



Balearic Islands
Coastal Observing
and Forecasting
System

Spatial Characterization of Badia de Palma

(Mallorca, W. Mediterranean)

SOCIB



Balearic Islands
Coastal Observing
and Forecasting
System

0 2,5 5 km



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

Sistema de Observación y Predicción Costero de las Illes Balears



GOBIERNO
DE ESPAÑA

MINISTERIO
DE CIENCIA
E INNOVACIÓN



Balearic Islands
Coastal Observing
and Forecasting
System

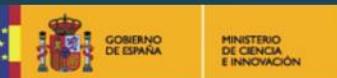


1.- INTRODUCTION



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

Sistema de Observación y Predicción Costero de las Illes Balears



MINISTERIO
DE CIENCIA
E INNOVACIÓN



Balearic Islands
Coastal Observing
and Forecasting
System

INTRODUCTION

SOCIB

Balearic Islands Coastal Observing and Forecasting System

SOCIB is composed of three Divisions:

SOS Division

- Observing Facilities
- Modelling and Forecasting Facility
- Data Center Facility

Systems Operation and Support Division

ETD Division

- Facility Support and Technology Development
- New Technology Pilot Programme

Engineering and Technology Development Division

SIAS Division

- Sustainability Science & ICOM Research
- Tools for Science based ICOM

Strategic Issues and Applications for Society Division

www.socib.es

0 2,5 5 km



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

Sistema de Observación y Predicción Costero de las Illes Balears

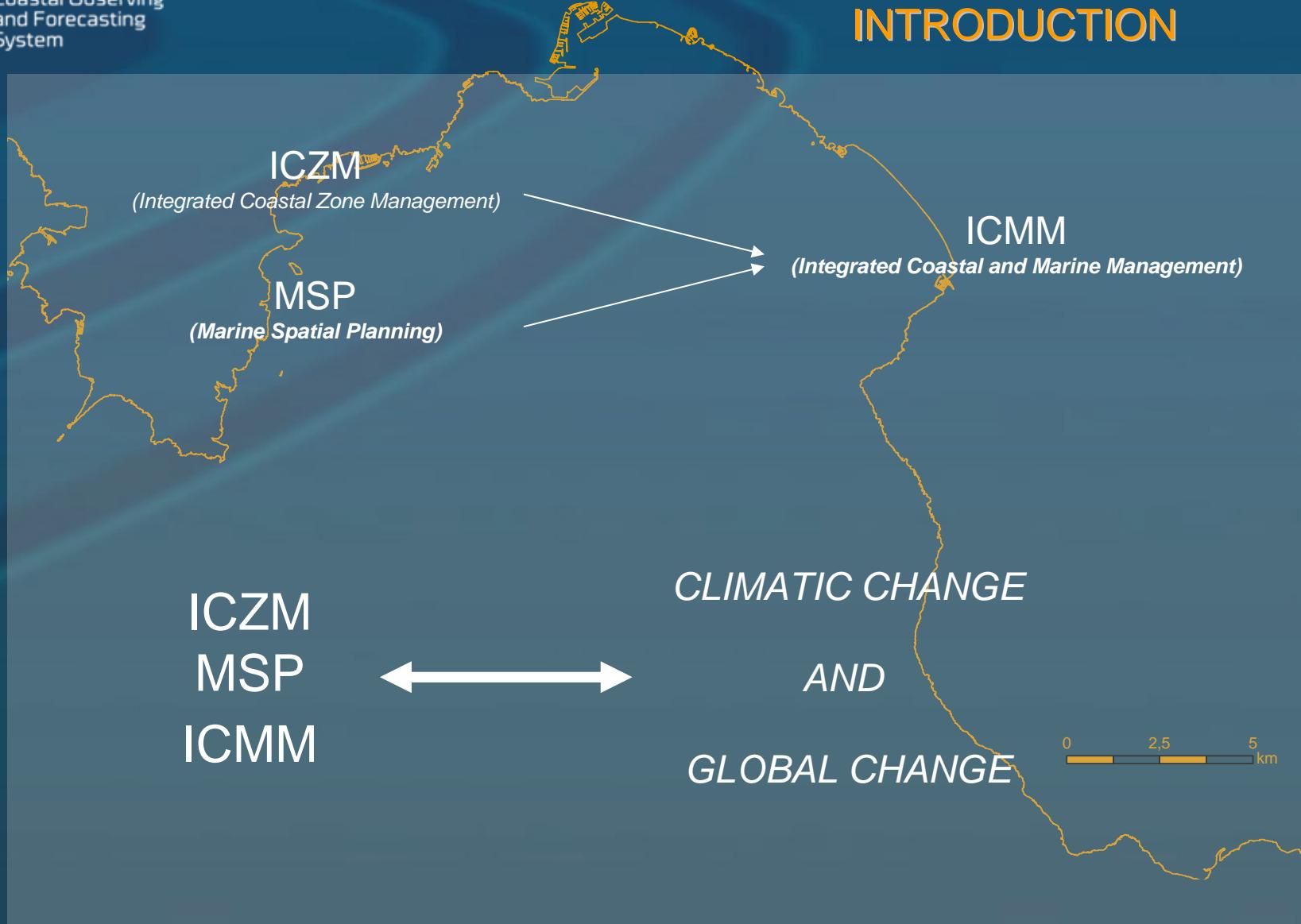


GOBiERNO
DE ESPAÑA
MINISTERIO
DE CIENCIA
E INNOVACIÓN



Balearic Islands
Coastal Observing
and Forecasting
System

INTRODUCTION



Govern

de les Illes Balears

Conselleria d'Innovació, Interior
i Justícia

Sistema de Observación y Predicción Costero de las Illes Balears



MINISTERIO
DE CIENCIA
E INNOVACIÓN

INTRODUCTION

- The aim of this proposal is the application of a criteria for zoning the coastal areas according with a ICZM initiative in order to determine areas with greatest influence on the coastal zone.
- Expected results are based on the recognition of areas that receive a major influence of the whole of the Badia de Palma (areas with the greatest influence on the rest of the territory)



INTRODUCTION

-The structure of the proposal is organized as follows:

- Determine the boundaries of the coastal zone (landward and seaward) of the Badia de Palma. According with an initiative of ICZM.
- Identify the areas with the greatest influence on the coastal zone and vice versa.

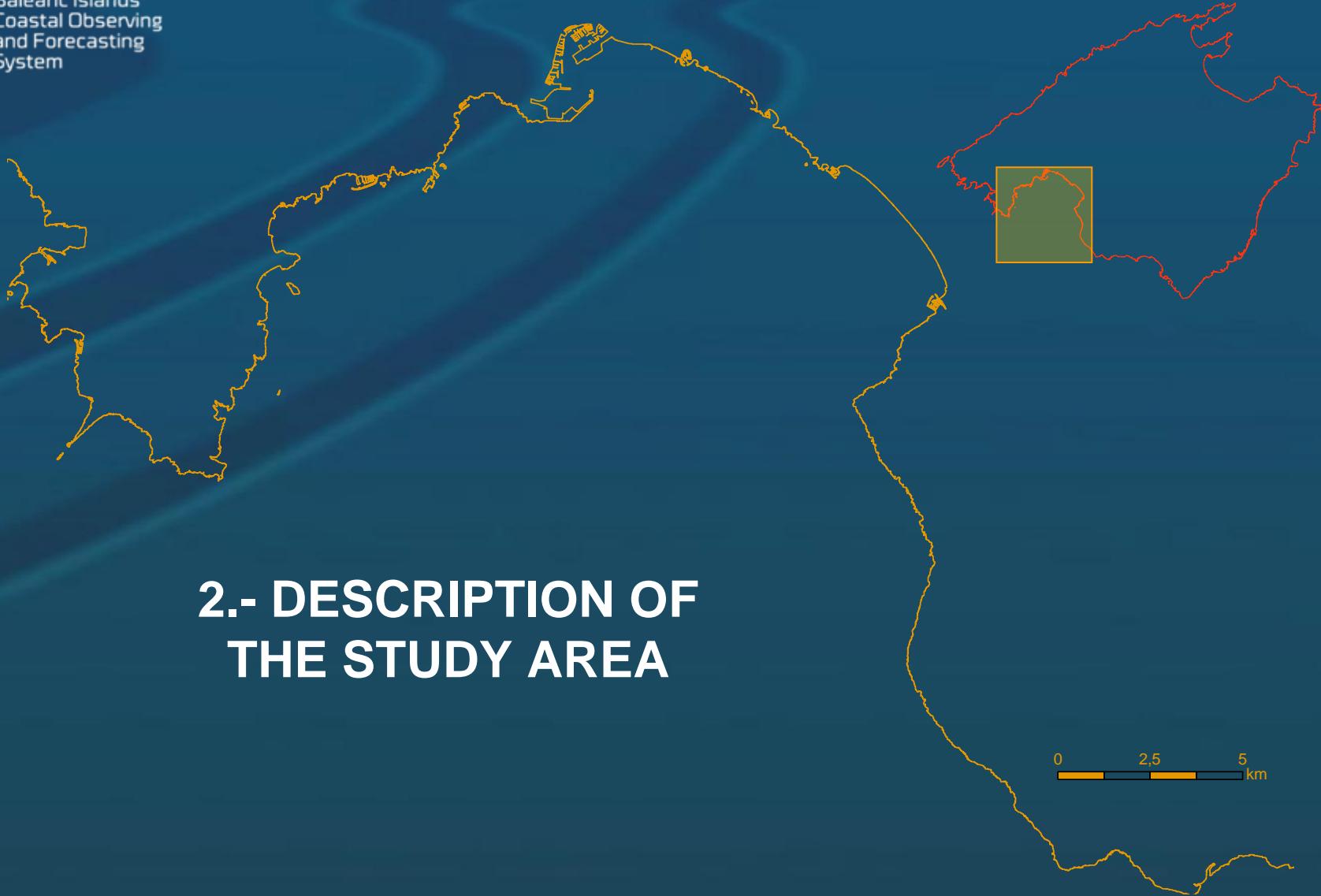
POSSIBLE APPLICATIONS (¿¿?)

- *Establishment the main uses of marine areas of Badia de Palma.*
- *Analyze the compatibility of existing uses with the distribution of areas with greater influence over the whole bay.*





Balearic Islands
Coastal Observing
and Forecasting
System



2.- DESCRIPTION OF THE STUDY AREA



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

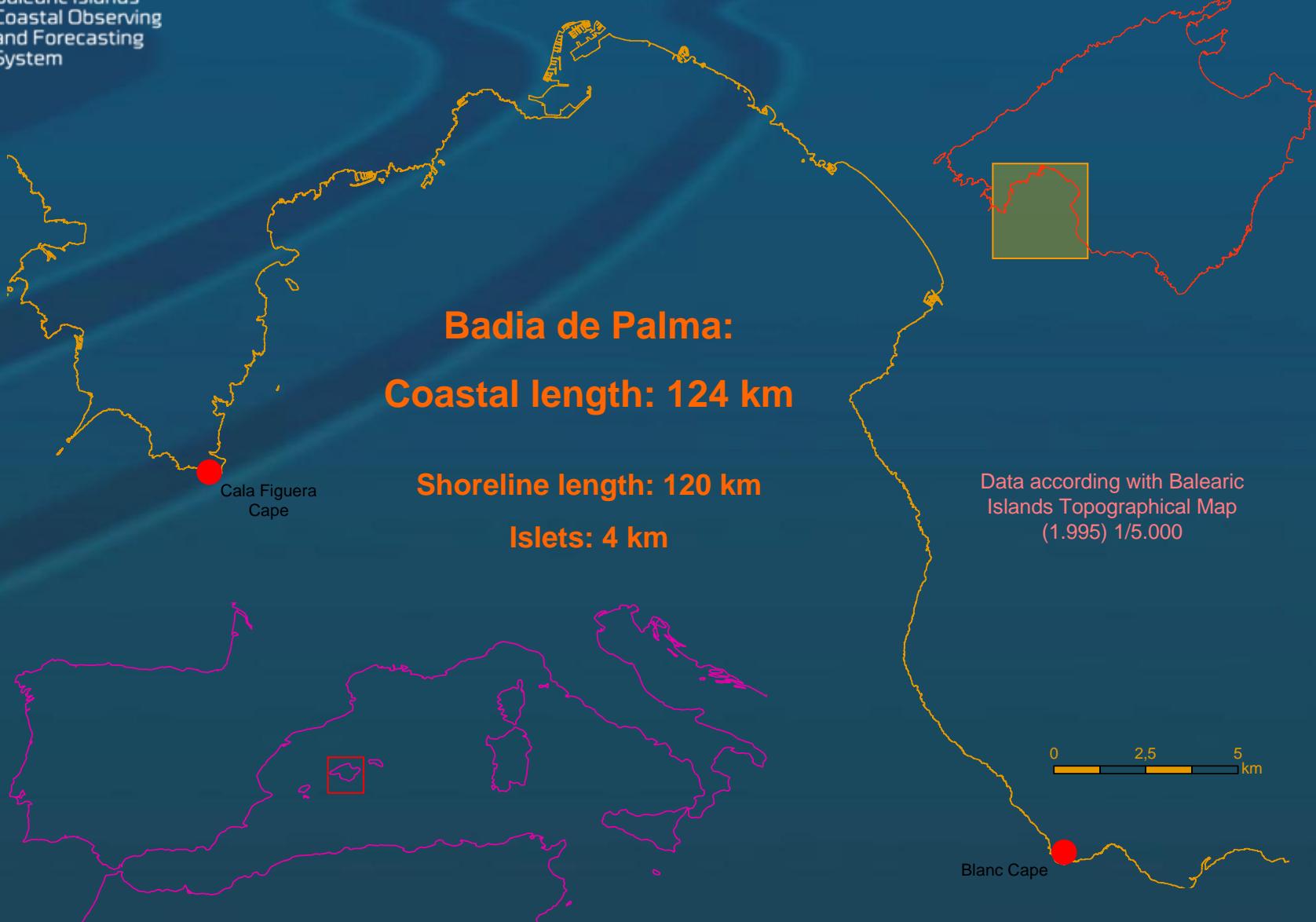
Sistema de Observación y Predicción Costero de las Illes Balears



