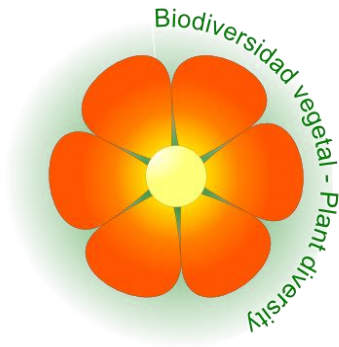


Fieldtrip manual for Plant Biodiversity



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Introduction

Plant Biodiversity is a subject taught during the second year of the Undergraduate Degree in Biology at the University of Alicante. The main principles about the diversity and morphology of the plants are mostly given during the theoretical classes. This fieldtrip practical manual, together with the laboratory sessions, gives the students an opportunity to see our most common wild plant species. Their direct observations allow them to identify properly the main botanical families, genera and species of our wild flora.

This *Fieldtrip manual for Plant Biodiversity* has been written to enhance the understanding of plant diversity and to identify the different ecological conditions for plant species. Students have to understand that “plants do not grow everywhere”. Most of our natural flora, and specially the endemic one, requires specific environmental conditions to grow. So, the objectives of these fieldtrips are to identify wild flora and to recognise the ecological habitats where many of the identified plant species live.

According to the official organisation of the subject **Plant Biodiversity** at the University of Alicante, nine hours correspond to two field practical sessions, which last 4 and 5 hours, respectively. This manual has been organised in only two chapters. Each chapter includes the description of the places to visit:

- Chapter 1. Fieldtrip “*Urbanova*”: study of coastal sand dunes and salt marshes.
- Chapter 2. Fieldtrip “*Estación Biológica de Torretes*”: study of mountain habitats.

These two areas have been selected as examples of the wide diversity of natural habitats within the Alicante province. For each one, a brief explanation of its geographical location is given. Independently of the geographical area, each chapter includes some exercises to be completed within the practical session based on direct observations plus the given information. In each chapter, several photos of the most common genera and species are also available for the students to know perfectly their main morphological characteristics and their appearance.



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Chapter 1

Fieldtrip “Urbanova”:

study of coastal sand dunes and salt marshes

1.1. Geographical location

Urbanova is located about 5 km south of Alicante and corresponds to a small urban complex (Fig. 1.1). Two well-differentiated environmental areas can be distinguished close to the urban area: (i) the beach and (ii) the salt marsh. In this practical fieldtrip, we will study both natural environmental habitats.

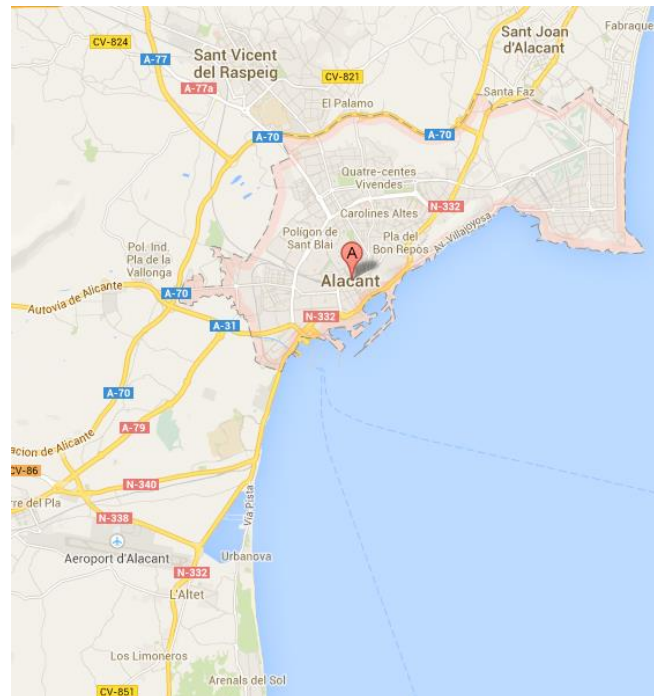


Figure 1.1. Geographical situation of Urbanova.

The Urbanova beach is also known as Los Saladares beach (or the Salt Marsh beach). The reason for this name is that behind the beach there is a wetland area of high environmental interest, which is known as Agua Amarga salt marsh, which was once used as a salt mine. The beach has a length of nearly 2 km. and its environment has a semiurban appearance. Nevertheless, the beach retains a belt of dunes that shows a wild look at its south end, which is in contact with the L'Altet beach.

The Agua Amarga salt marsh is a coastal ecosystem that is regularly flooded by sea and freshwater. This peculiar habitat is dominated by herbs, grasses or low shrubs. These plants help to the stability of the salt marsh trapping and binding sediments. They also shelter terrestrial animals and provide coastal protection. Most salt marshes represent a flat landscape with low elevations but a vast wide area, making them attractive for human populations.

Two different transport systems can be easily used to get to Urbanova. On the one hand, you can use your own car driving on the national road N-332 towards Santa Pola. On the other hand, take the bus [line 27: Alicante (O. Esplá) – Urbanova]. The meeting point for this practical fieldtrip is clearly marked in the figure 1.2.



Figure 1.2. Situation of the meeting point for this practical fieldtrip (the red arrow points to the precise position of the meeting point).



1.2. Objectives

The main objectives of this practical session are summarised in the following points:

1. To distinguish the main plant species of the Mediterranean coastal sand dunes.
2. To distinguish the main plant species of the Mediterranean salt marshes.
3. To learn the ecological importance of each studied habitat, and to distinguish the spatial distribution of the flora within each natural habitat.
4. To identify the main morphological adaptations of the specific flora for each studied habitat.

1.3. Material necessary for this practical session

- This practical manual (obligatory)
- Adhesive tape (obligatory)
- Notebook (obligatory)
- Identification keys (recommended)
- A hand magnifier (recommended)

1.4. Natural ecosystems to study

Part 1. COASTAL SAND DUNES: Los Saladares beach

A.1. Special adaptations to the wind and sea spray

In sand dunes, the vegetation zonation is directly influenced by wind, by soil composition and its capacity of movement and also by sea spray. The wind has a strong influence on the mobility of the grains of sand and the intensity of sea spray.



