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ICCCM10
International Conference on Coastal Conservation and Management in the Atlantic and Mediterranean
ESTORIL 2010 PORTUGAL | 11 - 17 APRIL

Spatial analysis of recreational boating activity in Mallorca, Balearic Islands, Spain.

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SOCIB Balearic Islands Coastal Observing and Forecasting System

1.- Introduction

Recreational boating is a growing sector of the leisure industry which, in the absence of appropriate management measures, can result in a number of negative environmental and social impacts in the coastal zone.

Recreational boats tend to anchor near beaches and in coves and bays that are sheltered from prevailing winds and swells, which are often host to sensitive natural habitats and additional recreational activities.

Informed management measures are necessary to ensure recreational boating does not conflict with associated sustainability goals.

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1.- Introduction

In the Balearic Islands, Spain, which are located in the Western Mediterranean, similar to many coastal areas, there is no clearly defined spatial vision of marine areas.

The distribution and prevalence of some activities such as anchoring are not well-known.

Spatial studies about human activities in marine environments will contribute to improving future planning and decision making in marine and coastal environments.

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1.- Introduction

Prevalent and common effects of recreational boating

Due to boat acnchoring

- **Degradation of seagrass habitats.**
- **Transmission of invasive species.**
- **Pollution from anti-fouling paints**
- **Waste waters**

Due to boat traffic

- **Disturb the natural behaviour of birds, cetaceans and others (sea turtles).**
- **Accumulation of pollutants in food chains**
- **Safety of users in bathing areas**
- **Risk of collision and accident**
- **Noise Pollution**

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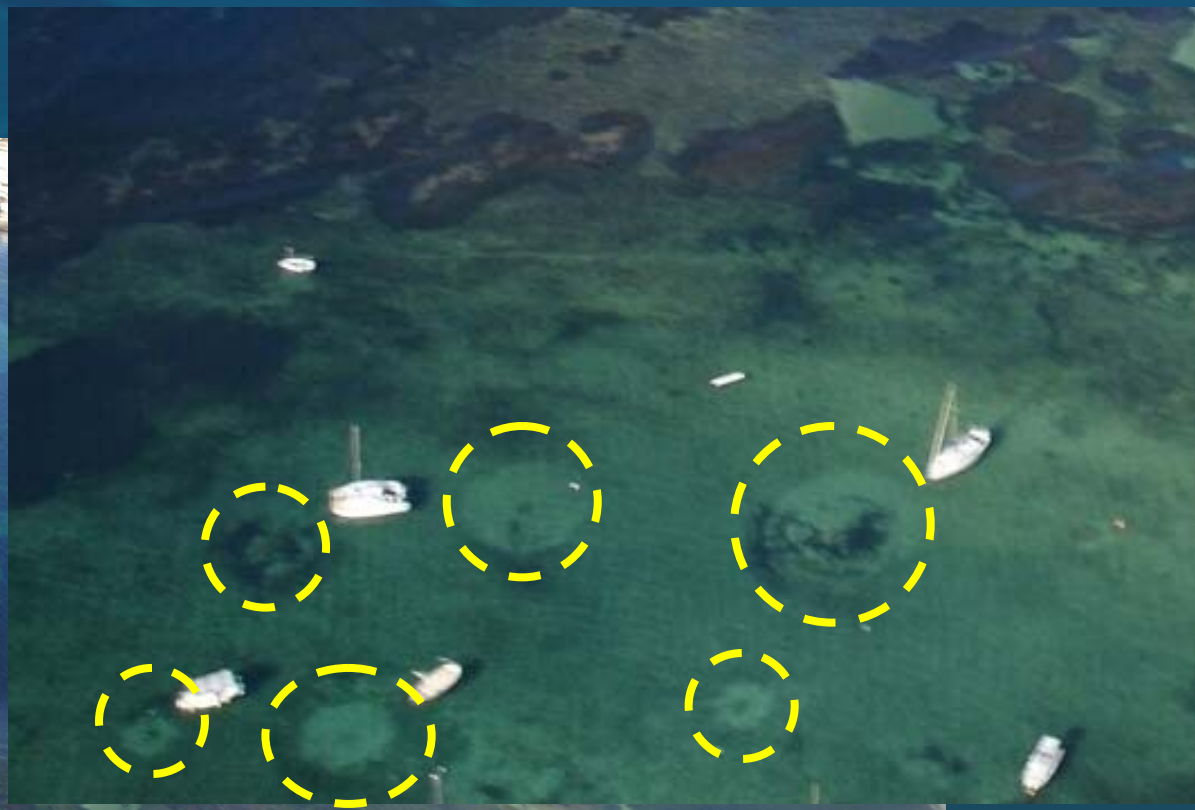
1.- Introduction

Structural damage of seabed caused by anchors and rolling moorings



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1.- Introduction

This study will measure the space available for anchoring around the island of Mallorca.

The analysis has been based on:

a) available seabed for anchoring (resource).
b) estimation of potential demand for anchor (pressure).
c) establishment of spatial scenarios that explore the relationship between space and pressure.
d) wave climate characterization for determining suitable days for anchoring in the various coastal zones around the island.

These analysis have supported on Geographic Information Systems (GIS)

