Chapter 5
The Arid Southeast

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Abstract The Southeast of the Iberian Peninsula presents large tracts of arid land with many species and plant communities with the closest relationships to the North African ones in the whole of Western Europe. This territory has been considered a special biogeographical province, the Murcia-Almería province. The area lies in SE Spain between 36.67° – 38.66° N and 0.1° E – 3.04° W, encompassing the area from the surroundings of Benidorm city until the Baetic massifs of the Sierra de Gádor and the Alpujarras. The macrobioclimate of the area is Mediterranean, with bioclimates ranging from xeric oceanic to desertic oceanic. The geology is complex and there are many different rock types, predominantly rich in calcium. The flora of the area is essentially Mediterranean, but is very special, with a high percentage of endemic taxa and also an interesting component of plants with Iberian-North African distribution areas. A great deal of the endemic taxa of the Murcia-Almería province is concentrated in a few genera (*Helianthemum, Limonium, Sideritis, Teucrium* and *Thymus*), and most of the endemics are restricted to particular soils (gypsaceous, marly, rocky, volcanic acid, sand dunes, saline and subsaline). The potential natural vegetation types are usually not true forests, but shrublands, with more or less scattered trees, belonging to the Pistacio-Rhamnetalia alaterni. The seral scrub of this territory, locally called "tomillar", is open-structured and low-sized, but extremely diverse and rich in endemics. Most of the associations are grouped in the endemic order Anthyllidetalia terniflorae. Perennial grasslands with *Stipa tenacissima* and *Lygeum spartum* as prominent species are very common on slopes and plains. There are also annual pastures that, from fall to spring, cover the open areas between perennial vegetation; they are rich in Iberian-African species, and mainly belong to the Stipion retortae alliance. Among the special environments, the riparian vegetation is remarkable, with the narrowest African relations in Europe, as well as the nitrophilous bushes, of the almost exclusive Haloxylo-Atriplicion alliance.

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J. Loidi (ed.), *The Vegetation of the Iberian Peninsula*, Plant and Vegetation 13,
DOI 10.1007/978-3-319-54867-8_5

5.1 Introduction: Climate, Substrates, Flora and Biogeography

The Southeast of the Iberian Peninsula presents large tracts of arid land (Alcaraz and Delgado 1998) with many species and plant communities with the closest relationships to the North African ones in the whole of Western Europe (Alcaraz et al. 1991). This area seems to have been under arid conditions for a long time, allowing the evolution and persistence of hundreds of plants species adapted to those environments, some of them endemics, and others shared with the semiarid Magreb (Algeria and Morocco) and the northern Sahara desert Alcaraz et al. (1989, 1991). So, despite its relatively small size, this area merits the biogeographical rank of province (Murcia-Almería province) (Alcaraz et al. 1991).

The area lies in SE Spain between 36.67° – 38.66° N and 0.1° E – 3.04° W (Fig. 5.2), covers 12,361 km^2 and spans altitudinal ranges from 0 to 1387 m. It embraces the lands near the Mediterranean Sea between the southern slopes of the Dianic ranges, in the area surrounding Benidorm, and the Baetic massifs of the Sierra de Gádor and the Alpujarras, including the southern areas of the provinces of Alicante, Albacete, Murcia and Almería. The altitudinal range of this fringe is variable, reaching its lowest level in the Segura valley. Murcia-Almería is a low-relief biogeographical province, with just two mountains (the Sierras de Carrascoy and Alhamilla) reaching 1000 m in height; the rest of the mountains in the province are geographically continuous introgressions of the Baetic ranges and cannot be considered as Murcia-Almería from a biogeographical point of view (Peinado et al. 1992).

The macrobioclimate of the area is Mediterranean (Rivas-Martínez et al. 1999); the bioclimate is xeric oceanic and, locally, desertic oceanic. Inframediterranean, thermomediterranean and, restricted to the interior and a few mountain summits, mesomediterranean, are the thermotypes represented. It is remarkable that the areas under inframediterranean thermotype are the only ones in the Peninsula (Alcaraz and Delgado 1998). The annual rainfall ranges from 180 to 400 mm and is very seasonal, showing a clear summer minimum (Alcaraz and Delgado 1998). This climatic aridity is a result of its sheltered position in the southeastern extreme of the Peninsula, which positions this region in a severe rain shadow with respect to the most important precipitation sources from the Atlantic and the northern Mediterranean sea (Rivas-Martínez et al. 1999) (Fig. 5.1). Accordingly, arid (this ombrotype is not present in any other area of the European continent), semiarid and dry, the latter restricted to a few mountains summits (the Sierras of Carrascoy, Almenara, Cabrera and Alhamilla), are the ombrotypes represented.

The geology is complex and there are many different rock types (gypsum, limestone, marl, phyllite, quartzite, schists, slate, volcanic rock, etc.). The area's climate favors soils with a high $CaCO_3$ content, except when they are developed from rocks of a very acid nature, as in the Cabo de Gata mountains. Of particular interest are some isolated hills, called "*cabezos*", between Águilas and Mazarrón, in the Cartagena plain and forming islands in Mar Menor, that are volcanic post-orogenic uplifts of Neogenous origin.

Fig. 5.1 The alternation of marl, on the slopes, and saline soils, in "*ramblas*", form one of the most impressive landscapes of the arid Southeast (rambla de Tabernas, Almería)

The flora of this province is essentially Mediterranean (46.9% of the taxa), but is very special, with a high percentage of taxa that are endemic to this province (4.18%) and a high proportion of taxa that are Iberian endemics (9.63%); furthermore, this province contains an interesting component of taxa with an Iberian-North African distribution pattern (4.88%). Contrasting these figures that indicate endemicity, mediterraneity and relationships with North Africa, are the 1.59% Mediterranean-Atlantic species (Alcaraz 1984).

The Murcia-Almería province has one of the highest floristic diversities of all Spanish areas (Alcaraz et al. 1991) and includes three endemic genera (*Euzomodendron, Guiraoa* and *Lycocarpus*). Much of the endemic diversity of the Murcia-Almería province is concentrated in a few genera which may still be actively evolving (*Helianthemum, Limonium, Sideritis, Teucrium* and *Thymus*); other endemics are undoubtedly of desertic or steppic origin (Saharo-Arabian or Irano-Turanian), but they have evolved in isolation, due to area disjunction; this seems to be the case of *Anabasis hispanica, Haloxylon salicornicum, Suaeda pruinosa* and several *Salsola* species.