The sand movement (saltation) is helped or hindered by wind velocity, grain size and shape, and sand dampness. The main adaptations are due to sea spray and its consequent abrasion, low water availability and the presence of continuous wind, and are the following:

- Sea spray and abrasion: cell tolerance of salt, large cells, few stomata, creeping growth, succulence, glaucous colour, major presence of trichomes, summer flower bloom, short-lived flowers, etc.
- Low water availability: presence of trichomes, presence of revolute leaves, superficial roots, etc.
- Presence of wind: unidirectional growth, cushion-shaped plants.
- Movement of the soil: presence of rhizomes, creeping growth, hard epidermal tissues.

A.2. Typical zonation of the vegetation in the coastal sand dunes

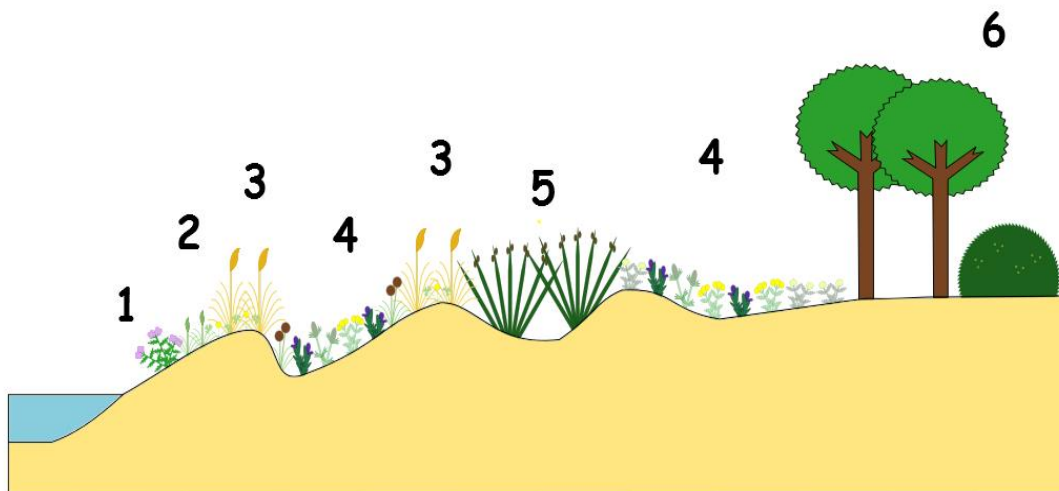


Figure 1.3. Vegetation zonation of a coastal sand dune.

See table 1.1. for the meaning of numbers.

**Table 1.1.** Main characteristics of the vegetation zones in a coastal sand dune.

	Vegetation zone	Main characteristics
1	Beach or strandline	Vegetation appears along the high tide line. It is ephemeral, salt tolerant and composed of a limited number of species. Place where dead seaweed, shells and driftwood appear.
2	Embryo dune or foredune	The first part of the dune to develop. Once formed the embryo dunes trap further sand and grow larger becoming foredunes. As these reach heights of around 1 to 2 metres, they are no longer flooded by the sea even during spring tides and severe weather. Stabilisation occurs via grasses (Poaceae), which act as traps for sand. Conditions are dry and plants adapt to this via long roots, or thorny leaves to reduce evapotranspiration.
3	Yellow dune	These are usually the largest dunes and are also often referred to as yellow dunes or the main dune ridges. Colour is due to a lack of humus, but with distance inland they become increasingly grey due to greater amounts of humus. Dunes can reach heights in excess of 100 m, but 10 to 20 m is more usual. The dune crests are well above the water table and sand is very free-draining, so only plants which are well adapted to 'drought' can survive here.
4	Fixed grey dunes	Fixed and semi-fixed dunes are generally stable. They lie between the more dynamic communities of the mobile and mainly shifting dune zone (yellow dune) and the scrub and dune woodland zone.
5	Dune slacks	Slacks are the low areas between the dunes. Depressions between dune ridges, which will be damp in summer and water-filled in winter.
6	Woodland	Sand totally fixed, and covered by high shrubs of the genus <i>Juniperus</i> . Often disturbed by human activities.



A.3. Activities to do during this practical session

After reading the previous information about the typical vegetation of coastal sand dunes, we here identify the main zones at Los Saladares beach (Fig. 1.4 and Fig. 1.5) and you have to answer different questions about the identification of the main plant species and their morphological adaptation.



Figure 1.4. Aspect of the coastal sand dunes on Los Saladares beach. Numbers correspond to the vegetation zones described in table 1.1.



Figure 1.5. Detail pictures of the vegetation zones of the dunes. **1.** Beach. **2.** Embryo dunes. **3.** Yellow dunes. **4.** Fixed grey dunes.



Vegetation zone 1

Identify the most representative species of this area using the photos (Fig. 1.6), and complete the table (Table 1.2).

Table 1.2. Main species from the beach or strandline

Name of the species	Family	Identify their morphological adaptations	Stick a small piece of the plant



Figure 1.6. Main species of the beach or strandline. **1.** *Cakile maritima*: 1a. General aspect of an individual; 1b. Detail of a fruit of this species. **2.** *Salsola kali*: 2a. General aspect of the plant; 2b. Detail of a branch.



Vegetation zones 2 and 3

In these two vegetation areas, three different species of grasslands can be found (Fig. 1.3. and Fig. 1.4). Among them, two species (*Ammophila arenaria* and *Elymus farctus*) are specific from these coastal sandy habitats. Those plants, which only grow on sandy soils, are in general called psammophilous plant species.

You must identify and distinguish the main plant species of these vegetation zones. Pay attention that sometimes one of these two species might be missing around the studied area. Use the following dichotomous keys to identify these grasses.

