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Andalusia, Spain: An Assessment of Coastal Scenery

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ABSTRACT *The 1101 km length of the Andalusian coast (Spain) was assessed for coastal scenery at 45 specific locations. Selected areas covered resort (3), urban (19), village (8), rural (10) and remote (5) bathing areas. Scenery was analyzed for physical and human parameters via 26 selected parameters. These parameters were obtained by interviews of >500 people on European beaches. Each parameter was assessed via a one-to-five-point attribute scale, which essentially ranged from presence/absence or poor quality (1), to excellent/outstanding (5). Results were subsequently weighted by interviewing >600 bathing area users (not all 26 parameters have equal weight) and subjected to fuzzy logic mathematics in order to reduce recorder subjectivity. High weighted averages for attributes 4 and 5 (excellent/outstanding) reflected high scenic quality, vice versa for attributes 1 and 2. Sites were classified into five classes ranging from Class 1 sites having top grade scenery to Class 5, poor scenery. Seven sites each were found in Classes 1 and 2; 10 sites each in Classes 3 and 5; 11 sites in Class 4. The finest coastal scenery was found in remote areas whilst urban areas scored mainly as Class 3 or 4. Three out of the ten rural sites had Class 3 and 4 values assigned them whereas the rest scored as Class 1 and 2; village sites invariably had scores within Class 3 and 4. Of the three resort sites investigated, one scored as a Class 1 site, the others as Class 3.*

KEY WORDS: Coastal scenic evaluation, landscape assessment, physical and human parameters, coastal landscape, fuzzy logic assessment (FLA)

Introduction

Coastal Scenic Evaluation is an important tool for managers/planners for coastal preservation, protection and development, as evaluation outcomes provide baseline information and a scientific basis for any envisaged development plan. Scenery can be defined as "the appearance of an area", and the coastal landscape can be described as "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors" (Council of Europe, 2000,

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p. 32). Coastal areas are under threat due to the pressure of people who use the area for habitation, recreation and/or industrial development and this pressure affects an extremely strategic asset—coastal scenery itself. Scenery is a highly valued resource for aesthetic, cultural, economic and historical reasons and managers need to evaluate its resources in an objective and quantitative manner, as "coastal scenery is a resource, partly because of the economic value and partly because it is an accepted component of resource assessment programmes" (Kay & Alder, 1999, p. 303).

Coastal tourism is one of the world's largest industries (Klein *et al.*, 2004). In the Mediterranean region, it is the most important activity with 298 million international tourist arrivals in 2008, followed by approximately 400 million domestic tourist arrivals. In many Spanish coastal areas the built up zone exceeds 45% (EEA, 2006), with tourism receipts accounting for some 5% of the gross domestic product (WTO, 2006). Spain plus Italy, France, Greece and Turkey account for "the most significant flow of tourists . . . . a sun, sea and sand (3S) market" (Dodds & Kelman, 2008, p. 58) and 'Travel & Tourism' worldwide, is expected to grow at a level of 4.0% per year over the next ten years. Wilson and Liu (2008, p. 130), showed that beach recreation "got inordinate attention in the economic literature" and Williams (2011) has shown that five parameters were of the greatest importance to coastal tourists: safety, facilities, water quality, litter and scenery; this paper concentrates on the latter.

Coastal managers together with planners need coastal landscape inventories in order to base sound management decisions on ascertained facts. Most scenic assessments have been subjectively valued within a framework where scenery is only one aspect of wider landscape assessment. For example, the Resource Management Act (RMA) 1991 of New Zealand specifically outlines provisions to protect outstanding natural landscapes from inappropriate development, but fails to provide guidelines for how this should be achieved. Evaluation can be utilized mainly in landscape preservation (e.g. conservation), and protection (development) and benefits should be of high interest for various governmental and non-governmental organizations working on management strategies.

A major reason why scenic assessment is not widely applied is due to the inability of scenic evaluation methodologies to represent people's perceptions, so heavy reliance is placed upon subjective data. The method of assessment adopted for this research on Andalusia (Spain) coastal areas (Figure 1) utilizes fuzzy logic mathematics and parameter weighting matrices, allowing one "to overcome subjectivity and quantify uncertainties" (Ergin *et al.*, 2004, p. 1).

History of Landscape Assessment

Landscape descriptions have appeared in many a Victorian explorer's notebook, as well as military manuals, but originally coasts were seen only as having ecological value (Sheail, 1984). Several early studies attempted to address some key issues underlying the limitations of landscape assessments. For example, Fines (1968) stressed photographic analyses in his identification of landscape units. Linton (1968, 1982) obtained a landscape scenic assessment number from assessing six landform parameters with seven usage parameters. In a seminal paper, Leopold (1969) stressed scenic uniqueness based upon physical, human and biological parameters. Robinson

