poor). Almost half of the Cuban beaches obtained excellent cleanliness scores, although many needed to be better managed. In this baseline, the most common types of residue were general litter (8% grade D and 35% grades B/C) and potentially harmful litter (<68% with grade A). Resort beaches and those with international visitors showed the best litter management. Tourism Impacts seems to be related to visitor origin therefore choices to develop sustainable tourism in rural and village beaches (64%) appears low, if beach cleaning gross investment is focused on resort beaches (24%). Finally, this paper highlights geographical distribution and types of litter patterns.

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Beaches are globally one of the top tourist attractions and a clean beach is one of five main preferences/priorities for tourists (Williams et al., 2016b), and the topic has attracted the attention of many researchers during the last 30 years (Davies, 1989; Madzema and Lasiak, 1997; do Sul and Costa, 2007; Poeta et al., 2016). Tourism is the world's biggest industry (UNWTO, 2015) and globally international tourist arrivals (overnight visitors) grew by 5% in 2013 (1087 million people), by 4.3% in 2014 (1.133 million people) and by 4.4% (1184 million people) in 2015 (UNWTO, 2016). Beaches are considered the major motivation for more than half of the tourists who are invariably looking for sun, sea and sand (3S) destinations (Doods and Kelman, 2008). The Caribbean region recorded 23.8 million visitors in 2015, which within the Americas, was the greatest improvement in international tourist arrivals (7.4%) with respect to 2014. At this time, Cuba recorded an increase of 5% with respect to 2013 and recorded 2970 million tourist arrivals in 2014 (UNWTO, 2015). Keeping beaches clean should be a major concern for any governmental authority in a tropical coastal country, even more if it is an island (Anfuso et al., 2014; Pranzini et al., 2016).

Global studies about beach litter have been carried out, including diverse topics, such as, spatial distribution (Kusui and Noda, 2003; de Araújo and da Costa, 2007; Schulz et al., 2015), composition of litter (Moore et al., 2001; Oigman-pszczol and Creed, 2007; Zhou et al., 2015), litter sources (Claereboudt, 2004; Carson et al., 2013; Topçu et al., 2013) or users' perception (Tudor and Williams, 2008; Campbell et al., 2016; Slavin et al., 2012). Some countries such as Colombia (Williams et al., 2016b), Chile (Bravo et al., 2009), Spain (Williams et al., 2016a) and Wales (Williams et al., 2014) have recent information of marine debris over wide areas, although few countries have a baseline data set of beach litter for all regions of its coastline.

Within this context, Cuba has not been a frequent player, at least in indexed scientific literature. Research about Cuban beach litter is scarce (Apin, 2013), despite the fact that the island is a worldwide 3S<sup>c</sup> tourist destination (UNWTO, 2015), with >5 billion dollars of gross profits and tax revenues for tourism (Cerviño and Cubillo, 2005). Cuba is the biggest island in the Caribbean Sea, with 5746 km of coastline, >200 rivers and 1200 smaller island and cays. The archipelago stretches from east to west, therefore political and administrative issues are divided into three regions and 14 subdivisions namely provinces: western region (5 provinces), central region (5 provinces) and eastern region (4 provinces); moreover, there is a special island province, namely Isla de