MINISTERIO
DE CIENCIA
E INNOVACIÓN



Balearic Islands
Coastal Observing
and Forecasting
System



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

Sistema de Observación y Predicción Costero de las Illes Balears

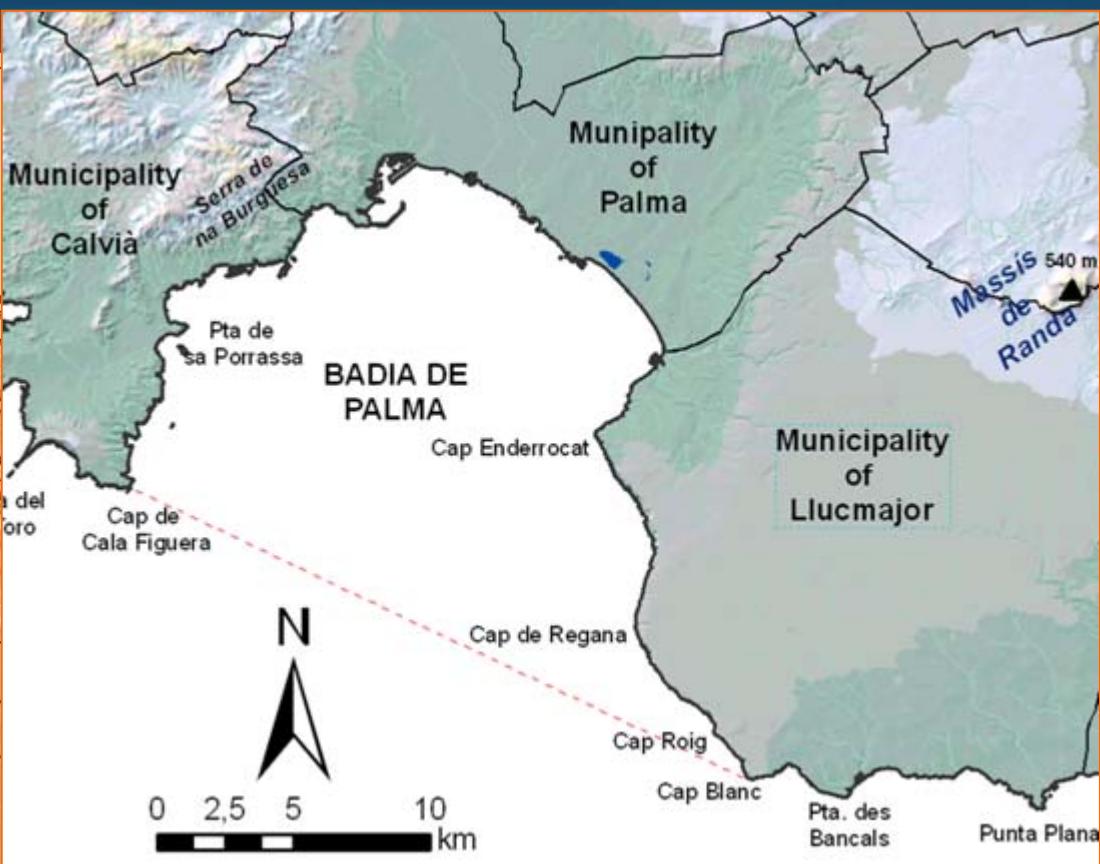
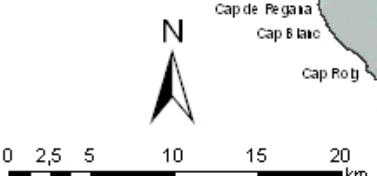
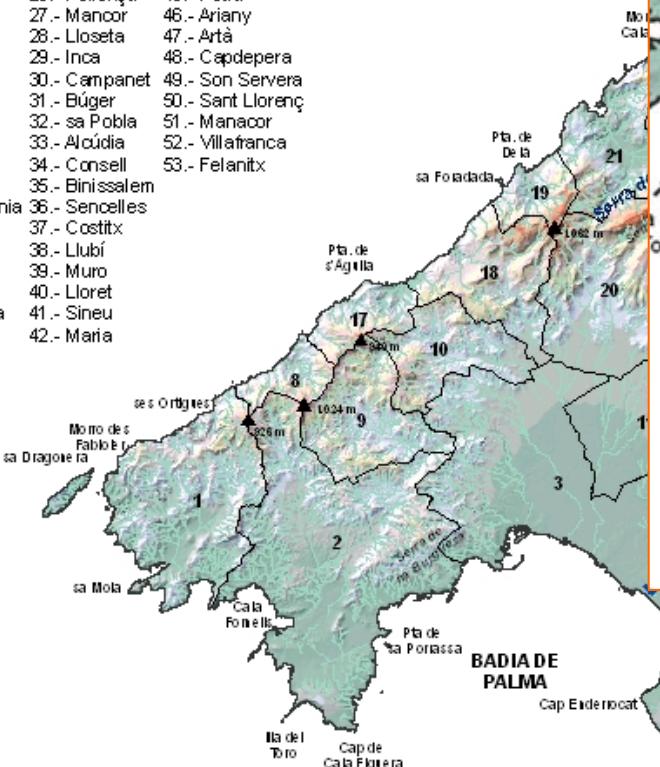


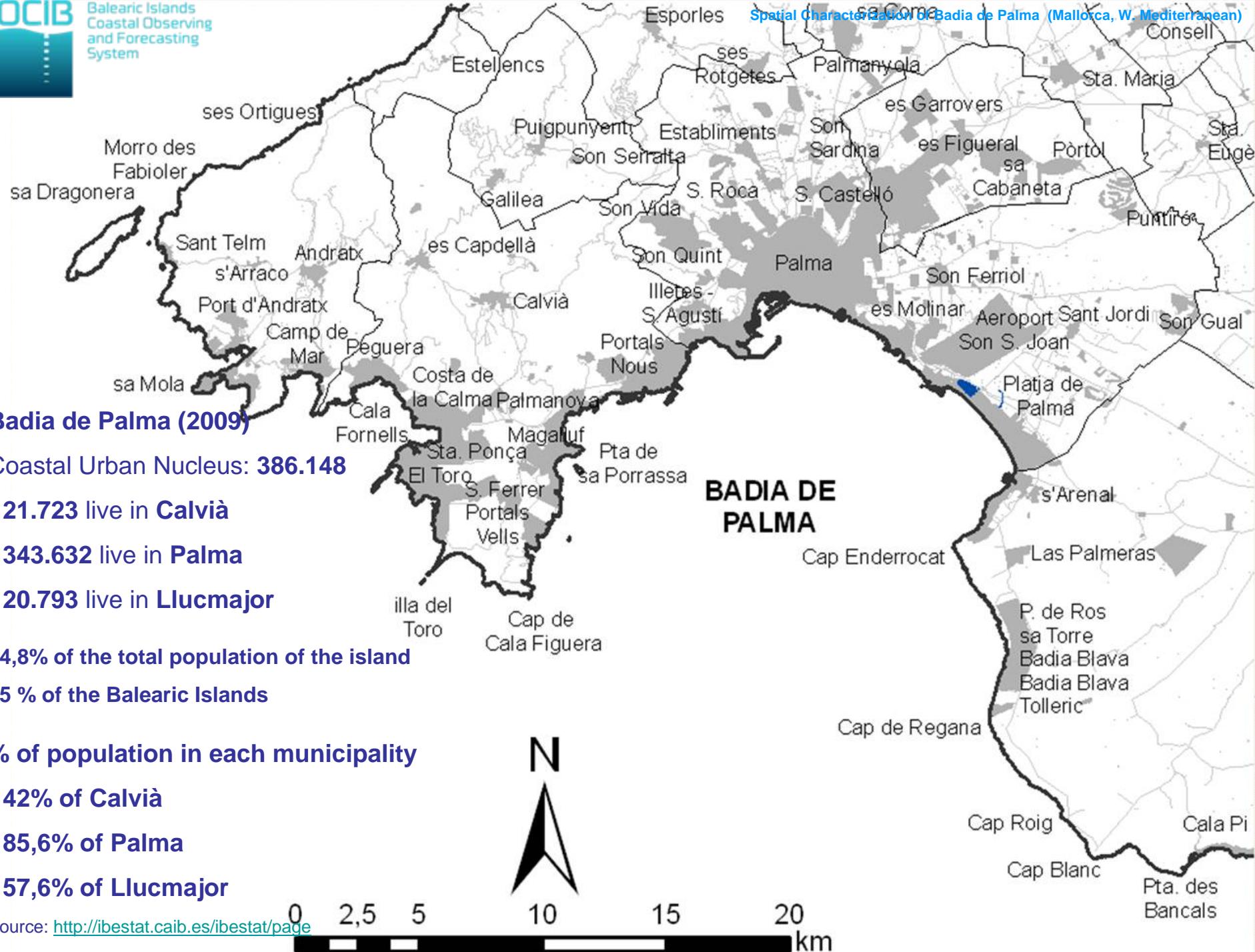
MINISTERIO
DE CIENCIA
E INNOVACIÓN

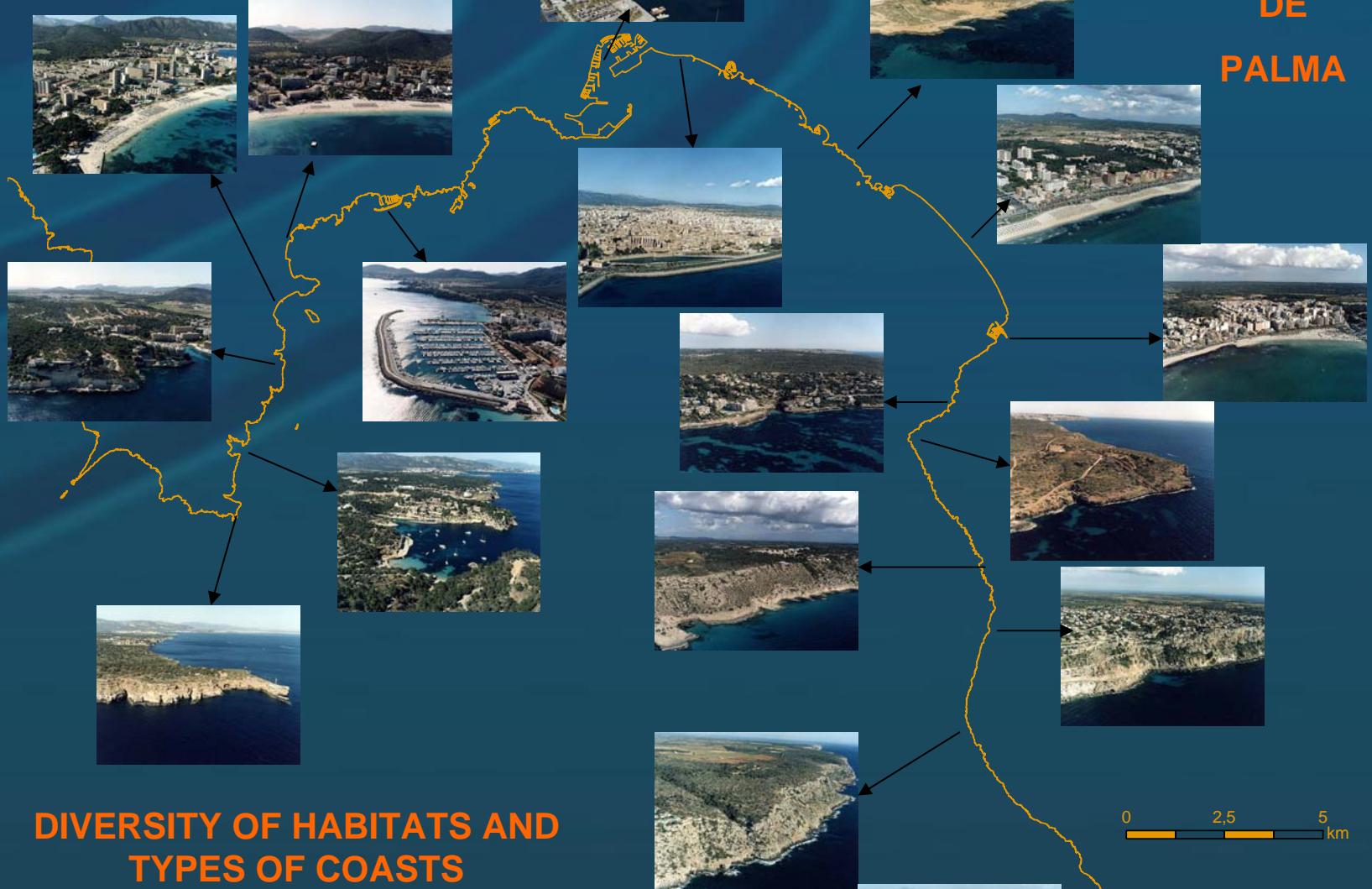
Mallorca (Balearic Islands, Spain) (municipalities and relief)

name of municipalities

- 1.- Andratx
- 2.- Calvià
- 3.- Palma
- 4.- Llucmajor
- 5.- Campos
- 6.- Ses Salines
- 7.- Santanyí
- 8.- Estellencs
- 9.- Puigpunyent
- 10.- Esporles
- 11.- Marratxí
- 12.- Santa Maria
- 13.- Santa Eugènia
- 14.- Algaida
- 15.- Montúri
- 16.- Porreres
- 17.- Banyalbufar
- 18.- Valldemossa
- 19.- Deià
- 20.- Bunyola
- 21.- Sóller
- 22.- Fornalutx
- 23.- Alaró
- 24.- Escorca
- 25.- Selva
- 26.- Pollença
- 27.- Manacor
- 28.- Lloseta
- 29.- Inca
- 30.- Campanet
- 31.- Búger
- 32.- sa Pobla
- 33.- Alcúdia
- 34.- Consell
- 35.- Binissalem
- 36.- Sencelles
- 37.- Costitx
- 38.- Llubí
- 39.- Muro
- 40.- Lloret
- 41.- Sineu
- 42.- Maria
- 43.- Sta. Margalida
- 44.- Sant Joan
- 45.- Petra
- 46.- Ariany
- 47.- Artà
- 48.- Capdepera
- 49.- Son Servera
- 50.- Sant Llorenç
- 51.- Manacor
- 52.- Villafranca
- 53.- Felanitx







DIVERSITY OF HABITATS AND TYPES OF COASTS

Sistema de Observación y Predicción Costero de



Balearic Islands
Coastal Observing
and Forecasting
System



5.898 berths for recreational boats. Distributed in 18 marinas (CITTIB, 2009)



