

# Integrating climate change adaptation into planning of protected areas. A case study: Sierra de Santo Domingo Protected Landscape (Spain)

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## RESULTS FROM A SURVEY TO MANAGERS AND SCIENTISTS

### **Climate change is already here**

changes in phenology and life-cycle, species distribution, local extinctions, more intense perturbations ...

### **Some habitats or species are more vulnerable**

Habitats at their limit of distribution, relict habitats, rare species/habitats, wetlands, high mountains

### **Climate change is not considered in management**

Management plans do not include climate change  
Very few adaptation projects/actions in place

### **There is scientific knowledge - but it is not used by managers**

Lack of practical tools  
Incomplete transfer from science to practice

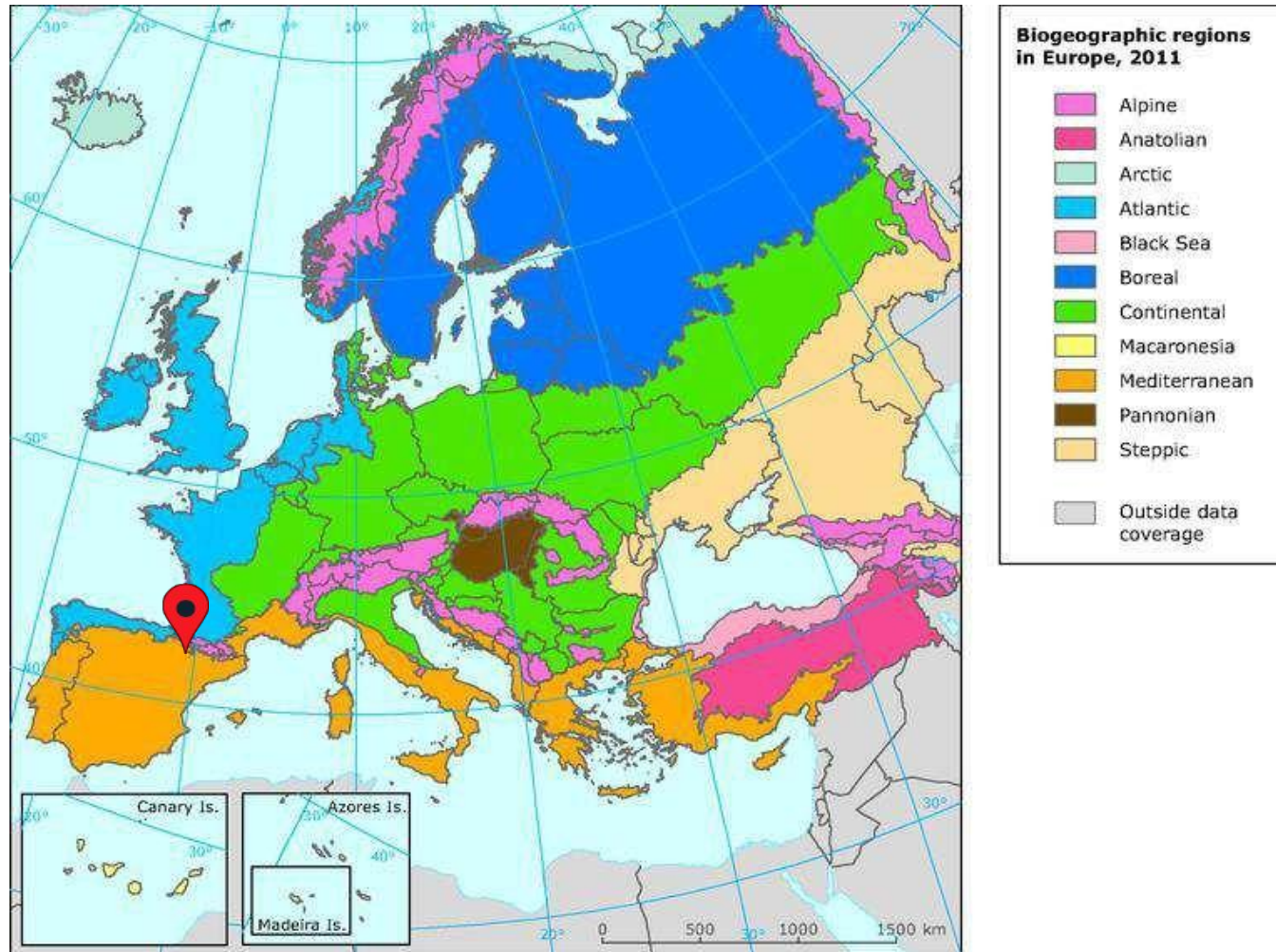
## PILOT CASE:

- **Sierra de Santo Domingo Protected Landscape**
- (Management Plan *in progress*)



