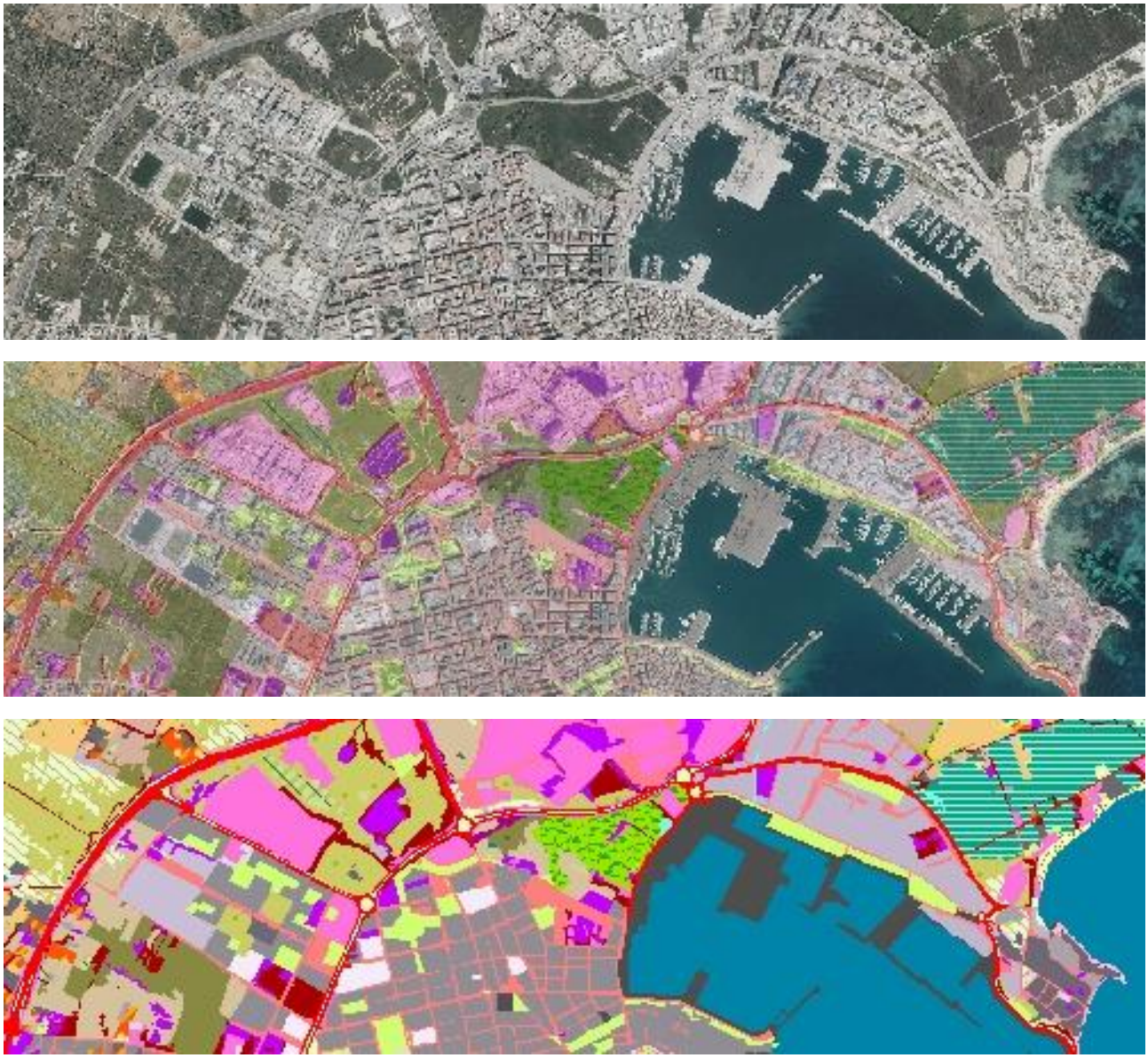
DIGITAL LAND COVER AND LAND USE CARTOGRAPHY OF THE ISLAND OF IBIZA 2018

Executive summary at the end of the projects' first phase: Municipalities of Eivissa and Sant Josep de sa Talaia



OBSERVATORIO DE SOSTENIBILIDAD DE IBIZA

IBIZA SUSTAINABILITY OBSERVATORY
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obsam

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Overview

The following document is a summary of the final report elaborated at the end of the first phase of the "Digital Land Cover and Land Use Cartography of the Island of Ibiza 2018" project. This project was born with the main goal of creating a set of land cover and land use maps that would allow to carry out accurate and thorough land and environmental analyses, as well as a follow up monitoring on the island of Ibiza. The methodology is based on a combination of photo interpreting and field work, using Geographic Information Systems (GIS) as the main tool. The project follows the guidelines of the European programme CORINE Land Cover (1985) and links it to the EU's Habitats Directive (1992). This first phase of the project has focused on the municipalities of Eivissa and Sant Josep de sa Talaia, which together comprise the Southern half of the island.

1. Main Goals

From the projects' early days, the following set of general aims were established:

- To create a baseline land cover and land use map at an appropriate scale for Ibiza. Whether for its study, for land management or for landscape analysis.
- To locate, demarcate and quantify all the artificial, modified, and natural covers present in Ibiza at a particular moment in time.
- To locate, demarcate and quantify the different land uses that take place in Ibiza at a particular moment in time.
- To begin a process of monitorisation of land cover and land use changes with regular updates, approximately every 5 years.
- To create a cartography useful for education, for the building up of understanding and for the enjoyment of the reality of Ibiza's territory and landscape.

