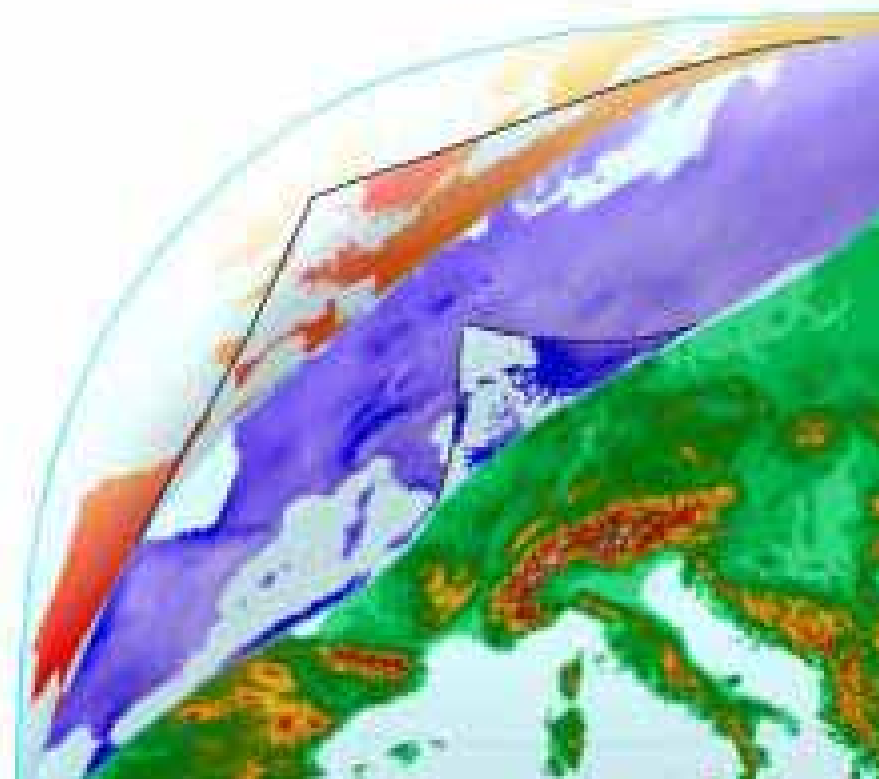


# Spatial and Ecogeographical Approaches for Selecting Genetic Reserves in Europe

Mauricio Parra Quijano  
José María Iriando  
Elena Torres

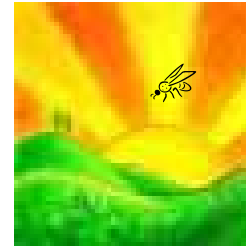
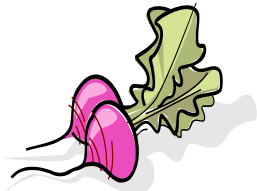
"Towards Establishment of Genetic Reserve for Crop Wild Relatives  
and Landraces in Europe" Symposium  
Madeira, Portugal, 13-16 September 2010



# Introduction

## Ecogeography

**Phenotype = Genotype + Environment + (GxE)**



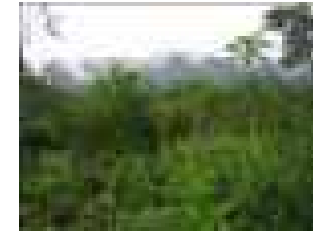
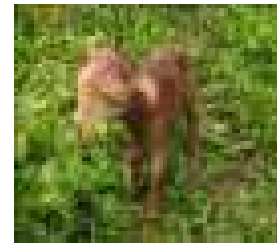
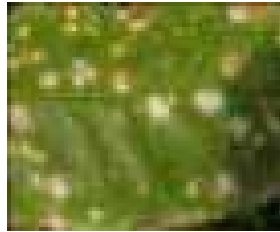
Ecogeography is every environmental factor which determines plant survival, in other words....