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### SOME FACTS

9.600 has

760m – 1.524m

Transition between Mediterranean and Atlantic Region

Natura 2000 site

Mediterranean pine forests

*Quercus* forests

Relict beech forests in humid locations

Extensive grazing / rural abandonment

# ADAPTATION IN THE PLANNING PROCESS

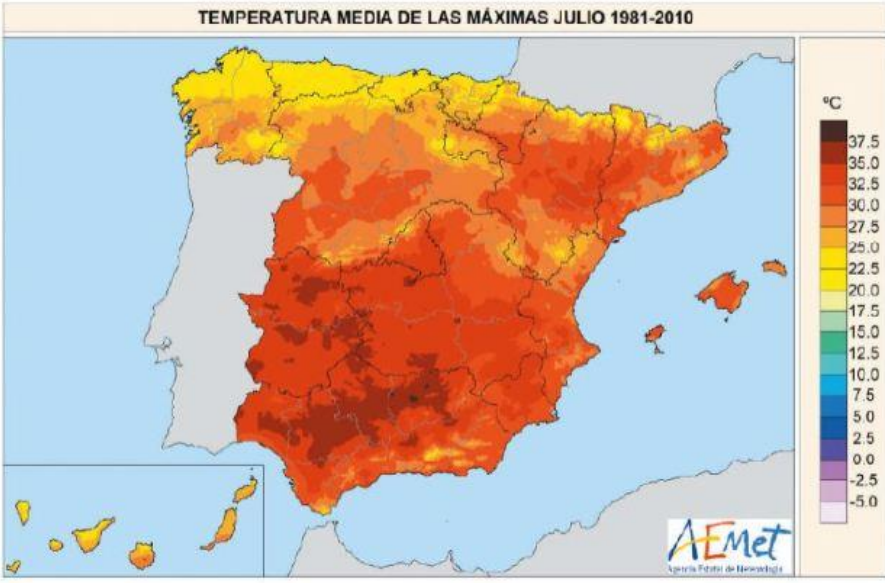
## PLANNING PROCESS

Diagnosis

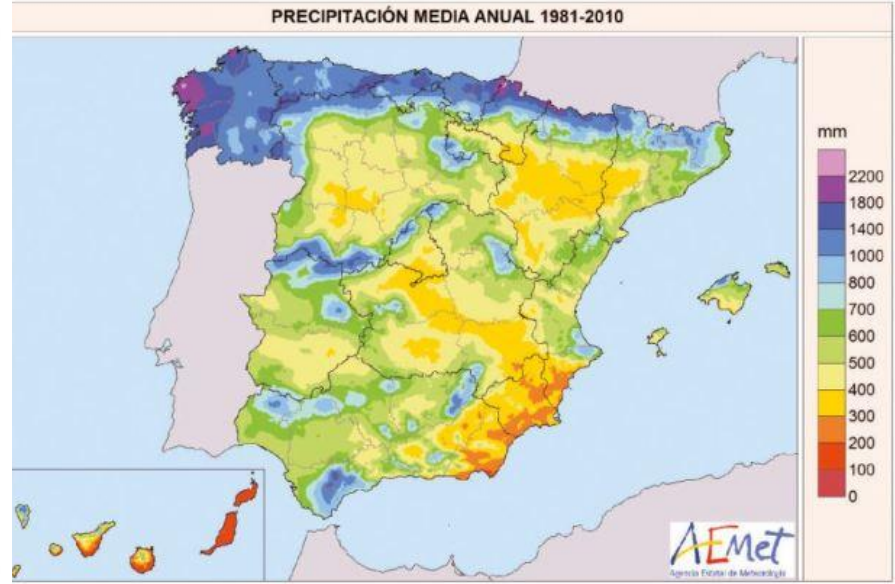
Current climate and registered trends



## CLIMATE CHANGE ISSUES



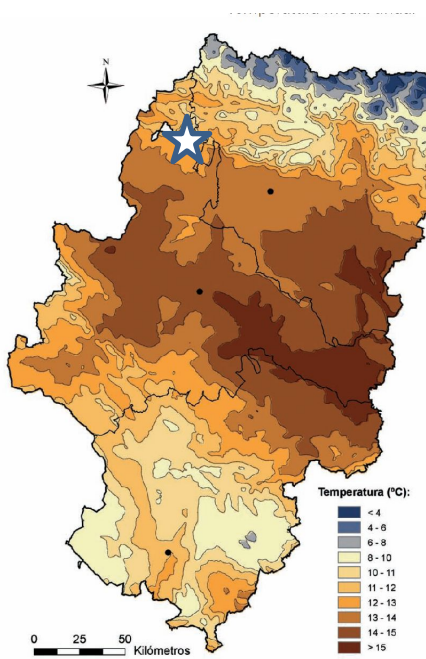
Mapa 5. Temperatura media de las máximas del mes de julio en el periodo 1981-2010 (Chazarra *et al.*, 2018).



Mapa 1. Precipitación media anual en el periodo 1981-2010 (Chazarra *et al.*, 2018).