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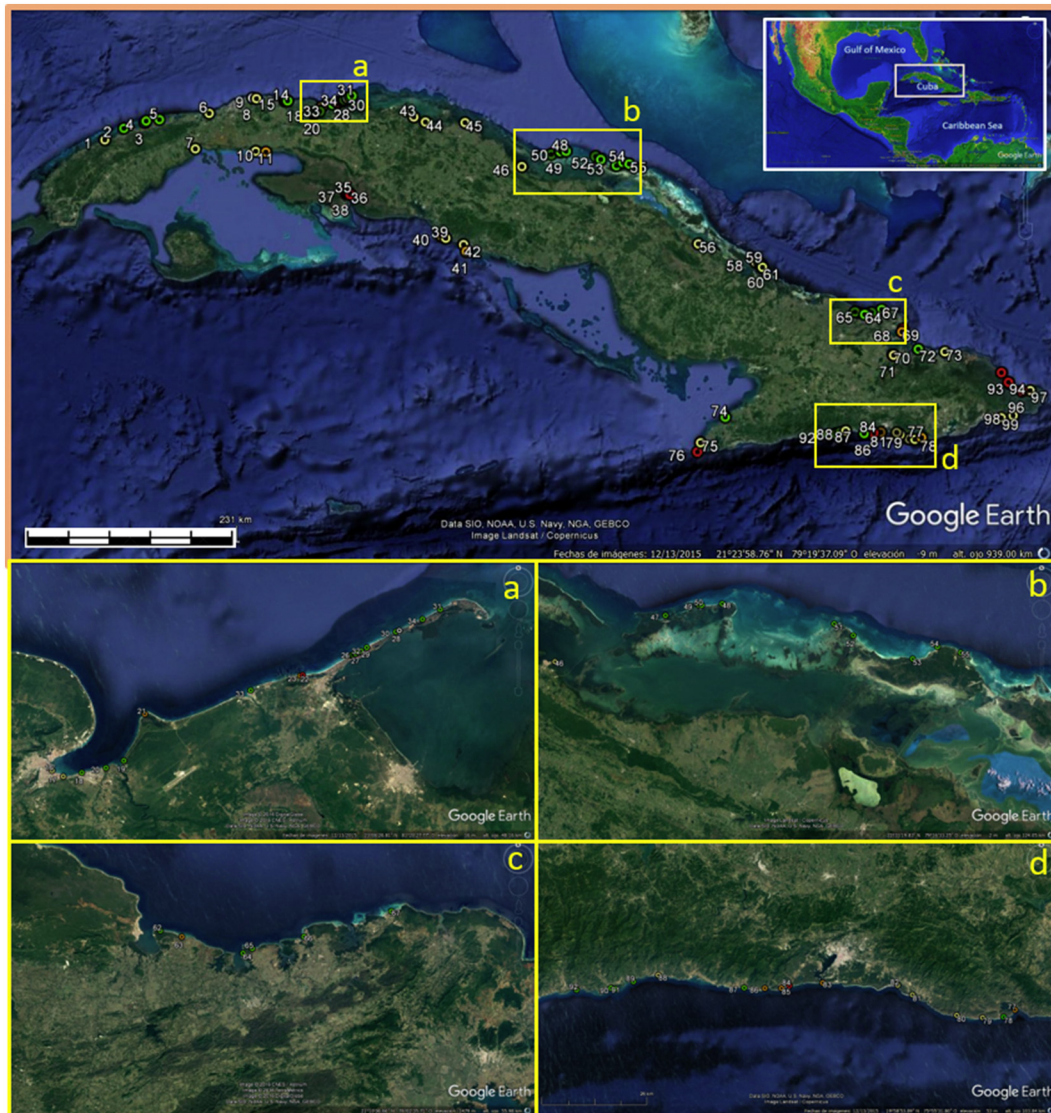
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la Juventud. Cuban tourism is highly concentrated in two areas, La Habana and Varadero (Cerviño and Cubillo, 2005). Other areas of tourist interest, especially because of the great affluence of international visitors, are the archipelago of Sabana-Camagüey and Holguín province. Overall, the archipelago contains a variety of the typical marine ecosystems found in tropical waters, from coral reef habitats to extensive seagrass beds, which contribute to the formation of sandy beaches as a tourist attraction and a source of livelihood for many Cubans (Gerhartz-Abraham et al., 2016). This paper provides a first baseline of beach litter covering 99 sandy beaches (Fig. 1) in the 14 provinces.

Data were collected in two fieldtrips, in June 2012 and May 2015, with the participation of three Cuban researchers (one from each geographical region) and three foreign researchers with previous experiences in beach features sampling. The research team visited all 99 beaches and applied the EA/NALG (2000) technique (Table 1). This method demarcated a 50 m stretch of beach, either side of an access point and stretching from the beach top (seawall, dune, etc.) to the sea counted numbers associated with nine litter types, which were inserted it into a matrix, then classified into four grades (A to D; Table 2). Each beach was classified according to the lower grade shown; i.e. A particular beach could have Grade A for six of the classes, but if one of the types was circled Grade D in the matrix,

that beach is given an overall Grade D. This method (Earll et al., 2000) has been used in many countries around the world, such as, the UK (Williams et al., 2014), Greece (Williams and Markou, 1995), Turkey (Demirci, 2001), Spain (Williams et al., 2016a) and Colombia (Williams et al., 2016b). This paper is the first time a whole Latin-American country was assessed systematically with this method.

The 99 beaches studied were divided amongst the three main regions of Cuba, which are often used to divide the country from historical, political and administrative basis (Pichardo, 1980; Figueroa, 1993). Western and Eastern regions had same number of beaches assessed (38 each), meanwhile 24 beaches were evaluated in the Central region (Table 1); it is important to highlight that the latter has the majority of tourist beaches on the north coast (Fig. 1). The province with most beaches visited was Matanzas, where the famous Varadero beach is located (a sand spit of 22 km length and responsible of c. 60% of the tourism income of Cuba). In addition to litter grades, beaches were classified according to their beach type and tourist use (Figs. 2 & 3). The typology is based on the Williams and Micallef (2009) classification, which includes four categories: resort (n = 24), urban (n = 11), rural (n = 47) and village (n = 17); the majority of resort beaches were in the Central region (n = 11),



**Fig. 1.** Location of the 99 studied beaches in Cuba (key zoom-boxes: a = Varadero; b = Northern Cays; c = Guardalavaca; d = Santiago; key colors: Green = Grade A, Yellow = Grade B; Orange = Grade C; Red = Grade D; all content in KML file). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

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