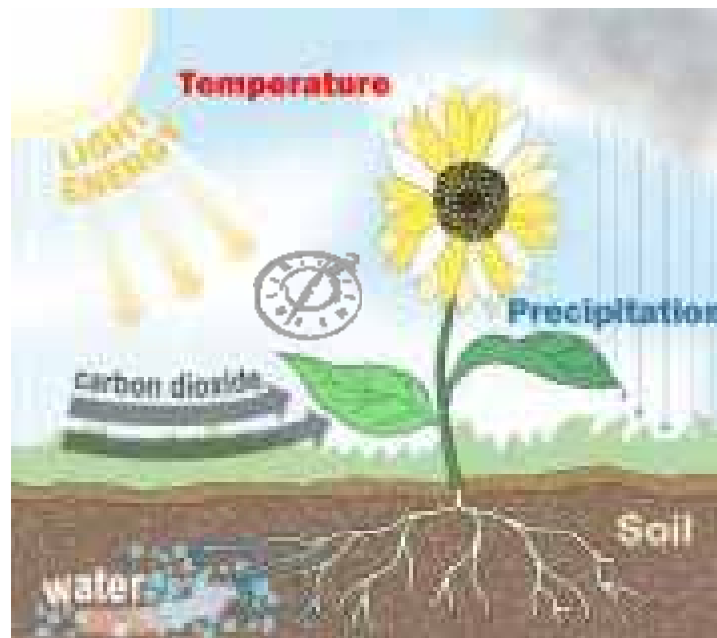
**ADAPTATION**

# Introduction

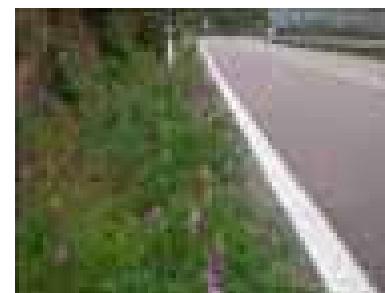
## Biotic



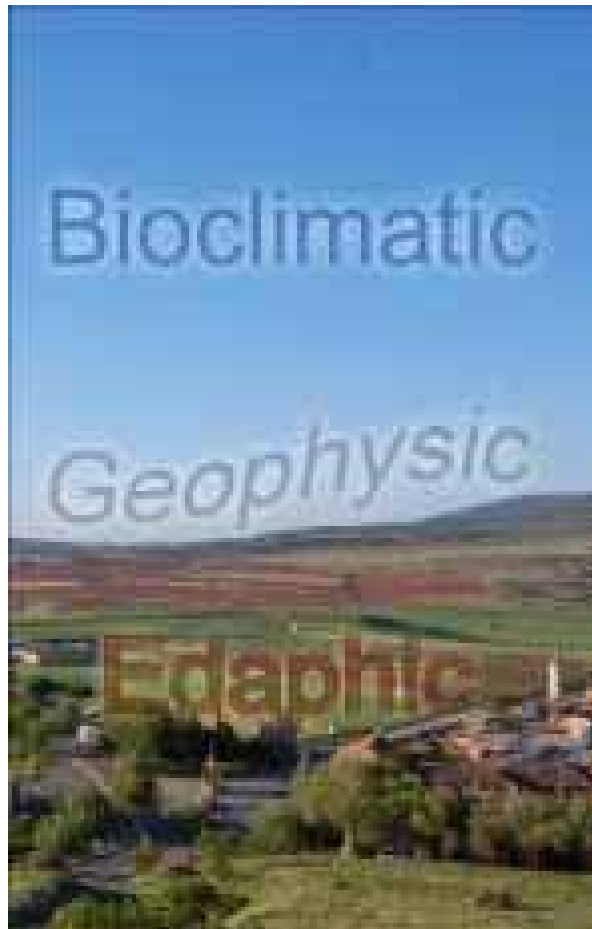
## Abiotic



## And Anthropogenic factors



## Abiotic variables classification

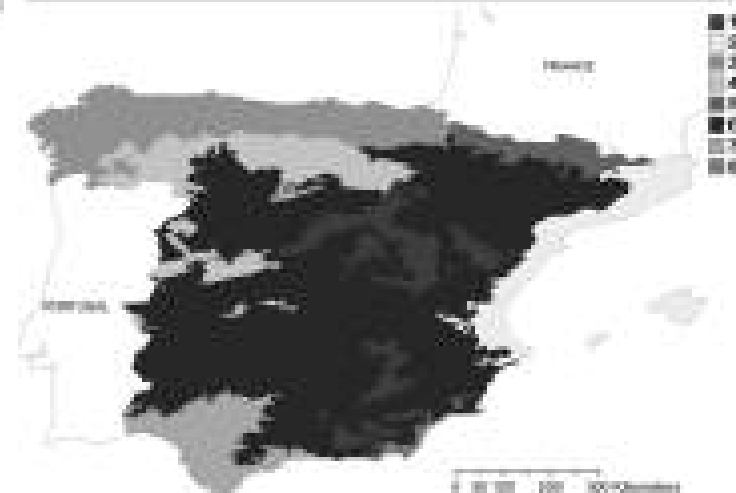
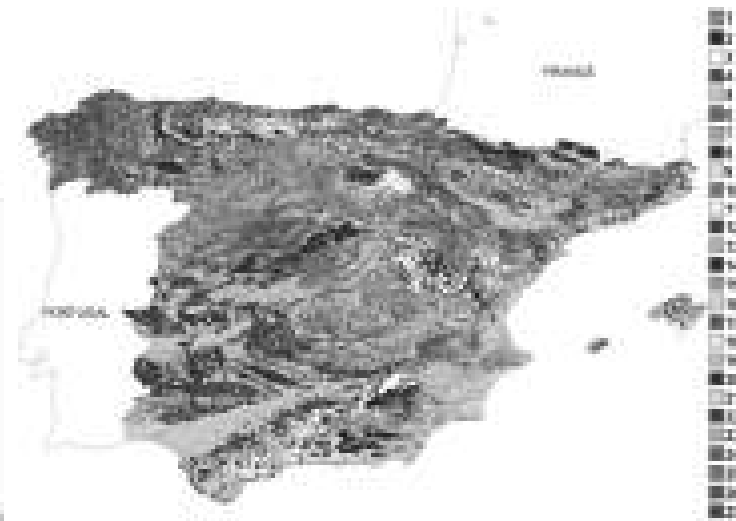
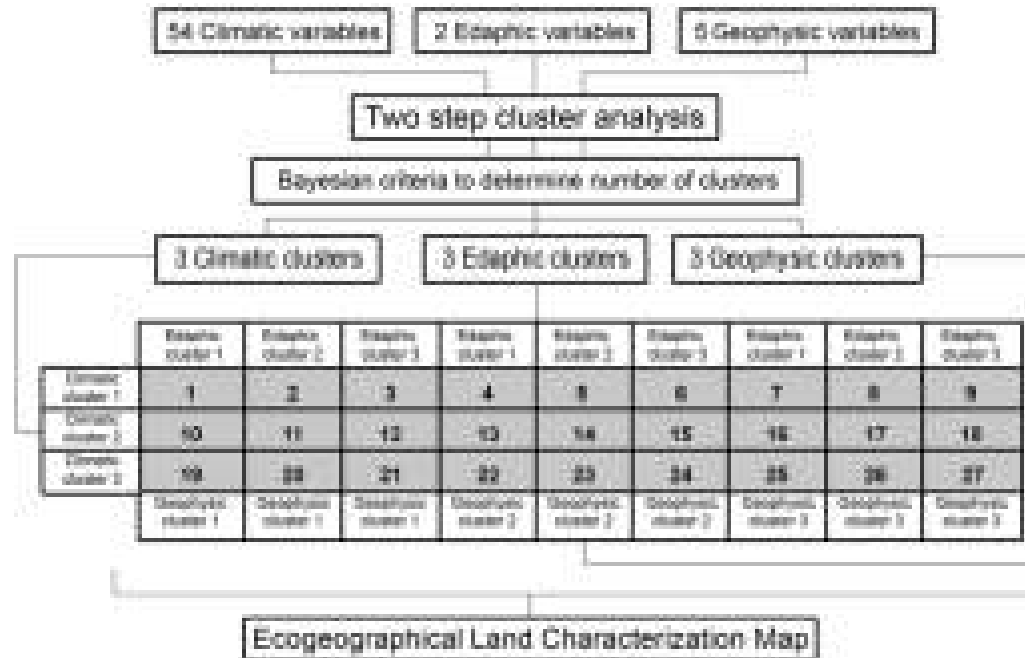


**Temperature, precipitation, climate indexes, etc.**

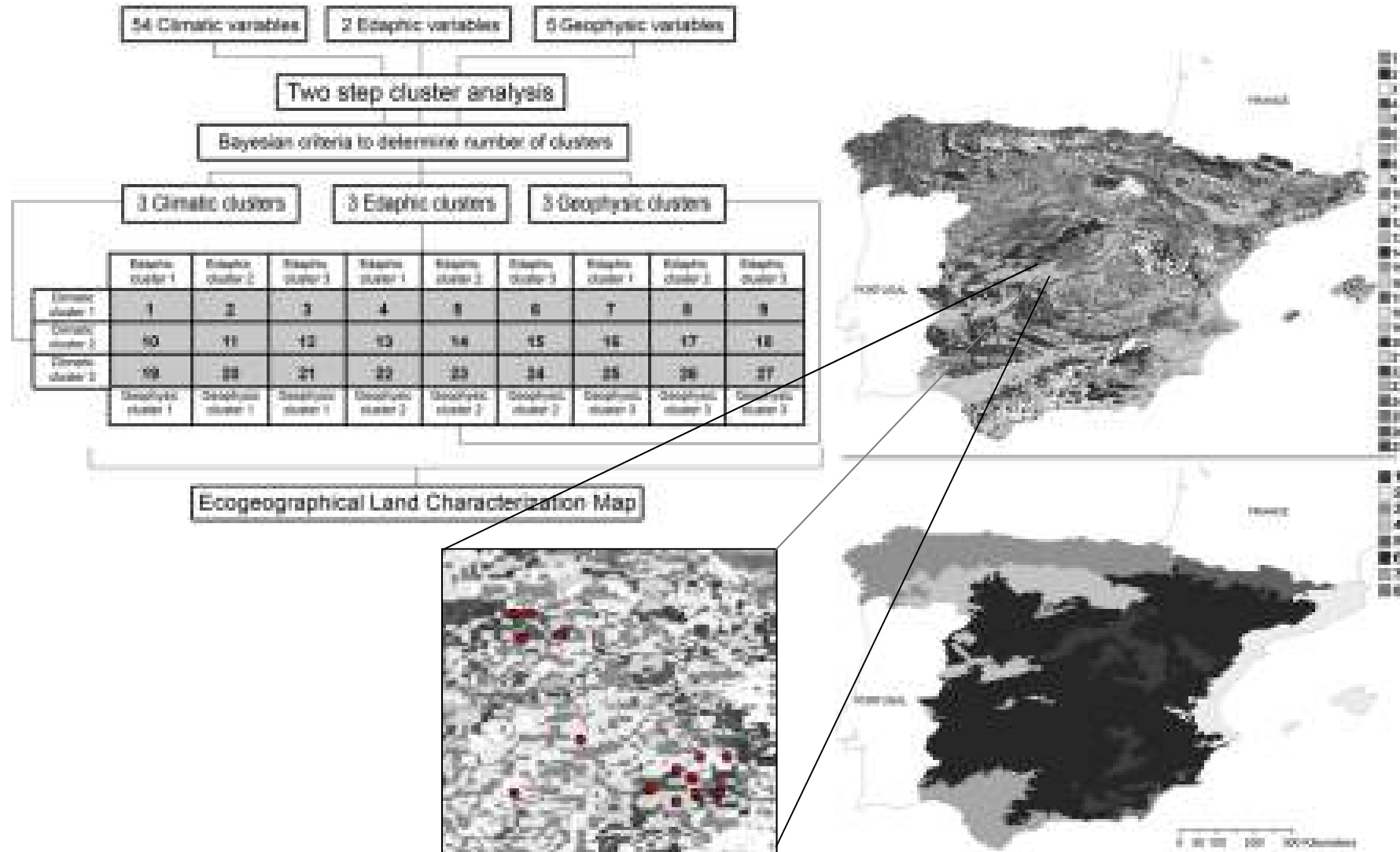
**Slope, aspect, hillshade, topographic shape, etc.**

**Soil type, pH, salinity, organic carbon, etc.**

## Ecogeographic land characterization maps

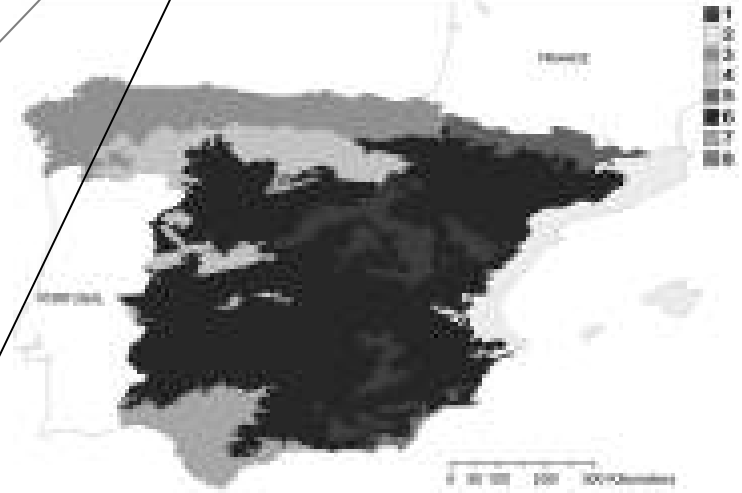
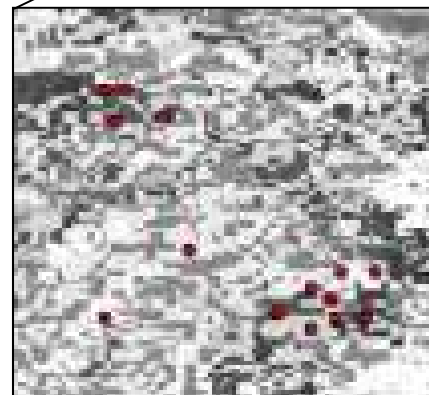
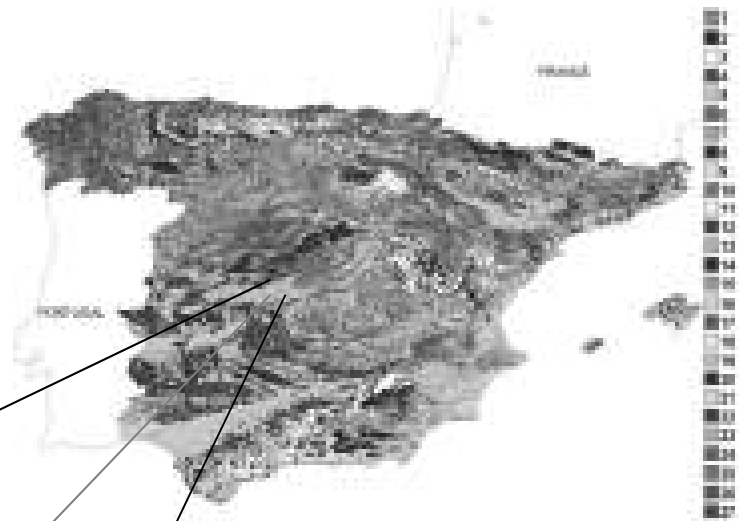
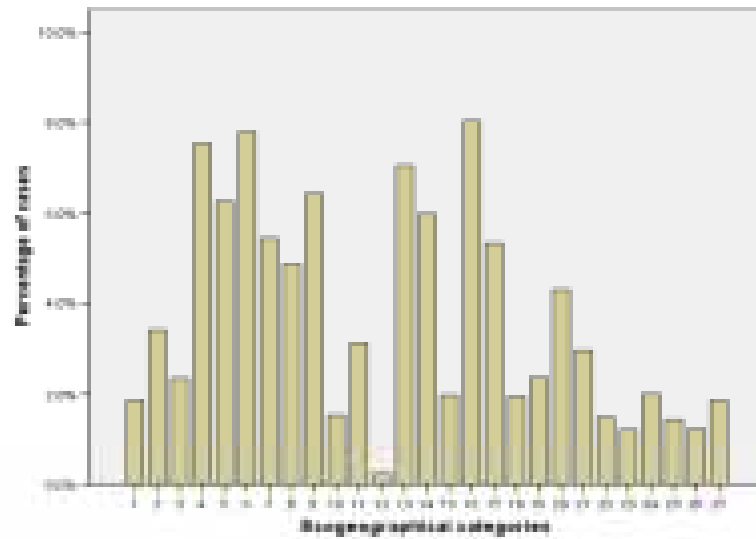