The restriction of plants to certain soil types is an important feature of the Murcia-Almería flora. Gypsaceous soils are an important hotspot of reduced-area endemics such as *Chaenorhinum grandiflorum*, *Coris hispanica, Helianthemum alypoides, Herniaria fruticosa* subsp. *erecta, Santolina viscosa, Teucrium*

balthazaris, Teucrium lepicephalum and *Teucrium turredanum.* Marls also support endemics in Murcia-Almería province, with *Achillea santolinoides* subsp. *santolinoides, Astragalus hispanicus, Euzomodendron bourgeanum, Genista ramosissima, Genista valentina* subsp. *jimenezii, Haloxylon salicornicum, Herniaria fontanesii* subsp. *almeriana, Moricandia foetida, Salsola genistoides,* etc. Rocky places, mostly formed by limestones and dolomite, are also rich in exclusive plants as *Antirrhinum hispanicum* subsp. *mollisimum, Centaurea saxicola, Galium ephedroides, Genista murcica, Lafuentea rotundifolia, Satureja obovata* subsp. *canescens, Sideritis glauca, Teucrium rivasii, Teucrium freynii* and *Teucrium intricatum.*

A particularly interesting edaphically delimited region is the volcanic area of the Cabo de Gata*;* several taxa are endemic in this area and they are restricted to acid volcanic rocks: *Antirrhinum charidemi, Dianthus charidemi, Sideritis osteoxylla, Ulex canescens* and *Verbascum charidemi.*

On coastal sand dunes the recently described *Asparagus macrorhizus, Helianthemum marminorense* and *Ononis talaverae* are exclusive of the Murcia-Almería province.

On saline and subsaline soils there are several endemics, such as *Anabasis hispanica, Frankenia corymbosa, Helianthemum motae, Salsola papillosa* and the remarkable genus *Limonium* (*Limonium album, Limonium caesium, Limonium carthaginense, Limonium cossonianum*, *Limonium delicatulum, Limonium estevei, Limonium furfuraceum, Limonium insigne, Limonium parvibracteatum, Limonium santapolense, Limonium supinum* and *Limonium tabernense*).

Biogeographically, two sectors have been distinguished in the Murcia-Almería province: **Alicante-Murcia** (Fig. 5.2, 1a–1c) and **Almería** (Fig. 5.2, 2a–2c). The Alicante-Murcia sector shows influences of The Mancha and coastal Levantine areas, while the Almería sector has influences from the Baetic ones (Alcaraz et al. 1991).

The Alicante-Murcia sector comprises the northern areas of the Murcia-Almería province; it includes the territories of the basins of the Segura and Vinalopó rivers and an important part of the Campo de Cartagena, as well as the coastal areas of the Mar Menor, reaching in the north the region of Polop-La Nucia-Altea in the southern part of the Dianic ranges. Some summits above 1000 m, such as the Carrascoy range (Murcia), have Manchegan vegetation. Minor differences can be used to characterize the three subsectors existing within it: Alicante (1a), South Murcia (1b) and North Murcia (1c) (Fig. 5.2) (Alcaraz et al. 1991).

The Almería sector, which includes the coastal and sublitoral regions between the Cabo de Palos (Murcia) and Adra (Almería), also includes more inland areas in the basin of the Guadalentín (Lorca, La Paca), Almanzora (Olula del Río) and Andarax (Abla, Canjáyar) valleys. It comprises some plains (Fuente Álamo, Lorca, Puerto Lumbreras, Níjar), including also some modest ranges (Almenara, Cabrera and Alhamilla). Minor variations led to recognize three subsectors: East Almería (2a), Cabo de Gata (2b) and West Almería (2c) (Fig. 5.2) (Alcaraz et al. 1991).

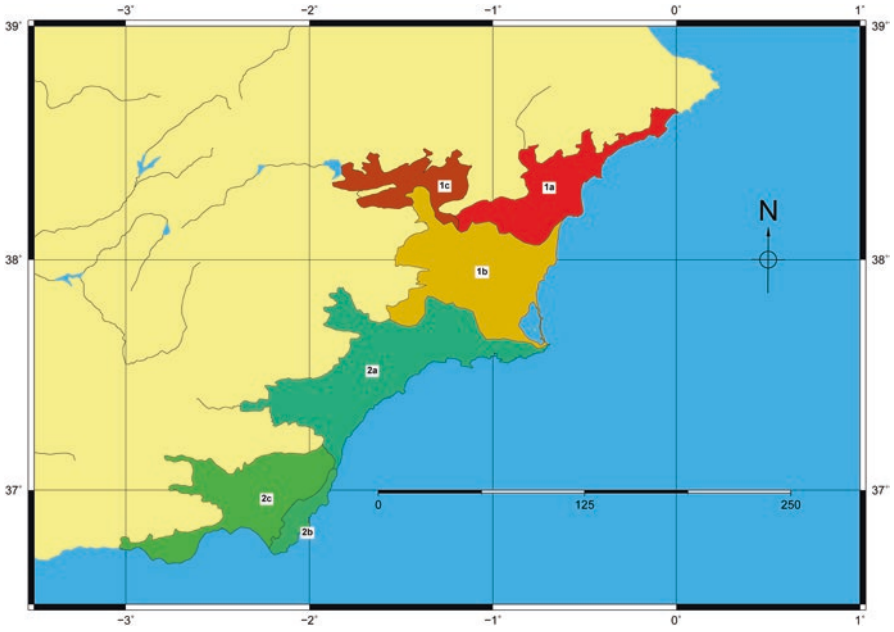

Fig. 5.2 Map of the arid Southeast (Murcia-Almería province). *1*. Alicante-Murcia sector: *1a* Alicante subsector, *1b* South Murcia subsector, *1c* North Murcia subsector. *2*. Almería sector: *2a* East Almería subsector, *2b* Cabo de Gata subsector, *2c* West Almería subsector

5.2 Forest, Woodlands and Mantel Vegetation

Because of the arid conditions, the potential natural vegetation of the Murcia-Almería province (Tables 5.1 and 5.2), is not true forest, but shrublands with more or less scattered trees, belonging to the Pistacio lentisci-Rhamnetalia alaterni order, mostly to the alliances Periplocion angustifoliae and Asparago albi-Rhamnion oleoidis, and Cytiso villosi-Telinetalia monspessulanae, alliance Genisto spartioidis-Phlomidion almeriensis, the latter being endemic to the province, and, in the mesomediterranean belt, to the Rhamno lycioidis-Quercion cocciferae. The only exception to this trend occurs on some north-exposed slopes and on some mountains summits, where the dry ombroclimate is present; there the potential natural vegetation is holm-oak forest of the Quercetalia ilicis order.

