

Sierra del Aljibe (Los Alcornocales Natural Park, Strait of Gibraltar region) - Hiking over the Mediterranean paradigm

Field trip led by:

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The western Mediterranean Basin is characterized by a markedly seasonal, winter rainfall climate regime (Mediterranean climate). Dominant soils are loamy to marly, have a neutral to basic pH, and moderate to high fertility. Such climatic and edaphic conditions explain the preponderance of garrigue-like shrublands and woodlands in this region. They are dominated by sclerophyllous woody species and represent the paradigm of Mediterranean vegetation in the Mediterranean Basin.

By contrast, the Strait of Gibraltar region is characterized by mountains and hills composed of Oligo-Miocene siliceous sandstone ("Aljibe sandstone") that produce highly acidic, nutrient-poor, sandy soils. These mountains appear in the form of edaphic islands (Figure 1), surrounded in the lowlands by more fertile, non-acid, loamy or marly soils. Climate is mild Mediterranean owing to the oceanic influence determined by its geographic location between two seas (Figure 1). Mean annual rainfall ranges from ca. 750 to over 1500 mm. In summer, a prevailing southeastern wind (locally known as *Levante*) coming directly from the sea brings moisture to these sandstone mountains, which condenses into thick, low clouds (Figure 2) and contributes to somewhat alleviate in this region the characteristic severity of summer drought of the Mediterranean Basin. Such contrasting climatic and edaphic features, together with its particular Plio-Pleistocene history (Rodríguez-Sánchez et al. 2008) explain the replacement of typical garrigue-like shrublands in these sandstone mountains by a distinct flora and vegetation. Extensive cork oak woodlands, moist semi-deciduous oak forests and spectacular *canutos* in deep gorges, together with Mediterranean heathlands or *herrizas* covering sandstone crests and ridges, are major vegetation formations in the Strait of Gibraltar region.

Most of the northern (European) side of this region is preserved under the umbrella of *Los Alcornocales* Natural Park. It covers ca. 1700 km² of rugged relief formed by not very high mountains and hills (highest elevation of 1092 m) mainly composed of Oligo-Miocene siliceous sandstone. This natural park was formally declared in 1989 so as to promote the sustainable management of forest resources and to maintain its outstanding biodiversity. Main natural resources in the region are cork extraction, free-range livestock (mainly *Retinto* cattle) (Figure 3), game hunting (red- and roe-deer) and, more recently, eco-tourism.

Hike details

This field trip is scheduled for the 4th of February 2017. Minibuses will depart from "Reina Mercedes" Science Campus at 08:00h. After about 1h 40 min driving, we will stop 20 min in Alcalá de los Gazules (Cádiz) for breakfast. Then, we will drive uphill ca. 20 km through a winding, mountaing road to "El Refugio", at the lower slopes of El Aljibe, where we will start an all-day hike (Figure 4).

The hike follows an ascending jeep track for about 5.4 km through the main vegetation types of these sandstone mountains (see "Ecological details" below). It finishes in the Junction after having ascended ca. 550 m (Figure 4). From there, turn around and travel back the same path downhill, making a total of about 11 km. For the sake of sport, and also to enjoy the view (clouds permitting), a little walk of less than 0.3 km further up will take us to the Aljibe Peak. There is an optional detour for tireless hikers that goes along a hiking path from the Junction through a long, wide ridge that makes the trail a circular walk of ca. 14 km (Figure 4) and gives splendid views (again, clouds permitting).

<p>This is not a heavily demanding hike, but good health conditions and willingness to walk for 5-6 hours are required.</p>
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What to bring:

- ✓ Clothing appropriate for a winter day, including hat, gloves and a windstopper jacket. In the event of rain, spare clothing (to be left in the bus) is advisable.
- ✓ Hiking boots and backpack to carry lunch/snacks and water (at least, 1 litre). A lunch pack and water will be provided by the organization.
- ✓ Hat & sunscreen, if we're fortunate to hit a winter sunny day.
- ✓ Recommended: hiking pole and camera.