Dichotomous keys for grasses in coastal sand dunes:

1. Long and cylindrical leaves. Plant up to 1.20 m high. Inflorescence in long terminal spikes. They are mainly located in the yellow dunes
..... ***Ammophila arenaria*** (Fam. Poaceae)
1'. Clearly smaller plants..... 2
2. Alternate and long basal leaves. Spikes disposed distichously
..... ***Elymus farctus*** (Fam. Poaceae)
2'. Clearly distichous leaves ***Sporobolus pungens*** (Fam. Poaceae)

Answer the following questions:

How are these plants fixed to the mobile sand dune soils?

Describe the morphology of these leaves. How are these leaves adapted to this odd environment?



After their proper identification, match their scientific name with each correspondent photo. At least, you must identify two different species.

All photos taken by J. Moreno and A. Terrones



Vegetation zones 3 and 4

In these two areas, some small shrubs (chamaephytes), which are mostly specific of these sandy habitats (psammophilous plant species), can grow. Look for them in the sand dunes and try to identify them. You must fill the table 1.3 with, at least, seven different plant species. For their proper identification, use the following dichotomous keys (attention: not all of them can be easily located in these dunes):

1. Clearly spiny or hispid plants (sensitive by touching them) 2
 - 1'. Plants without spines or hispid hairs 3
2. Purple or lilac flowers, with the corolla tubular; mostly prostrate vegetative stems..... ***Echium sabulicola*** (Fam. Boraginaceae)
 - 2'. Clearly spiny plant, with large, hard and divided leaves
 - ***Eryngium maritimum*** (Fam. Apiaceae)
3. Plant with small and clearly imbricate leaves
 - ***Crucianella maritima*** (Fam. Rubiaceae)
 - 3'. Plants with other features 4
4. Prostrate plant, with trifoliolate leaves 5
 - 4'. Plant with other features 7
5. Plant with stipules and covered by glandular hairs; green leaflets.....
 - ***Ononis natrix*** (Fam. Fabaceae)
 - 5'. Plants without glandular hairs; whitish or greyish leaflets..... 6
6. Plants with straight and dehiscent fruits (pods), similar leaves and stipules, looking like 5 leaflets ***Lotus creticus*** (Fam. Fabaceae)
 - 6'. Plants with coiled fruits (pods), different leaves and stipules, 3 leaflets
 - ***Medicago marina*** (Fam. Fabaceae)
7. Inflorescences in capitula (heads) and alternate leaves..... 8
 - 7'. Another type of inflorescences 9
8. Whitish, filiform and alternate leaves. Capitula (heads) with disc flowers. Plant with a strong odour..... ***Helichrysum stoechas*** (Fam. Asteraceae)
 - 8'. Green leaves, inferior leaves deeply divided in narrow segments finished with rigid mucro or tips. Capitula (heads) with ligulate flowers
 - ***Launaea fragilis*** (Fam. Asteraceae)



9. Grey, opposite and decussate leaves; revolute with clearly crenate apical margin. Inflorescence in glomerule ***Teucrium dunense*** (Fam. Lamiaceae)
 9'. Plant with other features 10
10. Green, ribbon-like leaves up to 50 × 2 cm, appearing before anthesis; large and white flowers (appearing in summer)
 ***Pancratium maritimum*** (Fam. Amaryllidaceae)
 10'. Plant with other features 11
11. Solitary stems (up to 30 cm), leaves 20-40 × 0.1-0.6 cm; inflorescence with a unique dense, sessile and globose glomerule (2-3 cm)
 ***Cyperus capitatus*** (Fam. Cyperaceae)
 11'. Clearly branched plants, non-solitary stems (up to 50 cm), smaller leaves, with a peculiar pair of fused sheathing stipules known as ochrea. Whitish ochrea, somewhat transparent. Flowers disposed on the axil of the leaves
 ***Polygonum maritimum*** (Fam. Polygonaceae)

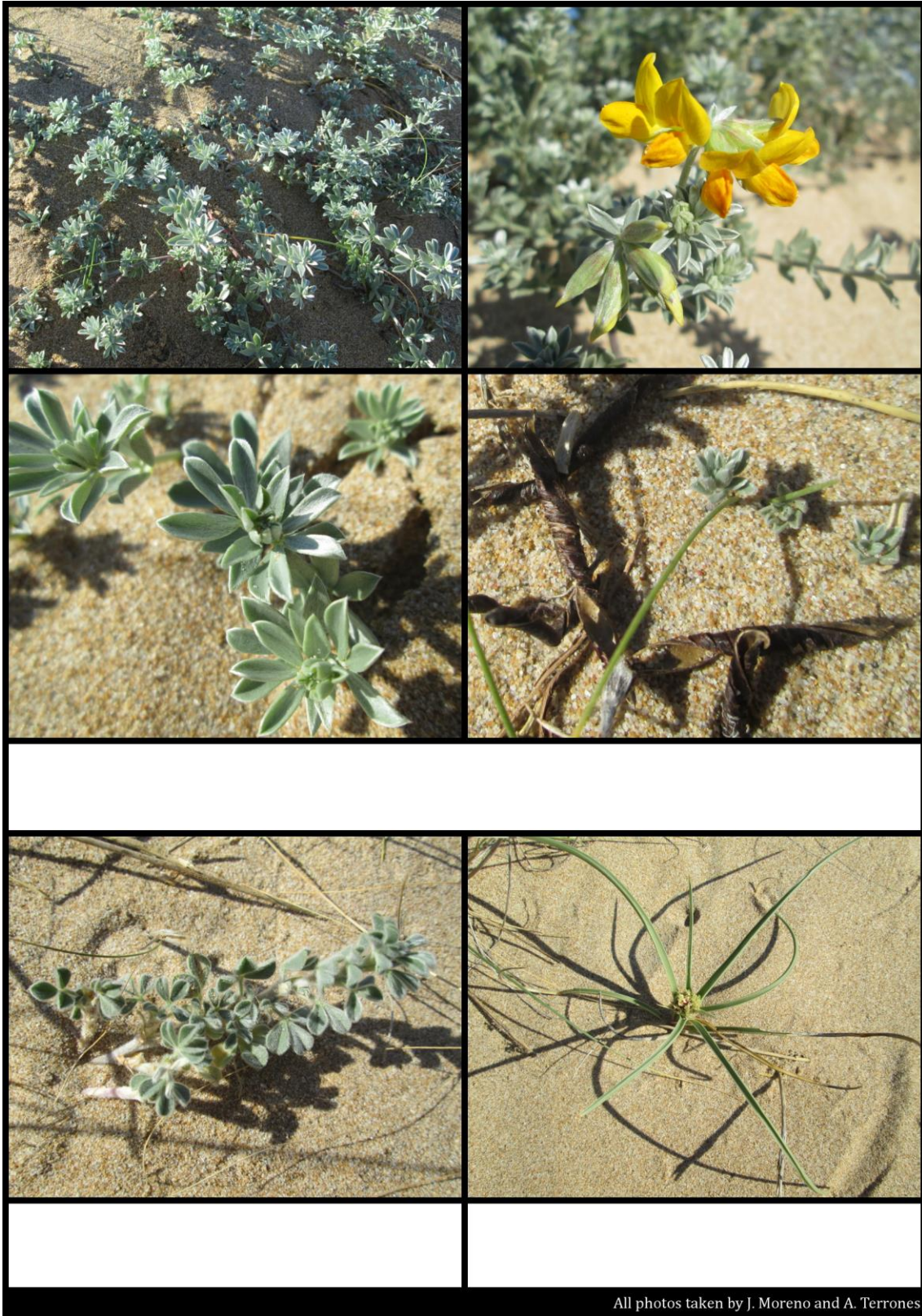
Table 1.3. Complete the table with the required information about some selected plant species from zones 3 (yellow dune) and 4 (grey dune). You should complete the information about the written species (depending on the year, certain of these species sometimes may not appear). Add more rows if you find additional plant species.