The Periplocion angustifoliae alliance (Table 5.1, rows 1–4) includes communities dominated by *Periploca laevigata* subsp. *angustifolia* (*cornical*), *Gymnosporia senegalensis* (*arto*), *Ziziphus lotus* (*azofaifo*), and some open woodlands of *Tetraclinis articulata*. The *Periploca laevigata* subsp. *angustifolia* brushwoods are the potential natural vegetation of the inframediterranean arid belt, the only localities with a desertic oceanic bioclimate in continental Europe (Table 5.1, row 1). Thorny brushwoods of *Ziziphus lotus* (Table 5.1, rows 2–3) are the potential natural vegetation in closed basins (Fuente Álamo, Lorca-Puerto Lumbreras, Níjar, etc.) (Ziziphetum loti), and in the western part of the West Almería subsector on plains

Table 5.1 Natural potential associations (sclerophyllous) in the Murcia-Almería province

Association or plant community	Biogeography	Soil	Bioclimatic belt
Mayteno europaei-Periplocetum angustifoliae	East Almería & Cabo de Gata	Loamy	Inframediterranean arid-semiarid
Ziziphetum loti	East Almería & West Almería (E part)	Gravelly, closed bassins	Thermomediterranean semiarid
Gymnosporio europaei-Ziziphetum loti	West Almería (W part)	Loamy	Thermomediterranean semiarid
Arisaro simorrhini-Tetraclinietum articulatae	East Almería	Rocky, sunny slopes	Thermomediterranean semiarid
Chamaeropo humilis-Rhamnetum lycioidis	Alicante-Murcia and East Almería (subass. typical), West Almería and Cabo de Gata (subass. salsoletosum webbii)	Loamy	Thermomediterranean semiarid
Querco cociferae-Pinetum halepensis	Murcia-Almería	Loamy	Lower mesomediterranean semiarid
Rubio longifoliae-Quercetum rotundifoliae	Alicante-Murcia	Loamy, calcicolous, northern slopes	Thermomediterranean dry
Myrto communis-Quercetum rotundifoliae	East Almería	Loamy, calcifugous, northern slopes	Thermomediterranean dry
Asparago horridi-Quercetum rotundifoliae	South Murcia (Carrascoy mountain), East Almería (Almenara mountain)	Loamy, calcicolous	Lower mesomediterranean dry
Paeonio coriaceae-Quercetum rotundifoliae	West Almería (Alhamilla mountain)	Loamy, calcicolous	Mesomediterranean dry
Adenocarpo decorticantis-Quercetum rotundifoliae	West Almería (Alhamilla mountain)	Loamy calcifugous	Mesomediterranean dry

leading to the coast (Gymnosporio-Ziziphetum loti). *Ziziphus lotus* shrublands create landscapes that are very similar to those of the Saharan wadis. The Arisaro simorrhini-Tetraclinidetum articulatae is a relict vegetation related to the north African woodlands of this species; it forms an open forest growing on the east-facing, sunny

Table 5.2 Natural potential associations (brooms) in the Murcia-Almería province

Association or plant community	Biogeography	Soil	Bioclimatic belt
Rhamno lycioidis-Genistetum murcicae	South Murcia, East Almería	Marly, sandstone	Thermomediterranean semiarid
Lavandulo dentatae-Genistetum retamoidis	North Murcia, West Almería, Cabo de Gata	Marly, gypsiferous and rocky (volcanic acid and calcareous)	Thermomediterranean and lower mesomediterranean semiarid
Thymelaeo valentinae-Genistetum ramosissimae	West Almería (arround Sorbas)	Marly	Thermomediterranean semiarid

Fig. 5.3 The Arisaro simorrhini-Tetraclinidetum articulatae is an open forest. Here (Peña del Águila, Murcia) this remarkable tree *Tetraclinis articulata* grows naturally at its only location on the European continent

rocky slopes of the Sierra de Cartagena (East Almería subsector) (Table 5.1, row 4; Fig. 5.3).

Apart from the above mentioned brushwoods and woodlands, the main type of potential natural vegetation in the thermomediterranean semiarid bioclimatic belt

Fig. 5.4 The main thermomediterranean potential vegetation in the arid Southeast is the sclerophyllous Chamaeropo humilis-Rhamnetum lycioidis, in the photo dominated by the "palma chica" (*Chamaerops humilis*) (Calblanque, Murcia)

on loamy soils corresponds to sclerophyllous shrublands with *Chamaerops humilis, Pistacia lentiscus*, *Quercus coccifera, Rhamnus lycioides, Rhamnus oleoides* subsp. *assoana*, etc., with scattered pines (*Pinus halepensis*). These vegetation types are included in the Chamaeropo humilis-Rhamnetum lycioidis association (Table 5.1, row 5; Fig. 5.4). On heavy clay and sandstone soils the potential vegetation are plant communities dominated by brooms (*Coronilla juncea, Genista ramosissima, Genista spartioides* and *Genista valentina* subsp. *jimenezii*) of the Genisto-Phlomidion almeriensis alliance (Table 5.2; Fig. 5.5). Where those broom shrubs are abundant, the appearance of the landscape is very striking in springtime, by the yellow color and fragrance of their flowers.

In the mesomediterranean semiarid belt many thermophilic plants vanish, and the potential vegetation is the pine woodland of Querco cocciferae-Pinetum halepensis (Table 5.1, row 6).

On northerly faced and moister slopes, the thermomediterranean dry belt can be locally present and then the potential vegetation consists of oak forests (*Quercus ilex subsp. rotundifolia*), which can be divided into those of acid (Myrto communis-Quercetum rotundifoliae) and of basic substrates (Rubio longifoliae-Quercetum rotundifoliae) (Table 5.1, rows 7–8).

Fig. 5.5 The potential vegetation on clay and sandstone soils is dominated in the arid Southeast by brooms (Rhamno lycioidis-Genistetum murcicae), with *Genista valentina* subsp. *jimenezii* on Cabo Tiñoso (Murcia)

The mesomediterranean dry belt is confined to the upper elevations, such as some mountain summits (Sierras de Carrascoy, Almenara, Cabrera and Alhamilla), and has a potential vegetation of holm-oak forests (Quercetalia ilicis) (Table 5.1, rows 9–11).

5.3 Seral Scrub

The scrub of this territory covers most of the area in the hills and slopes, being a dominant element in the landscape. It is called *tomillar* (due to the abundance of thymes), and is an open-structured and low-sized vegetation but, at the same time, it is extremely diverse and rich in endemic species and vegetation types (Alcaraz and Delgado 1998). The numerous associations are grouped in the endemic Anthyllidetalia terniflorae order (Table 5.3; Fig. 5.6), except those on gypsum soils which belong to the Gypsophiletalia struthium order (Table 5.4) and a relict patch of the alliance Lavandulo lanatae-Genistion boissierii (order Rosmarinetalia officinalis) in the upper elevations such as the Carrascoy and Alhamilla mountain summits.

