COASTAL SCENIC EVALUATION,
A PILOT STUDY FOR ÇIRALI

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

EVRİM GEZER

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF SCIENCE
IN
CIVIL ENGINEERING

JULY 2004

Approval of the Graduate School of Natural and Applied Sciences

Prof. Dr. Canan Özgen
Director

I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Science.

Prof. Dr. Erdal Çokça
Chair of Civil Engineering Department

This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

Dr. Engin Karaesmen
Co-Supervisor

Prof. Dr. Ayşen Ergin
Supervisor

Examining Committee Members

Prof. Dr. Halil Önder	(METU,CE)	
Prof. Dr. Ayşen Ergin	(METU,CE)	
Assoc. Prof. Dr. Ahmet C. Yalçıner	(METU,CE)	
Dr. Işıkhan Güler	(YÜKSEL PRJ.)	
Dr. Engin Karaesmen	(METU,CE)	

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Last name : Evrim GEZER

Signature :

ABSTRACT

COASTAL SCENIC EVALUATION,
A PILOT STUDY FOR ÇIRALI

Gezer, Evrim
M.S., Department of Civil Engineering
Supervisors : Prof. Dr. Ayşen Ergin
Dr. Engin Karaesmen

July 2004, 110 pages

It is well known that, socioeconomic development in coastal regions is in many respects are more rapid than elsewhere. The rapid development has been the outcome of recognition of these regions as a means providing ideal conditions for relatively cheap transport, food and mineral resource, petroleum, natural gas, agricultural and industrial development, housing and recreation, etc. Therefore, coastal areas are under threat due to forcing function of human activities.

A novel technique addressed scenic evaluation through application of fuzzy logic methodologies to values obtained from checklist that itemized 26 human and physical parameters rated on five-point attribute scale. The methodology enabled calculation of an Evaluation Index (D) which categorizes all sites and statistically best described attribute values in terms of weighted areas.

The methodology developed for coastal scenic evaluation using Fuzzy Logic Approach (FLA) is a very useful tool in making future management plans for coastal areas by simulating different human usages.

With regard to coastal zone management this technique is suitable for evaluating future potential changes especially with regard to influence of coastal structures on the coastal scenery. This work will hopefully be utilized by coastal mangers, planners, academics, governmental agencies, as to improve the especially human usage of the coastal areas also this work will be a tool for the preservation and conservation and the sustainable development of the coastal areas.

For the pilot site, Çıralı, D values are calculated and corresponding classes are found for different attributes of parameters rising from the human usage.

Keywords: Coastal Scenic Evaluation, Scenario Simulations

ÖZ

KIYI ALANLARI DEĞERLENDİRİLMESİ,
ÇIRALI PİLOT ÇALIŞMASI

Gezer, Evrim
Master, İnşaat Mühendisliği Bölümü
Tez Yöneticileri : Prof. Dr. Ayşen Ergin
Dr. Engin Karaesmen

Temmuz 2004, 110 sayfa

Sosyo-ekonomik gelişmenin kıyı bölgelerinde başka yerlere göre çok daha hızlı olduğu bilinmektedir. Hızlı gelişme kıyı bölgelerinin görece ucuz ulaşım, yiyecek, petrol, doğal gaz, tarımsal ve endüstriyel kaynaklar, barınma ve eğlence olanakları vb. sağlamasının bir sonucudur. Bu nedenle, kıyı alanları insan kullanımı zorlamasından kaynaklı olarak tehdit altındadırlar.

Bulanık mantık yöntemi kullanılarak, kıyı alanları doğal yapı ve kullanım değerlendirmesinine olanak tanıyacak bilimsel bir metod geliştirilmiştir. Geliştirilen kıyı alanları görsel değerlendirme sisteminde kullanımlan 26 tane değerlendirme parametresi beş dereceli bir puanlamaya tabi tutulmuştur. Bu metod her kıyı alanına

özgü bir değer puanı (D) hesaplanmasına olanak sunmaktadır ve bu puanlara göre de beş gruplu bir sınıflandırma yapılmıştır.

Bulanık Mantık Yöntemiyle kıyı alanları değerlendirilmesi için geliştirilen metod, değişik insan kullanımlarının modellemesi yoluyla geleceğe dönük yapılacak yönetim planları için faydalı bir araçtır.

Bu yöntem özellikle kıyı yapılarının doğal güzelliğe etkisi üzerinden gelecekte olabilecek potansiyel değişikliklerin değerlendirilmesi için çok uygundur. Bu çalışmanın sonuçlarının kıyı alanları insan kullanımının iyileştirilmesi için kıyı alanları plancıları, akademisyenler ve hühümete bağlı kuruluşlar tarafından kullanılması beklenmektedir. Yine bu çalışma, kıyı alanlarının korunması ve sürdürülebilir gelişme için bir araç olacaktır.

Pilot saha seçilen Çıralı için değişikinsan kullanımlarından kaynaklanan parametre niteliklerindeki değişimler için D değerleri hesaplanmış ve sınıflandırmadaki yerleri bulunmuştur.

Anahtar Kelimeler: Kıyı Alanları Değerlendirilmesi, Senaryo Simülasyonları

ACKNOWLEDGMENTS

The author wishes to express his deepest gratitude to his supervisors Prof. Dr. Ayşen Ergin and Dr. Engin Karaesmen for their guidance, advice, criticism, encouragement and insight throughout the research.

The assistance of Mehmet Somel and Ozan Alphan is gratefully acknowledged.

The author would like to thank to the British Council (Ankara, Turkey and Valetta, Malta), who provided the financial support necessary to carry out the field work of this thesis.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Coastal Scenic Evaluation is an important tool for managers or planners for coastal preservation, protection and development. The outcomes of such an evaluation will provide baseline information and a scientific basis for any envisaged management plans.

Coastal areas of the world are under threat due to the forcing function of people who wants to use the coastal areas for habitation and/or recreation. This pressure affects an extremely strategic asset – the coastal scenery itself. Scenery is a resource and managers need to attempt evaluation of scenic resources in an objective and quantitative manner. Coastal managers together with planners need coastal landscape inventories in order to base sound management decisions on ascertained facts. Until today, most scenic assessments have been carried out on a subjective basis. In Mediterranean countries, scenery is a source and not been competently analyzed on any scientific basis. Evaluation of the coast can be utilized mainly in landscape preservation (e.g. conservation), and protection (development). This is a pilot project for Çıralı on coastal scenic assessment. Benefits should be of high interest for various governmental and non-governmental organizations working on management strategies, planning and investigation for these and the other areas.

With respect to selected Çıralı coastal area the main objectives of the study were;

- To evaluate the coastal scenic quality by selected component based on scientific methodology developed.
- To carry out questionnaire surveys at Çıralı.

- To provide simulation models on the possible management plans using the coastal scenic evaluation methodology developed.
- To provide baseline information so that a sound scientific basis could be available for any envisaged subsequent management plans.

Coastal Scenic Evaluation using Fuzzy Logic Approach (FLA) brings a classification methodology for coastal areas on a scientific basis which is a first in the world. Çıralı is selected as a pilot work for this study among hundreds of coastal areas from different countries firstly because of its high scenic value, and secondly because it is under threat of forcing function of human activities. Some simulations using the developed coastal scenic evaluation methodology for different human usage cases together with their reflection on human parameters have been made, and probable results of these changes in human parameters for Çıralı have been investigated. Questionnaire surveys were carried out in Çıralı to be used in the fuzzy logic approach.

The coastal scenic evaluation methodology and the details of fuzzy logic mathematics are given in Chapter 2. The location, history, ecosystem and other important characteristics of Çıralı are given in Chapter 3. Simulations for different human usages are presented in Chapter 4 and a conclusion and recommendations are given in Chapter 5.

CHAPTER 2

METHODOLOGY

2.1 Literature Survey

Landscape evaluation is an important subject studied all over the world. Final Conclusive Recommendation of European Landscape Conference announced on December 9, 2003 in Cardiff, WALES states that:

- Landscape is a vital element in the quality of life of people everywhere.
- Landscape is the context in which communities understand their environment and make decisions about future development. Its protection, management and planning depend on full public participation.
- Use of landscape assessment techniques and the application of the results are very important.

Landscape evaluation is strongly rooted in the man-environment tradition. Scenery is a resource and managers need to attempt evaluation of scenic resources in an objective and quantitative manner. Coastal landscape evaluation can be utilised for landscape preservation (identifying the value to society of particular views/areas); protection (identifying high quality landscapes / controlling developments); improvements (identification of components that can detract from views).

Various models/rating schemes have been developed mainly in the past 25 plus years. Important papers have been those of Fines (1968), Linton (1968, 1982), Leopold (1969), Briggs and France (1980), Buyoff and Arndt (1981), Penning-Rowsell (1982, 1989), Williams (1986), Countryside Commission (1993), CCW (2001), Ergin *et al* (2002).

Many of the above mentioned authors have used checklists, a methodology common in much natural/socio-economic research. However, subjectivity has existed and a desirable goal is to try to put forward an optimum semi-quantitative objective analysis for coastal landscapes. Reviewing of existing techniques and field application for most of them, few were found to be directly applicable to coastal areas and most did not take cognisance of many coastal features. Therefore, it was felt that a novel approach, specifically aimed at coastal scenic evaluation was required, namely fuzzy logic systems (Zadeh, 1965; Dubois and Parade, 1979; Kandel, 1986) (Ergin, *et al*, 2003).

2.2 Parameters

"Coastal Scenic Evaluation" should be based on the presentation of scenic characteristics of landscape and sea of the selected site as Coastal Scenery can be defined to be the union of the esthetic qualities of landscape and the sea. But there is a need for determination of the coastal scenic parameters and these parameters should be valid for a universal use.

As part of a three-year study (Ergin, *et al*, 2003), a literature search, together with questionnaires given to coastal users in Turkey and the UK, and consultation with coastal landscape experts, an assessment was made as to what were the main parameters essential in coastal scenery perception. Landscape values 'can be assessed and described or illustrated in objective and subjective terms by landscape professionals, consulting with a wide range of interest groups and people and analysing all relevant information'. Results obtained through this work, enabled key elements to be condensed down to 26 'coastal scenic assessment parameters' and these are given in Table 1 and Appendix A (Çakır, 2004), together with the 'attributes' represented by numbers ranging from low to a high rating (1,2,3,4 and 5).

Table 1.Coastal Scenic Evaluation System

Site Name :

No:	Physical Parameters		RATING 1	2	3	4	5
1	CLIFF	Height	Absent	>5 -<30m	30 - <60m	61 - 90m	>90m
2		Slope	45° - 55°	55° - 65°	65° - 75°	75° - 85°	Circa Vertical
3		Special Features*	Absent	1	2	3	Many >3
4	BEACH FACE	Type	Absent	Mud	Cobble / Boulder	Pebble / Gravel (±Sand)	Sand
5		Width	Absent	<5m - >100m	5m - <25m	25m - <50m	50m-100m
6		Colour	Absent	Dark	Dark Tan	Light Tan / Bleached	White/Gold
7	ROCKY SHORE	Slope	Absent	<5°	5°-10°	10°-20°	20°-45°
8		Extent	Absent	<5m	5m-10m	10m-20m	>20m
9		Roughness	Absent	Distinctly Jagged	Deeply Pitted and/or Irregular (uneven)	Shallow Pitted	Smooth
10	DUNES		Absent	Remnants	Fore-dune	Secondary Ridge	Several
11	VALLEY		Absent	Dry Valley	(<1m) Stream	(1m-4m) Stream	River / Limestone gorge
12	SKYLINE LANDFORM		Not Visible	Flat	Undulating	Highly Undulating	Mountainous
13	TIDES		Macro (>4m)		Meso (2m-4m)		Micro (<2m)
14	COASTAL LANDSCAPE FEATURES **		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 (marram/gorse, bramble, etc)	Wetlands / Meadow	Coppices, Maquis (±Mature Trees)	Variety of Mature Trees / Mature Natural Cover
18	VEGETATION DEBRIS		Continuous >50cm high	Full Strand Line	Single Accumulation	Few Scattered Items	None
	Human Parameters		1	2	3	4	5
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		Some Evidence (1-3 items)		No Evidence of Sewage
22	NON-BUILT ENVIRONMENT		None		Hedgerow / Terracing / Monoculture		Field Mixed Cultivation ± Trees / Natural
23	BUILT ENVIRONMENT***		Heavy Industry	Heavy Tourism and/or Urban	Light Tourism and/or Urban and/or Sensitive Industry	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	Unattractive	Sensitively Designed High / Low	Very Sensitively Designed	Natural / Historic Features
26	UTILITIES ****		>3	3	2	1	None

* Cliff Special Features:	Indentation, banding, folding, screes, irregular profile
** Coastal Landscape Features:	Peninsulas, rock ridges, irregular headlands, arches, windows, caves, waterfalls, deltas, lagoons, islands, stacks, estuaries, reefs, fauna, embayment, tombola, etc.
***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.
**** Utilities:	Power lines, pipelines, street lamps, groins, seawalls, revetments

2.3 Perception

Perception is closely related to personal experience and imagination. Coastal assessment parameter ratings are usually obtained from subjective observations for most of the coastal scenic assessment studies. These gradings depend on various factors such as the national and cultural background, age, gender, education and training.

Landscape appreciation can be viewed as a function of national and cultural differences. Eletheriadis *et al* (1990) found agreement amongst various European nationality groups with regard to the most/least preferred landscapes – but also many significant differences, attributed mainly due to cultural differences and home environment familiarity. Fines (1968) and Kaplan and Kaplan (1989) were of the opinion that natural landscapes could be perceived as more distinguished/spectacular, when viewed by culturally homogenous participants. However, Zube and Pitt (1981) argued that not all cultures/ nations had the same perception for anthropogenic landscapes, concluding that scenic beauty is characteristic of unmodified landscapes and that experience of the environment and together with familiarity shaped perceptions (Ergin, *et al*, 2003).

2.4 Questionnaire Surveys

The idea of coastal scenic parameters having the same weights is obviously open to criticism. To re-evaluate the validity of "equal weights" of assessment parameters assumption and to bring out the viewers priorities and preferences about different assessment parameters, it is decided to carry out a perception survey by questionnaires. The methodology for field-work (coastal questionnaire surveys) was interviewing actual users for this study. A ‘Coastal Scenic Assessment Inquiry Form’ was finalised according to the results obtained from these questionnaire surveys (Table 2).

Table 2. Past Questionnaire Results for Turkish Beaches

(Number of Respondents, n = 270)

Numbers in bold in the first column correspond to the evaluation numbers of the parameters used. 'Top Six' = number of people choosing this parameter. The actual 'top 6' numbers are given in bold.

Parameters				Grading: Not Important → Very Important 1	2	3	4	5	'Top6'
1	1	Cliff	Height	47	29	76	64	54	6
2	2	Cliff	Slope	50	34	81	53	52	6
3	3	Cliff	Special Features (Indentation, Bending; Folding)	34	19	49	58	110	13
4	4	Beach Face	Type: Sand	32	17	24	51	146	**81**
	5	Beach Face	Type: Pebble	75	46	68	45	36	18
	6	Beach Face	Type: Rocky	124	40	44	31	31	5
5	7	Beach Face	Width	30	22	48	58	112	22
6	8	Beach Face	Colour	42	30	54	57	87	8
7	9	Rocky Shore Platform	Slope	58	47	77	52	36	2
8	10	Rocky Shore Platform	Extent	45	54	79	53	39	3
9	11	Rocky Shore Platform	Roughness	38	35	62	54	81	16
10	12	Sand Dunes		74	64	53	40	39	4
11	13	Valley and River Mouth		42	25	42	75	86	14
12	14	Landform	Flat	70	51	68	43	38	12
	15	Landform	Undulating	51	40	86	66	27	3
	16	Landform	Mountainous	37	23	43	53	114	28
13	17	Tides		85	52	61	33	39	5
14	18	Coastal Landscape Features (Caves, Waterfalls, Islands, Rocks, …)		7	5	21	53	184	**90**
15	19	Vistas of far Places		18	15	49	65	123	23
	20	Historical Features (Castles, Towers, Historical Remains, …)		8	16	23	63	160	85
16	21	Water Colour and Clarity		4	0	5	21	240	**183**
18	22	Seaweed Banquettes		35	24	44	41	126	35
	23	Biotype Diversity (Fauna)		17	6	44	58	145	64
17	24	Natural Vegetation Cover		10	7	23	71	159	76
19	25	Absence of Noise		7	6	13	39	205	**138**
20 **21**	26	Absence of Litter and Sewage		6	0	5	13	246	**210**
22	27	Land Use (Monoculture, Many Crops, …)		40	24	84	62	60	15
23 **25** **26**	28	Absence of Buildings and Utilities (Power-lines, ..), Natural View of Skyline		3	5	16	40	206	**137**
24	29	Ease of Access		26	33	44	53	114	48

Coastal Scenic Assessment Inquiry Form includes 29 parameters and respondents were asked to grade parameters on a five-point scale (1 being not important, 5 being extremely important). In Table 2, the column for the ‘top six’ preferences is for a quick preview of the public’s priorities to the parameters.

These questionnaire surveys were also applied in Çıralı in May, 2004 (see Photos 1,2 and 3 in Appendix C). The results and details of these questionnaires are given in Tables 3 and 4, respectively. As it can be seen in the Table 3, top five are listed as:

Absence of Sewage and Litter,

Water Colour and Clarity,

Absence of Noise,

Absence of Buildings and Utilities and

Natural Vegetation Cover.

These results are analysed and a perception study is carried out according to age, gender, education, etc in another thesis study (Uçar, 2004). The re-calculated weight matrices and D sequence curve according to the questionnaire survey made in Çıralı are consistent with the calculations according to past questionnaire surveys. The combined results of all of the applied questionnaires are given in Table 4.

Table 3. Questionnaire Results for Çıralı Beach

ÇIRALI (2004)										
Number Of People Contributed To The Inquiry is 86										
Parameters				**Importance**					**Top Five**
				1	**2**	**3**	**4**	**5**	
1	Cliff	Height		6	15	37	21	7	3
2	Cliff	Slope		9	25	38	13	1	1
3	Cliff	Special Features (Indentation,Bending,Folding)		10	19	31	20	6	0
4	Beach Face	Type	Sand	1	6	30	21	28	13
5	Beach Face	Type	Pebble / Gravel	7	14	39	22	4	3
6	Beach Face	Type	Rocky	19	11	34	14	8	2
7	Beach Face	Width		4	13	32	24	13	4
8	Beach Face	Colour		5	15	34	26	6	1
9	Rocky Shore Platform	Slope		7	25	35	18	1	0
10	Rocky Shore Platform	Extent		12	24	32	13	5	0
11	Rocky Shore Platform	Roughness		12	12	32	20	10	1
12	Sand Dunes			14	8	27	25	12	2
13	Valley and River Mouth			3	6	20	34	23	6
14	Landform	Flat		18	20	33	11	4	0
15	Landform	Undulating		5	13	39	24	5	1
16	Landform	Mountainous		2	6	23	22	33	9
17	Tides			9	24	37	6	10	1
18	Coastal Landscape Features (Caves,Waterfalls, Islands, Rocks…)			1	1	20	27	37	15
19	Vistas of Far Places			2	7	35	24	18	1
20	Historical Features (Castles, Towers, Historical Remains...)			0	2	16	28	40	19
21	Water Colour and Clarity			0	0	2	22	62	**56**
22	Seaweed Banquetts			2	8	25	23	28	6
23	Biotype Diversity (Fauna)			1	0	8	25	52	26
24	Natural Vegetation Cover (Flora)			1	0	11	23	51	**44**
25	Absence of Noise			0	0	1	28	57	**56**
26	Absence of Sewage and Litter			0	0	0	13	73	**69**
27	Land use(Monoculture, Many Crops...)			4	11	23	22	26	16
28	Absence of Buildings and Utilities (Powerlines…), Natural View of the Skyline			0	0	3	22	61	**49**
29	Ease of Access			2	5	9	26	44	26

Table 4. Combined Questionnaire Results

Çıralı, Turkey (2004)+Croatia +Malta +Southern down (UK) + Previous Study(BCR2003)										
Number Of People Contributed To The Inquiry is 485										
Parameters				**Importance**					**Top Five**
				1	2	3	4	5	
1	Cliff	Height		63	71	160	114	77	22
2		Slope		77	102	159	82	65	10
3		Special Features (Indentation, Bending, Folding)		58	72	119	99	137	23
4	Beach Face	Type	Sand	44	39	72	101	229	136
5			Pebble / Gravel	104	99	141	91	50	28
6			Rocky	160	80	120	73	52	17
7		Width		40	46	110	143	146	39
8		Colour		56	69	130	119	111	13
9	Rocky Shore Platform	Slope		80	120	154	86	45	4
10		Extent		69	115	155	89	57	10
11		Roughness		66	88	121	102	108	27
12	Sand Dunes			111	103	119	86	66	11
13	Valley and River Mouth			65	54	92	146	128	31
14	Landform	Flat		110	99	120	97	59	25
15		Undulating		72	81	168	122	42	10
16		Mountainous		59	59	89	106	172	52
17	Tides			121	96	140	64	64	18
18	Coastal Landscape Features (Caves, Waterfalls, Islands, Rocks…)			10	14	53	120	288	**162**
19	Vistas of Far Places			22	33	117	142	171	41
20	Historical Features (Castles, Towers, Historical Remains...)			17	33	74	123	238	127
21	Water Colour and Clarity			6	4	15	73	387	**333**
22	Seaweed Banquets			68	62	104	86	165	48
23	Biotype Diversity (Fauna)			32	27	87	116	223	102
24	Natural Vegetation Cover (Flora)			20	37	53	136	239	142
25	Absence of Noise			8	13	33	116	315	**238**
26	Absence of Sewage and Litter			7	4	17	38	419	**371**
27	Land use(Monoculture, Many Crops...)			67	65	141	108	104	40
28	Absence of Buildings and Utilities (Power lines…), Natural View of the Skyline			5	14	42	109	315	**213**
29	Ease of Access			39	53	82	106	205	105

2.5 Fuzzy Logic Approach

The scenic checklist type of ratings used in coastal scenic assessment is open to criticism with regards to its subjectivity, particularly in rating the aesthetic qualities of a scene where the viewer preferences and priorities dominate. Maybe some parameters used to evaluate a certain coastal area can be measurable like cliff height, slope, etc but there are also some other parameters whose assessments depend on the experts' point of view.

Experts are also sometimes guilty of using vague concepts based upon experience, intuition, human nature, environmental conditions, national cultural and social policies and economic conditions (Ergin, *et al*, 2003). Further, when several factors are to be considered in an analysis and/or assessment, it is difficult to describe a mathematical expression based on deterministic methods. Fuzzy Logic Approach (FLA) is a tool to assess the possibility (magnitude) and the degree of each factor considered to affect the evaluation results. Zadeh (1965) proposed making the membership function (or the values True and False), operate over the range of real numbers in the interval [0.0, 1.0] instead of on 0 and 1 of classic Boolean logic. This implies that fuzzy logic may allow more than one conclusion per rule. Since Zadeh (1965), the theory has developed and found uses in several wide–ranging areas where subjective pronouncements are inherent in most scientific fields as from communication to financial systems (Ambala, 2001).

Each assessment parameter is introduced as weighted averages in the statistical development for scenic evaluation using FLA where the expectation is to arrive at robust decisive factors. Also within the scheme put forward the dominance of physical and human factors with subsections become very important in obtaining the weights of scenic assessment parameters.

The coastal scenic assessment factor set F is a combination of physical (P) and human (H) factors and F is expressed as:

$$F = (\text{Physical, Human}) = (P, H)$$

where the subsets are formed from the assessment parameters as:

P = (cliff, beach, rocky shore, dunes, valley, land form, tides, coastal landscape features, vistas, water colour and clarity, natural vegetation cover, vegetation debris)

H = (noise disturbance, litter, sewage, non-built environment, built environment, access type, skyline, utilities)

The set P is further subdivided into the following groups and P is expressed as:

$$P = (P_1, P_2, P_3, P_{other})$$

where:

P_1 = (height, slope, special features) refers to the cliff parameter

P_2 = (type, width, colour) refers to the beach parameter

P_3 = (Slope, extent, roughness) refers to the rocky shore parameter

P_{other} = refers to the remaining nine physical parameters in P that are not listed in P_1 , P_2 and P_3 , i.e. from dunes to vegetation debris and will be denoted as P_4 to P_{12} .

P and H includes 18 and 8 coastal assessment parameters, respectively.

2.5.1 Weights of assessment parameters

To emphasize their significance in the whole evaluation process, weights to the parameters P and H are assigned. For the present study, these weights are represented by the matrix W_F which is formed by assigning equal weights to each parameter as

$$W_F = (1/2 \quad 1/2)$$

Re-evaluation of this equal weighting was done via the Turkish perception survey. Further, the weights of the parameters (or subsets) in P and H are estimated from public perception survey data (Uçar, 2004).

Normalized weights for all parameters are listed in the last columns of Tables 5 and 6. As it can be seen from these tables, sewage and litter have the maximum weight among human parameters and water color has the maximum weight among the physical parameters. The least important physical parameters are the rocky shore parameters and the human parameter with the smallest weight is the non-built environment parameter.

Table 5. Weight Evaluation for Physical Parameters

Physical Parameters		Number of Ticks (From Table 2)		Overall Weighted Average	Significance Grades for Parameters	$w_i \times g_i$	Normalized Final Weights of Parameters, w_P
No	Name	Box 4 N_4	Box 5 N_5	w_i	g_i		
1	Cliff Height	114	77	1,7340	1/36	0,0481	0,0186
2	Cliff Slope	82	65	1,3464	1/36	0,0374	0,0144
3	Special features	99	137	2,2289	1/36	0,0619	0,0239
4	Beach Type	101	229	3,1938	1/36	0,0887	0,0342
5	Beach Width	91	50	2,6845	1/36	0,0746	0,0287
6	Beach Colour	73	52	2,1258	1/36	0,05905	0,0227
7	Rocky Shore Slope	143	146	1,1732	1/36	0,0326	0,0126
8	Rocky Shore Extent	119	111	1,3216	1/36	0,0367	0,0141
9	Rocky Shore Roughness	86	45	1,9546	1/36	0,0543	0,0209
10	Dunes	89	57	1,3897	1/12	0,1158	0,0446
11	Valley	102	108	2,5237	1/12	0,2103	0,0810
12	Landform	86	66	2,6474	1/12	0,22067	0,0850
13	Tides	146	128	1,1876	1/12	0,099	0,0381
14	Landscape Features	97	59	3,9588	1/12	0,3299	0,1271
15	Vistas	122	42	2,9340	1/12	0,2445	0,0942
16	Water Colour	106	172	4,5918	1/12	0,3827	0,1474
17	Vegetation Cover	64	64	3,5856	1/12	0,2988	0,1151
18	Seaweed	120	288	2,4103	1/12	0,2009	0,0774
				Total	**1**	**2.5958**	**1.000**

Table 6. Weight Evaluation for Human Parameters

Human Parameters		Number of Ticks (From Table 2)		Overall Weighted Average	Significance Grades for Parameters g_i	w_i x g_i	Normalized Final Weights of Parameters w_H
No	Name	Box 4 N_4	Box 5 N_5	w_i			
19	Disturbance Factor	116	315	4,2041	1/8	0,5255	0,1362
20	Litter	38	419	4,6330	1/8	0,5791	0,150
21	Sewage	38	419	4,6330	1/8	0,5791	0,150
22	Non-Built Environment	108	104	1,9629	1/8	0,2454	0,063
23	Built Environment	109	315	4,1464	1/8	0,5183	0,134
24	Access Type	106	205	2,9876	1/8	0,3735	0,096
25	Skyline	109	315	4,1464	1/8	0,5183	0,134
26	Utilities	109	315	4,1464	1/8	0,5183	0,134
				Total	**1**	**3,8575**	**1,000**

2.5.2 FLA Matrices

As given in the previous section, the dominance of physical and human parameters becomes very important in obtaining weight matrices. In return, weight matrices affect the final assessment results via weighted averages of the parameters. A Fuzzy Logic Assessment Matrix is given as an example, in Table 7 for Çıralı. The weight matrices W_P and W_H for factors Physical and Human parameters, are 1 x 18 and 1 x 8 row matrices respectively and entries are also listed in column 3 of Table 7.

A possible square membership-grading matrix $\mathbf{M}_j$ was established with estimated membership grades for every graded scenic assessment parameter j. This square membership-grading matrix was based on the idea of an error that may be introduced in the chosen grades, as one is obliged to make a unique decision among several other possible grades over an attribute. For this study, attributes were formed from a set of five ordered grades (1,2, 3, 4, 5).

As an example for the 7'th parameter, that is, the rocky shore slope (the angle between the rocky shore and the horizontal), the membership grading matrix M_7 and related attributes are as follows (Ergin *et al*, 2003);

$$
\begin{array}{cc}
 & \begin{array}{ccccc} 1 & 2 & 3 & 4 & 5 \end{array} \\
M_7 = & \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0.5 & 0 & 0 \\ 0 & 0.5 & 1 & 0.5 & 0 \\ 0 & 0 & 0.5 & 1 & 0.5 \\ 0 & 0 & 0 & 0.2 & 1 \end{bmatrix}
\end{array}
$$

- 1- Absent
- 2- Smaller than 5°
- 3- Smaller than 10° greater than 5°
- 4- Smaller than 20° greater than 10°
- 5- Smaller than 45° greater than 20°

In matrix M_7 each row corresponds to each of the attributes listed above with the order 1 to 5. The first row's elements will be reserved for the grading of no rocky shore (absent state), second row for the angle of the rocky shore being less than 5°, and so on. The estimated membership grades for each attribute that is every element of the matrix is formed from possibilities ranging from 0 to 1, where 0 implies no possibilities and 1 implies the highest possibility on the given grades.

