

Plant Formations in the Adriatic BioProvince

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Adriatic Megacliff Formations

This is a province of gigantic cliffs the largest of which occur along the Velebit channel in the northeastern Adriatic. These huge cliffs can reach heights of 1200 m, while the adjacent cliffed islands of Krk, Pag and Rab have escarpments up to 460 m. But these are far from being straight up and down and have ledges ranging from a few square metres to several hectares many of which have retained their natural vegetation due to their inaccessibility. Some of the best examples of these isolated shelves can be found on the escarpments of the Velebit and Biokovo mountains, the Konavli coast, the Boka canyon, and on the islands of Svetac, Krk and the Senj archipelago. In the northeast, the maritime vascular plant assemblages of exposed windswept cliffs form three main vegetation belts. A lower hygrohaline belts, regularly sprayed by surf - a middle much dryer (xerohaline) belt - and an upper subhaline belt only affected by the strongest aerosaline hurricanes. The lower belt is characterised by a succulent rock scrub comprising a canopy of endemic taxa such as *Astragalus curictanus*, *A. dalmaticus*, *A. uraganicus*, *Melilotus turbulentus* (Fabaceae), *Aurinia media* (Brassicaceae), *Centaurea procellaria* (Asteraceae), *Silene microloba* (Caryophyllaceae), and an under story also largely composed of endemic taxa such as *Allium horvattii* (Liliaceae), *Asperula dalmatica* (Rubiaceae), *Corydalis acaulis* (Fumariaceae) and *Limonium antractum* (Plumbaginaceae). In the open windswept middle belt herbaceous elements like *Crithmum maritimum*, *Iris cengialtii* subsp. *illyrica*, *Euphorbia epithymoides*, *Limonium cancellatum* and the endemic taxa *Campanula fenestrellata* subsp. *istriaca* (Campanulaceae) and *Centaurea dalmatica* (Asteraceae), while the upper belt comprises a semi-evergreen scrub. Here endemic or near endemic taxa include *Anthyllis montana* subsp. *atropurpurea* (Fabaceae), *Campanula subalpine* (Campanulaceae), *Cyathoselinum tomentosum* (Apiaceae), *Dianthus sylvestris* subsp. *nodosus* (Caryophyllaceae), *Iris rothschildii* (Iridaceae), *Micromeria kernerii* (Lamiaceae), *Onosma croatica* (Boraginaceae) and *Sedum dinaricum* (Crassulaceae). Other formations include 'guano' vegetation dominated by tall columnar nitrophilous forbs such as the endemic *Peucedanum pachyphyllum* and *Seseli varium* subsp. *promonense* (Apiaceae), and shady cave communities with the endemic moss *Barbula adriatica*, the endemic fern *Adiantum capillus-veneris* subsp. *visianii* (Adiantaceae) and the endemic flowering plants *Campanula fenestrellata* subsp. *debarensis* (Campanulaceae) and *Centaurea dalmatica* subsp. *rabensis* (Asteraceae). In the southeastern Adriatic on the Konavli coast of southern Dalmatia another stretch of megacliffs can be found reaching heights of up to 1050 m. Here a different assemblage of species occur, but can still be divided into a lower, middle and upper belt. In the lower zone up to about 70 m an unusual candelabriform rock scrub with rosette tuft-treelets has developed growing up to about 3 m tall. The canopy includes *Cephalaria mediterranea*, *Coronilla valentina* subsp. *glauca* and the endemic *Cyathoselinum palmoides* (Apiaceae), while sub-canopy species typically comprise *Allium cornutum*, *Cheilanthes perisica* and the three endemic species *Centaurea adriatica* (Asteraceae), *Iris dalmatica* (Iridaceae) and *Limonium japygicum* (Plumbaginaceae). This gives way to an evergreen rock scrub in the middle zone with taxa such as *Lavandula latifolia*, *Phlomis fruticosa*, *Putoria calabrica* and the endemic *Brassica incana* subsp. *mollis* (Brassicaceae). The upper belt above about 350 m is semi-evergreen rock scrub up to 1 m tall. It is usually dominated by *Moltkia petraea* and *Potentilla speciosa*, but also includes endemic or near endemic taxa such as *Campanula pocharskyana*, *Edraianthus baldaccii* (Campanulaceae), *Centaurea incompta* (Asteraceae), *Dianthus sanguineus*, *Heliosperma tommesinii*, *Petrorhagia illyrica* (Caryophyllaceae) and *Scabiosa leucophylla* (Dipsacaceae).