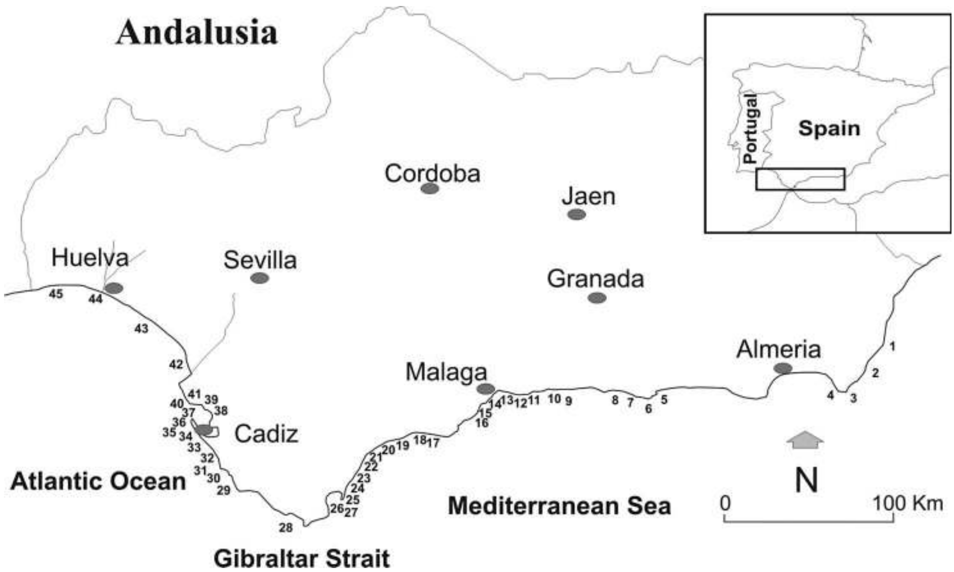

Figure 1. Location map of the 45 studied beaches in Andalusia (Spain). 1: Las Negras: 2: Cala del Carnaje; 3: Playa de los Genoveses; 4: Playa de Monsul; 5: Rijana; 6: La Chucha 1; 7: La Chucha 2; 8: La Guardia; 9: Las Alberquillas; 10: Peñoncillo; 11: Torre del Mar; 12: Almayate; 13: Benhajarafe; 14: Las Acacias; 15: Los Alamos; 16: Santa Amalia; 17: Nueva Andalusia; 18: Nagueles; 19: Fontanilla; 20: Isdabe (Casasola); 21: La Rada; 22: Torreguadiaro; 23: La Atunara; 24: Santa Barbara; 25: Palmones; 26: El Rinconcillo (Natural Park); 27: El Rinconcillo; 28: Valdevaqueros; 29: Conil (urban); 30: La Cala del Aceite; 31: Calas de Roche; 32: La Barrosa (hotel); 33: La Barrosa (urban): 34: La Cortadura; 35: La Victoria; 36: Santa María del Mar; 37: La Caleta; 38: La Puntilla; 39: Fuentebravia; 40: El Rompidillo; 41: La Costilla; 42: Natural Park of Doñana; 43: Base Arenosillo; 44: Punta Umbría; 45: Islantilla.

et al. (1976) derived landscape scores by using a 'best/worst' case score obtained from 1 km square grids. Crofts (1975) created a landscape evaluation method to measure physical components considered to be determinants of scenic quality. The aim was to compare results to those obtained via different methodologies and consequently to assess the methodological variability and he highlighted the inconsistencies between studies claiming to assess the same landscape. Similarly, Appleton (1975) attempted to place a theoretical concept in landscape assessment, concluding that no theories underpinned the principles of human senses, and while one bases landscape assessment on what people prefer, the best one can do is to distinguish between shades of opinion. Yamashita (2002) explored variations in scenic perception between children and adults, concluding that the former focused greater attention on environmental aspects within their immediate surroundings; whereas adults were more aware and interested in both immediate and distal landscape aspects, thus posing the question: can scenic evaluation studies adequately represent children's perceptions?

Modern approaches focused on developing more detailed aspects and new techniques have emerged for evaluating landscapes that move away from criteria based assessment, for example, GIS imagery. Henderson and de Lambert (1992) suggested that the use of GIS to overlay land types in combination with the application of other landscape assessment techniques could be a more effective tool. Using such a combination is more suitable and could be useful for studies covering large areas (e.g. the Countrywide Council for Wales [CCW], 2001). The UK Countryside Commission (1987, 1993) obtained a range of landscape types from assessing the natural landscape, cultural, aesthetic and associations and the CCW (1996, 2001) LANDMAP series was similar in taking a GIS approach. Lee *et al.* (1999) proposed assessment of landscape quality based on vegetation cover evaluation, as areas of high ecological value were considered to coincide with areas perceived to have significant natural beauty. Canters (2002) and Gulinck *et al.* (2001) documented similar techniques. These highlight the increasingly technical nature of scenic evaluation, but fail to address simple issues such as variations in people's perception, or the basic inaccuracies in analyzing landscapes based on images. There is a huge gap between constructing a representative analysis of scenic quality and mapping land cover, and it is worth noting that, in this paper, vegetation played a minor role in people's perception of scenery.

Legislation strategies for coastal protection exist in most countries and many outstanding areas of scenic value have become reserves, for example, Australia bases its classification on physical parameters; in the UK, Areas of Outstanding Natural Beauty (AONB) and National Parks exist, but legislation is a difficult process due to the private/public land mix (Harvey & Caton, 2003). In the USA, a move from 'visual resource management' determined by 'experts' to a community focused and public participatory approach has been mooted in order to obtain better environmental outcomes (Dakin, 2003). Individual aesthetic experiences of landscapes vary significantly, so expert assessment of public assumptions must be looked at with caution (Smith & Theberge, 1987). Palmer and Hoffman (2001) researched the implications of a US Supreme Court decision requiring experts to provide reliability or validity assessments when providing evidence. Few scenic assessment reports compiled by 'landscape experts' were found to contain such assessments, and some of those that did revealed alarming results.

However, expert reliability can be partly ameliorated by repeating assessments made by others and cross-checking the results. In order to increase credibility, experts can incorporate a balance of qualitative and quantitative judgements (The Landscape Institute, 1995). Cocklin *et al.* (1990) looked at scenic evaluation (quantitatively grading sites as having High, Medium, or Low scenic value), as a major component regarding the potential of areas for recreation. Scenic value was based on land form and land cover and presence of rare features. Results were largely subjective, making the technique rather weak. Priskin (2001), in assessing the presence of infrastructure, levels of attraction, and levels of environmental degradation for eco-tourism in Western Australia, attempted to indicate areas with a particular scenic quality, as against those that needed improvement. However, he did not make any concession to observer subjectivity.

Scenery is a vital component of beach holiday selection and drives the economy of many coastal countries. For example, Morgan and Williams (1995) questioned >200 beach users at Gower, UK, and concluded that scenery was the first choice of prioritized beach aspects; Unal and Williams (1999) questioned 120 beach users at

Cesme peninsula, Turkey, and found that scenery ranked second after clean bathing water in the enjoyment of a beach based holiday. It is a coastal *value* and consequently scenic evaluation is an important element for comparison purposes. Many designated areas, such as National Parks, etc., all reflect the scenic component as this mirrors the natural beauty of an area.

The scenic assessment facets outlined above indicates the need to adopt a methodology that can uphold the purposes/principles of resource management strategies, while reducing subjectivity. Difficulties involved with establishing empirical relationships between landscape and people's perceptions have been contested in the past and will be in the future (Preece, 1980). The methodology used in this research paper seeks to address and counter these arguments. Ergin *et al.* (2004) suggested that a coastal scenic evaluation based on public perception and a quantitative methodology to remove subjectivity can serve this purpose.

Physical Background

The littoral of Andalusia extends along the Mediterranean Sea, the Gibraltar Strait, and the Atlantic Ocean (Figure 1, Table 1). The Mediterranean littoral of Andalusia is a micro-tidal environment particularly exposed to wind and waves approaching from the east and southeast. The landscape is dominated by the Betic Chain, which is well developed and reaches high elevations close to the coast, as well as by several, small coastal plains, especially extended at the mouth of short rivers and *ramblas* that drain the Chain. Beaches are usually composed of fine and medium dark sands and frequently are of small dimensions. They are often interrupted by rocky sectors and headlands that give rise to pocket beaches (*calas*) of different sizes. The nearshore region usually has important slopes and beaches show a more reflective state when compared with the ones on the Atlantic side.

The Gibraltar Strait sector is also a micro-tidal one, exposed to winds and waves approaching from the east and secondarily, from the west. In the central part of this sector, the Betic Chain gives rise to high cliffs and bluffs resistant to coastal erosion and rocky shore platforms. Rectilinear beaches are observed at the eastern and western sides, sand sediments varying from dark to gold in colour; medium to fine grained in size.