Table 7. Fuzzy Assessment Matrices for Çıralı

No;	Assessment Parameters	Graded Attributes	Weights Of Parameters Wp	Input Matrices Dj					A Matrices	Fuzzy Assessment Matrices				
	Physical									Attributes C10 to C14				
C1*	C2	C3	C4	C5 to C9						1	2	3	4	5
1	Cliff Height (1-1)	3	0,019	0	0	1	0	0	Ap	0	0,3	1	0,3	0
2	Cliff Slope (1-2)	4	0,017	0	0	0	1	0		0	0	0,5	1	0,5
3	Special Features (1-3)	2	0,028	0	1	0	0	0		0	1	0,3	0	0
4	Beach Type (2-1)	4	0,034	0	0	0	1	0		0	0	0	1	0
5	Beach Width (2-2)	4	0,029	0	0	0	1	0		0	0	0,2	1	0,6
6	Beach Color (2-3)	4	0,024	0	0	0	1	0		0	0	0,6	1	0
7	Shore Slope (3-1)	1	0,014	1	0	0	0	0		1	0	0	0	0
8	Shore Extent (3-2)	1	0,015	1	0	0	0	0		1	0	0	0	0
9	Shore roughness (3-3)	1	0,022	1	0	0	0	0		1	0	0	0	0
10	Dunes (4)	2	0,039	0	1	0	0	0		0	1	0	0	0
11	Valley (5)	4	0,079	0	0	0	1	0		0	0	0	1	0,1
12	Landform (6)	5	0,085	0	0	0	0	1		0	0	0	0,2	1
13	Tides (7)	5	0,036	0	0	0	0	1		0	0	0	0	1
14	Landscape Features (8)	3	0,122	0	0	1	0	0		0	0	1	0,2	0
15	Vistas (9)	5	0,095	0	0	0	0	1		0	0	0	0,3	1
16	Water Color (10)	5	0,139	0	0	0	0	1		0	0	0	0,2	1
17	Vegetation Cover (11)	5	0,117	0	0	0	0	1		0	0	0	0,2	1
18	Seaweed (12)	5	0,086	0	0	0	0	1		0	0	0	0,2	1
Weighted Averages Matrix For Subset Physical (Kp = Wp Ap)										**0,05**	**0,07**	**0,18**	**0,33**	**0,59**
	Human													
19	Disturbance Factor (1)	5	0,137	0	0	0	0	1	Ah	0	0	0	0,2	1
20	Litter (2)	4	0,149	0	0	0	1	0		0	0	0,2	1	0,2
21	Sewage (3)	5	0,149	0	0	0	0	1		0	0	0,2	0	1
22	Non-built Environment (4)	5	0,064	0	0	0	0	1		0	0	0,2	0	1
23	Built Environment (5)	5	0,137	0	0	0	0	1		0	0	0	0	1
24	Access Type (6)	5	0,091	0	0	0	0	1		0	0	0	0,2	1
25	Skyline (7)	5	0,137	0	0	0	0	1		0	0	0	0	1
26	Utilities (8)	5	0,137	0	0	0	0	1		0	0	0	0,2	1
Weighted Averages Matrix For Subset Human (Kh = Wh Ah)										**0**	**0**	**0,07**	**0,22**	**0,88**

Fuzzy Weighted Averages Matrix							
Elements of Fuzzy Weighted Averages Matrix	Wf	Matrix K	Attributes (1-5)				
			1	2	3	4	5
Fuzzy Weighted Averages Matrix of Subset Physical VP	1/2		0,05	0,07	0,18	0,33	0,59
Fuzzy Weighted Averages Matrix of Subset Human VH	1/2		0	0	0,07	0,22	0,88
Final Fuzzy Assessment Matrix (WF x K)							
Final Assessment Matrix (R) : Membership Degree			**0,03**	**0,04**	**0,12**	**0,27**	**0,74**

Evaluation Index (D) = 1.31

The possibilities for the present study are based on expert opinions and they are usually based on the possible error that one could make in deciding on the grades. If the parameter is absent or not relevant then the first element of the first row is 1 while all other entries of this row are zero, denoting the sureness of the grade “absent”. If the rocky shore slope is present but has an angle of less than 5°, then 1 is inserted into the second entry of the second row. Due to possibility of error in assessing the angle as less than 5° while it may truly be larger than 5°, the third entry of the second row (actually implying the third attribute) is given as 0.5. As it is extremely unlikely that the error ‘jumps’ an assessment grade, the remainder of the row is given a zero probability. Similarly, if it scores 4, the error could now be on either side of the true grade, so 0.5 is given on either side. These degrees may be subject to further changes, in this study they are developed by the consensus of the expert group. The remaining rows of the matrix are built up with similar reasoning. Grading matrices M_j for all 26 parameters are presented in Appendix B.

Since grades given by experts to the same parameter for the same beach may be different, fuzzy assessment matrices $\mathbf{A}_P$ and $\mathbf{A}_H$ were developed based on the degree of possibility among the grades obtained from $\mathbf{M_{j.}}$ $\mathbf{A}_P$ and $\mathbf{A}_H$ are 18 x 5 and 8 x 5 rectangular matrices where any j’th row of both matrices refers to the membership grades decided by the experts, evaluated from its input matrix and membership grade matrix as:

$$\mathbf{A}_{P,j} = \mathbf{D}_j \quad \mathbf{M_j} \ (j = 1 \text{ to } 18) \text{ and, } \mathbf{A}_{H,j} = \mathbf{D}_j \quad \mathbf{M_j} \ (j = 19 \text{ to } 26)$$

Where: $\mathbf{A}_{P,j}$ and $\mathbf{A}_{H,j}$ are the j’th rows of the fuzzy assessment matrices for the physical and human factors, respectively.

Elements of $\mathbf{A}_{P,j}$ and $\mathbf{A}_{H,j}$ are listed in columns 10 to 14 reflecting the corresponding attributes from 1 to 5, respectively. In Table 7, $\mathbf{D}_j$ is the 1 x 5 input matrix with the entry as 1 on the ticked attribute, all other entries being zero (as shown row-wise in Table 7, under the heading of ‘input matrices’ from columns 5 to 9, for every parameter).

If the ticked grade box (graded attribute given in column 4 of Table 5) for the rocky shore slope (parameter 7) is 1 as for Çıralı, the input matrix is:

$$\mathbf{D}_7 = (1 \quad 0 \quad 0 \quad 0 \quad 0)$$

The assessment matrix for this parameter is obtained by matrix multiplication of $\mathbf{D}_7$ with $\mathbf{M}_7$

$$\mathbf{A}_{P,7} = \mathbf{D}_7\,\mathbf{M}_7 = (1.00 \quad 0.00 \quad 0.00 \quad 0.00 \quad 0.00)$$

and is given in row seven of the assessment matrix - columns 10 to 14 in Table 7.

Among the several mathematical models used in fuzzy logic applications, the weighted mean model was preferred for this study due to its simplicity and capability of holding useful information concerning all assessment evaluation parameters.

The process of assessment was carried out by direct multiplication of the fuzzy weight and assessment matrices, resulting in two weighted assessment matrices $\mathbf{K}_P$ and $\mathbf{K}_H$ for the factors P and H as:

$$\mathbf{K}_P = \mathbf{W}_P\ \mathbf{A}_P \qquad \text{and} \qquad \mathbf{K}_H = \mathbf{W}_H\ \mathbf{A}_H \qquad \text{respectively.}$$

The final assessment matrix $\mathbf{R}$ (1 x 5) is obtained from the following matrix multiplication

$$\mathbf{R} = \mathbf{W}_F\,\mathbf{K}$$

where the matrix $\mathbf{K}$ is formed from the matrices $\mathbf{K}_P$ and $\mathbf{K}_H$ as its rows.

The absolute values of the entries (membership grades) of the final assessment matrix $\mathbf{R}$ are not significant, but the entry with the maximum membership grade and its relative differences with the other entries will be the decisive factor for the assessment (Ergin, Williams, Micallef, 2003).

For Çıralı (Table 7), the final assessment matrix is given by the following steps:

As a first step the fuzzy weighted average matrix $\mathbf{K}_P$ for the physical parameters is:

$$\mathbf{K}_P = \mathbf{W}_P\ \mathbf{A}_P = (0.051 \quad 0.073 \quad 0.177 \quad 0.327 \quad \overset{\downarrow}{0.592})$$

As stated previously, the absolute values of the elements of the fuzzy matrix has only a meaning relative to each other. In the above matrix, the maximum entry is on the fifth column implying that the beach assessed may be graded by the attribute 5 with respect to its physical characteristics. Similarly, the fuzzy weighted average matrix $\mathbf{K}_H$ for the human parameters is:

$$\mathbf{K}_H = \mathbf{W}_H\ \mathbf{A}_H = (0.000 \quad 0.000 \quad 0.072 \quad 0.222 \quad \overset{\downarrow}{0.881})$$

where the maximum entry is in the last column implying that when the human parameters are considered this beach may be graded as 5.

As a second step and synthesizing all factors of the first step, one arrives at the final assessment matrix **R:**

$$\mathbf{R} = \mathbf{W}_F\ \mathbf{K} = (0.5 \quad 0.5) \begin{matrix} 0.051 & 0.073 & 0.177 & 0.327 & 0.592 \\ 0.000 & 0.000 & 0.072 & 0.222 & 0.881 \end{matrix}$$

$$= (0.026 \quad 0.036 \quad 0.125 \quad 0.275 \quad \overset{\downarrow}{0.736})$$

As in the previous assessment matrices, the j’th element of assessment matrix **R** is the membership grade of the j’th attribute. In this example, Çıralı beach is grade “5” according to the principle of maximum membership grade.

2.5.3 Data presentation and scenic rating

Data presentation using the "Coastal Scenic Evaluation System" tables and results of scenic rating assessment using Fuzzy Logic Approach can be presented by:

1) ***Scenic Evaluation Score Histogram:*** The histogram is formed by plotting the scores taken from the "Coastal Scenic Evaluation System" on the x-axis for each parameter presented on the y-axis. The y-axis is further grouped into physical and human sub-sections taken from the "Coastal Scenic Evaluation System" tables. A score histogram for Çıralı is given as an example in Figure 1.

2) ***Fuzzy Logic Approach (FLA):*** Calculations for Fuzzy Logic Approach were carried out in two basic steps:

- Fuzzy assessment matrices for assessment parameters as weighted averages of physical and human factors (V_P , V_H).
- Membership degrees of physical and human factors (final assessment matrix R of attributes from 1 to 5).

These calculations were carried out for all investigated sites. The results are represented in graphical forms for Çıralı in Figures 2 and 3 as an example:

- The graph of weighted average of attributes grouped into physical and human parameters (V_P , V_H) (Figure 2).

- The graph of membership degrees of attributes (R) (Figure 3).

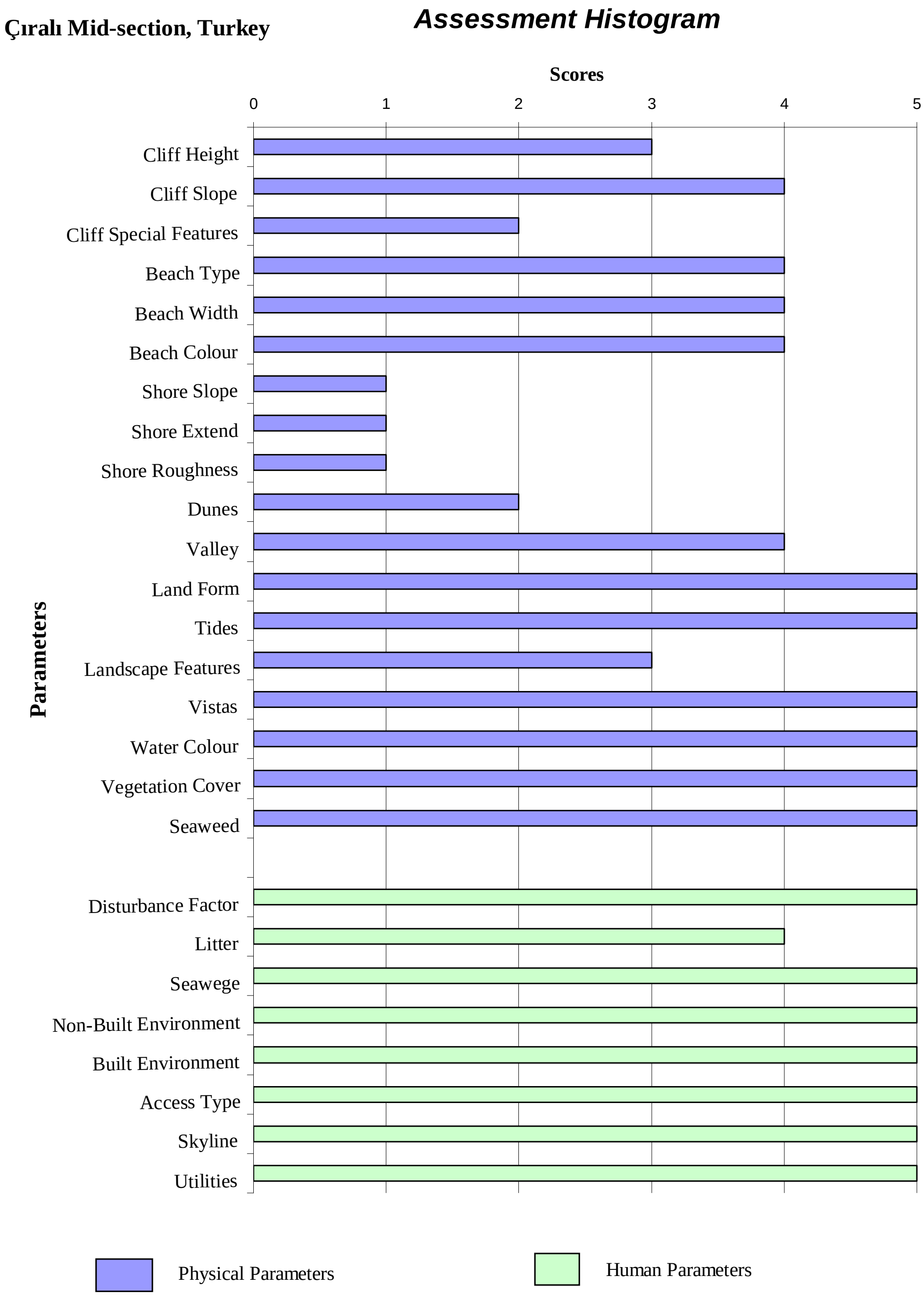


Figure 1. Scenic Evaluation Score Histogram for Çıralı

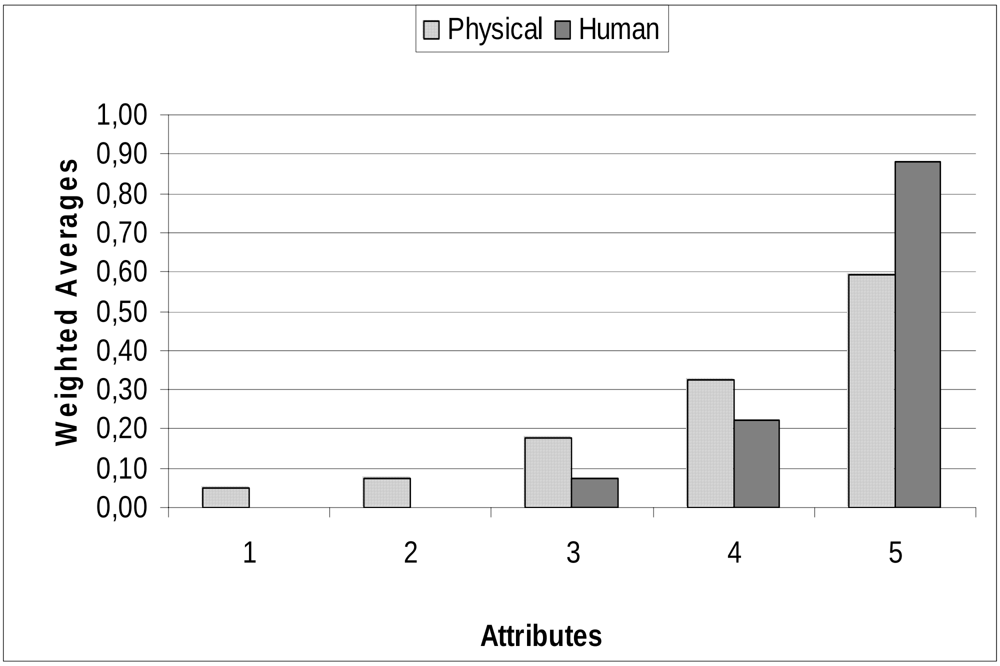


Figure 2. Weighted Averages Histogram for Çıralı

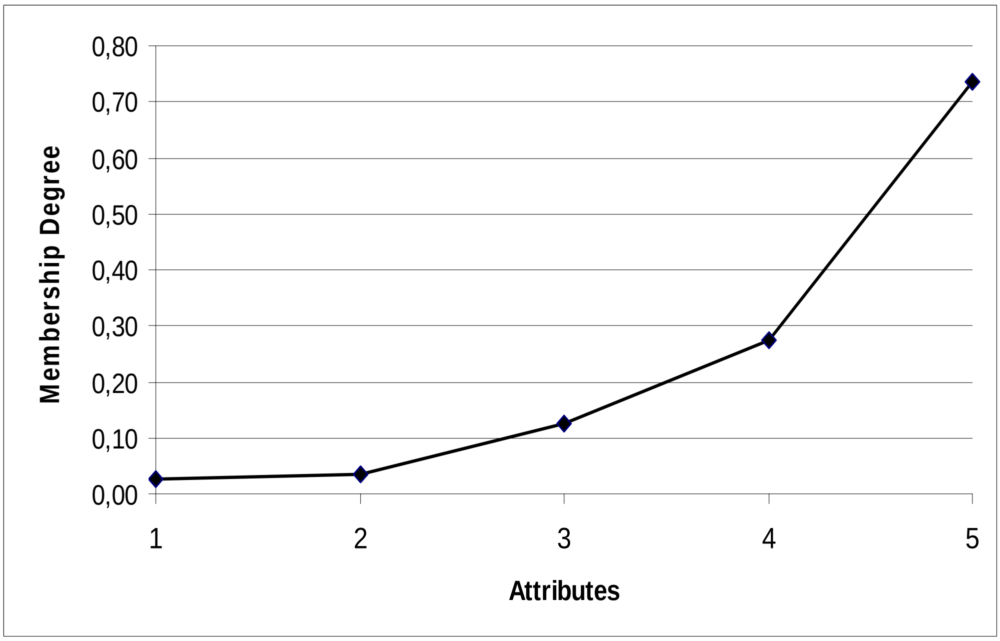


Figure3. Membership Degree Curve for Çıralı

2.5.4 Interpretation of the Data

With respect to the weighted averages vs. attributes histograms, high weighted averages at lower attribute values such as 1 and 2 reflect the adverse impact of the physical or human parameter. The reverse holds true for high attribute values, such as 4 and 5, which reflect the positive influencing impact of the physical/human parameter as given in Figure 2 for Çıralı. With respect to coastal management issues, high human parameters at low attribute values may be interpreted, for example as having too much litter present, etc. Most sites have physical parameters for which managers can do little to alleviate their scenic impact, so perhaps emphasis should be given to assessing ways of upgrading the human parameter scores.

With respect to membership degree vs. attribute curves, a right hand skew (RHS) indicates a high scenic rating as given in Figure 3 for Çıralı, compared to a low scenic rating with a left hand skew (LHS) curve.

For comparison between sites, a decision parameter (D) was defined (Ergin, Williams, Micallef, 2003).

$$\mathbf{D} = \frac{(-2\times A_{12})+(-1\times A_{23})+(1\times A_{34})+(2\times A_{45})}{A_T}$$

Where: the area under the curve between the attributes i and j is named A_{ij} with: i =1, 2, 3, 4 and j = 2, 3, 4, 5 (Figure 4). The total area under the curve is A_T.

For D, It can be seen that;

$$A_{12}+A_{23}+A_{34}+A_{45}=A_T \Rightarrow 2 \geq \frac{(-2\times A_{12})+(-1\times A_{23})+(1\times A_{34})+(2\times A_{45})}{A_T} \geq -2$$

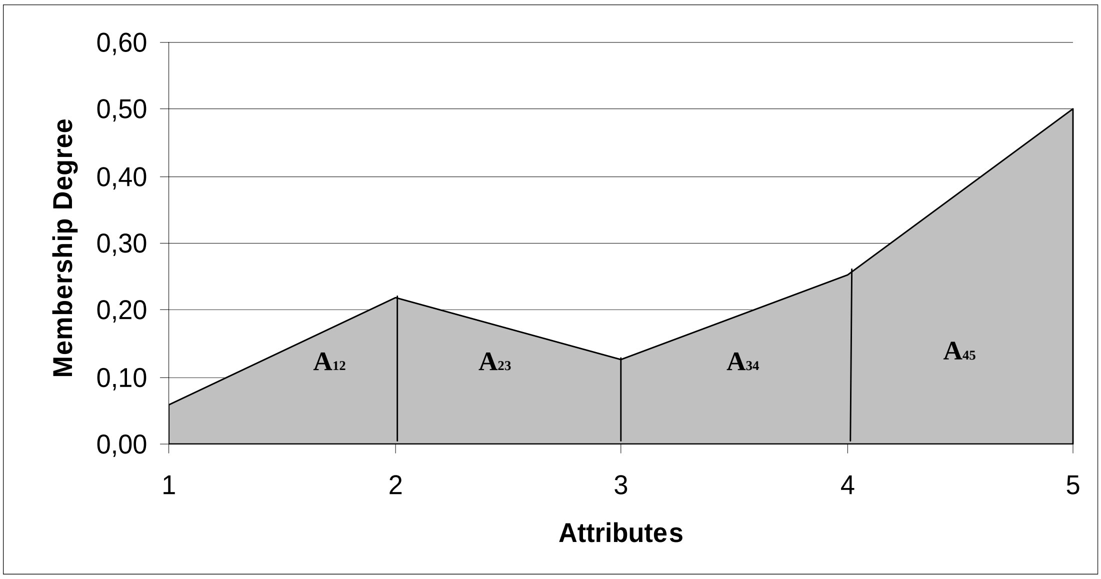


Figure 4. Sample Membership Degree Curve (with area names)

Calculations were carried out for all 57 evaluated sites using D decision parameters. D was assigned as a decision tool since it reflected all attributed values in terms of weighted areas; with negative and positive weights referring respectively to the sequence of attributes from 1 to 5. These were applied in order to distinguish the attributes' impact on the evaluation of the coastal scenery. The decision parameter was named as the Evaluation Index (D). Sequence figures/curve for D, are given in tabular form in Table 8 together with a graphical form in Figure 5, for all 57 sites.

Table 8. Site Sequence with respect to D Criteria

k	Sites (UK, Turkey, Malta)	D
1	Çıralı Mid-section (TR)	1.31
2	Çıralı Karaburun (TR)	1.26
3	Phasalis Small Bay (TR)	1.08
4	Little Haven (UK)	1.00
5	Dingli Cliffs (MT)	0.97
6	Phaselis Large Bay (TR)	0.91
7	Poppit (UK)	0.91
8	Tisan Back Bay Mersin (TR)	0.83
9	Fungus Rock (MT)	0.77
10	Nash (UK)	0.74
11	St Govans (UK)	0.69
12	Tisan Tample, Mersin (TR)	0.68
13	Whitesands (UK)	0.68
14	Karaburun Akyar Mersin (TR)	0.67
15	Newgale (UK)	0.66
16	Göksu Hurma, Mersin (TR)	0.61
17	Tenby S (UK)	0.57
18	Ghajn Tuffieha (MT)	0.56
19	Manikata (MT)	0.56
20	Southerndown (UK)	0.54
21	Calypso Cave (MT)	0.48
22	FreshWater West (UK)	0.46
23	Blue Lagoon (UK)	0.45
24	Mellieha (MT)	0.37
25	Wisemans Bridge (UK)	0.34
26	Broadhaven (UK)	0.34
27	Angle (UK)	0.33
28	Alata West, Mersin (TR)	0.31

k	Sites (UK, Turkey, Malta)	D
29	Alata Mid, Mersin (TR)	0.29
30	Tenby N (UK)	0.26
31	Antalya Old Harbour (TR)	0.19
32	Tekirova North (TR)	0.19
33	Tekirova South (TR)	0.18
34	Kercem Cliffs (MT)	0.16
35	Saundersfoot (UK)	0.15
36	Konyaaltı West (TR)	0.10
37	White Towers (MT)	0.10
38	Konyaaltı East (TR)	0.09
39	Xwieni Point (MT)	0.08
40	Xlendi Bay (MT)	0.07
41	Alata East, Mersin (TR)	0.07
42	Llantwit (UK)	0.04
43	Konyaaltı Middle (TR)	0.04
44	Ogmore (UK)	0.03
45	Porthcawl (UK)	0.02
46	Antalya Waterfalls (TR)	-0.01
47	Mygarr Ix-xini	-0.02
48	Ramla Bay (MT)	-0.06
49	Amroth (UK)	-0.08
50	Ghallis Rocks coastline (MT)	-0.12
51	Antalya Lara Barınak (TR)	-0.16
52	Antalya Dedeman Hotel (TR)	-0.21
53	Lara Beach (TR)	-0.28
54	Marsalforn (MT)	-0.37
55	Bahar Ic-caghaq (MT)	-0.41
56	Kız Kalesi Mersin (TR)	-0.58
57	St. George's Bay (MT)	-0.64

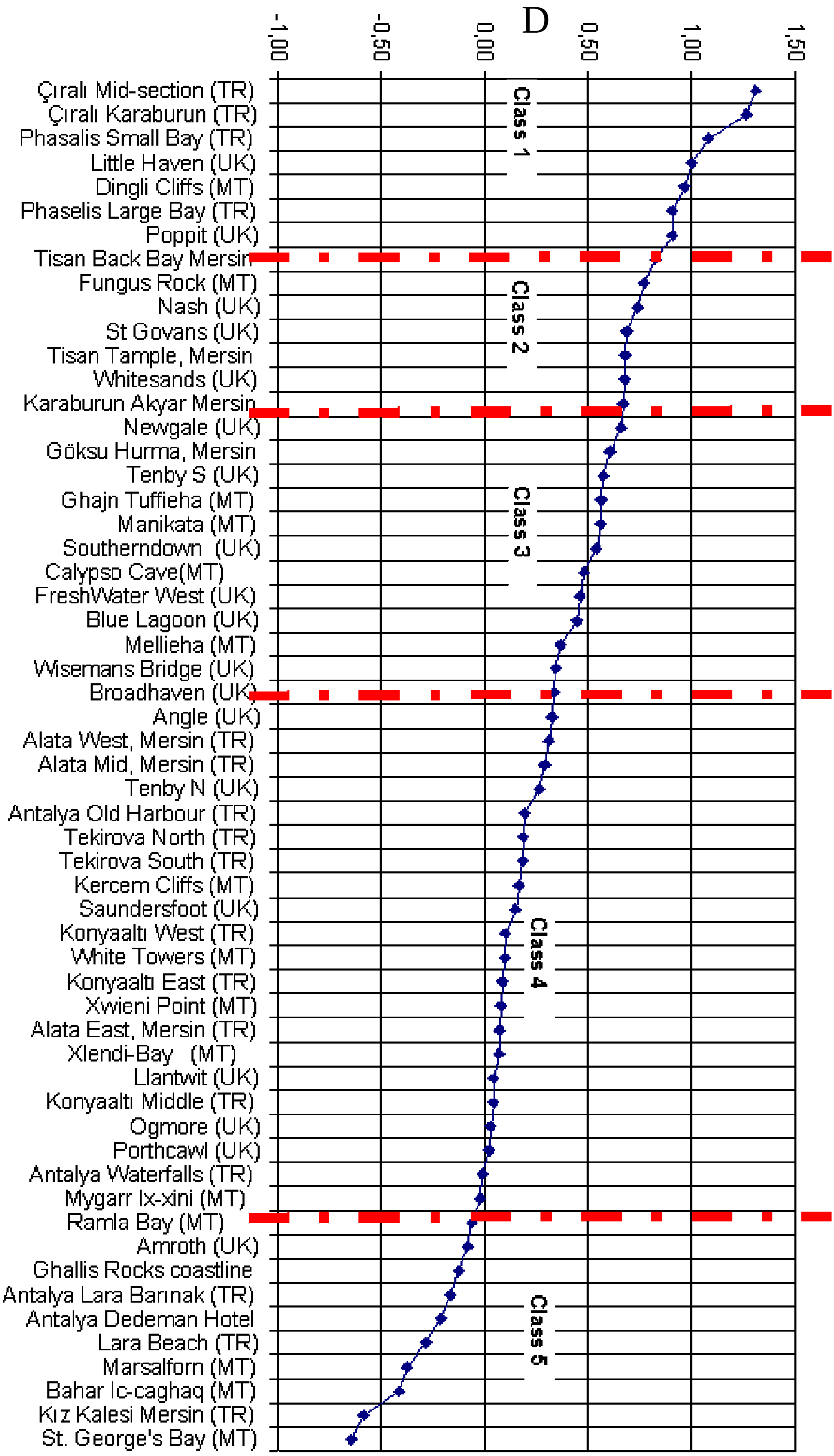


Figure 5. Evaluation Index curve for 57 sites

Site classifications were made on the final sequence curve produced, based on the Evaluation Index D (Figure 5). Curve break points based on the midpoint change of slope, allowed a division of sites into five main classes. This simple rule is also compared to the percentile values of the D criteria on a normal plot (Figure 6) where Class 1 and Class 5 were within the lowest 15th percentile and top 85th percentile, respectively. The normal plot of the cumulative percentages versus the D- criteria was almost linear as shown in Figure 6**.** The break-point statistical distributions were also tested for Gaussian (normal) distribution that would indicate study unbiasedness. For this purpose, normality tests using chi-square and Kolmogorov-Smirnov tests were performed at the 5% significance level confirming normality of the break point distributions (Ergin, Williams, Micallef, 2003). Classes obtained were as follows:

CLASS 1: Extremely attractive natural site with a very high landscape value, having a D value above 0.85, e.g. Çıralı and Phasalis Bay Turkey.