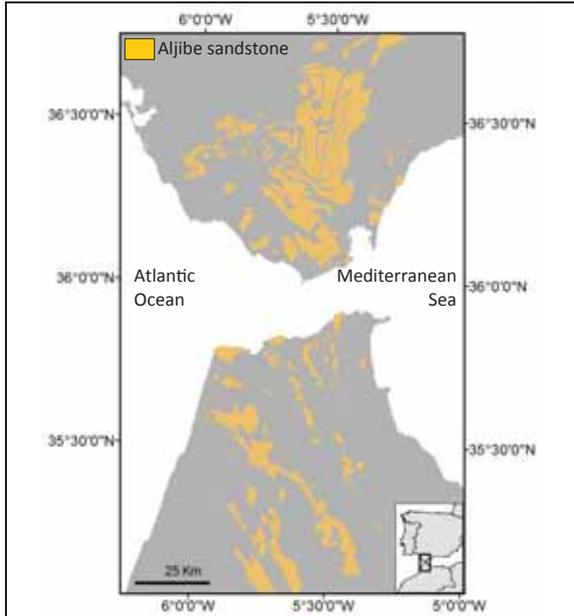


Figure 1. Location of the Strait of Gibraltar region with patches of Oligo-Miocene sandstone (Aljibe sandstone) highlighted in orange.

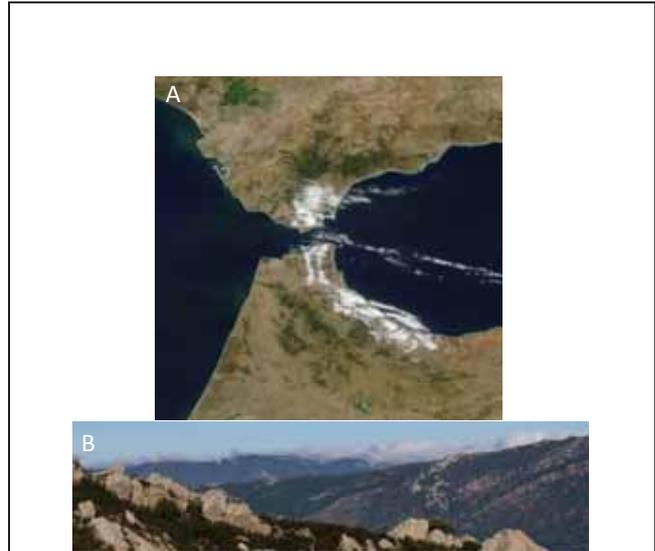


Figure 2. Low, dense clouds formed over mountains of the Strait of Gibraltar by strong southeastern wind (*Levante*). (A) Satellite image from last August 9, 2016, when a strong *Levante* blew in the region (image taken from <https://worldview.earthdata.nasa.gov>). (B) View of sandstone mountains of the Strait during a strong *Levante* day.



Figure 3. Left: cork-harvesting. Right: free-range *Retinto* cow.