## Ecogeographic land characterization maps



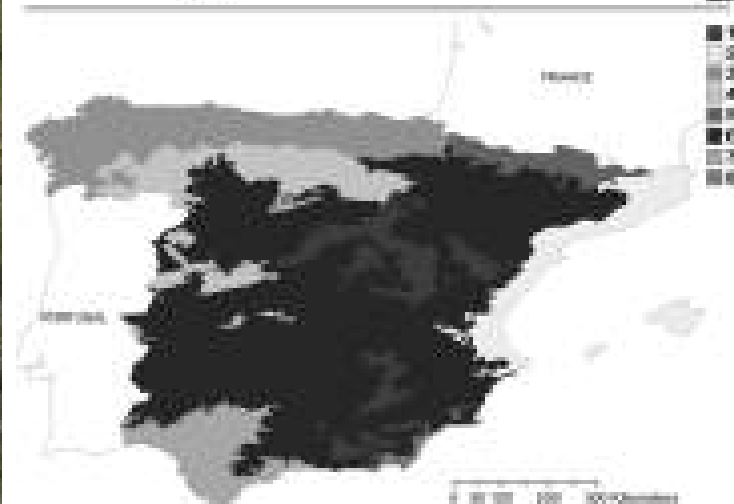
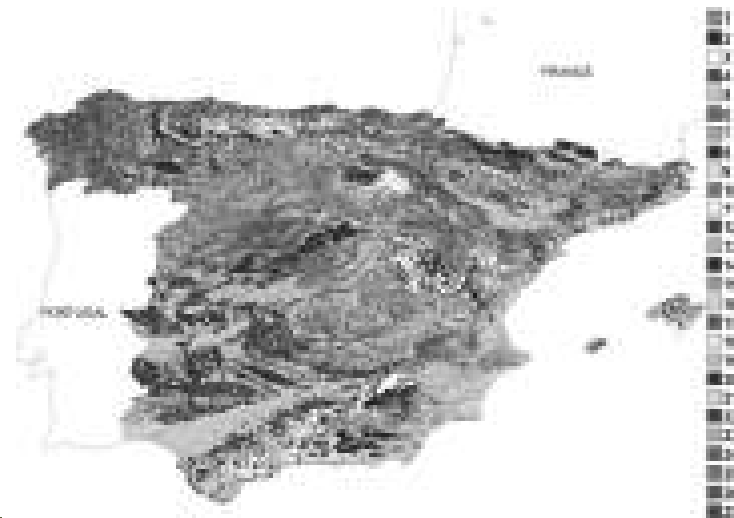
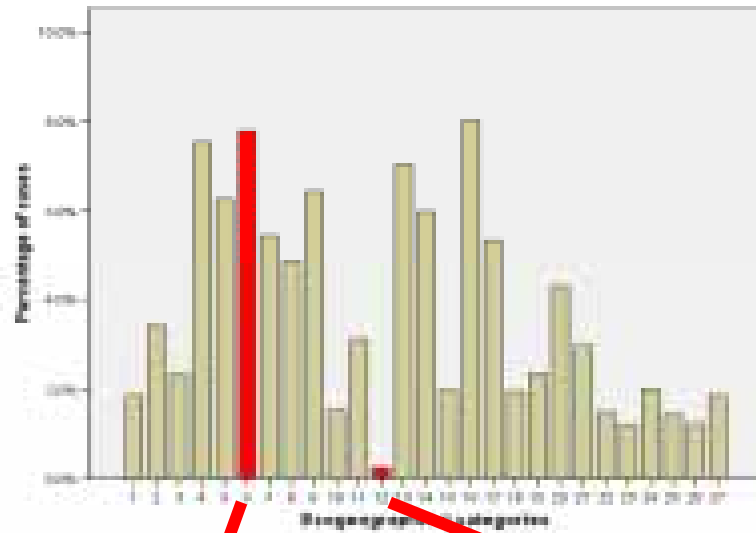
# Introduction

## Ecogeographic land characterization maps



# Introduction

## Ecogeographic land characterization maps

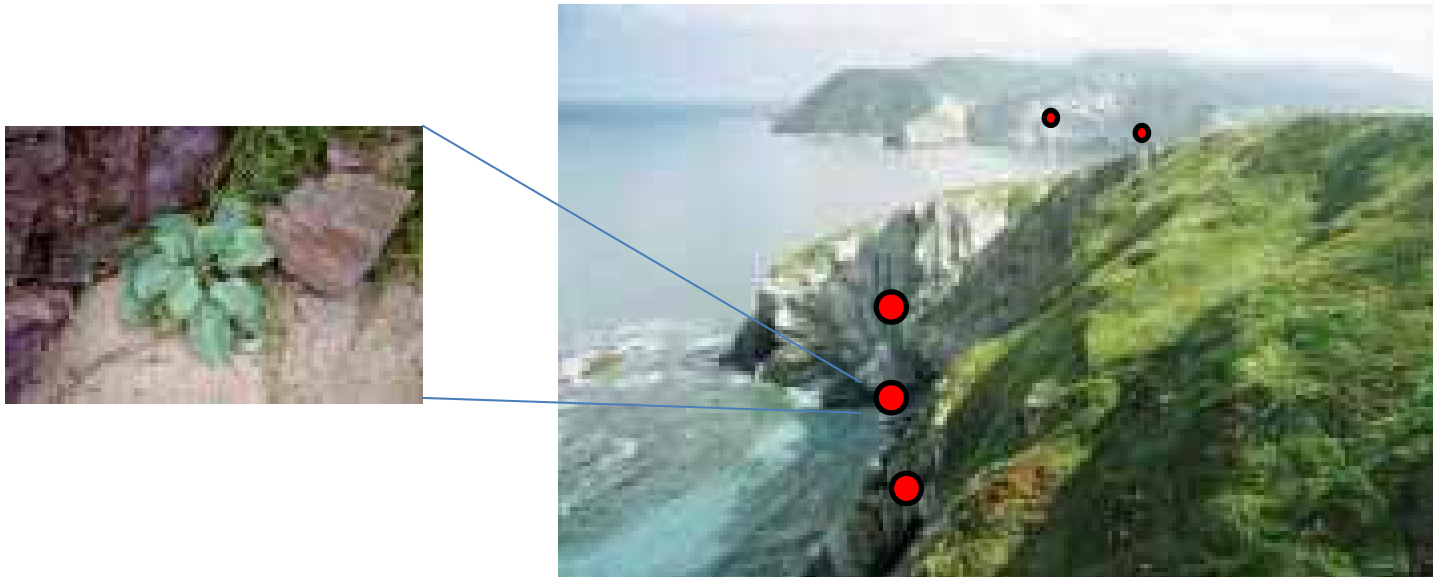


## Objective

Set up a Genetic Reserve selection process for Crop Wild Relatives in Europe based on ecogeographic representativeness and spatial aspects. We used *Beta* (AEGRO project) as study case.

Other aspects to consider when selecting genetic reserves:

- 1) Effective presence of the greatest number of populations of the focal threatened or, otherwise, priority CWR species



## Objective

Set up a Genetic Reserve selection process for Crop Wild Relatives in Europe based on ecogeographic representativeness and spatial aspects. We used *Beta* (AEGRO project) as study case.

Other aspects to consider when selecting genetic reserves:

- 2) Maximum legal protection of the area



## Objective

Set up a Genetic Reserve selection process for Crop Wild Relatives in Europe based on ecogeographic representativeness and spatial aspects. We used *Beta* (AEGRO project) as study case.

