

Litter impacts on scenery and tourism on the Colombian north Caribbean coast



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HIGHLIGHTS

- Assessment of beach type, litter, scenery and management for 35 Colombian Caribbean beaches.
- Colombia depends on the above for economic growth.
- A Sector analysis approach is introduced.

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ABSTRACT

This paper provides the location, scenery and litter evaluation of 35 Colombian Caribbean beaches (9 remote, 9 village, 14 urban and 3 resort). Four litter grades were found. A: excellent (5); B: good (8); C: fair (19) and D: poor (3). A Decision Value parameter (D), for scenery gave: Class I – extremely attractive/natural, $D > 0.85$, 6 sites; Class II – attractive/natural sites, $D = 0.85 - 0.65$, 2 sites; Class III – mainly natural sites, few outstanding features, $D = 0.65 - 0.4$, 1 site; Class IV – mainly unattractive sites, $D = 0.4$ to zero, 6 sites; Class V – very unattractive sites, $D = < 0$, 20 sites. Litter amounts placed most beaches into a poor scenic category and many scenic beaches could jump a grade by means of clean-ups. A graphic methodology highlighted beaches with contradictory results for litter/scenic grades. Tourists abhor littered beaches and clean-ups would improve scenery scores.

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1. Introduction

Tourism is one of the largest growth industries in the world (EEA, 2006) and its GDP contribution ranges from ~2% for small scale tourism countries where the tourism weighting can be very large, to >10% for countries, such as, Colombia (Briguglio, 1995). Currently tourism represents one of the most important activities for Colombia and during 2007–2015, its Caribbean coast had

2,441,033 international arrivals (mostly from the U.S.A., Canada and the European Union) and close to 4,000,000 domestic arrivals (ANATO, 2015). The industry's growth capacity appears to be almost limitless. An increase of 21,000 international arrivals occurred between 2013 and 2014 and the same trend was currently recorded with 115,100 international arrivals during January–March, 2015 (ANATO, 2015). The tourist industry's rapid growth meant an increase of almost US\$ 270 million per year in the Colombian Gross Domestic product (BANREP, 2015). The Gross National Product, relating to tourism (>US\$ 3600 million in the balance of payments for travel/transportation), is the third highest source of foreign exchange after oil and coal, exceeding exports of coffee, bananas and flowers (ANATO, 2015).

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The tourism trend is likely to be exacerbated globally and as Colombia wants to increase tourism numbers and for beach management to be successful it is important to know what coastal tourists desire? From >1000 beach questionnaires regarding visitor beach preferences/priorities at Mediterranean tourist destinations, the beach was deemed to provide some 80–85% of a holiday's enjoyment and much of a country's revenue. For example, [Yepes \(2005\)](#) pointed out that in Spain, with only 0.001 per cent of beach space, beaches generate roughly 10% of the Gross National Product; [Clark \(1996\)](#) has stated that good beaches are worth billions of dollars. [Wilson and Liu \(2008, 130\)](#) carried out a number of peer-reviewed non-market valuation studies (1970–2006) of coastal-marine ecosystems and found that beach recreation had 'inordinate attention in the economic literature'. As to what parameters tourists desire from a beach, these can be grouped under five major headings the 'Big Five'; namely very good water quality, safety, facilities, no litter and excellent scenery ([Williams & Micallef, 2009](#)). The priority changes as they are functions of location type, e.g. urban, resort etc.

Beaches can be classified in many ways ([Williams & Micallef, 2009](#)) and headings given in [Table 1](#) can be found in any beach setting, but for the purpose of this paper, which deals with sites utilized by national and foreign tourists, the anthropogenic classification has been used. Water quality and its testing are basically a function of Government and beach managers usually have little control over such matters. Safety usually tends only to be important at urban and resort beaches where lifeguards, facilities (showers, sun loungers, etc.) and safety equipment are usually mandatory in the latter, but less so in the former as they are the responsibility of the urban governing authority. In Spain, lifeguards can be found even on village beaches.

Scenery may be defined as 'the appearance of an area' ([Council of Europe, 2000, 4](#)) and is a part of a coastal landscape inventory available for different coastal zone disciplines. Similarly, coastal landscapes can be described as 'a littoral area, as perceived by people, whose character results from the numerous interactions of natural and/or human factors' ([Council of Europe, 2000, 32](#)). In Brazil, [Barbosa de Araujo and Costa \(2008, 1448\)](#) indicated that landscape was probably highly rated as an attribute in visitor's choice and 'the maintenance of the landscape quality of beaches must be the main priority.' Scenic destinations for tourism purposes now seem to be well ensconced in tourism literature, e.g. 'Landscape is most frequently exploited by the government and the media as advertisements of Pernambuco State tourist resources.' ([Barbosa de Araujo & Costa, 2008, 1445](#)). [Boley, Nickerson, and Bosak \(2011\)](#) and [Nickerson, Jorgenson, and Boley \(2016\)](#) utilizing the Geotraveler Tendency Behavior Scale showed that environmentally concerned tourists will specifically travel to an area for its scenic beauty. This usually satisfies the main tourism driver force – cash revenue – whilst helping to conserve the environment. However, environmentally concerned tourists could potentially have a devastating

impact on the environment ([Das & Chatterjee, 2015](#)).

Most checklist and rating schemes e.g. [Leatherman \(1998\)](#) used for coastal assessment are open to criticism with regard to subjectivity and weighting. Grading assessments obtained from qualitative, subjective observations and/or pronouncements made in linguistic terms, as in the case of many coastal scenic assessment and landscape evaluations do not replace or overcome data vagueness. Evaluations used and given in the methodology used in this paper overcome this point, i.e. scenic assessment was based upon beach user interviews and utilizes a weighting/fuzzy logic scale resulting in a semi-objective analysis; litter grades are based upon actual field determined figures.

The basic scenic approach in study area locations ([Fig. 1](#)) was formulated upon the seminal work of [Leopold \(1969\)](#), where parameters were inventoried and assessed as to their suitability for addressing the aesthetic aspects of scenery in order to reduce subjectivity, so that, 'the results promise to be a useful, new kind of basic data needed in many planning and decision making circumstances.' ([Leopold, 1969, 1](#)). Pilot scenic assessment studies of beach users asked the question ([Table 2](#)), 'what parameters make up a beautiful coastal scene?' A further n > 500 beach user cohort then ranked the top 26 given parameters (18 physical and 8 human in order to give weighting indices, which tended to emphasise human factors). X scale parameter values ([Table 2; Fig. 2](#)) were carried out via discussions by coastal experts and expressed numerically via a qualitative Delphi approach – a forward thinking procedure which uses specialist opinion and data collection for good practice and evaluation ([Balkey, 1968](#)). For precise details see [Anfuso, Williams, Cabrera Hernández, and Pranzini \(2014\)](#), [Ergin, Karaesmen, Micallef, and Williams \(2004\)](#), [Ergin, Özölçer, and Şahin \(2010\)](#), [Rangel-Buitrago, Correa, Anfuso, Ergin, and Williams \(2013\)](#). To quantify data vagueness/uncertainties and subjectivities inherent in parameter assessment, fuzzy logic was used ([Ambala, 2001; Zadeh, 1965](#)). This technique produces robust decisive factors based on individual parameter probabilities introduced as weighted averages into the assessment procedure culminating in a Decision Value parameter (D; [Table 3](#)).

Successful field-testing (>4000 interviews, a standard sampling error of <0.02) has been carried out in many countries: Portugal, Cyprus, Bosnia, Croatia, and southern Spain, but further field tested in, amongst other countries: Cuba, Colombia, Brazil, USA, China, the South Pacific, New Zealand, Australia, Pakistan, Tunisia and Morocco. For example, see [Anfuso et al. \(2014\)](#), [Barbosa de Araujo and Costa \(2008\)](#), [Cristiano et al. \(in press\)](#), [Ergin et al. \(2004\)](#), [Ergin, Williams, and Micallef \(2006\)](#), [Langley \(2006\)](#), [Rangel-Buitrago et al. \(2013\)](#), [Ullah, Johnson, Upton, and Williams \(2006\)](#), [Williams \(2011\)](#), [Williams and Khattabi \(2015\)](#), [Williams and Micallef \(2009\)](#). In ALL countries studied, similar D value natural breaks occurred when sites vs the D value are plotted; the higher this D value, the higher the scenic evaluation. Chi-square and Kolmogorov–Smirnov testing of the break points for these Gaussian

Table 1

Examples of some existing beach classifications ([Williams & Micallef, 2009](#)).