Table 5.3 Murcian-Almerian thyme-brushwoods (excluded those of gypsum soils)

Association or plant community	Biogeography	Soil	Bioclimatic belt
Saturejo canescentis-Cistetum albidi	Murcia-Almería	Carbonated, rocky pavements	Thermomediterranean semiarid
Stipo tenacissimae-Sideritidetum leucanthae	Alicante	Loamy	Thermomediterranean semiarid
Anthyllido terniflorae-Teucrietum dunensis	Alicante	Sandy	Thermomediterranean semiarid
Helianthemo marminorensis-Teucrietum dunensis	South Murcia	Sandy	Thermomediterranean semiarid
Sideritido littoralis-Helianthemetum capiti-felicis	South Murcia	Salt rain affected	Thermomediterranean semiarid
Paronychio suffruticosae-Sideritidetum murgetanae	South Murcia	Loamy	Thermomediterranean semiarid
Saturejo canescentis-Cistetum albidi	Murcia-Almería	Rocky	Thermomediterranean-lower mesomediterranean semiarid
Teucrio belionidis-Helianthemetum scopulori	Almería	Sandy	Thermomediterranean semiarid
Sideritido marminorensis-Thymetum hyemalidis	East Almería (East part)	Loamy	Infra-thermomediterranean semiarid
Teucrio lanigeri-Sideritidetum ibanyezii	East Almería (West part)	Loamy	Infra-thermomediterranean semiarid
Teucrio charidemi-Lavanduletum multifidae Sanz & Costa Tenorio 1988	Cabo de Gata	Acid volcanic	Infra-thermomediterranean semiarid
Helianthemo almeriensis-Sideritidetum pusillae	West Almería	Loamy	Thermomediterranean semiarid
Anthyllido lagascanae-Thymetum antoninae	North Murcia	Loamy	Lower mesomediterranean semiarid
Thymus membranaceus – Sideritis leucantha subsp. bourgeana community	North Murcia	Marly	Lower mesomediterranean semiarid
Anabasio hispanicae-Salsoletum genistoidis	Alicante-Murcia	Subsaline marly	Thermomediterranean semiarid

(continued)

Table 5.3 (continued)

Association or plant community	Biogeography	Soil	Bioclimatic belt
Limonio insignis-Anabasietum hispanicae	Almería	Subsaline marly and phyllites affected by salt rain	Thermomediterranean semiarid
Salsolo papillosae-Limonietum carthaginensis	East Almería (East part)	Subsaline	Infra-thermomediterranean semiarid
Anabasio hispanicae-Euzomodendretum bourgeani	West Almería	Subsaline marly	Thermomediterranean semiarid
Limonietum estevei	East Almería (arround Mojácar)	Subsaline phyllites	Thermomediterranean semiarid

Fig. 5.6 Seral scrublands ("tomillares") are very diversified in the arid Southeast, and are mainly represented by the endemic order Anthyllidetalia terniflorae (Stipo tenacissimae-Sideritidetum leucanthae in the vicinity of Agost, Alicante)

Table 5.4 Gypsicolous thyme-brushwoods (Gypsophiletalia)

Association or plant community	Biogeography	Bioclimatic belt
Helianthemo thibaudii-Teucrietum lepicephali	Alicante (N part)	Thermomediterranean semiarid
Thymo moroderi-Teucrietum libanitidis	Alicante (S part)	Thermo-mesomediterranean semiarid
Teucrio libanitidis-Thymetum membranacei	Murcia	Thermo-mesomediterranean semiarid
Teucrio balthazaris-Santolinetum viscosae	East Almería	Thermomediterranean semiarid
Helianthemo alypoidis-Gypsophiletum struthii	West Almería	Thermomediterranean semiarid
Santolino viscosae-Gypsophiletum struthii	West Almería	Lower mesomediterranean semiarid

According to the detailed study of Alcaraz and Delgado (1998), the order Anthyllidetalia terniflorae encompasses three alliances:

- Thymo moroderi-Sideritidion leucanthae: chamephytic thyme-brushwoods, South Murcia, Alicante and Almería, on loamy and rocky soils usually avoiding the salt-rich soils of marly depressions and coastal zones affected by salinity (Table 5.3, rows 1–12).
- Sideritidion bourgeanae: thyme-brushwoods of the North Murcia and Murcia-Manchego subsectors (Table 5.3, rows 13–14).
- Anthyllido-Salsolion papillosae: thyme-brushwoods of subsaline marly and phyllite substrates as well as of coastal zones affected by salt spray due to sea breeze. It is present all over the Murcia-Almería province (Table 5.3, rows 15–19).

On the Carrascoy and Almenara summits, up to 900 m, Peinado et al. (1992) found some relict communities of thyme-brushwoods related with those of the Sierra Espuña (Manchego-Espuña) and belonging to the association Teucrio webbiani-Helianthemetum origanifolii, of the Lavandulo lanatae-Genistion boissieri alliance. They also detected some vestiges of Convolvulo lanuginosi-Lavanduletum lanatae (Lavandulo lanatae-Genistion boissieri), on calcareous outcrops of the upper levels of the Sierra de Alhamilla in the mesomeditarranean level, a community type related to the western Alpujarras-Gádor sector (Baetic province).

Gypsaceous substrates are common in the Murcia-Almería province. They occur as scattered spots, isolated from each other, and thus they have been very favorable sites for the evolution of endemic taxa. The characteristic vegetation consists of brushwoods of the order Gypsophiletalia struthium, dominated by chamaephytes, some of which are widely distributed in the Iberian Peninsula gypsum outcrops (*Gypsophila struthium* subsp. *struthium, Helianthemum squamatum, Lepidium subulatum, Ononis tridentata*, etc.), while others have very limited ranges (*Coris hispanica, Helianthemum alypoides, Herniaria fruticosa* subsp. *erecta, Santolina viscosa, Teucrium balthazaris, Teucrium lepicephalum, Teucrium libanitis* and

Teucrium turredanum). The Thymo-Teucrion verticillati alliance is endemic of the province (Alicante-Murcia & East Almería) (Table 5.4, rows 1–3), while in the West Almería subsector those thyme-brushwoods are represented by the alliance Lepidion subulati, with an endemic suballiance (Gypsophilo-Santolinenion viscosae) (Table 5.4, rows 4–6).

On siliceous soils, in the mesomediterranean areas with a dry ombroclimate, the seral scrub is dominated by *Cistus ladanifer* (*jara pringosa*) and *Cistus albidus,* with other less abundant species, such as *Cistus salviifolius, Lavandula stoechas, Teucrium compactum* subsp. *compactum,* etc. These brushwood are confined, in the Murcia-Almería province, to small areas in mountains above 700 m, mainly in the Almería sector (sierras of Alhamilla, Carboneras and Almenara), however, they reach, floristically impoverished, the Northern slope of the Sierra de Carrascoy, in the South Murcia subsector. These *jarales* belong to the Thymo gracilis-Cistetum ladaniferi association, and widely occur in the Baetic biogeographical province.

In thermomediterranean shaded areas and northern slopes of hills, the soils can have a neutral pH and the seral scrub is dominated by *Cistus monspeliensis*, looking as a *jaral* or silicolous *Cistus* garrigue (Calblanque, Carrascoy mountain, etc.), but the rest of the species are typical of base-rich soils. For that reason, despite its physiognomy, those thermophylous "jaral" brushwoods belong floristically to the order *Anthyllidetalia terniflorae.*

5.4 Grasslands

In the Murcia-Almería grasslands we can distinguish two main groups: that dominated by perennial grasses (class Lygeo-Stipetea), and that of pastures dominated by therophytic plants (class Helianthemetea guttati) occurring at open spaces between patches of other vegetation types.