Species	Area where the species is frequent	Family	Main morphological adaptations	Stick a small piece of plant
<i>Lotus creticus</i>				
<i>Crucianella maritima</i>				
<i>Teucrium dunense</i>				



<i>Helichrysum stoechas</i>				
<i>Echium sabulicola</i>				
<i>Medicago marina</i>				
<i>Eryngium maritimum</i>				
<i>Cyperus capitatus</i>				
<i>Pancratium maritimum</i>				
<i>Polygonum maritimum</i>				
<i>Launaea fragilis</i>				
<i>Ononis natrix</i>				

After their proper identification, match their scientific name with each correspondent photo. For certain species, ask the teacher for help. Important: not all the species of these pictures can appear in this sand dune due to the early dates of this fieldtrip (nevertheless, you can find them in other sand dunes or in this same area in later dates).



All photos taken by J. Moreno and A. Terrones



All photos taken by J. Moreno, A. Terrones and A. Vicente



All photos taken by J. Moreno, A. Terrones and A. Vicente



Part 2. SALT MARSHES: Agua Amarga salt marsh

A.1. Main characteristics of subtropical salt marshes

In salt marshes, flora composition and vegetation zonation is directly influenced by high soil salinity and the degree of natural floods (Fig. 1.7). Floods could be originated by the natural entrance of seawater and even by rain. These peculiar ecological features are directly influencing the existence of low plant diversity in these habitats. Some of the main ecological features are summarised in the following sentences:

- Floods determine the decrease in the salinity around plant roots.
- During the rainy periods, the salinity decreases in the upper layer of the soil.
- During dry seasons, the water goes up through capillarity and it is quickly evaporated. Therefore, salts are deposited in the soil, originating a saline soil.

A.2. Special adaptations of the typical salt marsh flora

Due to the special ecological features of these habitats, plant species are typically characterised by the following morphological adaptations (not all of them have to appear on the same plant species):

- Leaf size is usually tiny, so transpiration is decreased.
- Stems and/or leaves are succulent.
- The number of nerves and stomata are reduced.
- Plants show trichomes and special glands to secrete salt.
- Flowering is delayed.



A.3. Typical zonation of the vegetation in Mediterranean salt marshes

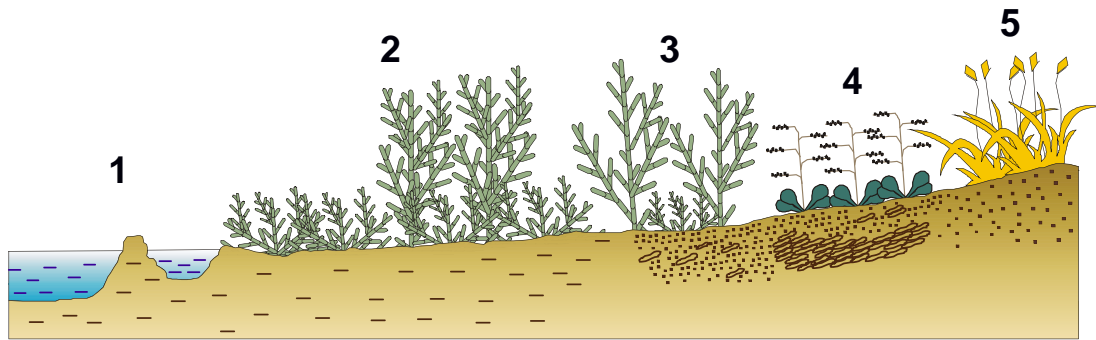
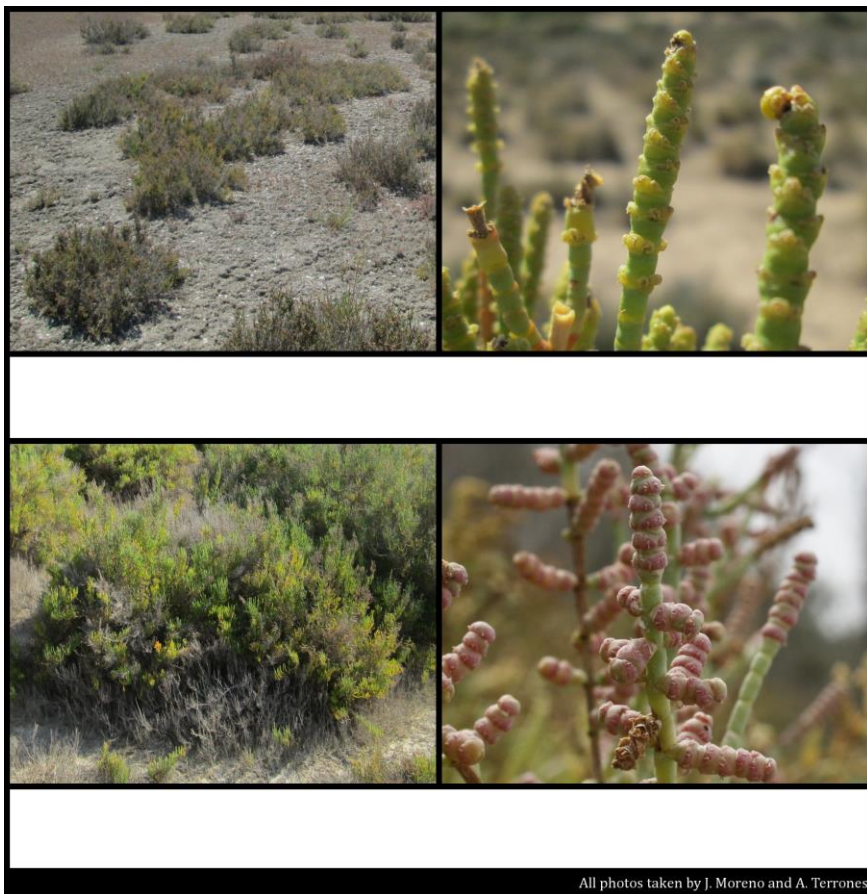