Blanc Cape

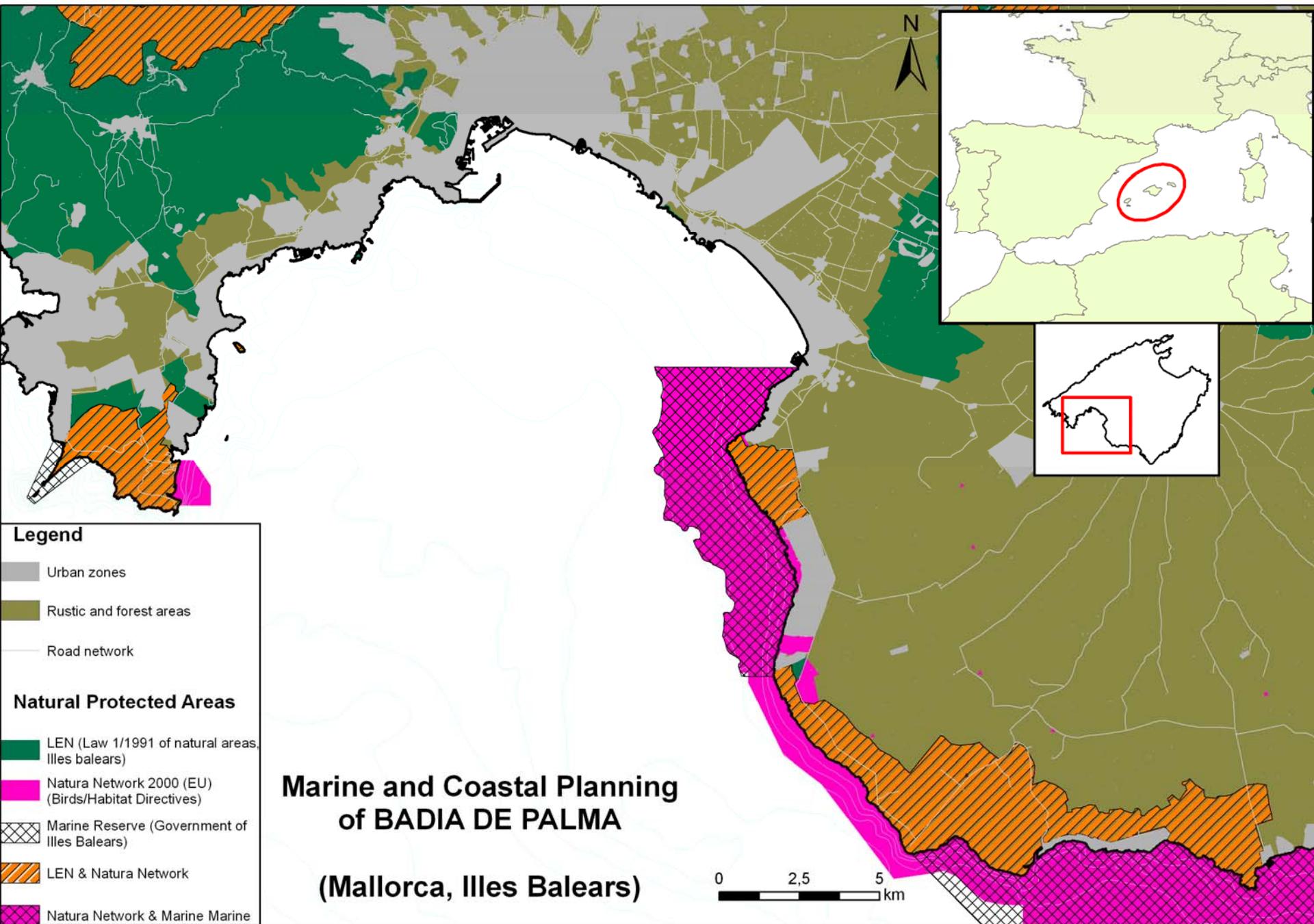


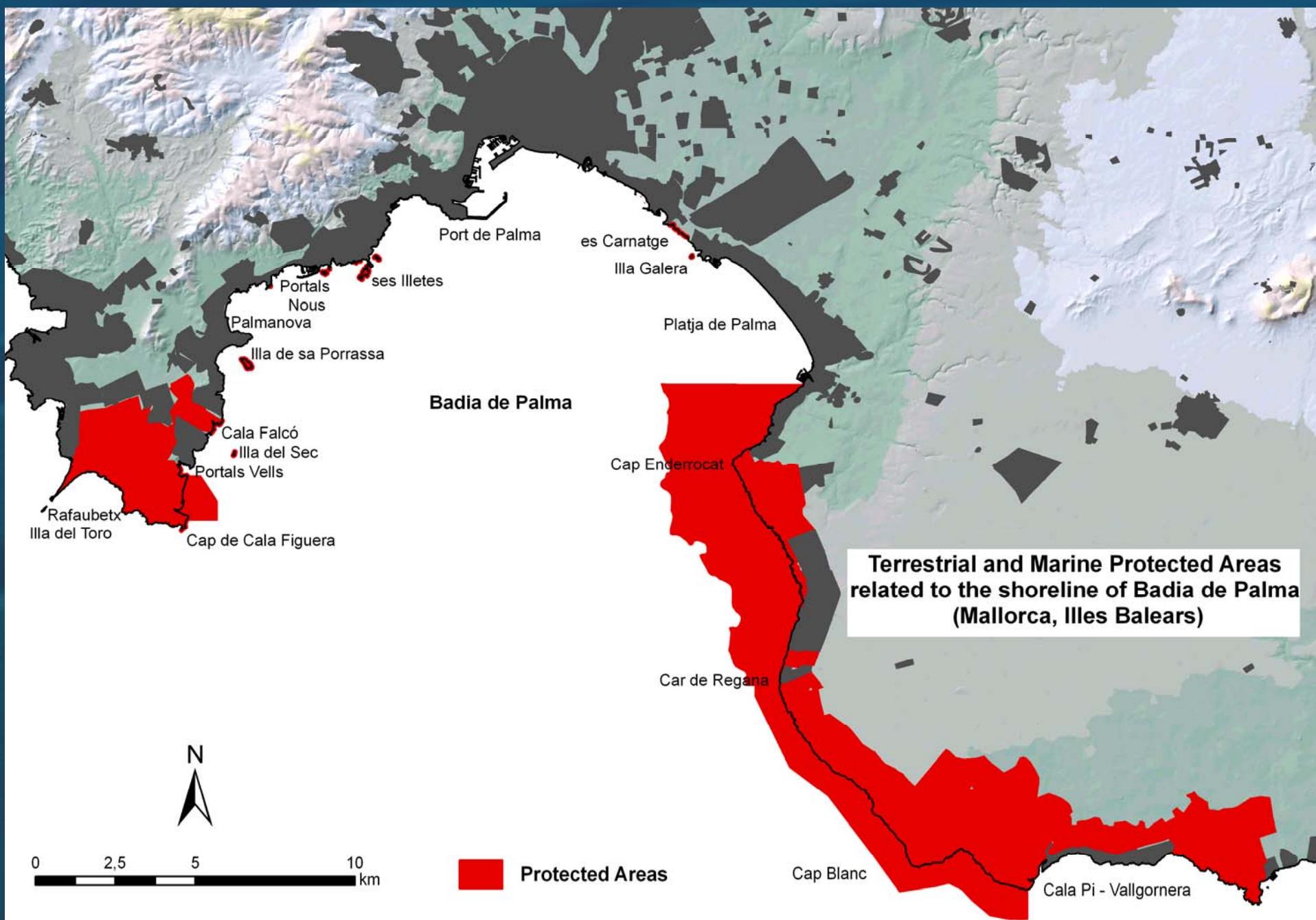
Govern
de les Illes Balears
Conselleria d'Innovació, Interior
i Justícia

Sistema de Observación y Predicción Costero de las Illes Balears



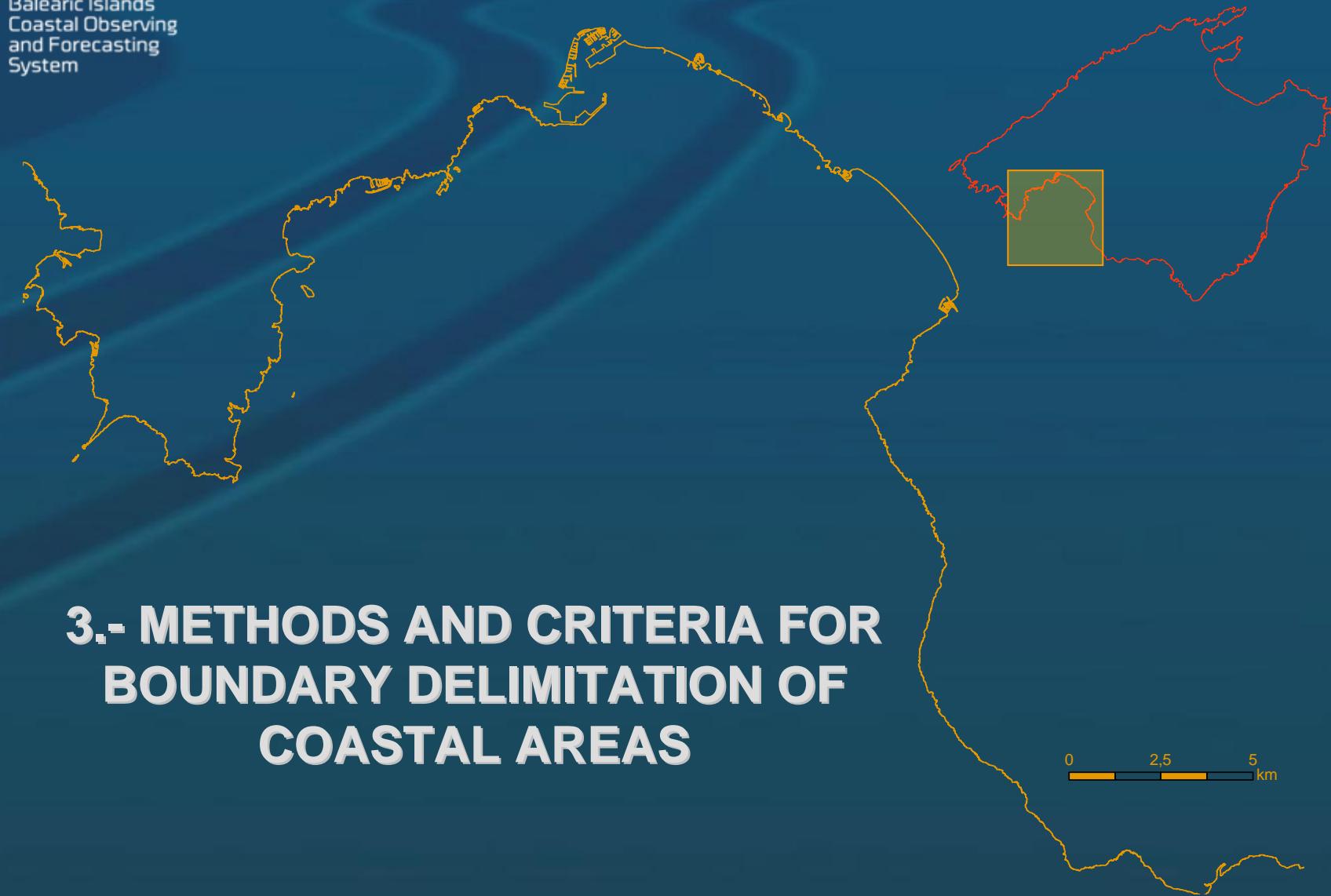
GOBIERNO
DE ESPAÑA
MINISTERIO
DE CIENCIA
E INNOVACIÓN







Balearic Islands
Coastal Observing
and Forecasting
System



3.- METHODS AND CRITERIA FOR BOUNDARY DELIMITATION OF COASTAL AREAS



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

Sistema de Observación y Predicción Costero de las Illes Balears



MINISTERIO
DE CIENCIA
E INNOVACIÓN

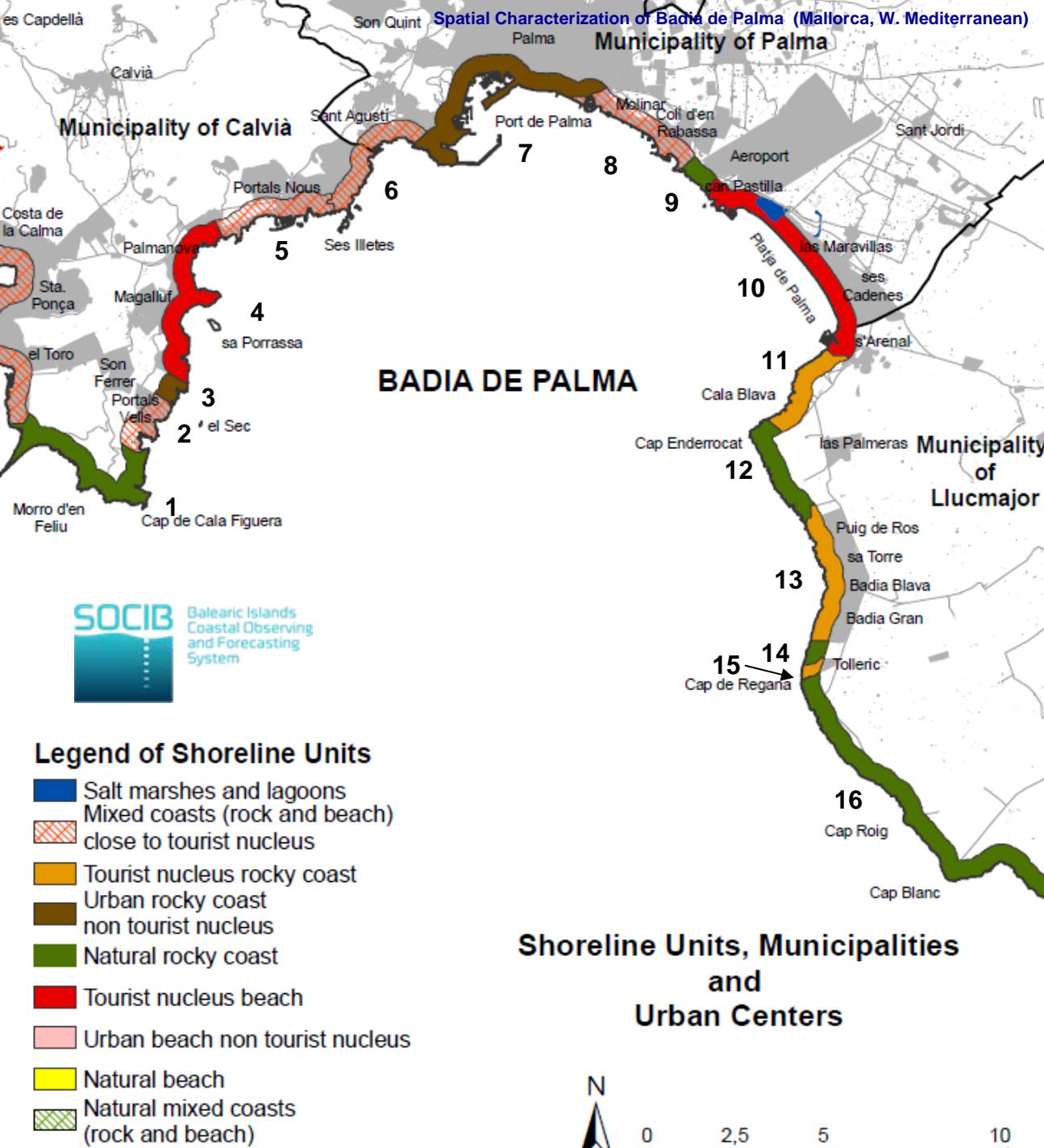


METHODS AND CRITERIA FOR BOUNDARY DELIMITATION OF COASTAL AREAS

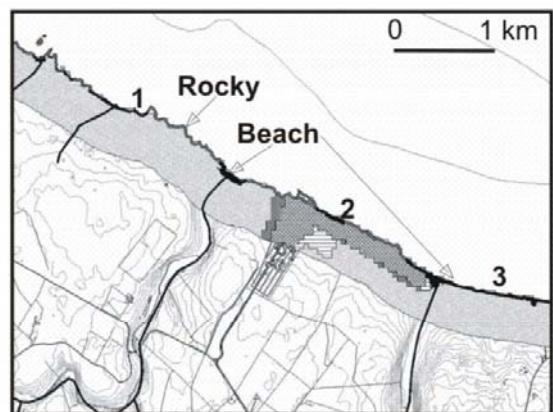
- Definition of Shoreline Units (SU)
- Shoreline Units defined according to the following criteria:
 - Elevation (0-200m, > 200m)
 - Coastal typologies (rocky, sandy)
 - Tourist nucleus (POOT, Arrangement plan of Touristic Supply))
 - Land uses (natural protected, rural landscapes or urban areas)
- Definition of Functional areas of SU.
 - Management nucleus
 - Complementary management zones
 - Adjacent management zones
- Analysis Units (AU).