Characteristic	Attributes
Geomorphological	Reflective – Dissipative.
Composition	Muds, Sands, Gravels, Pebbles, Cobbles, Boulders, Mixtures.
Shape	Linear; Pocket; Logarithmic spiral.
Anthropogenic	Remote; Rural; Village; Urban; Resort.
Natural or artificial	
Usage	Heavy; Medium; Light.
Colour	Black–white.
Activity	Recreation – conservation.
Cliffed/Non cliffed.	

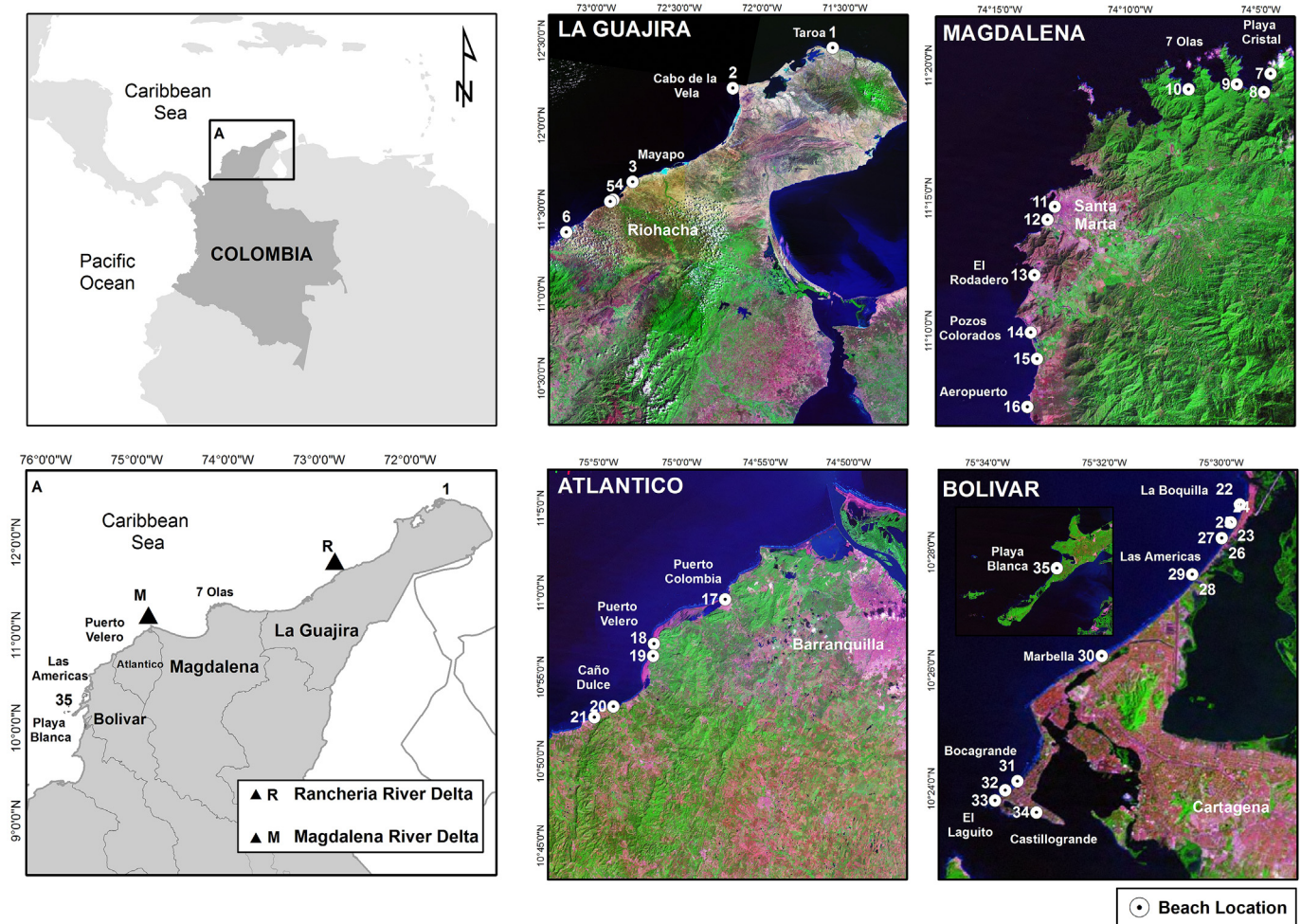


Fig. 1. Study area with the indication of beach locations used in this paper.

distributions (0.05 level) conformed normality (Williams & Khattabi, 2015), indicating the technique was mathematically robust and sound. Further details for Colombian D values are given in Rangel-Buitrago et al. (2013).

Based on this evaluation, coastal scenery may be divided into five distinct scenic classes: Class I (extremely attractive natural sites) with D values ≥ 0.85 (6 in total); Class II (attractive natural sites), $D = 0.85$ to 0.65 (2 in total); Class III (mainly natural sites with few outstanding landscape features), $D = 0.65$ to 0.4 (one only); Class IV (mainly unattractive urban sites, with low landscape values) $D = 0.4$ to zero (6 in total); Class V (very unattractive, intensively developed urban) D below zero; (20 in total).

Beach litter is a ubiquitous worldwide problem that can change the perception of an environment (Galgani et al., 2010) and it is one fundamentally linked to people's behaviour, whether intentional or unintentional (Oigman-Pszczol & Creed, 2007; Slavin, Grage, & Campbell, 2012; UNEP, 2006; Williams, Pond, Ergin, & Cullis, 2013). Over the past few decades concern has been growing regarding the amounts of litter that accumulate in beaches and seas, as well as public awareness (both local and tourist). Ryan, Moore, van Franeker, & Moloney (2009) have shown that litter presence is a reason NOT to visit a beach. Consequently, concern for environmental issues, specially related to 'sun and sand tourism', has become a serious problem of rising magnitude (Tudor & Williams, 2003, 2006). Coastal tourism together with bathing water quality is very vulnerable to beach litter, as an example, the

potential costs of such litter in the UK are some £16 m per year (Mouat, Lozano, & Bateson, 2010).

Litter can be collated and given as/from: amount from water's edge to splash zone (Dubsky, 1990); transect line quadrats (Dixon & Hawksley, 1980), strand line counts (Williams & Simmons, 1997), postal surveys (Dixon, 1992), plastic bin bags/trucks (Earl et al., 1996; Earl, Williams, Simmons, & Tudor 2000). The USA Ocean Conservancy (OC, 2009), co-ordinates the International Coastal Cleanup (ICC), an international network of environmental and civic organizations, government agencies, industries and individuals working with the objective to remove marine litter and collect valuable information on litter amounts and types. In this paper, the EA/NALG (2000) methodology was utilised, which was the end result of a three year project involving government agencies (DEFRA – Environment Agency, academics, NGOs, practitioners, consultants) to assess the aesthetic quality of coastal and bathing beaches used for recreational purposes and to enable beaches to be graded (Table 4).

The issue of litter along Colombian Caribbean beaches produces, deterioration of scenic quality, health hazards for humans and wildlife, needs financial investments for 'cleanups' and has severely threatened the 'sun, sea and sand' industry. To be effective, management plans must take cognizance of the tourism model together with an increasing problem of beach litter; therefore their characteristics, impacts and trends are deemed indispensable for effective coastal management. Beach litter obviously is unsightly and

Table 2
Scenic evaluation checklist.

N:		Rating				
		1	2	3	4	5
Physical parameters						
1	Height (m)	Absent	5–30 m	31–60 m	61–90 m	90 m
2	Cliff Slope (°)	Absent	45°	circa 60°	circa 75°	circa vertical
3	Special features ^a	Absent	1	2	3	Many (3)
4	Type	Absent	Mud	Cobble/Boulder	Pebble/Gravel	Sand
5	Beach face Width (m)	Absent	5 > 100	>5 ≤ 25	>25 ≤ 50	>50 ≤ 100
6	Colour	Absent	Dark	Dark tan	Light tan/bleached	White/gold
7	Slope (°)	Absent	5°	5°–10°	10°–20°	20°–45°
8	Rocky shore Extent (m)	Absent	5 m	5–10 m	10–20 m	20 m
9	Roughness	Absent	Distinctly jagged	Deeply pitted and/or irregular	Shallow pitted	Smooth
10	Dunes	Absent	Remnants	Fore-dune	Secondary ridge	Several
11	Valley	Absent	Dry valley	(1 m) Stream	(1–4 m) Stream	River/limestone gorge
12	Skyline landform	Not visible	Flat	Undulating	Highly undulating	Mountainous
13	Tides	Macro (4 m)		Meso (2–4 m)		Micro (2 m)
14	Coastal landscape features ^b	None	1	2	3	3
15	Vistas	Open on one side	Open on two sides		Open on three sides	Open on four sides
16	Water colour & clarity	Muddy brown/grey	Milky blue/green/opaque	Green/grey/blue	Clear blue//dark blue	Very clear turquoise
17	Natural vegetation cover	Bare (10% vegetation only)	Scrub/garigue (marran/gorse, bramble, etc.)	Wetlands/meadow	Coppices, maquis (mature trees)	Variety of mature trees/mature natural cover
18	Vegetation debris	Continuous (50 cm high)	Full strand line	Single accumulation	Few scattered items	None
Human parameters						
19	Noise Disturbance	Intolerable	Tolerable		Little	None
20	Litter	Continuous accumulations	Full strand line	Single accumulation	Few scattered items	Virtually absent
21	Sewage discharge evidence	Sewage evidence		Same evidence (1–3 items)		No evidence of sewage
22	Non-built environment	None		Hedgerow/terracing/monoculture		Field mixed cultivation trees/natural
23	Built environment ^c	Heavy Industry	Heavy tourism and/or urban	Light tourism and/or urban and/or sensitive	Sensitive tourism and/or urban	Historic and/or none
24	Access type	No buffer zone/heavy traffic	No buffer zone/light traffic		Parking lot visible from coastal area	Parking lot not visible from coastal area
25	Skyline	Very unattractive		Sensitively designed high/low	Very sensitively designed	Natural/historic features
26	Utilities ^d	3	3	2	1	None

^a Cliff Special Features: indentation, banding, folding, screes, irregular profile.