Furthermore, a wide list of specific goals and calculus can be drawn from the different types of land cover and land use classifications mapped. The following are just some examples:

- Determining accurately the wooded and non-wooded forest surfaces of Ibiza.
- Determining the damages immediately after a wildfire.
- Pinpointing and delimiting the areas of influence of wetlands.
- Quantifying the changes in land use.
- Quantifying the degree of urban developments on the island's coastline.
- Evaluating the phenomenon of rural dispersion.
- Quantifying intensive farming areas.
- Quantifying the degree of farmland abandonment at a geographical level.
- Analysing and quantifying the evolution of the aforementioned aspects through the years.

2. Ibiza's land cover and land use digital mapping background

The history of thematic digital mapping on the island of Ibiza is rather scarce. There are only two previously existing maps, both digitised at large scales, one above 1:50000 and another, the most useful one to date, at a scale of 1:25000. These scales are far too rough to reveal any kind of useful detail in a mostly small parcelled island such as Ibiza.

In 2019, OBSAM (*Observatorio Socioambiental de Menorca*) created a sea bottom habitat distribution map of Ibiza and Formentera at a scale of 1:5000. This map will complement the cartography object of this report, providing it with a land-sea continuity.

3. Work method

Work scale

For the current work, and as previously justified, the scale used is that of 1:5000. This allows for a minimum mappable unit (m.m.u from here onwards) of approximately 500m^2. Additionally, lineal elements wider than 4m if they exceed the m.m.u of 500m^2 and all buildings with a surface larger than 4m^2 visible in the aerial photographs have also been included.

Procedure

The work has been carried out by a team of GIS technicians following the guiding hand of the OBSAM from Menorca, which counts with 20 years of experience on a very similar project. Initially, there was one technician resident in Ibiza and another working from Catalonia. In September, the team expanded from two to five workers with the objective of doubling efforts during the second half of the projects' first phase to reach the deadlines on time. The three new additions to the team worked from Menorca and Catalonia.

To produce the maps the usual method for this type of thematic cartography has been followed:

1. Examination of the digital aerial photographs from 2018 (the most recent ones at the time of starting the work).
2. Initial on-screen computer digitation using GIS tools.
3. Checking, through field work, land covers and uses difficult to discern through photo interpreting alone.
4. Amending and complementing the initial digitation with the data gathered during field work.
5. Once all areas are completed and revised by the photo interpreters, the process of unifying the five separate map parts takes place.
6. Finally, the symbology of the final maps is edited and the results extracted.

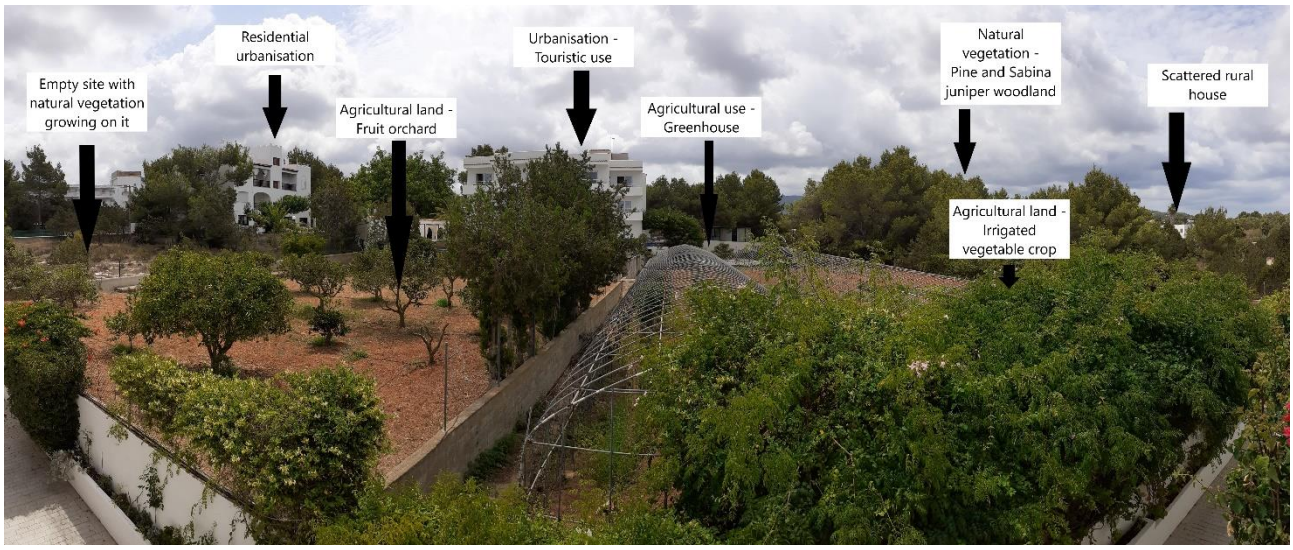


Image 1: Image of a specific landscape during field work used to exemplify the interpretative process through which different land covers and land uses are classified.

Image 2. The two technicians working from the beginnings of the project during a Meeting in Ibiza just before the start of the pandemic. Here photo-interpreting and digitising using GIS tools.

4. Results

From the maps that have been produced and using GIS technology, a wide range of analyses and calculus related to Ibiza's territory can be obtained. This enables a characterization of this territory and a monitoring of its evolution. In the future, it will also permit comparing its landscape with that of the other Balearic islands, allowing for a better understanding of its current structure, assessment of its management and forecasting of its future evolution.

Even though only one third of the island has been mapped so far, the results presented on this section already point towards some interesting trends, as well as showing some differences between the two of the five municipalities mapped so far.

4.1 Land Cover

The table below displays the 53 different land cover typologies identified for Ibiza. These typologies are based on the ones proposed on the EU's CORINE Land Cover but adapted to the reality of the island so that it is useful and communicable.

The main report includes a classification guide offering a detailed description of the nature of each of the typologies in Ibiza as well as providing each with one or more examples of the aerial and the land views. The following images are an example of the typology "sparsely vegetated rocky areas".