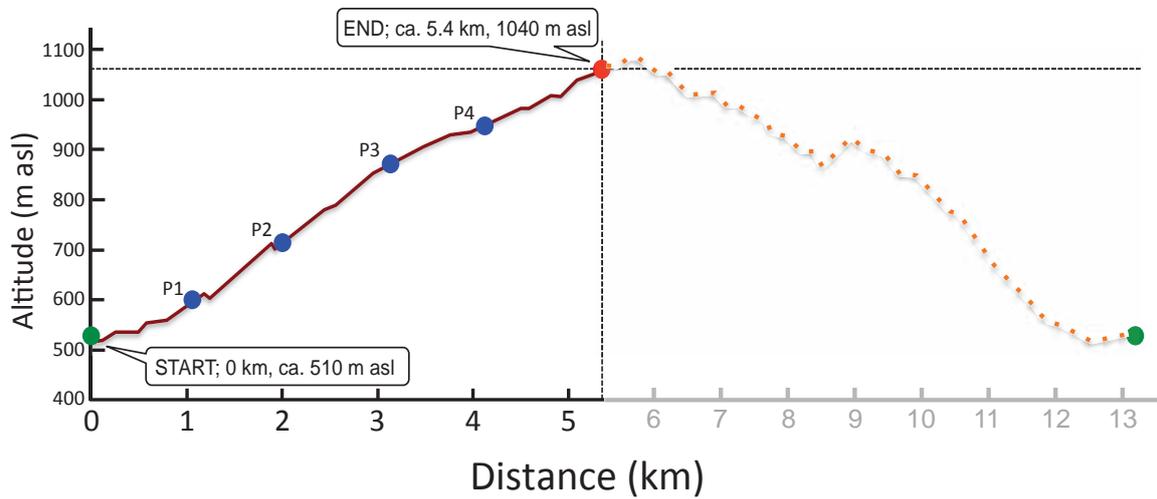
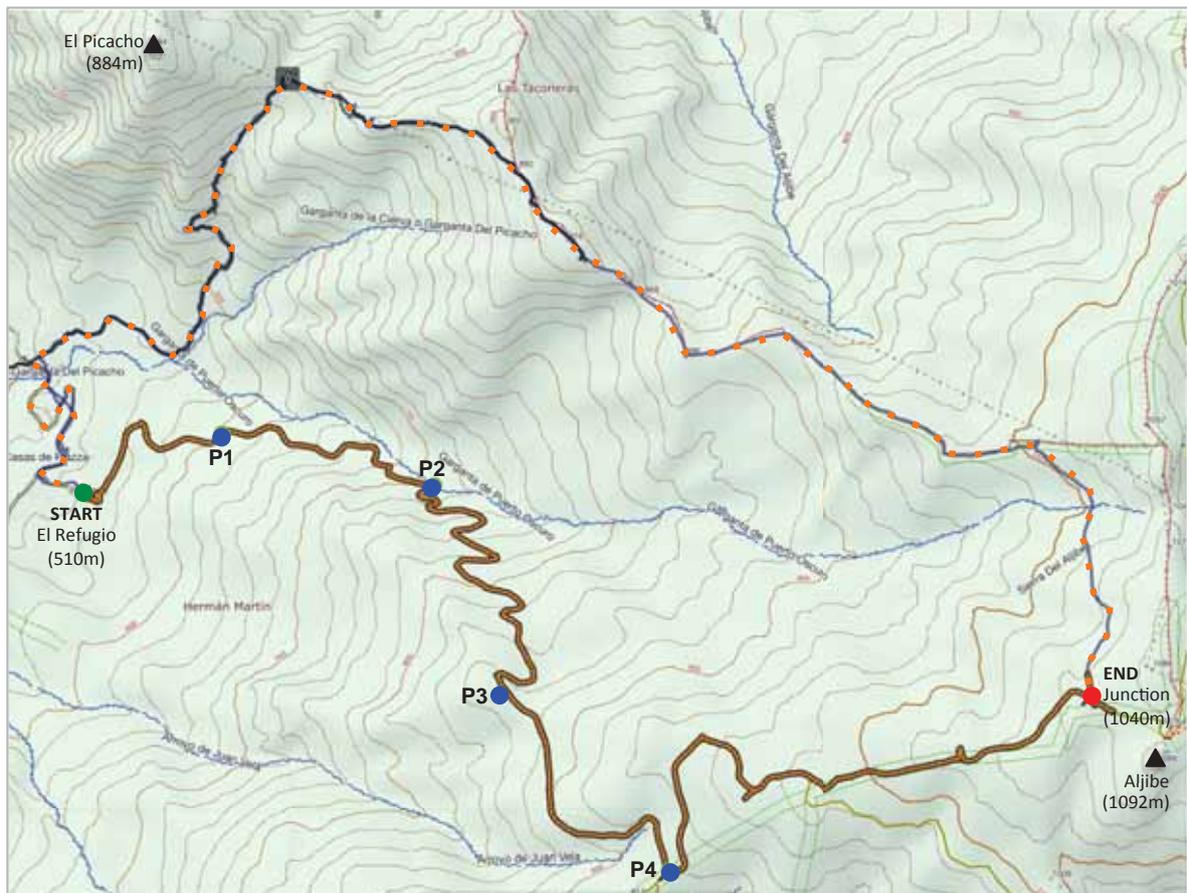