Badia de Palma 16 Shorelines Units

- 1.- Cala Figuera (Calvià)
- 2.- Portals Vells
- 3.- Cala Falcó
- 4.- Palma Nova –Magalluf
- 5.- Portals Nous
- 6.- Sant Agustí
- 7.- Palma Ciudad
- 8.- Molinar – Coll d'en Rabassa
- 9.- es Carnatge
- 10.- Platja de Palma
- 11.- Son Verí – Cala Blava
- 12.- Cap Enderrocat
- 13.- Urbanitzacions Llucmajor
- 14.- Torrent de s'Osca d'es Pi
- 15.- Tollerí – El Dorado
- 16.- Cap Blanc



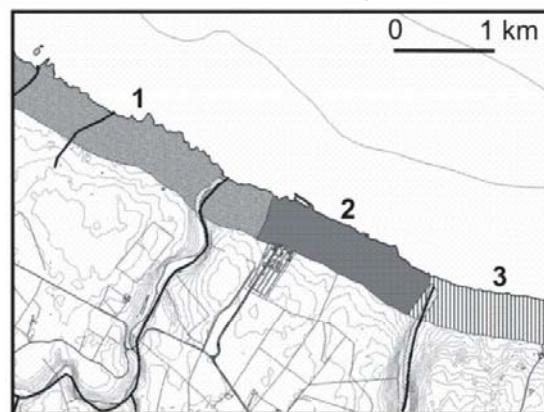
Methods and criteria for boundary delimitation of coastal areas. SUs (Shoreline Units, SUs)



Raster information concerning land use,
height and coast type (rocky or beach)

→

Territorial homogenization
of Shoreline Units



Establishment of Shoreline Units
(territorial organization types of the coastline)



1.- Son Real
Natural mixed coast (rocky and beach)



2.- Son Serra
Tourist nucleus beach



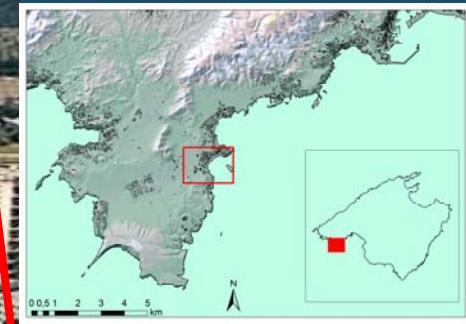
3.- Sa Canova
Natural beach

Analysis of maps and geoprocessing has been supported by

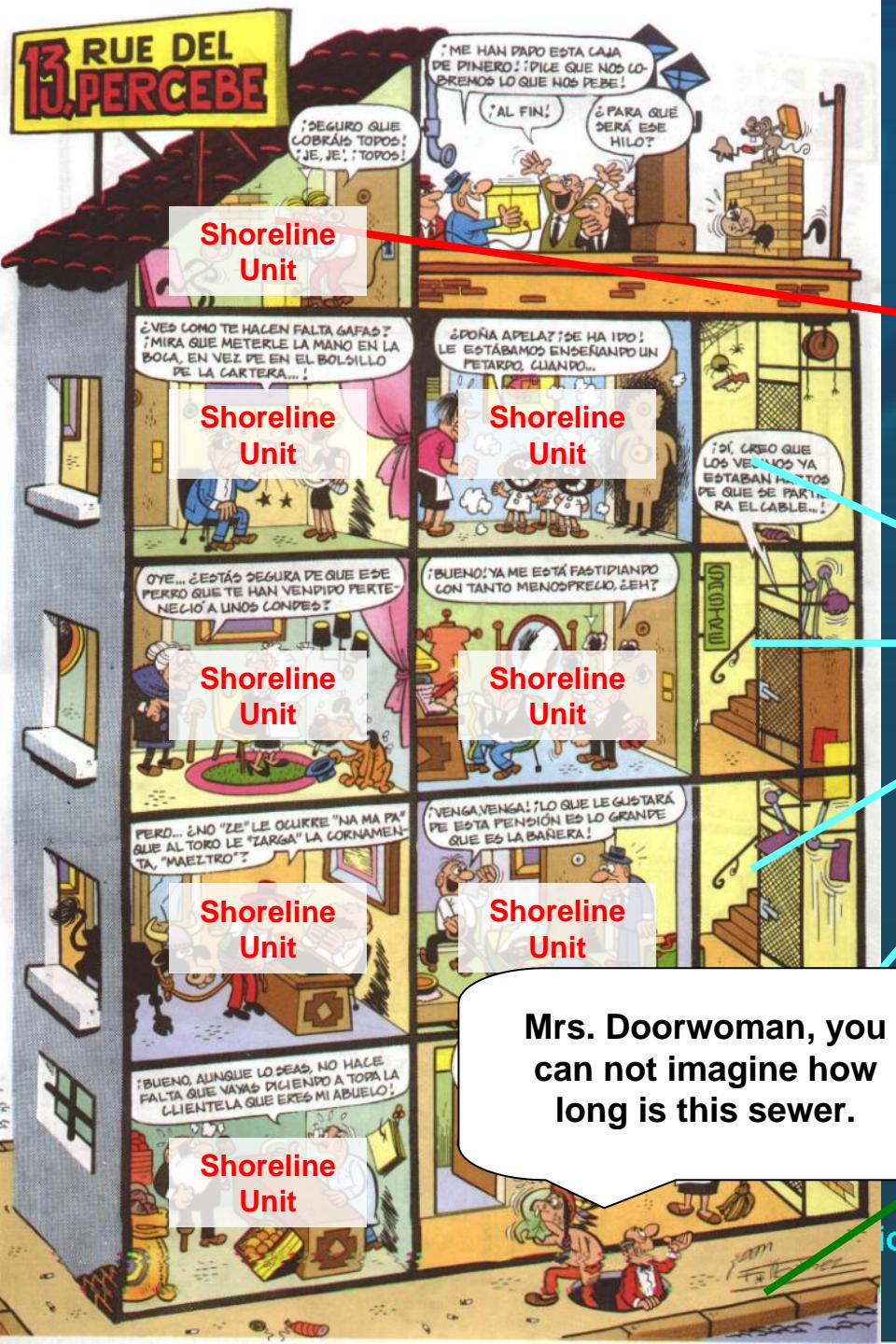
Geographical Information Systems (GIS)

Sistema de Observación y Predicción Costero de las Illes Balears

Methods and criteria for boundary delimitation of coastal areas.



Management Nucleus:
 Represents the central focus of the ICZM initiative (urban zone, popular beach, critical habitat, protected area or an area of agricultural productions).



Each apartment represents a Shoreline Unit (represents the state and organization of coastal areas). Every person, at home, is organized as best as can be...

EXISTING REALITY

SHORELINE UNIT AND MANAGEMENT UNIT

(Nucleus can include the entire area of the Shoreline Unit)

(i.e. Beach and Dunar System may extend inland beyond 500 m, limits of Shoreline Units)

COMPLEMENTARY MANAGEMENT ZONE

(stairs or common areas)

May suffer the effects of one or several Shoreline Units (apartments).

Shoreline Units can be influenced through the Complementary Management Zone

(i.e. marine environment of Badia de Palma)

ADJACENT MANAGEMENT ZONE

(outside, street)

Homogeneous areas related to other Shoreline Units which incorporates a part in the complementary management area.

(p.e. part of a natural habitat or Natural protected area)



Balearic Islands
Coastal Observing
and Forecasting
System



5.- PRELIMINARY RESULTS



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

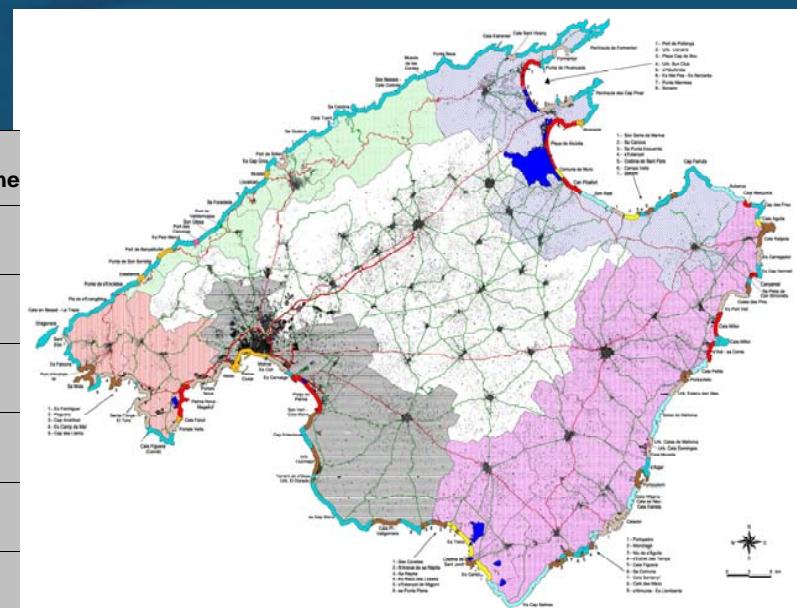
Sistema de Observación y Predicción Costero de las Illes Balears



MINISTERIO
DE CIENCIA
E INNOVACIÓN



| Shoreline Unit (type) | Number of SU | Length of coastline (km) | % of coastline |
|---|---------------|--------------------------|--------------------------|
| Natural beach | 7 | 15.04 | 2.2 |
| Urban beaches non tourist nucleus | 3 | 2.99 | 0.4 |
| Tourist nucleus beach | 10 | 70.66 | 10.3 |
| Natural rocky coast | 41 | 272.81 | 39.6 |
| Urban rocky coast | 7 | 39.14 | 5.7 |
| Tourist nucleus rocky coast | 22 | 96.31 | 14 |
| Salt marshes and lagoons | 1 | 0.73 | 0.1 |
| Mixed natural coasts (rock and beach) | 8 | 62.38 | 9.1 |
| Mixed coasts (rock and beach) close to tourist nucleus | 23 | 128.24 | 18.6 |
| HEMUs | SU categories | Number of SU | Length of coastline (km) |
| Palma – Migjorn | 5 | 15 | 103.63 |
| Llevant | 7 | 42 | 190.10 |
| Nord | 9 | 29 | 181.30 |
| Tramuntana | 5 | 18 | 85.38 |
| Ponent | 5 | 18 | 126.83 |



General results for Mallorca

(Balaguer et al., 2008)



Functional Areas of Shoreline Units of Badia de Palma

boundary delimitation according with Integrated Coastal and Marine Zone Management

Name of shoreline units of Badia de Palma

A.- Cala Figuera; B.- Portals Vells; C.- Cala Falcó; D.- Palmanova-Magalluf;
 E.- POrtals Nous; F.- Illetes-Sant Agustí; G.- Palma; H.- Molinar-Coll d'en Rabassa;
 I.- Es Carnatge; J.- Platja de Palma; K.- Son Verí-Cala Blava; L.- Cap Enderrocat;
 M.- Urbanitzacions Llucmajor; N.- Torrent de s'Osca d'es Pi; O.- El Dorado/Tolleric;
 P.- Es Cap Blanc.