CLASS 2: Attractive natural site with high landscape value, having a D value between 0.65 and 0.85, e.g. St Govans, UK and Tisan Back Bay. Turkey.

CLASS 3: Many natural with little outstanding landscape features and a D value between 0.35 and 0.65, e.g. Mankata, Malta, Southerndown Bay. UK; or urban sites with exceptional scenic characteristics e.g. Tenby, UK.

CLASS 4: Mainly unattractive urban, with a low landscape value, and a D value between 0 and 0.35, e.g. Kercem Cliffs and Xlendi Bay, Malta.

CLASS 5: Very unattractive urban, intensive development with a low landscape value and a D value below 0, e.g. Kızkalesi, Turkey. And St Georges Bay, Malta.

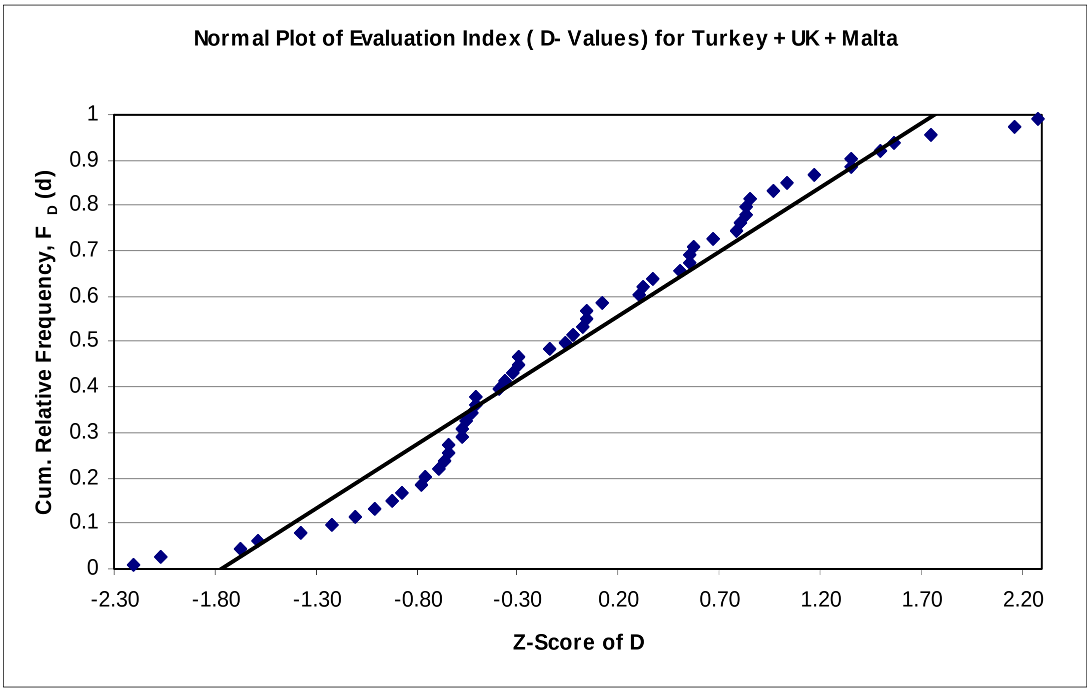


Figure 6. Normal Plot of D values for Turkey, UK and Malta Sites

(Z- score $= \frac{\text{D} - \text{Average of D}}{\text{Standard Deviation of D}}$ and Cumulative Relative Frequency, $F_D(d) = \frac{n - k + 0.5}{n}$, where

k is the order of D values in descending form (Table 6) and n is total number of sites)

CHAPTER 3

ÇIRALI

Olympos - Çıralı has been home to numerous civilisations down through history, as well as being the subject of many legends. It is also outstanding for its natural attributes. General information for Çıralı could be reached at the web site; www.cirali.org.tr.

3.1 Location

Çıralı is located 70 km west of Antalya within Antalya's Kemer township district. Extending to the beach from Ulupınar village, Çıralı can be reached by a 7 km road leading east of the Antalya-Kaş highway. The gulf is surrounded by the Tahtalı range of the Toros Mountains in the north, the Yazır village in the south, Altınkaya township in the west and the Mediterranean on the east. Northwest of the villages 3,2 km long shore, a natural fire known as Yanartaş (Chimeira) burns continuously. The southern extremity of the Çıralı shore ends at Musa Mountain and the Olympos brook, which crosses through the ancient city of Olympos. The northern end is bounded by Karaburun, a rocky cape. Ulupınar, a major river, meets the sea on the southern Çıralı shore. A photo from Çıralı can be seen in Appendix C (Photo C4).

3.2 History

Ancient sources report that there was once a temple to Hephaistos at the site of Olympos. In ancient times it was believed that the blacksmith god Hephaistpos's furnaces were located beneath volcanoes; thus, temples in his name were erected at sites of constantly burning flames such as those at Yanartaş. When Prometheus stole fire from Olympos to bring to man, Zeus ordered Hephaistos to create Pandora to get revenge on Prometheus; of all the gods on Olympos, Hephaistos alone possessed this creative power. So goes the legend as related in Homer's Iliad about Lycia's undying flame ("Burning Rock" or Yanartaş, in Turkish) of the region of Çıralı known by the ancient name Chimeira. Geological research, however, tells us that this legendary flame is the result of natural gas produced at points of contact between serpentine and limestone, the two rock types characteristic of the region.

3.3 Fauna

3.3.1 Sea Turtles

The Çıralı shore is the one of the major nesting sites along Turkey's Mediterranean coastline for the sea turtle, an internationally threatened species. Every year, during its reproduction from May through September, the sea turtle swims thousands of kilometers to return to its native shore for nesting. During this period, The Society for the Protection of Nature places a cage over each of the sea turtle nests along Çıralı's 3,2 km long shoreline, in order to protect them until hatching time. Survival of this threatened species needs being careful to leave these turtles, their nests and babies, in peace.

3.3.2 Birds

North of the Çıralı shore, especially where the Olympos Brook meets the sea, one can encounter woodchat shrike, Krüper's nuthatch, green wood pecker, Rüppel's warbler, long-tailed tit, as well as kentish plover and crested lark, all along the shore. The Olympos ruins and steep slopes behind them accommodate rufous bush robin and short-toed eagle. Çıralı is the furthest-western habitat of the yellow-wented bulbul, a subtropical species. Yellow-wented bulbul is one of the unusual beauties of Çıralı, with its huge round eyes, bright yellowunder-tail feathers, and early morning warble. The careful observer is sure to spoat it among Çıralı's bushes and gardens.

3.3.3 Chameleons, Lynxes and Butterflies

The slow-moving *Chamaeleo chameleon* appearing from time to time in the bushes along the road brink, the common tree frog *Hyla arborea* appearing frequently at Summer’s end, and the lizard *Agama stellio* are among interesting animal species of Çıralı. Occasionally hte *Lynx caracal* can be seen by night on the road to Çıralı. The region is also an important habitat for dragon-flies and many different types of butterflies.

3.4 Flora

Çıralı has a changing beauty, renewing itself with every season as the life cycles of the trees, flowers and vegetation create new harmonies of scents and colors. The northern Çıralı shore is home to the stone pines, a species foun along many beaches of the Antalya region. The Yanartaş (“Burning Rock”) road, lined by lavender an heath bushes, myrtle, carob and sandalwood trees, takes you up to its eternally burning flame. The spring months bring tamarisk and bellflover alive along the banks of brooklets near the site of Olympos; this is also the season for the spreading of rosary bush and red poppies. And the ethereal scent of orange blossoms lingers in the memory of anyone who has visited Çıralı in the spring. Iris, crocus, wild orchids, anemone, buttercup, shepherd’s purse, and cyclamen should also be counted among the jewels of nature bestowed on Çıralı. Laurel, thyme, and daisies are among the other plants which, although part of our daily lives, present a fresh beauty in their natural settings.

Ononis serrata is one of the rare species found along the sand dunes of Çıralı. Arare and endemic species found among the pebbles of the brooks that flow down from Burning Rock is *Centaurea dichora. Phlomis chimerae* is aspecies endemic to the Olympos Coast National Park. The word “chimera” in its name is a reference to Burning Rock, presumed prigin of the legend of the Chimera. The steep limestone slopes rising up behind the local village, as well as the southern site of the river running toward the Olympos Archeological SIT area, are home to several rare species. *Verbascum spodiotrichum*, for example, lives in three sites in the world;

Çıralı is one of them. *Echinops onopordum* lives among the rocky limestone slopes near Olympos and the Kesme Canyon. Another native species native to the Antalya area is *Onosma strigosissimum*. Furthermore, during a survey undertaken by the Society for the Protection of Nature, two plant species, a pea-relative common on the lower parts of the beavh amd a grass from the serpentine gravel, are thought to be new to science and thus still await names.

3.5 Çıralı under Protection

Çıralı's historical and natural riches are protected by legal statutes. The walley sheltering the ancient city of Olympos and leading all the way to the sea has been disgnated as an Archeological SIT area. The beach and immediate inland zone extending for 3 km to the north of Olympos have been declared 1st and 2nd degree Natural SIT areas.

The Society for the Protection of Nature (Doğal Hayatı Koruma Derneği, DHKD) has been carrying out conservation projects in Çıralı since 1994. As of 1997, these activities continue under a European Community sponsorship project called "Coastal Management and Tourism in Turkey: Çıralı and Belek". Major components of the project includes the drafting of the "Çıralı Conservation Zoning Development Plan" and the "Çıralı Coastal Management Plan", a process which brings together the contributions of local administration agencies and organisations, as well as the direct participation and support of local residents. Another component consists in educational activities to heighten local residents'awareness os natural values. Other projected activities include developing the economic strength of the region through organic farming and eco-tourism, a project whose major goal is to ensure citizen participation in the planning process. Efforts are also aimed at creating a professional team committed to solve present issues and make plans for the future of Çıralı, which will also serve as a model for environmental protection along the entire Mediterranean coast.

CHAPTER 4

SIMULATIONS OF DIFFERENT HUMAN USAGES

With regard to coastal zone management this technique is suitable for evaluating future potential changes especially with regard to influence of coastal structures on the coastal scenery. This work will hopefully be utilized by coastal mangers, planners, academics, governmental agencies, as to improve the especially human usage of the coastal areas also this work will be a tool for the preservation and conservation and the sustainable development of the coastal areas.

Simulations are carried out with the fuzzy logic methodology as given in Chapter 2 where some possible changes were applied on the parameters. Physical parameters are the geological, geographical and other characteristics such as cliffs, beaches, etc, so simulations were not also carried out by changing the attribute values of physical parameters. Therefore, simulations have been started firstly by changing the attribute values of parameters which can be controlled by human usagenamely human parameters such as built environment, litter, sewage, etc. Yet, influence of the changes in some of the human parameters reflected on some physical parameters such as water color are taken into consideration.

As it can be seen from the scenic evaluation score histogram for Çıralı (Figure 1), except one, all of the human parameters have the attribute value five. Also we can see that the values in the weight matrices for human parameters are significantly greater than the physical parameters (Tables 5 and 6). As a result, the changes in attribute values of human parameters significantly effect the calculations of FLA and these changes on human parameters will change the index value of the selected coastal area which is the basic criteria used for classification of coastal sites.

A computer program which is the main tool for the simulations was written in excel environment for the calculations in coastal scenic evaluation using FLA (Ergin, Williams, Micallef, 2002). The input of the programme are the attribute values of 26 physical and human parameters. Fuzzy assessment matrices, scenic evaluation score histograms, weighted averages histograms, membership degree curves and D values for the studied sites are the output of the program.

4.1 Simulation Work on Çıralı

Çıralı is the most suitable site among the Turkish coasts studied in the project to apply the methodology developed using fuzzy logic mathematics. Çıralı has a high scenic value because of its good physical and especially human parameters and Çıralı is under threat of forcing function of human usage. According to the classification methodology for coastal sites using FLA, Çıralı is the first in Turkey and a Class I site, and this has made Çıralı quite popular. Happily, Çıralı is a Natural SIT area and this status helps to protect the nature and to keep the human usage same. That's why, with its dominating human parameters Çıralı is a suitable site to make simulations using FLA.

4.2 Sensitivity of Parameters

In general, for a selected site the difference in attribute values mainly rises from the different human usages (e.g. built environment, litter, sewage) which to some extent reflects on physical parameters such as water color, vegetation cover, seaweed, dunes, beach color and beach width. In simulation of the impact of different human usage, for example changing the attribute value of built environment, the attribute value of the human parameter taken into consideration changed between one to five while keeping all the other attribute values of the remaining parameters constant. Then, D values for this parameter as the attribute values changed from one to five were computed. This procedure was repeated for all of the parameters. In Table 9 only the human prameters and those physical parameters affected from the changes in the human parametersare given.

For Çıralı simulation application, different attribute values from one to five are given to each parameter while all the others are kept constant as given in Figure 1. The D values for each case are given in a tabular form in Table 9. The bold values are the existing values for Çıralı.

At the last column difference between maximum and minimum D values can be seen. As an example for litter parameter; original attribute value is four and corresponding D value is 1,31. If the attribute value of litter is changed from one to five while all tthe other attribute values of the remaining parameters are kept as the original attribute values, maximum and minimum D values are computed as 1,34 and 1,00. From Table 9 it is seen that litter is the first, water color is the second and skyline is the third sensitive parameter. Six of the eight human parameters are in the first ten of all parameters.

D values decrease by decreasing attribute values. This is the general case. But for attribute value two there is an exception. D values for attribute two are smaller than the ones for attribute value one. This deviation comes from the assigned values for attributes one and two in the assessment matrices. In Appendix B fuzzy assessment matrices are given. Attribute one is a strict case and it means the parameter is absent, so zero is assigned for the neighbouring attribute which is two. But for the attribute two, the possibility of the attribute value being one or three is also taken into account. Because of this, the area under the membership degree curve between one and two, A_{12}, (Figure 4) is increased and the D value is decreased.

Table 9. D Values for Çıralı for Different Conditions (D Values for Different Attribute Values of Each Parameter While the Others Are Kept Constant)

PARAMETER	ATTRIBUTE VALUE					DIFFERENCE
	1	2	3	4	5	
Disturbance Factor	1,13	1,03		1,25	**1,31**	0,28
Litter	1,09	1	1,14	**1,31**	1,34	0,34
Sewage	1,13		1,15		**1,31**	0,18
Non-Built Environment	1,23		1,24		**1,31**	0,08
Built Environment	1,14	1,04	1,14	1,26	**1,31**	0,27
Access Type	1,16	1,12		1,27	**1,31**	0,19
Skyline	1,06	0,99	1,1	1,26	**1,31**	0,32
Utilities	1,13	1,02	1,13	1,27	**1,31**	0,29
Cliff Height			**1,31**			0,05
Cliff Slope				**1,31**		0,05
Cliff Special Features		**1,31**				0,06
Beach Type				**1,31**		0,06
Beach Width	1,28	1,26	1,27	**1,31**	1,31	0,05
Beach Colour	1,29	1,27	1,3	**1,31**	1,32	0,05
Shore Slope	**1,31**					0,04
Shore Extend	**1,31**					0,03
Shore Roughness	**1,31**					0,05
Dunes	1,34	**1,31**	1,34	1,38	1,38	0,07
Valley				**1,31**		0,15
Land Form					**1,31**	0,18
Tides					**1,31**	0,07
Landscape Features			**1,31**			0,26
Vistas					**1,31**	0,19
Water Colour	1,09	1	1,08	1,25	**1,31**	0,31
Vegetation Cover	1,12	1,05	1,16	1,28	**1,31**	0,26
Seaweed	1,17	1,13	1,22	1,28	**1,31**	0,18

The general tendency of the changes on D value reflected from different human parameter attribute values are also studied. The original D value of Çıralı was 1,31. D values as the attributes decrease in steps are given below;

when attribute values of human parameters are decreased by one, D is 0,96
when attribute values of human parameters are decreased by two, D is 0,29
when attribute values of human parameters are decreased by three, D is -0,16.

It is seen from Figure 7 that D value decreases from 1,31 to -0,16 and change the class of Çıralı from Class I to ClassV. These results show clearly that human usage is very important and should be well planned.

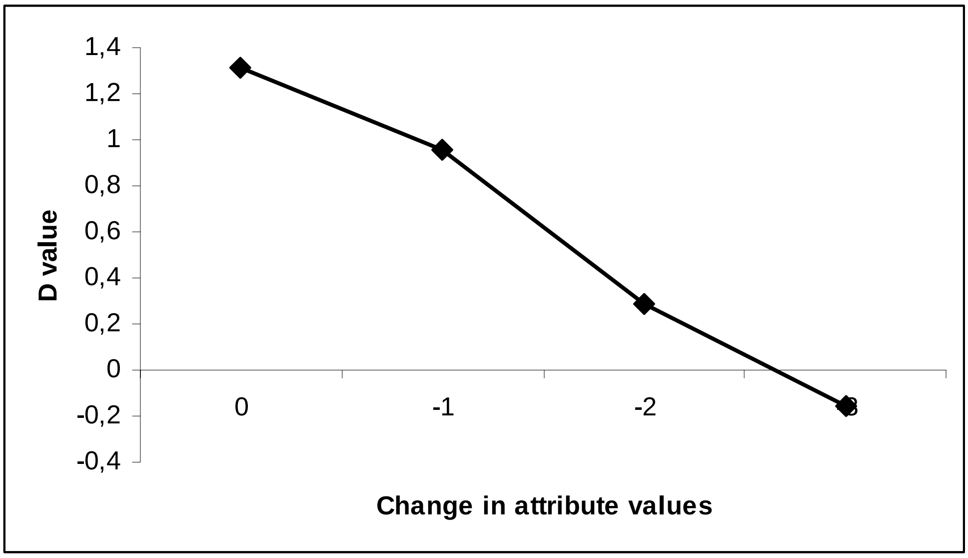


Figure 7. D Values – Decreasing Attributes for Human Parameters Graph for Çıralı

4.3 Comparison of Kemer and Çıralı

Within the Kemer region, developments in Kemer Town are already at a stage where harm to both physical and human parameters are evident. From the perspective of human usage there is a distinct difference between Kemer Town and Çıralı Beach. Therefore, it was decided that a comparison of these two cases will be a good guidance to the managers and planners to show the overuse of the coastal areas under the threat of heavy tourism and urban development.

Çıralı is located 70 km west of Antalya within Antalya’s Kemer township district. Kemer has high quality physical parameters similar to Çıralı. Fauna, flora, landform and other physical characteristics in Kemer are not very different from Çıralı as they are close to each other.

In the site studies, Kemer was also included for Coastal Scenic Evaluation during the technical trip to Çıralı, May 2004. For Kemer, scenic evaluation score histogram (Figure 8), weighted averages histogram (Figure 9) and membership degree curve (Figure 10) are given.

Such a comparison using Coastal Scenic Evaluation methodology where Çıralı stands for as a good axample for human usage parameters and Kemer on the other hand stands for just the opposite will certainly be a good example in the application of the methodology.

During the public perception studies in Çıralı, some of the interviews with locals given below (Çıralı, May 2004) show clearly people’s behavior, appreciation and approach to the environmental issues.

A Taxi driver: “If huge hotels were built here Çıralı would loose its atmophere. Also Çıralı would not be as clean as today. Look at the situation in Kemer now. Hotels placed barriers everywhere. Swimming is a problem there.”

A farmer at the village cafe: “They have built hotels at the most beautiful sites of our country. They should build them on the mountains. They are killing the sea. They filled at least 3000 m^2 in Kemer. European tourists are not coming to Kemer now, although they made the rooms cheaper and cheaper. Now, they are trying to attract Russian tourists.”

Kemer is a well known coastal site with a highly developed tourism industry. There is a line of big hotels and tourism complexes which starts at the point where the narrow beach ends (see Photo C5 in Appendix C). Also there is a marina at the southern edge of the coast. All these mean that human exploitation of natural resources is in great amounts in Kemer and this lowers the grade of Kemer for human parameters. Reflection of low grades for human parameters to the D value is easily observed as it is 0,11, which makes Kemer a Class IV site.

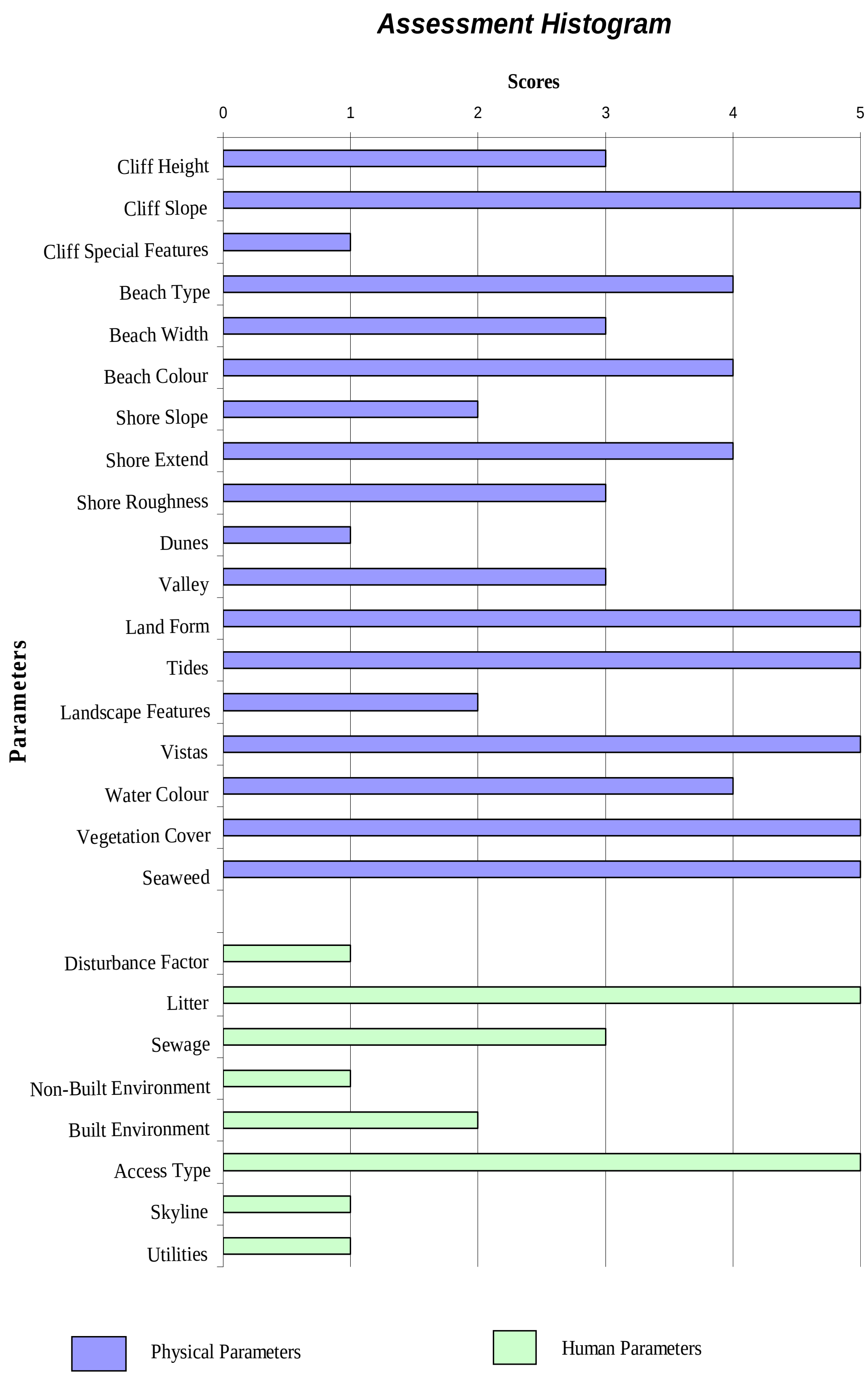


Figure 8. Scenic Evaluation Score Histogram for Kemer

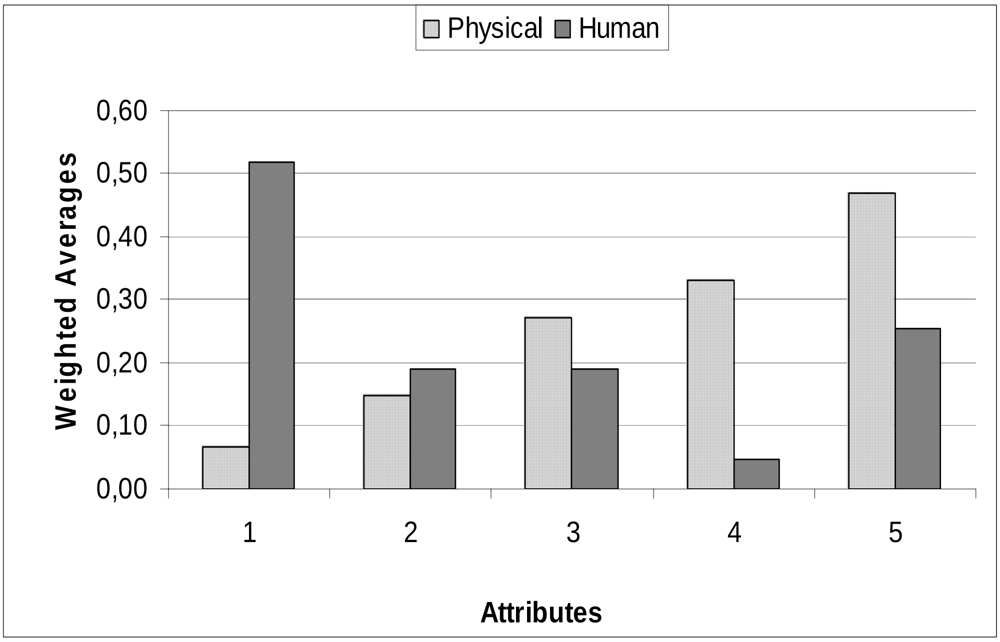


Figure 9. Weighted Averages Histogram for Kemer

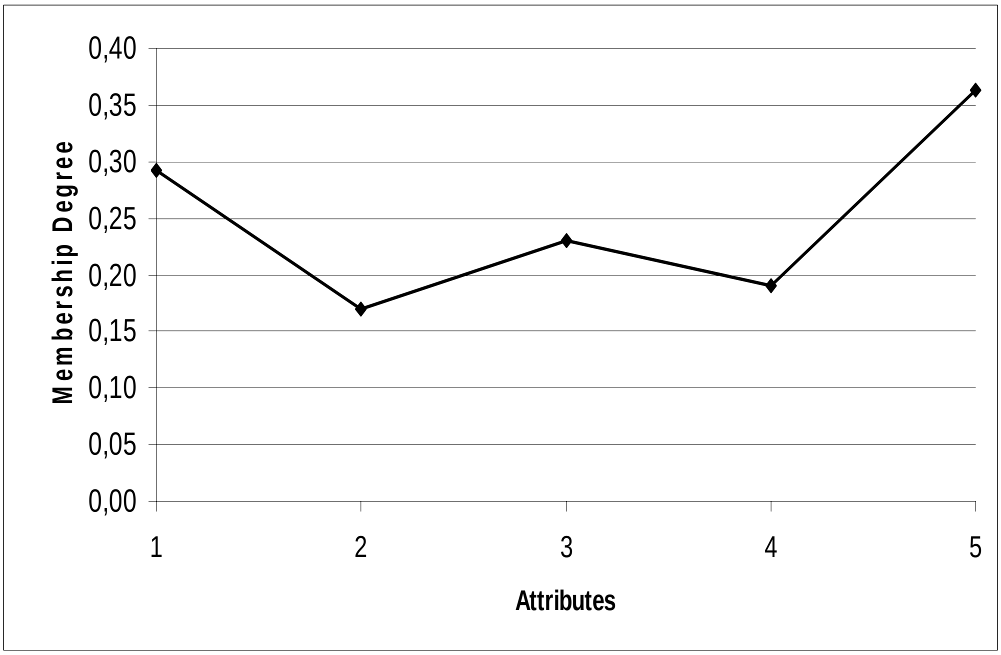


Figure 10. Membership Degree Curve for Kemer

As it is seen from Figure 8, the average of attribute values for physical parameters for Kemer is near four but this is not true for human parameters. Except the parameters litter and access type, all of the human parameters have low grades. Access type takes five because there is a buffer zone along the beach, and parking areas can not be seen from the beach. Also the area is clean of litter. Hotels’ and tourism complexes’ customers would not prefer a dirty beach, so at least beach is kept clean.