Other aspects to consider when selecting genetic reserves:

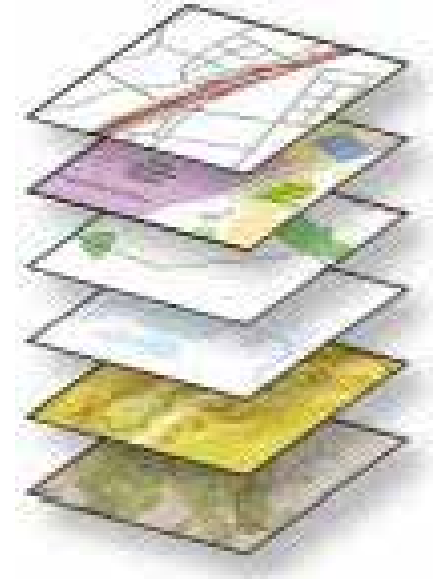
- 3) Maximum coverage of populations of other non-focal CWR species



# Material

## Data:

- PLIS Database
- Ecogeographic variables (GIS layers)
- Natura 2000 sites (GIS layer)
- Anthropic information (GIS layers)



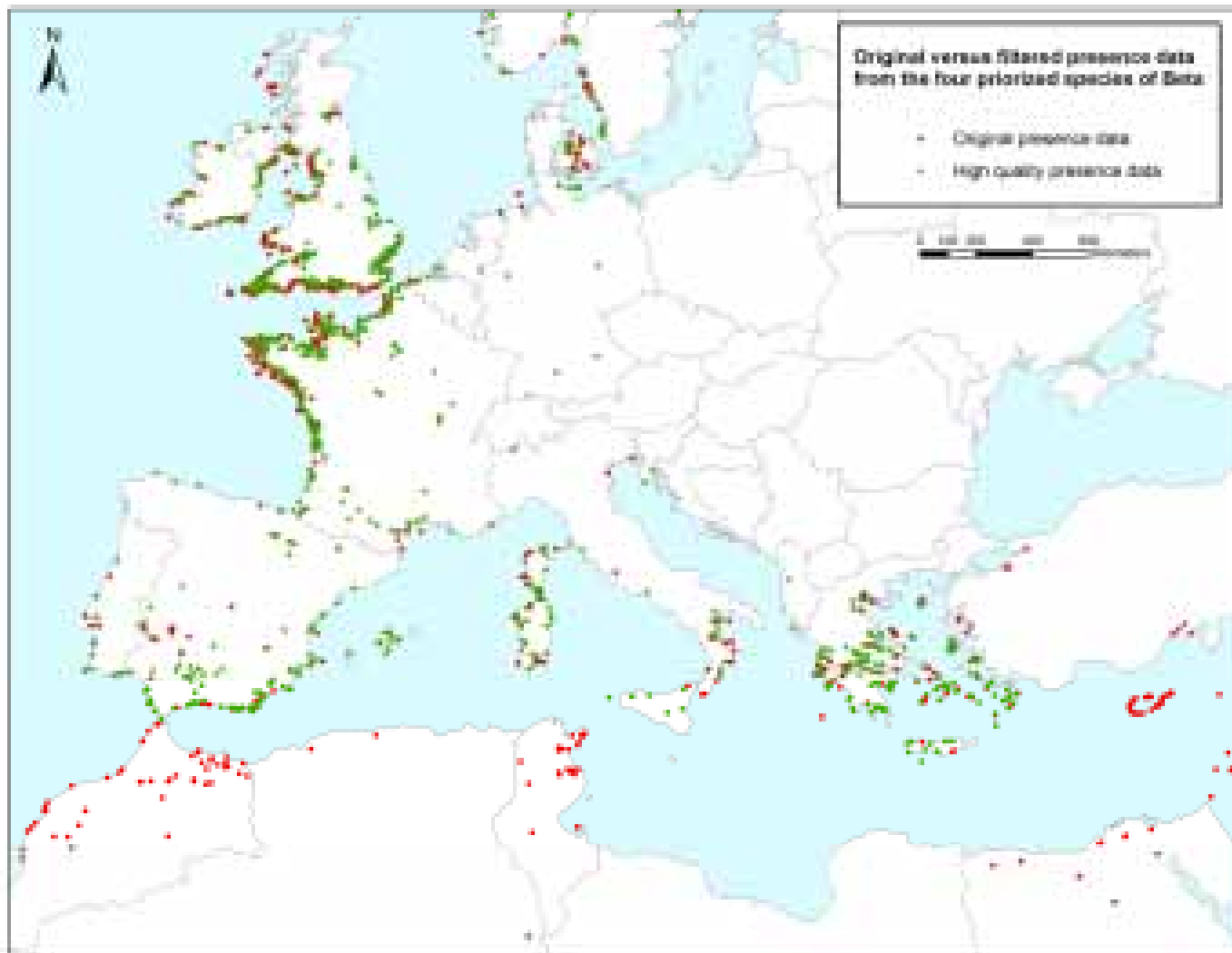
## Software:

- GIS
- Species distribution modelling (Maxent)
- Statistical



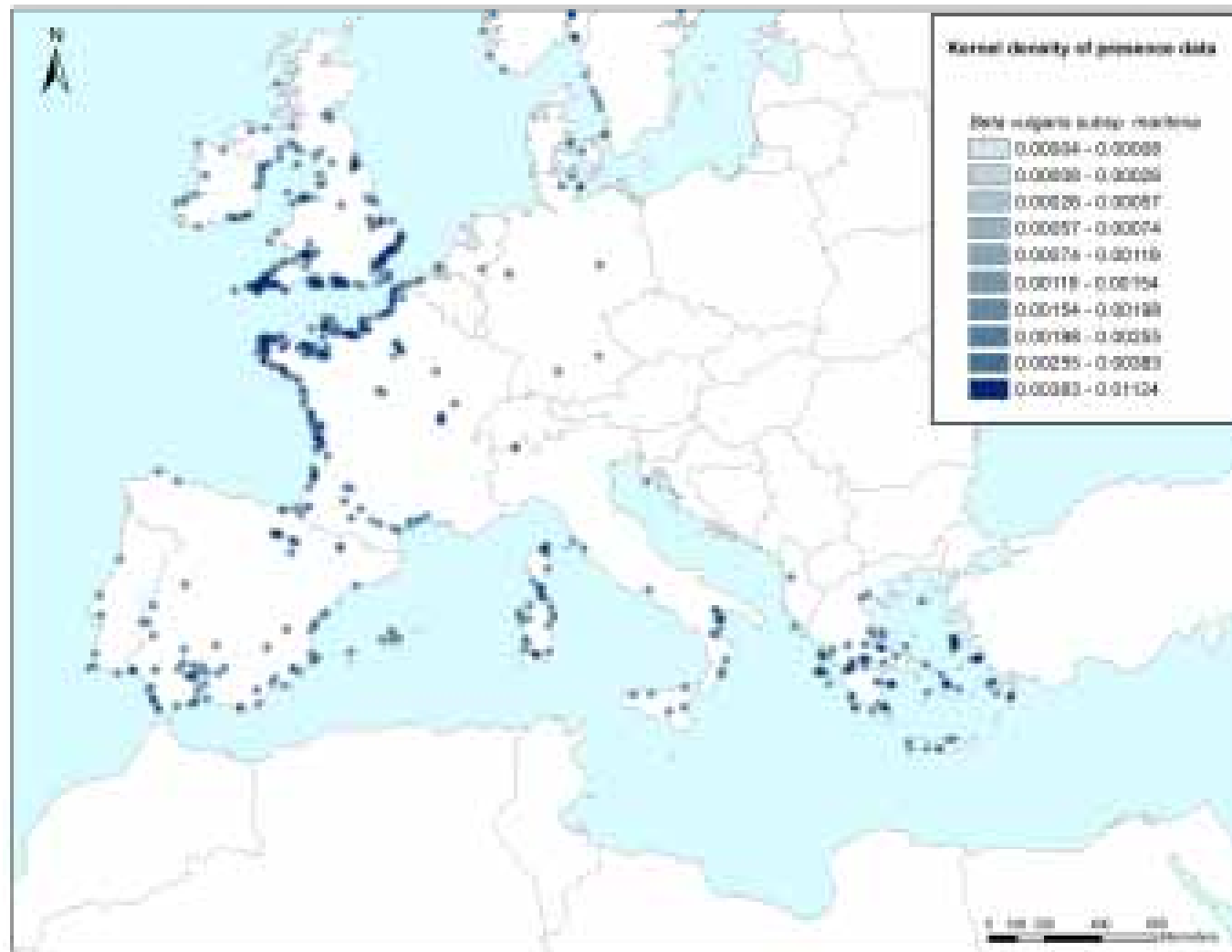
## Stepwise method

**Step 1** - Selecting high quality georeferenced presence data from PLIS database (AEGRO project)



# Stepwise method

Detection of high-density presence data areas

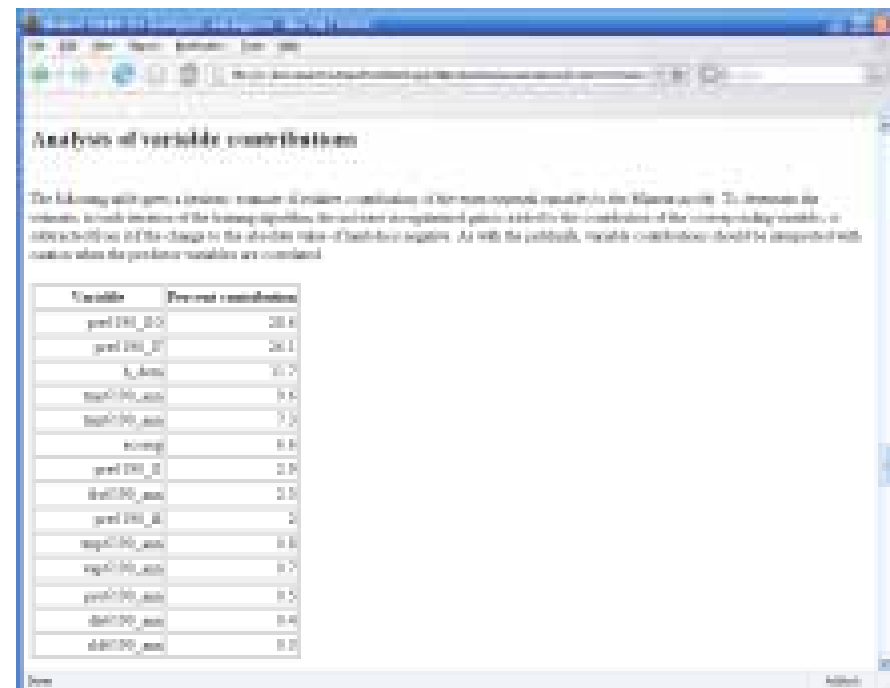


# Stepwise method

**Step 2** - Compilation of ecogeographical layers/variables and subjective/objective variables selection process related to adaptation.