## PLANNING PROCESS

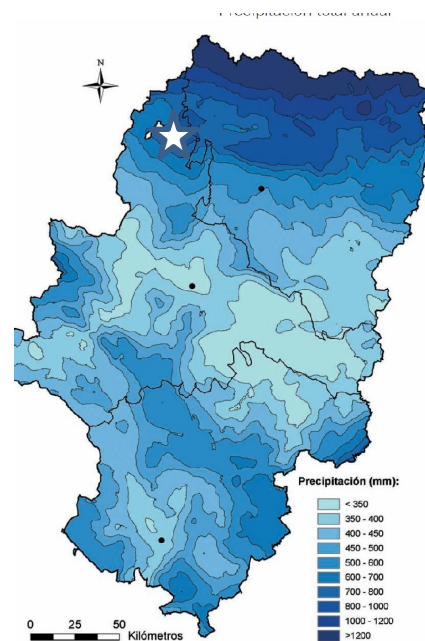
Diagnosis



**Annual Mean Temperature**

## CLIMATE CHANGE ISSUES

Current climate and registered trends



**Annual Precipitation**

SOURCE: Atlas Climático de Aragón

## PLANNING PROCESS

## CLIMATE CHANGE ISSUES

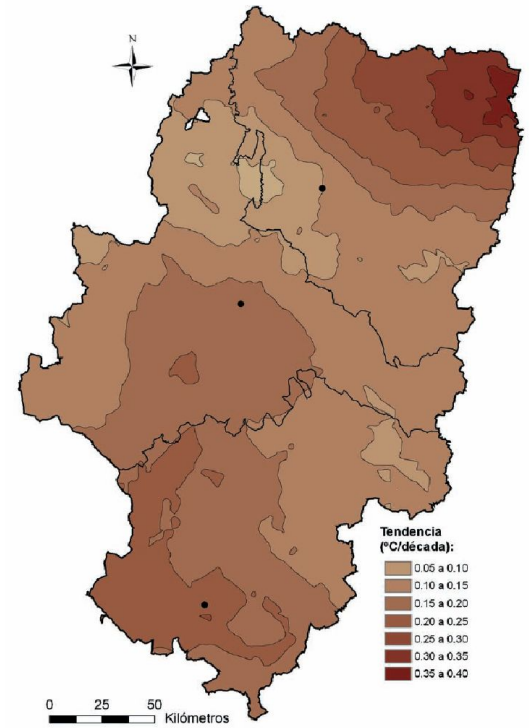
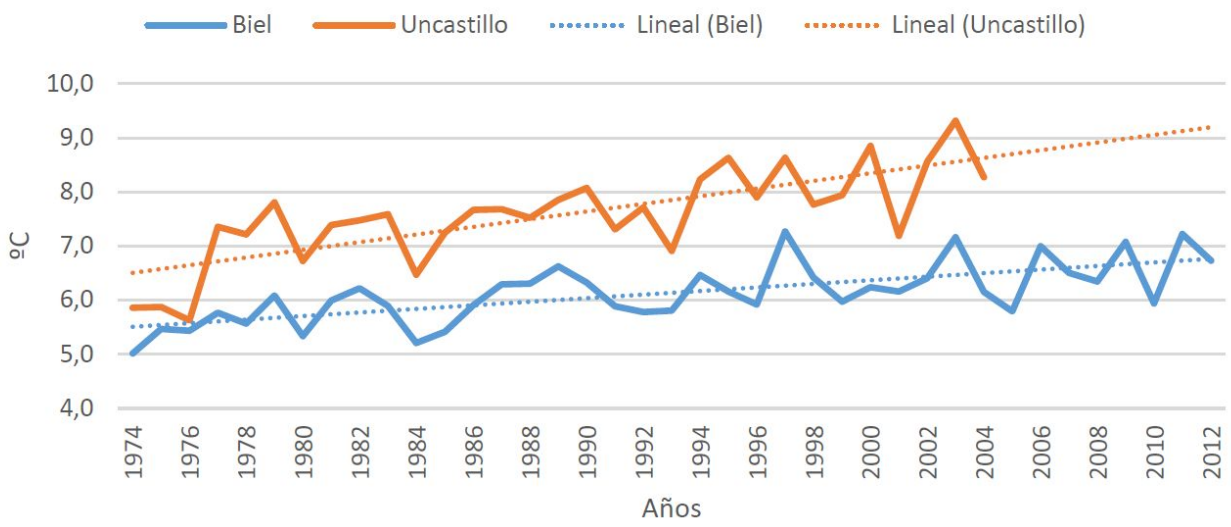
**Diagnosis**

Current climate and registered **trends**

**The climate record 1974-2012 shows a clear trend:**

- +0,5°C Mean temperature (spring and autumn)
- +1°C minimum temperature
- precipitation decrease 12mm/decade

Temperatura media anual de las mínimas (1974-2012) en Biel y Uncastillo, Zaragoza.