For the other six human parameters there seems there is no chance to upgrade the present situation. The beach is noisy because of the crowd, music coming from seaside hotels and the jet skis. There are some evidence of sewage in Kemer. There is a small stream reaching the sea which does not seem to be 100 % clean. Also one gets the impression of pollution due to visiting yachts, although the marina is a blue flagged one. Land is mainly exploited for tourism and it can be said that there is no agricultural use. There is heavy tourism and also urbanization which means grade two for built environment parameter. The skyline is very unattractive and takes grade one. Also there are more than three utilities like piers, breakwater, marina, etc.

A scenario was simulated for Kemer by upgrading the human parameters to show the adverse effect of human usage. In the first simulation it was assumed that Kemer has the same grades as Çıralı for human parameters (physical parameters are constant). Then the new D value was obtaines as 1,08. The scenic evaluation score histogram, weighted averages histogram and membership degree curve for this new Kemer are given in Figures 11, 12 and 13 respectively. If Kemer was sustainably developed or protected with a Natural SIT area status like Çıralı, Kemer would be a Class I site with a D value of 1,08.

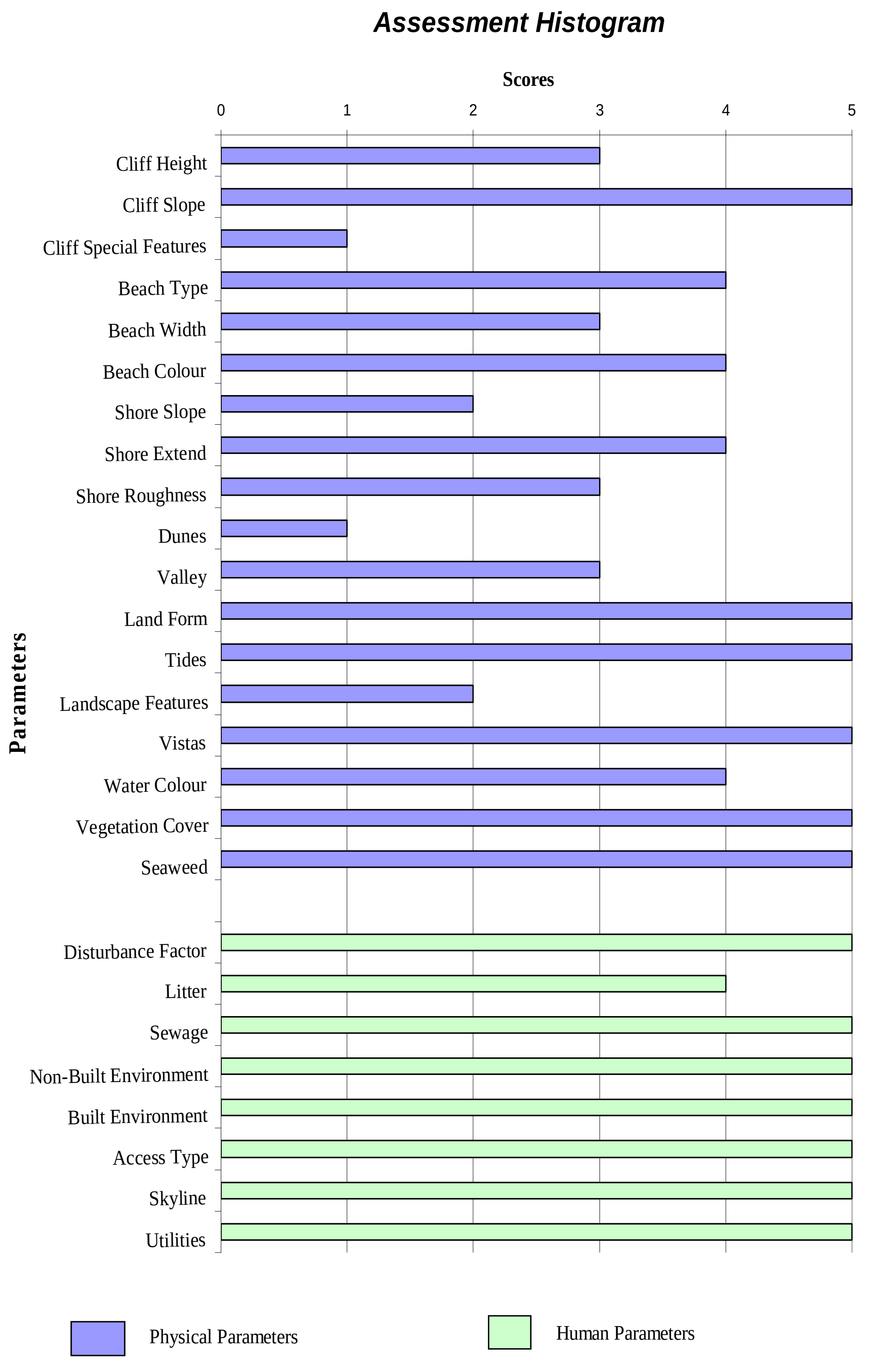


Figure 11. Scenic Evaluation Score Histogram for Kemer (attributes for the human parameters are replaced with the attributes of Çıralı)

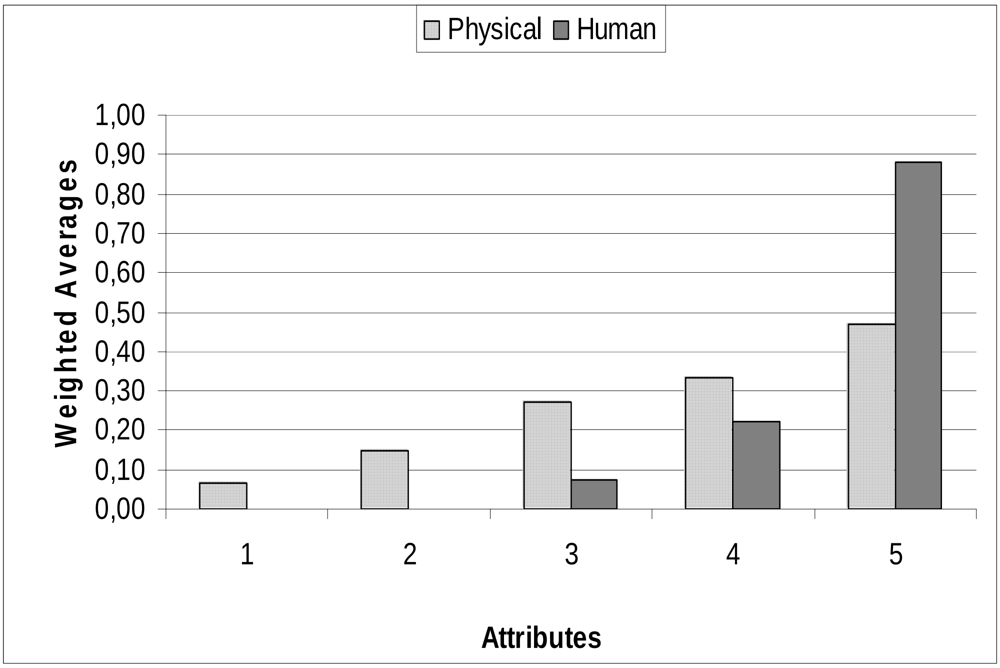


Figure 12. Weighted Averages Histogram for Kemer (attributes for the human parameters are replaced with the attributes of Çıralı)

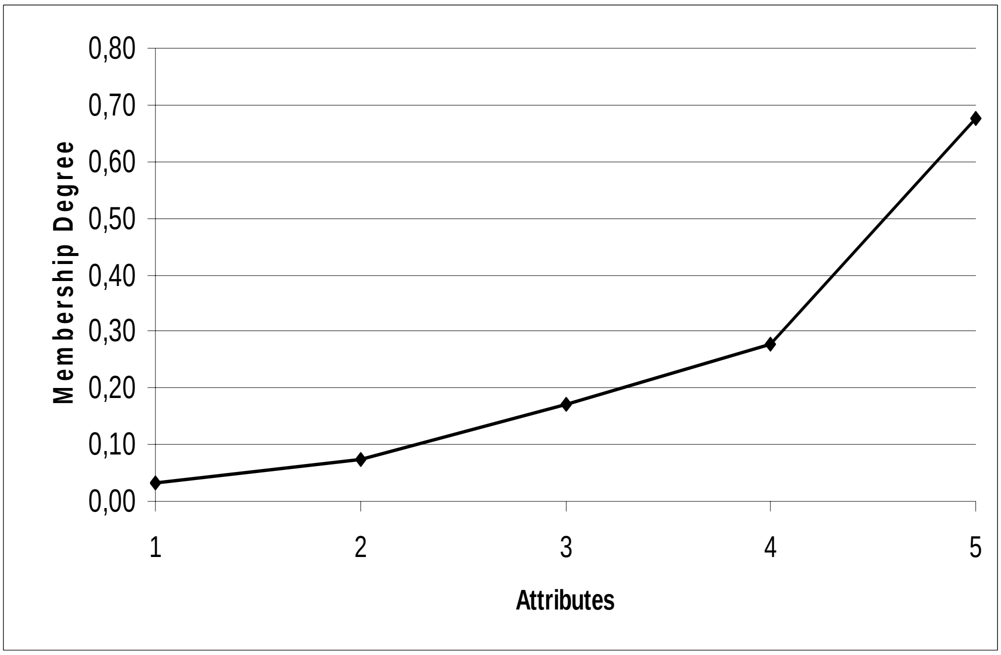


Figure 13. Membership Degree Curve for Kemer (attributes for the human parameters are replaced with the attributes of Çıralı)

4.4 Çıralı in Short Term Under Current Trends

In this section, what is likely to happen under current development trends will be discussed as a scenario in the simulation by downgrading some of the human parameters likely to change. Çıralı is luckily a Natural SIT area and this status of Çıralı is not expected to change in the short term. Altough Çıralı is a Natural SIT area, "life is not so simple" and some points need to be emphasized. Çıralı is a Class I site mainly because it has Natural SIT area status, but this may not persist if regulations and rules are not obeyed and protection on Çıralı is weakened.

For noise disturbance criteria, Çıralı will probably keep its high attribute value of five. The only source of noise for the Çıralı beach is the music coming from the restaurants at the seaside. In the past they were 30 m away from the shoreline, but they were moved backwards and today, they are located 90 m away from the shoreline. If music is not very loud it will not be heard from the beach. Also it is said that, restaurant owners are sensitive to the environment and regulations, and when requested or at the *Caretta carettas* coming period they stop playing music. As a result, Çıralı will continue to have attribute five for noise disturbance criteria in short term.

Litter is the only human parameter which has an attribute value different from five. In the site investigations as shown in Figure 1 attribute four is assigned for this parameter. There are a fev scattered items of litter which can be seen on the beach of Çıralı. Therefore, the municipality must take precautions and there must be an organisation to keep the beach clean. If not, litter on the beach will continue to accumulate. In the short term, litter criteria might get worse and a single accumulation of litter might be seen on the beach. Therefore, in the simulation the attribute value for litter was downgraded from four to three.

A similar discussion can be made for sewage criteria. Not only small and medium but also large sized yachts are berthing at the southern parts of Çıralı beach. There is not any control and restriction for these yachts and local people say that every year the number of yachts are increasing. There is not so much evidence of pollution originating from yachts today, but there may be in the future if the current situation persists. Also Ulupınar river is getting polluted day by day.The main reson for this is the fishing farms at the upstream of the river. Therefore, in the simulation the attribute value for sewage was downgraded from five to three.

For agriculture (non-built environment) criteria, no change is assumed in the short term. Eco-agriculture is an important issue in Çıralı and this is a major part of the activities of the Ulupınar Village Cooperative. Eco-agriculture has the second place in theeconomy of Çıralı after tourism. As a result, the current situation for agriculture will not change in near future. Therefore, in the simulation the attribute value for non-built environment was kept constant.

Altough it is restricted, new houses and pensions are being built or new parts being added to existing buildings in Çıralı. This is especially done by owners who are not locals. They are building houses with two or three floors, which is also restricted. Local people say that the owners are only fined and they pay the money and no other measures are taken to control this situation. The increase in number of buildings will bring a decrease in the attribute value for built-environment criteria. Therefore, in the simulation the attribute value for built environment was downgraded from five to four which means sensitive tourism.

Cars are not allowed to pass beyond the road along the coast. There are “forbidden” signs at the passages to the beach. But this is not sufficient and especially daily visitors do not obey this rule. There is a parking area but most of the cars do not park there, instead prefer to park very near to the beach. If the restrictions are not strengthened, parking near to the beach may become a general practice. Therefore, in the simulation the attribute value for access type was downgraded from five to four.

In the short term there can not be significant changes for the skyline. To change the skyline there must exist big hotels near the beach -like Kemer- which close the beatiful landscape backwards, or some touristic or industrial buildings must be constructed at the top parts of the mountains which become a part of the skyline, which seems rather not applicable in a short term. Therefore, in the simulation the attribute value for skyline was kept constant.

The reflection of changes in human parameters on physical parameters are assumed to take place on beach width, beach color, water color, vegetation cover and seaweed parameters. Therefore, in the simulation attribute value two for beach width, three for beach color, four for water color, vegetation cover and seaweed are assigned.

With the lower attribute values of some of the human and physical parameters Coastal Scenic Evaluation was carried out for Çıralı and results are presented in Figures 14, 15 and 16. Calculated D value for the simulated case is 0,84. There is a significant drop from the original D value of 1,31. Çıralı will be a Class II site in the near future as the D value will be between 0,65 and 0,85. Top view illustrations of Çıralı for existing situation and the simulated case are given in Appendix D.

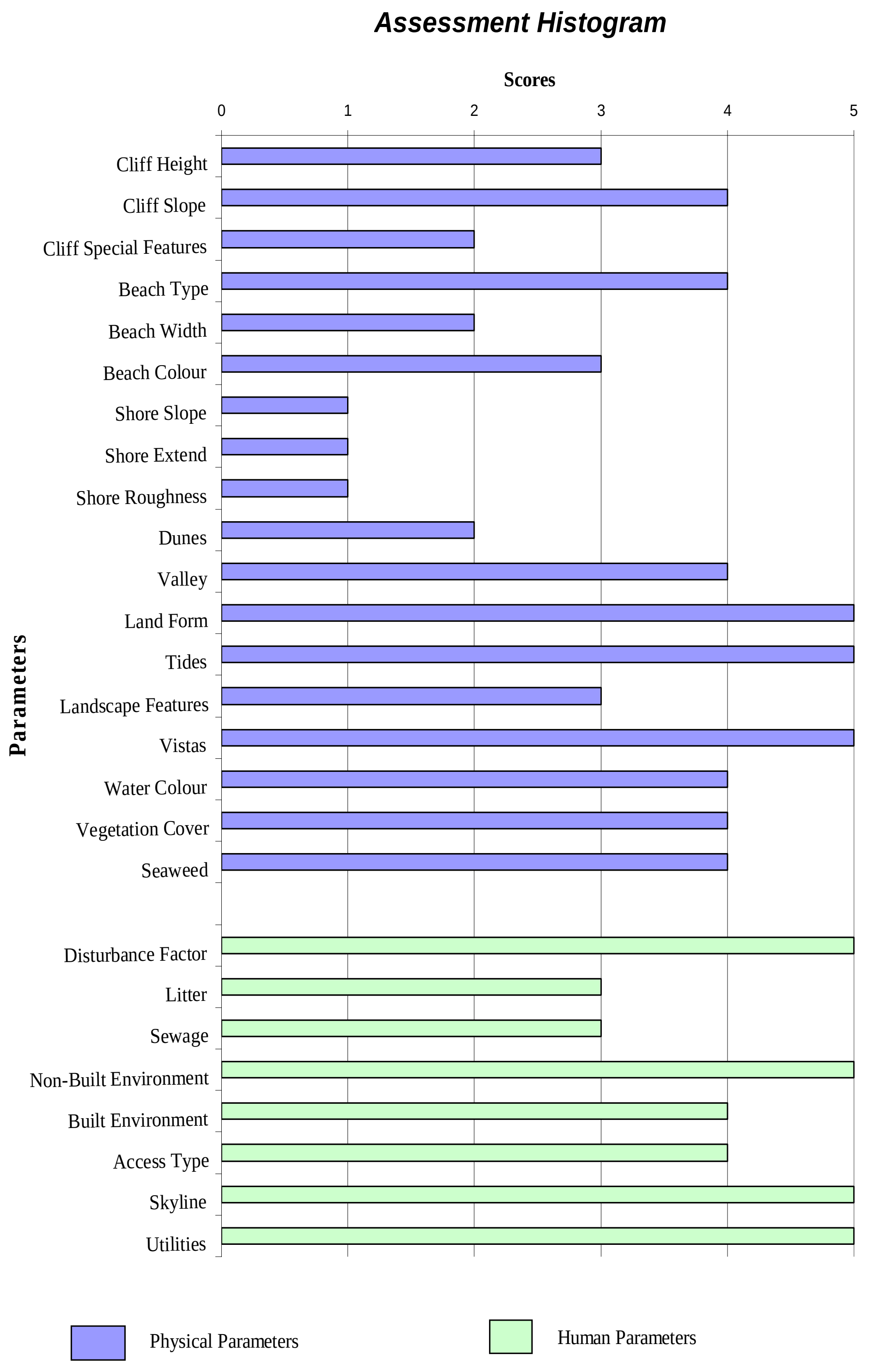


Figure 14. Scenic Evaluation Score Histogram for Çıralı (short term)

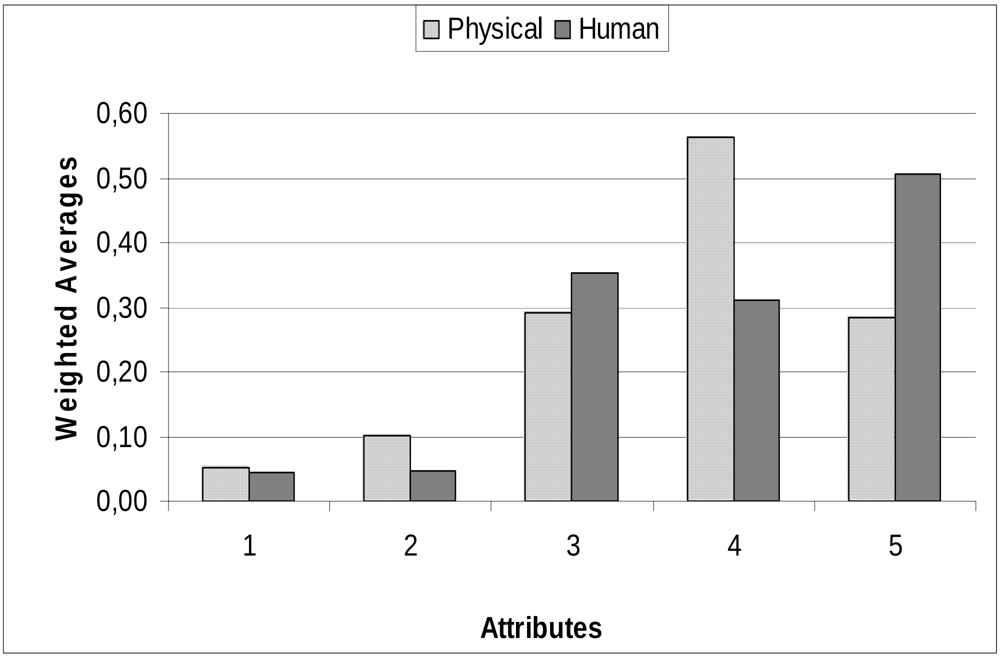


Figure 15. Weighted Averages Histogram for Çıralı (short term)

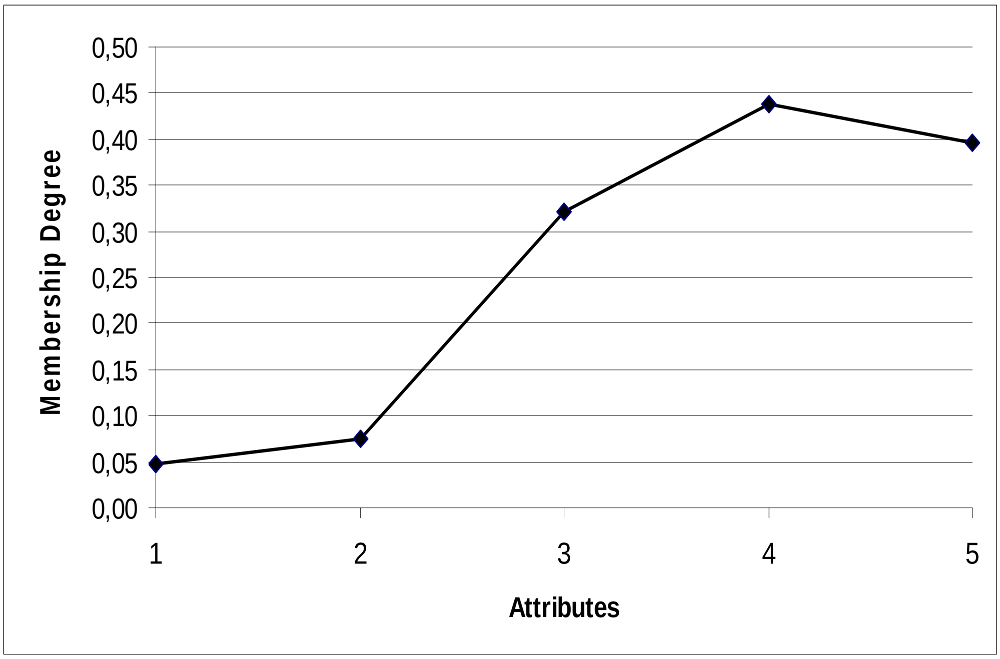


Figure 16. Membership Degree Curve for Çıralı (short term)

4.5 Çıralı in Long Term Under Current Trends

Another scenario was simulated by predicitng th future developments based on current trends. It is assumed that, in the long term development of Çıralı which will be a sustainable development, a balnce between the human usage and the natural sources will be kept to some extant.

In the development scenario, the number of restaurants at the seaside will probably increase. This will make Çıralı beach a bit noisier as they will play music for their customers. If we add the fact that Çıralı will become a more crowded place, in the simulation the attribute value of noise disturbance parameter was downgraded to four.

As for the litter parameter, it is assumed that, realizing the fact, there will be rules and regulations to control the litter. No one would travel a place where there are a lot of evidences of litter and sewage. I t is believed that necessary measurements will be taken by the municipality. Therefore, in the simulation attribute value of litter parameter is assigned as four.

Similarly, a coast where sewage is evident can not be a touristic place. So no change in sewage is assumed. Predicted attribute value of three for short term is assumed to be constant for long term simulation.

An important part of the land is now used for agricultural purposes. Because of the economical benefits which will come by developing tourism, the land around the pensions used for agriculture and also the kinds of the crops will decrease. As a result Çıralı will have the grade three for non-built environment in long term.

For the built-environment parameter, developments are parallel to the non-built environment. If Çıralı is not protected against over building with laws and nature-friendly development plans, new pensions -and maybe some small hotels- will be built. With its light tourism Çıralı will have the attribute value three in long term.

It would be very pessimistic if it is said that there will be traffic in Çıralı under current trends. Topography does not give permission to heavy traffic in Çıralı. Highway is passing seven km distant from Çıralı and it is impossible to construct a new highway passing through Çıralı. Çıralı is a seperate place and source of cars are not independent from Çıralı's visitors or local people. As we assume Çıralı will not have heavy tourism and protection will somehow continue, not only heavy but also light traffic is not ecpected in long term under crrent trends. It is also assumed that parking of cars at the beach will be contralled. So, the grade for access type can stay as four.

In accordance with the above possible developments in long term, some additional facilities and houses may be built at the foot of the mountains backwards. These buildings will not hide the natural features of the skyline, but below the skyline these small buildings will strike viewer's eyes. Grade for skyline will drop to four in long term for Çıralı.

After sunset, it is a problem to walk between Çıralı and Olimpos because of dark. Some street lamps will probably be placed especially at the southern parts of the Çıralı coast. Also a small pier is assumed to be built at the southern edge where the yachts are coming with their tourists. These two utilities corresponds to attribute 3 for the utilities parameter.

The reflection of changes in human parameters on physical parameters are assumed to take place. In the simulation attribute values of beach color, dunes, water color, vegetation cover and seaweed are downgraded from the attribute values in short term by one. Therefore, two for beach color, one for dunes, three for water color, vegetation cover and saeweed are assigned in this scenario.

In this simulation, there will not be any human parameters having the attribute value five anymore in long term under current conditions as shown in Figure 17. Weighted averages histogram and membership degree curve for Çıralı in long term are given in Figures 18 and 19 respectively. For this simulation D value drops to 0,43 which is also a drop in the classification system. Under current trends, Çıralı will become a Class III site in long term. Top view illustration of Çıralı for long term is given in Appendix D.

As a consequence of the above given discussion, this result is a very important warning to the planners and managers. Çıralı will loose its high scenic value under current trends.

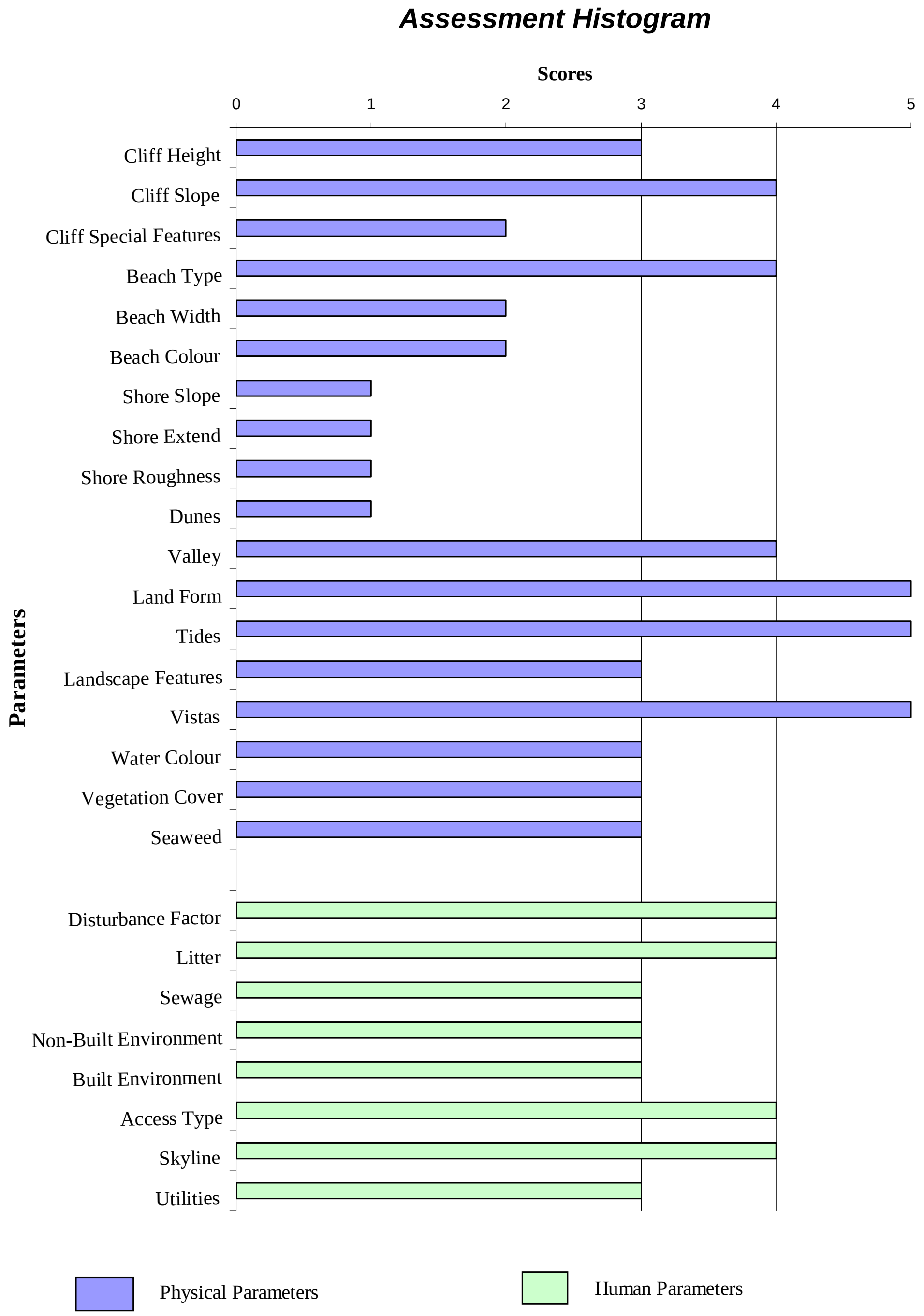


Figure 17. Scenic Evaluation Score Histogram for Çıralı (long term)

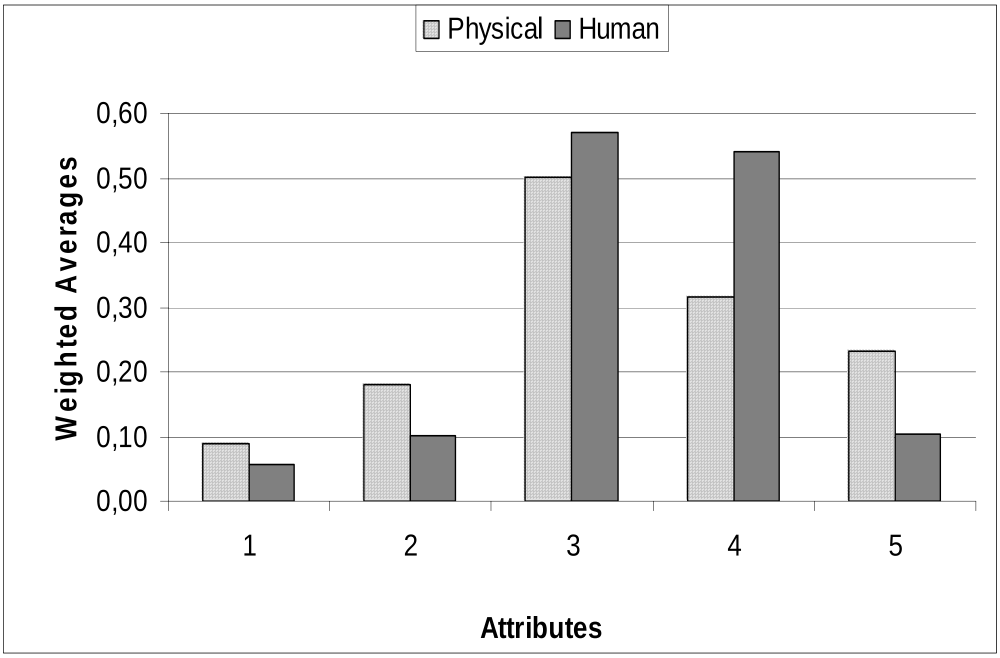


Figure 18. Weighted Averages Histogram for Çıralı (long term)

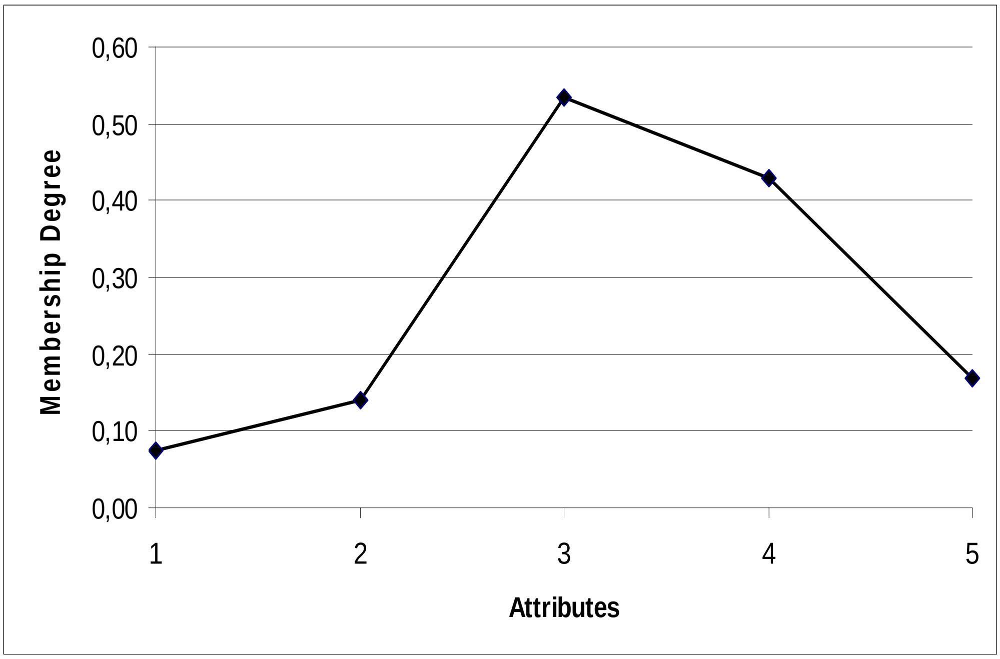


Figure 19. Membership Degree Curve for Çıralı (long term)

4.6 Çıralı Under Danger

In this section, it isassumed that protection on Çıralı is finished and Çıralı is not a Natural SIT area anymore. According to this scenario, economical benefits were imposed on Çıralı and the results are reflected on the development of Çıralı. In other words; in this simulation human usage parameters of Çıralı will be similar to exisitng situation in Kemer.