5.4.1 Perennial Grasslands

The Murcia-Almería landscape, especially in the inframediterranean, thermomediterranean and lower mesomediterranean belts under semiarid conditions, is strongly influenced by the conspicuous occurrence of both *esparto* fields (*Stipa tenacissima*) of the Stipion tenacissimae alliance (Table 5.5, row 1; Fig. 5.7), and *albardín* fields (*Lygeum spartum*) of the Agropyro pectinati-Lygeion sparti alliance (Table 5.5, row 2). The former develop on dry soils, slopes and plains, not affected by soil hydromorphy, while the latter occur on valley bottoms and floodplains with a certain amount of edaphic moisture.

At higher elevations, on Murcia-Almería mountains under mesomediterranean dry conditions, grasslands are represented by the Festucion scariosae alliance, with

Table 5.5 Perennial grassland of the Murcia-Almería province

Association or plant community	Biogeography	Soils	Bioclimatic belt
Lapiedro martinezii-Stipetum tenacissimae	Murcia-Almería	Loamy	Inframediterranean, thermomediterranean, lower mesomediterranean semiarid
Dacylido hispanicae-Lygeetum sparti subass. Salsoletosum genistoidis	Murcia-Almería	Clayey, valley bottoms and floodplains	Inframediterranean, thermomediterranean, lower mesomediterranean semiarid
Daphno hispanicae-Festucetum capillifoliae	South Murcia, (Carrascoy mountain) and East Almería (Almenara mountain)	Loamy	Mesomediterranean dry
Dactylido hispanicae-Festucetum scariosae	West Almería (Alhamilla mountain)	Loamy	Mesomediterranean dry
Teucrio pseudochamaepityos-Brachypodietum ramosi	Murcia-Almería	Loamy	Inframediterranean, thermomediterranean, lower mesomediterranean semiarid-dry

Fig. 5.7 Esparto fields (Lapiedro martinezii-Stipetum tenacissimae) are widespread in the arid landscapes of the Southeast (slopes in the vicinity of Alhama de Murcia, Murcia)

two associations (Table 5.5, rows 3 and 4): the Daphno hispanicae-Festucetum capillifoliae (South Murcia and East Almería subsectors), with a levantine and manchegan optimum, and the Dactylido hispanicae-Festucetum scariosae (West Almería subsector), with a Baetic optimum. Other perennial grasslands dominated by *Brachypodium retusum* (Phlomido lychnitidis-Brachypodion retusi alliance), of smaller size, are widespread on all types of soils, especially under pine forests (Table 5.5, row 5).

5.4.2 Annual Pastures

A good representation of annual pastures is only to be seen in wet years with substantial spring rains, and they develop within the open areas between the perennial vegetation. In the Murcia-Almería province they occur as annual grasslands rich in Iberian-African species, some of which being the only European populations (*Aristida adscensionis*, *Asphodelus tenuifolius, Eryngium ilicifolium, Euphorbia dracunculoides* subsp. *inconspicua, Koelpinia linearis, Leysera leyseroides, Limonium lobatum, Neotorularia torulosa, Neurada procumbens, Notoceras bicorne, Plantago notata, Plantago ovata, Pteranthus dichotomus, Spergula fallax*, etc.), and others being endemics (*Centaurium rigualii*, *Chaenorhinum grandiflorum* subsp. *carthaginense, Euphorbia medicaginea, Linaria benitoi, Linaria nigricans, Linaria oligantha, Moricandia foetida, Pallenis hierochuntica, Senecio flavus*, etc.). Those annual grasslands belong mainly to the Stipion retortae alliance (Table 5.6, rows 1–11; Fig. 5.8). On gypsy soils there are some specialists, such as *Campanula fastigiata, Chaenorhinum grandiflorum* subsp. *grandiflorum* and *Chaenorhinum rupestre,* and the grasslands are included in the Sedo-Ctenopsion gypsophilae (Table 5.6, rows 13–14). At some mountain summits (Carrascoy, Almenara, Cabrera and Alhamilla), in the mesomediterranean dry belt, annual grasslands are dramatically different, with species as *Arabis auriculata, Cardamine hirsuta, Cerastium gracile, Erophila verna* and *Hornungia petraea*, characteristics of the mesophilous association Saxifrago tridactylitae-Hornungietum petraeae (Trachynion distachyae) (Table 5.6, row 15).

5.5 Coastal Vegetation

5.5.1 Dune Ecosystems

Sandy shores have been severely altered in the territory by tourism development. However, dune ecosystems are still well preserved along several stretches of the Murcia-Almería coast (Sierra Helada, Arenales de San Pedro del Pinatar, Cabo de Gata, Punta Entinas, Punta del Sabinar, etc.).

Table 5.6 Therophytic non-nitrophilous communities in the Murcia-Almería province

Association or plant community	Biogeography	Soils	Bioclimatic belt
Eryngio ilicifolii-Plantaginetum ovatae	Alicante, South Murcia	Loamy	Infra-thermomediterranean arid-semiarid
Spergulo fallacis-Plantagineutm ovatae	Almería	Loamy	Thermomediterranean semiarid
Campanulo erini-Bellidetum microcephalae	Murcia-Almería	Loamy, Northern slopes	Thermomediterranean & lower mesomediterranean semiarid
Lygeo-Scorpiuretum sulcatae	Murcia-Almería	Clayey	Infra-thermomediterranean semiarid
Bupleuro semicompositi-Filaginetum mareoticae	Murcia-Almería	Salty	Infra-thermomediterranean arid-semiarid
Leysero leyseroidis-Rumicetum gallici	Almería	Gravelly	Infra-Thermomediterranean Arid-Semiarid
Stipo capensis-Diplotaxietum lagascanae	Murcia-Almería	Marly, slopes	Infra-thermomediterranean arid-semiarid
Guiraoa arvensis community	Murcia-Almería	Vertic	Thermo-lower mesomediterranean semiarid
Plantagini ovatae-Diplotaxietum ilorcitanae, Alcaraz et al. (1998)	Murcia-Almería	Marly plains	Infra-thermomediterranean arid-semiarid
Ammochloo palestinae-Linarietum nigricantis	West Almería	Sandy	Thermo-lower mesomediterranean semiarid
Iflogo spicatae-Silenetum adscendentis	West Almería	Gravelly to sandy	Thermomediterranean semiarid
Campanulo fastigiatae-Chaenorhinetum rupestris	North Murcia, Alicante	Gypsum	Thermo-lower mesomediterranean semiarid
Plantagini ovatae-Chaenorhinetum grandiflori	West Almería	Gypsum	Thermo-lower mesomediterranean semiarid
Saxifrago tridactylitae-Hornungietum petraeae	Murcia-Almería	Loamy	Mesomediterranean dry