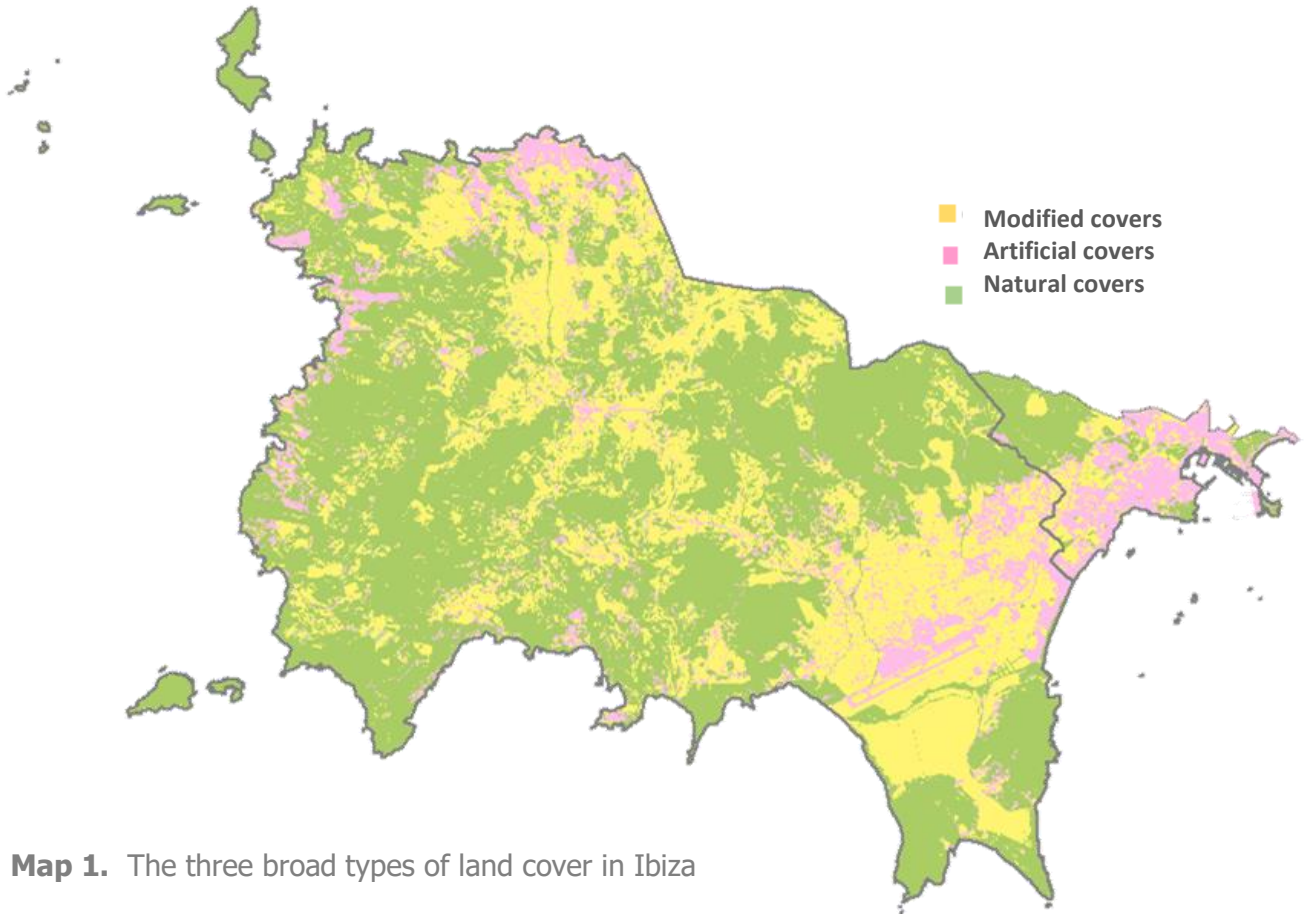
Images 3, 4 and 5. Two different examples of the typology 3.3.3 (Sparsely vegetated rocky areas) and an aerial view of the same typology.