In this scenario not only restaurants but also discos and bars will be constructed and opened along the beach with large numbers in this worst condition. Çıralı will become more crowded with the increasing capacity of hotels. Also recreatioanal facilities will be inceased. All of the above developments will create a noise disrurbance in Çıralı. Therefore, two was assigned for the noise disturbance criteria in this simulation.

In a touristic place, some precautions must be taken for litter and sewage criterias as discussed before. The attributes of these parameters were assumed to be constant. Attribute value of litter was taken as four and attribute value of sewage was taken as three in this simulation.

It is assumed that tourism is heavily developed for this condition. Land is very valuable in Çıralı and touristic hotels and complexes are built everywhere for the economical benefits. Land is not used for agriculture anymore. This condition corresponds to grade one for the non-built environment parameter.

As for the built-environment parameter attribute value two was assigned in this simulation.

Parking will be a potential problem as Çıralı will become crowded. Therefore, in the simulation attribute value two is assigned for access type parameter.

The changes in the skyline parameter depends on the developments in the built environment criteria. Land will become very valuable and not only the flat lands but also the mountains will be covered with hotels. As a result skyline will become unattractive. And its attribute value will be two.

A yacht marina is assumed to be built which is consistent with the developing tourism. This development will decrease the attribute value to two from three for the utilities parameter.

The changes in human usage parameters are reflected on physical parameters same as before in the previous scenarios. Therefore, attribute values of beach width, beach color, water color, vegetation cover and seaweed parameters are all downgraded. In the simulation, one is assigned for beach width and beach color, two is assigned for water color, vegetation cover and seaweed parameters.

According to these developments in human and physical parameters; scenic evaluation score histogram (Figure 20), weighted averages histogram (Figure 21) and membership degree curve (Figure 22) are given. D value was calculated as -0,48 in this situation. If Çıralı is not protected as a Natural SIT area anymore, D value will be smaller than zero which will place Çıralı to Class V. Top view illustration of Çıralı for the simulated case is given in Appendix D.

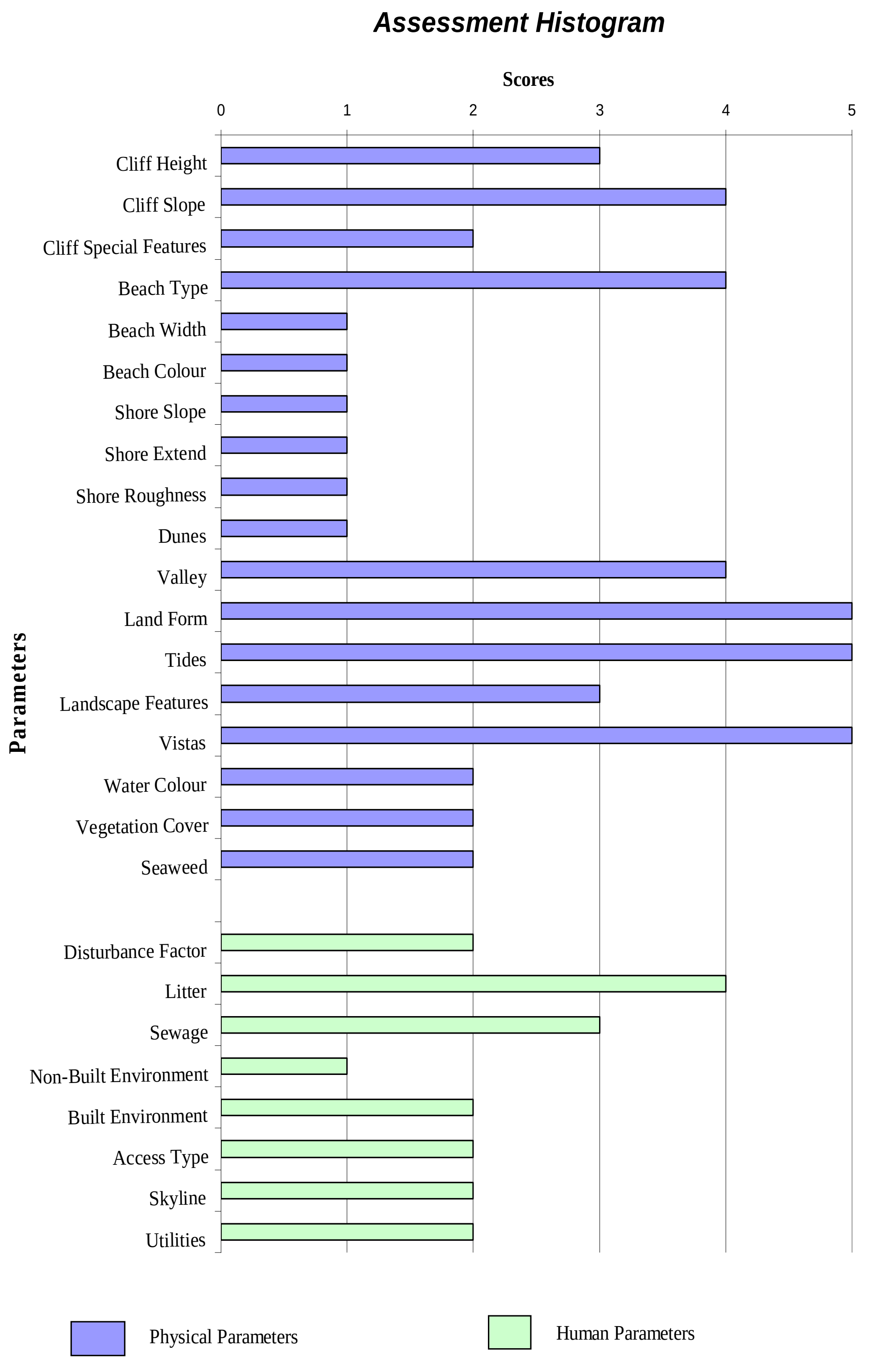


Figure 20. Scenic Evaluation Score Histogram for Çıralı (under danger)

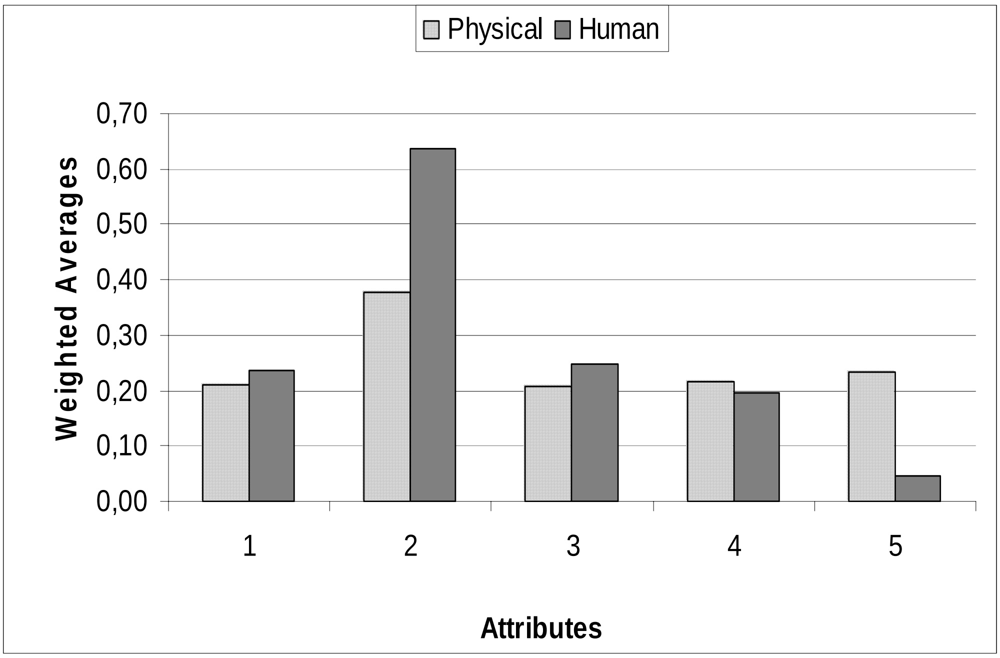


Figure 21. Weighted Averages Histogram for Çıralı (under danger)

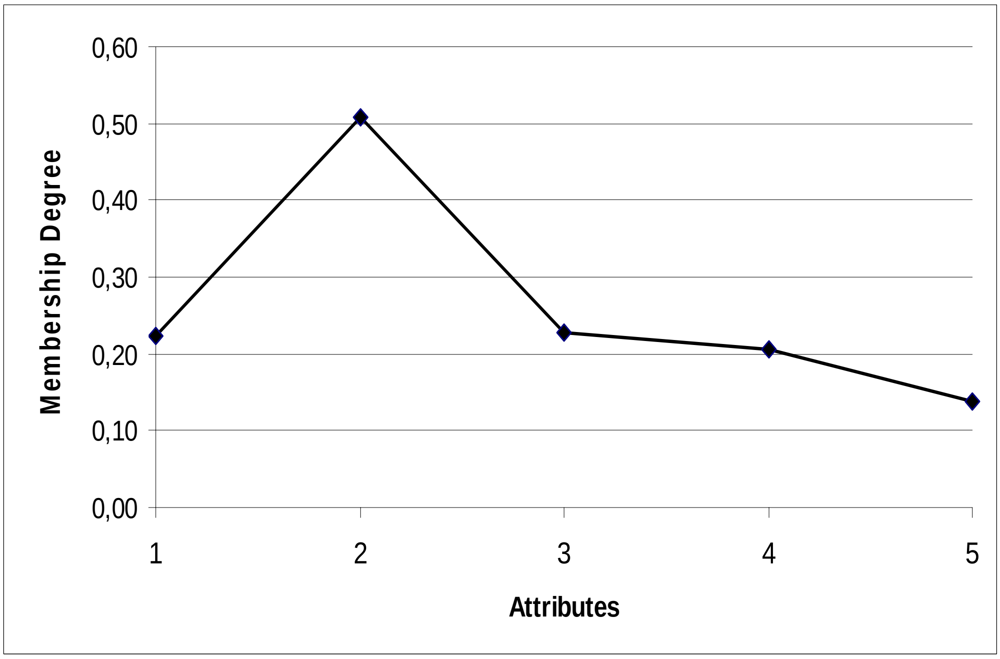


Figure 22. Membership Degree Curve for Çıralı (under danger)

4.7 A 'Special' Condition

There is a closed chrome mine quarry at the northern part of Çıralı. In this section it is assumed that production starts in this mine quarry. The effects of chrome mine quarry in use will be studied as an additional development to the conditions as described in Section 4.6.

In this scenaro, the attribute values of noise disturbance and non-built environment prameters were assumed to be constant. Similar assumptions of the previous section kept valid for noise disturbance. The grade for non-built environment was already one.

Over population will increase litter accumulation, so in this scenario simulation the attribute value of litter is downgraded to two.

The most important effect of the chrome mine will be on sewage and water color criterias. Water color is a physical parameter, but the sharp change in sewage parameter will obviously effect the water color. Here, the pollution because of the chrome mine is the case. The most suitable human parameter in the coastal scenic evaluation system for this kind of pollution is sewage, and simply studies are carried out on the sewage parameter.

By the restart of the production in the chrome mine quarry, compounds including chrome will mix with ground and underground water. As the mine is near to the coast, these compounds will reach to the sea in a short time.This pollution will vitally effect the flora and fauna. But the most obvious effect will be observed in the sea as the water color will get darker (in some examples reddish). Attribute value one is assigned for water color parameter. Also the attribute for sewage is decreased to one for this special condition.

Chrome mine production will be a sign of heavy industry in Çıralı. For the built-environment parameter attribute value one was assigned which corresponds to heavy industry.

Chrome mine quarry will effect the population in Çıralı with the newcoming employees. The mine quarry will necessitate the construction of new berthing piers and access roads. Therefore, in the simulation attribute value of access type parameter was assigned as one.

A small harbour is assumed to be built to meet the transportation needs of the chrome mine. The number of utilities will increase with this development and the grade for utilities parameter will be one.

The skyline will become very unattractive with the constructed industrial buildings. Attribute value one is assigned for the skyline parameter in this special condition.

The changes in human usage parameters are reflected on physical parameters, Attribute value of water color parameter was downgraded to one. In the simulation, attributes of vegetation cover and seaweed parameters are also downgraded to one.

For this scenario, scenic evaluation score histogram (Figure 23), weighted averages histogram (Figure 24) and membership degree curve (Figure 25) are given. The D value was computed as -0,82 and this corresponds to Class V. Top view illustration of Çıralı for the simulated case is given in Appendix D.

The special condition simulated for Çıralı has a very dramatic effect on the overall Coastal Scenic Beauty of Çıralı, where Çıralı existing as Class I drops down to Class V.

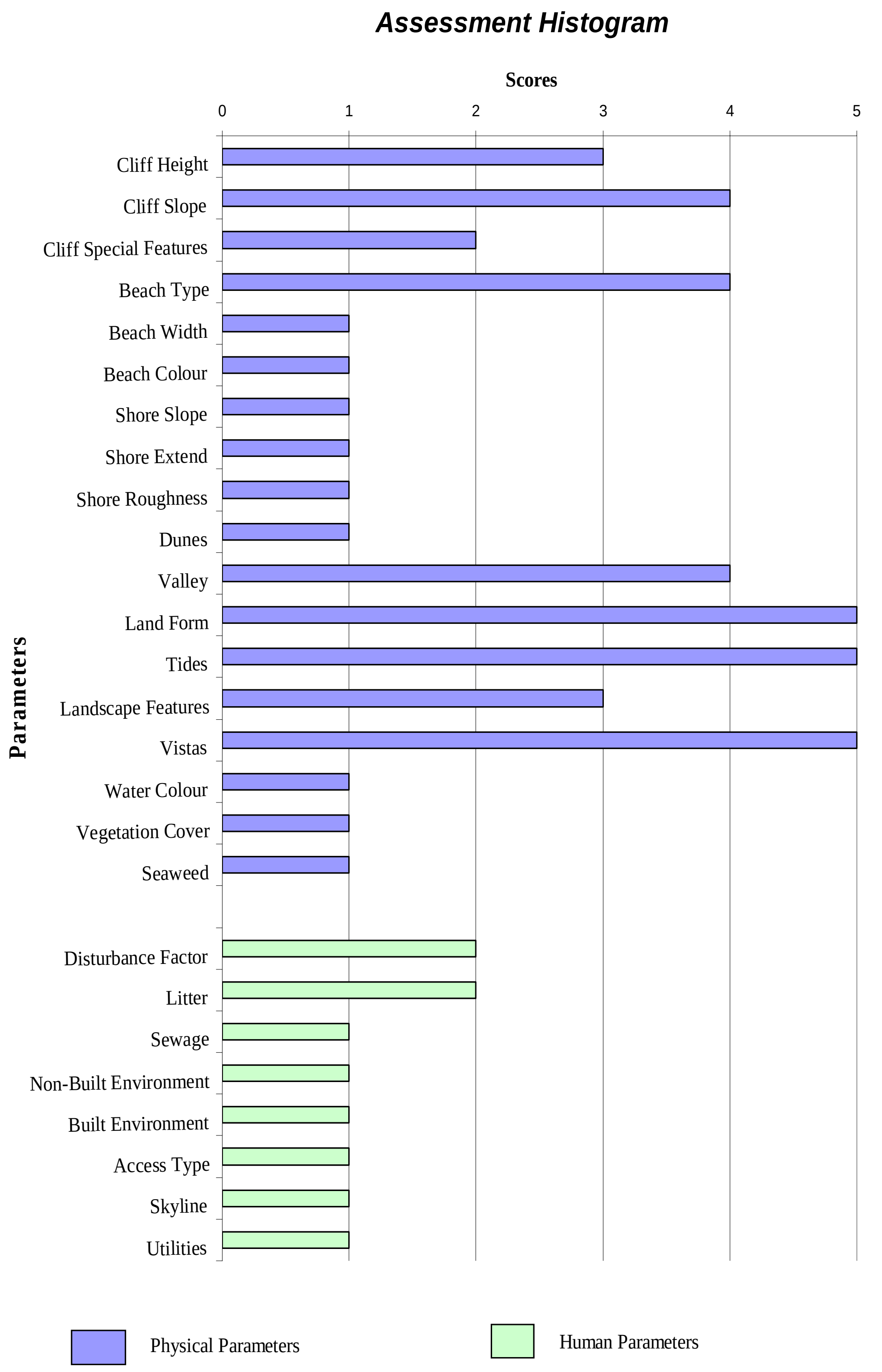


Figure 23. Scenic Evaluation Score Histogram for Çıralı ('special' condition)

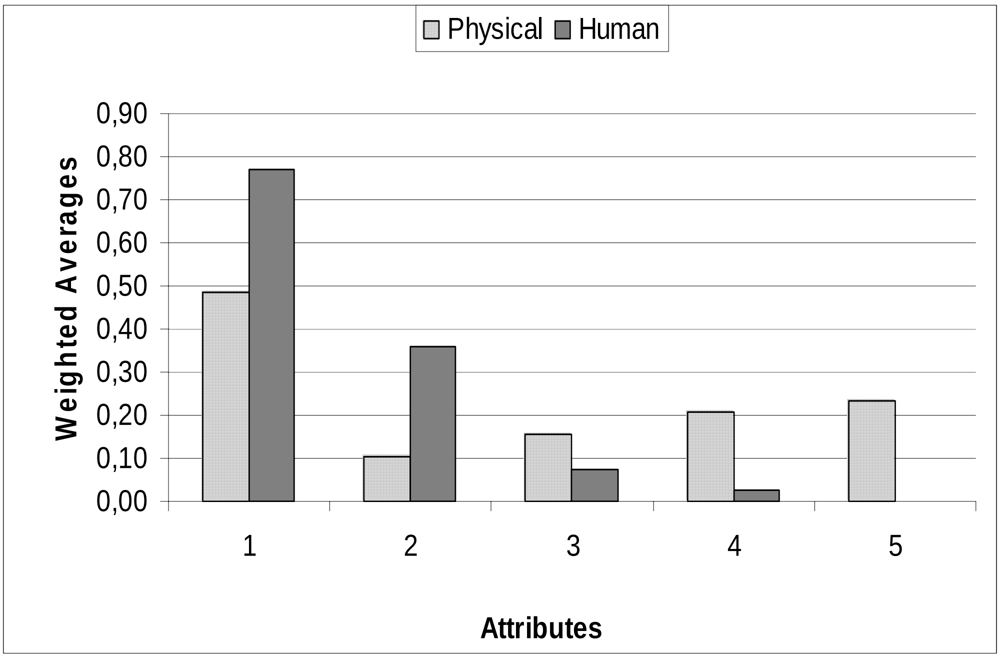


Figure 24. Weighted Averages Histogram for Çıralı (‘special’ condition)

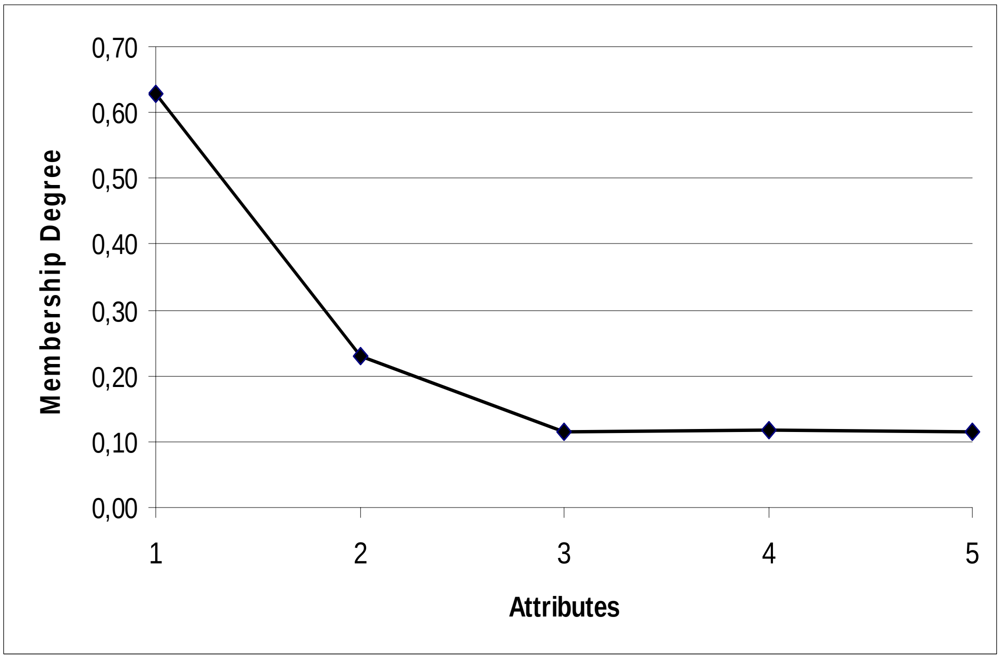


Figure 25. Membership Degree Curve for Çıralı (‘special’ condition)

CHAPTER 5

CONCLUSION

The methodology developed for coastal scenic evaluation using Fuzzy Logic Approach is a very useful tool in making future management plans for coastal areas. What will happen under current trend or in special conditions can be estimated using this tool.

An index value (D) which is specific for each coastal area is calculated using FLA and a classification is made on this basis. Coastal areas can have different places in this classification for different situations. The place of a coastal site in this classification methodology under different situations can also be predicted using FLA. For the pilot site, Çıralı, the calculated D values and corresponding classes for different conditions are summarized below:

Çıralı in Short Term Under Current Trends	0,84	Class II
Çıralı in Long Term Under Current Trends	0,43	Class III
If Çıralı is Not Protected	-0,48	Class V
If Production in Chrome Mine Quarry Restarts	-0,82	Class V

Although Çıralı is a protected site with a Natural SIT area status, Çıralı will loose its value under current trend in short term. It will continue to be a site with scenic beauty in short term, but D value will drop to 0,84 and Çıralı will become a Class II site.

If the restrictions and rules are not obeyed and protection is not strenghtened Çıralı will become a Class III site with a D value of 0,43 in long term.

If protection on Çıralı is completely removed and Çıralı is not a Natural SIT area anymore, Çıralı will fall two steps more in the classification methodology and become a Class V site.

There is a closed chrome mine quarry at the northern part of Çıralı. The effects of the restart of production in this mine quarry is also analysed and it is found that Çıralı will have a D value of -0,82 which is a dramatic drop. Çıralı will appear as a Class V site if production restarts in the mine quarry..

Çıralı is a Class I site, because it was protected. 20 years ago Kemer was also a very beautiful site. Today, Kemer is a Class IV site, because it was not protected and the coastal sources in Kemer were exploited for economical benefits. That’s why, protection on Çıraı should continue.

Under current trend, Çıralı is getting worse in human usage. So, continuation of protection on Çıralı is not sufficient. Protection on Çıralı should be strenghtened, existing rules must be obeyed and some additional restrictions should be taken.

Human parameters are the dominating factors in the coastal scenic evaluation system and simulations are mainly carried out by working on these parameters. The main aim of this study was to show the possible effects of human usage on coastal sites. Misuse or exploitation of coastal sources will decrease the value of the coastal area, and as a result, the natural beauties will loose their attractiveness. At the end, importance should be given to the results of this study as they are very important warnings to the planners and managers.

REFERENCES

1. Ambala V. P. (2001) “Analytical Structures and Analysis of Fuzzy PD Controllers with Multifuzzy Sets Having Variable Cross-Point Level”, Fuzzy Sets and Systems, 129, 311- 334

2. Briggs D.J., France J. (1980) “Landscape Evaluation: A Comparative Study”, J. Environmental Management, 10, 263-275

3. Buyoff G.J., Arndt L.K. (1981) “Interval Scaling of Landscape Preference by Direct and Indirect Measurement Methods”, Landscape Planning, 8,257-267

4. Çakır D. (2004), “Evaluation of Coastal Scenic Parameters; Pilot Study for Selected Coastal Area Antalya Konyaaltı Beach”, Ms. Thesis, METU, Ankara, Turkey

5. Countryside Commission (1993) “Landscape Assessment Guidance”, CCP423, CC., Cheltenham, Gloc. UK

6. Countryside Council for Wales (CCW) (2001) “The LANDMAP Information System”, 1st edition, Countryside Council for Wales

7. Dubois D., Parade H. (1979) “Fuzzy Sets and Systems: Theory and Applications”, Academic Press

8. Eletheriadis N., Tsalikidis I., Manos B. (1990) “Coastal Landscape Preference Evaluation; A Comparison among Tourists in Greece”, Environmental Management, 14(4), 475-487

9. Ergin A., Karaesmen E., Williams A.T., Micallef A., Karakaya S.T., Dedeoglu M. R. (2003) “Turkish Coastal Scenery Evaluation: The Application of Fuzzy Logic Mathematics at Selected Sites”, Electronic publishing (CD Rom), Paper 164, (13 pages), Proc. of the 6th International Conference on Coastal and Port Engineering in Developing Countries, "Engineering the Coastal Environment”, COPEDEC VI, The Permanent

Secretariat of COPEDEC, c/o Lanka Hydraulic Institute, John Rodrigo, Mawatha, Katubedd, Morutuwa, Sri Lanka

10. Ergin A., Williams A. T., Micallef A. (2002) “Coastal Scenic Assessment at Selected Areas: Turkey, UK, Malta”, BC Project Interim Report
11. Ergin A., Williams A. T., Micallef A. (2003) “Coastal Scenic Assessment at Selected Areas: Turkey, UK, Malta”, BC Project Final Report
12. Ergin A., Williams A.T., Micallef A., Karakaya S.T. (2002) “An Innovative Approach to Coastal Scenic Evaluation”, (In),‘Beach management in the Mediterranean and Black Sea’, (ed). E. Ozhan, 215-226, Medcoast/METU, Ankara, Turkey
13. European Landscape Conference Final Conclusive Announcement (December 9, 2003)
14. Fines K.D. (1968) “Landscape Evaluation; A Research Project in East Sussex. Regional Studies”, 2, 41-55
15. Kandel A. (1986) “Fuzzy Mathematical Techniques with Applications”, Addison Wesley
16. Kaplan R., Kaplan S. (1989) “The Visual Environment: Public Participation in Design and Planning”, Jn. Social Issues, 45(1), 59-86
17. Leopold L.B. (1969) “Quantitative Comparisons of Some Aesthetic Factors Among Rivers”, US. Geol. Survey Circ, 620, 16pp
18. Linton D.L. (1968) “The Assessment of Scenery as a Natural Resource”, Scottish Geographical Magazine, 84, 219-238
19. Linton D.L. (1982) “Visual Assessments of Natural Landscapes”, Western Geographical Series, 20, 97-116
20. Penning-Rowsell E.C. (1982) “A Public Preference Evaluation of Landscape Quality”, Regional Studies, 16, 97-112
21. Penning-Rowsell E.C. (1989) “Landscape Evaluation in Practise – A Survey of Local Authorities”, Landscape Research, 14(2), 35-37

22. Uçar B. (2004), “Coastal Scenic Evaluation by Application of Fuzzy Logic Mathematics”, Ms. Thesis, METU, Ankara, Turkey

23. Williams A.T. (1986) “Landscape Aesthetics of the River Wye”, Landscape Research, 11(2), 25-30

24. www.cirali.org.tr

25. Zadeh L. (1965) “Fuzzy Sets”, Information & Control, 8: 338-353

26. Zube E.H., Pitt D.G. (1981) “Cross Cultural Perceptions of Scenic and Heritage Landscapes”, Landscape Planning, 8, 69-87

APPENDIX A

DEFINITIONS OF COASTAL SCENIC PARAMETERS

Cliff:

A high (>5m) area usually composed of rock with a > 45˚ slope.