^b Coastal Landscape Features: Peninsulas, rock ridges, irregular headlands, arches, windows, caves, waterfalls, deltas, lagoons, islands, stacks, estuaries, reefs, fauna, embayment, tombola, etc.

^c Built Environment: Caravans will come under Tourism, Grading 2: Large intensive caravan site, Grading 3: Light, but still intensive caravan sites, Grading 4: Sensitively designed caravan sites.

^d Utilities: Power lines, pipelines, street lamps, groins, seawalls, revetments.

potentially a health hazard but it does have a positive effect on beach biodiversity, as a host of small creatures utilise it for shelter and food (Llewellyn & Shackley, 1996). Some previous Colombian research has been carried out regarding beach type (Botero & Hurtado, 2009) and coastal scenery (Botero, Anfuso, Duarte, Palacios, & Williams, 2013; Rangel-Buitrago et al., 2013), but little has been done about the integration of Colombian beach type, litter and scenery. The scope of this paper is to analyze these three interrelated variables from a management perspective.

2. Study area

The north Colombian Caribbean coast extends for 1539 km, between the Bolivar department, and the eastern boundary with Venezuela (Fig. 1). Its general coastal orientation is NE–SW with some sectors oriented W–E so that long linear segments alternate with bays (Rangel-Buitrago, Anfuso, & Williams, 2015). It is a complex region where tectonic movements have defined a contrasting topography with landscape units including extensive low relief deltaic plains and medium – high relief mountain areas

(Correa & Morton, 2011; Rangel-Buitrago et al., 2013). Quaternary interactions amongst a tropical climate, oceanographic processes and tectonic activity make a mixed unstable coastal geomorphology characterized by spits, bars and beaches along the flat coastal plains and cliffed coastlines (Martínez et al., 2010). Seasonal precipitation shows two rain periods (e.g. April–May and October–November) and two dry periods, (November–April and July–September). Maximum annual precipitation values, circa 2500 mm, while mean temperatures of <28° C, make it attractive for tourism development (Rangel-Buitrago et al., 2013).

Tides are mixed semi-diurnal, with maximum amplitudes of 65 cm (Andrade, 2008). Coastal dynamics are influenced by how both the intensity and trade wind seasonality affect wave propagation in the shallow waters and rising sea levels (Restrepo, Otero, Casas, Henao, & Gutierrez, 2012). The average significant wave height fluctuates between 1 and 2 m and peak period average varies between 6 and 10 s. From November to July, the wave system is dominated by NE swells and shores on the study area periodically experience large waves (up 4 m), with a regional average height (H_{sig}) between 1 and 2 m. For the remainder, waves from NW, WSW

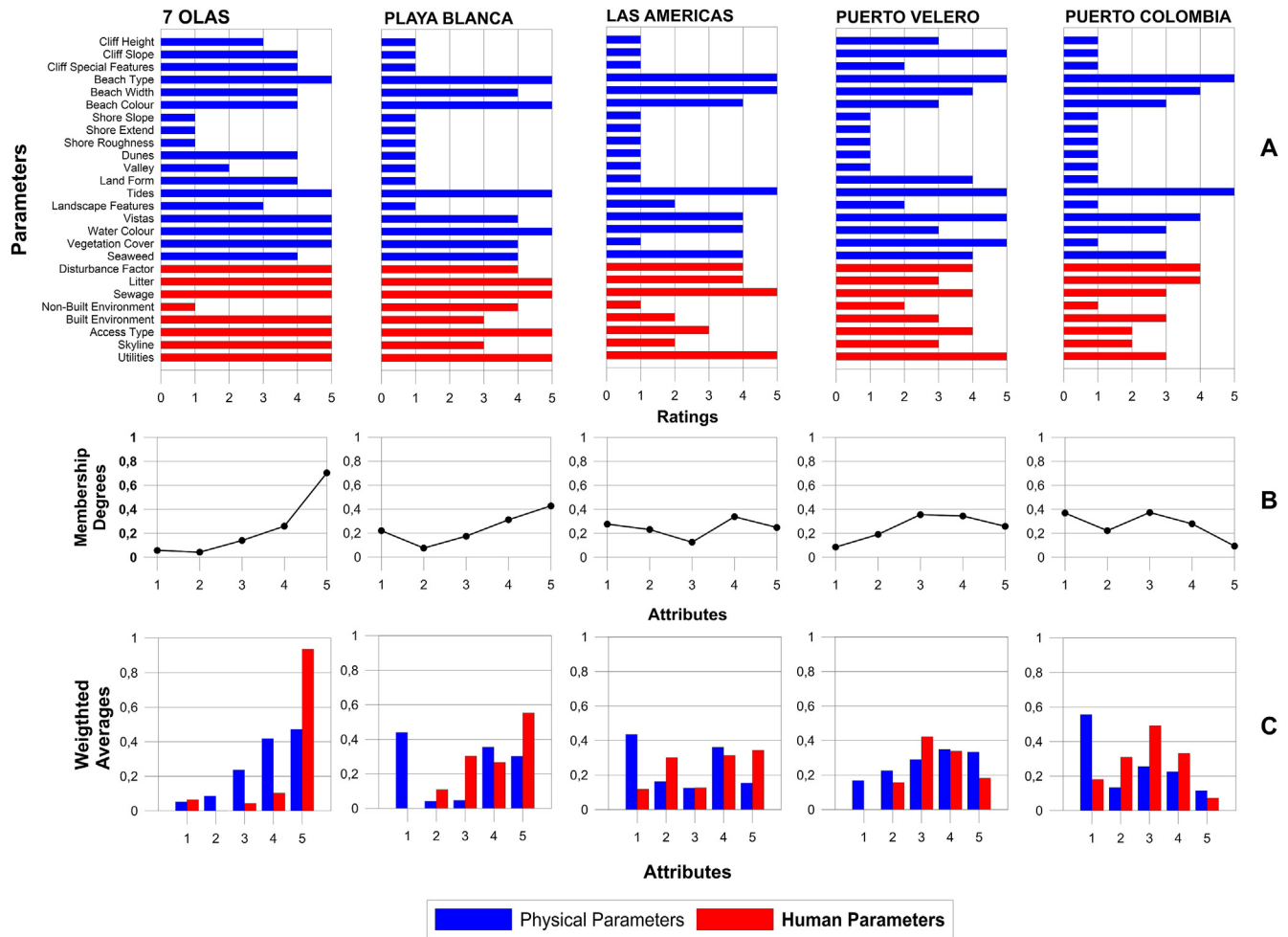


Fig. 2. A) Scenic evaluation rating histograms, B) Membership degree curve and C) Scenic histogram of weighted averages for 7 Olas (Remote, Class I, Litter Grade D), Playa Blanca (Remote, Class III, Litter Grade B), Las Americas (Resort, Class IV, Litter Grade C), Puerto Velero (Village, Class IV, Litter Grade A) and Puerto Colombia (Urban, Class V, Litter Grade D).

even SW occur. This wave direction seasonal variation corresponds with a decrease in significant wave height, with the lowest values occurring between August and October (≤ 1.5 m); whereas the highest energy conditions occur from November to July where wave heights can exceed 2 m (INVEMAR, 2006; Restrepo et al., 2012). The main water circulation pattern in the Caribbean sea of Colombia is via warm water current that transports significant amounts of water and flows from NE to SW, in the same direction as longshore currents. Net longshore sand drift has a dominant south-westward component, but minor reversals to the northeast occur during rain periods when southerly winds become dominant in some sectors and set up short, high-frequency waves able to cause significant shore erosion along cliffed and mud coastlines (Correa & Morton, 2011).