Figure 4. Detailed map and elevation profile of the Sierra del Aljibe hike. Blue points (P1-P4) are approximate locations referred in *Ecological highlights* (see text). Dotted line: optional detour back to El Refugio.

Ecological highlights: vegetation, management and biodiversity

From Alcalá de los Gazules to El Refugio, the landscape we will see from the bus is dominated by garrigue-like vegetation (Figure 5), where sclerophyllous shrub species such as the kermes oak *Quercus coccifera*, the mastic tree *Pistacia lentiscus* and the wild olive tree *Olea europaea* are preponderant, with other species such as the dwarf palm *Chamaerops humilis*, gorses (e.g. *Ulex borgiae*) and rock roses (*Cistus* spp.).



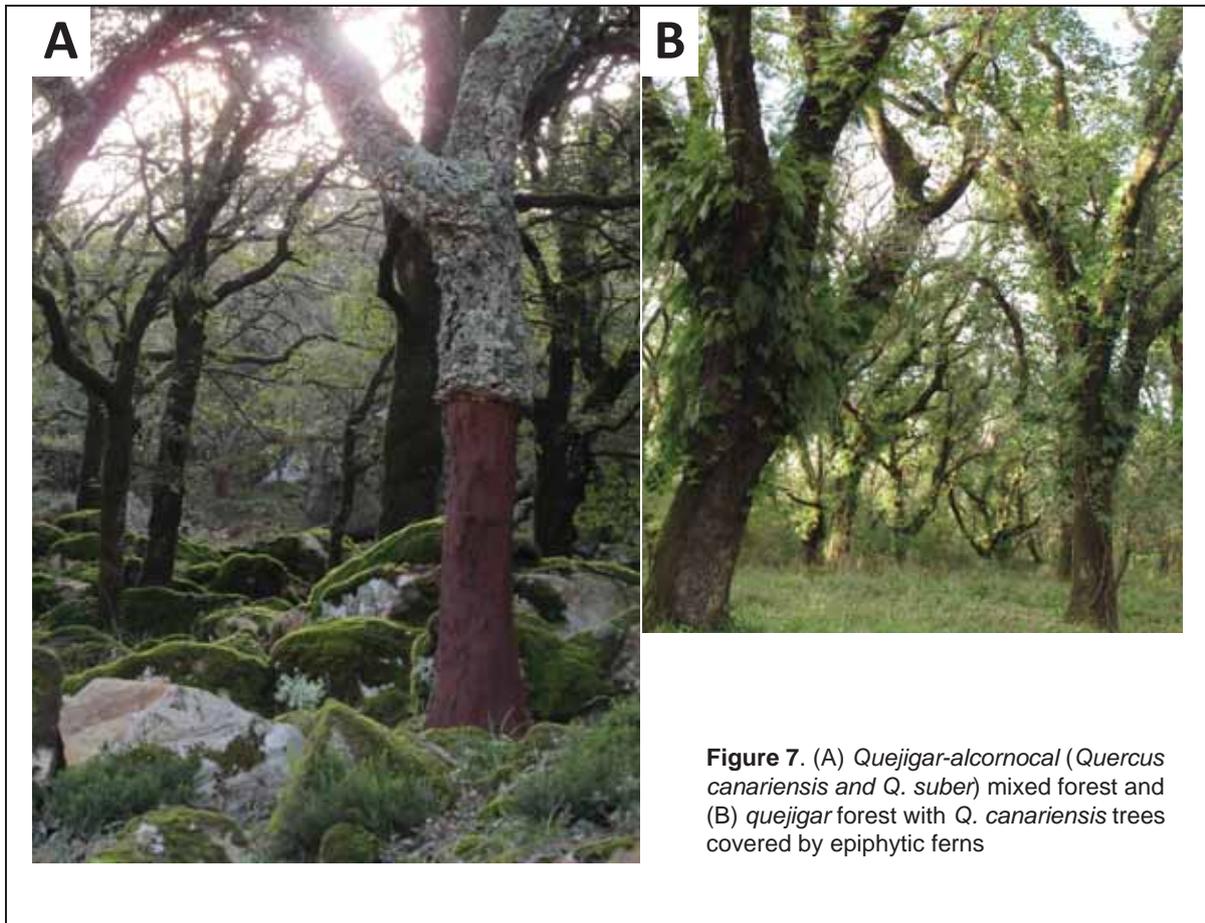
Figure 5. Garrigue shrubland (cork-oak woodland in the background) of the lower slopes of sierra del Aljibe.