**Minimum annual temperature trend in two nearby observatories**



## PLANNING PROCCES

Diagnosis

Definition of **future scenarios**

## CLIMATE CHANGE ISSUES

Current climate and registered **trends**

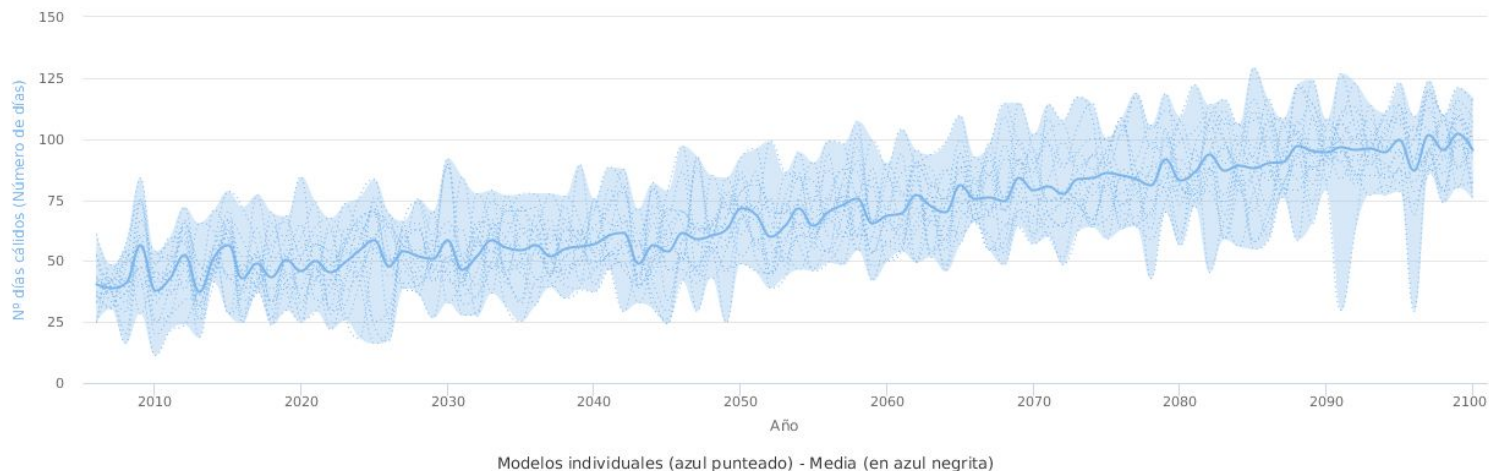
Regional climate change scenarios



<https://escenarios.adaptecca.es>

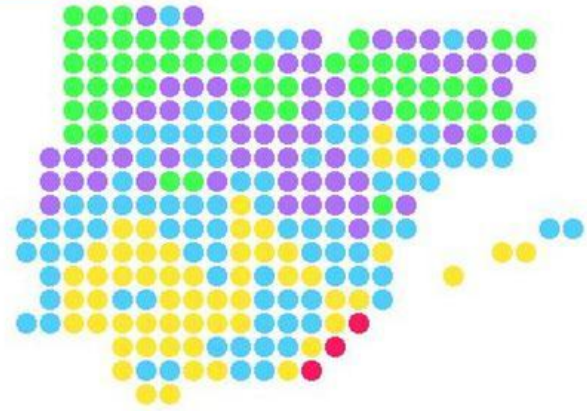
R.C.P. 6				
	WINTER 2050	SPRING 2050	SUMMER 2050	AUTUMN 2050
Increase in T max (°C)	0,56	1,85	2,51	2,00
Increase in T min(°C)	No data	1,3º	1,86º	2,55º
Rainfall variation (%)	0,45%	-1,16%	-0,87%	-1,73%

Escenarios AdapteCCA - Nº días cálidos - Datos en rejilla ajustados (media) - RCP 8.5 - Año completo

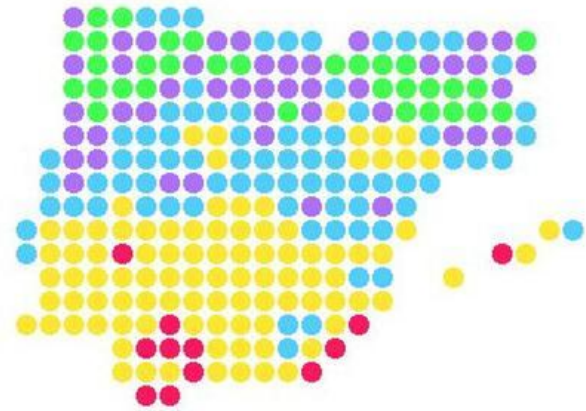


# 2. Climate scenarios

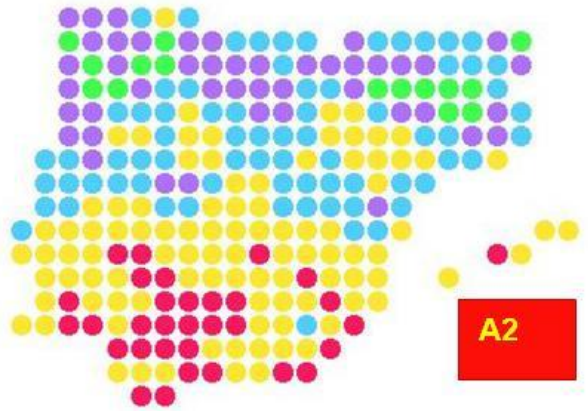
Actual



B2



A2



- Ombrotipo
- Arido
  - Semiarido
  - Seco
  - Subhumedo
  - Humedo

## ADAPTATION IN THE PLANNING PROCESS

### PLANNING PROCESS

**Diagnosis**

Definition of **future scenarios**

Identification of **conservation objects** ( target elements/process)

