

Incorporation of Socio-economic Features' Ranking in Multicriteria Analysis Based on Ecosystem Services for Marine Protected Area Planning



הכללת דירוג ישויות חברתיות-כלכליות בניתוח
ברב-קריטריוני מבוסס שירותי מערכת לצורך
תכנון שמורות טבע ימיות

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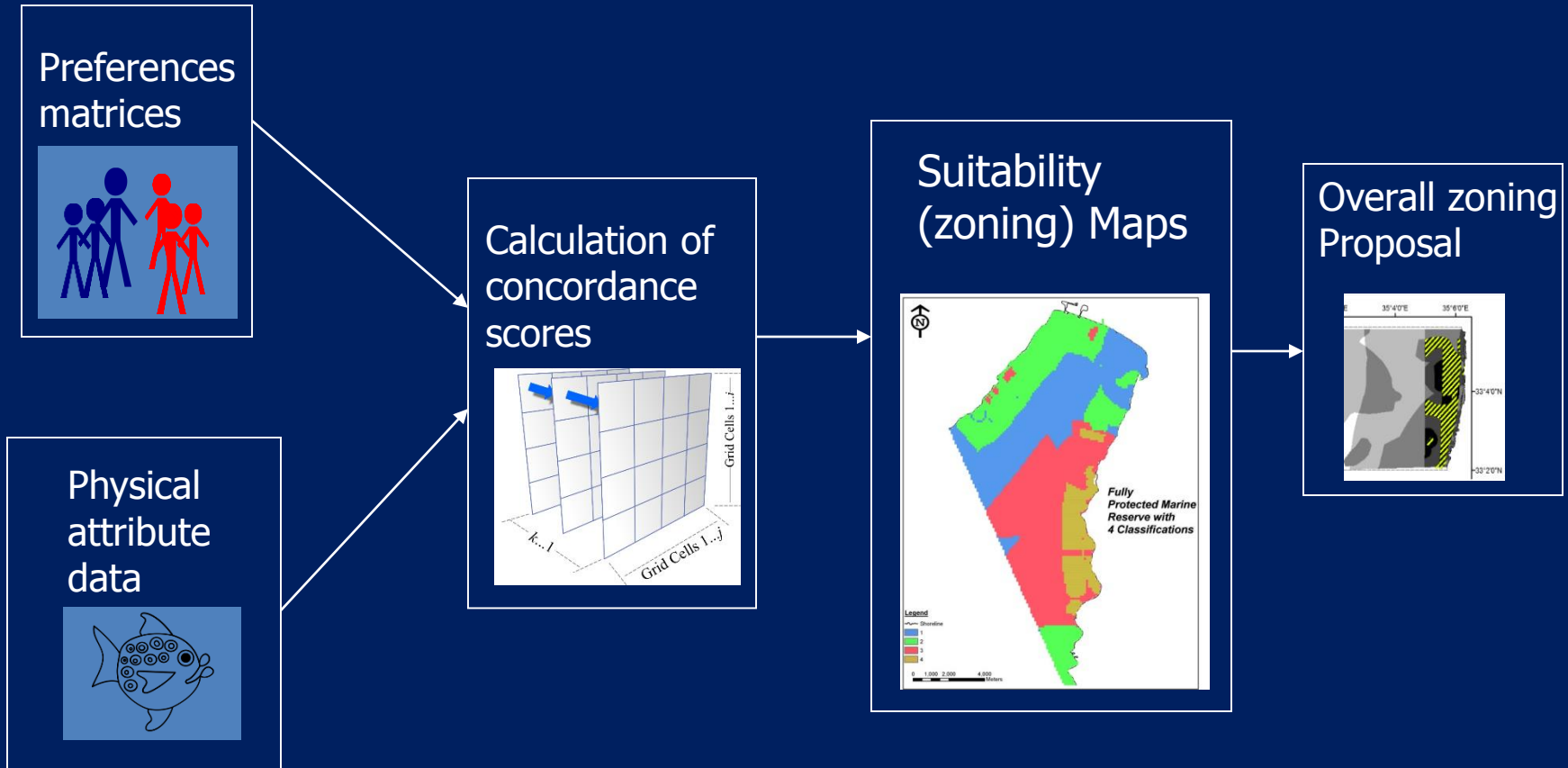