A little before arriving to “El Refugio” and during the first part of our hike (P1 in Figure 4), evergreen *Quercus suber* (cork oak) woodlands or *alcornocales* dominate the area (Figure 6). The heath *Erica scoparia* co-occurs in the understorey of these woodlands with *Ulex borgiae*, *Genista triacanthos*, two gorse species, and the rockrose *Cistus salvifolius* as the most abundant shrub species. Despite their relevance as the iconic vegetation formation of the Natural Park, the long-term sustainability of *Q. suber* woodlands is currently an important ecological and social concern given the lack of regeneration and increasing adult mortality suffered by the species (Gómez-Aparicio et al. 2012; Ibáñez et al. 2015)



Figure 6. Left: *corcheros* (cork-harvesters) getting the cork out of the tree (further details of how cork is extracted in this short video: <https://www.youtube.com/watch?v=ztr-RP0XYd8>). Right: *alcornocal* (cork-oak woodland) showing trees with bark stripped off.

Further up, in shady slopes facing north, cork oak woodlands are replaced by semi-deciduous *Quercus canariensis* forests (*quejigares*) (Figure 7). The understorey of these close forests is formed by broadleaf tall shrubs such as *Phillyrea latifolia*, *Viburnum tinus* and *Rhamnus alaternus*, among others. *Erica arborea* is the only heath species able to tolerate the shady conditions of these forest understoreys.



After a bit further uphill, the trail will overlook the *Puerto Oscuro* Gorge (*Garganta de Puerto Oscuro*; P2 in Figure 4), which conceals a very interesting example of warm-temperate forest or *canuto* (Figure 8). These *canutos* are very diverse in tree and arborescent shrub species, including Tertiary (premediterranean) relict species such as *Rhododendron ponticum* subsp. *baeticum*, the bay-tree *Laurus nobilis*, the alder buckthorn *Frangula alnus* subsp. *baetica* and the holly *Ilex aquifolium*, highlighting the role of the Strait of Gibraltar region as a premediterranean refuge (Rodríguez-Sánchez et al. 2008).