Over the last 30 years while tourism activities increased, coastal erosion became a serious problem rising in magnitude and dominance along the Colombian Caribbean coast. Erosion is experienced at 48.3% (1182 km) of coastline; 33.2% (812.6 km) is stable, and 18.5% (450.5 km) is accreting (Rangel-Buitrago et al., 2015). Coastal erosion can be associated with a diversity of factors contrasted in their degree of magnitude and influence, such as, amongst others: sedimentary imbalance, extreme waves, ecosystem destruction and sea level rise. These processes are often multiplied by human activities e.g. inappropriate building of coastal infrastructures, i.e. groins, illegal mining of sand and mangrove destruction.

The study area is a developing region divided into four Departments, which have 15 Municipalities with 3,468,196 inhabitants (Table 3). This population (7.2% of the Colombian total), is mainly concentrated in four commercial and tourist cities: Barranquilla, Cartagena, Santa Marta and Riohacha. Cartagena and Santa Marta cities are the most visited destinations for 'Sun, Sea and Sand' associated tourism and they are experiencing a considerable increase of 'high level' tourism developments, principally consisting of five star hotel chains and golf courses. Further developments are observed close to the Riohacha and Barranquilla surrounding areas consisting of enlargement of existing coastal small towns and villages, which will have associated impacts on landscape scenery (Rangel-Buitrago et al., 2013). Three large rivers (Sinú, Magdalena and Rancheria) drain the Colombian Andean region, as well as numerous smaller distributaries (Rangel-Buitrago et al., 2015), and these are the conduits for litter sources. The Caribbean drainage basins of these rivers are characterized by high-moderate rainfall patterns ranging from 1750 to 4944 mm in their watersheds, resulting in $1464 \text{ t km}^2 \text{ yr}^{-1}$ of sediment yield, influencing observed litter abundances (Restrepo & Lopez, 2008; Rangel-Buitrago et al., 2015; Restrepo, Kettner, & Syvitski, 2015).

3. Methods

Many papers relate to beach litter, but almost all are focused on

Table 3
Beach categorization. Location and main characteristics of investigated sites. Site name, location, type, setting, “D” value, class and litter grade. Shaded areas refer to Fig. 2 beach locations.

Number	Name	Department/Province	Beach type	D value	Scenic class	Litter grade
1	Taroa	La Guajira	Remote	1.10	I	A
2	Cabo de la Vela	La Guajira	Remote	1.15	I	B
3	Mayapo	La Guajira	Remote	0.67	II	C
4	Riohacha (EAST)	La Guajira	Urban	−0.34	V	A
5	Riohacha (WEST)	La Guajira	Urban	−0.34	V	B
6	Punta Camarones	La Guajira	Remote	0.69	II	C
7	Playa Cristal	Magdalena	Remote	1.29	I	B
8	Neguanje	Magdalena	Remote	1.14	I	C
9	7 Olas	Magdalena	Remote	1.18	I	D
10	Chengue	Magdalena	Remote	1.29	I	A
11	Bahía de Santa Marta	Magdalena	Urban	−0.48	V	C
12	Los Cocos	Magdalena	Urban	−0.46	V	D
13	El Rodadero	Magdalena	Urban	0.04	IV	C
14	Pozos Colorados	Magdalena	Urban	0.13	IV	B
15	Irotama	Magdalena	Resort	−0.02	V	A
16	Aeropuerto	Magdalena	Urban	−0.33	V	C
17	Puerto Colombia	Atlantico	Urban	−0.17	V	D
18	Puerto Velero	Atlantico	Village	0.34	IV	A
19	Palmarito	Atlantico	Urban	−0.05	V	B
20	Caño Dulce	Atlantico	Village	0.38	IV	B
21	Santa Verónica	Atlantico	Village	−0.47	V	C
22	La Boquilla	Bolivar	Village	−0.62	V	C
23	Manzanillo	Bolivar	Village	−0.62	V	C
24	Tamarindo	Bolivar	Village	−0.62	V	C
25	Casa Grande	Bolivar	Village	−0.62	V	C
26	Caremojo	Bolivar	Village	−0.62	V	C
27	Los Morros	Bolivar	Village	−0.62	V	C
28	Las Americas	Bolivar	Resort	0.14	IV	C
29	Blas el Teso	Bolivar	Resort	0.14	IV	C
30	Marbella – Chiringuito	Bolivar	Urban	−0.60	V	B
31	Bocagrande	Bolivar	Urban	−0.42	V	C
32	Playa el Bony – Hotel Caribe	Bolivar	Urban	−0.42	V	C
33	El laguito	Bolivar	Urban	−0.42	V	C
34	Castillo Grande	Bolivar	Urban	−0.33	V	C
35	Playa Blanca	Bolivar	Remote	0.63	III	B

Table 4
Categories for grading a beach (EA/NALC, 2000).

Category	Type	A	B	C	D
Sewage related debris	General. e.g. condoms, nappies	0	1–5	6–14	15+
	Cotton Buds (Q tips)	0–9	10–49	50–99	100+
Gross litter	e.g. trolleys, car parts.	0	1–5	6–14	15+
General litter	e.g. cans, sweet wrappers	0–49	50–499	500–999	1000+
Potentially harmful litter	Broken Glass	0	1–5	6–24	25+
	Other	0	1–4	5–9	10+
Accumulations	Number	0	1–4	5–9	10+
Oil		Absent	Trace	Nuisance	Objectionable
Faeces		0	1–5	6–24	25+

quantity and type of elements rather than management and tourism sector impacts (Araujo et al., 2003; Ariza, Jiménez, & Sardá, 2008; Oigman and Creed, 2007; Storrier, McGlashan, Bonellie, & Velander, 2007; Topcu et al., 2010). Similarly, landscape studies tend to be subjective rather than objective and extremely few utilise the views of the public. As a result of the above, a composite of four methods were utilized in this paper: scenic class, litter grade, and beach typology and information obtained integrated in a sector analysis.

3.1. Scenic class

At every location, an assessor ticked one box of each of the 26 parameters (y axis given in histograms shown in Fig. 2a) and Table 2 according to one of the five parameter sub-divisions (x axis Fig. 2a – termed attributes). Attribute values ranged from a low (1) to high

rating (5). A computer programme calculated an assessment parameter ‘D’ (based on weighted parameters plus a fuzzy logic programme which counteracts a tick being placed in the wrong box), and produced histograms of the 26 parameters (Fig. 2a); attribute values (Fig. 2b); and weighted averages (Fig. 2c). Curve interpretation of Fig. 2c was based on the skew, a curve skewed to the right hand side reflects high scenic value, e.g., Cabo de la Vela; a left skewed curve reflects a low scenic value, e.g. Puerto Colombia. Fig. 2c exemplifies these points as the curve moves from a steep upward trend to a downward one, signifying a drop in scenic quality.

3.2. Litter grade

The EA/NALC (2000) methodology demarcated a 50 m stretch of beach, either side of an access point and counted litter items

(Table 4) in the area of usable beach behind the highest high water strandline, up to, for example, a sea wall or the dune line edge (to assess primarily, wind-blown litter accumulations). The sampler assesses this area recording the number of items (Fig. 3). The actual numbers pertaining to each of the seven sub-categories is noted and inserted into Table 4. Categorization was simple in that the beach was classified according to the furthest grade shown, i.e. A grades could be given for six of the classes but if the 100+ cotton buds box was circled (D grade in Table 4), that beach was given an overall D grade. Colombian grades and numbers calculated from Table 4 found: A = 6, B = 7, C = 19, D = 3. This methodology has been extensively utilised in the UK (Earll, Williams, Simmons, & Tudor, 2000); Greece (Williams & Markou, 1995); Turkey (Demirci, 2001); Spain (Williams et al., *in press*); New Zealand and the USA, (unpublished data collected by Williams).

3.3. Beach typology

As stated, beaches can be classified in many ways and for this paper the optimum classification seemingly was the anthropogenic (Table 1), as it is concerned with people's views of some of the main preferences for beach choice. Each site was classified into one of four categories (Williams, 2011; Williams & Micallef, 2009; Table 3).

- Resort (n = 3, e.g. Fig. 4)

These should be located on a beach adjacent to an accommodation complex (hotel/apartment/camp site), where a substantial proportion of beach users are resident and management is the complex responsibility. A host of facilities is usually prevalent e.g. wind surfing, speed boat towing activities 'e.g. 'rings', 'bouncy castles', 'bananas') as recreation is the main aim; Club Med epitomises this type of resort.