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Designation and Management of Marine Reserve Networks (DEMARN)

- Part I— Spatial analysis and characterization of MPAs of the Mediterranean Sea
- Part II— Relationship between “conservation identity” (i.e., propensity for marine conservation) and MPA management regimes
- Part III— Use of the decision support tools (DST) for MPA management and zoning

Methodology – Spatial Multi-criteria Analysis (based on Villa 2002 and Portman 2007)



Phase I

Phase II

Phase II

Phase I – Stakeholder questionnaires

PART B: Below are 6 questions for each of the three zoning alternative each two values shown in each of the tables, one versus the other. Mark accurately (closest to your views) the relative importance of values for e

1. Highest level of preservation:

1a. Marine nature val

check one much more important

1b. Marine nature val

check one much more important

1c. Marine nature val

check

الثالثة - 18 سؤالاً بالمجمل. قارن/قارني بين كل قيمتين
ب طريقة إلى أرائك عن الأهمية النسبية التي

قيم المناظر الطبيعية البحرية

أهم بكثير أهم بقليل

قيم الثقافة والرياضة البحرئيين

أهم بكثير أهم بقليل

قيم التجارة البحرية

أهم بكثير أهم بقليل مساوي في الأهمية أهم بقليل

חלק ב': בשאלון 6 שאלות נפרדות לכל אחד משלושת התרחישים – בסה"כ 18 שאלות. השווה/י כל שני ערכים המוצגים בכל אחת מן השורות, אחד לעומת השני. סמני/י את המשבצת המביעה בצורה הטובה ביותר (הקרובה ביותר לדעותיך) את החשיבות היחסית של הערכים של התרחיש לפי התרחיש (1 עד 3).

1. רמת שימור הגבוהה ביותר

ערכי טבע ימיים ערכי נוף ימיים

הרבה יותר חשוב קצת יותר חשוב שווה ערך קצת יותר חשוב הרבה יותר חשוב

1א. סמן אחת בלבד

ערכי טבע ימיים ערכי תרבות וספורט ימיים

הרבה יותר חשוב קצת יותר חשוב שווה ערך קצת יותר חשוב הרבה יותר חשוב

1ב. סמן אחת בלבד

ערכי טבע ימיים ערכי מסחר ימיים

הרבה יותר חשוב קצת יותר חשוב שווה ערך קצת יותר חשוב הרבה יותר חשוב

1ג. סמן אחת בלבד

ערכי נוף ימיים ערכי תרבות וספורט ימיים

הרבה יותר חשוב קצת יותר חשוב שווה ערך קצת יותר חשוב הרבה יותר חשוב

1ד. סמן אחת בלבד

ضع إشارة في مربع احد

Phase I – Questionnaire results

Table 1: Stakeholder (rounded) weights derived from the eigenvectors of the pairwise comparison questionnaire.

High-level criteria	Fully Protected (FP)**				Seascape Reserve (SR)**				Marine Park (MP)**			
	SV	WS	CV	NMV	SV	WS	CV	NMV	SV	WS	CV	NMV
Academic Experts(8)	1.613	0.454	0.291	4.209	1.630	0.590	0.319	3.977	1.908	1.695	0.646	2.927
Scuba divers (7)	1.059	1.165	0.346	4.176	1.792	1.924	0.734	2.925	1.428	2.584	0.730	2.549
Fisherman (8)	2.232	2.983	1.030	1.533	1.570	2.603	0.810	1.849	1.345	2.357	0.857	2.192
Recreationists (7)	2.295	1.891	0.401	3.770	2.170	1.960	0.535	3.008	2.034	2.289	0.545	3.194
Tourists (10)	2.169	0.690	0.700	3.416	2.020	1.167	1.034	2.627	1.566	2.547	1.642	1.942
Reserve employees (7)	1.770	0.897	0.730	4.037	1.595	1.226	0.726	3.814	1.961	1.725	0.848	3.193
Field experts (12)*	1.601	0.661	0.355	4.437	1.938	1.035	0.500	3.552	1.871	1.881	0.738	2.659
Total average (59)	1.820	1.249	0.550	3.654	1.816	1.501	0.666	3.108	1.730	2.154	0.858	2.665