The gradient from the beaches on the coastline to the inner fixed dunes is expressed by the sequence of plant communities as described now. In the first band, close to the sea, the annual community of Salsolo kali-Cakiletum aegyptiacae establishes in the band where organic remains (mainly of *Posidonia oceanica*) accumulate and nitrification occurs. Next comes the band on very mobile sand, occupied by the Cypero mucronati-Elytrigietum juncei. The third band develops on the mobile crests of dunes, the Medicagini marinae-Ammophiletum australis subass. lotetosum cretici. The semi-stabilized sand dunes (grey dunes) are occupied by the chamaephytic community of Loto cretici-Crucianelletum maritimae, with the psammophilous annual association Triplachno nitentis-Silenetum ramosissimae in

Fig. 5.8 Annual pastures are very diversified and show strong floristic relations with the North African ones (Stipo capensis-Diplotaxietum lagascanae on a plot dominated by *Moricandia foetida*, vicinity of Tabernas, Almería)

clearings of this low scrub. Finally, the completely stabilized sand biotopes are covered by thyme-brushwoods of the order Anthyllidetalia terniflorae (Anthyllido terniflorae-Teucrietum dunensis in the Alicante subsector, Helianthemo marminorensis-Teucrietum dunensis in the South Murcia subsector, Teucrio belionis-Helianthemetum scopulori in the Almería sector), with annual pastures in clearings (Erodio laciniati-Maresietum nanae in the Alicante-Murcia sector and East Almería subsector, Wahlenbergio nutabundae-Loeflingietum pentandrae in the Cabo de Gata and West Almería subsectors).

The potential natural vegetation of fixed coastal dunes (thermomediterranean semiarid stage) are communities of *Juniperus macrocarpa* (Coremato albi-Juniperetum macrocarpae) in the Alicante subsector (Sierra Helada, Benidorm), and the *Juniperus turbinata* association (Rhamno angustifoliae-Juniperetum turbinatae) in scattered areas of the South Murcia subsector (San Pedro del Pinatar to Cabo de Palos) and West Almería subsector (Punta Entinas-Punta del Sabinar).

5.5.2 Maritime Cliffs

Maritime cliffs comprise sloping to vertical faces of the rocky coastline where a break in slope is formed by slippage and/or coastal erosion. In the Murcia-Almería province two main plant communities appear, one non-nitrophilous (Limonio cossoniani-Lycietum intricati), dominated by *Crithmum maritimum, Helichrysum stoechas* subsp. *caespitosum, Limonium cossonianum* and *Pallenis maritima*, and the other ornithocoprophilous, on cliffs where gulls and other seabirds nest (Withanio frutescentis-Lycietum intricati), dominated by *Lycium intricatum, Salsola oppositifolia* and *Withania frutescens.* Maritime cliffs are best developed, from North to South, in the Sierra Helada (Benidorm, Alicante), the coast between the capes of Palos and Tiñoso (Cartagena) and between Carboneras and Cabo de Gata (Almería).

5.5.3 Saltmarshes

The Murcia-Almería province has large tracts of saltmarshes, both in coastal and in inland areas (salt plains and wadis on marls). A typical and complete zonation of saltmarshes includes up to five different belts of plant communities from the humid to the dry salty soils (Fig. 5.9).

The lower part of the saltmarsh, under permanent inundation, is occupied by communities of rushes (*Juncus maritimus*) of the association Elymo elongati-Juncetum maritimi. The next step in the saltmarsh is occupied by communities of *Sarcocornia perennis* subsp. *alpini* (Sarcocornietum alpini), being under submersion with salty water from autumn to winter; in the same biotopes the annual community Salicornietum emerici is also found. The next step in the halophilous geosigmetum is occupied by the Cistancho phelypaeae-Arthrocnemetum fruticosi, a dense community dominated by the nanophanerophyte *Sarcocornia lagascae*, and in open stands by the annual association of the Suaedo spicatae-Salicornietum patulae. The next higher community along the elevational gradient can be the Frankenio corymbosae-Arthrocnemetum macrostachyi on loamy soils, a plant community dominated by *Arthrocnemum macrostachyum,* or, on sandy soils, by *Halocnemum strobilaceum* (Frankenio corymbosae-Halocnemetum strobilacei). The transition between the humid saltmarsh and the dry one is the habitat of an association dominated by *Suaeda vera* (Cistancho phelypaeae-Suaedetum verae).

The outer part of the saltmarshes is not affected by submersion with salty water. These areas are colonized by communities of *Lygeum spartum* and/or species of the genus *Limonium* (*Limonium angustebracteatum, Limonium caesium, Limonium cossonianum, Limonium delicatulum, Limonium furfuraceum, Limonium insigne, Limonium parvibracteatum, Limonium santapolense, Limonium supinum, Limonium tabernense,* etc.). The six associations of this belt in saltmarshes are included in the alliance Lygeo sparti-Limonion furfuracei that is almost endemic to the Murcia-Almería

Fig. 5.9 Saltmarsh vegetation is common in the lower parts of valleys, on dry soils (*right side* of the picture, with the Limonio caesio-Lygeetum sparti) and on wet soils (*center* of the picture, with the Cistancho phelypaeae-Arthrocnemetum fruticosi). El Ajauque, Fortuna (Murcia)

province. Finally, on the deeper saltmarsh soils, there are stands of tamarisk (Inulo crithmoidis-Tamaricetum boveanae).

Nowadays, the best preserved saltmarshes are located at El Alted and Santa Pola (Alicante), San Pedro del Pinatar, Calblanque, Águilas and Fortuna (Murcia), and at Vera and to West of Cabo de Gata (Almería).

5.6 Rupicolous Vegetation

Most of the rocky places of the Murcia-Almería province are composed of limestone or dolomite, and host many endemic plants. Settling into deep fissures that give access to large pockets of soil permits establishing an open vegetation composed of large shrubs, some sclerophyllous and others brooms, of the class Quercetea ilicis (Table 5.7, rows 1–4). On rocky slopes with protruding ledges having still some soil, the *cerrillar* grassland, dominated by *Hyparrhenia sinaica* (Table 5.7, row 5), covers significant areas being a very important association of the rocky landscapes (Lygeo-Stipetea).