Expert's knowledge survey (subjective)

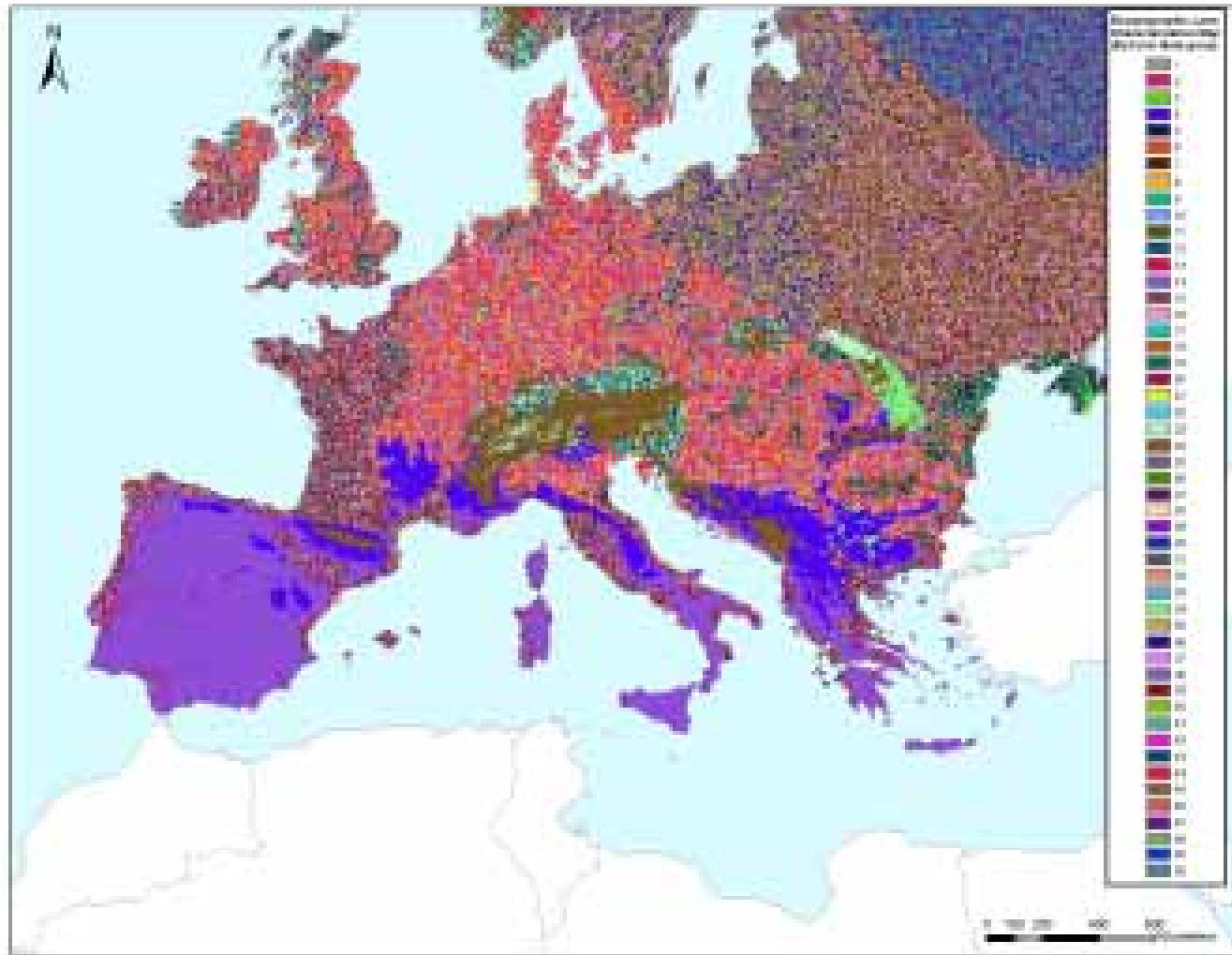
Statistical significance (objective)



Consensus

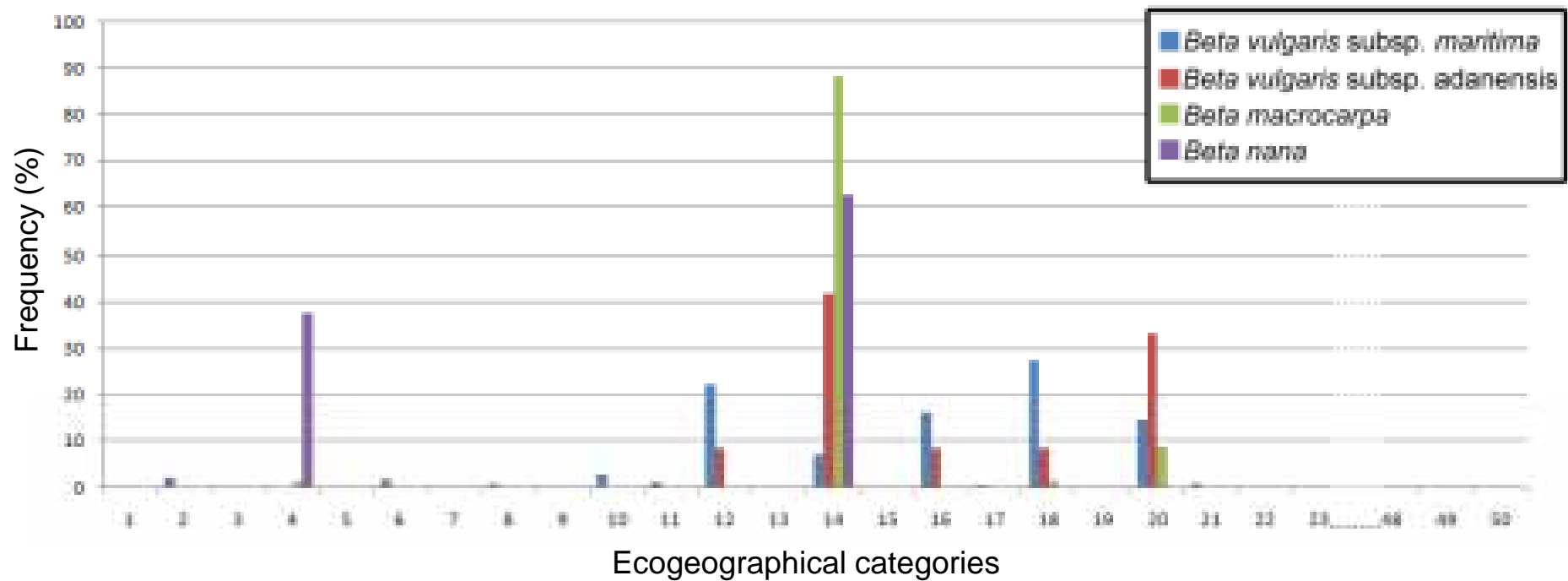
## Stepwise method

**Step 3** – Creation of ecogeographic map (5-minutes grid resolution)



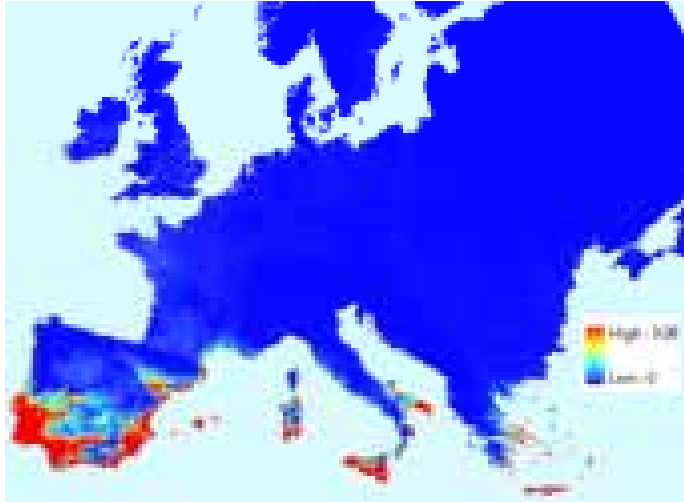
# Stepwise method

## Step 3 - Creation of ecogeographic map (5-minutes grid resolution)

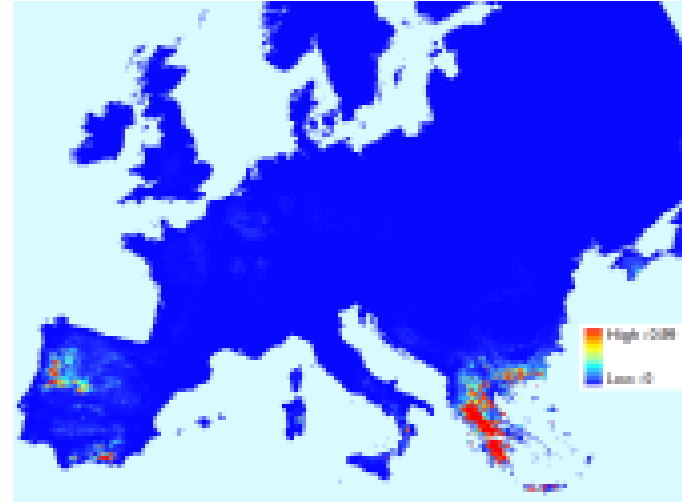


## Stepwise method

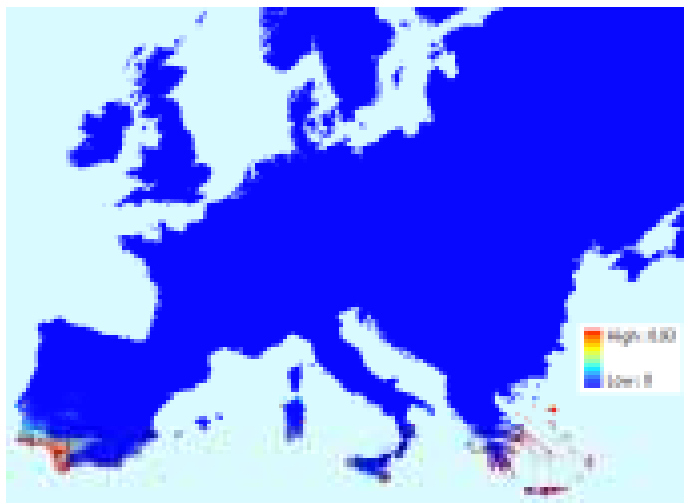
**Step 3** – and Maxent's species distribution models (for prioritized species)