The Atlantic sector is a meso-tidal environment exposed to wind and waves approaching from the west and secondarily from the southeast. The southern part is composed by cliffs and sand sectors with several embayments which are occupied by sedimentary environments fed by short rivers draining the western Betic Chain. The northern part is a low sand coast with long, wide beaches and littoral spits. Coastal sediments are composed of fine and medium gold coloured sands which give rise to smooth beach and nearshore areas.

Methodology

A major aim in any scenic assessment is reduction of subjectivity so that results "could be used in many planning and decision making contexts" (Leopold, 1969, p. 4). Therefore, a checklist approach (Table 2) loosely based on the work of Leopold (1969), was utilized in order to assess scenery in coastal Andalusia, Spain.

Table 1. List of: Beaches, Class, Scenic evaluation value, Classification and Council

Map number	Beach	Class	D value	Type	Council	Province	Blue Flag (B) Natural Protected Area (N)
1	Las Negras	3	0.57	village	Nijar	Almeria	N
2	Cala del Carnaje	1	0.88	remote	Nijar	Almeria	N
3	Playa de los Genoveses	1	1.26	remote	Nijar	Almeria	N
4	Playa de Monsul	1	1.13	rural	Nijar	Almeria	N
5	Rijana	2	0.69	rural	Gualchos-Castell de Ferro	Granada	
6	La Chucha 1	4	0.23	village	Motril	Granada	
7	La Chucha 2	4	−0.28	village	Motril	Granada	
8	La Guardia	3	0.51	village	Salobreña	Granada	
9	Las Alberquillas	2	0.67	remote	Nerja	Granada	
10	Peñoncillo	4	0.38	village	Torrox	Granada	
11	Torre del Mar	4	0.21	urban	Velez	Malaga	
12	Almayate	2	0.66	rural	Velez	Malaga	
13	Benhajarafe	4	0.03	village	Velez	Malaga	
14	Las Acacias	5	−0.14	urban	Malaga	Malaga	
15	Los Alamos	4	0.23	rural	Torremolinos	Malaga	
16	Santa Amalia	5	−0.44	urban	Fuengirola	Malaga	B
17	Nueva Andalucia	2	0.75	urban	Marbella	Malaga	
18	Nagueles	3	0.57	urban	Marbella	Malaga	
19	Fontanilla	4	0.24	urban	Marbella	Malaga	
20	Isdabe (Casasola)	3	0.49	resort	Estepona	Malaga	
21	La Rada	3	0.48	urban	Estepona	Malaga	B
22	Torreguadiaro	4	0.14	village	San Roque	Cádiz	B
23	La Atunara	3	0.54	rural	La Línea de la Concepción	Cádiz	
24	Santa Barbara	4	0.3	urban	La Línea de la Concepción	Cádiz	
25	Palmones	4	0.29	village	Los Barrios	Cádiz	
26	El Rinconcillo (Natural Park)	3	0.41	rural	Algeciras	Cádiz	N
27	El Rinconcillo	5	−0.24	urban	Algeciras	Cádiz	
28	Valdevaqueros	2	0.82	rural	Tarifa	Cádiz	
29	Conil	3	0.64	urban	Conil	Cádiz	BN
30	La Cala del Aceite	2	0.73	rural	Conil	Cádiz	
31	Calas de Roche	1	0.99	rural	Conil	Cádiz	B
32	La Barrosa (Hot.)	1	0.89	resort	Chiclana	Cádiz	B
33	La Barrosa (Urb.)	4	0.03	urban	Chiclana	Cádiz	B
34	La Cortadura	3	0.51	urban	Cádiz	Cádiz	B
35	La Victoria	5	−0.36	urban	Cádiz	Cádiz	B
36	Santa María del Mar	5	−0.47	urban	Cádiz	Cádiz	
37	La Caleta	5	−0.05	urban	Cádiz	Cádiz	B
38	La Puntilla	5	−0.36	urban	El Puerto de Santa Maria	Cádiz	B
39	Fuentebravia	5	−0.21	urban	El Puerto de Santa Maria	Cádiz	B
40	El Rompidillo	5	−0.48	urban	Rota	Cádiz	
41	La Costilla	5	−0.21	urban	Rota	Cádiz	B

(*continued*)

Table 1. (*Continued*)

Map number	Beach	Class	D value	Type	Council	Province	Blue Flag (B) Natural Protected Area (N)
42	Natural Park of Doñana	1	0.91	remote	Almonte	Huelva	N
43	Base Arenosillo	1	0.87	remote	Almonte	Huelva	N
44	Punta Umbría	2	0.83	rural	Punta Umbria	Huelva	B
45	Islantilla	3	0.42	resort	Ayamonte	Huelva	B

This involved ranking selected parameters on a 1–5 attribute scale (presence/absence or poor quality to excellent/outstanding), from which an aesthetic rating could be attained for any site.

A series of questionnaires given to >500 beach users in the UK, Turkey, Malta and Croatia, asking what was important for coastal scenic assessment, enabled establishment of a 26 parameter list (18 physical and eight human). These items were then assessed by a further cohort of beach users as to their relative importance in order that a weighting could be placed on each parameter. Each listed parameter (the y axis in Table 2) was then sub-divided into five sub-unit attributes and placed in a matrix (the x axis in Table 3). Previous investigations of such matters have frequently ignored the weighting effect when investigating what parameters are important in judging, for example, the 'best' beach (Leatherman, 1998). Weightings are needed as no one would expect to find lifeguards on, for example, a remote beach. In order to quantify uncertainties and subjective pronouncements inherited in assessment parameters, for example, vagueness, uncertainty, errors, a Fuzzy Logic Assessment (FLA) approach was used (Ergin *et al*., 2004). Fuzzy logic is a mathematical analysis tool used for processing data that contains uncertainty and whose purpose is to help eliminate individual subjectivity. It has been used in many fields where subjectivity affects the achievement of accurate results, from financial systems to remote sensing of cloud and ice cover.

Every parameter was looked at and a probability estimate in obtaining the weight matrices for a FLA approach undertaken to assess the possibility (magnitude) of participation of each assessment parameter introduced as weighted averages for the parameters. Table 3 is an example for parameter 17–vegetation cover on strand line and 23–the Built Environment. This would quantify uncertainties and subjective pronouncements inherited in assessment parameters. A matrix system was used that weighted parameters according to coastal users' preferences and priorities (Ambala, 2001; Zadeh, 1965). This enabled histograms together with graphs of weighted averages and membership degrees to be obtained with respect to the five attributes (Figures 2–4). The algorithm involved both weighting and fuzzy logic values and incorporated all of the above enabling a Scenic Evaluation Value (D) to be obtained (Figure 5; Table 1), which could classify scenic assessment into one of five classes (see Ergin *et al*., 2003, 2006 for details) ranging from Class 1 (extremely attractive natural beaches) to Class 5 (very unattractive urban beaches). The higher the D value the

Table 2. Coastal Scenic Evaluation checklist

No:	Physical parameters		Rating 1	2	3	4	5
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)	Varity of mature trees/mature natural cover
18	Vegetation debris		Continuous (>50 cm high)	Full strand line	Single accumulation	Few scattered items	None

(*continued*)

Table 2. (*Continued*)

No:	Physical parameters	Rating				
		1	2	3	4	5
	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.