- Banding : the cliff can be composed of various layers of rock e.g. alternate shale and limestone.
- Colour : Various colours can differentiate the bands.
- Faulting : Where earth movements have displaced the rock bands so that a line can be seen (fault line) which has shifted the layers on either side.
- Folding : Where the rocks have been under pressure and have folded to accommodate the pressure. Folding can be gentle of severe.
- Gullying : Rain can form gullies/rills along which cliff materials can be washed away.
- Indentation : The shape of the cliff edge. It could be straight or curved, the more curved, the more highly indented the cliff face.
- Scree : Accumulation of rock material at the foot of, or mantling cliff slopes.
- Tufa : A deposit of calcareous material on a limestone cliff face due to water seepage.
- Unconformity : represents the junction between two sets of rocks formed under different geological ages.

Beach Face:

The area between the water’s edge and the back of beach. The latter could be a wall, dune, building etc.

Rocky Shore Platform :

An area of rock with a smaller than 45 degree slope. Formed by shore processes, especially wave action.

Dunes:

Foredune: The main dune adjacent to the beach. Frequently termed yellow dunes.

Secondary dune ridges: Located behind the foredune and representing old foredunes that have been colonised by plants. There may be many ridges and they are loosely called grey dunes.

Valley and River Mouth:

A valley is a V shaped landscape feature formed by flowing water. If no water is present, it is termed as a dry valley.

Landform:

Landform represents the distant land form type or in the side view of the coast.

Tides:

Tide is the alternating rise and fall in sea level with respect to the land, produced by the gravitational attraction of the sun. And more impoortantly, the moon.

Coastal landscape features:

Peninsula/headland is an area of land taht juts out into water which covers three sides.

A **bay** is the reverse of the above an area of water bordering land on three sides.

A **cave** is a hollow in a cliff face that can be caused by wave action, rock slippage, weathering, faulting etc. Where the cave breaks through a cliff headland it is called an arch.

A **lagoon** is a stretch of comparatively shallow salt/fresh water seperated from the sea by a shallow or exposed sandbank, coral reef, shingle beach or similar structure.

A **sandbank** is a mound of and located offshore which is exposed to the air. If completely submerged it is a sand bar.

A **stack** is steep, often vertical, sided column of rock in the sea formed as aresult of collapse of an arch (see cave above).

A **tombolo** is a deposition landform (usually sand or shingle) which connects an island to the shore.

A **delta** is a land usually a triangular in shape, formed by deposition of riverine sediment where a river enters the sea.

An **estuary** is an area of water bounded on one side by marine water and the other side by riverine input. It is the junction zone between salt/fresh water.

A **reef** is a degraded stack located at oir beneath sea level.

A **window** occur if cave(s) carve through a headland above the water line resulting a hole through the cliff.

Vistas:

It is related to far off views. For example a site could be enclosed on 4 sides, so no far off views can be seen. Alternatively it could be open on 1 or more sides. A far vista is where the foreground hill has another secondary background feature visible; e.g. a higher hill/mountain.

Water colour & clarity:

The colour of the ocean is determined by the interactions of incident light with substances or particles present in the water. The most significant constituents are free floating photosynthetic organisms (phytoplankton) and inorganic particulates. Clarity is related to whether sea bedcan be seen or not. Nutrient free waters tend to have the best clarity.

Natural vegetation cover:

It represents the flora of the coastal area vicinity, close enough to affect the beach and beach users visually and etc.

Vegetation debris:

Seaweed refers to the large marine algae that grow almost exclusively in the shallow waters at the edge of the world's oceans. Excessive seaweed accumulation in the coast represents unattractive views to beach users most of the time.

Disturbance Factor:

Relates to the noise factor on thr beach, e.g. playing of radios, jet skies, heavy traffic, etc.

Litter:

This is anthropogenic generated discards and includes building rubble. Examples are beer cans, sweet wrappers, plastic bags, sewage etc. Accumluations represent piles of these materials, Measurement surveys are usually carried out over a 100 m stretch of beach site

Non-built environment:

Rural areas, few buildings

Skyline:

The silhoutte of buildings on the skyline. They are in harmony with the environment if building lines are of the same height as the tree cover etc. Discord exists if they stand out from the surroundings.

Sewage:

Human/ animal waste products.

Utilities:

These include items such as power lines, telegraph lines/ poles, roads, etc

Access Type:

Buffer zone. An area that divides two seperate entities. For example, a grass/tree lined street that seperates a beach from a coastal road.

Built Environment:

The urban environment. It could include heavy industries (steel works, plants, etc); light industries.