Legends

Functional areas of shoreline units of Badia de Palma

1, 2, 3.. Municipalities affected

A, B, C.. Name of Shoreline Units

shoreline units categories

Natural mixed coasts (rock and beach)

Natural beach

Urban beach non tourist nucleus

Tourist nucleus beach

Natural rocky coast

Urban rocky coast non tourist nucleus

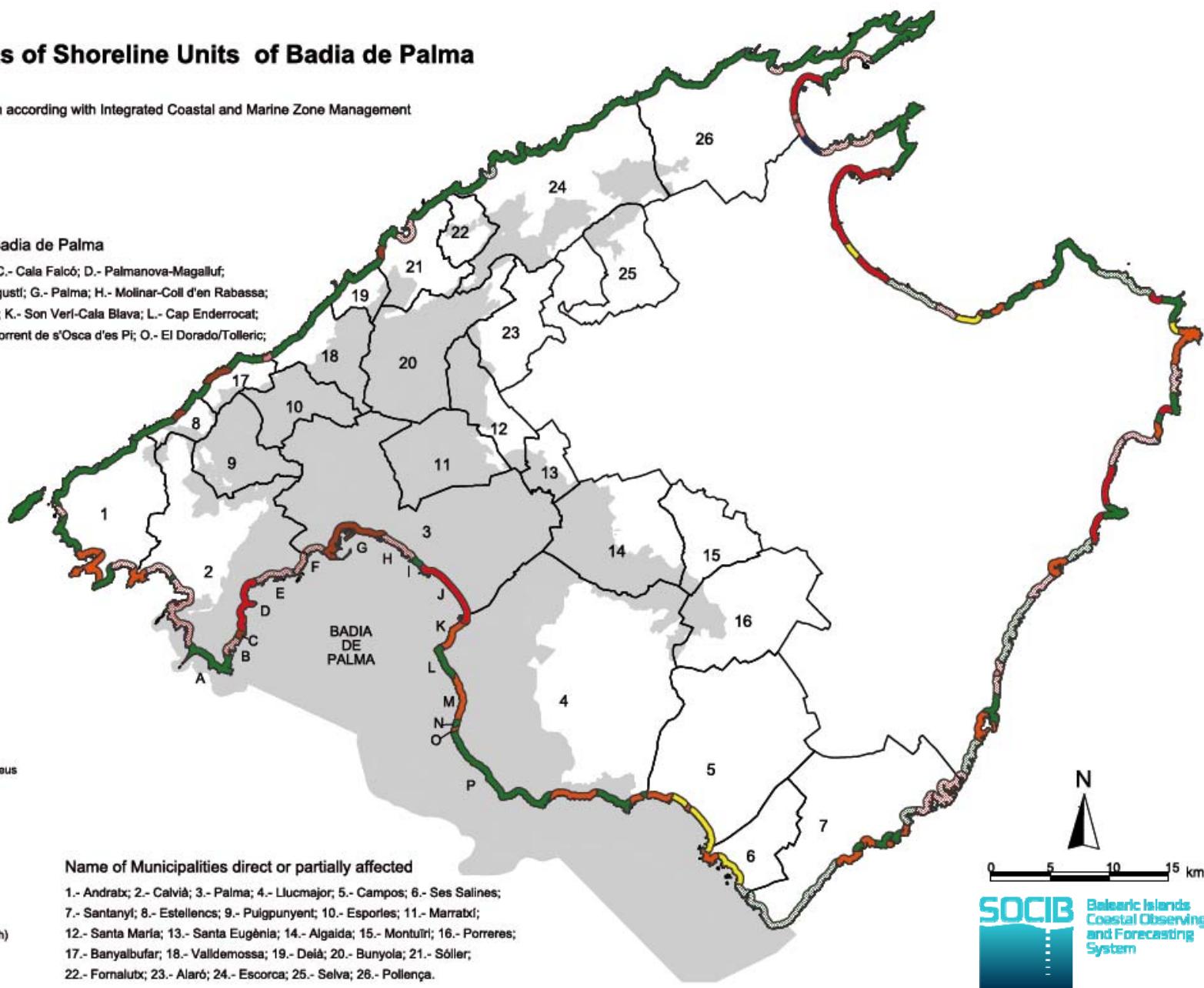
Tourist nucleus rocky coasts

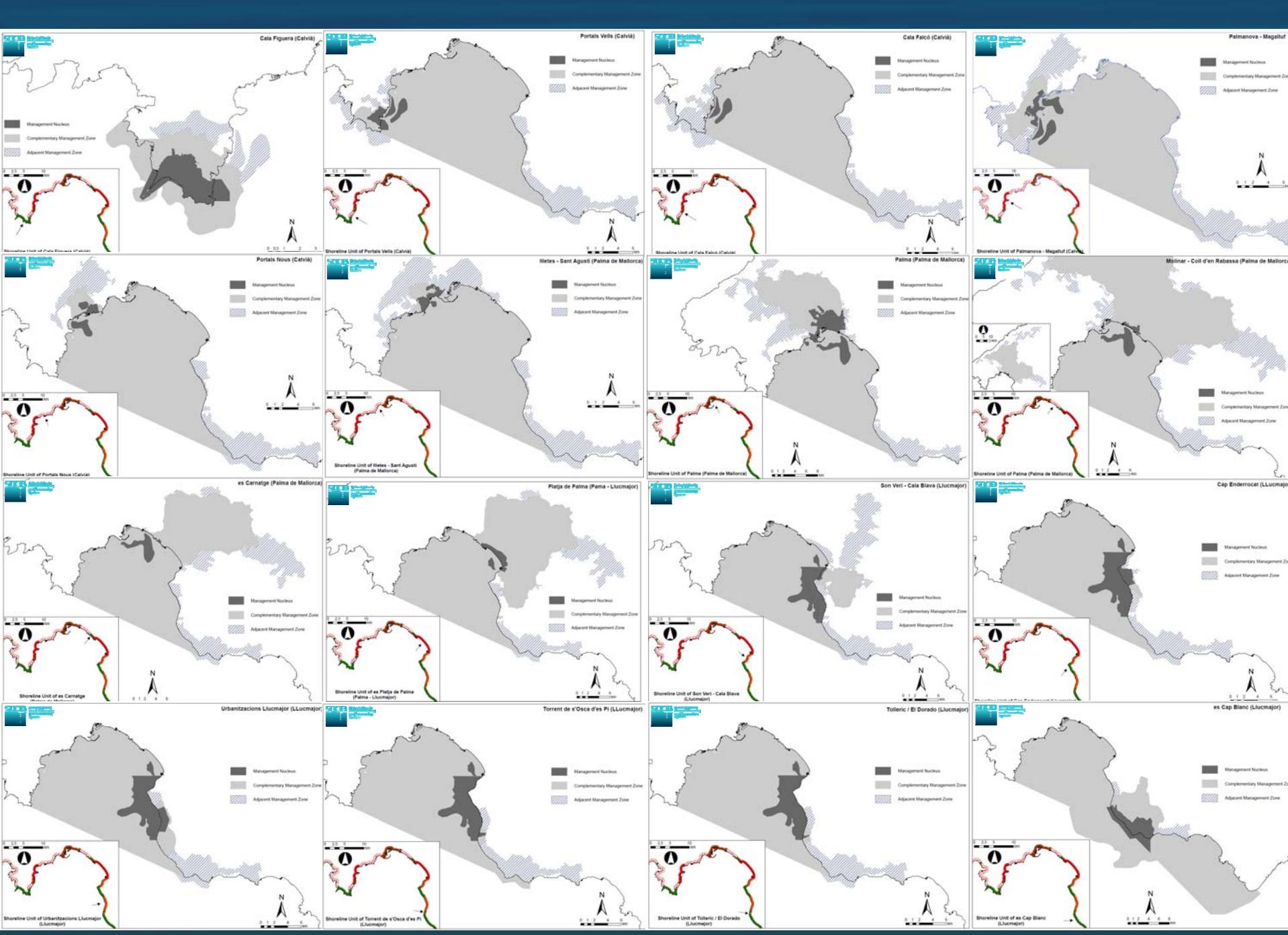
Mixed coasts (rock and beach) close to tourist nucleus

Salt marshes and lagoons

Name of Municipalities direct or partially affected

1.- Andratx; 2.- Calvià; 3.- Palma; 4.- Llucmajor; 5.- Campos; 6.- Ses Salines;
 7.- Santanyí; 8.- Estellencs; 9.- Puigpunyent; 10.- Esporles; 11.- Marratxí;
 12.- Santa Maria; 13.- Santa Eugènia; 14.- Algaida; 15.- Montuïri; 16.- Porreres;
 17.- Banyalbufar; 18.- Valldemossa; 19.- Deià; 20.- Bunyola; 21.- Sóller;
 22.- Fornalutx; 23.- Alaró; 24.- Escorca; 25.- Selva; 26.- Pollença.





Functional Areas of Shoreline Units of Badia de Palma

boundary delimitation according with Integrated Coastal and Marine Zone Management

Name of shoreline units of Badia de Palma

A.- Cala Figuera; B.- Portals Vells; C.- Cala Falcó; D.- Palmanova-Magalluf;
 E.- POrtals Nous; F.- Illetes-Sant Agustí; G.- Palma; H.- Molinar-Coll d'en Rabassa;
 I.- Es Carnatge; J.- Platja de Palma; K.- Son Verí-Cala Blava; L.- Cap Enderrocat;
 M.- Urbanitzacions Llucmajor; N.- Torrent de s'Osca d'es Pi; O.- El Dorado/Tolleric;
 P.- Es Cap Blanc.

Legends

Functional areas of shoreline units of Badia de Palma

1, 2, 3.. Municipalities affected

A, B, C.. Name of Shoreline Units

shoreline units categories

Natural mixed coasts (rock and beach)

Natural beach

Urban beach non tourist nucleus

Tourist nucleus beach

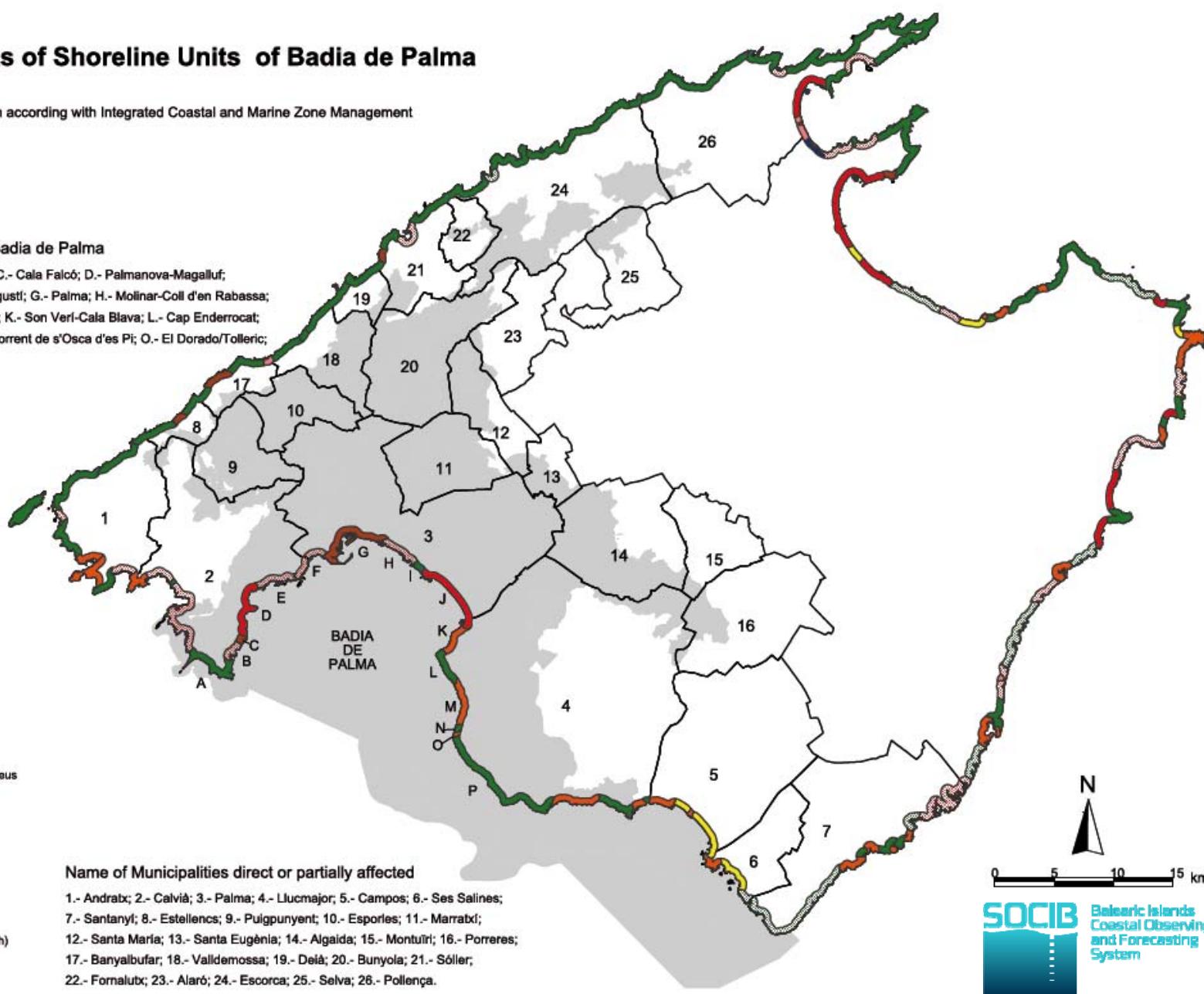
Natural rocky coast

Urban rocky coast non tourist nucleus

Tourist nucleus rocky coasts

Mixed coasts (rock and beach) close to tourist nucleus

Salt marshes and lagoons



Name of Municipalities direct or partially affected

1.- Andratx; 2.- Calvià; 3.- Palma; 4.- Llucmajor; 5.- Campos; 6.- Ses Salines;
 7.- Santanyí; 8.- Estellencs; 9.- Puigpunyent; 10.- Esporles; 11.- Marratxí;
 12.- Santa Maria; 13.- Santa Eugènia; 14.- Algaida; 15.- Montuïri; 16.- Porreres;
 17.- Banyalbufar; 18.- Valldemossa; 19.- Deià; 20.- Bunyola; 21.- Sóller;
 22.- Fornalutx; 23.- Alaró; 24.- Escorca; 25.- Selva; 26.- Pollença.