*Marine biologists; most working in the field



Phase I – Physical Attributes

(1) High-level Criteria	(2) Features (+ sphere of influence)	(3) Ranking parameters (% of total high-level criteria value)	(4) Grading convention (normalized)
Seascape values (SV)	<ul style="list-style-type: none"> • Submarine canyons • Abrasion tables • Visible archeological sites • Seaview: < 4.7 km from shore • Islets 	Visibility (50%) Contribution to seascape (15%) Distance from shore (35%)	1-5 (1= lowest) 1 = low 5 = high Inverse distance in <u>meters^a</u>
Water sports/ cultural values (WS)	<ul style="list-style-type: none"> • Accessible archeological sites • Inaccessible archeological sites • Beaches (nearby, mid-distant, distant) • Sites for kayaking, recreational fishing, surfing • Entire area of interest (AOI) 	User density (20%) Accessibility (50%) Cultural importance ^b (15%) Social importance ^c (15%)	0 ≤ 1 1-5 (1 = lowest) 1-5 (1=lowest) 1-5 (3=lowest)

Phase I – Physical Attributes (continued)

(1) High-level Criteria	(2) Features (+ sphere of influence)	(3) Ranking parameters (% of total high-level criteria value)	(4) Grading convention (normalized)
Commercial values (CV)	<ul style="list-style-type: none"> • Sites for diving, kayaking, recreational fishing, and other tourist activities 	Accessibility (33%) Cost (33%) Seasonality (33%)	1-5 (3=lowest) Distance from shore 1-5 (2= lowest)
Natural Marine Values (NMV)	<ul style="list-style-type: none"> • Entire AOI • Islets (100%)^d • Islets:400 m buffer (75%)^d • Islets: 401- 1000 m buffer (50%)^d • Deep sea • Continental slope and canyons • Continental shelf • Big canyons • <u>Kurkar ridges</u> • Continental ridges slope • <u>Kurkar rocks near shore</u> 	Number of species (50%) Habitat uniqueness (25%) Certainty /Accuracy (25%)	0-1 1-5 0-1

Based on ecosystem services literature

Seascape values

Parameters	Explanation	Data analysis/collection method
Visibility	View capability from features without special gear	Buffers and opinion
Contribution to seascape	Contribution of feature to the unique (visual) seascape experience. Ex: the islets attract sea-birds that add to the user's "beach" vistas	Expert opinion
Distance from shore	Inverse distance: the greater the distance, the lower the grade	Measurement (GIS)
Use density	Percent of feature's users from among all users in the AOI relative to the size of the feature. Higher values indicate higher use density. Ex: high percentage indicates a large number of visitors in a small feature area	Observation (surveying) and measurement (GIS)

Based on ecosystem services literature

Water sports (values)

Parameters	Explanation	Data analysis/collection method
Accessibility	Public accessibility (without special gear). Buffers around the features are respectively: nearby ≤ 50 ; mid-distant ≥ 50 and ≤ 100 ; distant: ≥ 100 . Higher grades indicate proximity	Measured (GIS) buffers
Cultural importance ^b	Archeology and recreational fishing of highest value. Other (lesser) values: bathing beaches (mid-values), kayaking, surfing and diving (lowest value).	Expert opinion
Social importance ^c	Public and non-material component of well-being. In descending order: archeology and nearby bathing beaches, distant bathing beaches; other recreational uses, including fishing.	Expert opinion

Based on ecosystem services literature

Commercial values

Parameters	Explanation	Data analysis/collection method
Accessibility	The same as public accessibility for WS (above)	Measured (GIS) buffers
Cost	Cost indicates a willingness-to-pay such that distant features used commercially will have a higher value.	Measurement (GIS)
Seasonality	Lower grades for uses limited to weekends/holidays and seasons; higher grades to year-round uses (i.e., recreational fishing)	Expert opinion