Code	Original CORINE name	Name adapted to Ibiza (English translation)
1.	Artificial surfaces	
1.1	Urban fabric	
1.1.1	Continuous urban fabric	Population center
1.1.2.A	Discontinuous urban fabric	Residential and touristic developments
1.1.2.B	Discontinuous urban fabric	Rural houses
1.2	Industrial, commercial and transport units	
1.2.1	Industrial or commercial areas	Industrial estates, commercial areas and equipments
1.2.2.A	Road and rail networks and associated land	Roads and paved paths
1.2.2.B	Road and rail networks and associated land	Rural paths and tracks
1.2.2.C	Road and rail networks and associated land	Streets
1.2.3	Port areas	Seaports
1.2.4	Airports	Airports
1.3	Mine, dump and consturction sites	
1.3.1	Mineral extraction sites	Quarries and mineral extraction areas
1.3.2	Dump sites	Landfill, dump sites and composting facilities
1.3.3.A	Construction sites	Construction sites
1.3.3.B	Construction sites	Marginal areas
1.4	Artificial non-agricultural vegetated areas	
1.4.1	Green urban areas	Green areas and gardens
1.4.2	Sport and leisure facilities	Sport and leisure facilities
2.	Agricultural and livestock areas	
2.1	Arable land	
2.1.1	Non-irrigated arable land	Non-irrigated extensive farming crops
2.1.2.A	Irrigated arable land	Irrigated intensive farming fodder crops
2.1.2.B	Irrigated arable land	Intensive farming vegetable crops
2.1.2.C	Irrigated arable land	Intensive farming greenhouse crops
2.2	Permanent crops	
2.2.1	Vineyards	Vineyards
2.2.2	Fruit orchards	Fruit orchards
2.2.3	Olive groves	Olive groves
2.3	Pastures	
2.3.1	Pastures	Pastures and abandoned farmland
2.4	Heterogeneous agricultural areas	
2.4.1	Annual crops associated with permanent crops	Sparse non-irrigated fruit trees associated with a herbacious cover
2.4.2	Complex cultivation patterns	Orchards mixed with vegetable gardens
2.4.3	Agricultural land with significant natural vegetation areas	Arable or pasture land mixed with natural vegetation
2.4.4	Agricultural land with significant natural vegetation areas	Agroforestry areas
3.	Forests and natural areas	
3.1	Forests	
3.1.1.A	Broad-leaved woodlands	Evergreen oak woodlands
3.1.1.C	Broad-leaved woodlands	Mixed broad-leaved woodlands
3.1.1.D	Broad-leaved woodlands	Edges with diverse vegetation
3.1.2.A	Coniferous forest	Pine forest
3.1.2.B	Coniferous forest	Phoenician Juniper woodland
3.1.2.C	Coniferous forest	Pine and Phoenician Juniper forests
3.2	Shrub and/or herbaceous vegetation areas	
3.2.1.A	Natural grassland	Natural wet grasslands
3.2.1.B	Natural grassland	Natural dry grasslands
3.2.1.C	Natural grassland	Prairies of annual and bulbous plants
3.2.2.B	Groves and shrubland	Shrubby riparian communities. Myrtle, Oleander, Tamarisk and Abraham's bush
3.2.2.C	Groves and shrubland	Natural hedges
3.2.2.D	Groves and scrubland	Coastal shrubs and herbs
3.2.3	Groves and shrubland	Sclerophyllous maquis. Mastic tree shrubland
3.2.4.A	Transitional scrub	Rosemary and Mediterranean Heath scrub and Thyme scrub
3.2.4.B	Transitional shrub	Transitional shrub
3.3	Open spaces with little or no vegetation	
3.3.1.A	Beaches, dunes and sand plains	Non vegetated beaches and dunes
3.3.1.B	Beaches, dunes and sand plains	Vegetated dunes and sand plains
3.3.2	Bare rock	Bare rock
3.3.3	Sparsely vegetated areas	Sparcely vegetated rocky areas
3.3.4	Burnt areas	Burnt areas
4.	Wetlands	
4.1	Inland wetlands	
4.1.1	Inland marshes	Marshes and seasonal pools
4.2	Coastal wetlands	
4.2.1	Salt marshes	Coastal salt marshes
4.2.2	Salines	Salines
5.	Water bodies	
5.1	Inland waters	
5.1.1	Water courses	Rain-dependent streams and their sea reach pools
5.1.2	Water bodies	Artificial water deposits
5.2	Marine waters	
5.2.3	Sea and ocean	Sea and ocean

Table 1. Classification of the 53 land cover typologies for Ibiza, with the original CORINE LC names and the adapted names for Ibiza.

The following are just a sample of some of the most interesting land cover results. Described with a full interpretation on the final report, here they are mainly shown with charts, tables, maps and brief interpretations:

To better understand the detailed classification of the different land covers, it is useful to first understand the classification in broader terms. The following map shows how artificial, natural and modified (mainly farmland) land covers are distributed over the municipalities of Eivissa and Sant Josep de sa Talaia:

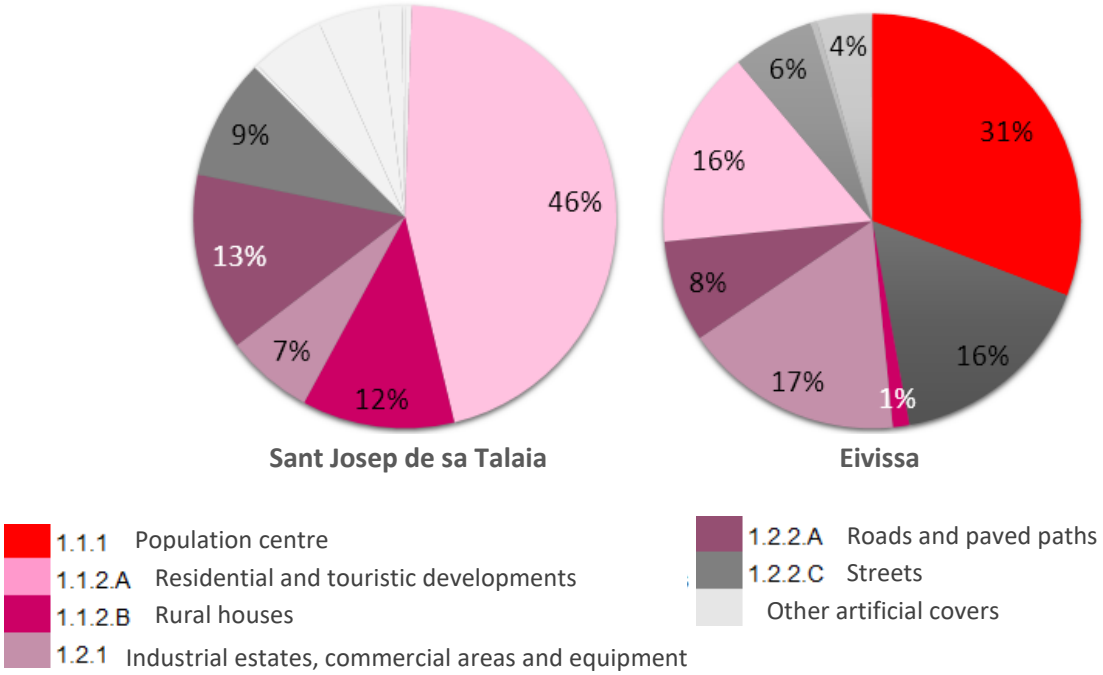


Map 1. The three broad types of land cover in Ibiza

Municipality and Land Cover Type	Area (Ha)	Area (%)
Eivissa	**1.128,22**	**7%**
Modified land cover	260,72	23%
Artificial land cover	473,70	42%
Natural land cover	393,80	35%
Sant Josep de sa Talaia	**15.704,75**	**93%**
Modified land cover	5.057,33	32%
Artificial land cover	1.508,87	10%
Natural land cover	9.138,55	58%
Total	**16.832,97**	**100,00%**

Table 2. Area (in Ha) and percentage of each of the three main land covers per municipality.