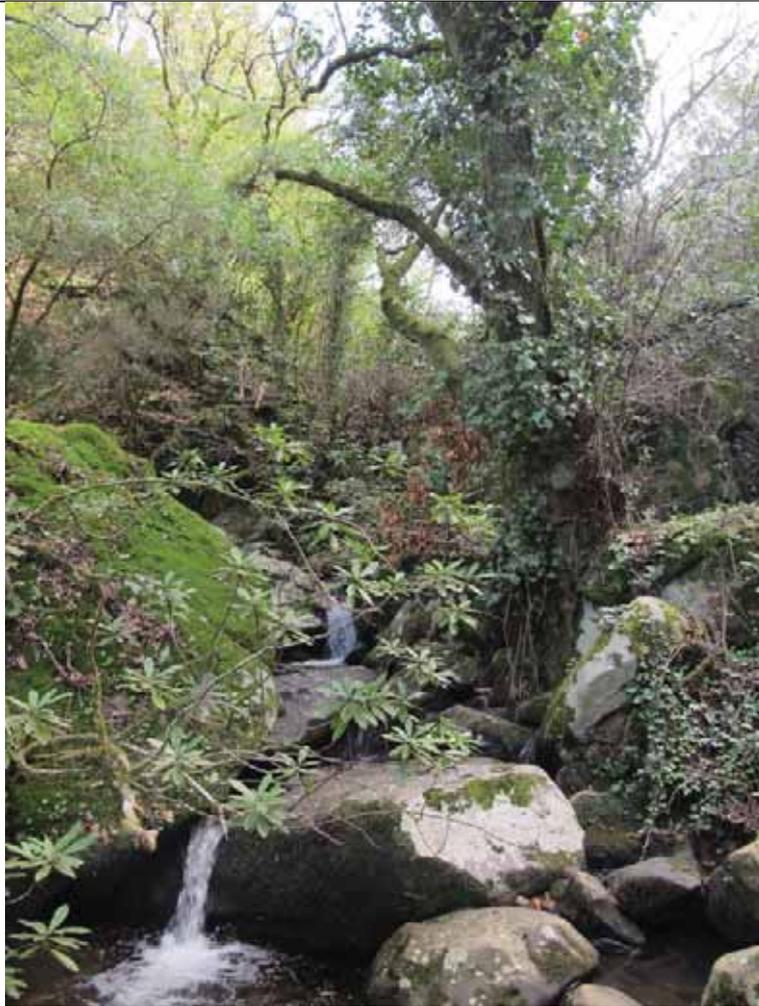


Figure 8. Riparian, warm-temperate forest (*canuto*) of *Garganta de Puerto Oscuro* in a sandstone gorge.

From P2, the track zig-zags uphill to reach the higher slopes (P3 and upwards; Figure 4), where oak forests are replaced by the Mediterranean heathland (locally known as *herriza*) (Figure 9). The *herriza* is dominated by heath species such as *Erica australis* and *Calluna vulgaris*, the rockrose *Cistus populifolius*, gorses such as *Genista tridentata* or *Stauracanthus boivinii*, and the prostrated oak *Quercus lusitanica*. In the *herriza* is where we can find the flypaper-trap species *Drosophyllum lusitanicum* (Figure 9) a unique carnivorous plant species (Bertol et al. 2015; Salces-Castellano et al. 2016). Although the *herriza* is floristically and fisiognomically similar to other European dry heathlands, it shows much higher levels of species richness and narrow endemism. But they are not only of high conservation value because of the number of narrow endemic species but, more remarkably, because of the singularity of its endemism (Rodríguez-Sánchez et al. 2008). Nevertheless, they have been traditionally and inexplicably disregarded or considered as mere “tree-less” or degraded “pre-forest” stages, and have been systematically “restored” by afforestation with pine trees (Andrés and Ojeda 2002). More about the *herriza* in the 8-min documentary *HERRIZA - The Cinderella of the Strait of Gibraltar* (<https://www.youtube.com/watch?v=u0YpOcl27Nw>).



Figure 9. Up: landscape view of Mediterranean heathland (*herriza*) vegetation on the upper slopes and ridges of the sierra del Aljibe. Bottom: *Drosophyllum lusitanicum* plants with sunset light shining through the mucilage droplets of their leaves.

Only *Quercus pyrenaica*, another semi-deciduous oak tree species, can form small scattered treelet patches in the *herriza* (Figure 10), always in wind-sheltered locations above 800 m elevation. From P4 in Figure 4 some of these small forest patches can be seen.



Figure 10. Upper ridge of sierra del Aljibe covered by *herriza* (hand-slashed to form a firebreak) and a small treelet patch of *Quercus pyrenaica* in the upper part facing west, sheltered from prevailing southeastern or *Levante* winds.

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