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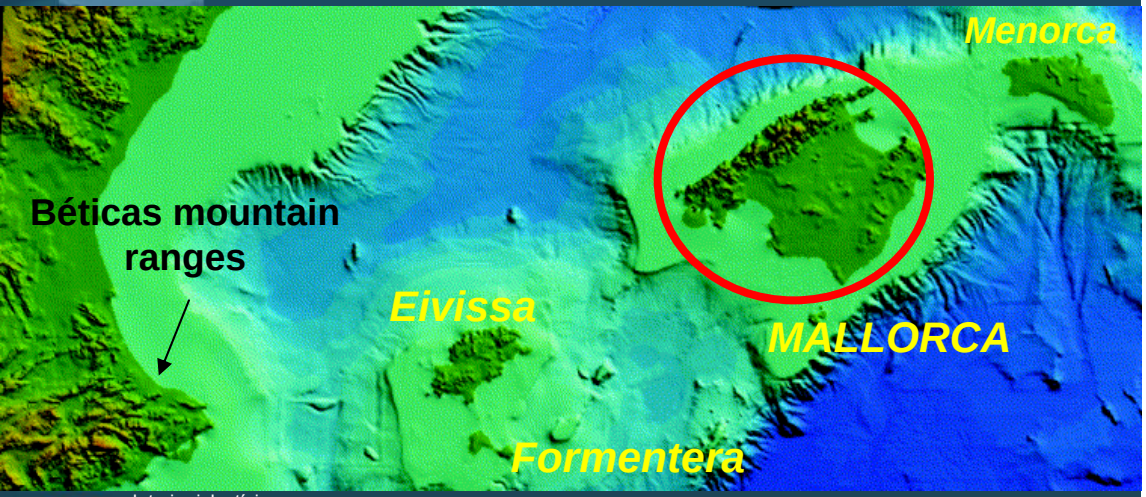
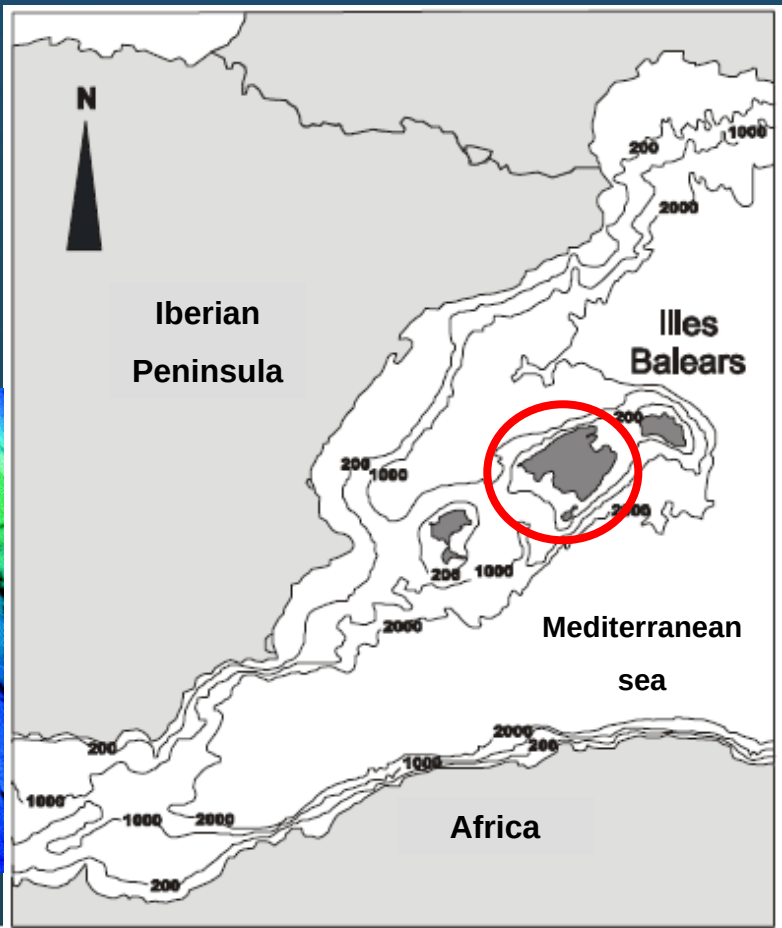
2.- Study Area

The Balearic Islands constitute the prolongation towards the NE of the *Béticas Mountain ranges*.

The Balearic Islands constitute an archipelago of Spain made up of four main islands. Mallorca is the most extensive island with an area of 3.640 km^2 and a coastline of 722 km (1:5.000 scale).

The island has a rhomboid shape, with the vertex directed towards the four cardinal points, and has four well defined coastal zones (NW, SW, SE and NE).





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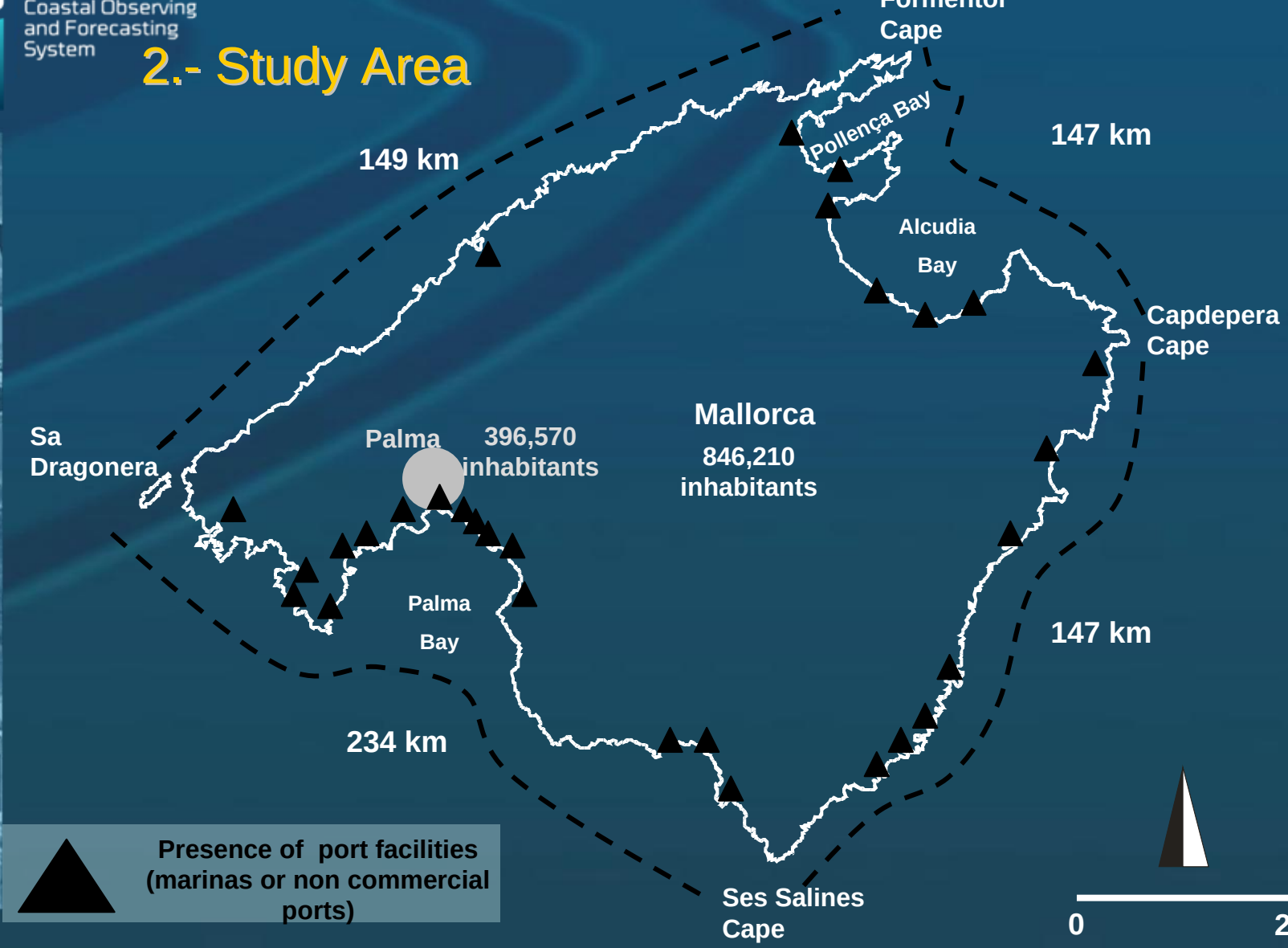
2.- Study Area



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3.- Legal framework

Limitations to boat anchoring are generally associated with the legislation related to the delimitation of bathing areas.

In Spain, the management of bathing zones is complex due to the coexistence of several regulations from different administrations.

The Spanish Coastal Law 22/1988 is compulsory throughout the country and establishes the dimensions and distances for the shoreline bathing area.

Law 22/1988 forbids the use (anchor) and navigation to all boats in bathing areas, and only allow to navigate to shore in marked channels.

When Bathing areas are not marked by buoys, they should extend 200 m seaward in beach coasts and 50 m in rocky coasts.