Based on ecosystem services literature

Natural Marine Values

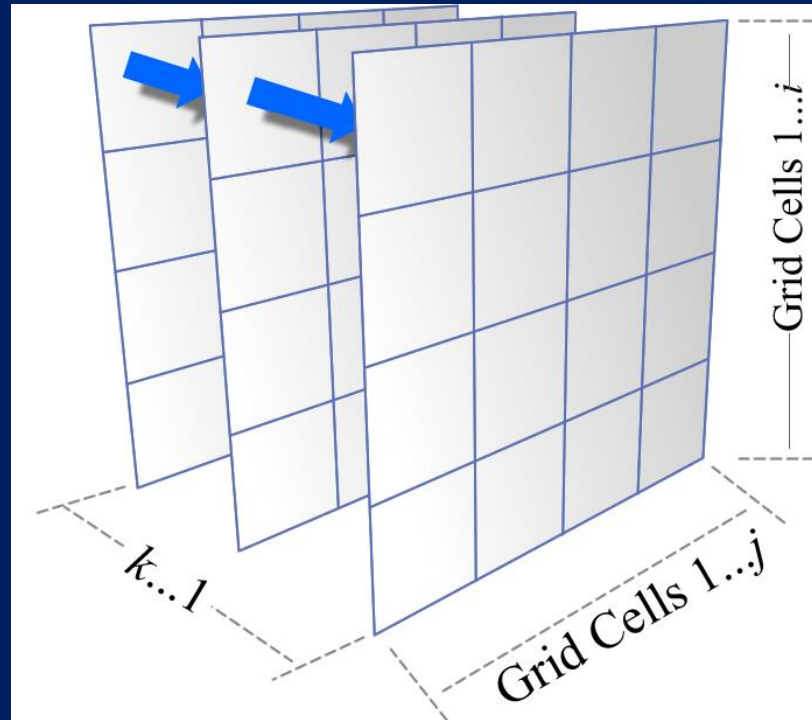
Parameters	Explanation	Data analysis/collection method
Number of species	Number of species relative to feature area	Raw data analysis or secondary source reports
Habitat uniqueness	Uniqueness and sensitivity of habitat based on hard and soft seabed surface.	Secondary source report
Certainty / Accuracy	Accuracy of data according to source. Ex.: direct measurement of fish and invertebrate species around the islets (i.e., Rilov 2014) results in higher scores than features scored using secondary source data (i.e., Mazor 2014).	Raw data analysis or secondary source reports

Emphases regarding ES-based physical attributes

Each attribute:

- addressed in ES literature
- characterized a bit differently
- low-level criteria given weight according to importance within high-level criteria (i.e., for SV: visibility 15%, contribution 50%, distance from shore 35%)
- has spatially-based relevance (i.e., distance from shore; around islets buffers farther from the core-value area have relatively less value)