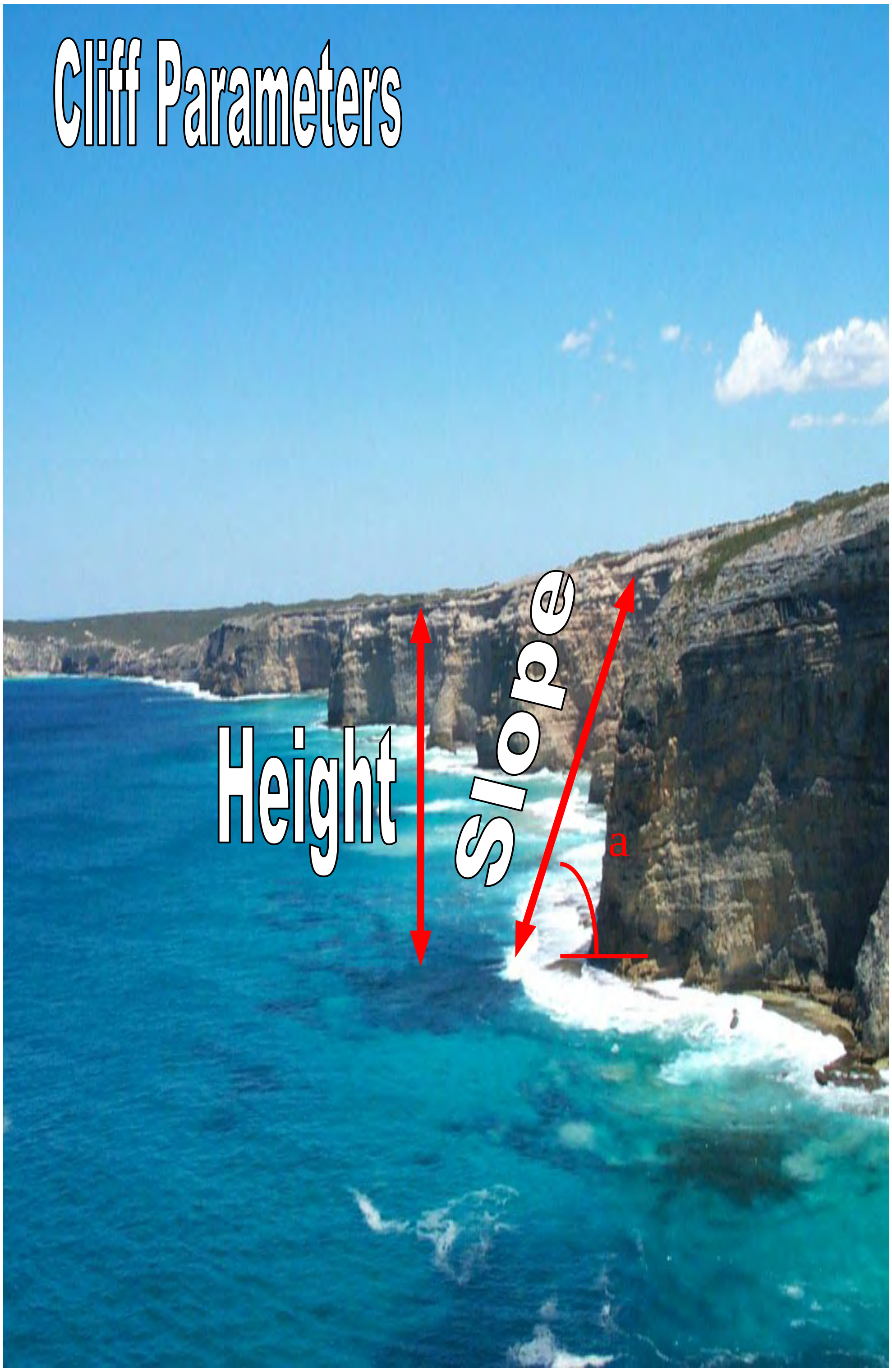


Figure A1. Cliff Parameters; Height and Slope

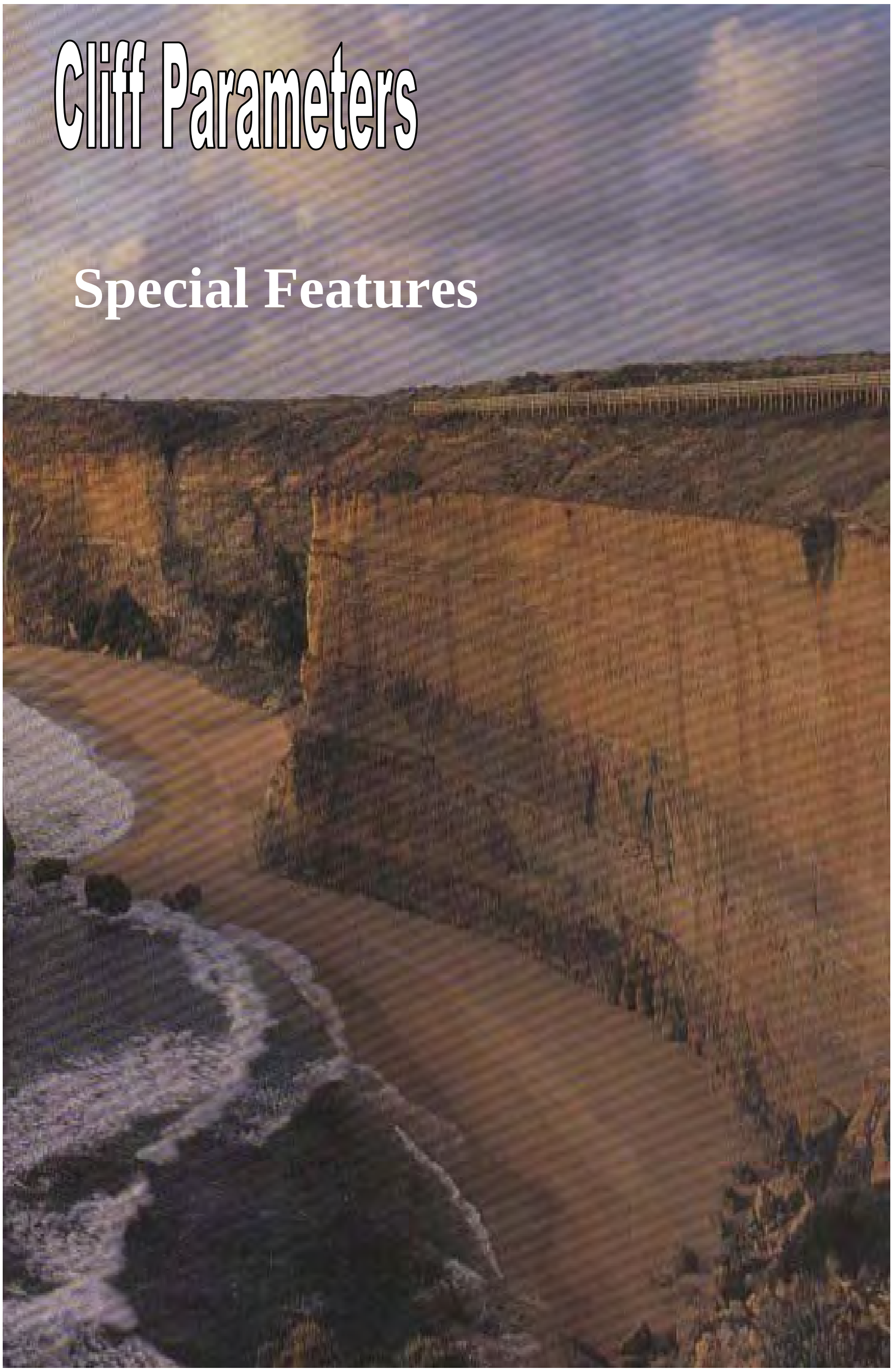


Figure A2. Cliff Parameters; Special Features

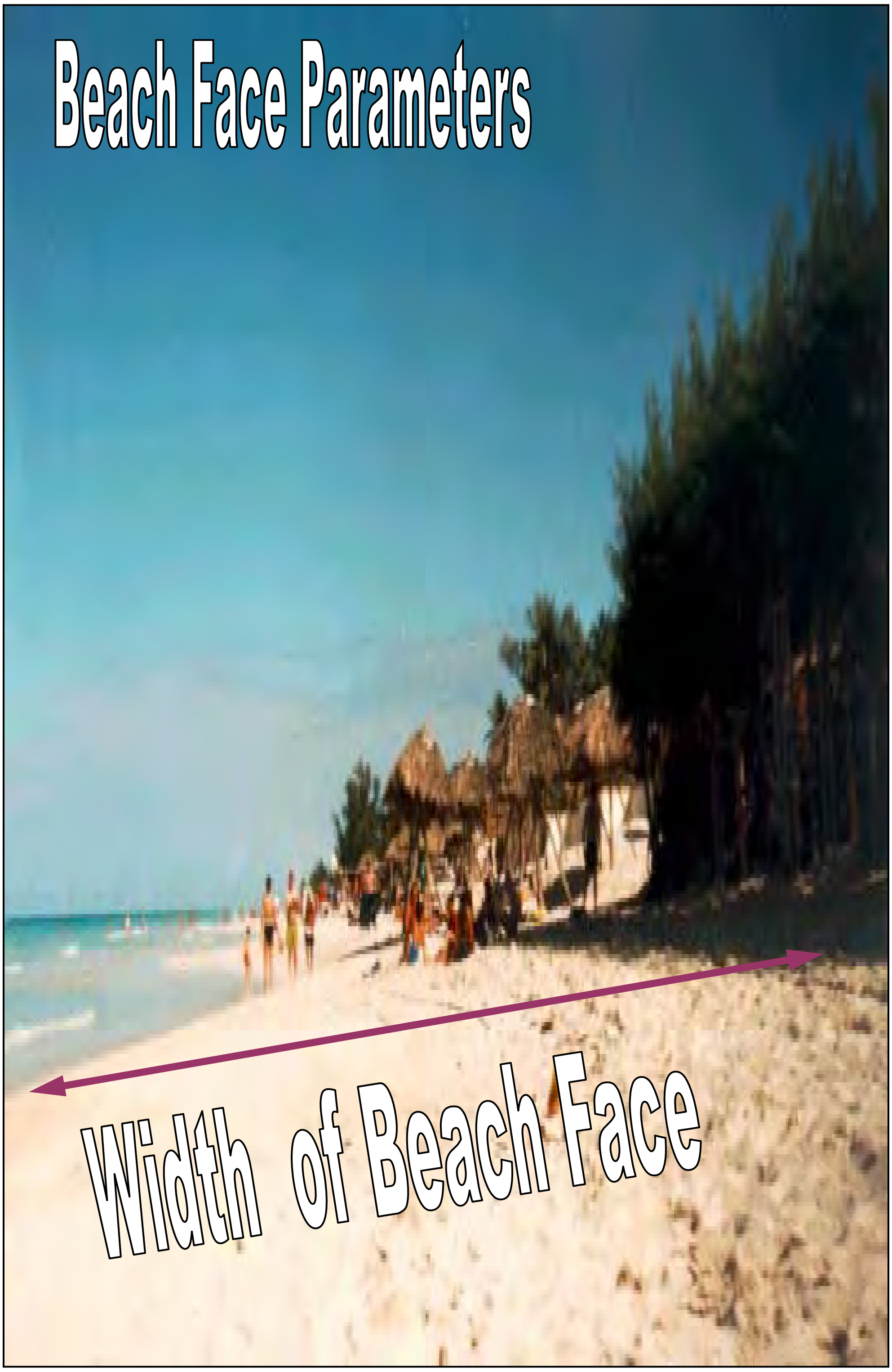


Figure A3. Beach Face Parameters; Type, Width, Color

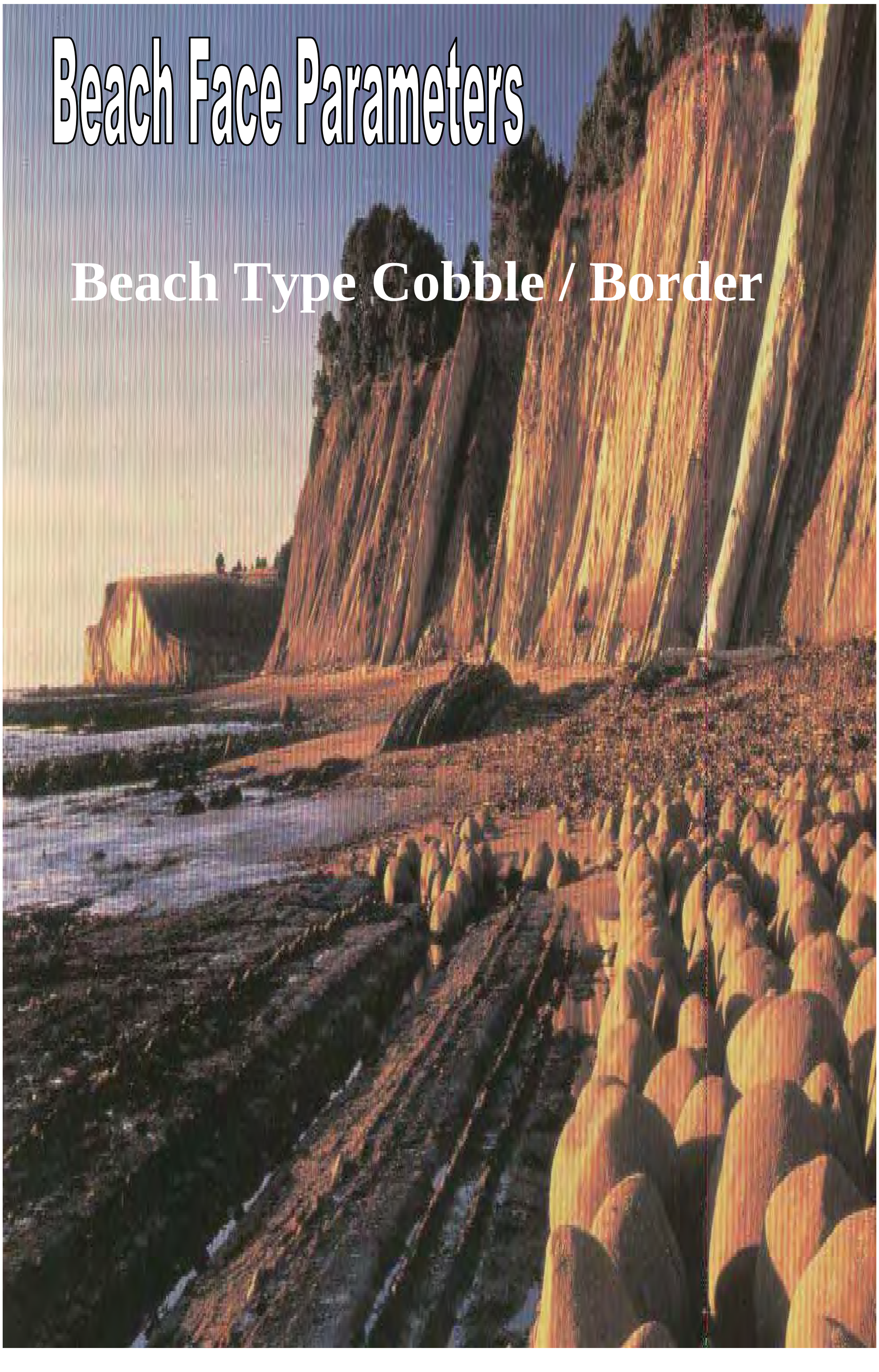


Figure A4. Beach Face Parameters; Beach Type Cobble/Border

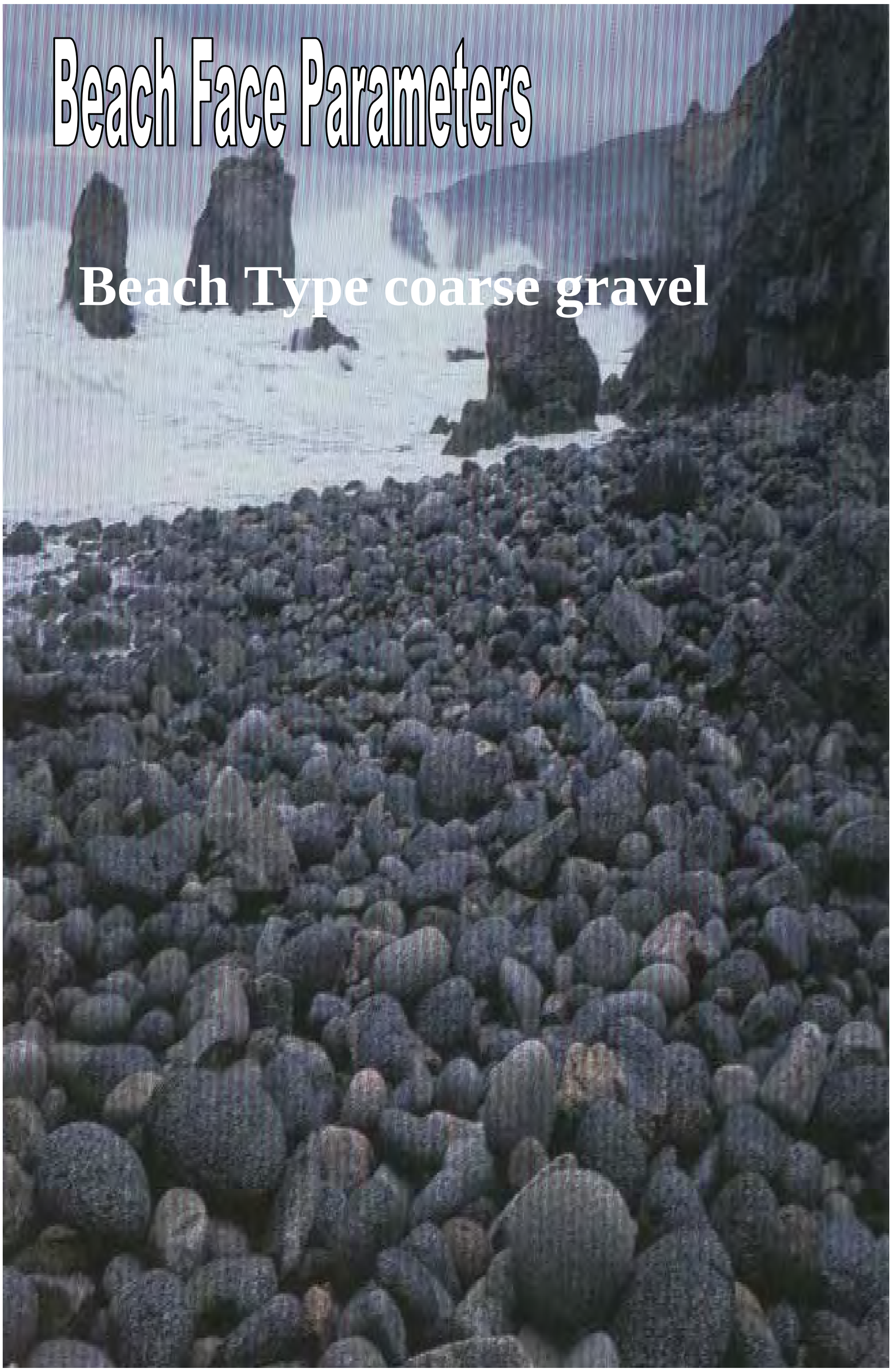


Figure A5. Beach Face Parameters; Beach Type Coarse Gravel

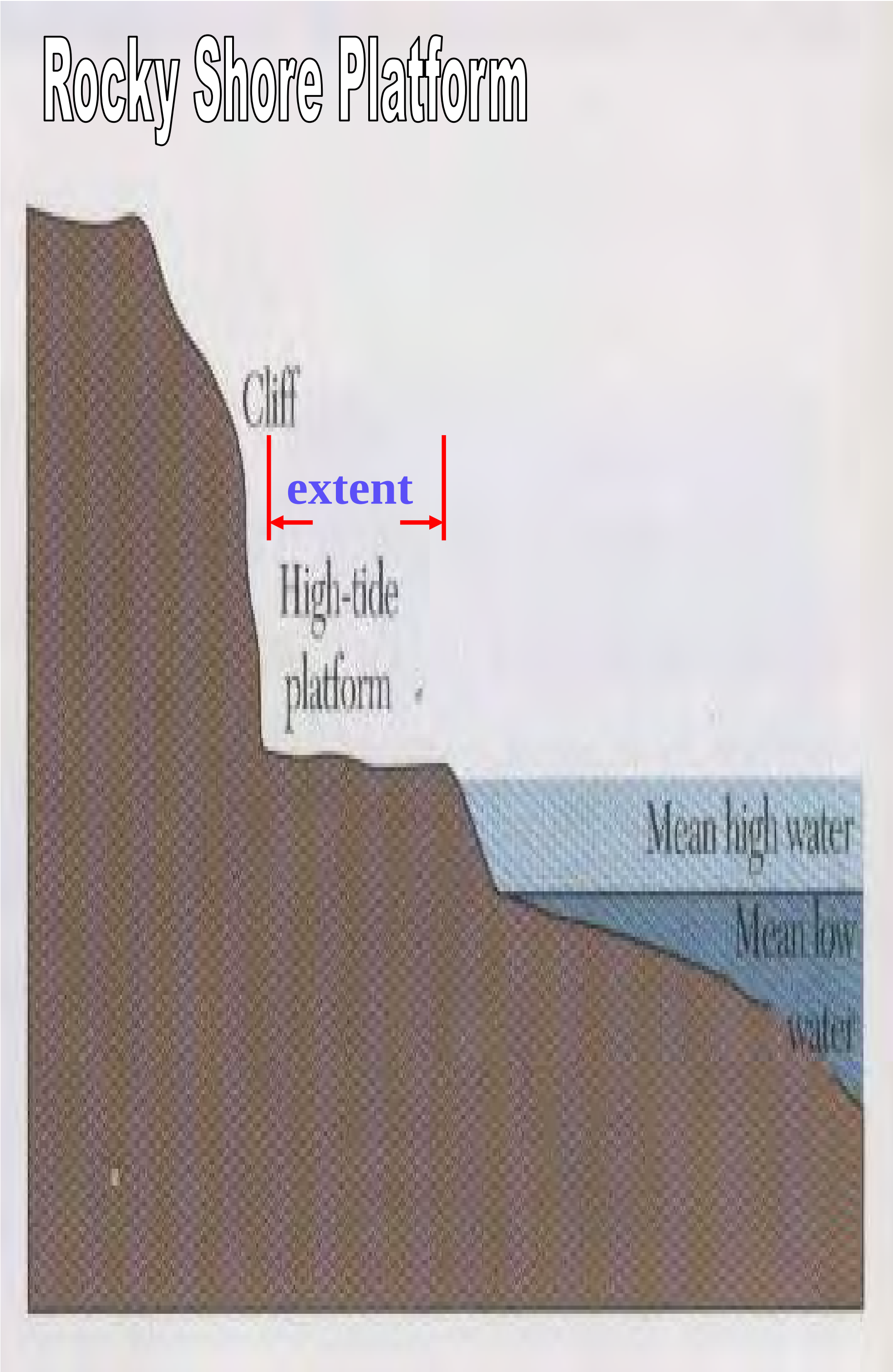


Figure A6. Rocky Shore Platform Parameters; Extent

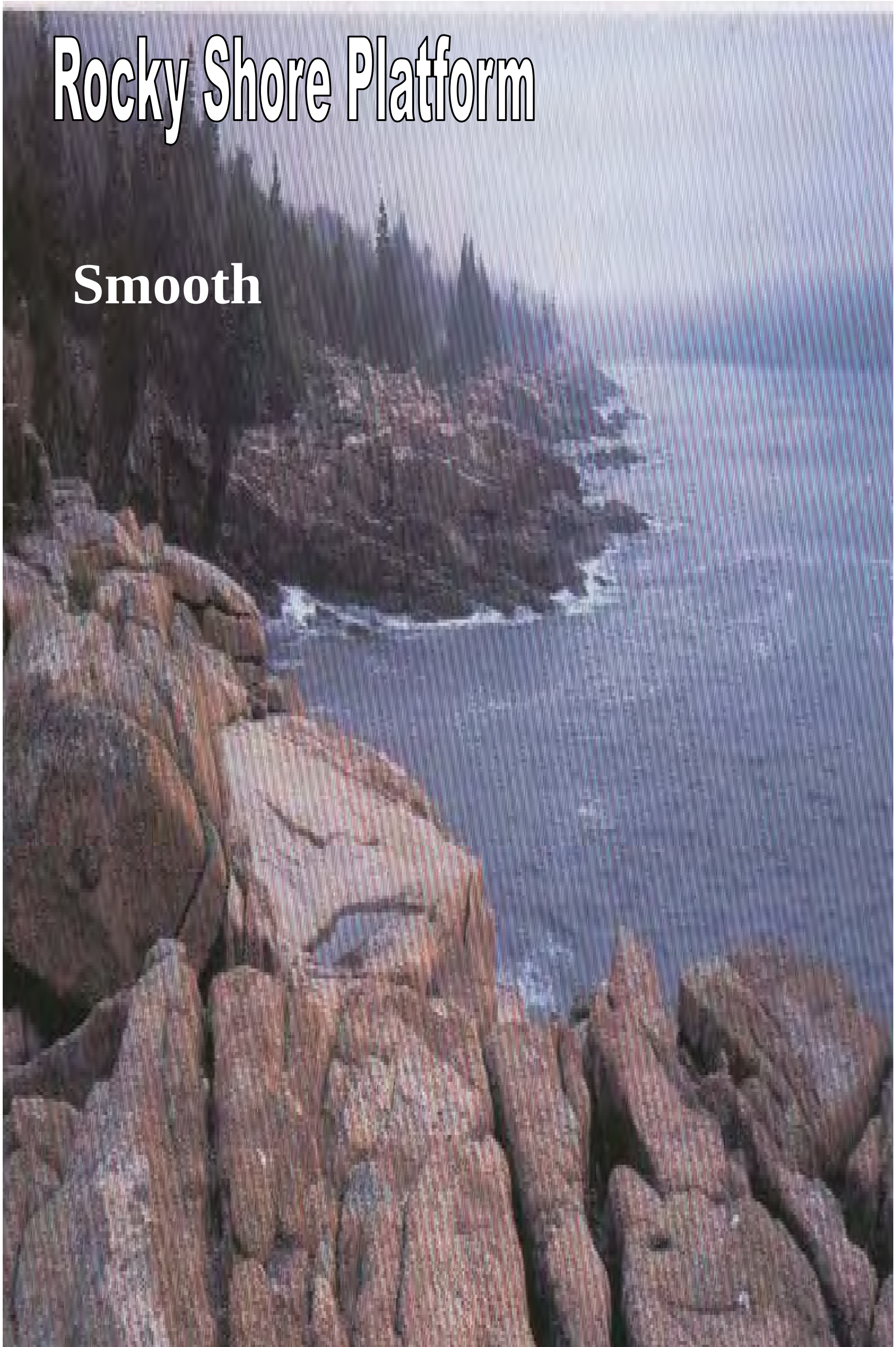


Figure A7. Rocky Shore Platform Parameters; Smooth

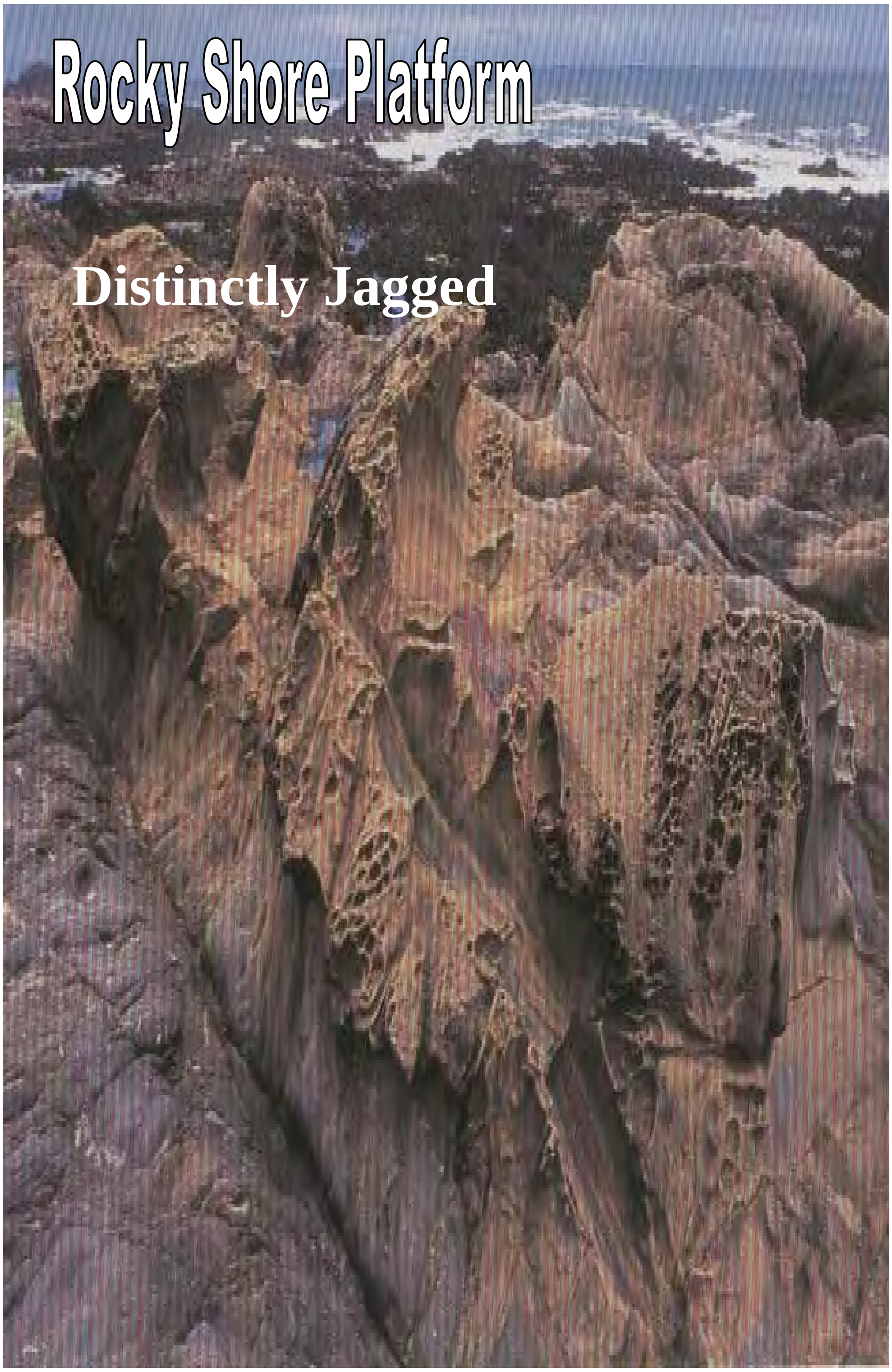


Figure A8. Rocky Shore Platform Parameters; Distinctly Jagged

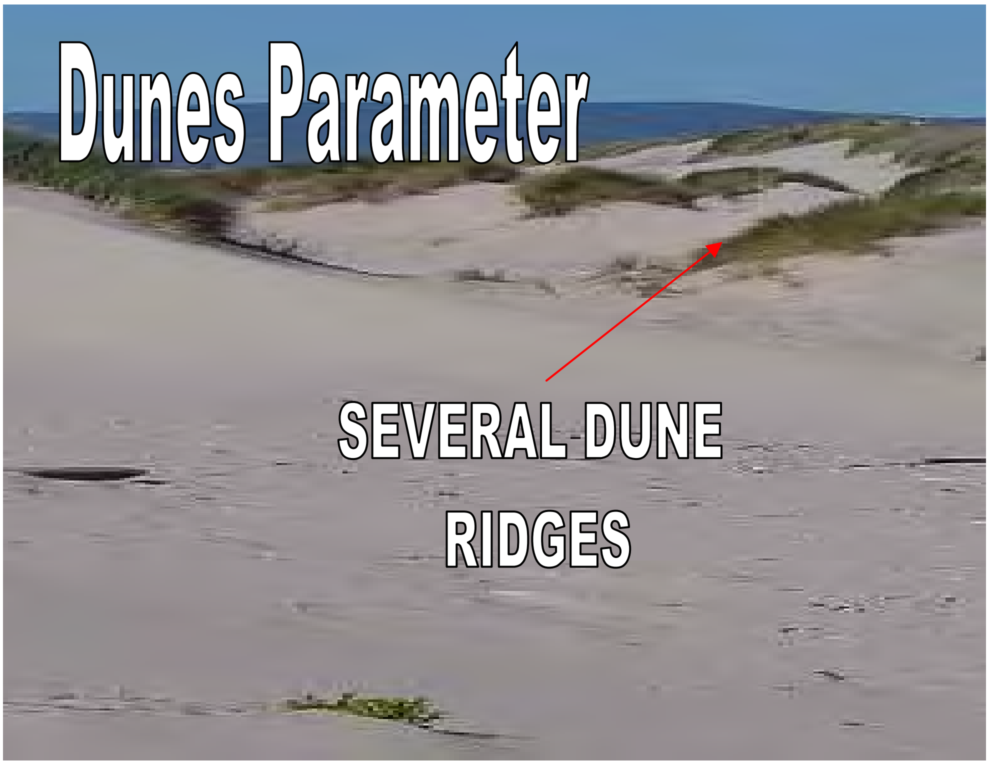
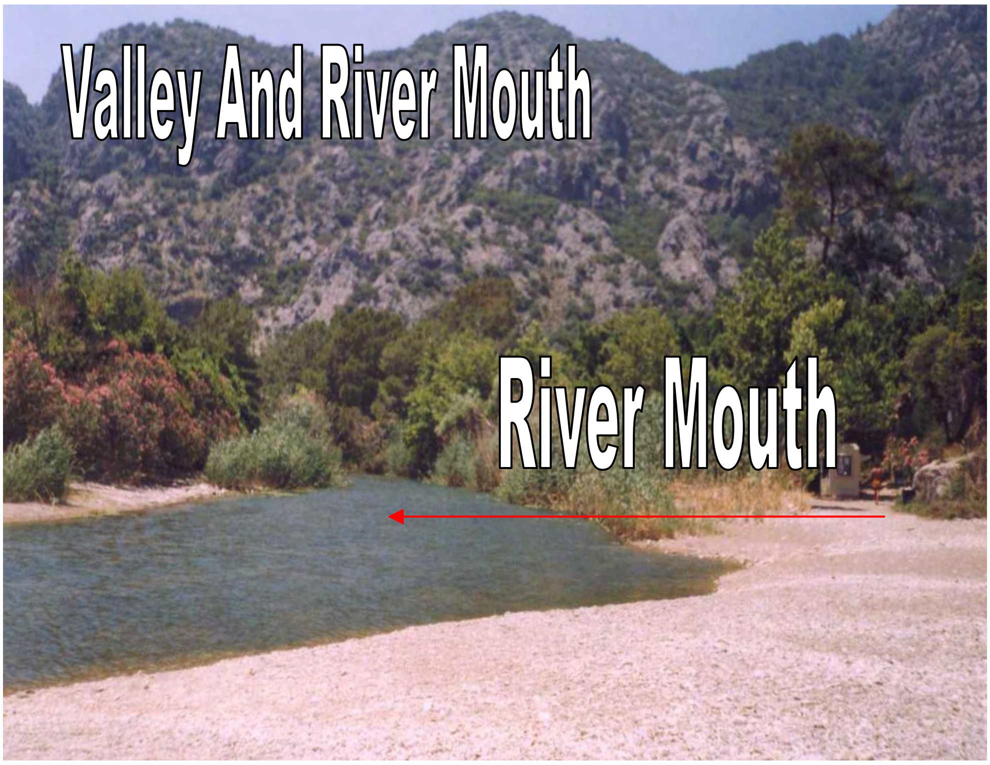


Figure A9. Dunes Parameter; Several Dune Ridges and Foredune



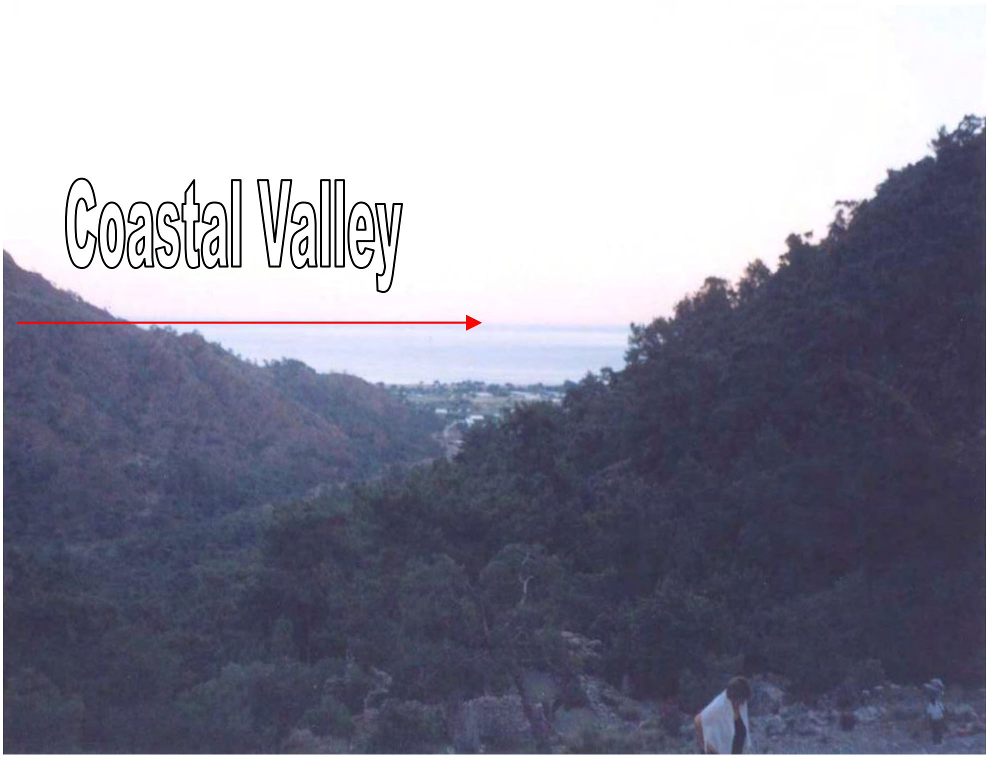
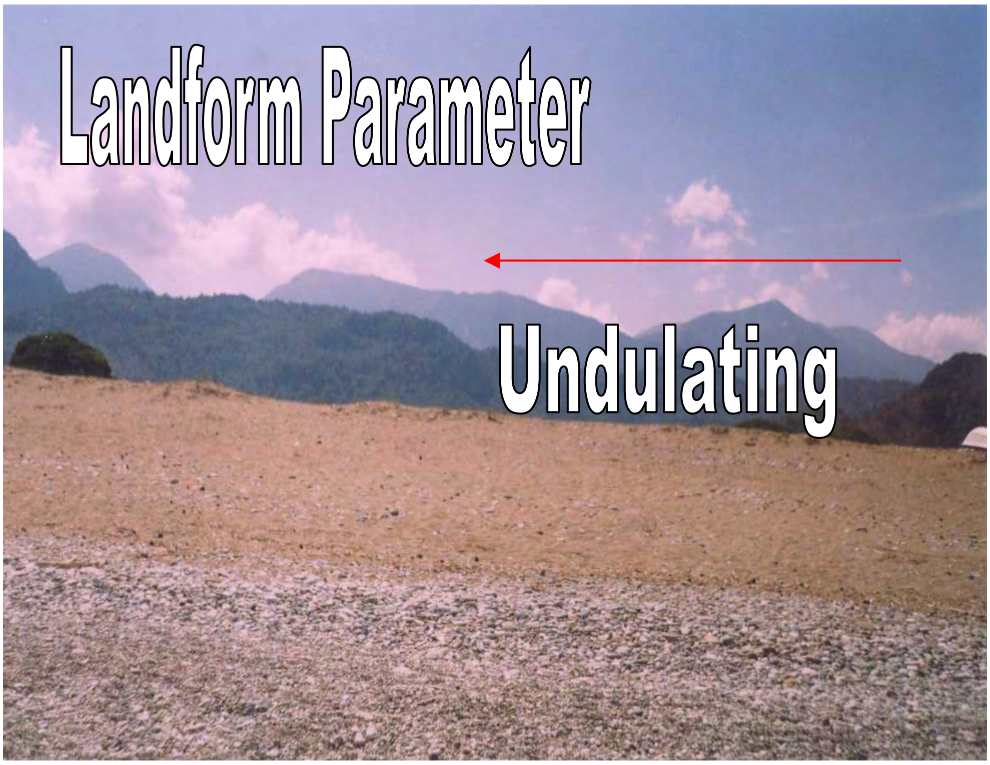


Figure A10. Valley and River Mouth



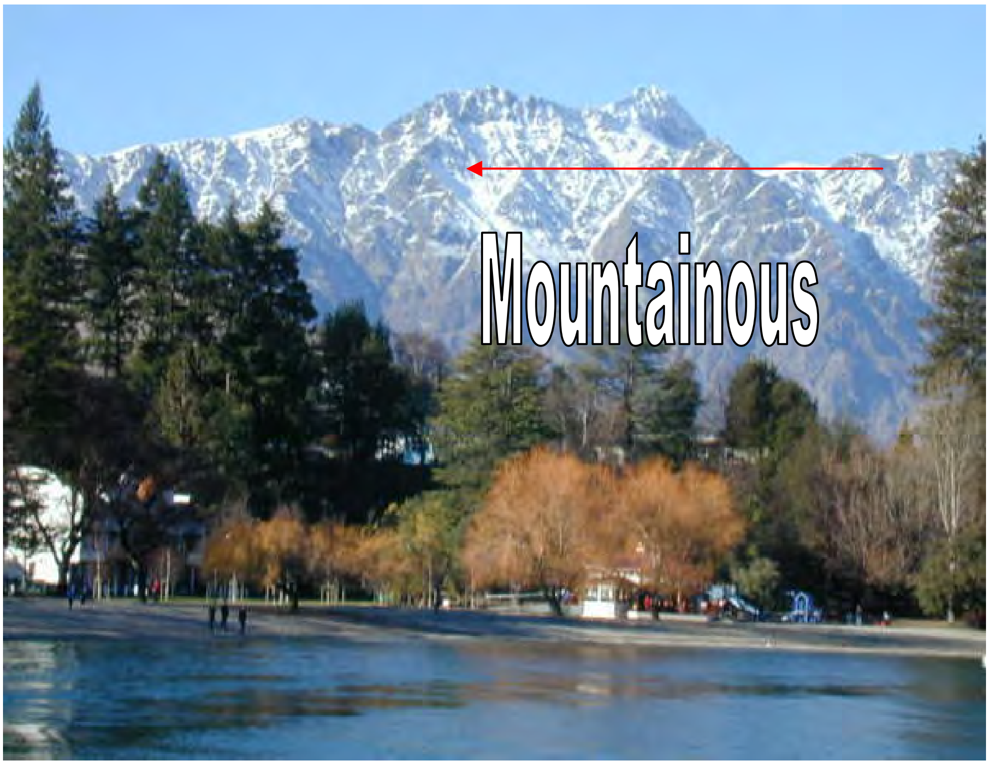


Figure A11. Landform Parameter; Undulating, Mountainous

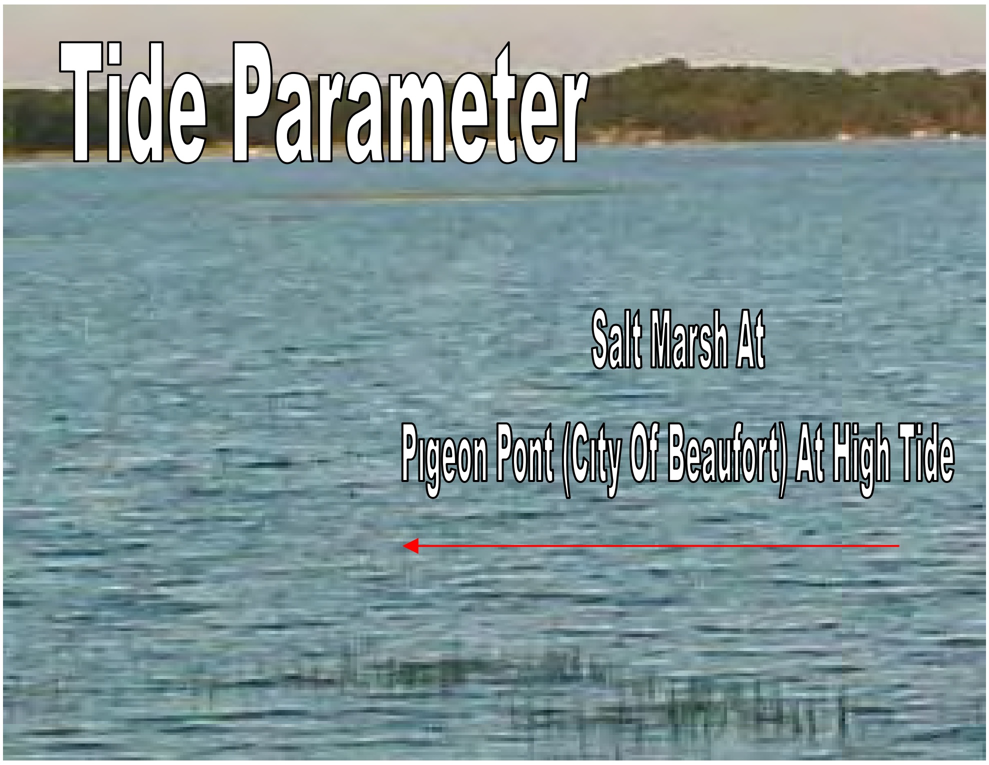
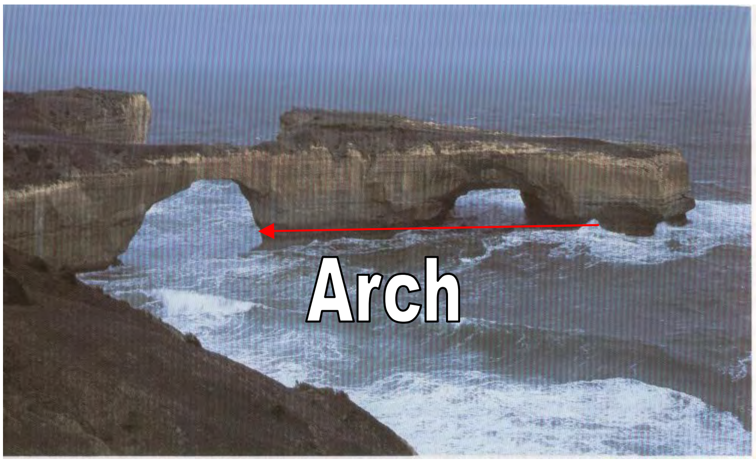


Figure A12. Tide Parameter; Views of the Same Place at Low Tide and High Tide

Coastal Landscape Features



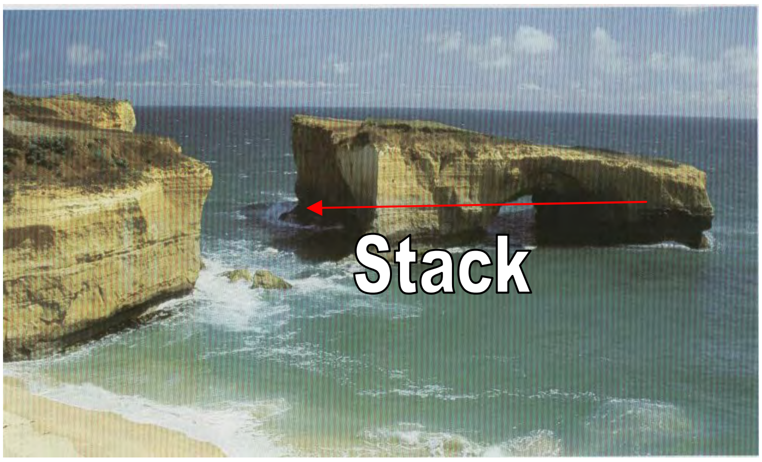


Figure A13. Coastal Landscape Features; Arch, Special Feature, Stack

Figure A14. Coastal Landscape Features; Island, Cave

Figure A15. Vistas of Far Places; Open In One Side

Vegetation Cover Parameter

Figure A16. Vegetation Cover Parameter; Bare, Scrub, Wetland

Vegetation Cover Parameters

Figure A17. Vegetation Cover Parameter; Maquis, Forest

Figure A18. Vegetation Debris Parameter, Seaweed Banquet

Figure A19. Water Color and Clarity; Muddy Grey, Turquoise

Figure A20. Evidence of Sewage

Figure A21. Built Environment; Heavy Industry

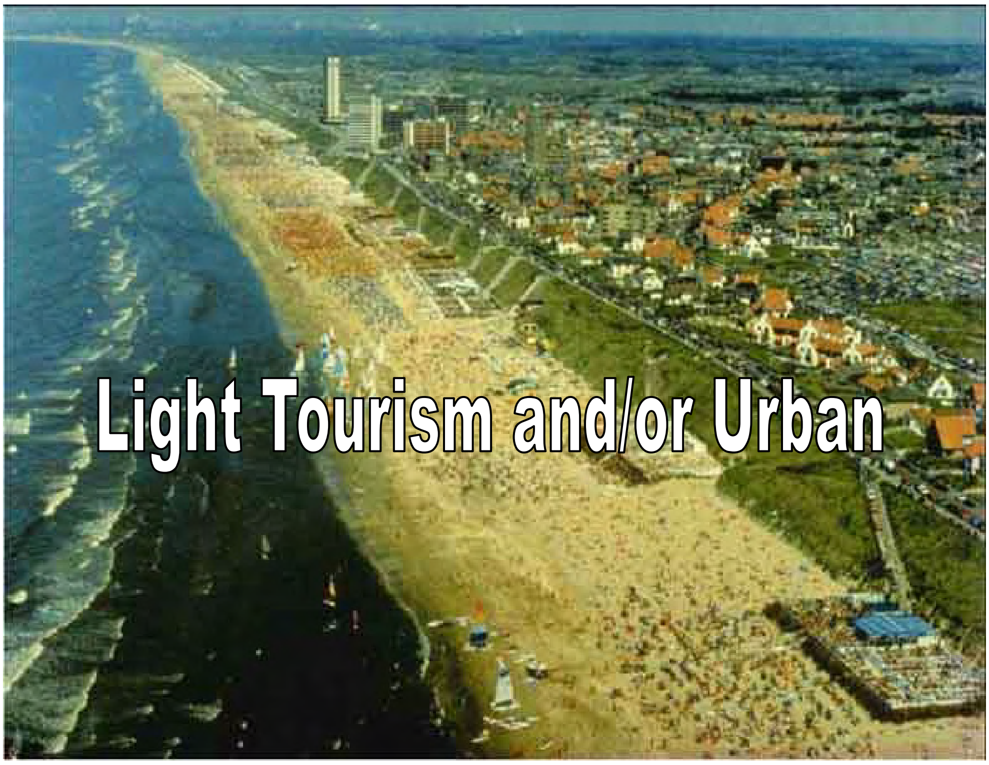


Figure A22. Built Environment; Heavy Tourism and/or Urban, Light Tourism and/or Urban

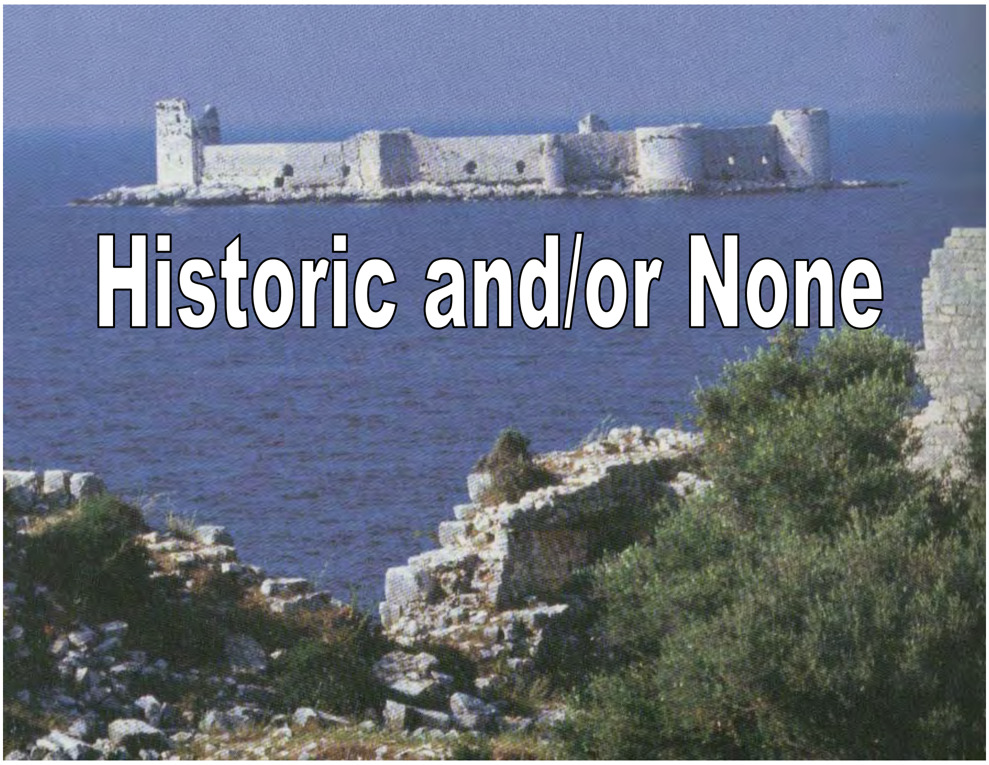


Figure A23. Built Environment; Sensitive Tourism and/or Urban, Historic and/or None