Fig. 1.7. General aspect of a typical plant zonation in Mediterranean salt marshes.

A.4. Activities to do during this practical session

Vegetation zones 2 and 3

Identify the most representative species of these areas using the photos and also the dichotomous keys (see below). After their proper identification, match their scientific name with each correspondent photo.



All photos taken by J. Moreno and A. Terrones



Which are the most remarkable morphological adaptations of these two species?

Take a leaf and bite it. Can you recognise its flavour? Explain the presence of that special flavour.

Dichotomous key for the identification of plant species from salt marshes

- 1. Annual plants 2
- 1'. Perennial plants 3
- 2. Articulate stems, opposite and fused leaves
 ***Salicornia ramosissima*** (Fam. Amaranthaceae)
- 2'. Non-articulate stems. Alternate leaves, well developed and easily identified.....
 ***Suaeda spicata*** (Fam. Amaranthaceae)
- 3. Plants with succulent stems 4
- 3' Plants without succulent stems 6
- 4. Free bracts, and lateral globose branches
 ***Halocnemum strobilaceum*** (Fam. Amaranthaceae)
- 4' Fused bracts, and lateral branches with other characteristics 5
- 5. Brown-brownish seeds. Two septa are visible, and three locules can be identified
 ***Sarcocornia fruticosa*** (Fam. Amaranthaceae)
- 5'. A unique locule, without septa. Bright black seeds
 ***Arthrocnemum macrostachyum*** (Fam. Amaranthaceae)
- 6. Alternate succulent leaves, cylindrical and short (2-10 mm)
 ***Suaeda vera*** (Fam. Amaranthaceae)
- 6'. Non-succulent, greyish leaves..... 7
- 7. Opposite leaves. Prostrate shrubs
 ***Halimione portulacoides*** (Fam. Amaranthaceae)
- 7'. Alternate leaves. Erect shrubs (up to 60 cm)
 ***Atriplex glauca*** (Fam. Amaranthaceae)



Despite the low plant diversity of these habitats, more plant species can be easily found. Using the above dichotomous key, identify more species (at least three more species) and complete the following table. Write down the species you can recognise and also their main morphological characteristics (those used for their identification). Stick a small piece of each species.

Species	Family	Main morphological adaptations	Stick a small piece of plant



Vegetation zone 4

This area is basically dominated by different species of the genus *Limonium* (Fam. Plumbaginaceae) (Fig. 1.8). The taxonomy of this genus is rather complicated and you would need the flower characteristics to identify them. These species bloom in summer, so, unfortunately, during this fieldtrip, we will not be able to see any flowering individuals.



All photos taken by J. Moreno and A. Terrones

Fig. 1.8. General and detailed aspect of plant zonation dominated by *Limonium*.

Identify the genus in the field and complete the following table. Write down their main morphological characteristics (those used for its easy identification). Stick a small piece of the plant.

Genus	Family	Morphological plant adaptations	Stick a small piece of plant
<i>Limonium</i>			

Which are the main ecological features of this area, clearly dominated by *Limonium*?



Vegetation zone 5

The plant diversity is clearly higher in this area. Nonetheless, this area is visibly dominated by one specific Poaceae species (*Lygeum spartum* – “albardín” or “falso esparto”). This typical vegetation is commonly called “albardinal” (Fig. 1.9). Identify this species using the pictures, and write down its scientific name and the main morphological features (those used for its easy identification).



All photos taken by J. Moreno and A. Terrones

Fig. 1.9. General aspect of an “albardinal” and a detailed aspect of *Lygeum spartum*.

Write down the name of the species

Describe the main morphological features of this species

Moreover, you can observe other perennial species within this zone. Look for some of these species, which are included in the following table and are shown in fig. 1.10.



All photos taken by J. Moreno and A. Terrones

Fig. 1.10. Aspect of the two main species of the “albardinal”

Complete the following table with their main morphological characteristics.