Table 3. Fuzzy Logic matrix for strand line vegetation debris (M_{17}) and the Built Environment (M_{23})

			1	2	3	4	5
M_{17}	=	1	1,0	0,2	0,0	0,0	0,0
		2	0,2	1,0	0,2	0,1	0,0
		3	0,0	0,2	1,0	0,2	0,0
		4	0,0	0,0	0,2	1,0	0,2
		5	0,0	0,0	0,0	0,2	1,0
			1	2	3	4	5
M_{23}	=	1	1,0	0,2	0,0	0,0	0,0
		2	0,0	1,0	0,2	0,0	0,0
		3	0,0	0,2	1,0	0,2	0,0
		4	0,0	0,0	0,3	1,0	0,0
		5	0,0	0,0	0,0	0,0	1,0

Note: vegetation cover on strand line; M_{23} the Built Environment.

higher the scenic evaluation. The site scenic value, calculated from membership degree versus attributes graphs (Figure 3) is:

$$D = (-2.A_{12}) + (-1.A_{23}) + (1.A_{34}) + (2.A_{45}) \tag{1}$$

Total area under curve.

Where: A_{12} = total area under the curve between attributes 1 and 2. Similarly, areas under the curve may be calculated for $A_{23,}$ $A_{34,}$ A_{45}.

Classes 1 and 5 occur within the lowest 15th and top 85th percentile respectively**.** Testing break points for Gaussian distributions (0.05 level) conformed normality (Figures 5 and 6) indicating *study unbiasedness*, and this has been confirmed by assessments in many countries, for example, UK, Turkey, Croatia, Bosnia, Malta, Portugal, Tunisia, Cyprus, Japan, China, Pakistan, eastern USA, several Pacific islands and New Zealand. Normality tests using chi-square and Kolmogorov-Smirnov tests have been performed at the 5% significance.

Once the checklist table (Table 2) had been produced and algorithms written, each of the 45 sites were ranked on a 1–5 attribute scale (Table 2). Other information was also gathered, such as location in natural areas, 'Blue Flag' status, etc. (Table 1).

Results and Discussion

In the present study, scenic evaluation scores were produced according to the described methodology. Histograms, weighted averages and membership degrees were presented as graphs histograms (Figure 2); of membership degrees (Figure 3); and weighted average of attributes (Figure 4), grouped into physical and human parameters for each site. Interpretation of the membership degree versus attribute graphs produced visual scenic assessment graphs, whilst the histograms (Figure 2) gave a visual state for recorded checklist attribute values (Table 2).

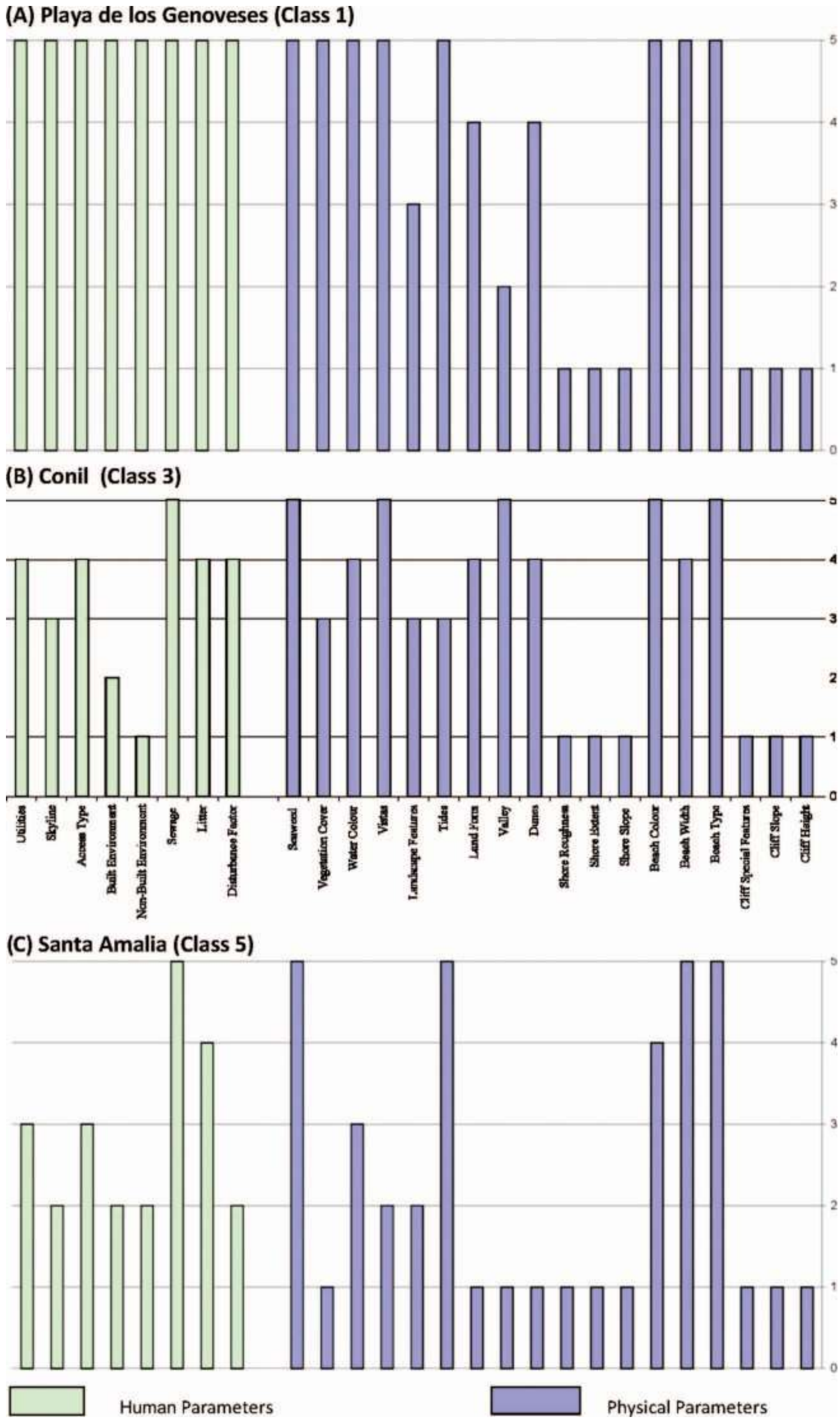

Figure 2. Assessment histograms for: (a) Playa de los Genoveses (Class 1); (b) Conil (Class 3) and (c) Santa Amalia (Class 5).