### CLIMATE CHANGE ISSUES

Current climate and registered **trends**

Regional climate change scenarios

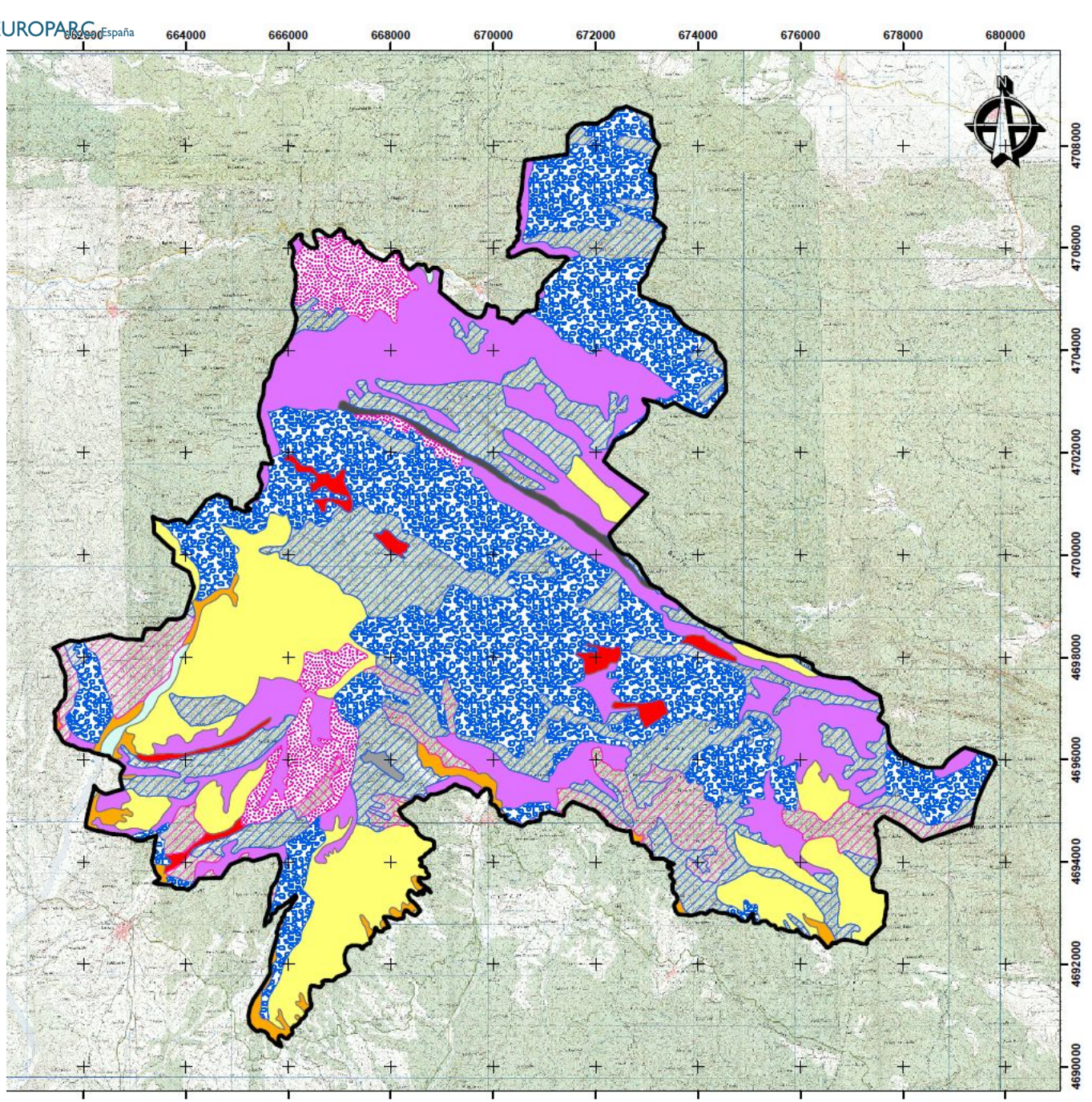
Select species, habitats, ecosystem services