Species	Family	Morphological characteristics
<i>Frankenia corymbosa</i>		
<i>Limonium furfuraceum</i>		



Chapter 2

Fieldtrip “*Estación Biológica de Torretes*”: study of mountain habitats

2.1. Geographical location

The “*Estación Biológica de Torretes*” is a research centre for investigation (Fig. 2.1), conservation and divulgation of the Mediterranean diversity. It was created by a mutual agreement between the council of Ibi and the University of Alicante through the research Institute CIBIO in 2006. This research centre includes several environmental conservation figures declared by the regional government (Generalitat Valenciana): Micro-reserve of flora “*Mas de Torretes*” (about 20 ha), Protected Municipal Place (“*Paraje Municipal Protegido*”) (more than 60 ha) and Voluntary Reserve of Fauna (“*Reserva Voluntaria de Fauna*”) (about 60 ha). In 2012, the gardens were declared Botanical Garden of the “*Estación Biológica de Torretes*”. See more information at www.torretes-jardinbotanico.com/index.html.



Figure 2.1. Different images of the “*Estación Biológica de Torretes*”.

The “*Estación Biológica de Torretes*” is located within the municipality of Ibi (Fig. 2.2). To access this area, you should drive through the motorway Alicante-Alcoy (A-7, “Autovía del Mediterrani”), and take the exit “Ibi Este”. Then, you should follow its signs.

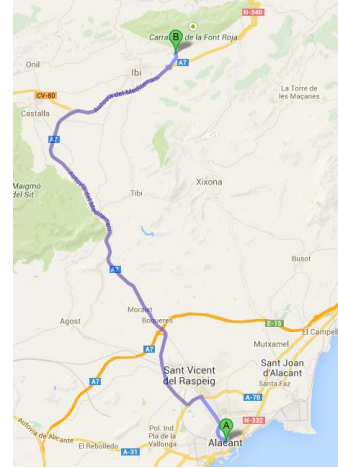


Figure 2.2. Geographical location of the “*Estación Biológica de Torretes*”.

This practical session takes place within the Micro-reserve of Flora “Mas de Torretes” (Fig. 2.3, point 12). This area is well characterised by a high presence of different natural mountainous habitats, such as oak forests, Mediterranean brushes, grasslands and vertical rocky cliffs (Fig. 2.4).

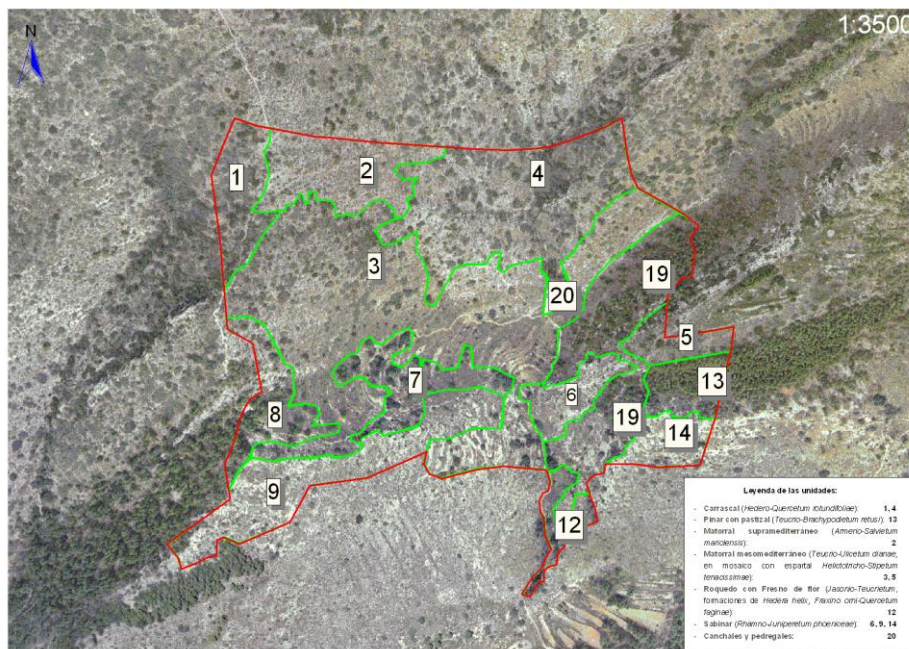


Figure 2.3. Map of the Micro-reserve of Flora “Mas de Torretes”.



Figure 2.4. General aspect of the Micro-reserve of Flora “Mas de Torretes”.

2.2. Objectives

The main objectives of this practical session are summarised in the following points:

1. To distinguish between the Mediterranean mountainous habitats.
2. To distinguish the main plant species, which characterise these Mediterranean habitats.
3. To learn the ecological importance of each studied habitat, and to distinguish the spatial distribution of the flora within each natural habitat.

2.3. Material necessary for this practical session

- This practical manual (obligatory)
- Adhesive tape (obligatory)
- Notebook (obligatory)
- Identification keys (recommended)
- A hand magnifier (recommended)



2.4. Natural ecosystems to study

Four well-differentiated ecosystems can be distinguished within the studied area (Fig. 2.5), here named as forests, grasslands, brushwood and vertical rocky cliffs.



All photos taken by J. Moreno, O. Rodríguez and A. Terrones

Figure 2.5. General aspect of the four ecosystems to study during this fieldtrip. 1. Forest; 2. Grasslands; 3. Brushwood; 4. Vertical rocky cliffs.

- Forests (Fig. 2.5-1): habitat dominated by oaks belonging to the genus *Quercus* and often, in this area, they might be mixed with certain deciduous species. Additionally, some brush species of the undergrowth can appear such as *Arbutus unedo*, *Phillyrea angustifolia*, *Rhamnus* sp., *Pistacia* sp., *Rubia peregrina*, *Smilax aspera*, *Lonicera implexa*, etc.



- Grasslands (Fig. 2.5-2): habitat dominated by two main species of the family Poaceae belonging to the genera *Stipa* and *Brachypodium*. In figure 2.5-2, a general aspect of grassland dominated by *Stipa* is shown. Certain species of the families Fabaceae and Lamiaceae can occur as well.
- Brushwood (Fig. 2.5-3): Habitat mainly dominated by different species of different botanical families. In the Mediterranean area, the main species mostly belong to families Cistaceae, Lamiaceae and Fabaceae.
- Vertical rocky cliffs (Fig. 2.5-4): this peculiar habitat is characterised by the lack of soil and therefore, few plant species can grow in this habitat. Among others, you might observe ferns, climbing plants, certain succulent species, etc.