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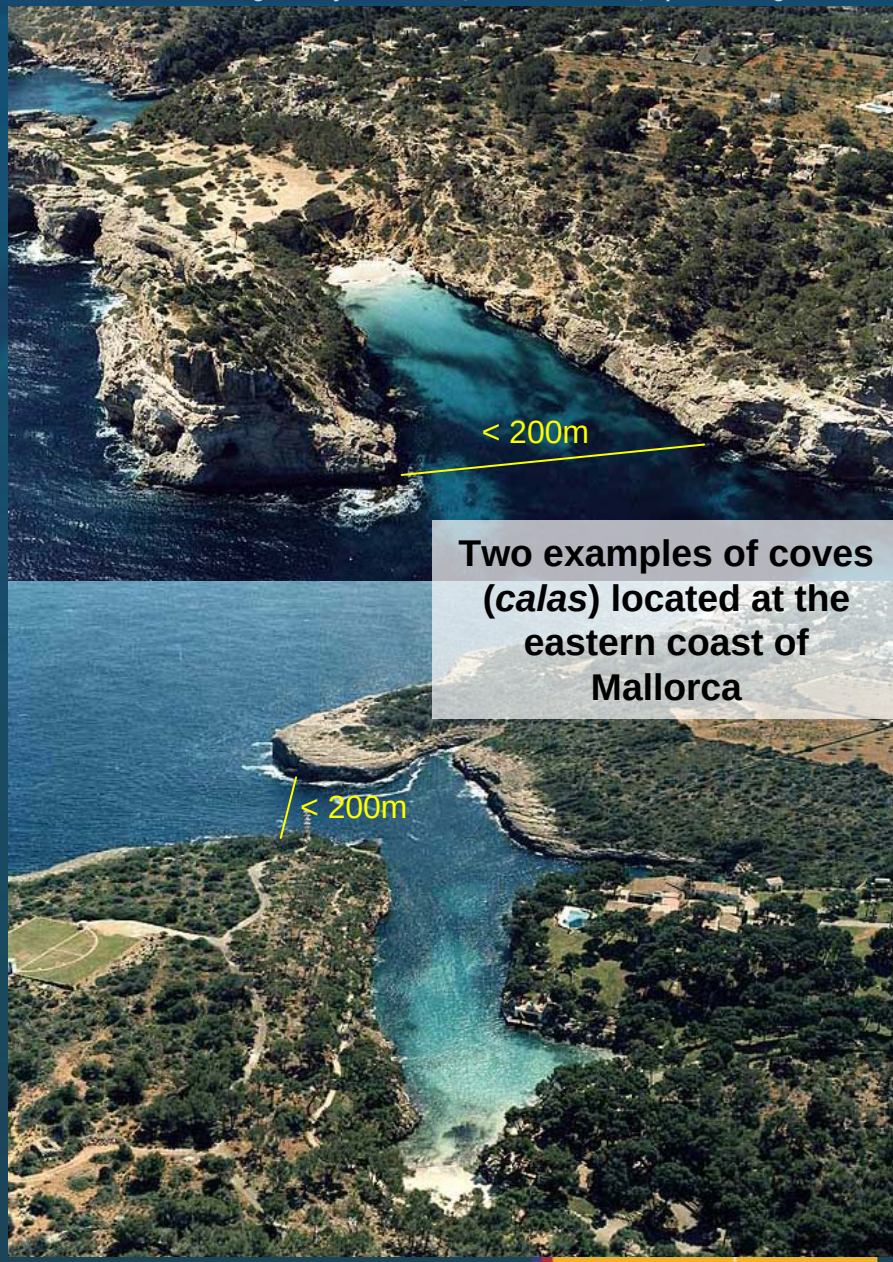
3.- Legal framework

Regional level (Balearic Islands)

- <u>Decree 72/1994 (of May 26th):</u>

Includes the established in coastal law and also states the case of coves ("*CALAS*"). The coves or "*calas*" where the distance between outer capes is less than 200 m, the entire area should be classified as bathing areas.



Two examples of coves (*calas*) located at the eastern coast of Mallorca

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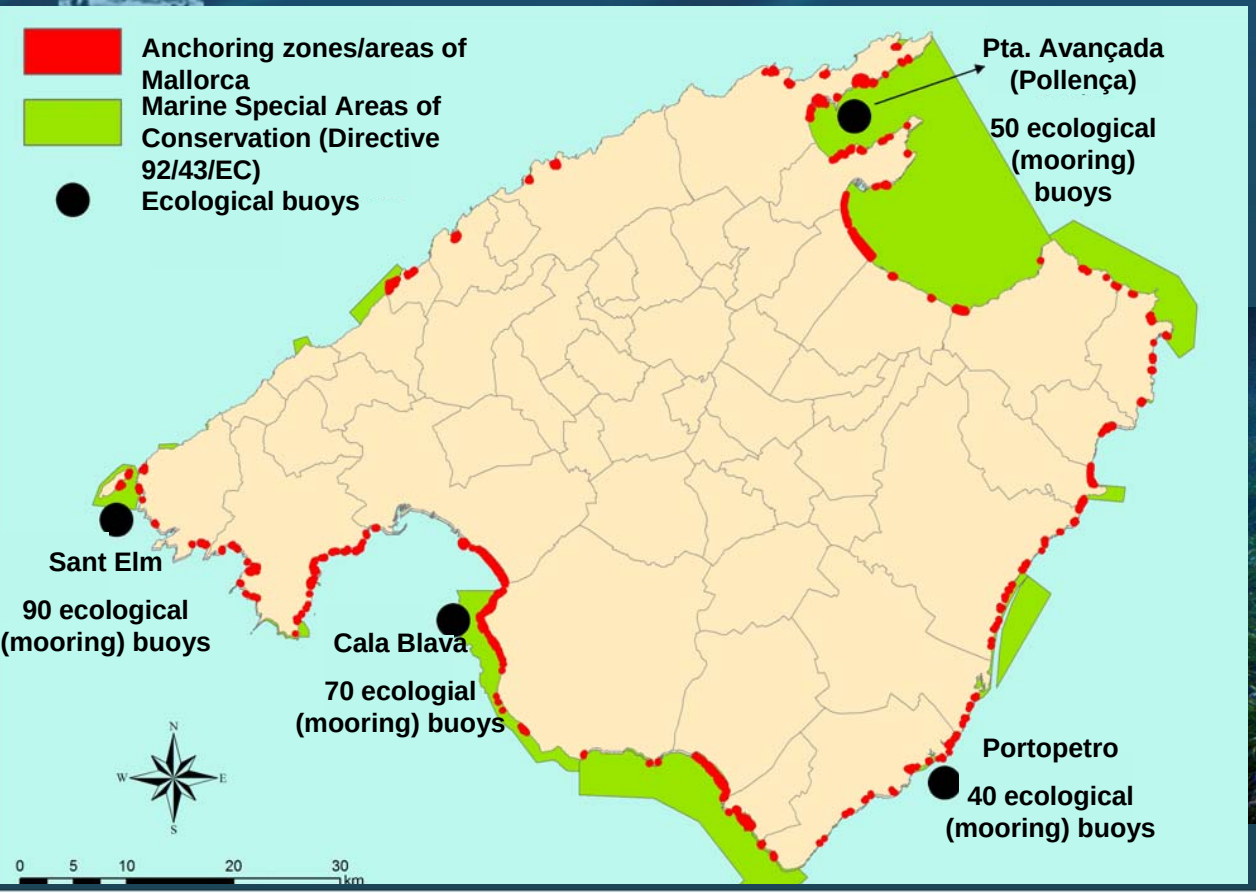
3.- Legal framework

There are currently four anchoring areas around the island that are Marine Special Areas of Conservation (SAC) of the Natura 2000 Network.

Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora). These sites have ecological buoys, installed in order to preserve seagrass meadows as part of the LIFE Posidonia Project.



Posidonia oceanica meadows

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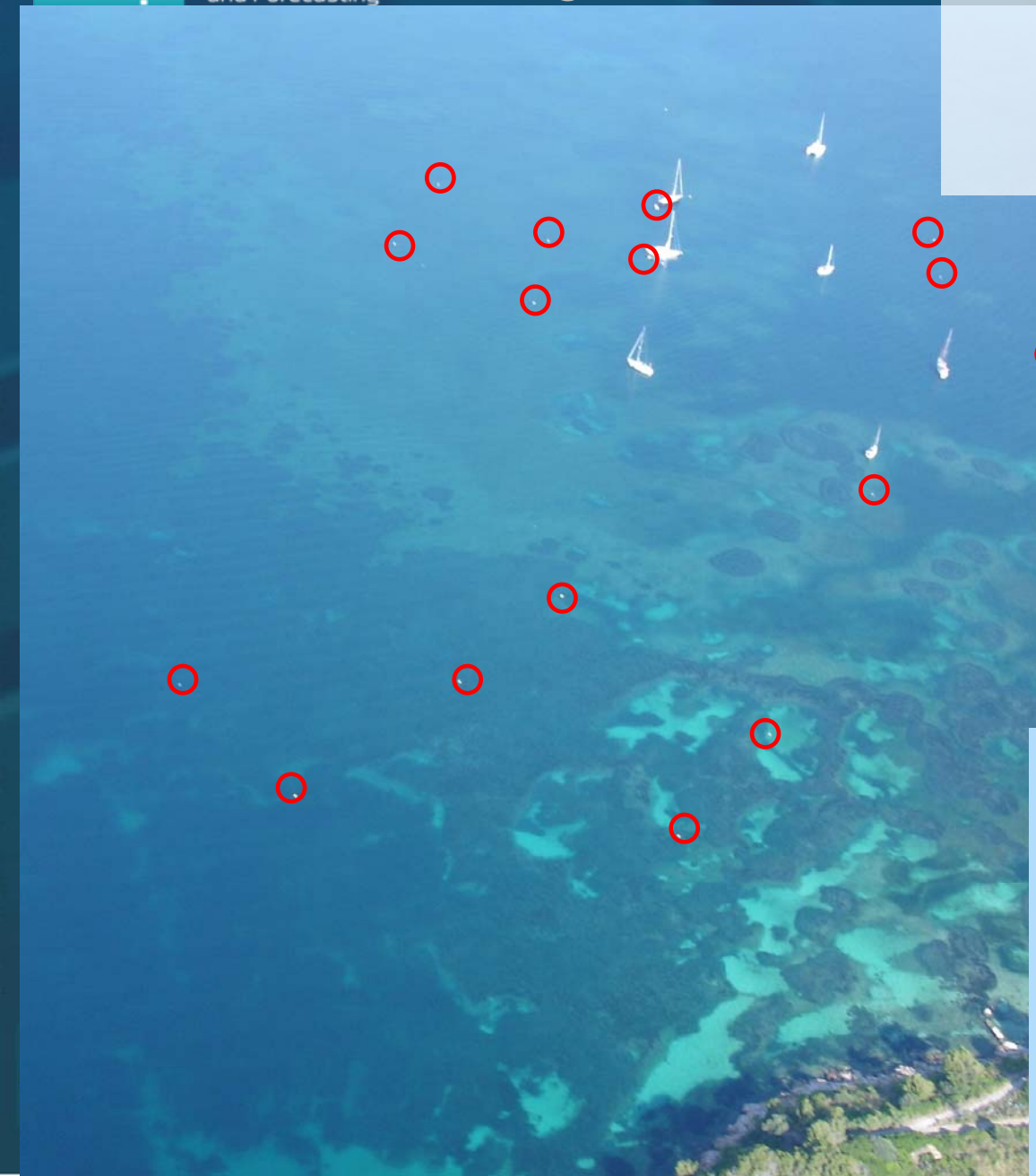
3.- Legal framework

Ecological buoys, installed in order to preserve seagrass meadows as part of the *LIFE Posidonia* Project. EXAMPLE FROM *POLLENÇA* (MALLORCA, BALEARIC ISLANDS)



Special Areas of Conservation (Nature Network 2000) Illes Balears, Spain, W. Mediterranean

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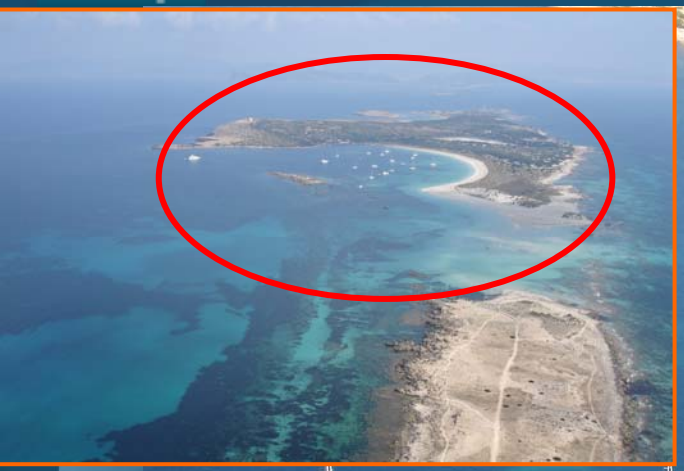
3.- Legal framework

Ecological buoys, installed in order to preserve seagrass meadows as part of the *LIFE Posidonia* Project. EXAMPLE FROM *s'ESPALMADOR* (FORMENTERA, BALEARIC ISLANDS)



Special Areas of Conservation
(Nature Network 2000)
Illes Balears, Spain, W. Mediterranean