FigureA24. Skyline

Figure A25. Litter

Figure A26. None-Built Environment

Figure A27. Noise Disturbance

Figure A28. Access Type; Parking Lot Visible From Coastal Area

Figure A29. Utilities

APPENDIX B

MEMBERSHIP GRADING MATRICES

$$M_1 = \begin{array}{cccccc} & 1 & 2 & 3 & 4 & 5 \\ 1 & 1{,}0 & 0{,}0 & 0{,}0 & 0{,}0 & 0{,}0 \\ 2 & 0{,}0 & 1{,}0 & 0{,}3 & 0{,}0 & 0{,}0 \\ 3 & 0{,}0 & 0{,}3 & 1{,}0 & 0{,}3 & 0{,}0 \\ 4 & 0{,}0 & 0{,}0 & 0{,}5 & 1{,}0 & 0{,}5 \\ 5 & 0{,}0 & 0{,}0 & 0{,}0 & 0{,}5 & 1{,}0 \end{array}$$

$$M_2 = \begin{array}{cccccc} & 1 & 2 & 3 & 4 & 5 \\ 1 & 1{,}0 & 0{,}0 & 0{,}0 & 0{,}0 & 0{,}0 \\ 2 & 0{,}0 & 1{,}0 & 0{,}5 & 0{,}0 & 0{,}0 \\ 3 & 0{,}0 & 0{,}5 & 1{,}0 & 0{,}5 & 0{,}0 \\ 4 & 0{,}0 & 0{,}0 & 0{,}5 & 1{,}0 & 0{,}5 \\ 5 & 0{,}0 & 0{,}0 & 0{,}0 & 0{,}5 & 1{,}0 \end{array}$$

$$M_3 = \begin{array}{cccccc} & 1 & 2 & 3 & 4 & 5 \\ 1 & 1{,}0 & 0{,}0 & 0{,}0 & 0{,}0 & 0{,}0 \\ 2 & 0{,}0 & 1{,}0 & 0{,}3 & 0{,}0 & 0{,}0 \\ 3 & 0{,}0 & 0{,}0 & 1{,}0 & 0{,}3 & 0{,}0 \\ 4 & 0{,}0 & 0{,}0 & 0{,}0 & 1{,}0 & 0{,}3 \\ 5 & 0{,}0 & 0{,}0 & 0{,}0 & 0{,}0 & 1{,}0 \end{array}$$

$$M_4 = \begin{array}{cccccc} & 1 & 2 & 3 & 4 & 5 \\ 1 & 1{,}0 & 0{,}0 & 0{,}0 & 0{,}0 & 0{,}0 \\ 2 & 0{,}0 & 1{,}0 & 0{,}0 & 0{,}0 & 0{,}0 \\ 3 & 0{,}0 & 0{,}0 & 1{,}0 & 0{,}0 & 0{,}0 \\ 4 & 0{,}0 & 0{,}0 & 0{,}0 & 1{,}0 & 0{,}0 \\ 5 & 0{,}0 & 0{,}0 & 0{,}0 & 0{,}0 & 1{,}0 \end{array}$$

$$M_5 = \begin{array}{cccccc} & 1 & 2 & 3 & 4 & 5 \\ 1 & 1{,}0 & 0{,}0 & 0{,}0 & 0{,}0 & 0{,}0 \\ 2 & 0{,}0 & 1{,}0 & 0{,}0 & 0{,}0 & 0{,}0 \\ 3 & 0{,}0 & 0{,}2 & 1{,}0 & 0{,}2 & 0{,}0 \\ 4 & 0{,}0 & 0{,}0 & 0{,}2 & 1{,}0 & 0{,}6 \\ 5 & 0{,}0 & 0{,}0 & 0{,}0 & 0{,}6 & 1{,}0 \end{array}$$

$$M_6 = \begin{array}{c|ccccc} & 1 & 2 & 3 & 4 & 5 \\ \hline 1 & 1,0 & 0,0 & 0,0 & 0,0 & 0,0 \\ 2 & 0,0 & 1,0 & 0,0 & 0,0 & 0,0 \\ 3 & 0,0 & 0,0 & 1,0 & 0,6 & 0,0 \\ 4 & 0,0 & 0,0 & 0,6 & 1,0 & 0,0 \\ 5 & 0,0 & 0,0 & 0,0 & 0,0 & 1,0 \end{array}$$

$$M_7 = \begin{array}{c|ccccc} & 1 & 2 & 3 & 4 & 5 \\ \hline 1 & 1,0 & 0,0 & 0,0 & 0,0 & 0,0 \\ 2 & 0,0 & 1,0 & 0,5 & 0,0 & 0,0 \\ 3 & 0,0 & 0,5 & 1,0 & 0,5 & 0,0 \\ 4 & 0,0 & 0,0 & 0,5 & 1,0 & 0,5 \\ 5 & 0,0 & 0,0 & 0,0 & 0,2 & 1,0 \end{array}$$

$$M_8 = \begin{array}{c|ccccc} & 1 & 2 & 3 & 4 & 5 \\ \hline 1 & 1,0 & 0,0 & 0,0 & 0,0 & 0,0 \\ 2 & 0,0 & 1,0 & 0,2 & 0,0 & 0,0 \\ 3 & 0,0 & 0,2 & 1,0 & 0,5 & 0,0 \\ 4 & 0,0 & 0,0 & 0,5 & 1,0 & 0,4 \\ 5 & 0,0 & 0,0 & 0,0 & 0,4 & 1,0 \end{array}$$

$$M_9 = \begin{array}{c|ccccc} & 1 & 2 & 3 & 4 & 5 \\ \hline 1 & 1,0 & 0,0 & 0,0 & 0,0 & 0,0 \\ 2 & 0,0 & 1,0 & 0,1 & 0,0 & 0,0 \\ 3 & 0,0 & 0,1 & 1,0 & 0,6 & 0,0 \\ 4 & 0,0 & 0,0 & 0,6 & 1,0 & 0,5 \\ 5 & 0,0 & 0,0 & 0,0 & 0,5 & 1,0 \end{array}$$

$$M_{10} = \begin{array}{c|ccccc} & 1 & 2 & 3 & 4 & 5 \\ \hline 1 & 1,0 & 0,0 & 0,0 & 0,0 & 0,0 \\ 2 & 0,0 & 1,0 & 0,0 & 0,0 & 0,0 \\ 3 & 0,0 & 0,0 & 1,0 & 0,0 & 0,0 \\ 4 & 0,0 & 0,0 & 0,0 & 1,0 & 0,0 \\ 5 & 0,0 & 0,0 & 0,0 & 0,0 & 1,0 \end{array}$$

$$M_{11} = \begin{array}{c|ccccc} & 1 & 2 & 3 & 4 & 5 \\ \hline 1 & 1,0 & 0,0 & 0,0 & 0,0 & 0,0 \\ 2 & 0,0 & 1,0 & 0,0 & 0,0 & 0,0 \\ 3 & 0,0 & 0,0 & 1,0 & 0,0 & 0,0 \\ 4 & 0,0 & 0,0 & 0,0 & 1,0 & 0,1 \\ 5 & 0,0 & 0,0 & 0,0 & 0,1 & 1,0 \end{array}$$

$$M_{12} = \begin{array}{c|ccccc} & 1 & 2 & 3 & 4 & 5 \\ \hline 1 & 1{,}0 & 0{,}2 & 0{,}0 & 0{,}0 & 0{,}0 \\ 2 & 0{,}0 & 1{,}0 & 0{,}3 & 0{,}0 & 0{,}0 \\ 3 & 0{,}0 & 0{,}6 & 1{,}0 & 0{,}6 & 0{,}0 \\ 4 & 0{,}0 & 0{,}0 & 0{,}6 & 1{,}0 & 0{,}2 \\ 5 & 0{,}0 & 0{,}0 & 0{,}0 & 0{,}2 & 1{,}0 \end{array}$$

$$M_{13} = \begin{array}{c|ccccc} & 1 & 2 & 3 & 4 & 5 \\ \hline 1 & 1{,}0 & 0{,}0 & 0{,}0 & 0{,}0 & 0{,}0 \\ 2 & 0{,}0 & 1{,}0 & 0{,}0 & 0{,}0 & 0{,}0 \\ 3 & 0{,}0 & 0{,}0 & 1{,}0 & 0{,}0 & 0{,}0 \\ 4 & 0{,}0 & 0{,}0 & 0{,}0 & 1{,}0 & 0{,}0 \\ 5 & 0{,}0 & 0{,}0 & 0{,}0 & 0{,}0 & 1{,}0 \end{array}$$

$$M_{14} = \begin{array}{c|ccccc} & 1 & 2 & 3 & 4 & 5 \\ \hline 1 & 1{,}0 & 0{,}2 & 0{,}0 & 0{,}0 & 0{,}0 \\ 2 & 0{,}0 & 1{,}0 & 0{,}2 & 0{,}0 & 0{,}0 \\ 3 & 0{,}0 & 0{,}0 & 1{,}0 & 0{,}2 & 0{,}0 \\ 4 & 0{,}0 & 0{,}0 & 0{,}0 & 1{,}0 & 0{,}2 \\ 5 & 0{,}0 & 0{,}0 & 0{,}0 & 0{,}0 & 1{,}0 \end{array}$$

$$M_{15} = \begin{array}{c|ccccc} & 1 & 2 & 3 & 4 & 5 \\ \hline 1 & 1{,}0 & 0{,}0 & 0{,}0 & 0{,}0 & 0{,}0 \\ 2 & 0{,}0 & 1{,}0 & 0{,}0 & 0{,}0 & 0{,}0 \\ 3 & 0{,}0 & 0{,}0 & 1{,}0 & 0{,}0 & 0{,}0 \\ 4 & 0{,}0 & 0{,}0 & 0{,}0 & 1{,}0 & 0{,}3 \\ 5 & 0{,}0 & 0{,}0 & 0{,}0 & 0{,}3 & 1{,}0 \end{array}$$

$$M_{16} = \begin{array}{c|ccccc} & 1 & 2 & 3 & 4 & 5 \\ \hline 1 & 1{,}0 & 0{,}2 & 0{,}0 & 0{,}0 & 0{,}0 \\ 2 & 0{,}2 & 1{,}0 & 0{,}2 & 0{,}0 & 0{,}0 \\ 3 & 0{,}0 & 0{,}5 & 1{,}0 & 0{,}5 & 0{,}0 \\ 4 & 0{,}0 & 0{,}0 & 0{,}5 & 1{,}0 & 0{,}2 \\ 5 & 0{,}0 & 0{,}0 & 0{,}0 & 0{,}2 & 1{,}0 \end{array}$$

$$M_{17} = \begin{array}{c|ccccc} & 1 & 2 & 3 & 4 & 5 \\ \hline 1 & 1{,}0 & 0{,}2 & 0{,}0 & 0{,}0 & 0{,}0 \\ 2 & 0{,}2 & 1{,}0 & 0{,}2 & 0{,}1 & 0{,}0 \\ 3 & 0{,}0 & 0{,}2 & 1{,}0 & 0{,}2 & 0{,}0 \\ 4 & 0{,}0 & 0{,}0 & 0{,}2 & 1{,}0 & 0{,}2 \\ 5 & 0{,}0 & 0{,}0 & 0{,}0 & 0{,}2 & 1{,}0 \end{array}$$

$$M_{18} = \begin{array}{c|ccccc} & 1 & 2 & 3 & 4 & 5 \\ \hline 1 & 1,0 & 0,2 & 0,0 & 0,0 & 0,0 \\ 2 & 0,2 & 1,0 & 0,0 & 0,0 & 0,0 \\ 3 & 0,0 & 0,0 & 1,0 & 0,2 & 0,0 \\ 4 & 0,0 & 0,0 & 0,2 & 1,0 & 0,0 \\ 5 & 0,0 & 0,0 & 0,0 & 0,2 & 1,0 \end{array}$$

$$M_{19} = \begin{array}{c|ccccc} & 1 & 2 & 3 & 4 & 5 \\ \hline 1 & 1,0 & 0,0 & 0,0 & 0,0 & 0,0 \\ 2 & 0,2 & 1,0 & 0,0 & 0,2 & 0,0 \\ 3 & 0,0 & 0,0 & 0,0 & 0,0 & 0,0 \\ 4 & 0,0 & 0,2 & 0,0 & 1,0 & 0,2 \\ 5 & 0,0 & 0,0 & 0,0 & 0,2 & 1,0 \end{array}$$

$$M_{20} = \begin{array}{c|ccccc} & 1 & 2 & 3 & 4 & 5 \\ \hline 1 & 1,0 & 0,2 & 0,0 & 0,0 & 0,0 \\ 2 & 0,2 & 1,0 & 0,2 & 0,0 & 0,0 \\ 3 & 0,0 & 0,2 & 1,0 & 0,2 & 0,0 \\ 4 & 0,0 & 0,0 & 0,2 & 1,0 & 0,2 \\ 5 & 0,0 & 0,0 & 0,0 & 0,2 & 1,0 \end{array}$$

$$M_{21} = \begin{array}{c|ccccc} & 1 & 2 & 3 & 4 & 5 \\ \hline 1 & 1,0 & 0,0 & 0,2 & 0,0 & 0,0 \\ 2 & 0,0 & 0,0 & 0,0 & 0,0 & 0,0 \\ 3 & 0,3 & 0,0 & 1,0 & 0,0 & 0,1 \\ 4 & 0,0 & 0,0 & 0,0 & 0,0 & 0,0 \\ 5 & 0,0 & 0,0 & 0,2 & 0,0 & 1,0 \end{array}$$

$$M_{22} = \begin{array}{c|ccccc} & 1 & 2 & 3 & 4 & 5 \\ \hline 1 & 1,0 & 0,0 & 0,2 & 0,0 & 0,0 \\ 2 & 0,0 & 0,0 & 0,0 & 0,0 & 0,0 \\ 3 & 0,2 & 0,0 & 1,0 & 0,0 & 0,2 \\ 4 & 0,0 & 0,0 & 0,0 & 0,0 & 0,0 \\ 5 & 0,0 & 0,0 & 0,2 & 0,0 & 1,0 \end{array}$$

$$M_{23} = \begin{array}{c|ccccc} & 1 & 2 & 3 & 4 & 5 \\ \hline 1 & 1,0 & 0,0 & 0,0 & 0,0 & 0,0 \\ 2 & 0,0 & 1,0 & 0,2 & 0,0 & 0,0 \\ 3 & 0,0 & 0,2 & 1,0 & 0,2 & 0,0 \\ 4 & 0,0 & 0,0 & 0,3 & 1,0 & 0,0 \\ 5 & 0,0 & 0,0 & 0,0 & 0,0 & 1,0 \end{array}$$

$$M_{24} = \begin{array}{c|ccccc} & 1 & 2 & 3 & 4 & 5 \\ \hline 1 & 1,0 & 0,2 & 0,0 & 0,0 & 0,0 \\ 2 & 0,2 & 1,0 & 0,0 & 0,2 & 0,0 \\ 3 & 0,0 & 0,0 & 0,0 & 0,0 & 0,0 \\ 4 & 0,0 & 0,2 & 0,0 & 1,0 & 0,2 \\ 5 & 0,0 & 0,0 & 0,0 & 0,2 & 1,0 \end{array}$$

$$M_{25} = \begin{array}{c|ccccc} & 1 & 2 & 3 & 4 & 5 \\ \hline 1 & 1,0 & 0,4 & 0,0 & 0,0 & 0,0 \\ 2 & 0,4 & 1,0 & 0,2 & 0,0 & 0,0 \\ 3 & 0,0 & 0,4 & 1,0 & 0,2 & 0,0 \\ 4 & 0,0 & 0,0 & 0,4 & 1,0 & 0,0 \\ 5 & 0,0 & 0,0 & 0,0 & 0,0 & 1,0 \end{array}$$

$$M_{26} = \begin{array}{c|ccccc} & 1 & 2 & 3 & 4 & 5 \\ \hline 1 & 1,0 & 0,0 & 0,0 & 0,0 & 0,0 \\ 2 & 0,2 & 1,0 & 0,0 & 0,0 & 0,0 \\ 3 & 0,0 & 0,2 & 1,0 & 0,0 & 0,0 \\ 4 & 0,0 & 0,0 & 0,2 & 1,0 & 0,0 \\ 5 & 0,0 & 0,0 & 0,0 & 0,2 & 1,0 \end{array}$$

APPENDIX C

PHOTOS

Photo C1. Questionnaires Applied to Locals

Photo C2. Questionnaires Applied to Foreign Tourists

Photo C3. Questionnaires Applied at the Village Cafe

Photo C4. Çıralı

Photo C5. Kemer

APPENDIX D

TOP VIEW ILLUSTRATIONS OF ÇIRALI

Figure D1. Top View Illustration of Çıralı for Existing Situation

Figure D2. Top View Illustration of Çıralı for Short Term

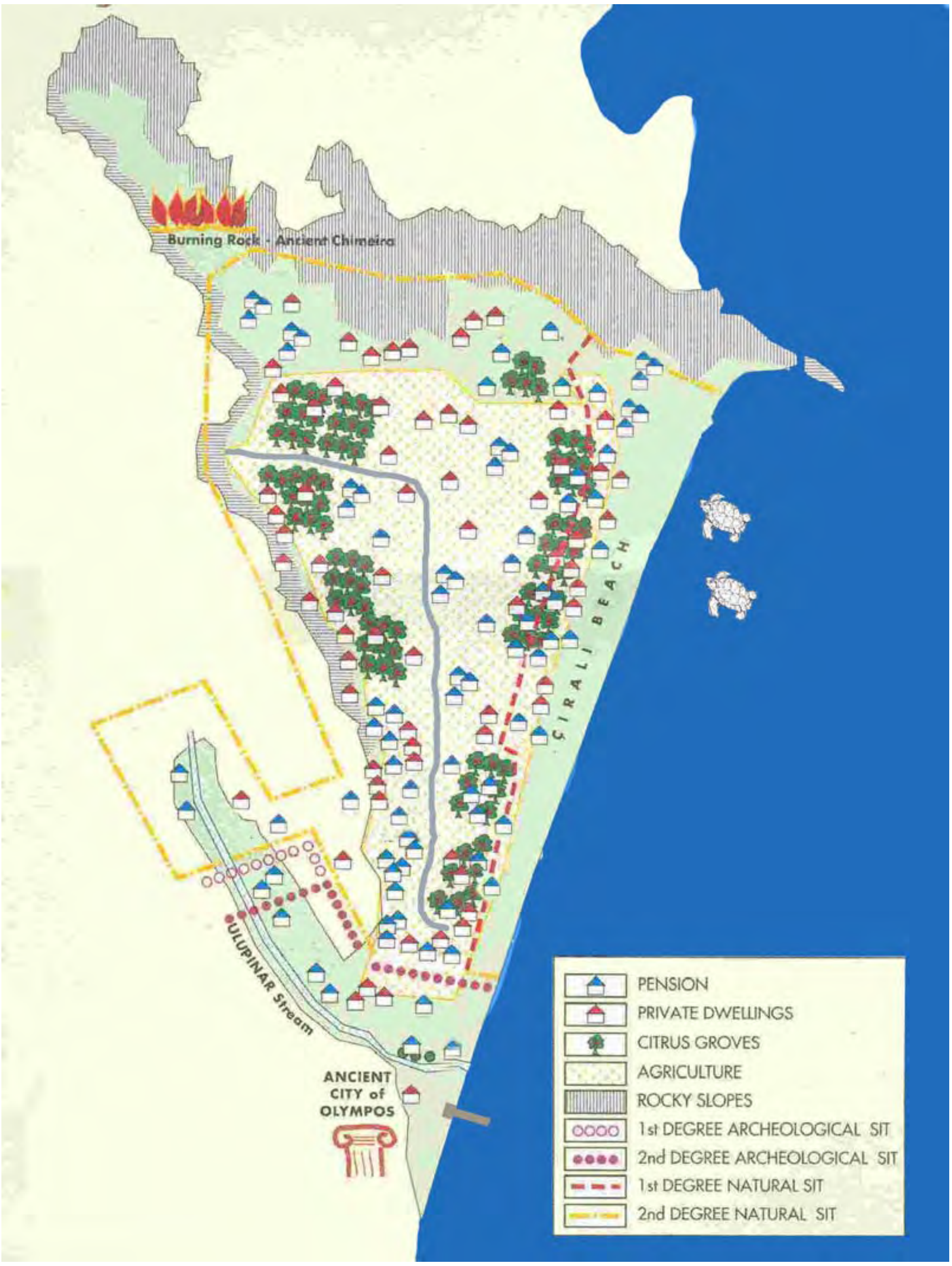


Figure D3. Top View Illustration of Çıralı for Long Term

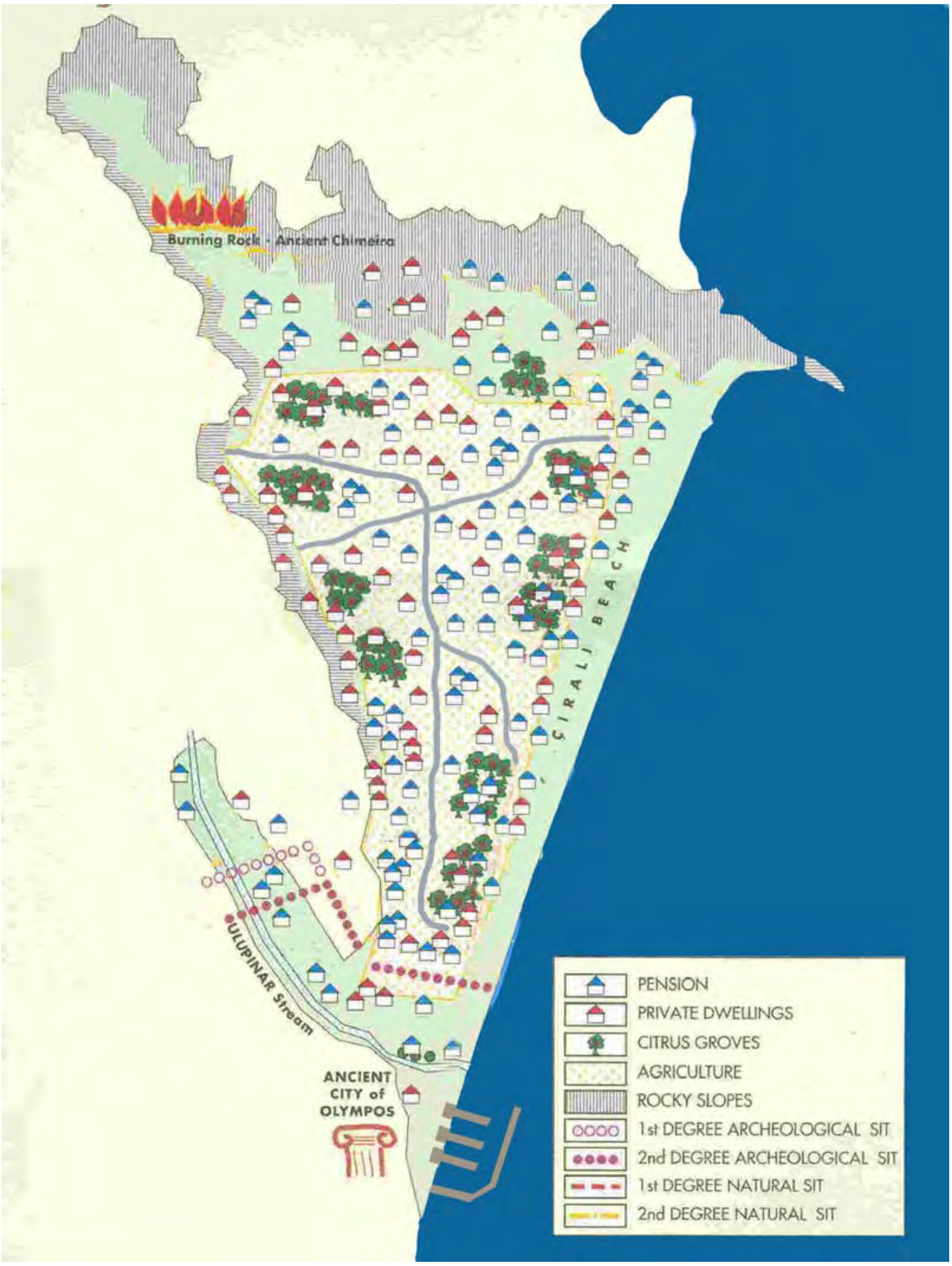


Figure D4. Top View Illustration of Çıralı for Not Protected Case

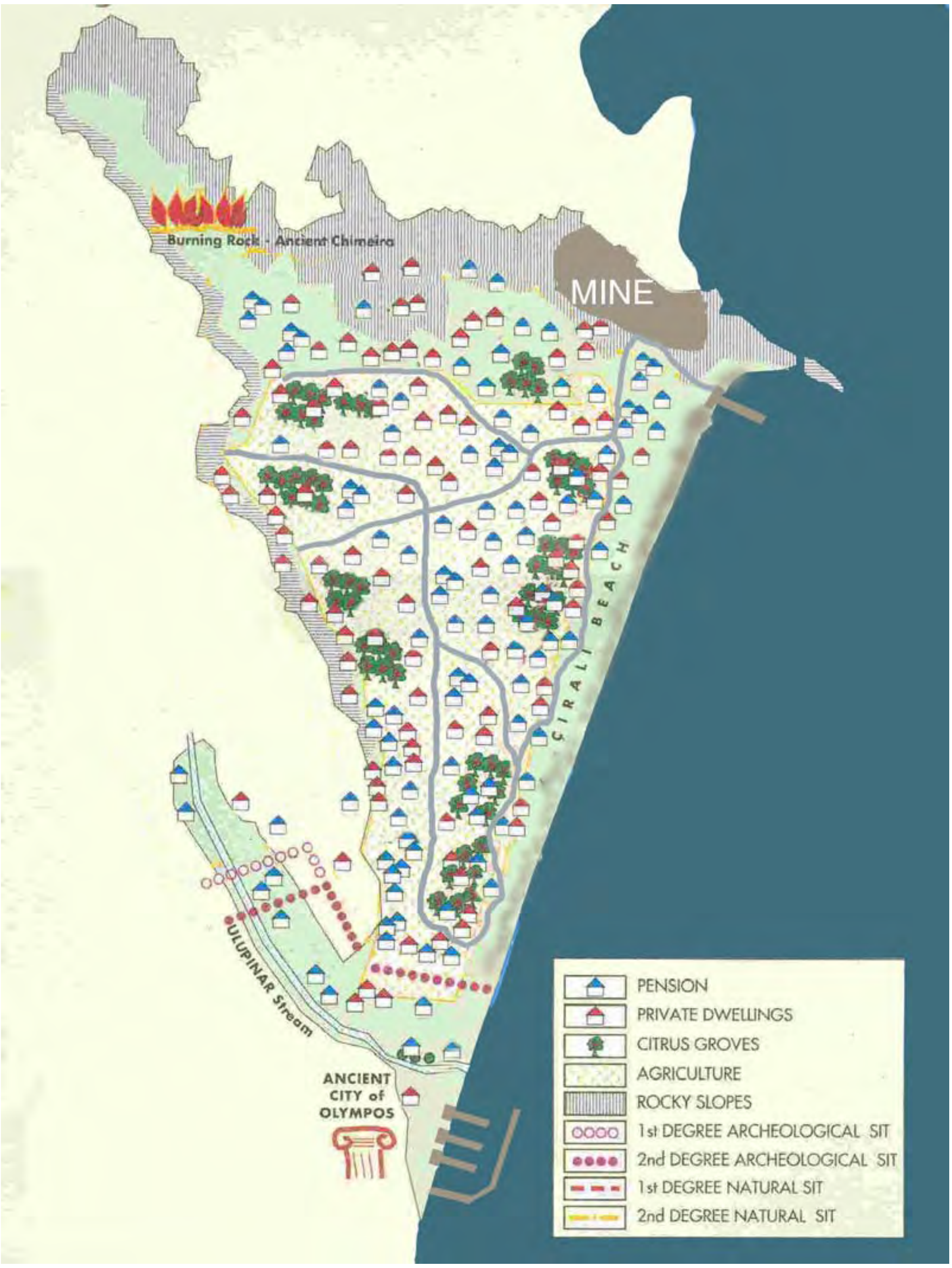


Figure D5. Top View Illustration of Çıralı for 'Special' Situation