2.4. Activities to do during this practical session

Question 1

Identify the most common trees, shrubs and herbs using the dichotomous keys and pictures (Annexes 1 and 2, respectively). The following list includes the minimum number of species you should identify during this practical class. Most of them have been previously studied during the practical lab sessions, as a consequence, no names are provided in their corresponding pictures (Annex 2).

Quercus rotundifolia

Quercus coccifera

Rhamnus alaternus

Rhamnus lycioides

Ulex parviflorus

Genista scorpius

Juniperus oxycedrus

Anthyllis cytisoides

Rosmarinus officinalis

Thymus vulgaris

Cistus albidus

Cistus clusii

Rubus ulmifolius

Fraxinus ornus

Rosa sp.

Hedera helix

Juniperus phoenicea

Rubia peregrina

Stipa tenacissima

Brachypodium retusum

Sideritis angustifolia

Teucrium sp. pl.

Euphorbia characias

Polypodium cambricum

Ceterach officinarum



During this practical session, you will observe and recognise these plants in nature and also the habitat/s where these species typically appear. For each species, you must complete the required information in the table (Table 2.1).

Table 2.1. Main plant species from the “Mas de Torretes”

Species (Family)	Shape of the leaves	Disposition of the leaves	Stick a small piece (except for the ferns)



Table 2.1. Main plant species from the “Mas de Torretes”

Species (Family)	Shape of the leaves	Disposition of the leaves	Stick a small piece (except for the ferns)



Question 2

Compare the main morphological features of each pair of plant species (see table 2.2). Write down the main differences you would use to identify each one.

Table 2.2. Compare the following pairs of plant species

Species 1	Species 2	Main morphological differences
<i>Quercus rotundifolia</i>	<i>Quercus coccifera</i>	
<i>Juniperus oxycedrus</i>	<i>Juniperus phoenicea</i>	
<i>Rhamnus lycioides</i>	<i>Rhamnus alaternus</i>	
<i>Genista scorpius</i>	<i>Ulex parviflorus</i>	



Question 3

In the area, you should find four different species of the genus *Sedum* (Crassulaceae). Find them, and write down their name and the main morphological characteristics you can use to identify them easily (Table 2.3). Use the provided dichotomous keys to identify them.

Dichotomous key for species of *Sedum*

- 1. Short, obtuse leaves, with triangular shape (initially tightly clustered) ***S. acre***
 1'. In general, cylindrical or ovoid leaves, and sometimes the upper part is somewhat flat, obtuse or acute 2

- 2. Ovoid leaves, similar length and width; mostly opposite leaves; glandular-pubescent or pruinose leaves. Small plants (up to 10 cm), creeping stems and in most of the cases, hanging on rocky habitats ***S. dasyphyllum***
 2'. Leaves are clearly longer than wide, glabrous leaves 3

- 3. Oblong or lanceolate leaves; apiculate or mucronate apex, 5-25 mm long; sometimes, the basal leaves are more or less cylindrical ***S. sediforme***
 3'. Linear-cylindrical to ovoid-globose leaves, obtuse apex ***S. album***

Table 2.3. Write down the name of the species of the genus *Sedum* and their main morphological features

Species	Main morphological characteristics	Stick a small piece of plant
<i>Sedum</i>		
<i>Sedum</i>		
<i>Sedum</i>		
<i>Sedum</i>		



Question 4

The grasslands are dominated by two main grasses: *Stipa tenacissima* and *Brachypodium retusum*. You have identified them previously (question one). As you can observe in the field, each grass species characterised a different habitat and its abundance is directly related to environmental features. Answer the following questions related to these two species and their corresponding natural habitats.

Write down the main morphological characteristics you would use to distinguish between them.

S. tenacissima:

B. retusum:

Describe the places where *Stipa tenacissima* and *Brachypodium retusum* are clearly abundant.

S. tenacissima:

B. retusum:

Write down a list of other dominant plant species (minimum 5 different species), which grow together with *Stipa tenacissima* and *Brachypodium retusum*, respectively. Put the name of the species in order of importance and abundance.

<i>Stipa tenacissima</i>	<i>Brachypodium retusum</i>



Question 5

After the identification of all the above plant species (questions 1-4), you have also to observe where each one is clearly abundant. Write down a list of the dominant plant species (minimum 5 different species) for each natural habitat (forest, brushwood and vertical rocky cliffs). Put the name of the species in order of importance and abundance.

Forest	Vertical rocky cliff	Brushwood



ANNEX 1. Dichotomous keys for the identification of trees, shrubs and bushes.

1. No leaves or these are reduced. Photosynthesis mainly carried out by greenish stems and cladodes (false leaves). Spiny plants 2
- 1'. Photosynthetic leaves 4
2. Climbing plant, plenty of cladodes, not thorny. The "leaves" are needle-like, modified stems ***Asparagus acutifolius*** (Fam. Asparagaceae; Esparraguera/wild asparagus)
- 2'. Non-climbing plants. Totally spiny shrubs 3
3. Dark greenish plant; five-toothed greenish calyx
..... ***Genista scorpius*** (Fam. Fabaceae; Aliaga, Argilaga)
- 3'. Yellow-greenish plant; bilabiatae yellow calyx
..... ***Ulex parviflorus*** (Fam. Fabaceae; Aliaga, Argilaga fina)
4. Pair of leaves on brachyblasts (limited-growth branches) 5
- 4'. Leaves on macroblasts 6
5. Umbrella canopy tree. Red-brown to orange bark. Sessile cone
..... ***Pinus pinea*** (Fam. Pinaceae; pino piñonero; stone pine)
- 5'. Other types of canopies. Grey bark. Pedunculate cone
..... ***Pinus halepensis*** (Fam. Pinaceae; pino carrasco, aleppo pine)
6. Opposite or whorled leaves 7
- 6'. Alternate leaves 17
7. Leaves in clusters of 3 8
- 7'. Opposite leaves 9
8. Needle-like leaves with two stomatal bands; brownish cones
..... ***Juniperus oxycedrus*** subsp. ***oxycedrus*** (Fam. Cupressaceae; enebro, ginebre, prickly juniper)
- 8'. Leathery narrow lanceolate leaves
..... ***Nerium oleander*** (Fam. Apocynaceae; adelfa, baladre, oleander)
9. Odd-pinnately compound leaves. Deciduous tree
..... ***Fraxinus ornus*** (Fam. Oleaceae; fresno de flor, manna ash)
- 9'. Evergreen simple leaves 10
10. Succulent cylindrical leaves ***Salsola oppositifolia*** (Fam. Amaranthaceae; salado negro)
- 10'. Non-succulent leaves, flattened leaves 11