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4.- Methods

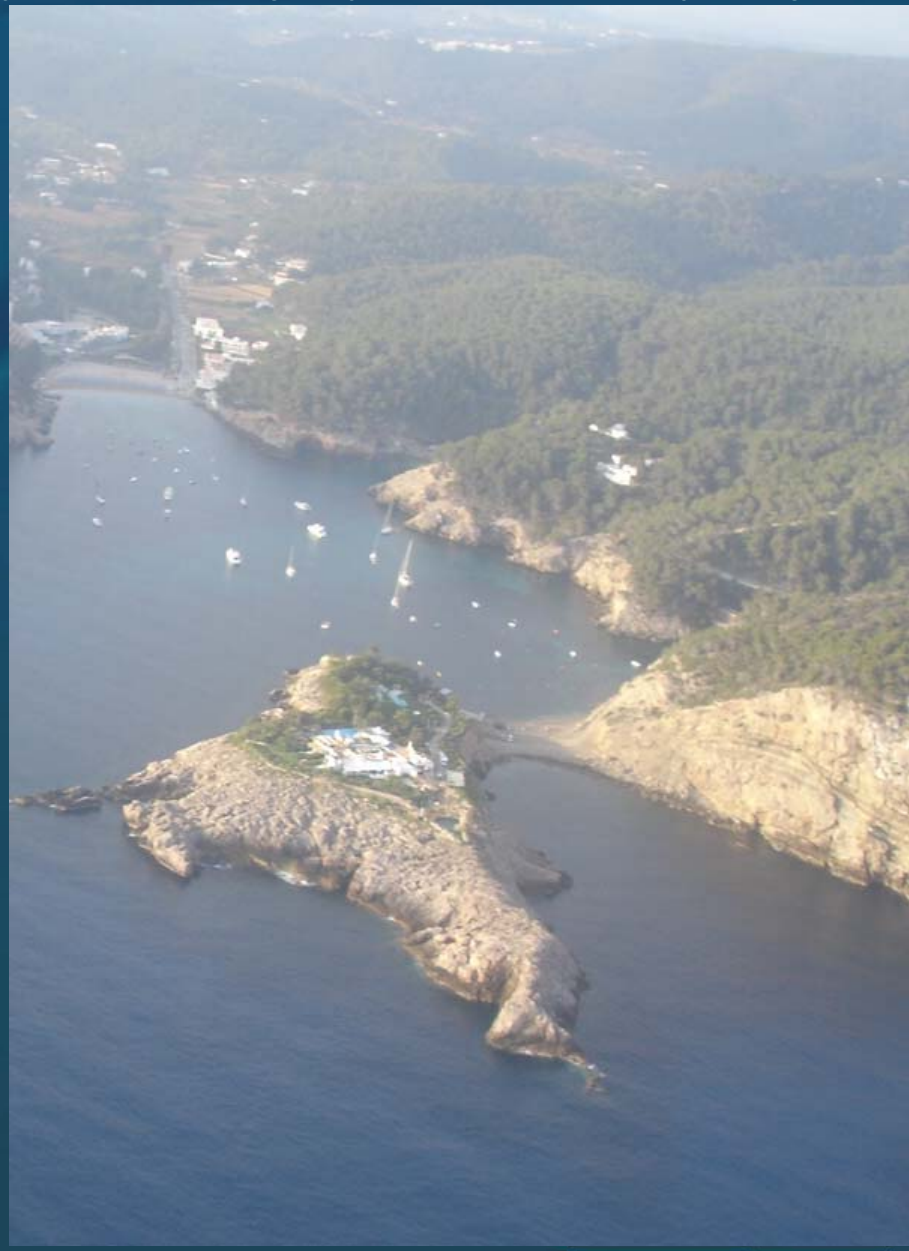
The methods for this study, described in the following subsections, were designed to estimate:

(a) Resource (seabed) available for recreational boating in Mallorca.

(b) Pressure (demand) for that space.

(c) Number and relative proportion of boats that can anchor around the island based on three spatial scenarios (i.e. the distance between anchored boats).

(d) Number of days suitable for anchoring based on wave climate characterization.



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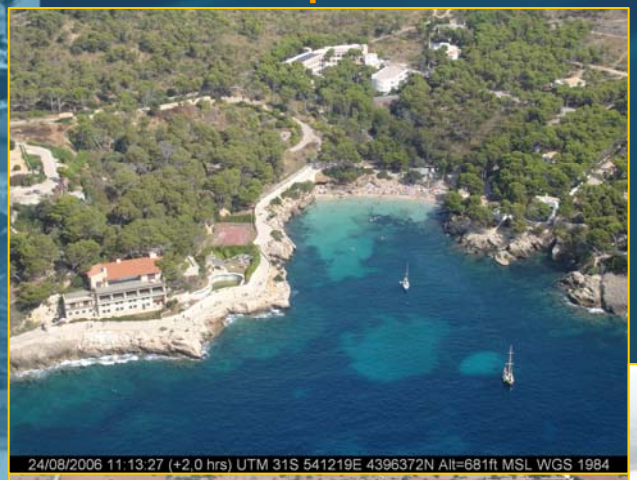
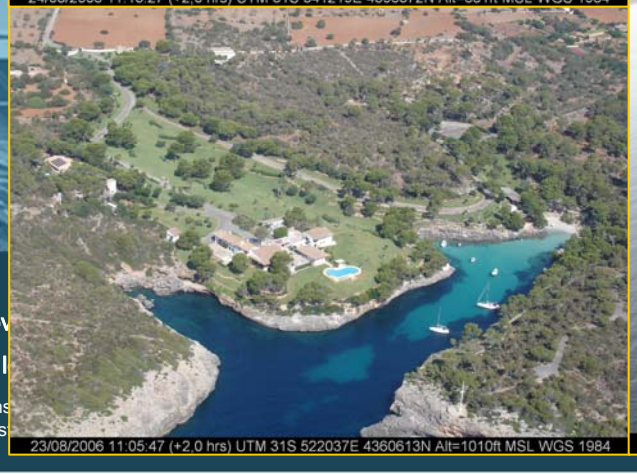
4.- Methods. RESOURCE (seabed available for anchoring)

Anchoring zones in Mallorca have been identified using georeferenced oblique aerial photographs, taken during the summers of 2006 and 2007 (June to September) by the Surveillance and Cleaning Service of the Balearic Government).

163 anchor areas have been identified along the coast of Mallorca (Figure 1), based on the presence of anchored boats in the photographs.





Anchoring zones identified include sheltered coasts (e.g. natural harbours, bays, coves), exposed coasts such as open beaches, popular due to their aesthetic and natural characteristics, and areas within close proximity to urban areas and/or ports,

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4.- Methods. RESOURCE (seabed available for anchoring)

The total seabed available for anchoring, understood as sensitive seabed (presence of seagrass) and non-sensitive (sandy seabed), has been mapped for all the identified anchoring zones using GIS (ArcGIS 9.1) and digital aerial orthophotographs taken in 2002 and 2006.

It was necessary to use aerial orthophotographs from two different flights and years (2002 and 2006) because specular reflections produced by the angle of incidence of sunlight did not always permit a clear view of the seabed.

Studies of seagrass growth tell us that appreciable changes in cover of seabeds is difficult to perceive from aerial photos separated by a period of 4 years.

Total seabed (presence of seagrass beds)

Sandy seabeds

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4.- Methods. RESOURCE (seabed available for anchoring)

Due to the absence of detailed bathymetric data close to the coastline (- 5m), demarcation of the landward boundary of anchoring areas was based on the presence of boats seen in the oblique aerial photographs (over 4,000 photographs).

Seaward boundaries of anchoring corresponds with the line that connects the outer capes of the bays, coves or natural harbours.

Anchoring areas located in open coasts (exposed to onshore winds and waves) the outer (seaward) boundaries have been determined to a depth of -10 m, a limit that is also backed up by the oblique aerial photographs of SCS of Balearic Government.

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4.- Methods. Pressure (demand) for space.

The total number of berths in recreational marinas in Mallorca represents the total potential demand for anchoring.

However, not all boats located in ports/marinas operate at the same time or with the same frequency, and there is a significant proportion that hardly ever, or never sail.

A survey was conducted in the summer of 2009 to determine this proportion of 29 of the 45 marinas (according with CITTIB, 2008) on the island (which represent 9.107 berths, or 64% of the total berths).