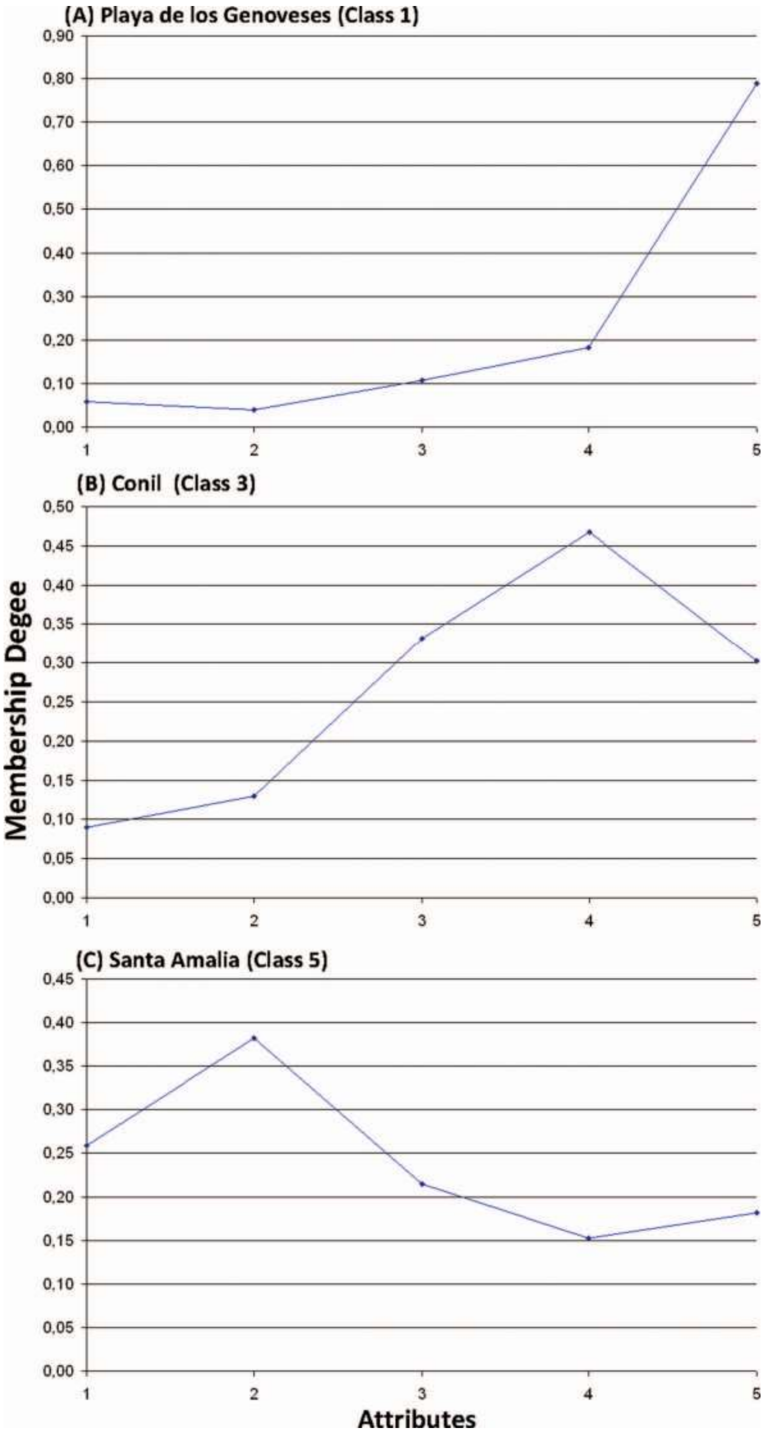

Figure 3. Membership degree for: (a) Playa de los Genoveses (Class 1); (b) Conil (Class 3) and (c) Santa Amalia (Class 5).