- Urban (n = 14, e.g. Figs. 5, 6)

These serve large populations which have well-established public services, e.g. primary school(s), bank(s), religious centre(s), internet cafes with a clearly demarcated central business district, commercial activities, e.g. harbours and marinas. Urban beaches are located within/adjacent to the urban area and are in the main freely open to the public.

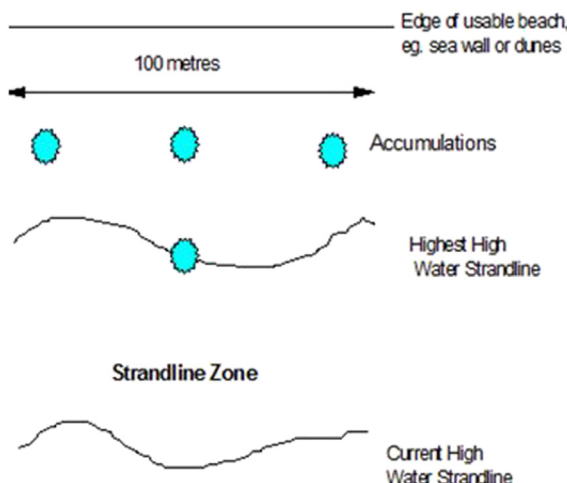


Fig. 3. Scheme of the litter collection methodology used in this work.

- Village (n = 9, e.g. Fig. 7)

These are found outside the main urban environment. They have a small, permanent population reflecting access to organised but small-scale community services (such as primary school(s), religious centre(s) and shop(s)). This also includes 'tourist villages' mainly utilized in the summer months as well as 'ribbon development' between urban and rural environments.

- Remote (n = 9, e.g. Fig. 8)

These may be defined by difficulty of access, largely by boat or on foot – a walk of up to 300 m+. They can be adjacent to either village or rural areas but rarely to urban areas. They are not supported by public transport and have very limited (<5 if any) temporary summer housing. In the Mediterranean/Caribbean restaurants/secondary summer homes may be found in the summer season but permanent dwellers are few and far between.

3.4. Sector analysis (Fig. 9)

The above techniques were integrated through Sector Analysis (Fig. 9) an innovative approach to interpret litter integration with coastal scenery for each beach typology. A square matrix was constructed for each beach type, with litter grades in columns (4) and scenic class in rows (5). Analysis was done for the whole cohort of beaches. Using the percentile technique (Langford, 2006) the matrix was divided into three sectors. The upper left quadrant (green sector) comprised four cells, representing beaches with a high litter grade and scenic class. The lower right quadrant (red sector), which also has four cells, located beaches having a low litter grade and scenic class. In the other two corners and middle cells (yellow sector) occur beaches with contradictory results of low litter grades and high scenic classes or vice versa.

4. Results

Table 3 gives an overall impression of the connection between beach type, litter and scenery.

4.1. Resort areas

Three beaches were classified and two being adjacent sites (Blas el Teso and Las Americas, Bolivar department (Figs. 2a, b, c; 4)), each scoring Class IV for scenery and a C litter grade. The two sites had many diapers, glass shards, silver pipes, cigarette stubs and tops. It is important to highlight that beach clean ups could easily change the litter grades found to an A.



Fig. 4. Example of Resort beach, Las Americas located at Bolivar department (Class IV, Litter Grade C).



Fig. 5. Example of Urban beach, Riohacha located at La Guajira department (Class V, Litter Grade A).



Fig. 6. Example of Urban beach Puerto Colombia located at Atlantico department (Class V, Litter Grade D).



Fig. 7. Example of Village beach, Puerto Velero located at Atlantico department (Class IV, Litter Grade A).

4.2. Urban areas

Fourteen were found and results were very mixed with respect to litter, ranging from grades A to D but scenically almost all were Class V (Table 3). Riohacha (Fig. 5), Santa Marta and Palmarito are tourist towns and beaches are cleaned daily, so it is hardly surprising that they scored grades A and B for litter. Puerto Colombia, Atlantico department (Figs. 2a, b, c; 6) is a large town that has a history of massive erosion, which has reached 29.5 m/yr in the last 20 years (Rangel-Buitrago et al., 2015). The beach litter numbers were immense, nappies, condoms plus all the regular types were found. The Marbella-Castillogrande stretch of coast in Cartagena

City is a homogenous stretch with little to differentiate boundaries. For example, at Marbella, which can be used as a typical case study, a minimum of 15 black plastic bags of litter is taken daily from the beach by council workers. This is one of the quandaries of litter research in that there appears to be no universal methodology, so site comparisons are difficult. The average was 25 but this can go up to 100 bags and if it is a weekend and/or during party time (i.e. local festivals, beach parties), 200 bags/day is not unusual. Ropes, nails, cigarettes, plastics of all sorts, wood, needles, cloth, condoms, straws, rope, pieces of kites, etc. were the usual components. This concurs with the work of Silva, Scheyla, Barbosa de Araujo, and Costa (2008), who looked at 'litter flags' that indicated the presence of beach users on urban Brazilian beaches, e.g. drinking straws, plastic cups, and these items were well replicated on the Colombian beaches studied.

4.3. Village areas

Seven were scenically graded as a scenic class V and litter as a C, apart from Puerto Velero (Figs. 2a, b, c; 7) and Caño Dulce, Atlantico department, which were scenically class IV with A and B grades respectively for litter. Condoms, water bottles broken glass, plastics, tops, straws, ropes, food packaging etc. all were to be found on these C grade beaches.

4.4. Remote areas

Nine in all, six falling in Scenic Class I, two in Class II and one in Class III; litter grades were A or B apart from three sites which scored a C and one site a D (Table 3). The very attractive 7 Olas Bay at the Tayrona National Park (Fig. 8; Table 3), had the highest D value, but also had the worst litter grade (D; Fig. 2a, b, c). The beach was covered with >1000 items of general litter and it also had a B grade for glass shards and a C for gross litter, but A for all other parameters. The beach was a sink for shoes, food packaging, ropes, tyres, plates, banding, polystyrene, bottles. Obviously litter had been around for many a year along with bleached oars, wood. Neguanje, in the same National Park, was similar in that it scored A for all categories apart from glass shards (C) and general litter (B). At Cabo de la Vela, Guajira Department, litter – similar to the above – was concentrated by wave action into a small gully and the beach was extremely clean.

In essence, the prevailing ubiquitous litter items found were: condoms – an average of five around Life Guard Stations – and nappies for sewage derived items, glass bottles (water, beer, rum) frequently broken, plastic water/soft drink variety, cloth, tops of all descriptions, straws, newspapers, wrappers, rope, plastic plates/knives/forks and kite pieces. Gross litter items were tyres, large oil drums and trolleys; accumulations, oil or faeces were occasionally seen and only the occasional syringe or plank with nails protruding forth was found; cotton bud sticks were rare.

5. Discussion

5.1. Litter sources

Corcoran, Biesinger, and Grifinn (2009), Rech et al., (2014), Williams and Simmons (1997), among others, have defined two main sources of beach litter:

- From inland sources from which they are transported to coasts by rivers, wind (i.e. drainage systems) or by human activity resulting from recreation.
- Directly from the oceans where low density floating varieties accumulate and are carried over vast distances.



Fig. 8. Example of Remote beach, 7 Olas located at Tayrona National Park, Magdalena Department (Class I, Litter Grade D). A) Panoramic view of the entire beach, B) litter types found along the beach, these include: shoes, food packaging, ropes, tyres, plates, banding, polystyrene, bottles.

		LITTER CLASS				
		A	B	C	D	
SCENIC CLASS	I	2	2	1	1	6
	II	0	0	2	0	2
	III	0	1	0	0	1
	IV	1	2	3	0	6
	V	2	3	13	2	20
		5	8	19	3	35

		LITTER CLASS				
		A	B	C	D	
SCENIC CLASS	I	2	2	1	1	6
	II	0	0	2	0	2
	III	0	1	0	0	1
	IV	0	0	0	0	0
	V	0	0	0	0	0
		2	3	3	1	9

		LITTER CLASS				
		A	B	C	D	
SCENIC CLASS	I	0	0	0	0	0
	II	0	0	0	0	0
	III	0	0	0	0	0
	IV	0	0	2	0	2
	V	1	0	0	0	1
		1	0	2	0	3

		LITTER CLASS				
		A	B	C	D	
SCENIC CLASS	I	0	0	0	0	0
	II	0	0	0	0	0
	III	0	0	0	0	0
	IV	0	1	1	0	2
	V	1	3	6	2	12
		1	4	7	2	14

Fig. 9. Sector Analysis Approach. Integration of litter with coastal scenery for each beach typology.