Table 5.7 Main rupicolous associations of the Murcia-Almería province

Association or plant community	Biogeography	Habitat	Bioclimatic belt
Rhamno hispanori-Periplocetum angustifoliae	South Murcia	Big earth bags	Inframediterranean
Chamaeropo humilis-Juniperetum phoeniceae	Alicante, East Almería	Big earth bags	Thermomediterranean
Asparago horridi-Genistetum retamoidis	North Murcia, Cabo de Gata, West Almería	Big earth bags	Thermomediterranean and Lower Mesomediterranean
Phlomidi almeriensis-Ulicetum canescentis	Cabo de Gata, shady places	Big earth bags, volcanic acid	Thermomediterranean semiarid
Aristido coerulescentis-Hyparrhenietum pubescentis	Murcia-Almería	Grassland on rocky places	Infra-thermomediterranean Lower Mesomediterranean Arid-Semiarid
Rhamno borgiae-Teucrietum rivasii	Alicante, South Murcia	Chasmophytic, on more or less vertical cliffs	Thermomediterranean Lower-Mesomediterranean Semiarid-Dry
Sideritido glaucae-Centaureetum saxicolae	South Murcia (Eastern Part)	Chasmophytic, on more or less vertical cliffs	Infra-Thermomediterranean Semiarid
Cosentinio bivalentis-Teucrietum freynii	East Almería	Chasmophytic, on more or less vertical cliffs	Infra-Thermomediterranean Semiarid
Galio ephedroidis-Phagnaletum saxatilis	West Almería, Cabo de Gata	Chasmophytic, on more or less vertical cliffs	Infra-Thermomediterranean Semiarid
Lafuenteo rotundifoliae-Centaureetum saxicolae	Murcia-Almería	Chasmophytic, on overhanging rock crevices	Infra-Thermomediterranean Lower Mesomediterranean Arid-Semiarid
Lapiedro martinezii-Cosentinietum bivalentis	Murcia-Almería	Chasmocomophytic, on sunny pavements and vertical cliffs with wide cracks	Infra-Thermomediterranean Lower Mesomediterranean Arid-Semiarid
Sedetum micrantho-sediformis	Murcia-Almería	Chomophytic	Infra-Thermomediterranean Lower Mesomediterranean Arid-Semiarid
Parietarietum judaicae	Murcia-Almería	Chasmophytic, on nitrified dry walls	Infra-Thermomediterranean Lower Mesomediterranean Arid-Semiarid
Cymbalarietum muralis	Murcia-Almería	Chasmophytic, on nitrified shaded walls.	Infra-Thermomediterranean Lower Mesomediterranean Arid-Semiarid

The chasmophytic (growing in fissures in rocks) vegetation on pavements is dominated by *Satureja obovata* subsp. *canescens, Hypericum ericoides* and *Dianthus broteroi* subsp. *valentinus*, characteristic taxa of the Saturejo canescentis-Cistetum albidi association (Table 5.3, row 1, Anthyllidetalia terniflorae). More diversified is the chasmophytic vegetation inhabiting narrow fissures in more or less vertical cliffs, with several associations of biogeographical importance (Table 5.7, rows 6–9). Crevices of the overhanging cliffs and the ceiling of some small caves are inhabited by the *Centaureo saxicolae-Lafuenteetum rotundifoliae* association, characterized by the remarkable Murcia-Almería endemic *Lafuentea rotundifolia* (Table 5.7, row 10). The chasmochomophytic vegetation in earth-accumulating, wide cracks is characterized by *Lapiedra martinezii* and the fern *Cheilanthes vellea* (Lapiedro martinezii-Cosentinietum velleae), a species capable of drying up almost completely under long and deep drought and reviving in a few minutes after a shower (poikilohydrous species) (Table 5.7, row 11). The chomophytic vegetation, rooted in soil resting on rocks slightly inclined, is represented by the Sedetum micrantho-sediformis association, dominated by succulent-leaved plants (Table 5.7, row 12). The chasmophytic vegetation of nitrified walls, mostly in areas under noteworthy human influence, is represented by the Parietarietum judaicae on dry walls, while on shady and moister walls the characteristic associations is the Cymbalarietum muralis (Table 5.7, rows 13–14).

5.7 Riparian Vegetation

There is only one true river in the area, the Segura, that traverses the Murcia-Almería province between Calasparra (Murcia) and Guardamar del Segura (Alicante). On the river banks and the fluvial terraces surrounding the Segura, there are a few remains of its riparian vegetation, which is more related to that of the North African rivers than to the European ones (Alcaraz et al. 1997). However there are many temporary streams and creeks, locally called *ramblas,* where the vegetation is rich in bushes and thickets of the Nerio-Tamaricetea class.

As highlighted by Alcaraz et al. (1997), Murcia-Almería riparian forests and shrublands belong, as in the Maghreb, to the Nerio-Tamaricetea class (Lonicero biflorae-Populetum albae), not to the Querco-Fagetea. Another African characteristic is the absence of willow groves in the first riparian vegetation zone. From the river's edge the following sequence of plant communities can be found: helophytic reedbeds (Typho-Schoenoplectetum tabernaemontani) and the poplar riparian forest (Lonicero biflorae-Populetum albae; Fig. 5.10). Other seral communities are those of rush (Holoschoenetum vulgaris), evergreen grasslands (Brachypodietum phoenicoidis), tamarisk groves (Saccharo ravennae-Tamaricetum canariensis; Fig. 5.10) and brambles with honeysuckle (Rubo ulmifolii-Loniceretum biflorae).

In the widespread ephemeral watercourses (*ramblas*), the vegetation varies greatly depending on the characteristics of the substrate and the degree of permanence of running water. The most common woody species are tamarisks (*Tamarix*

Fig. 5.10 The riparian forests of the arid Southeast belong to the Nerio-Tamaricetea (Lonicero biflorae-Populetum albae). In the picture there are also woodlands of tamarisks (Saccharo ravennae-Tamaricetum canariensis) and palm trees (*Phoenix dactylifera*), introduced by man, contribute to accentuate the similarities with North African landscapes. (Río Segura, Archena, Murcia)

canariensis, Tamarix africana), on loamy and clay soils (Saccharo ravennae-Tamaricetum canariensis), which can be subsaline (Agrostio stoloniferae-Tamaricetum canariensis subass. suaedetosum verae) or saline (Inulo crithmoidis-Tamaricetum boveanae). There are also oleander- (*Nerium oleander*-) dominated shrublands, which can develop on gravelly (Zizipho loti-Nerietum oleandri) or stony to rocky soils (Rubio longifoliae-Nerietum oleandri). When in full bloom the oleanders fill the *ramblas* with color, standing out conspicuously in the arid landscape. Also the occurrence of scattered populations of the Iberian palm (*Phoenix iberica*) in clayey, subsalty ramblas is remarkable; it gives them a truly African appearance.

5.8 Nitrophilous Vegetation

Nitrophilous bushes are another outstanding feature of the Murcia-Almería province, with a good number of associations belonging to the Haloxylo-Atriplicion alliance, on dry soils, and almost exclusive to the area, as well as some other bushes of the subhalophilous alliance Salsolo oppositifoliae-Suaedion fruticosae.

The Haloxylo-Atriplicion associations encroach on abandoned fields, and at crop and roads margins and other disturbed areas in which soil hydromorphy is absent. The best characteristic species in the Murcia-Almería province are *Artemisia barrelieri, Artemisia lucentica, Atriplex glauca, Capparis sicula* subsp. *sicula, Capparis zohary, Haloxylon salicornicum* (= *Hammada articulata*), *Launaea arborescens, Salsola vermiculata* and *Salsola genistoides.* The *Salsolo oppositifoliae-Suaedion fruticosae* associations also settle in disturbed areas but on soils with some hydromorphy and salinity. The main species in the Murcia-Almería area are *Atriplex halimus, Lycium intricatum, Salsola oppositifolia, Suaeda pruinosa, Suaeda vera* and *Withania frutescens.*

5.9 Human Influence

The landscape of the Murcia-Almería area is quite impressive because of the degradation and erosion observed everywhere as a result of a long human pressure throughout history, combined with a weak recovery capability of the aridity-adapted natural vegetation (Alcaraz et al. 1989, 1991; Alcaraz and Peinado 1987; Peinado et al. 1992).