ARTIFICIAL LAND COVER



Interpretation:

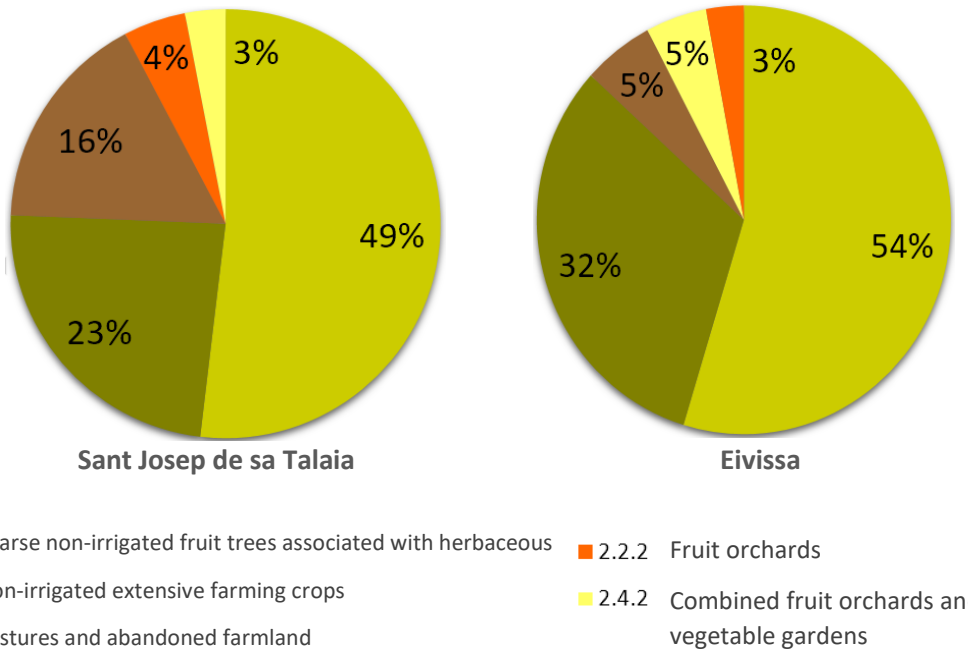
1. The most frequent type of **transport network** in each of the municipalities is closely related to their urbanistic model. While in Eivissa streets (land cover 122C) are the most abundant, in the neighbouring municipality there is a clear dominance of roads (land cover 112A), which link the great diversity of isolated housing.

2. Eivissa concentrates most **industrial covers and equipment**. This is due to the greater presence of industrial estates (land cover 121) and the harbour (land cover 123). In Sant Josep, it is important to highlight the large surface (85,05 Ha) occupied by the airport (cover 124).

3. It is quite surprising the large amount of **construction sites** in Sant Josep (69,74Ha). Fundamentally, this is due to the ampliation of housing developments in the west coast of the municipality (cover 112A) and, to a lesser degree, to the airport's improvement works.

4. Regarding **green areas and gardens** (land cover 141), they are not strictly contemplated as artificial cover, even though they are often closely interconnected. This relationship is clearly visible in Sant Josep where they are particularly abundant (220,56 Ha) in residential and touristic developments (cover 112A). It is likely that the current map underestimates the real garden cover since gardens in hotels have not been included being considered as one with the whole hotel complex. However, at any rate, it probably delivers the most accurate and up to date data on this area, which could be very useful for future quantifications of water consumption on this type of land cover.

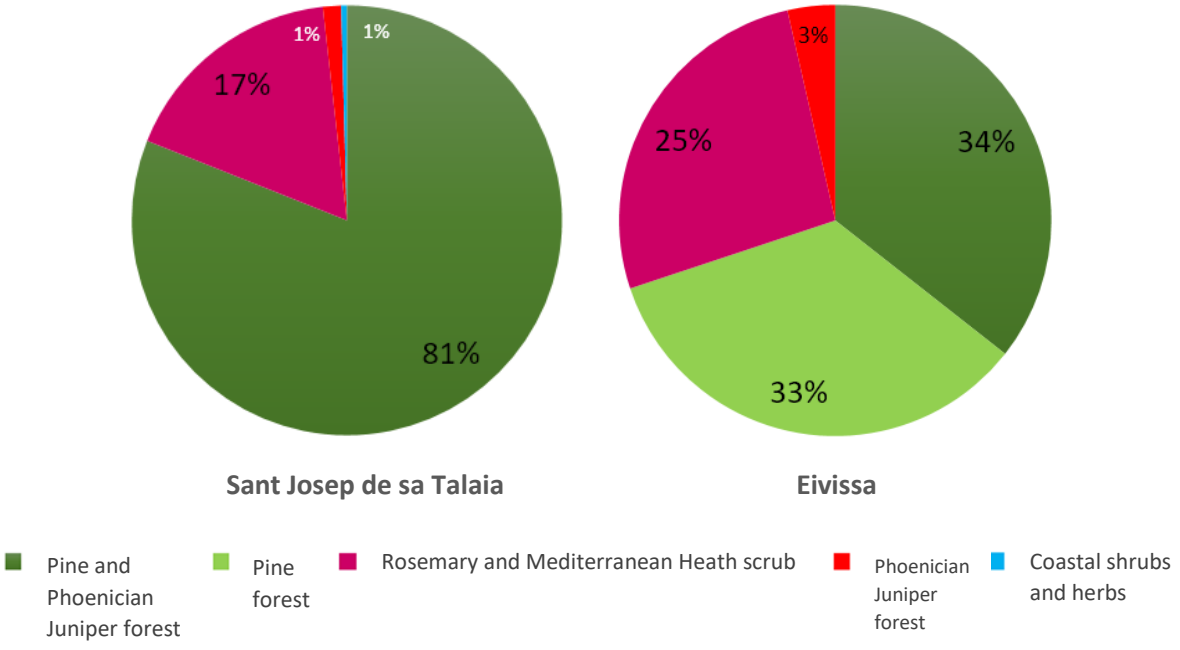
MODIFIED LAND COVER (AGRICULTURAL)