PRELIMINARY RESULTS

| Shoreline Units | Terrestrial Functional Areas (km ²) | | | |
|-----------------------------|---|---------------|----------|--------------|
| | Nucleus | Complementary | Adjacent | Total (area) |
| Cala Figuera | 6,7 | 7,7 | 11,3 | 25,7 |
| Portals vells | 3,1 | 6,1 | 43,5 | 52,7 |
| Cala Falcó | 0,2 | 1,4 | 51,6 | 53,2 |
| Palma Nova - Magalluf | 4,6 | 17,1 | 72,6 | 94,4 |
| Portals Nous | 3,1 | 7,9 | 56,9 | 67,9 |
| Illetes - Sant Agustí | 4,5 | 6,7 | 85,8 | 97,1 |
| Palma | 21,0 | 98,4 | 89,4 | 208,8 |
| Molinar - Coll d'en Rabassa | 2,1 | 409,0 | 213,8 | 624,9 |
| Es Carnatge | 0,3 | 160,0 | 99,7 | 260,0 |
| Platja de Palma | 6,1 | 210,8 | 82,3 | 299,2 |
| Son Verí-Cala Blava | 1,3 | 35,8 | 86,4 | 123,5 |
| Cap Enterrocàt | 4,1 | 2,2 | 36,6 | 42,9 |
| Urbanitzacions Llucmajor | 4,1 | 10,3 | 31,3 | 45,7 |
| Torrent Osca d'es Pi | 0,6 | 1,9 | 34,4 | 36,9 |
| Els Dorado-Tolleríc | 0,3 | 2,2 | 34,4 | 36,9 |
| Es Cap Blanc | 20,8 | 47,3 | 13,5 | 81,6 |

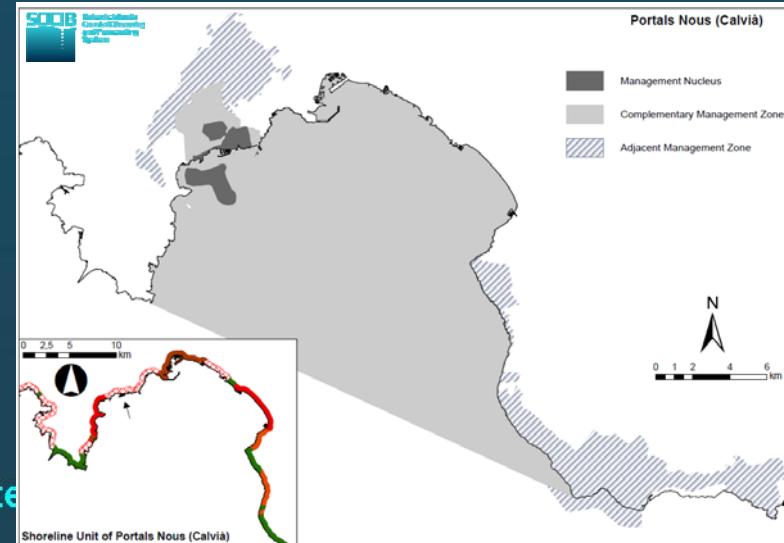
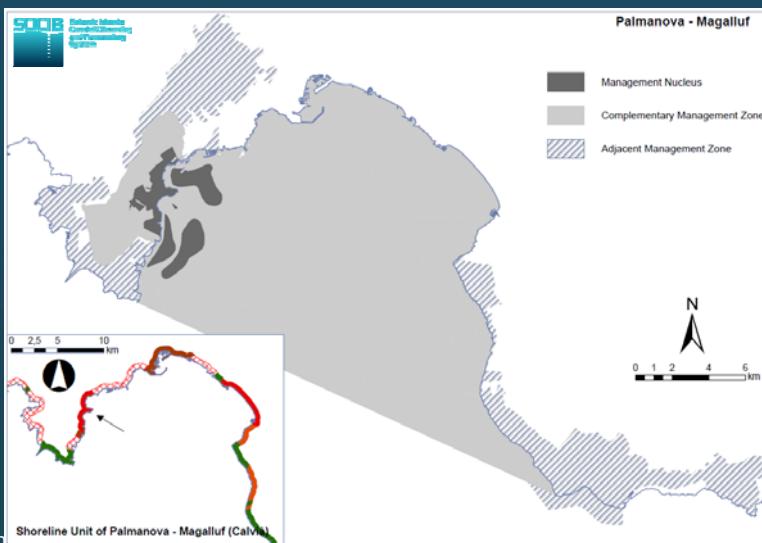
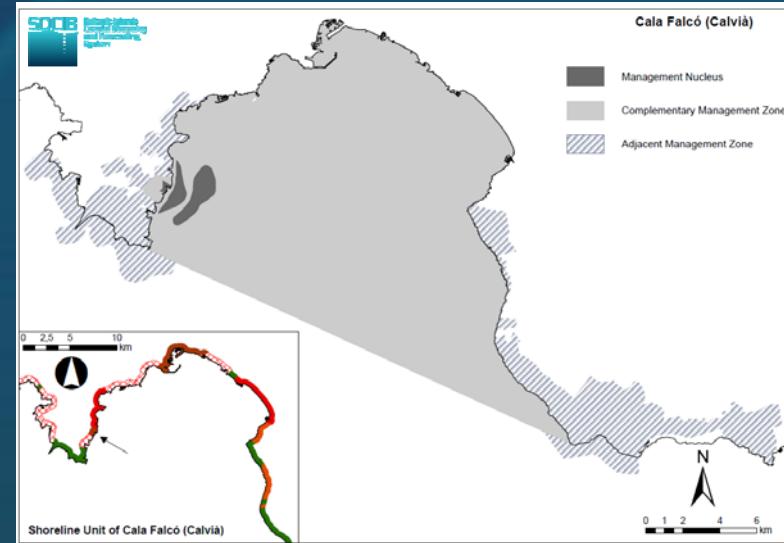
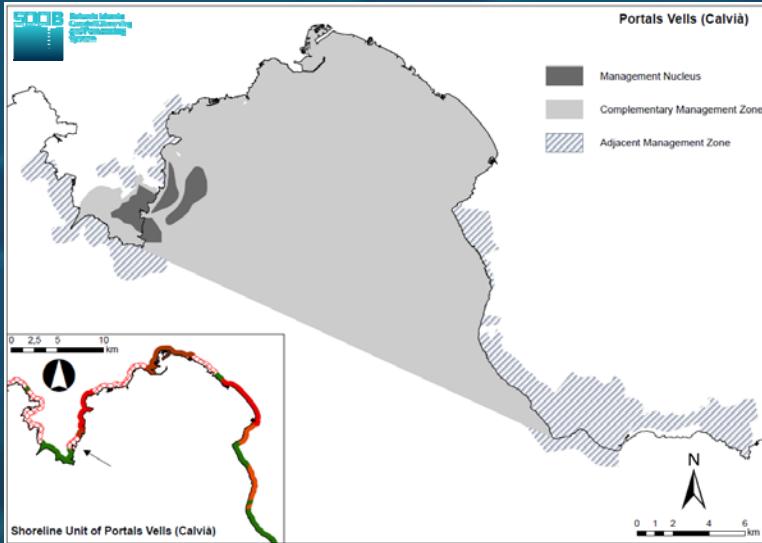
PRELIMINARY RESULTS

| Shoreline Units | Functional Areas (km ²) | | | | |
|------------------------------------|-------------------------------------|-----------------|-------------|--------------|---|
| | Marine | Islets (marine) | Terrestrial | Total (area) | |
| Badia de Palma | | | | | |
| Cala Figuera | 22,2 | 0,1 | 25,6 | 47,9 | |
| Portals vells | 277,4 | 0,2 | 52,5 | 330,1 | |
| Cala Falcó | 277,4 | 0,2 | 52,9 | 330,5 | |
| Palma Nova - Magalluf | 264,2 | 0,1 | 94,2 | 358,5 | |
| Portals Nous | 264,2 | 0,1 | 67,8 | 332,1 | |
| Illetes - Sant Agustí | 264,2 | 0,1 | 97,0 | 361,3 | |
| Palma | 264,2 | 0,1 | 208,7 | 472,9 | 5 |
| Molinar - Coll d'en Rabassa | 264,2 | 0,1 | 624,8 | 889,1 | 1 |
| Es Carnatge | 264,2 | 0,1 | 259,9 | 524,2 | 4 |
| Platja de Palma | 264,2 | 0,1 | 299,1 | 563,3 | 3 |
| Son Verí-Cala Blava | 264,2 | 0,1 | 123,3 | 387,6 | |
| Cap Enterrocated | 264,2 | 0,1 | 42,8 | 307,0 | |
| Urbanitzacions Llucmajor | 264,2 | 0,1 | 45,6 | 309,9 | |
| Torrent Osca d'es Pi | 264,1 | 0,1 | 36,8 | 301,0 | |
| Els Dorado-Tollerí | 264,1 | 0,1 | 36,8 | 301,0 | |
| Es Cap Blanc | 518,6 | 0,2 | 81,3 | 600,2 | 2 |

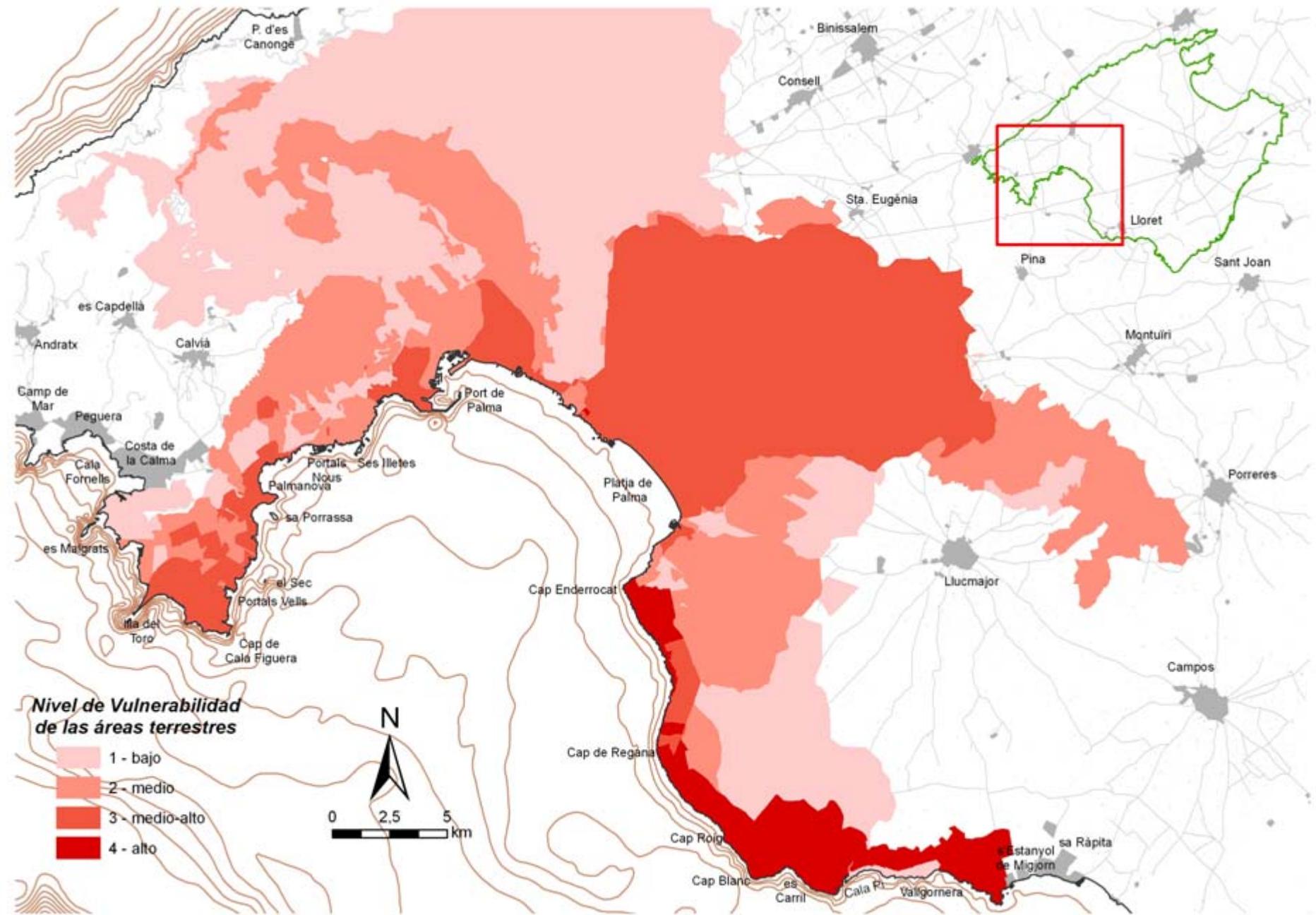


Methods and criteria for boundary delimitation of coastal areas

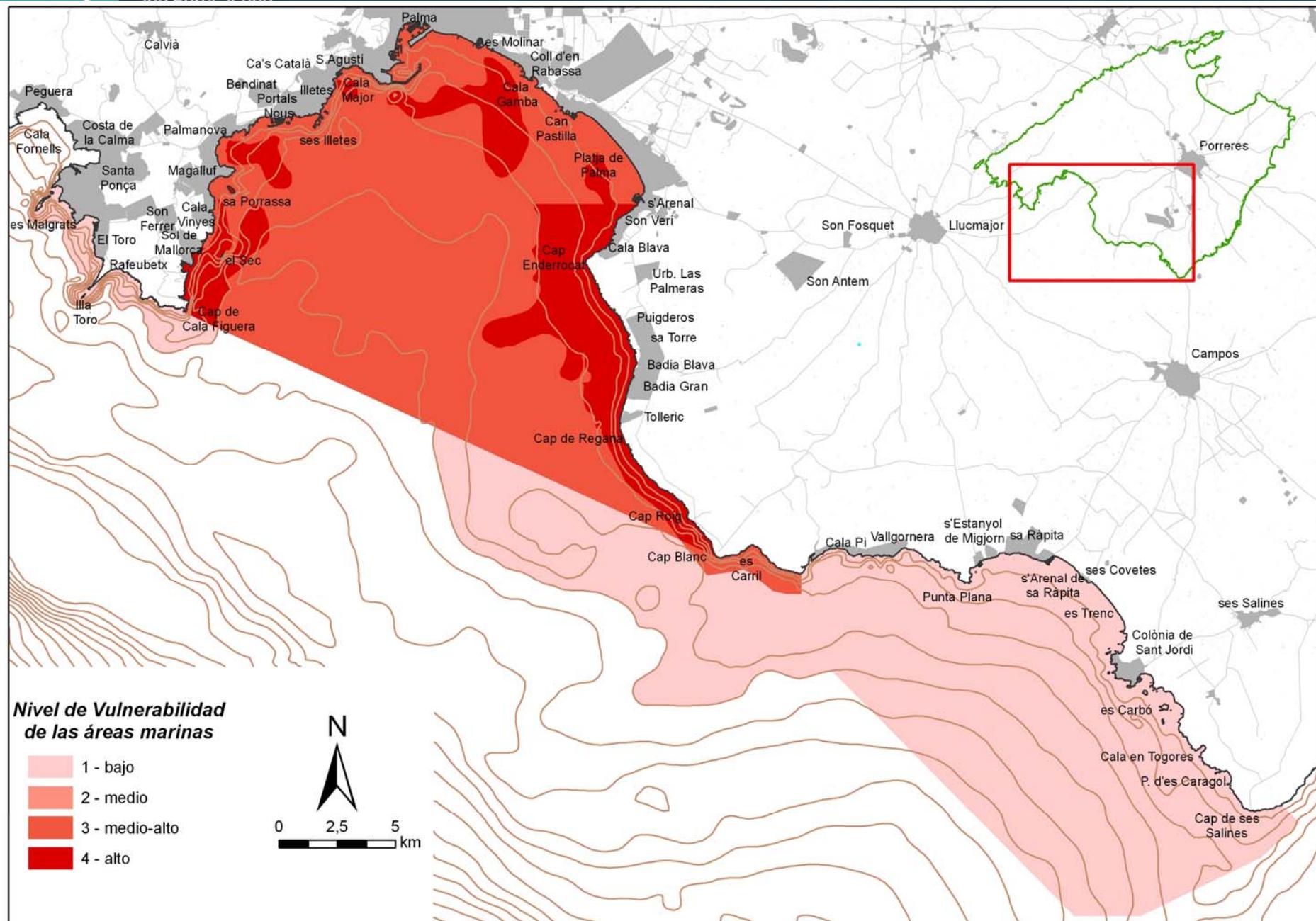
Functional areas can be shared for several Shoreline Units