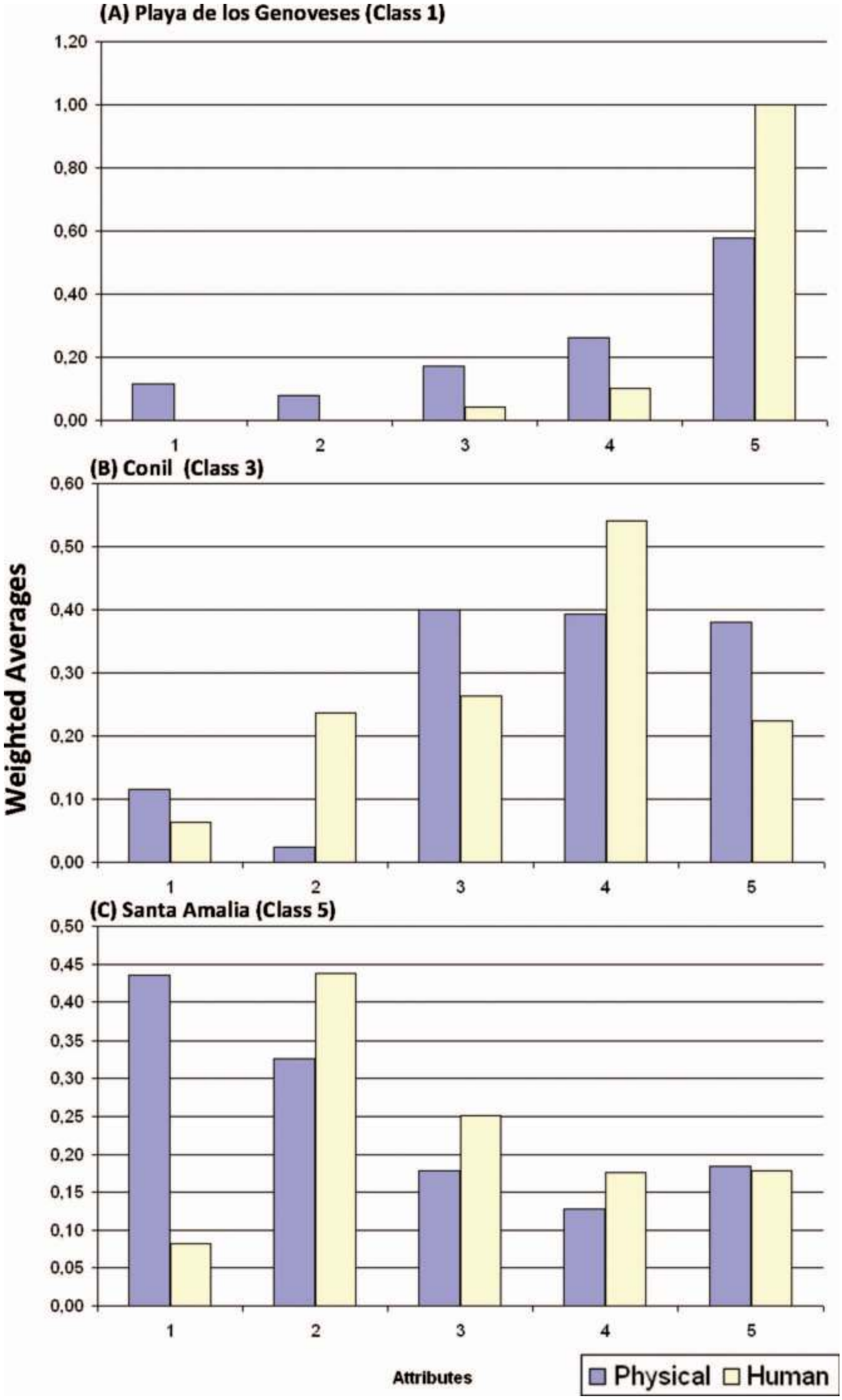

Figure 4. Weighted attributes for: (a) Playa de los Genoveses (Class 1); (b) Conil (Class 3) and (c) Santa Amalia (Class 5).

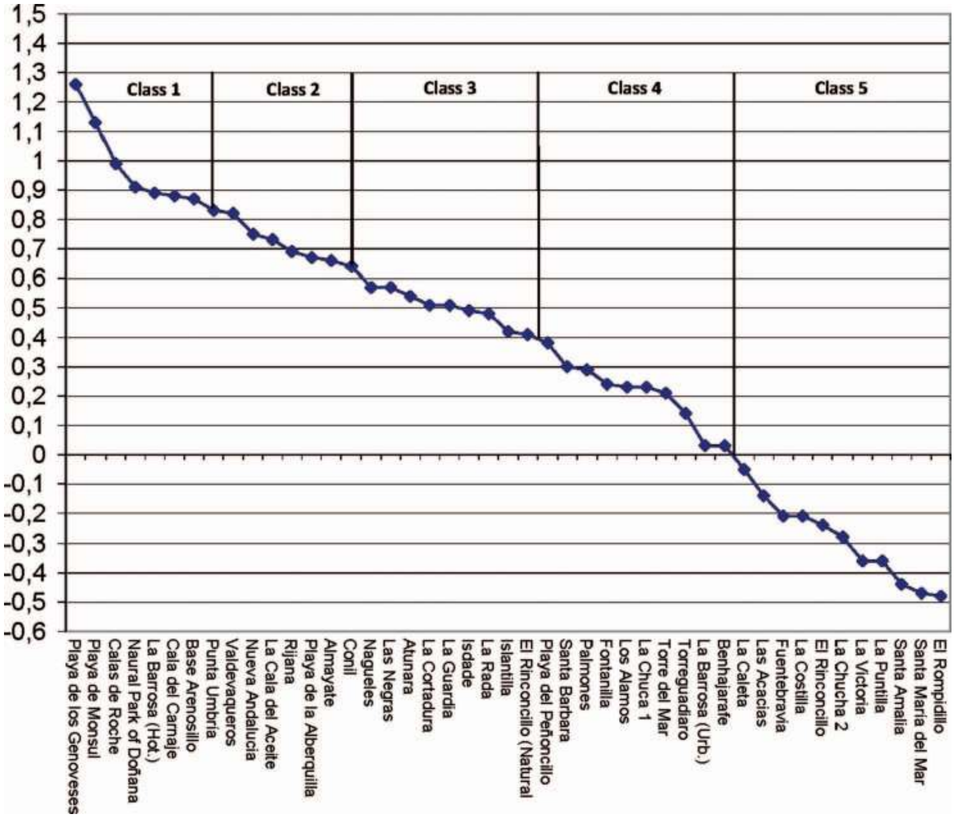

Figure 5. Scenic classification of studied beaches.

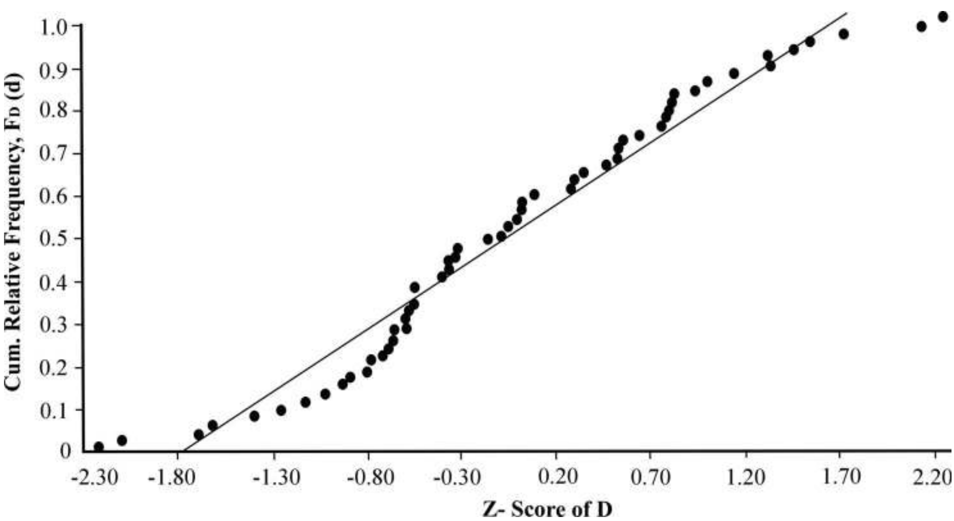

Figure 6. Normality testing of breakpoints. Cumulative Relative Frequency = n − k + 0.5/n, where n = number of sites; k = D value in decreasing order.

In essence, a curve skewed to the right reflects high scenic quality due to low scoring on attributes 1 and 2 (Figure 3a); vice versa for a left hand skew (Figures 3b and c). High attribute values, that is, 4 and 5, reflected the positive influencing impact of the physical/human parameter (e.g. Figure 4a); whilst high weighted averages at lower attribute values (i.e. 1 and 2), reflect the adverse impact of the physical or human parameter (Figures 4c and b). Detailed analysis of the technique can be found in Ergin *et al*. (2002, 2003, 2004, 2006); Gezer (2004); Langley (2006); Williams *et al*. (2004). The algorithm involving both weighting and fuzzy logic values and incorporating all of the above, enabled a Scenic Evaluation Value 'D' to be obtained, which could classify scenic assessment into one of five classes ranging from Class 1 (extremely attractive natural beaches) to Class 5 (very unattractive urban beaches). Therefore, investigated beaches were divided into five classes (Table 1, Figure 5):