The goal of the survey was to determine:

(a) the percentage of boats leaving their marina to navigate on the busiest day of the high season.

(b) the percentage of boats leaving the harbour that remain sailing around Mallorca

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4.- Methods. Establishment of spatial scenarios

Three spatial scenarios has been established according with the separation of anchor boats.

Distances considered has been every 25 m, 50 m and 75 m between anchor points.

Three raster grids were created using the Spatial Analyst Tool of ArcGIS 9.1, grids were converted into polygonal shapes and the geographical (X,Y) centroid of each cell (polygon) was calculated.

The centroids were exported as standalone point shapes which were clipped with the anchoring zones (sandy and total seabeds).

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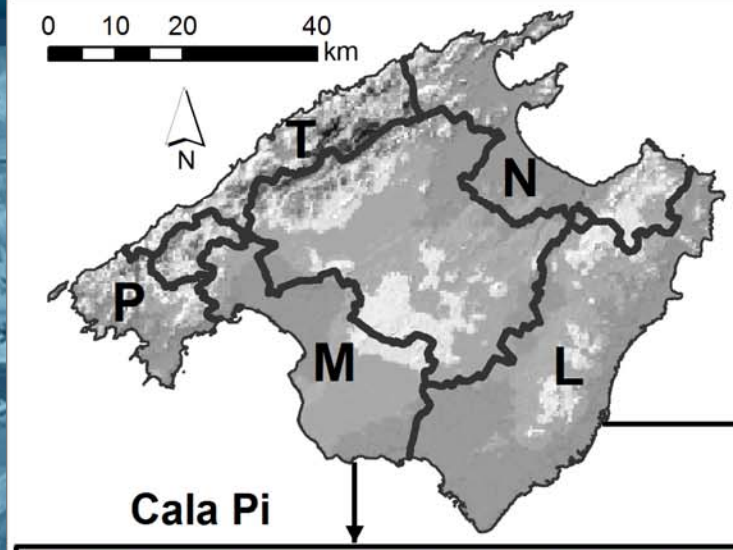
4.- Methods. Establishment of spatial scenarios

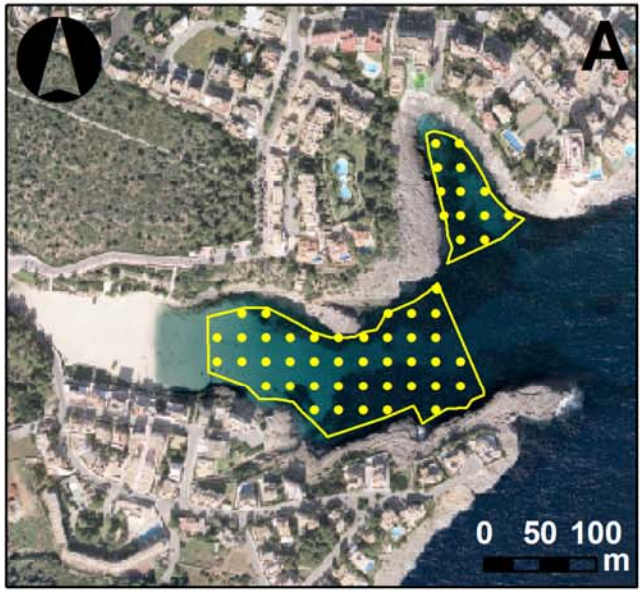


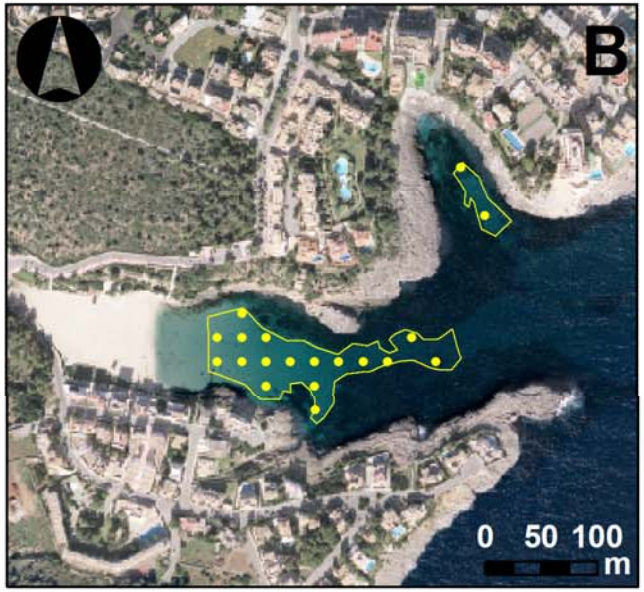
HEMUs

P: Ponent
M: Migjorn
L: Llevant
N: Nord
T: Tramuntana

Cala Marçal

Cala Pi





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4.- Methods. Number of days suitable for anchoring

It is important to note that all of the anchoring zones identified for this study will not be suitable for anchoring at the same time.

Wave climate conditions around the island determine the areas that are suitable for anchoring on any given day in the different coastal exposure zones.

Wave data used in this study is part of the HIPOCAS Project (Hindcast of Dynamic Processes of the Ocean and Coastal Areas of Europe). Data covers time period ranging from 1958 to 2001 on an hourly basis (providing 44 years of wave data).

This methodology was used to calculate the number of days not suitable for anchoring (Hs>0.5 meters) in the summer period ranging from June to September (122 days total) in the Balearic Coasts.

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5.- Results

In accordance with the four methodological processes described in the previous section, the main objectives of this analysis were to

(a) Estimate the total area of the anchoring zones around Mallorca, based on two types of seabed: seagrass and sandy.

(b) Estimate the pressure upon this resource from the recreational boating sector.

(c) Estimate the maximum number of boats that can anchor along the coast of Mallorca using three spatial anchoring scenarios.

(d) Estimate the total number of days suitable for anchoring based on wave climate characterization models.

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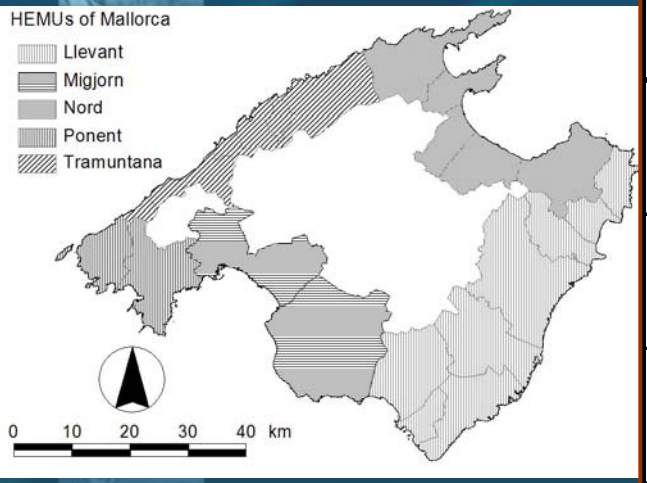
5.- Results. Resource (seabed) and Spatial Scenarios.

The total seabed available for anchoring around the island is 19,4 km^2, with 9,5 km^2 of sandy seabed.