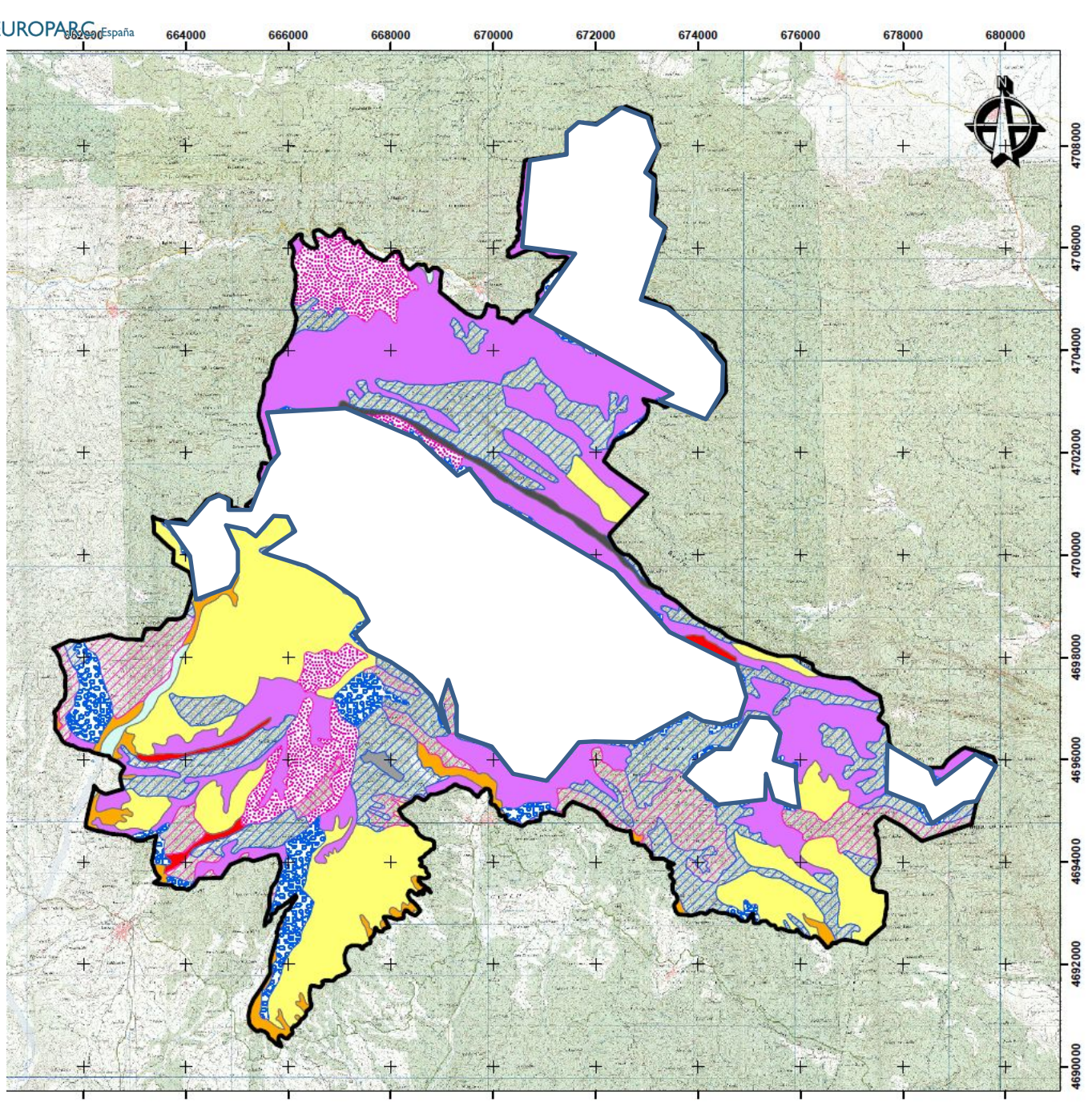


# 3. Identification of Conservation Objects

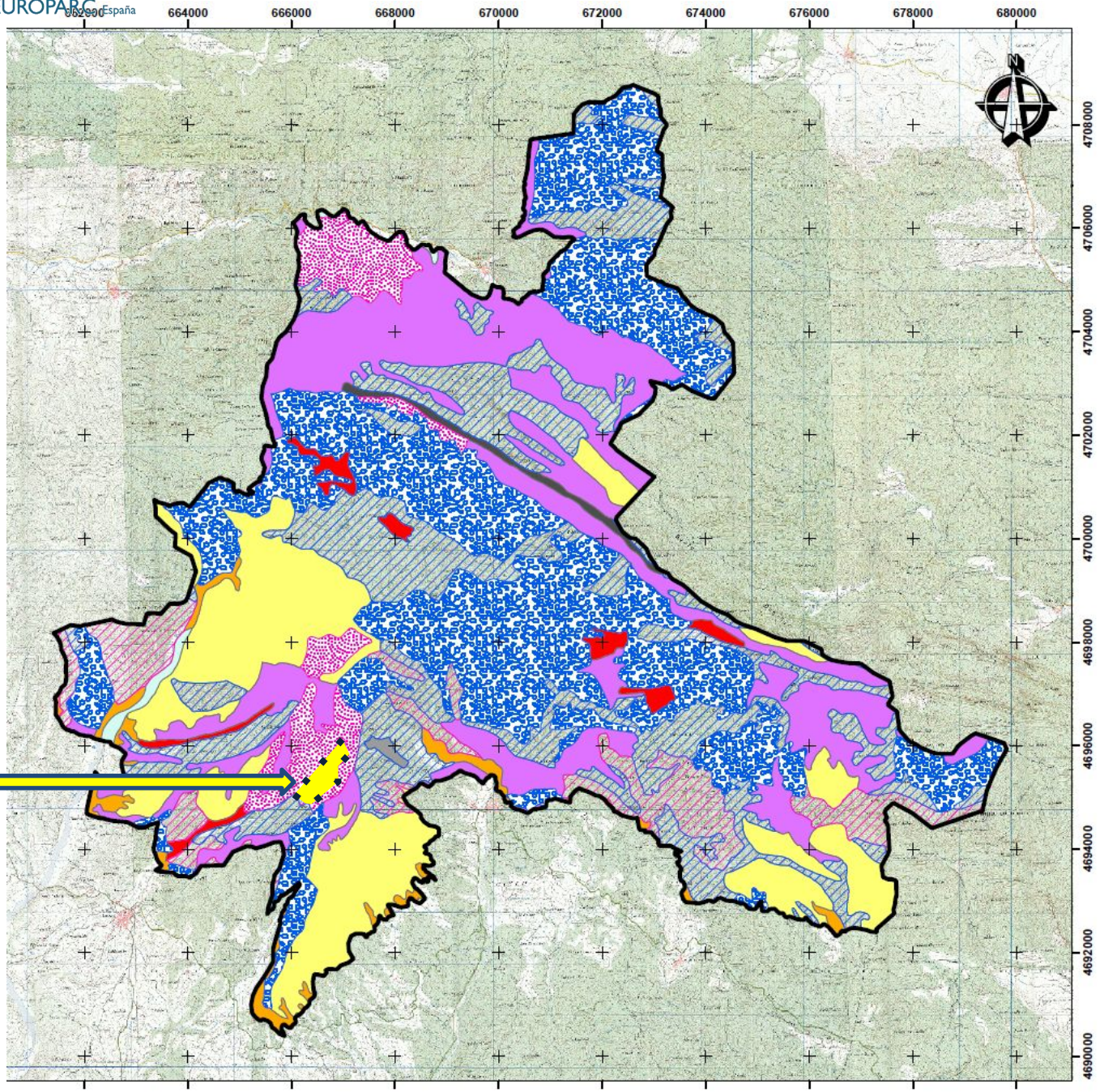
HÁBITATS RED NATURA 2000
Quejigares de <i>Quercus faginea</i>
Pinares endémicos de <i>Pinus nigra</i>
Hayedos ( <i>Fagus sylvatica</i> )
Encinares de <i>Quercus ilex</i> y <i>Quercus rotundifolia</i>
Formaciones de boj ( <i>Buxus sempervirens</i> )
Brezales oromediterráneos endémicos con aliaga
Matorrales de enebro ( <i>Juniperus</i> spp.)
Prados con molinias sobre sustratos calcáreos
Ríos alpinos con vegetación leñosa
Prados secos seminaturales*
Bosques de galería ( <i>Salix alba</i> , <i>Populus alba</i> , <i>Populus nigra</i> )
Manantiales petrificantes con tuf *
Desprendimientos mediterráneos occidentales y termófilos
Pendientes rocosas calcícolas con vegetación casmofítica
Aguas oligomesotróficas con <i>Chara</i> spp.
OTROS ECOSISTEMAS
Pinares de <i>Pinus sylvestris</i>
Pinares de <i>Pinus halepensis</i>