- *CLASS 1*: Extremely attractive natural sites with very high landscape values, having a D value above 0.85. In this study, a total of seven beaches were classified within this category, for example, Playa de los Genoveses (Figure 7a), Cala del Carnaje, Natural Park of Doñana, etc. These beach areas are located in remote (four), rural (two) and resort (one) areas and five lie in natural protected areas with excellent coastal scenery such as cliffs (Playa de los Genoveses, Figure 7a) or well developed dunes ridges (Natural Park of Doñana) and special landscape figures. Two have the Blue Flag (Table 1). Well known beaches around the world, such as Long Reef (Australia), Ihla de Santa Catarina (Brazil) and Sumner (New Zealand) belong to this category (Ergin *et al*., 2006).
- *CLASS 2*: Attractive natural sites with high landscape values and a D value lying between 0.65 and 0.85. Along the investigated littoral, seven beaches were classified within this category, for example, Punta Umbria, Nueva Andalusia, Las Alberquillas. These sites are generally rated lower than Class 1 due to a lower scoring of landscape features. Most of them (five) are rural areas located in the Mediterranean littoral. None are located in any natural protected areas (but a few of them may be found at the periphery) and only one has the Blue Flag (Table 1). The Giants Causeway (Ireland) and Tojo Beach (Japan) belong to this category (Ergin *et al*., 2006).
- *CLASS 3*: Little outstanding landscape features with a D value between 0.4 and 0.65. A total of 10 beaches belong to this category, for example, Conil (Figure 7b), Nagueles, La Cortadura, found throughout the spectrum of rural resort areas (Table 1). Three are located in natural protected areas and four have the Blue Flag. The tip of Magellan Foreland (Ireland) and Austenmeer Beach (Australia) belong to this category (Ergin *et al*., 2006).
- *CLASS 4*: Mainly unattractive urban sites having low landscape values together with a D value which lies between 0 and 0.4. Eleven beaches were classified within this category, for example, La Barossa, Los Alamos, La Chucha, all but one consisting of village and urban areas. Both Class 3 and 4 sites are common in the Mediterranean and Atlantic littoral. None is located in any natural protected areas and two fly the Blue Flag. Magellan Foreland and the Burren Area in Ireland and Bondi Beach in Australia belong to this category (Ergin *et al*., 2006).

- *CLASS 5*: Very unattractive urban sites with intensive development and low landscape values. Ten beaches, for example, Santa Amalia (Figure 7c); La Puntilla, Las Acacias, belong to this category. All are urban areas having features such as much noise, absence of buffer zone, a degraded natural environment and poor skyline quality. In the Cadiz area, low values are essentially due to the presence of anthropogenic structures, that is, groins, jetties and seawalls, for example, Santa Maria del Mar, (Figure 8). Blue Flag status is observed at six sites. Ergin *et al.* (2006) classified St George's Bay (Malta), Amroth (United Kingdom) and Manley (Australia) within this category.

As seen from the classification given, sites with high scenic quality (Class 1) are mostly located in natural protected areas, while very low scenic quality sites (Class 5) are observed in highly urbanized areas with human parameters exhibiting low attribute values (for example, areas with an environmentally insensitive skyline). From the basic input parameters given in Table 1, managers can see immediately where changes should be made. For example, Las Negras currently has a D value of 0.57 with an attribute value of 3 for litter. Simply by changing the attribute to 5 (making daily beach cleaning mandatory), takes the D value to 0.69, that is, a Class 2 site. Similarly, for Los Alamos, which is currently a Class 4 site, changing the noise disturbance attribute value (if possible) from a 2 to 5 changes the D value from 0.23 to 0.43, making it a Class 3 site.

Results clearly reflect physiographic landscape characteristics together with the oceanographic setting of the Mediterranean/Atlantic coastlines. The Mediterranean coastline physiography is at many places controlled by the presence of the Betic Chain which gives rise to high attribute values for different parameters (e.g. cliff, valley, skyline landscape, coastal landscape figures, etc.; Table 2). The Mediterranean oceanographic setting also provides low energy to the coastal zone (when compared with the Atlantic) and the microtidal range contributes to beaches with reduced width (a low grading at point 5, Table 2) and high grading at point 13 (tide, Table 2). In general, a low coastline prevails along the Atlantic coast, giving low values at the aforementioned related points. As it is a high energy mesotidal environment, this gives a low value at point 13 (tide, Table 2) but contributes to producing wider beaches which enhances dune formation, for example, high values at points 5 and 10, Table 2.

Many specially designated areas exist globally, all having a myriad of names: National Parks, Areas of Outstanding Beauty, Heritage Coasts, etc. Invariably all these designations reflect scenery, which in turn attracts tourists. Another important role in attracting beach tourists is an award, probably the best known being the FEE's Blue Flag award—15 Andalusian investigated bathing areas fly this flag (Table 1), which is a "symbol of quality recognized by tourists and tour operators" (http://flagspot.net, accessed 15 June 2009). At the international level, this comment is debatable as the most striking finding of research in many diverse locations was the beach users' emphasis on cleanliness. Questionnaire surveys carried out on beach user preferences (50 beach aspects) in Wales, UK ($n = 2345$, 98% locals); Hollywood beach, Florida, USA ($n = 83$, 76% locals), the Costa Dorada, Spain ($n = 157$, 95% locals); Malta ($n = 154$, 65% local and 34% northern European) and Turkey's Aegean coast ($n = 245$, 12% local and 88% northern European) showed that five

Figure 7. Photographs of different beaches: (a) Playa de los Genoveses (Class 1); (b) Conil (Class 3) and (c) Santa Amalia (Class 5).

parameters were of the greatest importance on beach choice: safety, facilities, water quality, litter and scenery (Williams, 2011).

At Benone beach (Figure 9) only 25 respondents out of 370 (c. 7%) explicitly mentioned Blue Flag status as a reason for visiting the beach and cleanliness was the most significant single factor (McKenna *et al*., 2011). This represents 11th place out of 17 in the rank order although Benone held both the Seaside Award and the MCS Recommended Beach award. For Welsh beaches, 'sand and water quality' were the

Figure 8. Groins at Santa María del Mar (Class 5).