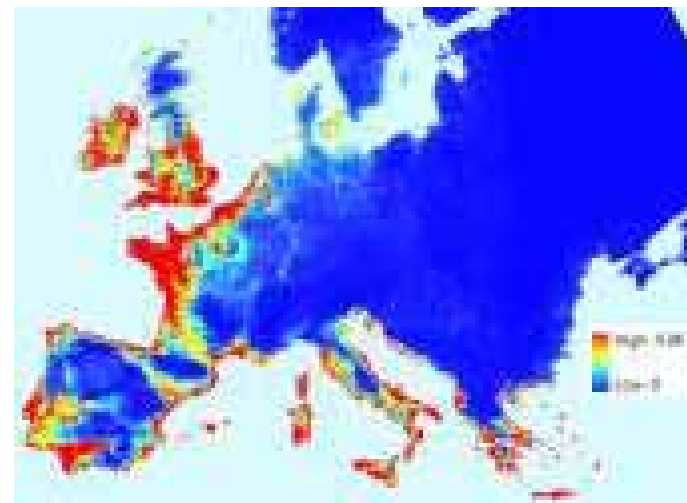
*B. macrocarpa*



*B. nana*



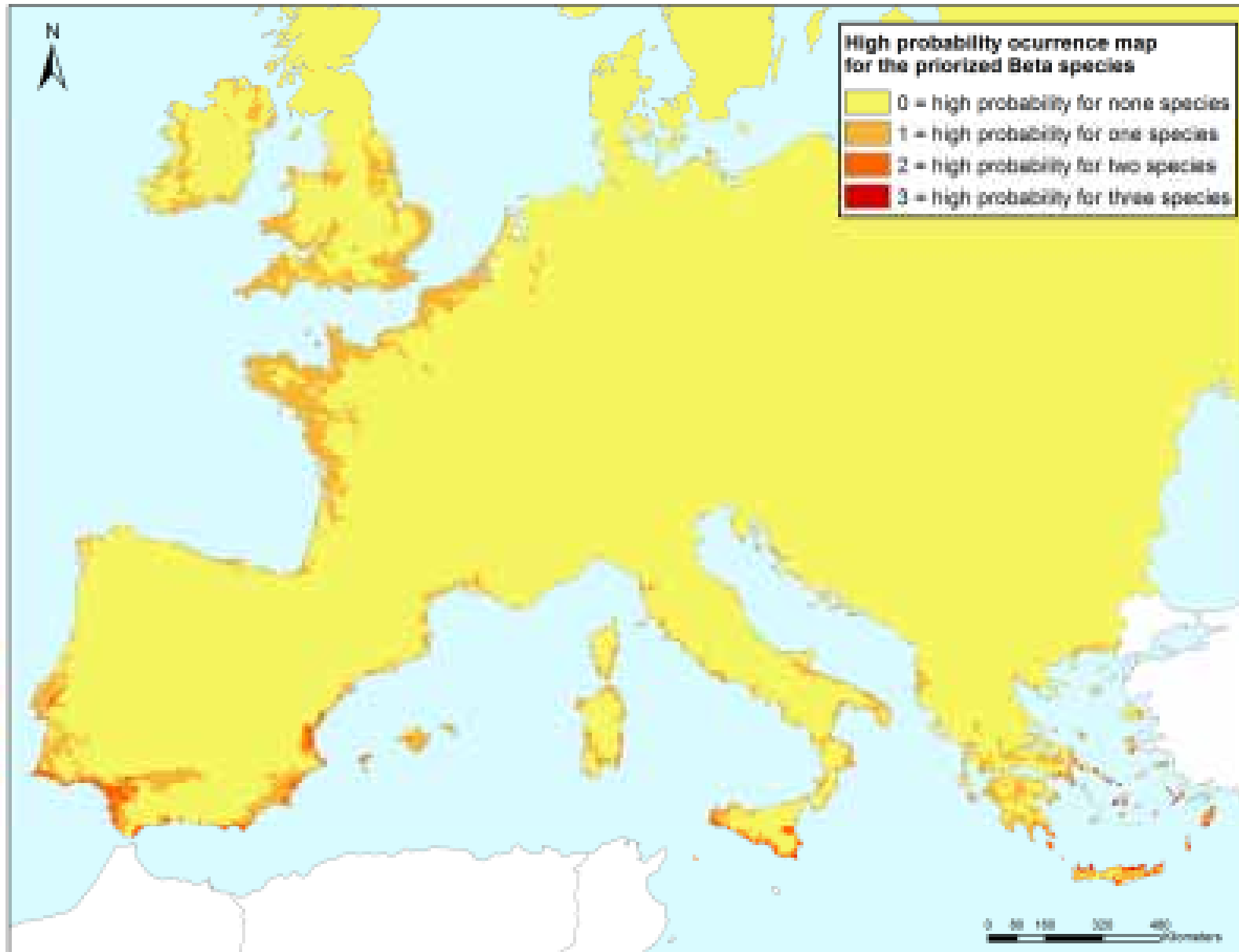
*B. vulgaris* subsp. *adanensis*



*B. vulgaris* subsp. *maritima*

## Stepwise method

### Step 3 – and Maxent's species distribution models (for prioritized species)



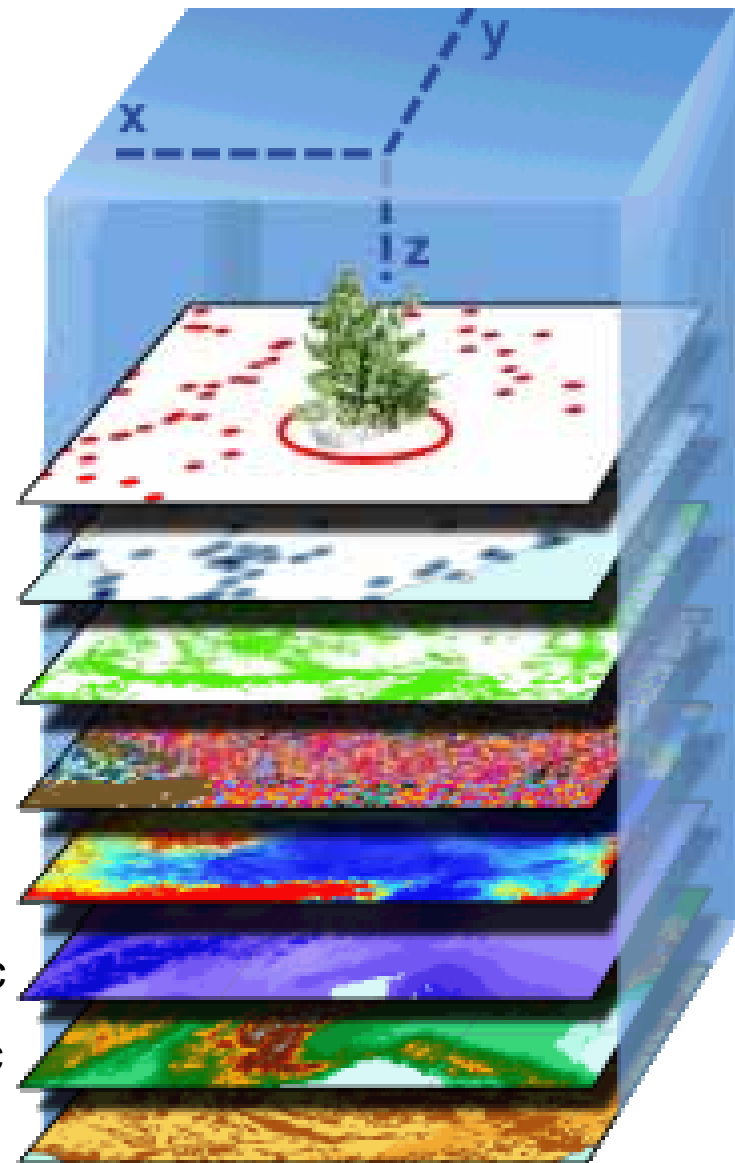
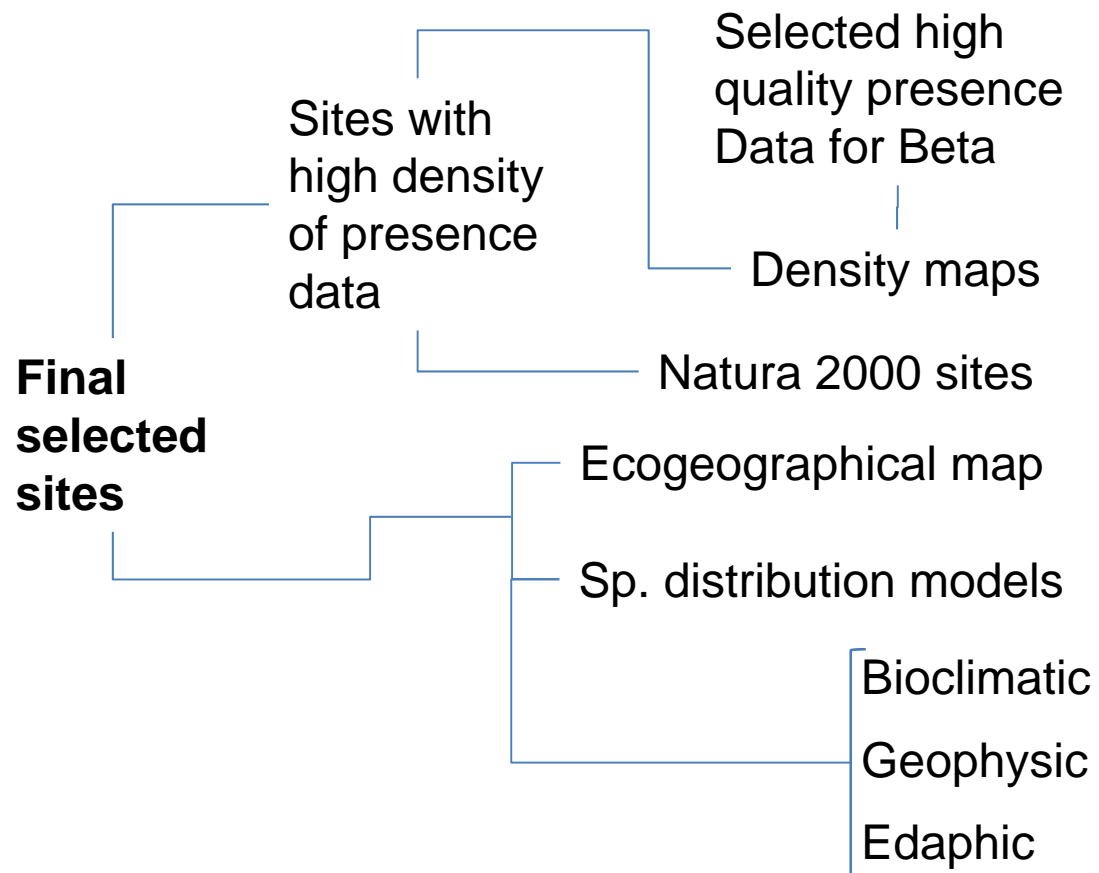
## Stepwise method