FAUNA	
Lepidópteros	<i>Euphydryas aurinia</i> (doncella de la madreSelva)
	<i>Parnassius apollo</i> (mariposa apolo)
Crustáceos	<i>Austropotamobius pallipes</i> (cangrejo de río)
Anfibios	Bufo bufo (sapo común)
	<i>Triturus marmoratus</i> (tritón jaspeado)
Reptiles	<i>Coronella austriaca</i> (culebra lisa europea)
Aves	<i>Alauda arvensis</i> (alondra común)
	<i>Carduelis chloris</i> (verderón)
	<i>Circus pygargus</i> (aguilucho cenizo)
	<i>Circus cyaneus</i> (aguilucho pálido)
	<i>Corvus corax</i> (cuervo grande)
	<i>Serinus serinus</i> (verdecillo)
	<i>Aquila fasciata</i> (águila- azor perdicera)
	<i>Gypaetus barbatus</i> (quebrantahuesos)
Mamíferos	<i>Crocidura russula</i> (musaraña gris)
	<i>Rhinolophus hipposideros</i> (murciélago pequeño de herradura)
	<i>Felis sylvestris</i> (gato montés)
FLORA	
Flora amenazada	<i>Erodium tordylioides</i> subsp. <i>Gaussonianum</i>
	<i>Genista tetetifolia</i>
	<i>Ilex aquifolium</i>
	<i>Lathyrus vernus</i>
	<i>Ophrys riojana</i>
	<i>Orchis simia</i>













## ADAPTATION IN THE PLANNING PROCESS

### PLANNING PROCESS

**Diagnosis**

Definition of **future scenarios**

Identification of **conservation objects** ( target elements/process)

**Vulnerability analysis**

### CLIMATE CHANGE ISSUES

Current climate and registered **trends**

Regional climate change scenarios

Select species, habitats, ecosystem services

Assess vulnerability to climate change of target elements



# 4. Vulnerability assessment

$$\text{VULNERABILITY} = \text{EXPOSSURE} + \text{IMPACT} - \text{ADAPTACION CAPACITY}$$

CONSERVATION OBJECT	EXPOSURE	IMPACT	ADAPTATION CAPACITY	VULNERABILITY
Species, hábitat type, ecosistem...	Components of climate change that affect the conservation object.	Foreseeable effect of exposure to climate change on the object of conservation	Ability to respond to climate change (due to genetic variability, changes in behavior ...)	<b>Global assessment</b>

- Analysis of bibliography ·
- Expert consultation ·

# 4. Vulnerability assessment

Beech forests (*Fagus sylvatica*)



EXPOSURE	IMPACT	ADAPTATION CAPACITY	VULNERABILITY
<p>Increase in temperature (minimun, mean)</p> <p>Decrease in annual rainfall</p>	<ul style="list-style-type: none"> <li>- Altitudinal ascent (probable)</li> <li>- Loss of vitality</li> <li>- Regeneration difficulty</li> <li>- Affection on phenology</li> <li>- Competence with <i>Pinus sylvestris</i></li> </ul>	<ul style="list-style-type: none"> <li>☹️ Capacity of adaptation hampered by drought</li> <li>☹️ Unfavourable conservation status (ancient use)</li> <li>☹️ Impacts from public use</li> <li>😊 High dispersion capacity (seeds, propagules)</li> </ul>	<p><b>HIGH</b></p>

# 4. Vulnerability assessment

Pine plantations (*Pinus halepensis*)



EXPOSURE	IMPACT	ADAPTATION CAPACITY	VULNERABILITY
Heat waves Severe droughts	<ul style="list-style-type: none"> <li>- Loss of vitality</li> <li>- Increase in fire recurrence and intensity</li> <li>- Insect outbreaks</li> </ul>	<ul style="list-style-type: none"> <li>☹️ Unfavourable conservation status (no management)</li> <li>☹️ Large continuous and homogeneous patches</li> <li>😊 Resistant to drought and high temperatures</li> <li>😊 High regeneration capacity</li> </ul>	HIGH

# 4. Vulnerability assessment

## Summary of vulnerability assessment of habitats and species

OBJETO DE CONSERVACIÓN	VULNERABILIDAD
<b>HABITAT TYPES</b>	
Quercus pirenaica forests	Medium
Beech forests	High
Quecus ilex forests	Low
Pinus sylvestris forets	High
Pinus halepensis forests	Low
Pinus nigra forests	Medium
Fores plantations	High
Buxus sempervirens bushes	Low
Juniperus bushes	Low
Meadows	¿
Riparian hábitats	Medium
Rocky hábitats	Low
<b>SPECIES</b>	
Amphibians	High
Reptiles	¿
Birds	¿
Mammals	¿
<i>Austrapotamobius pallipes</i>	High
<i>Parnassius apollo</i> and <i>Euphydryas aurinia</i>	High
Endangered flora: orchids	High
Endangered flora. Rupicolous species	Medium

## ADAPTATION IN THE PLANNING PROCESS

### PLANNING PROCESS

**Diagnosis**

Definition of **future scenarios**

Identification of **conservation objects** ( target elements/process)