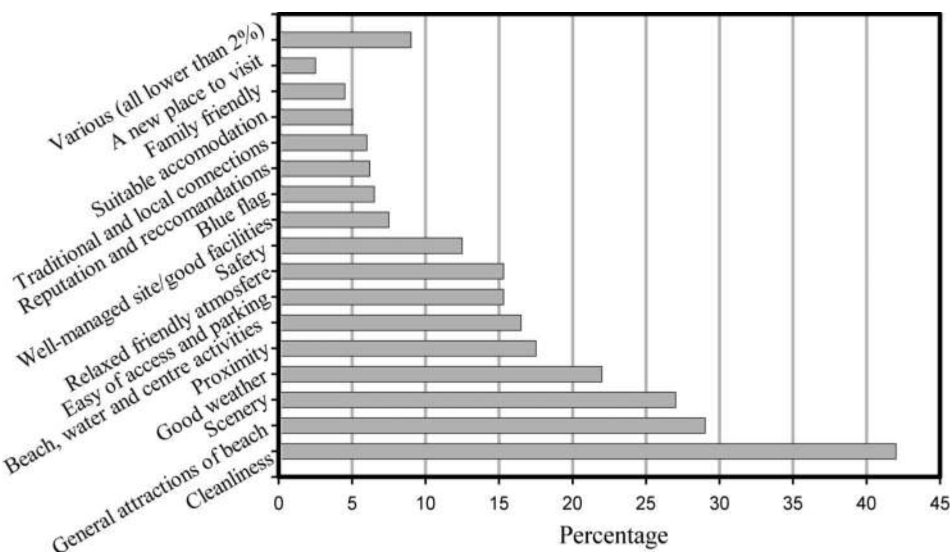

Figure 9. Benone beach, Ireland, user rankings of important parameters (adapted from McKenna *et al*., 2011).

most important aspects of beach selection, closely followed by safety and scenery (Morgan & Williams, 1995; Morgan *et al*., 1993; Nelson *et al*., 2000; Tudor & Williams, 2003, 2006, 2008; Young *et al*., 1996). In an extensive study of 37 UK beaches, Duck *et al*. (2009) found that beach users place a high value on litter-free sediment and clean seawater. Views from beach users on the south shore of the Bristol Channel, UK (shown in Tables 4 and 5) again reinforce the fact that beach cleanliness and safety are the driving forces behind beach selection (Nelson *et al*., 2000; Williams *et al*., 2000). It must be stressed that most beaches have a level of litter pollution, the degree of which is perceived differently by the general public. At Hollywood beach, Florida, USA, 90% of beach users picked that beach because of proximity followed by clean water and sand, scenery, toilets, access and safety. Despite the fact that the beach held the Blue Wave designation, award status was rated the tenth (out of ten). At a Belek (Turkey) Blue Flag beach, reasons given for visiting were: travel distance (36 out of 60), clean water and sand, scenery, toilets, access, refreshments and finally award status.

A BBC News online article 'Does Blue Flag signal a good beach?' (http://news.bbc.co.uk/1/hi/uk/4766061.stm, published 15 May 2006) indicated that the Blue Flag's resort bias meant it was unsuited for outstanding remote beaches and could deter visitors who prefer quiet rural sites, concluding that Britain's 'best' beaches are arguably those in northern and western Scotland, which have very few Blue Flags (McKenna *et al*., 2011). The majority of UK Blue Flag beaches are not necessarily where the best beaches occur, but where infrastructural investment has been carried out. Duck *et al*. (2009) noted that the Blue Flag award is given on the basis of facilities and a very visible management regime and not scenery, and the visitor infrastructure necessary to comply with the award criteria actually detracts from scenic quality and naturalness. Award schemes should perhaps switch from a

Table 4. Rationale for beach selection. Rank 1 is most important reason for beach selection, rank 10 is least important (n = 383)

Rank	All beaches	Minehead	Brean	Blue Anchor Bay	Ilfracombe
1	Clean sand	Clean sand	Clean sand	Clean water	Clean water
2	Clean water	Clean water	Clean water	Clean sand	Clean sand
3	Safety	Safety	Safety	**Views and landscape**	**Views and landscape**
4	Provision of toilet	Provision of toilet	Car park	Safety	Safety
5	**Views and landscape**	**Views and landscape**	**Views and landscape**	Car park	Provision of toilet
6	Access	Access	Provision of toilet	Provision of toilet	Access
7	Car park	Beach award rating/flag	Distance to travel	Access	Car park
8	Beach award rating/flag	Distance to travel	Access	Beach award rating/flag	Distance to travel
9	Distance to travel	Car park	Beach award rating/flag	Distance to travel	Beach award rating/flag
10	Refreshment kiosk	Refreshment kiosk	Refreshment kiosk	Refreshment kiosk	Refreshment kiosk

Table 5. Averaged Rank of Rationale for beach selection. Rank 1 is most important reason for beach selection, rank 10 is least important (n = 383)

Parameter	Average rank position
Clean sand	2.4
Clean water	2.8
Safety	4.8
Provision of toilet	5.0
Views and landscape	5.4
Access	5.7
Car park	5.9
Beach award rating/flag	6.5
Distance to travel	6.8
Refreshment kiosk	7.9

current emphasis on their own criteria to carry out basic research into the preferences and priorities of the revenue-generating component: the beach users themselves—and as seen in Tables 4 and 5, scenery is one of the top five attractions for beach users. This is especially important, as a recent (6 August 2010) article by Surfers against Sewage (SAS) indicated that out of 131 UK Blue Flag beaches at least 35 cannot possibly meet the Blue Flag Imperative Criterion 28 (Water Quality), that is, to warn the public during and after an emergency pollution event; for example, sewage discharge from a combined sewage overflow (SAS, 2010). It is because of too frequent and excessive spills from storm water overflows at Whitburn, a Blue Flag beach, that the European Commission is taking the UK to the European Court of Justice.

With respect to future development, in order to increase values of physical versus human parameters, beach nourishment and dune restoration works could be preferred versus construction of hard protective structures. Further, well vegetated dune ridges constitute a buffer between beach and built environment, producing a diminution of noise disturbance, visual impact of buildings, etc.

Conclusions

A coastal scenic evaluation system composed of 18 physical and eight human parameters, essentially covering presence/absence or poor quality (1) to excellent/outstanding (5), was applied to 45 beach locations in the Andalusia littoral (Spain). The strengths and weaknesses of the investigated sites were evaluated and data presented in weighted averages histograms and membership degree curve, the skew of which reflected the scenic value. A coastal scenic classification curve was obtained for all evaluated sites based upon calculated evaluation index values, the latter reflecting the importance of attribute values in terms of weighted areas. A five class evaluation system for coastal scenery was developed. Many Class 1 sites occur in remote areas and/or in natural protected areas, Class 2 sites are basically rural areas often located at the edge of natural protected areas. Class 3 sites are located in village and urban areas having little outstanding landscape features. Class 4 and 5 sites were typified by being located in heavily urbanized areas with usually a consequent fall in scenic quality. Class 3 and 5 sites recorded the most numerous cases of 'Blue Flag' awarded beaches. The coastal scenic classification curve obtained for evaluated sites was in strict accordance with break points and statistical distributions observed in assessments in many countries, thus further confirming the robustness of this methodology.

With respect to coastal zone management, this work and the methodology used, is a first step in the direction of evaluation of Andalusian coastal scenery, a very attractive destination for national and international tourists for much of the year. By this means, coastal scientists, planners and managers can collaborate in an attempt to improve low coastal physical scenic values of some areas by upgrading human parameters. This can help towards the preservation/conservation and sustainable development of many coastal areas, by providing a sound scientific basis for preventing, for example, construction of hard engineering structures or any of a myriad of potential coastal development projects which may negatively influence coastal scenery.

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