Interpretation:

It can be asserted that there is a clearly more important agricultural activity in Sant Josep de sa Talaia, since there is a predominance of arable land (834,32 Ha) and sparse non-irrigated fruit trees associated with a herbaceous cover (1.822,75 Ha). On the other hand, in Eivissa, the most abundant agricultural cover is abandoned farmland (68,18 Ha), it is therefore reasonable to affirm that agricultural activity in this municipality is inferior.

NATURAL LAND COVER



Interpretation:

Most forest covers concentrate on Sant Josep's municipality (8.516,95 Ha), mainly corresponding **to pine tree forests with an undercover of Phoenician Juniper** (cover 312C, 6.795,98 Ha). In Eivissa there is a large cover of **pine tree forest** (cover 312A, 112,63 Ha) without the aforementioned undercover. This is due to the presence of a large young pine forest area that has developed after a wildfire, in these cases Phoenician Juniper takes a long time to emerge again. In both cases, these forests are accompanied of **Mediterranean scrub** (cover 324A), most likely resulting from pine forest degradation or abandoned farmland regenerating towards forest. Additionally, **coastal shrubs and herbs** (cover 322D) appear mainly in the smaller isles, making of these areas of great biological interest.

4.2 Land Use

The classification used on the land use map comprises a total of 30 different classes. These have been defined from 16 basic classes plus 14 further classes resulting from combinations between the basic ones. The table below shows all the 30 different classes.

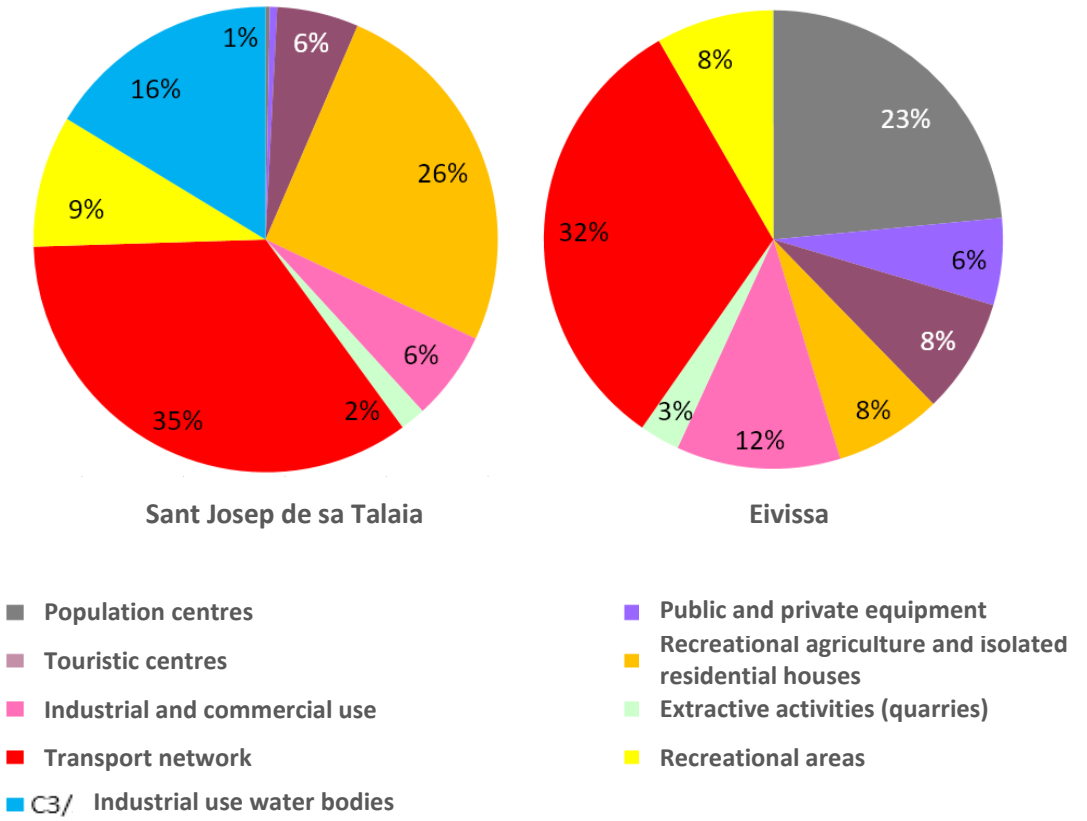
TYPE OF USE	USE CODE	TERMINOLOGY
Urban, residential, commercial, and industrial uses	A1	Population centres
	A2	Touristic centres
	A4	Recreational agriculture and isolated residential houses
	A5	Industrial and commercial uses
	A6	Extractive activities (quarries)
	A7	Transport network
	A8	Recreational areas
	A10	Private and public equipment
	C3/A5	Water bodies for industrial use
Farming uses	A3	Rural agricultural houses and related buildings
	A3/A9	Abandoned rural agricultural houses and related buildings
	B1	Extensive agricultural uses
	B1/C1	Extensive agricultural uses with natural vegetation
	B2	Intensive agricultural uses
	B3	Agricultural marginal uses
	C3/B2	Water bodies for intensive agricultural use
Natural uses	C1	Natural vegetation
	C2	Natural areas without vegetation
	C3	Water bodies
	C3/C1	Water bodies with natural vegetation
Abandoned uses and marginal peri-urban areas	A4/A9	Abandoned residential housing
	A5/A9	Abandoned industrial and commercial uses
	A5/C1	Industrial use with natural vegetation
	A6/A9	Abandoned extractive activities
	A7/A9	Abandoned transport network
	A8/A9	Abandoned recreational areas
	A10/A9	Abandoned equipment
	B3/C1	Abandoned farmland and pastures