- Step 4** - Adding Natura 2000 data – the European network of protected sites, as a base for the potential genetic reserves



# Stepwise method

**Step 5** - Superimposing layers on GIS and selecting potential genetic reserves.





# Results

NATURA 2000 site name (Potential Genetic Reserve)	Country	Km2 (aprox)	Site code
BAHIA DE CADIZ	Spain	103.8	ES0000140
CABO DE GATA-NIJAR	Spain	0.2	ES0000046
RADE DE BREST, ESTUAIRE DE L'AULNE	France	92.4	FR5300046
COTE DE GRANIT ROSE DE MILLIAU A TOME, ARCHIPEL DES SEPT-ILES	France	63.5	FR5300009
BAIE DE MORLAIX	France	53.1	FR5300015
ANSE DU FIER D'ARS EN RE	France	44.6	FR5410012
MARAIS ET ESTUAIRE DE LA SEUDRE, ILE D'OLERON	France	140.0	FR5412020
MARAIS DU NORD MEDOC	France	239.8	FR7210065
MARAIS POITEVIN	France	682.1	FR5410100
ETANGS PALAVASIENS ET ETANG DE L'ESTAGNOL	France	65.3	FR9110042
NOTIOANATOLIKOS PARNASSOS - ETHNIKOS DRYMOS PARNASSOU - DASOS TITHOREAS	Greece	184.3	GR2450005
ORI VARDOUSIA	Greece	193.8	GR2450001
VOREIA CHIOS KAI NISOI OINOUSES KAI PARAKTIA THALASSIA ZONI	Greece	344.1	GR4130001
ARKOI, LEIPSOI, AGATHONISI KAI VRACHONISIDES	Greece	124.0	GR4210010
KOS: AKROTIRIO LOUROS - LIMNI PSALIDI - OROS DIKAIOS - ALYKI-PARAKTIA THALASSIA ZONI	Greece	101.3	GR4210008
THE NEW FOREST	United Kingdom	293.1	UK0012557
ESSEX ESTUARIES	United Kingdom	461.5	UK0013690

# Results

Site code	Populations covered from Beta prioritized species				Total
	<i>B. vulgaris</i> subsp. <i>maritima</i>	<i>Beta macrocarpa</i>	<i>Beta nana</i>	<i>Beta vulgaris</i> subsp. <i>adanensis</i>	
ES0000140	2	4	0	0	6
ES0000046	2	7	0	0	9
FR5300046	2	0	0	0	2
FR5300009	3	0	0	0	3
FR5300015	3	0	0	0	3
FR5410012	3	0	0	0	3
FR5412020	2	0	0	0	2
FR7210065	4	0	0	0	4
FR5410100	2	0	0	0	2
FR9110042	2	0	0	0	2
GR2450005	0	0	23	0	23
GR2450001	0	0	15	0	15
GR4130001	2	0	0	0	2
GR4210010	0	0	0	2	2
GR4210008	1	0	0	0	1
UK0012557	2	0	0	0	2
UK0013690	7	0	0	0	7
<b>TOTAL</b>	<b>37</b>	<b>11</b>	<b>38</b>	<b>2</b>	<b>88</b>

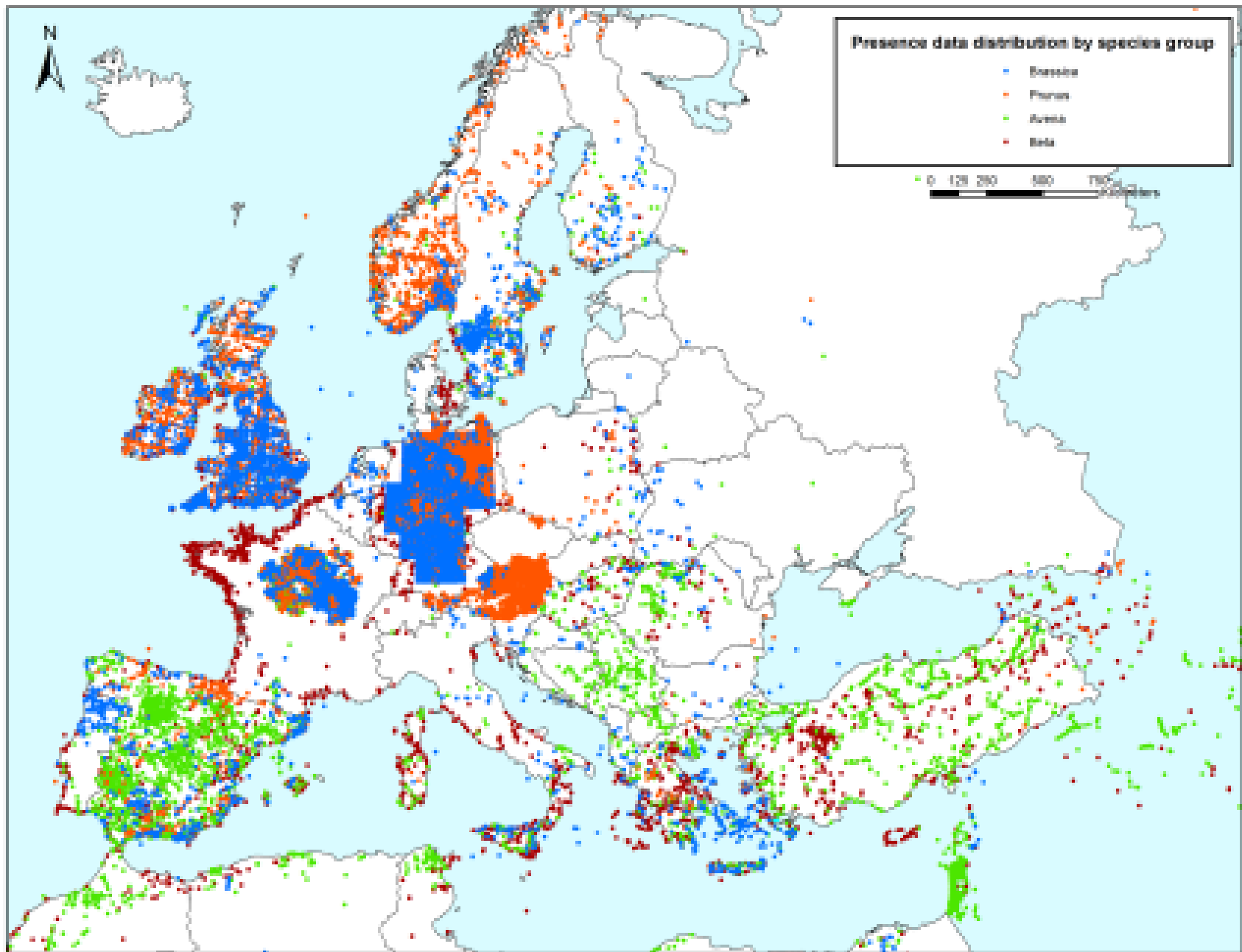
# Results

Site code	High probability of species occurrence within sites				
	Summarized (4) High probability for				
		<i>B. vulgaris</i> subsp. <i>maritima</i>	<i>Beta macrocarpa</i>	<i>Beta nana</i>	<i>Beta vulgaris</i> subsp. <i>adanensis</i>
	prioritized species				
ES0000140	2	1	1	0	0
ES0000046	2	1	1	0	0
FR5300046	1	1	0	0	0
FR5300009	1	1	0	0	0
FR5300015	1	1	0	0	0
FR5410012	1	1	0	0	0
FR5412020	1	1	0	0	0
FR7210065	1	1	0	0	0
FR5410100	1	1	0	0	0
FR9110042	1	1	0	0	0
GR2450005	1	0	0	1	0
GR2450001	1	0	0	1	0
GR4130001	2	1	0	0	1
GR4210010	3	1	1	0	1
GR4210008	3	1	1	0	1
UK0012557	1	1	0	0	0
UK0013690	1	1	0	0	0