Given the above, beach litter items were sorted according to usage to identify their potential source. UNEP (2009) consider that indicator items can be used to relate litter to user groups, such as, beach-goers, fishermen, among others, with the purpose of developing practical management tools to target the behaviour of groups that litter (Cheshire et al., 2009). This practice can be relatively easy when it comes to linking nets or buoys to fisheries or cotton buds in large numbers to a sewage source (Topcu et al., 2013). Nevertheless, some beach locations possess a mix of litter which can originate from several potential sources, so any specific attribution may be extremely difficult (i.e., Atlántico beaches); besides, some items from the same functional group, e.g. beverage related debris, can have several different sources (Williams, Tudor, & Randerson, 2003).

The primary source of litter corresponds to litter transported by rivers together with human activity, mainly related with beach tourism. A lesser percentage can be considered related with the ocean. The influence of the Sinú, Magdalena and Rancheria rivers on beach litter in the study area can be categorised as items deposited into the river due to the absence of treatment plants and waste collectors (plastics, cans, among others). For example, The Magdalena River basin (the most important in Colombia), influences 596 of the 1123 municipalities of the entire country. Along the whole Magdalena River, 46% of municipalities do not have a disposal system for solid waste. Most municipal and industrial solid

wastes, mixed with hospital and hazardous wastes, are dumped in the nearest location, in this case, the river basin. In Atlántico Department beaches (beaches 17 to 21; Table 3) the Magdalena River is responsible for the majority of litter.

Significantly higher litter densities are related to climatic events, such as heavy rains (and their related runoff), high waves and dominance of strong NE winds that drive surface currents to the SW along the Caribbean coast of Colombia (Fig. 10). Runoff of these rivers increases during the rainy season and litter along the entire basin is transported directly to the beaches or even further offshore (Rech et al., 2014). Similarly, heavy local rainfalls and flash floods wash litter away from riversides.

The circulation patterns (see study area) combined with extreme runoff generates a southward movement of large litter amounts termed 'litter blooms' (Fig. 10). When water energy decreases in shoal areas, litter accumulates generating deposits that reach areas up to 2 km² and/or extend linearly for some 30 km. High rains and inundations in the Colombian Andes combined with strong currents derived from extreme wave events produced a severe accumulation of litter along almost the entire Atlántico department (Fig. 10). These events are able to affect landscape values that result in unattractive sites, as observed in this paper.

Beach users (local and tourists) have been identified as an important litter source, as a result of both a lack of education and environmental responsibility and a lack of beach trash containers.



Fig. 10. Examples of Litter blooms observed during May (2015) and January (2016) along the Atlántico and Magdalena departments. A) Sabanilla, B) Punta Roca, C) Los Cocos.
(Source: El Heraldo de Barranquilla.)

This litter is carried to other beaches as a result of interaction with wind, tides, waves and coastal currents and it is possible to find litter at remote, isolated beaches, far from towns or coastal cities. In many of the remote areas investigated, small restaurants existed and owners were sympathetic to daily beach cleans, cleaning not only indigenous litter but that swept into the area by currents.

Litter related to fishing is more prevalent in village and remote areas, reflecting the wave climate of the region, as fishing-related litter is more likely to be directed onto these coasts than elsewhere. The lower wave energy in the bays is reflected in both the presence of extensive algae and sea grass beds and the fact that the majority of boat moorings occur here. The largest items, which included entire fishing nets and polystyrene buoys, were consistently found along the larger beaches in the Tayrona park sector (particularly at 7 Olas Beach) and Camarones in La Guajira.

5.2. The sites

The main scenic improvement must come from assessment of the human parameters, sewage discharge evidences and litter,

which would upgrade several beaches to the next class. This is a very similar to the Moroccan situation where many excellent beaches are marred by sewage and litter (Williams & Khattabi, 2015).

Urban and resort areas usually show litter derived from tourism and its related activities. Due to economic conditions and cultural habits, local tourists usually carry their own food (i.e. fried potatoes) to the beach in plastic bags, polystyrene boxes, etc. and beverages (i.e. cans, plastic and glass bottles), the waste being left directly on the beach after consumption. In some cases, the high amounts of this litter are related to the lack or total absence of waste storage elements, as well as insufficient cleaning of the beaches. Along Remote and Village areas, many items without any label or marking could also originate from nearby settlements, especially from the more populated tourist sites as Cartagena, Barranquilla, Santa Marta and Riohacha.

With respect to scenic values, several coastal tourism studies, e.g. Micallef, Morgan, and Williams (1999), Morgan, Jones, and Williams (1993) have shown that scenic grandeur can provide competitive advantages especially in rural and remote regions. However, White et al. (2010) showed that an emphasis on litter presence alone could distract the viewer from the extent and richness the environment has to offer and had a detrimental impact on preference, affect, and restoration likelihood, much of which depended on litter type. For example, 7 Olas bay is a dazzling scenic beach and a beach clean by the National Park would work wonders. The cure is simple – beach cleans – and all Class I beaches would become A grade litter ones. Where there is a recreational element involved (restaurant, water sport shop), e.g. at Playa Cristal, the restaurateurs involved tend to make sure that the beaches are pristine via daily cleaning. Additionally, Caño Dulce and Puerto Velero, could easily move from Class IV to Class III; Playa Blanca from a Class III to a Class II. For Class V beaches to improve, a massive investment would be needed although Palmarito could make it to Class IV. These could include structural work, such as, the removal of hard protection structures (Riohacha; Fig. 5); construction/monitoring of artificial dunes (García Mora, Gallego-Fernandez, Williams, & García Novo, 2001).

Removal of hard structures is a difficult practice and not always economically advantageous, but it can be done. A comment made by Bruun (1953, 68) is appropriate, ‘... in many cases it would probably have been better if groynes had never been constructed, because they have done more harm than good.’ A sound example of this is the Seaford, UK, groyne system. In 1987, all groynes apart from a terminal groyne at Splash Point were eliminated and a major beach recharge project formulated using seabed shingle. No groynes now arrest longshore drift, but each year 317 trucks take accumulated shingle westwards from the groyne to replenish the beach and the area is now a tourist ‘hot spot’ (Williams et al., in press).

In Cuba, the main tourist resort areas found in the Varadero region and coastal works are currently being carried out by the local agency of the Ministry of Science, Technology and Environment (CITMA), under Law 212 for Coastal Zone Management. Specifically, these works are cleaning, restoration and recovery of environmentally degraded spaces and have been/are being carried out at several places. Hotels, houses and other hard land based structures constructed on dune ridges have been demolished and dune reconstruction and stabilization enhanced by means of sand nourishment, construction of pathways, planting of native vegetation and/or emplacement of fences to facilitate and accelerate sand accumulation. As shown by point 10, Table 2, these measures will increase the D value. Overall, these interventions have enlarged

beach widths, protected and enhanced dune formation, which prevents loss of life and property during storms and hurricanes and preserves and increases coastal beauty and natural ecosystems protection. Natural scenery scores higher within the built environment (point 23, [Table 2](#)). As a tangible result, many physical and human parameters of the coastal scenery assessment gained better scores at the Varadero urban and resort areas than previously ([Anfuso et al., 2014](#)).

In Italy, Regional administration authorities are currently spending approximately EU\$ 65 million on erosion management plans that will trigger important changes in coastal dynamics. These have already been modified in the 20th century from a natural condition by construction of 16 km of hard engineering structures, e.g. seawalls, rip-rap revetments, detached breakwaters, groynes, and submerged structures. Most of these will now be reduced in size/height and beach nourishment will be the main defence strategy. Scenically nourished beaches are akin to natural ones and reduction of hard engineering structures will undoubtedly increase the D value. Point 26, [Table 2](#), explicitly shows that many hard engineering structures significantly lower D values.

- Resort areas.

Two of these (Blas el Teso and Las Americas ([Table 3](#); [Figs. 2, 4](#))); were large hotel structures adjacent to the beach and litter found was disappointingly high for a resort beach. One would have thought that such an area would be swept thoroughly – alas this was not the case. More cigarette stubs were found here than any other place investigated. These resorts could easily have an A rating in litter, but both had Cs. For scenic anthropogenic parameters the built/non built environment scored poorly; of the physical parameters, the beach itself scored well, but most others had low scores. To change the scenic score would be a major task.

- Urban areas

As a rule these fared well with respect to litter apart from Puerto Colombia ([Table 3](#); [Fig. 6](#)), which is a special case. The erosion is as a result of bathymetric characteristics, the areas high susceptibility to waves associated with cold fronts and hurricanes, and wave propagation patterns, influenced by jetties at the Magdalena River mouth ([Anfuso, Rangel-Buitrago, & Correa, 2015](#); [Rangel-Buitrago et al., 2015](#)). Scenically they can do very little to improve their ranking as the urban sprawl has gone on far too long.