Phase II – Concordance scores



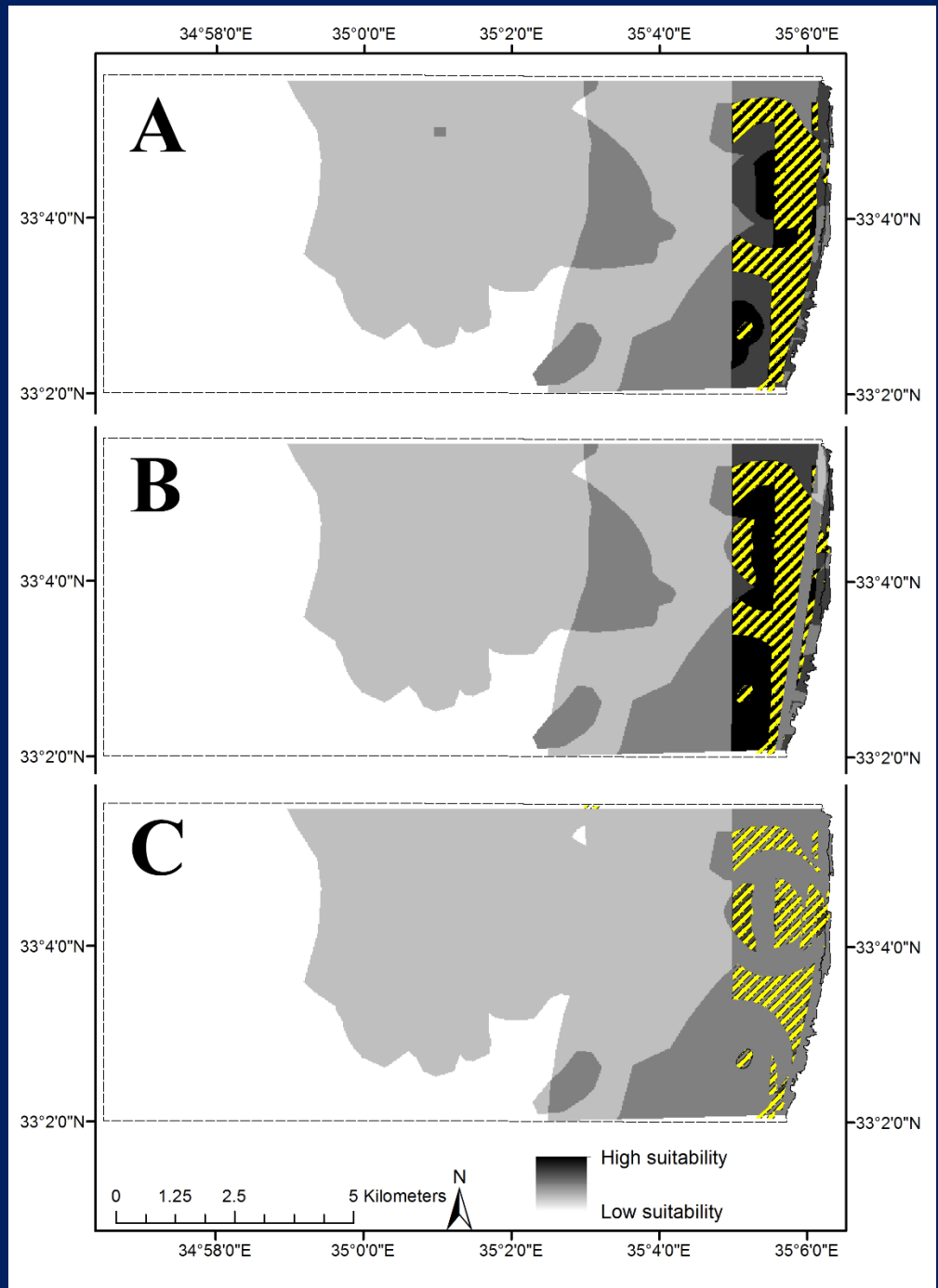
$$C_{ij} = \sum_k w_k \sum_{i'j'} \text{sgn}(e_{ijk} - e_{i'j'k}) \quad (\text{a})$$

Where $\text{sgn}(e_{ij} - e_{i'j'}) = [-1 \text{ if } e_{ij} < e_{i'j'}; 0 \text{ if } e_{ij} = e_{i'j'}; 1 \text{ if } e_{ij} > e_{i'j'}]$ (b)

Phase II – Map generation

Outcomes under different scenarios
from most restrictive to least:
(A) fully-protected;
(B) seascape reserve;
(C) marine park.

A significantly larger area of the AOI is indicated as suitable for protection under scenario (A) when considering the top quartile scores ($\geq 25\%$).



Conclusions

- Socio-economic (e.g., water sports; commercial values) aspects of spatially-explicit management zones can be included in planning using MCA
- Stakeholder preferences can be incorporated
- Most activity occurs in near-shore areas, therefore more emphasis needs to be placed on inclusion of offshore data

Conclusions (continued)

- There seems to be a trade-off between inclusion of socio-economic values/attributes and an emphasis on offshore protection
- Third dimension needs greater emphasis and a way to be expressed through MCA
- There is overall similarity between FP and SR (equivalents to shmorat teva/shmorat nof) at 25% highest values. Either could be good starting point for work with planners.



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