This means that 49% of the seabed suitable for anchoring in Mallorca is sandy, with the remaining 51% being largely constituted of seagrass, a sensitive habitat.



RESULTS RELATED/CLASSIFIED ACCORDING WITH HEMUS (*Homogeneous Environmental Management Units*)

regional-administrative division of the island

Anchoring zones (HEMUs)		seabed area (km^2)	distance between anchors 25 m	50 m	75 m	number of berths (2008)
Ponent	sandy seabed	1,1	1.759	447	184	2.377
	whole seabed	2,9	4.596	1.155	513	
Llevant	sandy seabed	2,8	4.602	1.176	497	3.203
	whole seabed	5,3	8.485	2.118	937	
Nord	sandy seabed	3,0	4.741	1.189	522	3.057
	whole seabed	6,5	10.359	2.592	1.151	
Tramuntana	sandy seabed	0,6	973	238	112	568
	whole seabed	1,0	1.659	409	184	
Migjorn	sandy seabed	2,0	3.191	794	364	5.065
	whole seabed	3,7	5.944	1.490	658	
Total Results	sandy seabed	9,5	15.266	3.844	1.679	14.270
	whole seabed (sensitive seabeds)	19,4	31.043	7.764	3.443	

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5.- Results. Resource (seabed), Pressure (demand) and Spatial Scenarios.

Results of the survey:

49% of boats leave the marina on the busiest day of the summer seasson. And 87% of them remain in coastal waters of Mallorca.

If those results are extrapolated to include the total number of berths in Mallorca (i.e. all the marinas, 14,270 berths), this amounts to an estimated total of 6,082 vessels

Anchoring zones (HEMUs)		seabed area (km^2)	distance between anchors 25 m	50 m	75 m	number of berths (2008)	boats sails regularly in coastal waters
Ponent	sandy seabed	1,1	1.759	447	184	2.377	1.013
	whole seabed	2,9	4.596	1.155	513		
Llevant	sandy seabed	2,8	4.602	1.176	497	3.203	1.365
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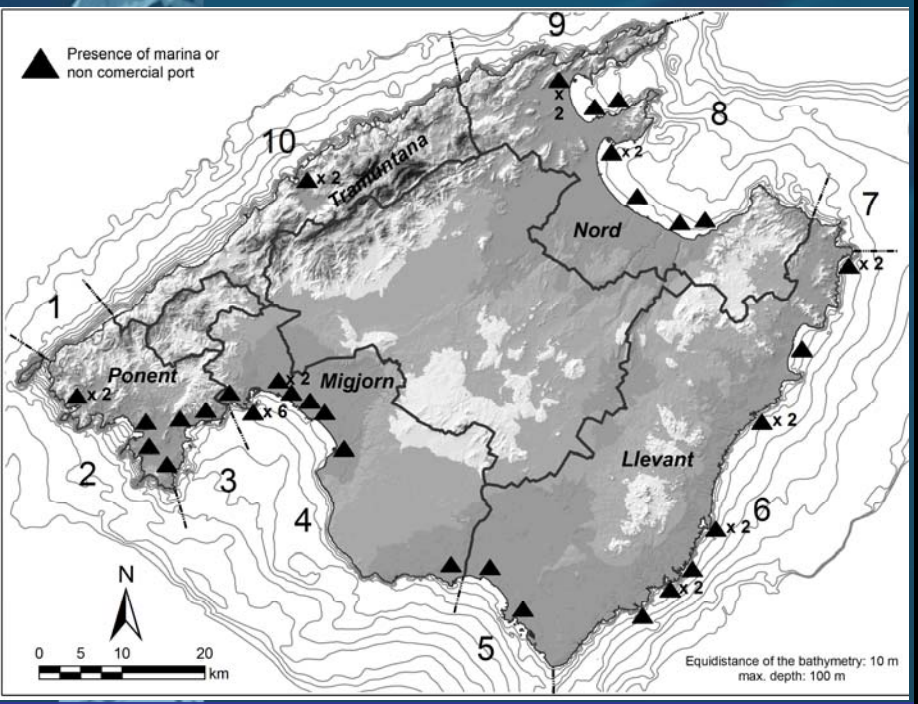

Boundary delimitation of the coastal exposure zones (1-10) used for the study of wave climate (determining the maximum Hs for anchoring),

HEMU	coastal exposure zone (figure 2)	suitable days (n = 122)	non suitable days (Hs>0.5m)
Ponent	1	110	12
	2	93	29
	3	99	23
Migjorn	4	99	23
Llevant	5	104	18
	6	110	12
	7	106	16
Nord	8	98	24
	9	92	31
Tramuntana	10	101	21

Number of suitable days for anchoring in the coastal zones (according with figure) of each HEMU according with the characterization of wave climate

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6.- Discussion

There is a need to understand and regulate coastal areas from a spatial perspective in order to increase compatibility among uses, and where necessary, establish limits (¿¿¿???).

The historical relationship between marine science and implementation of management policies is challenging and often conflictive.

(scientific works often do not respond to the needs of the management)

(Ojeda-Martinez *et al*., 2009; Stojanovic *et al*., 2009)

The aim of this work is to generate scientific information that responds to the need of spatial management of an important leisure activity in the coastal zone of Mallorca, which to date is not subject to much regulation.

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6.- Discussion

Discussion of spatial analysis recreational boating activity (anchoring)

Limitations

1.- Lack of bathimetries between 0 and -5 meters

2.- No data about number of boats in each anchoring area

3.- Anchoring areas bounded without taking into account legislation

Management Implications

1.- Spatial scenarios established may be proportionately related to the degree of saturation/occupation

High (25m) middle (50m) low (75m)

2.- Some international examples of regulation of distances between anchored boats (30m – 40 m)

3.- Analysis of distance between anchoring buoys of Spatial Marine Areas of the Balearic Islands

4.- Existing reality demonstrated (in numerous cases) that boats anchor at distances less than 15 m

5.- Results of this study may seem there are enough space for anchoring (???)