Table 3. Table showing the 30 different land uses possible in Ibiza sub divided within four broader groups.

The following table shows the area and percentage of each of the four broader types of use in both municipalities:

Municipality and type of use	Area (Ha)	Area (%)
Eivissa	**1.128,22**	**6,70%**
Abandoned uses and marginal per-urban areas	12,12	1,07%
Farming uses	59,92	5,31%
Natural uses	457,76	40,57%
Urban, residential, commercial and industrial uses	598,43	53,04%
Sant Josep de sa Talaia	**15.704,75**	**93,30%**
Abandoned uses and marginal per-urban areas	427,38	2,72%
Farming uses	3.240,14	20,63%
Natural uses	9.330,12	59,41%
Urban, residential, commercial and industrial uses	2.707,11	17,24%
Total	**16.832,97**	**100,00%**

ARTIFICIAL LAND USES



Interpretation:

Tourism (use A2) is one of the major economic activities in both municipalities. The surface dedicated to this activity in Sant Josep (146,45 Ha) is three times that of Eivissa (45,38 Ha). This difference is explained by the manner in which this activity is consumed in each municipality: while in Eivissa this activity is managed through large hotels (covers 111 i 112A) which occupy a

vertical surface, in Sant Josep it is managed in the form of urbanisations (cover 112A), which expand horizontally over the territory and which are particularly abundant along the coastline.

Industry (use A5) often appears arranged in the form of industrial estates (land cover 121). Industrial surfaces in Eivssa reach a surface cover of 64,73 Ha, almost half of the total area of the same surface in Sant Josep (159,12 Ha), even though Sant Josep is much larger. Additionally, in Sant Josep, a large part of this surface belongs to the Salines (use C3/A5, 420,64 Ha).