**Vulnerability analysis**

Definition of **management objectives**

### CLIMATE CHANGE ISSUES

Current climate and registered **trends**

Regional climate change scenarios

Select species, habitats, ecosystem services

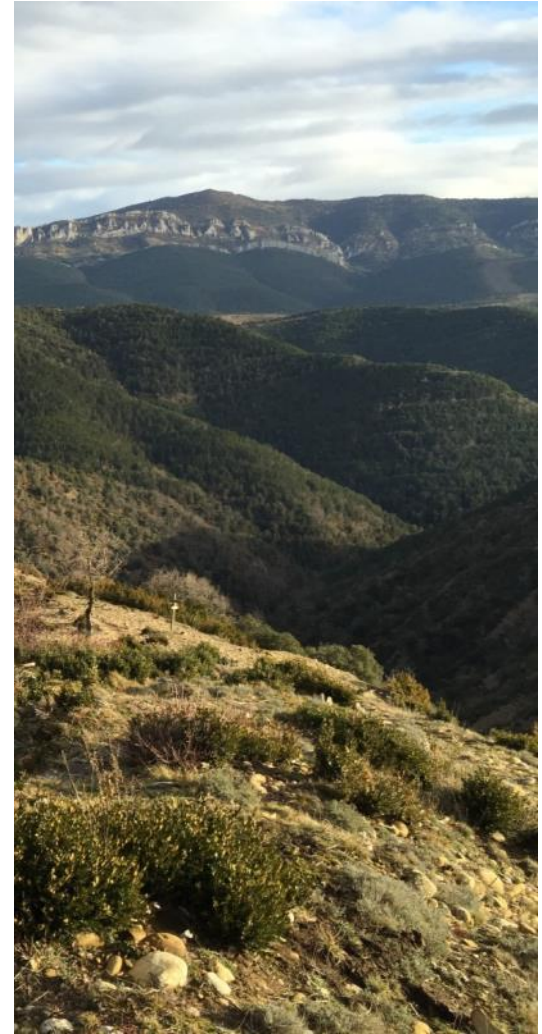
Assess vulnerability to climate change of target elements

Climate change-related objectives



# 5. Setting Adaptation Objectives

- **Reduce non-climate stressors**
- **Increase the resilience of conservation objects**
- **Improve knowledge of conservation objects in relation to their vulnerability to climate change**
- **Evaluate the effect of climate change on conservation objects**





## ADAPTATION IN THE PLANNING PROCESS

### PLANNING PROCESS

**Diagnosis**

Definition of **future scenarios**

Identification of **conservation objects** ( target elements/process)

**Vulnerability analysis**

**Definition of management objectives**

**Management measures**

**Monitoring and evaluation**

### CLIMATE CHANGE ISSUES

Current climate and registered **trends**

Regional climate change scenarios

Select species, habitats, ecosystem services

Assess vulnerability to climate change of target elements

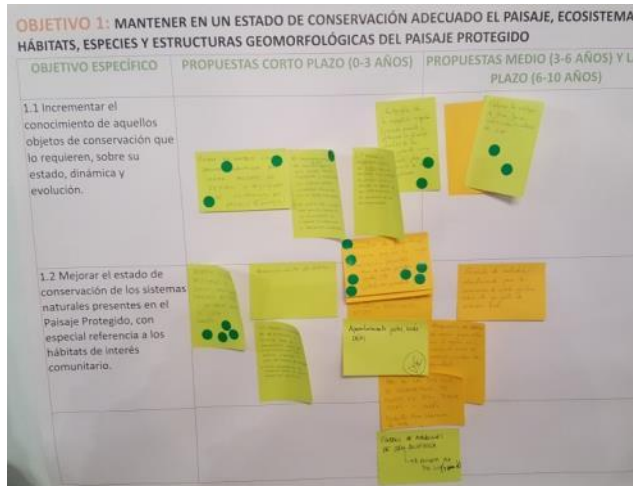
Climate change-related objectives

Specific adaptation measures.  
Regulation / zoning / proactive actions

Climate variables and other climate change indicators (i.e. Phenology)  
Effectiveness assessment

# ( Integration in a participatory process )

In the process of revision of Management Plan, Vulnerability Assessment is presented to stakeholders, and adaptation measures discussed



## 5. Adaptation measures - Beech forests

### Reduce non climatic stressors

Control livestock

Manage public use – improve trails – avoid erosion

Strict protection – designation of reserves inside the Protected Landscape

### Promote heterogeneity

Maintain old trees

Allow regeneration by small perturbations

Avoid timber extraction – favour uneven aged stands

### Promote biodiversity

Restore or create water habitats

Maintain or create deadwood



## 5. Adaptation measures - Pine plantations



### Reduce non climatic stressors

Incentives/subsidies for forest management

Allow timber revenues from adaptation measures

Promote forest products (or services) with market value

### Promote heterogeneity

Favour uneven aged stands

Open clearings – create a landscape mosaic

Reduce competence by thinning

Prescribed burns – reduce understory in strategic places

Manage grazing (domestic or wild) – build waterholes or shelters

### Promote biodiversity

Favour “secondary” species in the canopy (*Quercus*)

Artificial nests for insectivore species (birds, bats)

Identify and conserve legacy trees



## Key messages

- ❑ “Ecosystem-based Adaptation”: well conserved ecosystems as best option for adaptation
- ❑ Site – specific & Habitat - specific
- ❑ High uncertainty: Non-regret options
- ❑ Change is inevitable. Do not loss ecosystem services!
- ❑ Promote variability, heterogeneity, diversity at all scales (from genes to landscape)
- ❑ Need to consider not only habitats/species. Attention to socio economic effects
- ❑ Commitment of stakeholders needed

# Thanks !

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## Manual 13

EUROPARC-Spain series of manuals  
English Version

Protected Areas  
in the Face of Global Change  
**Climate Change Adaptation**  
in Planning and Management