11. Aromatic plants	12
11'. Non-aromatic plants	14
12. Nanophanerophyte, evergreen leaves 2-4 cm long, green above and white below; blue flowers	<i>Rosmarinus officinalis</i> (Fam. Lamiaceae; romero, romer, rosemary)
12'. Chamaephytes, smaller leaves, pink, white or yellowish flowers	13
13. Leaves with revolute margin, pink or white flowers	<i>Thymus vulgaris</i> (Fam. Lamiaceae; tomillo, timó, thyme)
13'. Leaves with flat margin, acute apex; yellowish flowers, flowers in verticillastrates	<i>Sideritis angustifolia</i> (Fam. Lamiaceae; rabo de gato, rabbet de gat, ironwort)
14. Chamaephyte, regular white flowers, ripe fruits with three-toothed capsule.....	<i>Helianthemum violaceum</i> (Fam. Cistaceae; jarilla, rock rose)
14'. Phanerophyte, with capsules or drupes	15
15. Narrow linear leaves, white regular flowers, fruit in capsule (5-teethed)	<i>Cistus clusii</i> (Fam. Cistaceae; falso romero, romer mascle, rock rose)
15'. Broad leaves	16
16. Dark green upper-side and white-silver lower side; whitish flowers, fruit in drupe	<i>Olea europaea</i> (Fam. Oleaceae; olivo, olive tree)
16'. Leaves are greenish and hairy on both sides; regular pink flowers, fruit in capsule	<i>Cistus albidus</i> (Fam. Cistaceae; jara blanca, rock rose)
17. Compound leaves	18
17'. Simple leaves, sometimes deeply lobed	23
18. Trifoliate leaves, the terminal leaflet is bigger; yellow flowers; legume included in the calyx	<i>Anthyllis cytisoides</i> (Fam. Fabaceae; albaida)
18'. Leaves with more than 3 leaflets	19
19. Palmate compound leaves, upper part of the leaflet is dark green, lower part of the leaflet is whitish	<i>Rubus ulmifolius</i> (Fam. Rosaceae; zarzamora, esbarzer, wild blackberry)
19'. Pinnate compound leaves	20
20. Odd pinnate compound leaves; deciduous plants	21
20'. Even pinnate compound leaves; evergreen plants	22



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21. Thorny and, sometimes, climbing plants ***Rosa*** sp. (Fam. Rosaceae; rosales, escaramujos; roses)
 21'. Not thorny; shrubs or small trees, sometimes with visible galls in leaflets
 ***Pistacia terebinthus*** (Fam. Anacardiaceae; cornicabra, turpentine tree)
22. Trees with big and round leaflets, large and non-dehiscent legume
 ***Ceratonia siliqua*** (Fam. Fabaceae; algarrobo, garrofer, carob)
- 22'. Shrub, small and lanceolate leaflets, with small red unripen drupes
 ***Pistacia lentiscus*** (Fam. Anacardiaceae; lentisco, llentiscle, mastic)
23. Sessile leaves 24
 23'. Petiolate leaves 26
24. Narrow and spatulate leaves; grayish bark, stems topped with a thorn, small red fleshy fruits..... ***Rhamnus lycioides*** (Fam. Rhamnaceae; espino negro, arçot, buckthorn)
 24'. Small-scale leaves; non-thorny plants 25
25. Deciduous trees; imbricate alternate leaves, acute apex; showy flowers in racemes
 ***Tamarix*** sp. (Fam. Tamaricaceae; taray, salt cedar; tamarisk)
- 25'. Evergreen plants; old branches with obtuse opposite or whorled leaves; without flowers, brown cones (berry-like).....
 ***Juniperus phoenicea*** (Fam. Cupressaceae; sabina mora, sabina negral, phoenicean juniper)
26. Leaves with palmate nerves 27
 26'. Leaves with reticulate nerves 28
27. Pinnatifid leaves, small shrub, not climbing
 ***Chamaerops humilis*** (Fam. Palmae; palmito, margalló, dwarf fan palm)
- 27'. Lobed and unlobed leaves; climbing plant; sometimes with aerial rootlets
 ***Hedera helix*** (Fam. Araliaceae; hiedra, heura, ivy)
28. Leaves with the lower part of the leaf clearly whitish (hairy), upper part is dark green .
 ***Quercus rotundifolia*** (Fam. Fagaceae; encina, carrasca, holm oak)
- 28'. Leaves with green upper and lower parts 29
29. Deciduous tree, soft lanceolate and serrate leaves
 ***Prunus dulcis*** (Fam. Rosaceae; almendro, ametller, almond)
- 29'. Evergreen shrubs; coriaceous leaves..... 30
30. Spiny leaves, reticulate venation (clearly visible against the light); with acorns
 ***Quercus coccifera*** (Fam. Fagaceae; coscoja, coscoll, kermes oak)
- 30'. Serrate leaves, reticulate venation (not visible against the light); small and red drupes
 ***Rhamnus alaternus*** (Fam. Rhamnaceae; aladierno, aladiern, buckthorn)
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ANNEX 2. Pictures of plant species from “Mas de Torretes”



All photos taken by J. Moreno and A. Terrones