# Results

Site code	Ecogeographical categories (from ecogeographical map created for Beta*) present or represented:			
	in the selected N2K site (covered by the N2K surface)		by the populations (priorized species) covered**	
	Number of total categories	Categories	Number of total categories	Categories
ES0000140	1	14	1	14
ES0000046	2	14,20	2	14,20
FR5300046	2	18,20	2	18,20
FR5300009	1	12	1	12
FR5300015	1	18	1	18
FR5410012	2	12,18	2	12,18
FR5412020	2	16,18	1	18
FR7210065	3	12,16,20	2	12,16
FR5410100	7	12,15,16,17,18,19,20	2	16,18
FR9110042	2	19,20	2	19,20
GR2450005	1	14	1	14
GR2450001	2	4,14	2	4,14
GR4130001	2	14,18	1	14
GR4210010	1	14	1	14
GR4210008	1	14	1	14
UK0012557	4	12,16,18,20	1	20
UK0013690	3	12,18,20	2	18,20

# Results



# Results

Site code	Number of populations of other wild <i>Beta</i> species covered by selected sites
	<i>Patellifolia patellaris</i>
ES0000140	0
ES0000046	4
FR5300046	0
FR5300009	0
FR5300015	0
FR5410012	0
FR5412020	0
FR7210065	0
FR5410100	0
FR9110042	0
GR2450005	0
GR2450001	0
GR4130001	0
GR4210010	0
GR4210008	0
UK0012557	0
UK0013690	0

# Results

Site code	AVENA		BRASSICA					PRUNUS					TOTAL
	<i>Avena</i>	<i>A.</i>	<i>Brassica</i>	<i>B.</i>	<i>B.</i>	<i>B.</i>	<i>B.</i>	<i>Prunus</i>	<i>P.</i>	<i>P.</i>	<i>P.</i>	<i>P.</i>	
	<i>barbata</i>	<i>sterilis</i>	<i>fruticulosa</i>	<i>napus</i>	<i>nigra</i>	<i>rapa</i>	<i>tourneforti</i>	<i>avium</i>	<i>cerasifera</i>	<i>cocomilia</i>	<i>prostrata</i>	<i>spinosa</i>	
ES0000140	2	0	0	0	0	0	0	0	0	0	0	0	2
ES0000046	0	0	2	0	0	0	2	0	0	0	0	0	4
FR5300046	0	0	0	0	0	0	0	0	0	0	0	0	0
FR5300009	0	0	0	0	0	0	0	0	0	0	0	0	0
FR5300015	0	0	0	0	0	0	0	0	0	0	0	0	0
FR5410012	0	0	0	0	0	0	0	0	0	0	0	0	0
FR5412020	0	0	0	0	0	0	0	0	0	0	0	0	0
FR7210065	0	0	0	0	0	0	0	0	0	0	0	0	0
FR5410100	0	0	0	0	0	0	0	0	0	0	0	0	0
FR9110042	0	0	0	0	0	0	0	0	0	0	0	0	0
GR2450005	0	0	0	0	0	0	0	0	0	0	2	0	2
GR2450001	1	0	0	0	0	0	0	0	0	0	1	0	2
GR4130001	0	1	0	0	1	0	0	1	0	2	0	0	5
GR4210010	0	0	0	0	0	0	0	0	0	0	0	0	0
GR4210008	0	0	0	0	0	0	0	0	0	0	0	0	0
UK0012557	0	0	0	2	1	1	0	0	0	0	0	0	4
UK0013690	0	0	0	0	0	0	0	1	1	0	0	2	4

## Conclusion

1. We selected potential genetic reserves for *Beta* prioritized CWR species as follows:

*Beta macrocarpa* : two genetic reserves, both in Spain, covering 50% of the ecogeographical categories of the species and 11 known populations.

*Beta nana* : two genetic reserves, both in Greece, covering 100% of the ecogeographical categories of the species and 38 known populations.

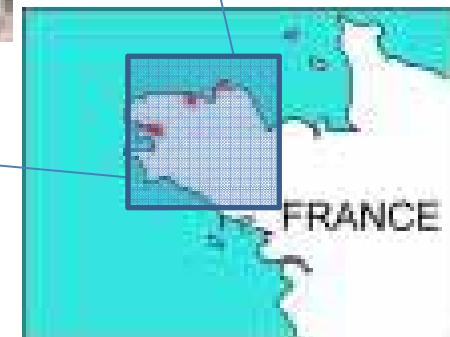
*Beta vulgaris* subsp. *adanensis* : one genetic reserve, in Greece (island), covering 20% of the ecogeographical categories of the species and 2 known populations.

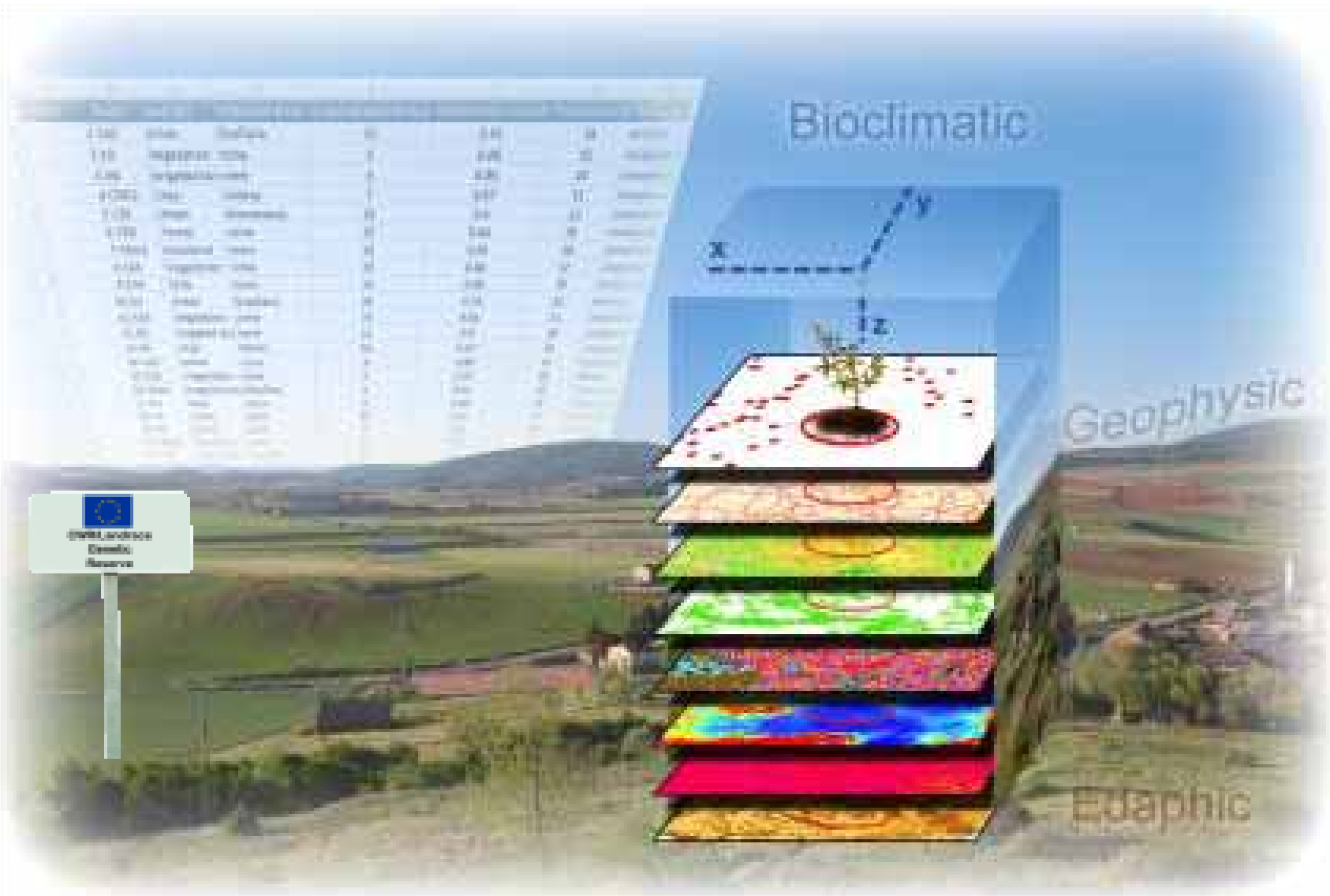
*Beta vulgaris* subsp. *maritima* : 12 genetic reserves, in France, Greece and UK, covering 24% of the ecogeographical categories of the species and 33 known populations. There are 4 populations covered by *B. macrocarpa* genetic reserves.

## Conclusion

2. There is a high probability of finding populations of *Beta* prioritized species in three of the potential genetic reserves selected here which were not selected for those species (according to SDM).
3. With these genetic reserves we also covered 4 known populations from one *Beta* non-prioritized species and 23 populations from 13 species from other groups (*Brassica*, *Avena* and *Prunus*).
4. The degree of ecogeographical coverage can be increased for widely distributed species with lower population density requirements (e.g., one-population threshold). It also would increase the number of genetic reserves.
5. This methodology is totally compatible with other approaches and would enrich an integrated analysis.
6. Verifications “on field” of the genetic reserves suitability are needed. Risk analysis is also advisable.

# Conclusion





**Thank you!**