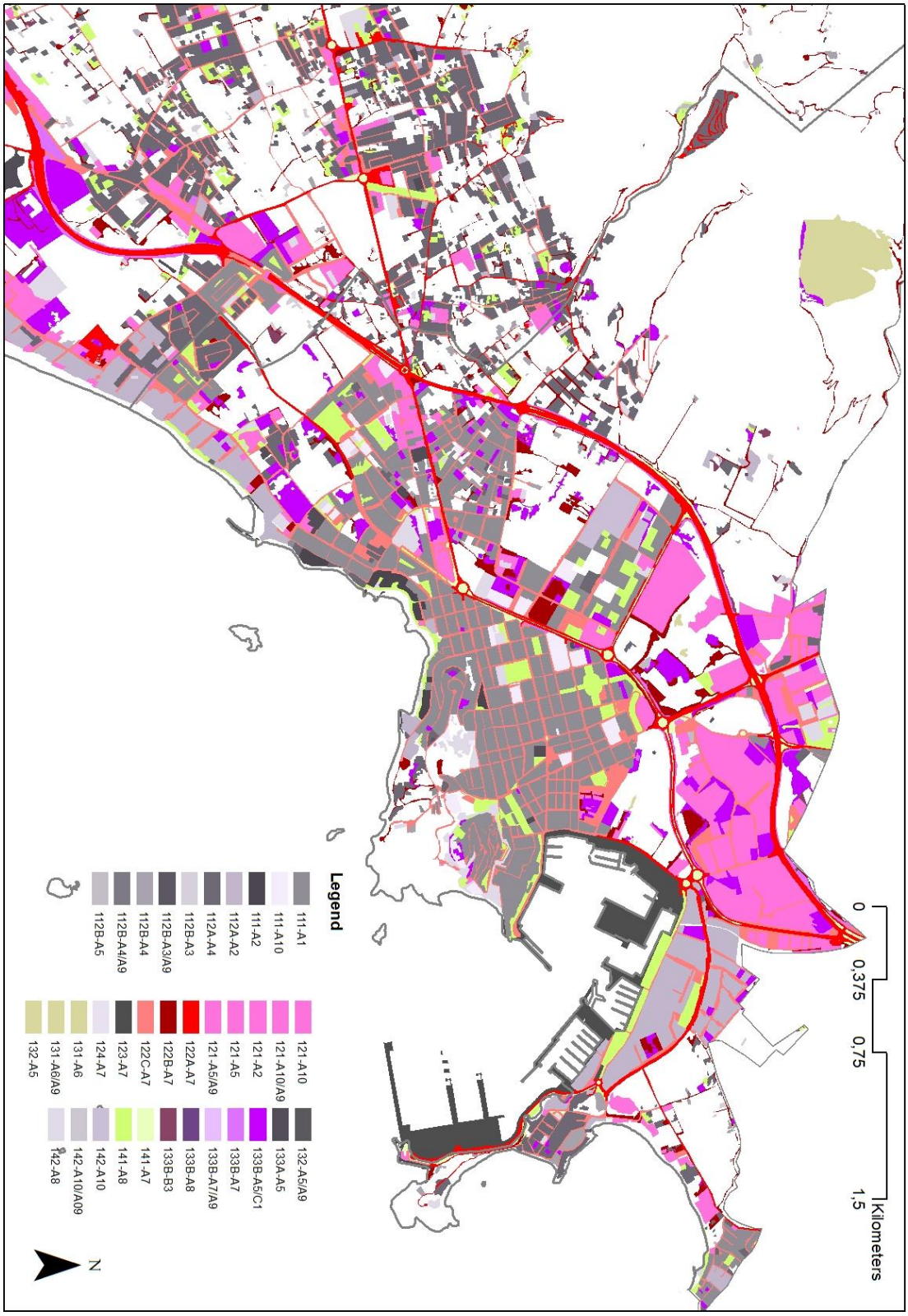
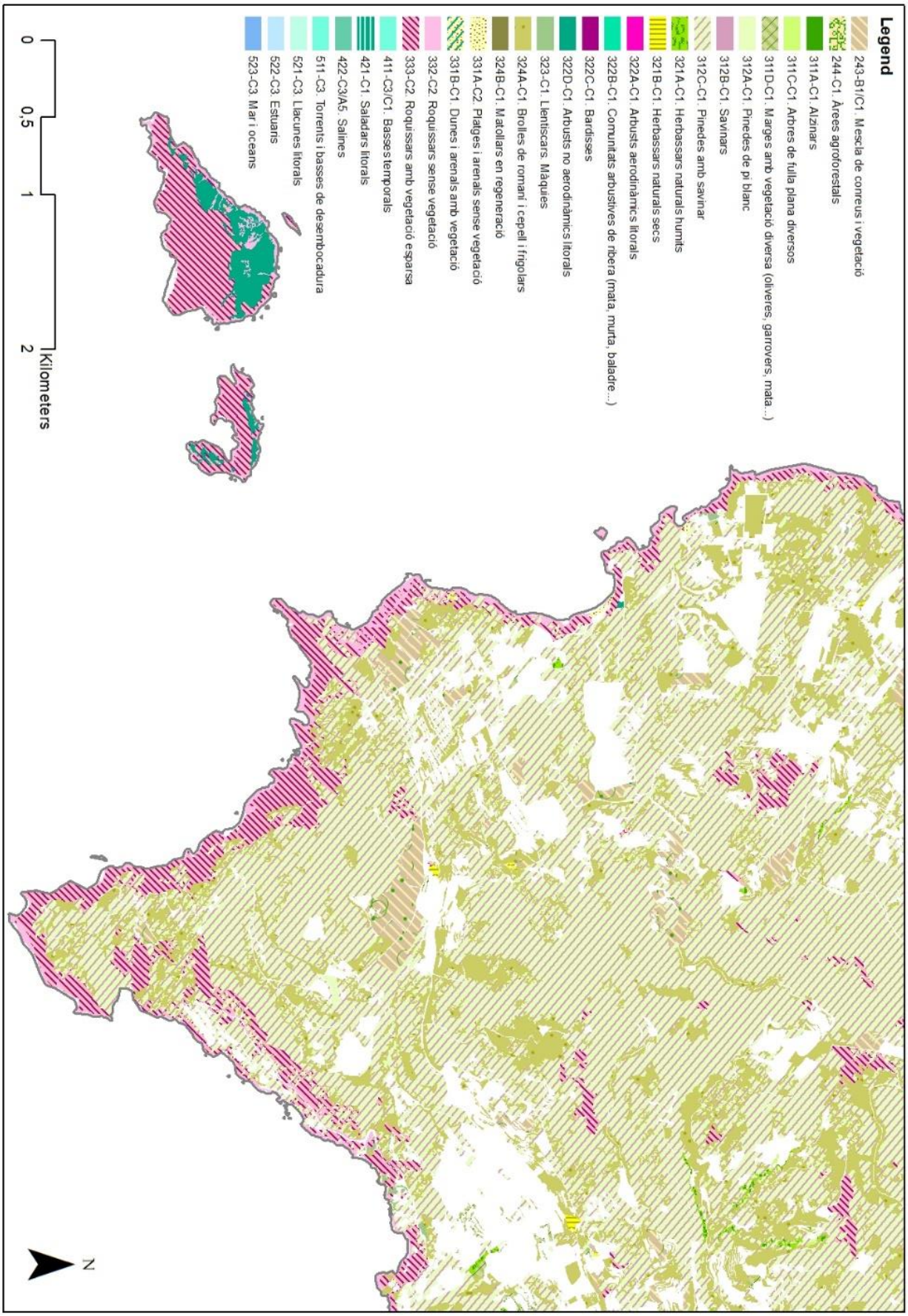
Equipment (use A10) for the public's general interest (sports facilities, schools, medical centres, etc.) concentrate in Eivissa. Even though much smaller than Sant Josep, Eivissa concentrates almost three times (34,30 Ha) the amount of equipment of Sant Josep (13,03 Ha).

Finally, looking at the residential uses, it is possible to characterise how the population lives in these two municipalities: while the greatest part of Eivissa's 51.128 habitants live in areas (131,49 Ha) mostly following a continuous urban fabric pattern (use A1 and cover 111) , most of the 27.732 inhabitants of Sant Josep live in isolated single family homes surrounded by gardens and which, in all, occupy a surface of 656,99 Ha (use A4 and cover 112A). This urbanistic model is defined as discontinuous urban fabric and is the one with the largest consume rates in terms of resources (energy, water...).

5. Maps

On this final section, there are two sample maps displayed which give a glimpse on what can be extracted from the main land cover and land use maps:

Ibiza town artificial land covers



Es Vedrà and Es Vedranell isles and the South-West of Sant Josep de sa Talaia municipality