- Village sites

These had very poor anthropogenic factors, resulting in low scores for scenery and the beaches were utilised by the 'less sensible' segments of society. The bathing areas were mostly flat and uninteresting. Puerto Velero benefitted by having a 'cleaner' beach. If the beaches had been cleaned of litter – as was the case at Puerto Velero ([Fig. 6](#)), which is a beach popular with tourists where peddlers manually clean the beach, all would have scored an A for litter.

- Remote areas.

Mayapo's ([Fig. 1](#); [Table 3](#)) scenery had no cliffs or coastal landscape features, together with an almost continuous dense line of strand line vegetation, which downgraded it scenically to a Class II. If the latter high ranking item had been cleared it would have moved into a Class I. Playa Blanca's built environment stopped it becoming a Class I and this would be difficult to remedy. Punta Camarones scored highly on virtually all anthropogenic factors but

its physical background again made it unlikely to move up a class. At Cabo de la Vela, litter was concentrated by wave action into a small gully and the beach was extremely clean. In addition, many items were transported by wind to the beach from the cliff top – plastic bottles, cans, etc. This concentration of litter would make removal easy.

Terrestrial vegetation debris (Palm and Coconut trees), was ubiquitous especially at rural and remote sites because of river discharges (large sediment and debris loads; absence of water treatment plants) and climatic conditions. The Magdalena River brings vegetation debris and litter to the coastline that affects many kilometres of downdrift coast, inevitably giving low scores for several scenery parameters e.g. water turbidity, litter. This is in contrast to European organic debris, which originates mainly from the sea, e.g. seaweed. Caribbean beach users do not appear to be concerned very much about this vegetation, as it seems they are used to a considerable inland vegetation cover, which results in a greater amount of beach vegetation debris ([Botero, Anfuso, Duarte, et al., 2013](#)). In fact, beach users at Tayrona and other remote areas, considered heavy strand line vegetation as an 'indicator' of a natural area. It is noteworthy that many groups were located adjacent to mounds of litter items deposited on the beach and subsequently left for cleaners to pick up; these were frequently related to the 'fun' activities.

The majority of Colombian beaches had low scores in both litter and scenic parameters. Sector analysis ([Fig. 9](#)) showed 18 beaches within the red area (51.4% of all), which represent 66.6% of resort beaches, 64.2% of urban beaches and 77.7% of village beaches. In summary, a large proportion of Colombian beaches have low natural scenery potential for 'sand, sea and sun tourism'. Special attention must be paid to beaches located in the yellow sectors ([Fig. 9](#)). Four beaches show very bad litter management (upper right quadrant), where 7 Olas beach is the worst case, as has been already commented upon. On the opposite area, lower left quadrant, eight beaches show an important effort to overcome low scenery and improve litter cleaning, highlighting Riohacha East and Irotama (Scenic Class V and Litter Grade A; [Table 3](#)). Sector Analysis Approach ([Fig. 9](#)) has demonstrated its usefulness to beach management for each of the three scenic/litter scenarios:

- The green sectors show high valued beaches, where protection measures should be applied;
- The red sectors show beaches with low or deficient management, where restoration and cleaning actions must be implemented;
- The yellow sectors show beaches with contradictory relations between scenic class and litter grade, which needs deeper analysis in order to focus management on specific tasks.

It should be stated that sector analysis is not sensitive for Class III, beaches on the scenic assessment scale, as the ranking has five levels and the litter grade only four (matrix 5×4). Special attention should be paid to Class III scenic beaches, where one is unable to discriminate scenic values from their litter grade and further observations will be needed to define management actions. This approach is more efficient in analysing groups of heterogeneous beaches than homogeneous ones; in the latter case, consideration is being given to further develop a means to integrate results from scenic and litter surveys. The green sector should be a warning for Colombian tourism authorities because only 11.4% of beaches have a high scenic and litter class – all in remote areas grade ([Fig. 9](#)). Beach managers and tourism policy makers should make a bigger effort to improve the human scenic parameters, litter being the foremost.

5.3. Management

Effective management involves knowledge of what are the preferences and priorities of the ‘customer.’ If it is possible to change matters for the better, then this should be carried out. For scenery, the main parameters for change would mainly be the human aspects. Pragmatically, changes to physical parameters, e.g. presence of cliffs, rivers, vistas etc. are really items that are almost impossible to change although matters such as strand line vegetation, nourishing a beach area with golden sand, etc. is not beyond the remit of any management plan. An example of this is Miami Beach, which was transformed in the 1970s by a \$51 million nourishment project, which pumped offshore white coral sand to the depleted beach, widening it by some 200 feet over some 10 miles of barrier shoreline, bringing 85 million tourists/year contributing US\$65 billion to the Florida economy (Houston, 2013).

A high density of buildings can currently be observed along several coastal tourist areas of France, Italy and Spain, where the built up area exceeds 45% (EEA, 2006). This usually involves landscape degradation, currently a big issue not only in Colombia but elsewhere. Benoit and Comeau (2005) showed that 60% of locals interviewed in Italy and Spain commented upon not only poor planning with respect to growth, but also landscape degradation. For example, in 2000 within the Mediterranean region, 40% of the coastline had been lost to buildings and by 2025 it is estimated that 50% would be irreversibly artificial (Benoit & Comeau, 2005). Table 5 gives D values for various global locations and many of the lower scores invariably relate to this parameter. In Colombia effective coastal planning is in its infancy and the infrastructure needed to cope with increased tourism needs additional scrutiny. It is almost an axiom that when an island e.g. Malta or area, triples its summer population, some landscape degradation, which affects scenery immensely, is bound to occur and this ultimately affects tourism (Williams & Micallef, 2009). Scenery is a very important component for beach tourism and drives the economy of many coastal country's and as beaches are under pressure from anthropogenic development and utilisation so proper evaluation outcomes can provide a scientific basis for any envisaged management plan.

Almost 75% of the Colombian population is centred on Barranquilla, Cartagena, Santa Marta and Riohacha, so ample scope exists to develop sound beach management policies for tourism, as well as for the local population. Tourism exhibits a broad range of linkages to other industries and indirectly affects incomes and job generation, producing qualified/unqualified jobs filled by many local people who often need specific training. In relation to turnover volume to invested capital it is relatively job intensive.

The cities represent urban/resort entities; the rest of the country is village based/remote. For the main cities, changes as suggested within the scenic evaluation techniques shown in this paper would probably be hard and cosmetic at the most. Certainly hard structures could be removed, as shown in the case of classic tourist regions, such as, Italy and Spain, and could be replaced with nourishment, but the cost/benefit in a region that is undergoing erosion for almost 50% of its length has to be considered. It is likely that the towns mentioned will probably retain hard engineering structures. For the remainder of the country, self-contained resorts can be constructed along the Club Med model and based alongside selected village areas. These buildings should meld into the physical background (Fig. 2, point 25) being sensitive to the environment (Fig. 2, point 23). It is mandatory to note that any tourist product is ideally the summation of original natural

attractions e.g. landscapes scenery, climate, water, beaches, wild-life, vegetation, etc., together with derived offerings, e.g. cultural attractions – historic, religious, typical architectural monuments, traditional handicrafts, folklore, festivals, everyday culture, special dishes, etc.

Similar thoughts can be expressed for litter. Windom (1992) suggested that the greatest impact associated with marine litter is NOT to organisms, but to the potential economic impact on marine and coastal tourism, as degraded coastal areas negatively affect tourism associated with a reduction of amenities. This is one of the prime motivations for beach clean-ups. Jang, Hong, Lee, Lee, and Shim (2014), McIlgorm et al. (2008, 2011), Ofiara and Brown (1999), Ofiara (2001), all have confirmed such findings. Coastal communities that rely heavily on tourism have their income severely depleted by marine debris; as if the beach appearance is unacceptable the public may avoid that beach (Sheavly & Register, 2007; Williams et al., 2003). For example, beach closures along with public perception of contaminated bathing areas in 1987 and 1988 resulted in approximately US\$ 2 billion of lost revenue for New Jersey and New York states. The losses were ascribed to debris (Rees & Pond, 1995).

Beach litter management is a complex problem which requires a holistic view to find effective solutions that goes beyond a national issue and acknowledgement of user perception to beach pollution should be essential for beach management (Vaz, Williams, Pereira da Silva, & Phillips, 2009). Morgan et al. (1993) was of the opinion that beach management must consider the perception of the beach user for effecting sustainable management strategies. Many studies have been carried out since the concept of aesthetic pollution and public perception of coastal debris was addressed by House and Herring (1995). Public perception of debris has been looked at via field experiments by Williams and Nelson (1997), who used three different litter compositions via a grid system (general litter, sewage related debris and a combination of the two) which was viewed by 166 beach users. Debris corresponding to the three categories was added to grid cells in increasing quantities and users were asked to say when the litter was offensive enough to stop them visiting the beach (the Circumplex Model of Affect, Russell, 1980). Results showed that the general public was more affected by a mixture of generic debris categories, typically found in Colombia, as opposed to individual categories and negative implications of beach debris were highlighted. On photographic evidence, Nelson, Botterill, and Williams (2000) rated all litter on a Condom Equivalent scale, as sewage is constantly rated as being the most offensive item (Tudor & Williams, 2003), and Wyles, Pahl, Thomas, and Thompson (2015, 23) recently pointed out that, ‘litter can undermine the psychological benefits that the coast ordinarily provides, thus demonstrating that, in addition to environmental costs of marine litter, there are also costs to people.’