The green color of the irrigated valley bottoms contrasts strongly with the arid appearance of the surrounding landscape. Mountains, slopes and plains above the floodplain of the Segura river are characterized by their ocher color and their sparse vegetation cover, which is still submitted to the pressure of sheep and goat husbandry, leaving a high proportion of the soil uncovered.

Arboreal and herbaceous crops are very important in all the areas irrigated by the waters of the Segura river, being part of the irrigation water brought in from the Tagus river. Some of the areas are prosperous, as those with the citric trees (oranges and, especially, lemons) while others, such as those with figs and mulberries, are declining although they were relevant in the past until not to so long ago. When salinity increases, some crops, such as barley, cotton, sweet pepper, tomato and even pomegranate, can still be cultivated. Along the fences and borders of the properties, palm trees grow successfully (Alcaraz 1991). Nowadays a prosperous agriculture with irrigation has developed under favorable climatic conditions, with an almost total absence of frost, with up to four yields per year: artichoke, broccoli, cauliflower, celery, cucumber, eggplant, endive, lettuce, melon, sweet pepper, spinach, tomato, watermelon, zucchini, etc. Some of these cultures are grown in plastic greenhouses. However, although intensive agriculture is widespread and dominant, in recent years organic farming is increasing in extent and recovering traditional varieties of arboreal and herbaceous crops.

With regard to cattle, goats and sheep are often grazing in the fields, after harvesting, as well as on the hills, while numerous pigs are raised in barns. Some native

livestock breeds are being recovered, such as pigs (chato murciano), goats (cabra murciano-granadina), sheep (oveja segureña) or chicken (gallo murciano).

Forestry in the Murcia-Almería area focuses on protecting soil from erosion and desertification, rather than timber production, due to the slow growth of trees.

The effects of the mining industry, today in clear decline, are evident in the coastal areas of Cartagena, Mazarrón (Murcia) and Rodalquilar (Almería). The minerals of this area (iron, zinc, lead, gold and silver) attracted many people since antiquity: Phoenicians, Greeks, Carthaginians, Romans. The regeneration of these zones remains a task for the future.

Coastal tourism is highly developed in the area, especially on the eastern (Alicante) and the western coasts (Almería), and it is an important resource for the economy of the Murcia-Almería area. But as a result, so many coastal areas are showing a very disturbed vegetation.

5.10 Vegetation Series

According to the previous sections, there are 12 climatophilous sigmeta that occur in the arid southeast:

1. Mayteno europaei-Periploco angustifoliae sigmetum
2. Zizipho loti sigmetum
3. Gymnosporio europaei-Zizipho loti sigmetum
4. Chamaeropo humlis-Rhamno lycioidis sigmetum
5. Rhamno lycioidis-Genisto murcicae sigmetum
6. Thymelaeo valentinae-Genisto ramosissimae sigmetum
7. Rubio longifoliae-Querco rotundifoliae sigmetum
8. Myrto communis-Querco rotundifoliae sigmetum
9. Querco cocciferae-Pino halepensis sigmetum
10. Asparago acutifolii-Querco rotundifoliae sigmetum
11. Paeonio coriaceae-Querco rotundifoliae sigmetum
12. Adenocarpo decorticantis-Querco rotundifoliae sigmetum

Maquis and brooms communities, with more or less scattered pine trees (*Pinus halepensis*), represent the potential vegetation for most of the Murcia-Almería province (Table 5.8, sigmeta 1–6 and 9), extensively replaced by scrublands (tomillares) and perennial grasslands (esparto grass), which are the most abundant types of vegetation as a result of prolonged human action in the territory. Of particular importance for its richness of endemic plants are the gypsicolous thyme-brushwoods, of the Order Gypsophiletalia.

In the open areas between the scrublands and grasslands appear, from autumn to spring, annual grasslands of North African origin (Stipion capensis) or, on gypsum soils, Spanish endemic gypsicolous annual grasslands (Sedo-Ctenopsion gypsophilae).

In the few mountains over 700 m (Carrascoy, Almenara, Cabrera and Alhamilla mountains) some habitats can be located in the dry ombroclimate, with a potential vegetation of oak forest (Table 5.8, sigmeta 10–12); but there are also thermomediterranean areas with oak forest potential in places protected from strong insolation due to their orientation to the North (Table 5.8, sigmeta 7 and 8).

The main associations and alliances of each sigmetum are detailed in Table 5.8.

Table 5.8 Main associations and alliances of the Murcia-Almería province climatophilous sigmeta

Sigmeta	1	2	3	4	5	6	7	8	9	10	11	12
Forests, woodlands and mantel												
Mayteno europaei-Periplocetum angustifoliae	■											
Ziziphetum loti		■										
Gymnosporio europaei-Ziziphetum loti			■									
Chamaeropo humilis-Rhamnetum lycioidis				■								
Rhamno lycioidis-Genistetum murcicae					■							
Thymelaeo valentinae-Genistetum ramosissimae						■						
Rubio longifoliae-Quercetum rotundifoliae							■					
Myrto communis-Quercetum rotundifoliae								■				
Querco cocciferae-Pinetum halepensis									■			
Asparago horridi-Quercetum rotundifoliae										■		
Paeonio coriaceae-Quercetum rotundifoliae											■	
Adenocarpo decorticantis-Quercetum rotundifoliae												■
Scrub												
Thymo moroderi-Sideritidion leucanthae	■	■	■	■	■	■	■	■				

(continued)

Table 5.8 (continued)

Sigmeta	1	2	3	4	5	6	7	8	9	10	11	12
Forests, woodlands and mantel												
Sideritidion bourgeanae									■			
Anthyllido-Salsolion papillosae	■		■	■								
Lavandulo lanatae-Genistion boissierii										■	■	
Gypsophiletalia				■	■	■						
Thymo gracilis-Cistetum ladaniferi												■
Grassland												
Lapiedro martinezii-Stipetum tenacissimae	■	■	■	■	■	■	■	■	■			
Dactylido hispanicae-Lygeetum sparti												
Daphno hispanicae-Festucetum capillifoliae										■		
Dactylido hispanicae-Festucetum scariosae											■	■
Teucrio pseudochamaepityos-Brachypodietum ramosi	■	■	■	■	■	■	■	■	■	■	■	■
Stipion retortae	■	■	■	■	■	■	■	■	■			
Sedo-Ctenopsion gypsophilae				■	■	■						
Trachynion distachyae										■	■	■

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