Degree of overlap of landward areas



Degree of overlap of marine areas





Balearic Islands
Coastal Observing
and Forecasting
System

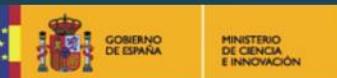


6.- CONCLUSIONS



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

Sistema de Observación y Predicción Costero de las Illes Balears

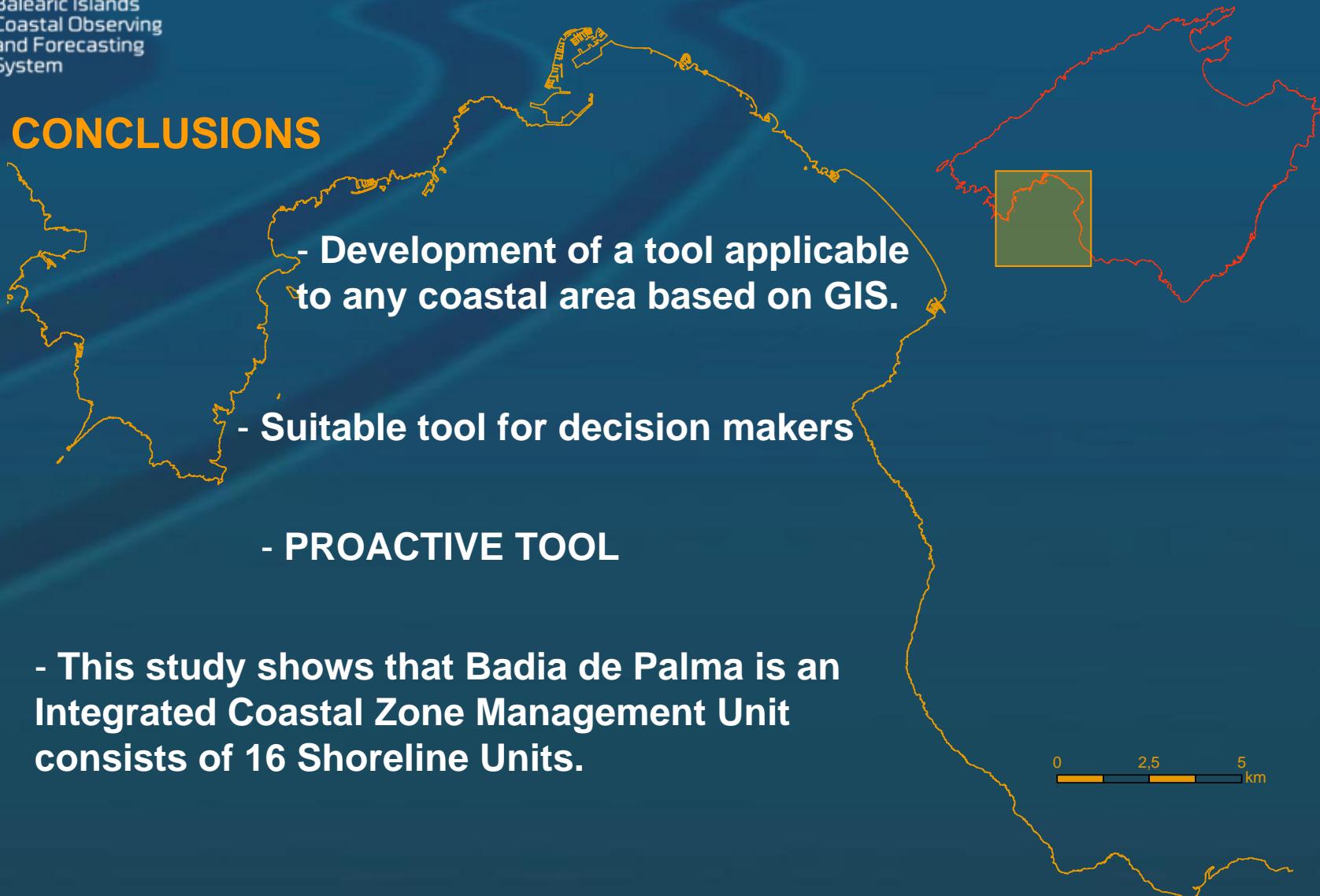


MINISTERIO
DE CIENCIA
E INNOVACIÓN



CONCLUSIONS

- Development of a tool applicable to any coastal area based on GIS.
- Suitable tool for decision makers
- PROACTIVE TOOL
- This study shows that Badia de Palma is an Integrated Coastal Zone Management Unit consists of 16 Shoreline Units.



0 2,5 5 km





Balearic Islands
Coastal Observing
and Forecasting
System



7.- APPLICATIONS



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

Sistema de Observación y Predicción Costero de las Illes Balears

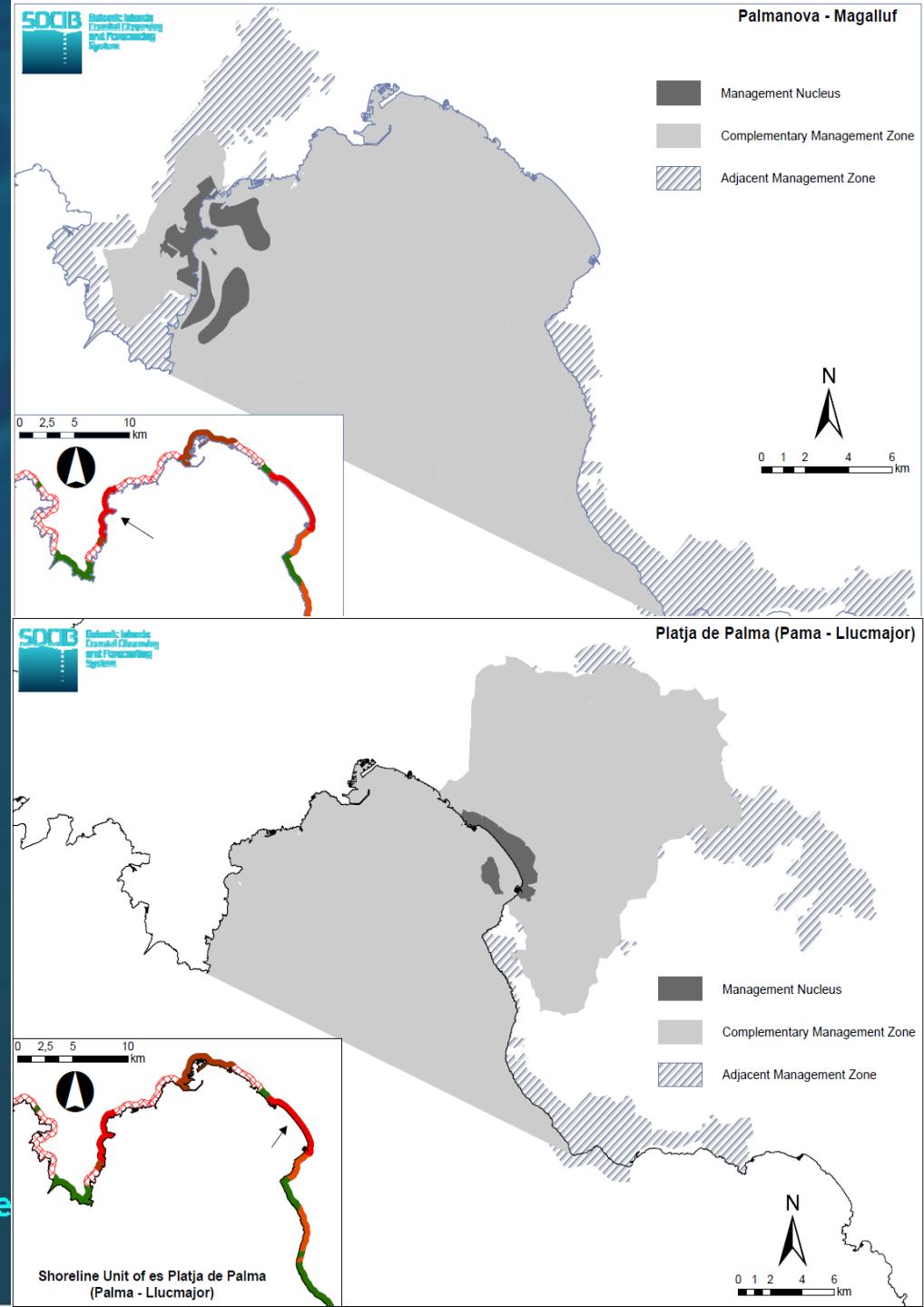


MINISTERIO
DE CIENCIA
E INNOVACIÓN



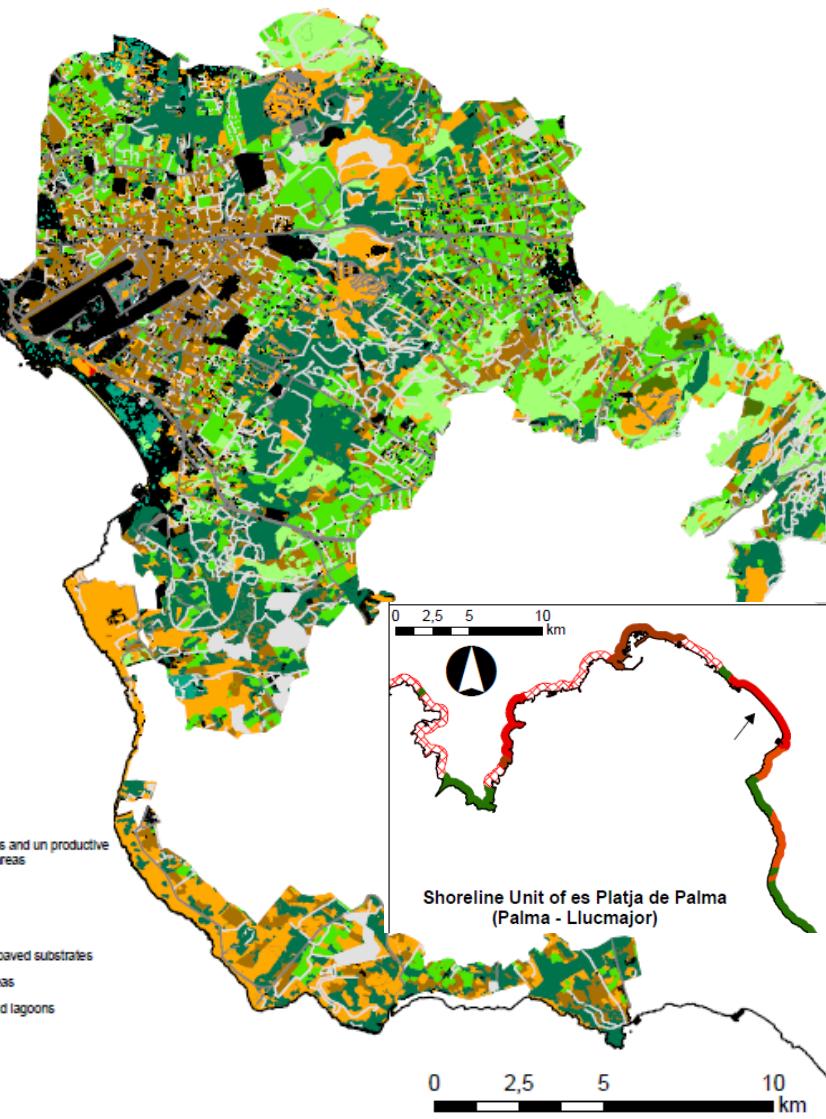
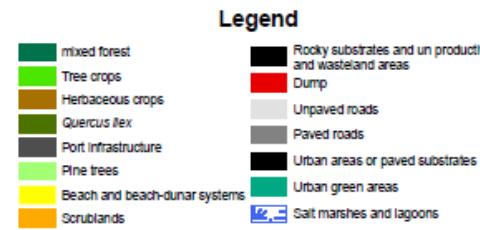
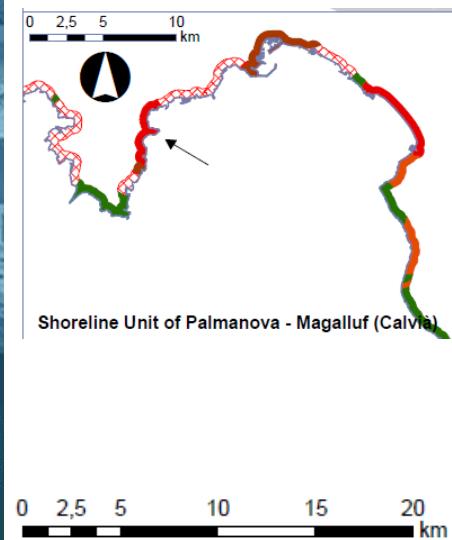
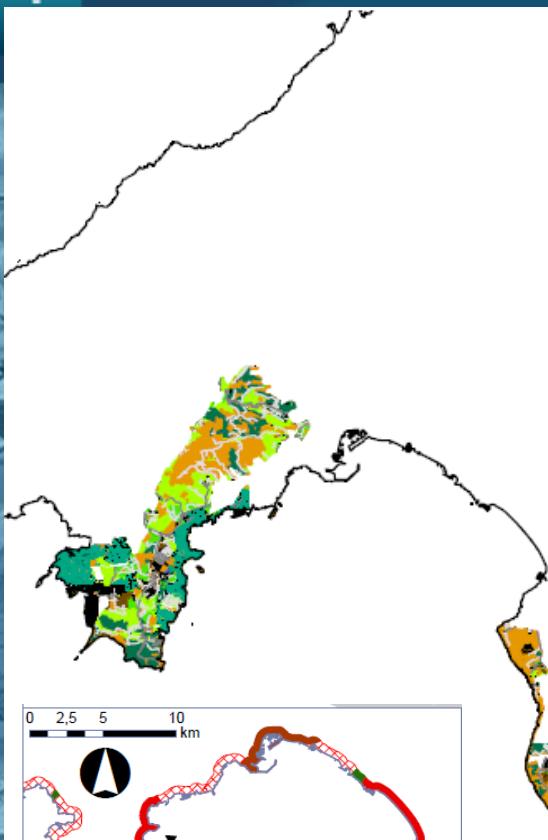
APPLICATIONS