The above indicates that marine debris undoubtedly adversely affects the environment, economy, human health and wildlife and some 80% originates from land-based sources (Lee, 2015; UNEP 2009, 2011; UNEP GESAMP, 2005). In the Mediterranean, a notable tourist destination, Gabrielides et al. (1991) and Golik and Gertner (1992) showed that the main sources were beach recreational sources – a similar finding to Colombia. The effect of aesthetic issues on the amenity value of marine environments involves: loss of tourist days; resultant damage to leisure/tourism infrastructure; damage to commercial activities dependent on tourism; damage to fishery activities and fishery-dependent activities; damage to the local, national and international image of a resort (Philipp, 1993). Marine debris-related damage to marine industries was estimated at US\$1.26 billion per annum in 2008 for 21 countries studied in the Asia Pacific rim (McIlgorm, Campbell, &

Table 5

D values from selected places (assessed by authors of this paper).

Class Places	
I	Long Reef, Australia , 1.39; Ursa, Portugal , 1.24; Zaglev, Croatia , 1.18; Sagg Main Beach, Long Island, USA , 1.10; Lagoonaaria, Morea, Tahiti , 0.95; Gritviken, South Georgia , 0.87; Dee Why, Australia , 0.86.
II	Pelosa, Sardinia, Italy , 0.84; Fungus Rock, Malta , 0.77; Carcass Island, Antarctica , 0.75; St Govans, UK , 0.69; Karaburun Akyar, Mersin, Turkey , 0.67; Porat, Croatia , 0.65;
III	Gore Bay, NZ , 0.64; Akaroa, NZ , 0.63; Aligade, N Cyprus , 0.57; Magelan Foreland Tip, Ireland , 0.56; Taj hotel, Gujerati, India , 0.55; Amroth, UK , 0.55; Old Stone Man, Qingdao, China , 0.53; La Guardia, Andalusia, Spain , 0.51; Guarita Park, 0.5, Brazil ; Kaka Pir, Pakistan , 0.50; Stanley Bay, Hong Kong , 0.44; Pleasant Cove, Falklands , 0.43; Irita, Japan , 0.41; Kalat, Morocco , 0.40.
IV	Ship Cove, West Falklands , 0.39; Bondi, Australia , 0.38; Ushuaia, Argentina , 0.30; Aqua Calde, Lipari, Aeolian Isles, Italy , 0.26; Praia do Pópulo, Azores , 0.26; Rosario, Cuba, 0.26; Bombarse, Sardinia, Italy , 0.18; La Playa, Peru , 0.16; Kercem Cliffs, Malta , 0.16; Plage Rouge, Morocco , 0.14.
V	Belem Portugal , –0.29; Lara beach, Turkey –0.28; Allende Matanzas, Cuba , –0.20.

Rule, 2011). UK municipalities spend some €18 million each year removing beach litter; approximately a €10.4 million per year cost to municipalities in the Netherlands and Belgium (Mouat et al., 2010). Gregory (1999) argued that where natural resources may be limited and economic development is largely dependent upon coastal tourism, then the litter issue is a major problem. Colombian beach sites exemplify this comment.

Colombian beach litter management should be based on strategies to eliminate or reduce litter sources and for that it is necessary to consider beach types to define the intensity and periodicity of actions to be implemented (Williams, 2011; Williams & Micallef, 2009). In general, these actions should consider beach users' awareness (local and tourists), the placing of trash cans (not really suitable at remote beaches where emptying the cans is problematic) and a mechanical or manual cleaning plan that considers extraordinary sources, e.g. litter blooms. The educational component should not be minimised, i.e. hammer home the message 'bag it' to take away or 'bin it', especially within National Parks.

Colombia has a 2013, law, which makes urban beach cleaning compulsory for all coastal Municipalities. This legal action is consequent with the fact that litter will affect the beach image, its landscape, and as a consequence the incomes of the tourist sector; additionally, the cleaning plan should consider litter classification as an economic income that will benefit the community. Flexible strategies, i.e. preventative and not reactive measures, should be in place. Adverse meteorological events, e.g. 'litter blooms' seldom occur, but plans must be in force to deal with these occurrences. Fig. 10 gives an indication of such an event, which occurred along almost the entire Atlantico and Magdalena coastlines in 2015 and 2016, respectively. For these events, it might be necessary to incorporate beach management with river basin management. As a final point, it is important to mention that 'proximity' is a most important pragmatic reason for beach choice in the north Caribbean coast of Colombia (Botero, Anfuso, Williams, et al., 2013; Botero et al., 2014). For preference, users would like clean beautiful beaches, but travel distance precludes this for most indigenous people; perhaps this is a reason for low attention to beach management by local authorities.

As plastics are the main Colombian litter component, the future should revolve around matters, such as, changes in plastic chemistry, personal and industry behavioural changes together with encouraging community beach clean activities. SAS (2014) even suggests legislation to address enforcing fines for beach littering and banning beach smoking, among other responsible behavioural changes. A positive approach to bioplastics for the packaging industry would help in cutting down the >50% plastic beach litter found. It is salutary that polyactic acid (PLA) is now becoming an alternative to petroleum based plastics as it is carbon neutral and biodegradable. Other strong research areas are production of hindered urea bond materials (PHUs), which keep the polymer stable for long lasting

applications; the production of fully bio-based polyester created from lignin, to make bio-based chemicals suitable for plastic production. The Take-Make-Dispose linear economy is dated and thinking is now related to the circular economy – biomass cascades, closed loops of abiotic materials, and circular products. A key tenet is to develop a model that retains value of all facets: financial, natural/sustainable, and social and in Europe, the European Commission (Materials World, 2016), believes that this will close the 'loop' of product lifecycles through greater recycling/reuse. Given time these research strands/ideas will not only cut down the plastics found at Colombian beaches, but plastics found on a global basis. It is noteworthy to recall Jambeck et al. (2015) comment that in 2010, some 270 million tons of plastic were produced globally, a figure expected to grow exponentially by 2025; and the USEPA (2015) who found that only 9% of the total plastic waste produced by the USA – a leader in this field – was recovered for recycling.

6. Conclusions

Beach users are essentially interested in 'safety, facilities, water quality, no litter and scenery.' The 'Big Five' virtually dominate all other considerations and it is the latter two that form the focus of this paper. These parameters have been found in surveys of beach users' preferences and priorities in many countries, e.g. Turkey, UK, Malta, Croatia, Portugal, Spain, the USA. Thirty five beach sites were investigated for type, scenery and litter along the northern Caribbean shoreline of Colombia, Beach type was categorized into resort: (3), urban (14), village (9) and remote (9). Scenic evaluation of types grouped them into one of five classes: 6 sites appearing in Class I; 2 in Class II; 1 in Class III; 6 in class IV; and 20 in Class V. Litter gave 6 sites an A grade (excellent); 7 sites a B grade; 19 sites a C grade and 3 sites a D grade (poor). Sector analysis indicated that a large proportion of Colombian beaches have a low natural scenery potential for 'sand, sea and sun tourism'. This analysis is not sensitive for Class III, beaches on the scenic assessment scale because the ranking has five levels and the litter grades only four (matrix 5 × 4). Further work is being considered for this issue.

The data gathered relates to parameters geared to tourism industry aspirations, i.e. these are some of the major issues that determine holiday choice. Colombia is currently re-building its tourism industry with an avowed aim of increasing its international appeal. A lynchpin in this effort must orientate around the litter issue, as beaches tend not to be as appealing to the international visitor (some 2 million) as to the local (some 6 million). Five star hotels, golf courses etc. are now being developed in areas, such as, Cartagena. Twenty two sites scored a C or D for litter. This is a high scoring weighted parameter on the scenery scoring scale and one that could easily be remedied to produce a higher scenic grade. Currently only urban beaches tend to be cleaned, seemingly on an ad hoc scale and remuneration for hand cleaners is very low.

Excluding some tourism types, e.g., eco-tourism and with a view to achieving more resort types of accommodation complexes, it behoves Government Agencies to look closer at the results given in this paper. Amongst other prime parameters tourists want litter free beaches and excellent scenery. Analyses as shown here can help determine the correct location for any new Greenfield site.

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