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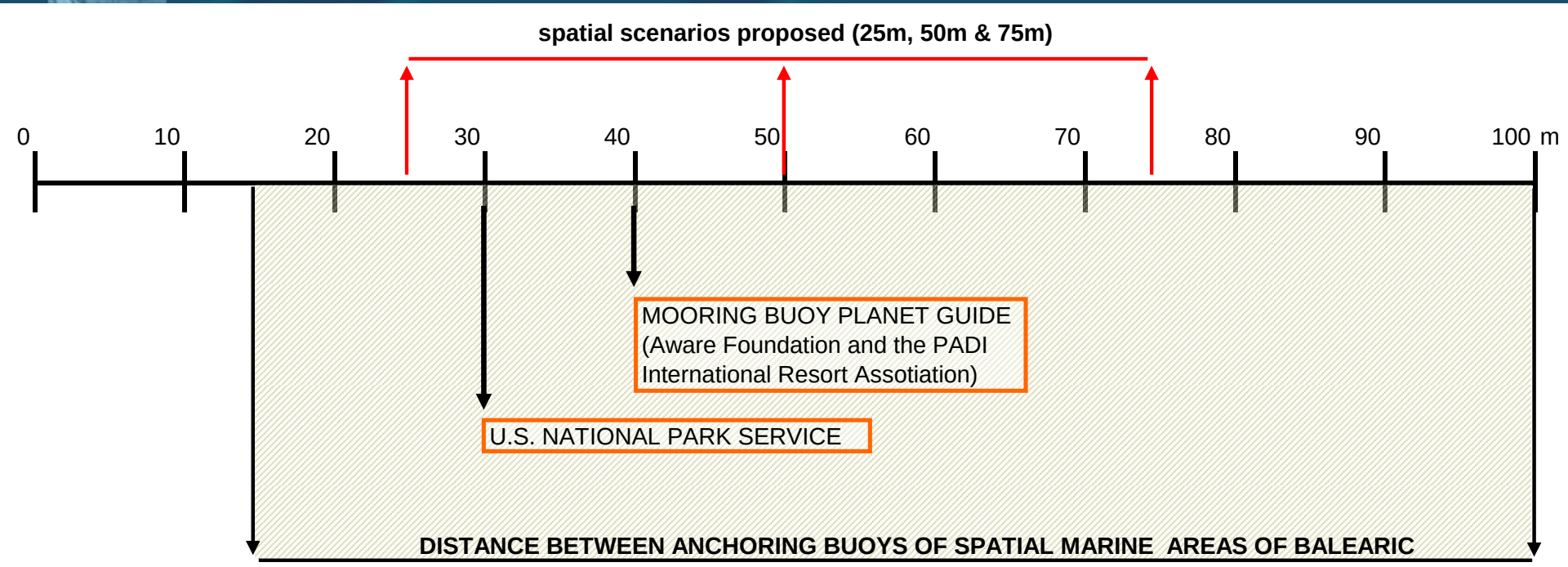

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Ponent	sandy seabed	1,1	1.759	447	184	2.377	1.013
	whole seabed	2,9	4.596	1.155	513		
Llevant	sandy seabed	2,8	4.602	1.176	497	3.203	1.365
	whole seabed	5,3	8.485	2.118	937		
Nord	sandy seabed	3,0	4.741	1.189	522	3.057	1.303
	whole seabed	6,5	10.359	2.592	1.151		
Tramuntana	sandy seabed	0,6	973	238	112	568	242
	whole seabed	1,0	1.659	409	184		
Migjorn	sandy seabed	2,0	3.191	794	364	5.065	2.159
	whole seabed	3,7	5.944	1.490	658		
Total Results	sandy seabed	9,5	15.266	3.844	1.679	14.270	6.082
	whole seabed (sensitive seabeds)	19,4	31.043	7.764	3.443		

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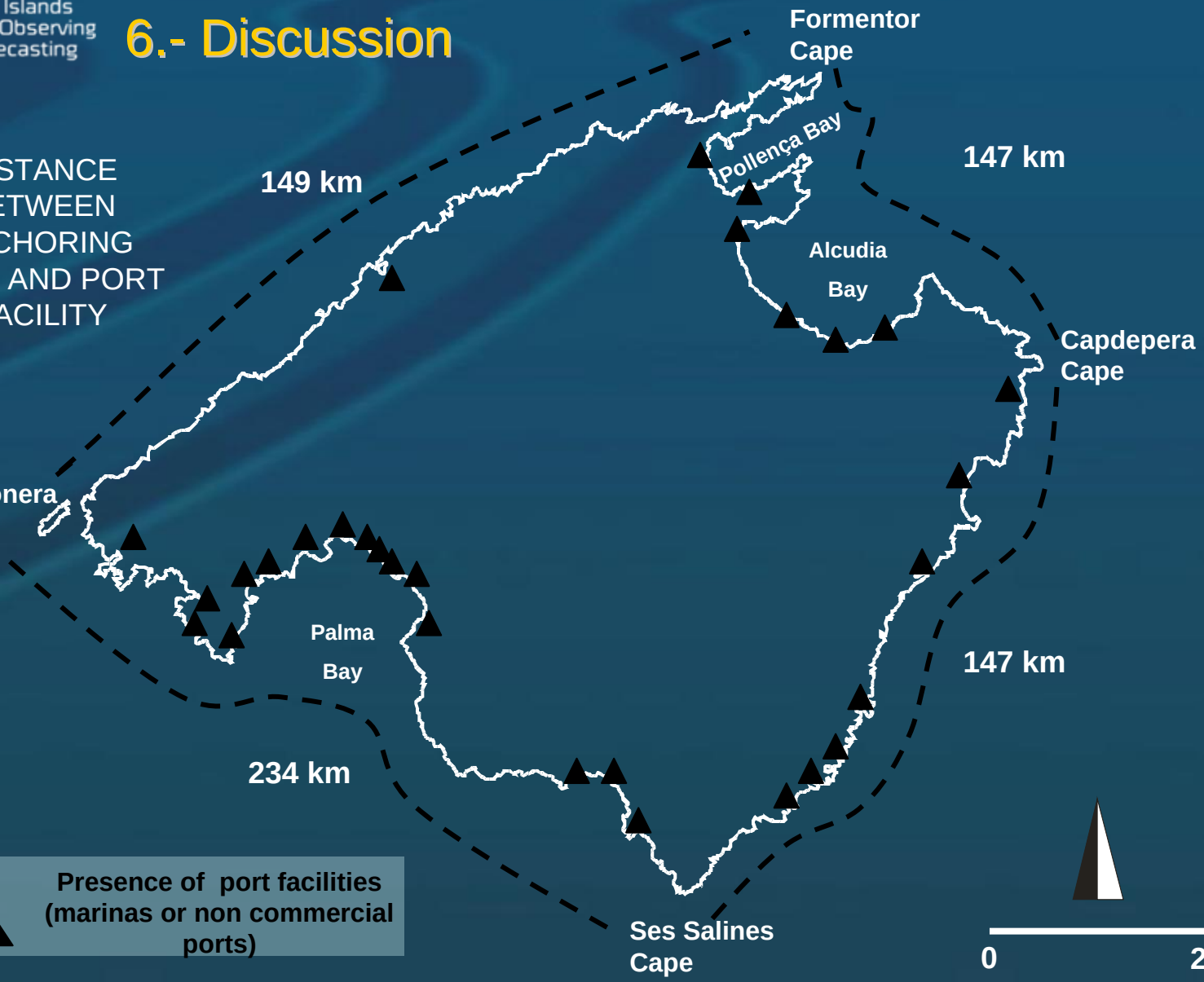
6.- Discussion

DISTANCE BETWEEN ANCHORING AREA AND PORT FACILITY



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7.- Conclusions

This work represents a preliminary step towards understanding the relationship between the availability of space for anchoring and the pressure exerted upon that space.

The study makes use of best available data and the simple methods could be applied to any coastal area where spatial information is needed to manage recreational boating.

The results indicate an elevated amount of pressure from recreational boating on available anchoring space and suggest that current regulations to protect benthic environments and regulate anchoring in general are not implemented.

NECESSARY MANAGEMENT MEASURES SHOULD BE PUT IN PLACE TO ENFORCE CURRENT LEGISLATION AND EDUCATE BOATERS ABOUT BEST PRACTICES

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Thanks for your attention!!!

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Cambra de Comerç Mallorca

Govern de les Illes Balears
Conselleria d'Innovació, Interior i Justícia

Sistema de Observación y Predicción Costero de las Illes Balears

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