*Inventory of land uses
of functional areas of SUs
of Badia de Palma*



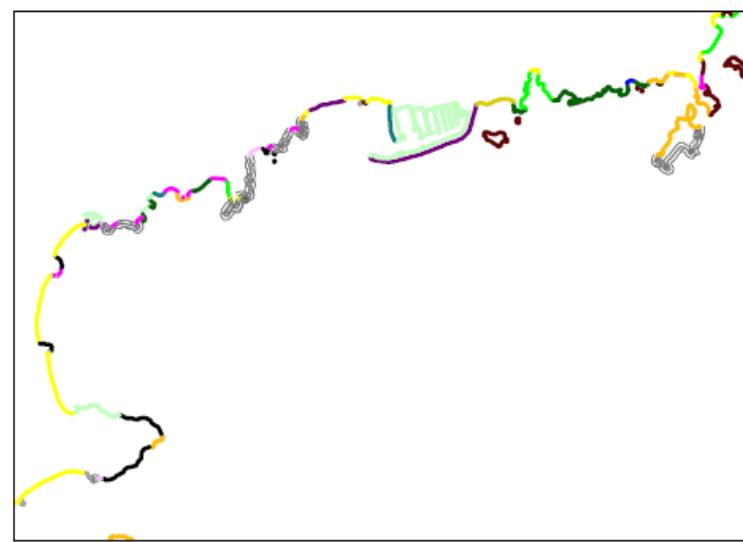
Inventory of land uses of functional areas of *Badia de Palma*

APPLICATIONS



Environmental Sensitivity of coasts of Badia de Palma

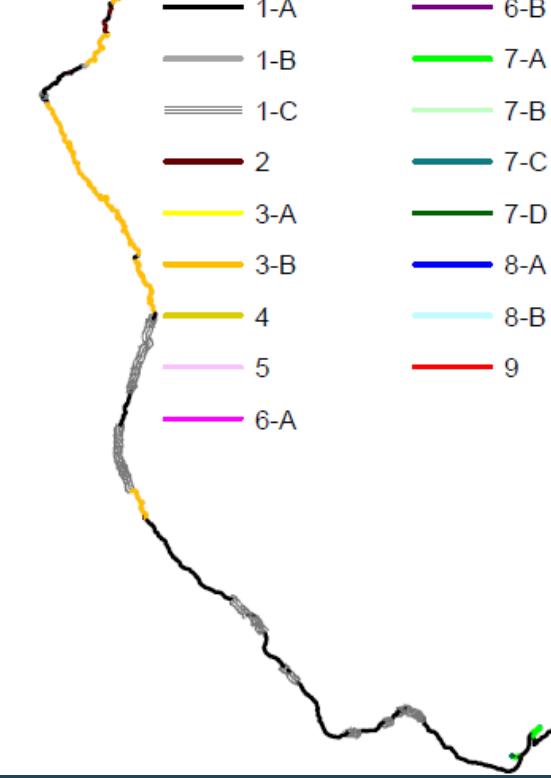
Badia de Palma



*Relationship with
Environmental
Sensitivity of coastline*

Legend

- 1-A — 6-B
- 1-B — 7-A
- 1-C — 7-B
- 2 — 7-C
- 3-A — 7-D
- 3-B — 8-A
- 4 — 8-B
- 5 — 9
- 6-A —



Relationship with system of indicators

APPLICATIONS

-Indicators extracted from a System of Indicators for the coastal zone of the Balearic Islands.



Official Opinion 5/2007 of the Economic and Social Council of the Balearic Islands



Govern
 de les Illes Balears
 Conselleria d'Innovació,
 Interior i Justícia
 Direcció General de Recerca,
 Desenvolupament Tecnològic i Innovació



I-M-E-D-E-A
 Institut Mediterrani d'Estudis Avançats



-A proposal of 54 Sustainability Indicators divided in three main groups:

- Governance Indicators (8)
- Socio-Economic Indicators (42)
- Environmental Indicators (4)

-Some of these indicators have been applied in the island of Menorca (2.009) and in the island of Mallorca (2.010).

- 17 Indicators has been applied in these islands.



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

Sistema de Observación y Predicción Costero de las Illes Balears



Relationship with system of indicators

APPLICATIONS

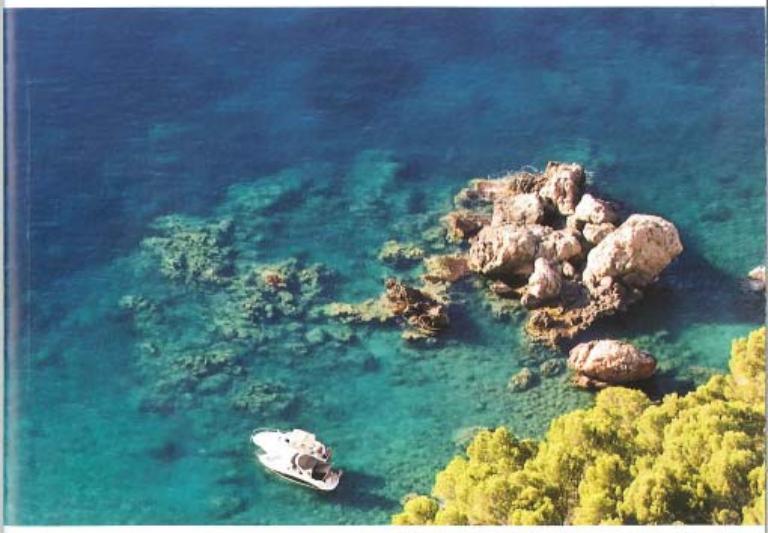
INDICATORS APPLIED:

- Area of land and sea protected by statutory designation
- Unemployment
- Occupation of tourism accommodation supply
- Evolution of tourism demand
- Quality of tourism accommodation supply
- Cost of tourism accommodation supply
- Water consumption
- Electricity consumption
- Fisheries
- Water treatment
- Density of resident population
- Seasonality of population
- Immigration
- Construction of homes
- Number of moorings
- Existence and use of roads and social infrastructures
- Quality of beaches

TERRITORIAL LIMITS OF THESE INDICATORS MAY ARE FOR SPECIFIC AREAS (i.e.BEACH, PORT, PROTECTED AREA) OR FOR EXTENSIVE AREAS (i.e. MUNICIPALITIES)



Official Opinion 5/2007 of the Economic and Social Council of the Balearic Islands



Govern
de les Illes Balears
Conselleria d'Innovació,
Interior i Recerca,
Desenvolupament Econòmic i Innovació



I-M-E-D-E-A
Institut Mediterrani d'Estudis Avançats
CSIC



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

Sistema de Observación y Predicción Costero de las Illes Balears

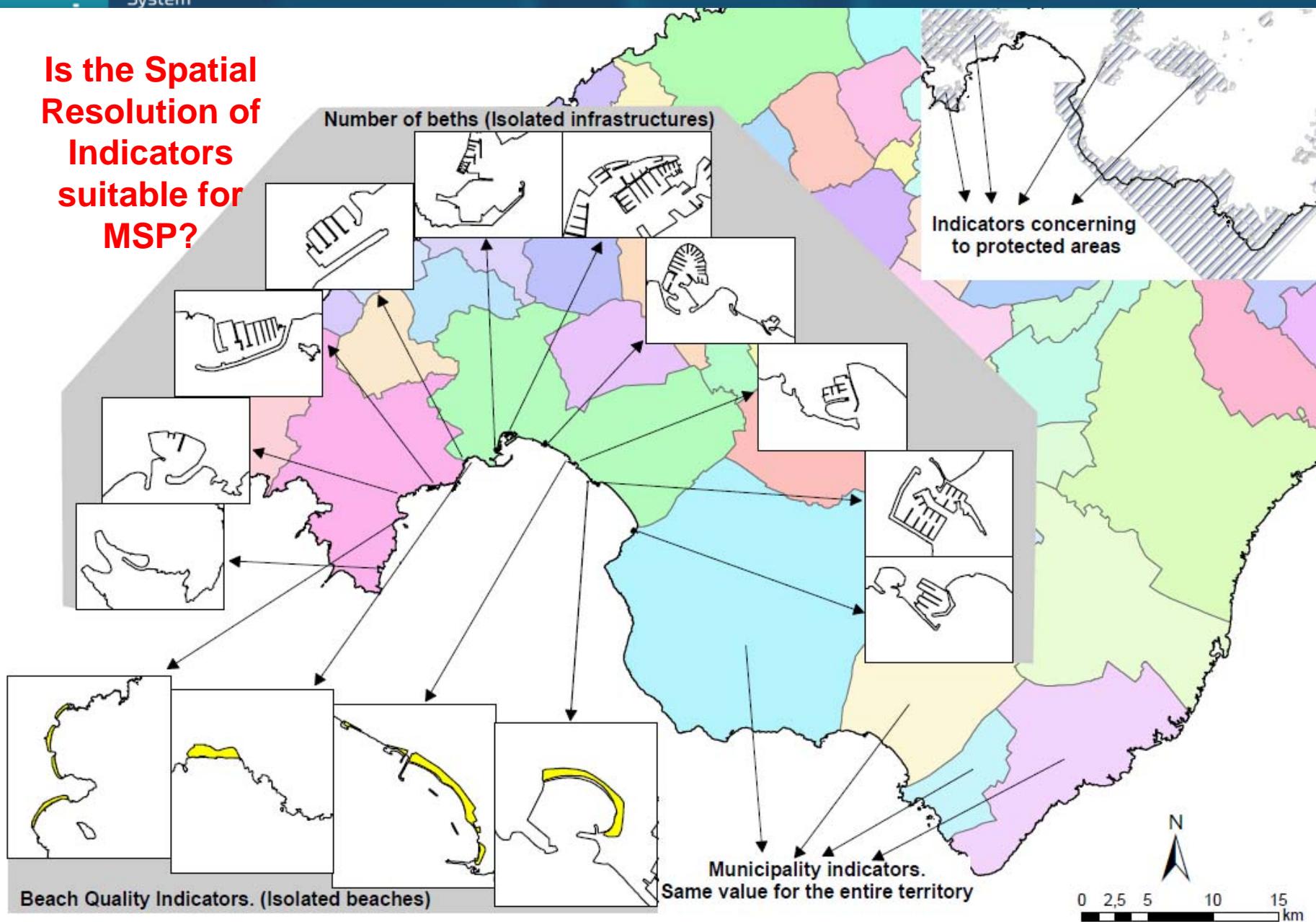


GOBIERNO DE ESPAÑA
MINISTERIO DE CIENCIA E INNOVACIÓN

Is the Spatial Resolution of Indicators suitable for MSP?

Relationship with system of indicators

APPLICATIONS





Balearic Islands
Coastal Observing
and Forecasting
System



7.- FUTURE WORK



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

Sistema de Observación y Predicción Costero de las Illes Balears

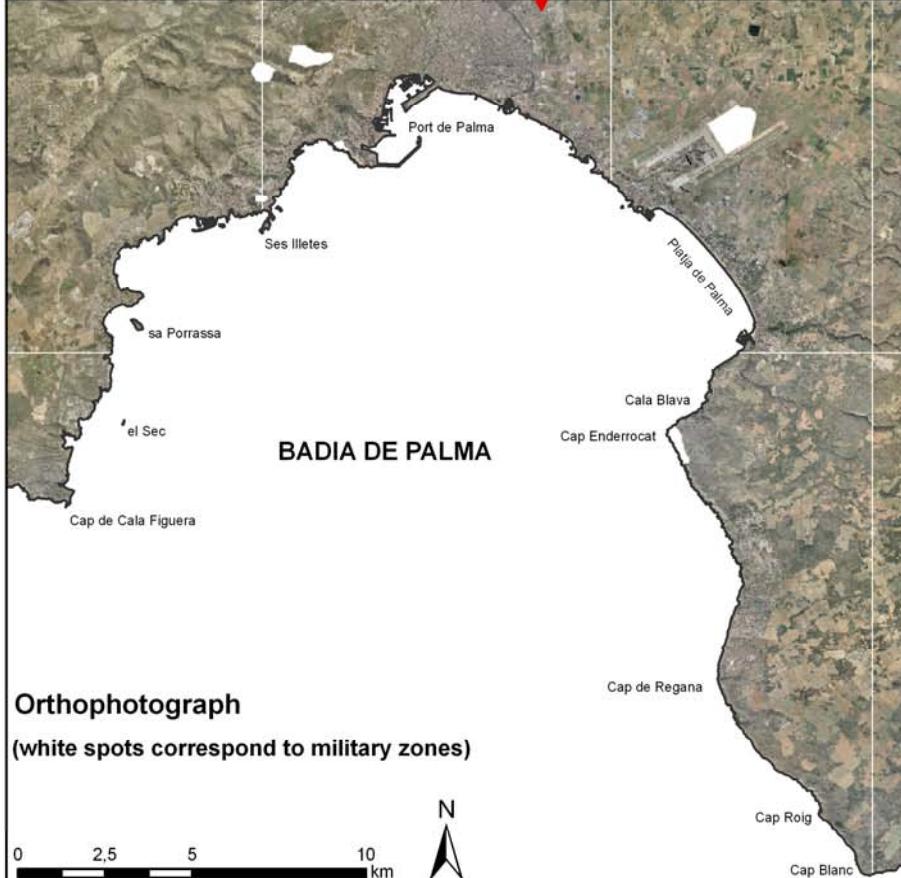
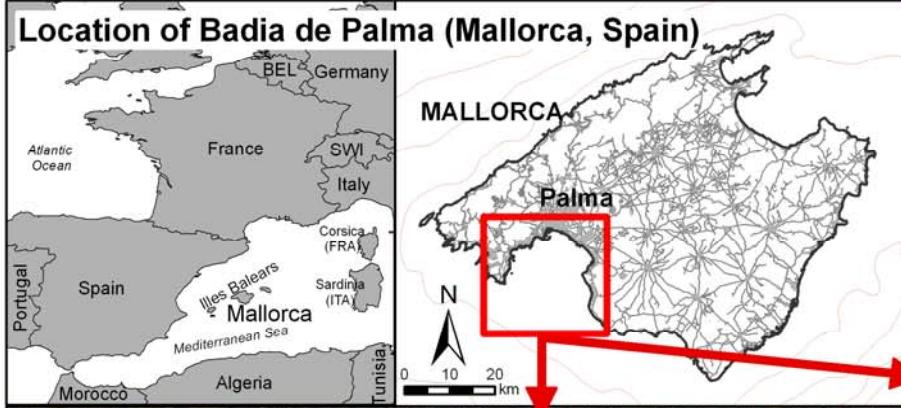


MINISTERIO
DE CIENCIA
E INNOVACIÓN

FUTURE WORK

- Peer review Process. Need to specify the criteria used for establishing Shoreline Units (SUs).
- Need to complement these types of studies with marine climate data to establish more accurately functional areas of marine environments.
- Need to collect suitable digital cartographic data (i.e. layer of *Posidonia oceanica*)
- This work supports the *Water Framework Directive* (2000/60/EC) which try to achieve an integrated management of coastal, surface waters and groundwater.

Location of Badia de Palma (Mallorca, Spain)



Orthophotograph

(white spots correspond to military zones)