Adriatic Mobile Coastal Scree Slopes

These structures are found on many of the oblique coastal slopes and as with mega cliffs, the vascular plant vegetation can be broadly divided into three belts: lower ultrasaline scree (up to 120 m), middle xerosaline scree (between 120-300 m) and upper sub saline scree (between 300-700 m). The lower belt, which tends to be covered with salt crust from aerosaline storms, supports a halophytic, succulent community characterized by species such as *Atriplex prostrata*, *Centaureum pulchellum* subsp. *meyeri*, *Daucus carota* subsp. *hispanicus*, *Salsola kali* subsp. *pontica*, *Suaeda maritima* subsp. *sola* and the endemic taxa *Limonium visianii* (Plumbaginaceae), *Microrhinum litorale* (Scrophulariaceae) and *Senecio fluminensis* (Asteraceae). The middle belt is usually powdered by salt crystals and supports a xerohalophytic, echinate, cushion community of *Drypis spinosa*, *Echium pustulatum*, *Sedum brevifolium* and the endemic taxa *Centaurea rossiana* (Asteraceae), *Cerinthe tristis* subsp. *smithiae* (Boraginaceae) and *Vincetoxicum croaticum* (Asclepiadaceae). The upper belt, only reached by occasional salt spray, comprises a xeric echinate cushion community with taxa such as *Aethionema thomasianum*, *Centaurea rupestris* subsp. *ceratophylla*, *Genista michelii*, *Satureja karstiana* and the endemic or near endemic *Edraianthus graminifolius* subsp. *carcinus* (Campanulaceae).

Adriatic Karstic Rock Fields

These occur sporadically along the entire eastern coast of the Adriatic on flat calcareous coastlands and adjacent skerry islands. In the northeast, such as the Senj archipelago, the dominant vegetation comprises a kind of semi-woody phrygana up to 70 cm in height. The characteristic species include *Artemisia alba*, *Asphodelus aestivus*, *Camphorosma monspeliaca*, *Colchicum kochii*, *Helichrysum italicum*, *Teucrium capitatum* and the endemic or near endemic *Centaurea hutteri* (Asteraceae), *Dianthus ciliatus* (Caryophyllaceae) and *Festuca lapidosa* (Poaceae). However, on some of the offshore skerries where seabird 'guano' has accumulated a nitrohalophytic grassland has developed with endemic taxa such as *Carduus nutans* subsp. *micropterus* (Asteraceae) and *Euphorbia eufragifera* (Euphorbiaceae). Further south in Dalmatia, a summer-deciduous scrub up to 2 m tall dominates karstic rock fields. *Artemisia arborescens* and *Obione graeca* dominated the canopy, together with various other species such as the endemic *Convolvulus tartonaira* (Convolvulaceae), while the under story is dominated by endemics like *Centaurea fridericii* (Asteraceae), *Muscari speciosum* (Liliaceae) and *Ornithogalum visianicum* (Liliaceae). Moving even further south to the Efafiti archipelago near Dubrovnik the vegetation includes a summer-deciduous pulvinate thorn scrub of *Calycotome villosa* and *Erica manipuliflora*. Other species here include *Coronilla valentina* and the endemic *Crocus dalmaticus* (Iridaceae).

Adriatic Coastal Dunes

Dunes in this province include red dunes (sometimes call *sif*-dunes) in the northeast composed of calcareous-ferruginous sand, and more typical siliceous dunes in the southeast. Only the latter have the more typical zoning of Mediterranean psammophytes. Red dunes, such as those at Zarauk near Baska have fringing orange foredunes dominated by *Arundo pliniana* and *Petasites spurius*. Other species include *Centaureum erythraea* subsp. *rhodense*, *Cichorium pumilum*, *Elymus elongatus*, *Equisetum ramossissimum* subsp. *campanulatum* and *Juncus littoralis*. Moving inland there is a series of ridges separated by dune slacks. Characteristic slack species include *Aster liburnicus*, *Centaurea vinyalsii* subsp. *approximata*, *Epipactis palustris*, *Molinia caerulea* and several mosses, but the intervening ridges or crests support an exclusively endemic psammophytic community dominated by the endemic species *Edraianthus pichleri* (Campanulaceae) and *Leucanthemum platylepis* (Asteraceae). Other common endemic

taxa include *Allium visianii* (Liliaceae), *Alyssum pagense* (Brassicaceae), *Artemisia biasoletiana* (Asteraceae) and *Iris marchesettii* (Iridaceae). Beyond the ridges a sandy plain of fixed brown dunes may be present. Here the characteristic plants include *Bromus condensatus* and endemic taxa like *Stachys recta* subsp. *subcrenata* (Lamiaceae), but moving further inland this gives way to dune scrub with *Vitex agnus-castus* and the endemic *Tamarix dalmatica* (Tamaricaceae). Siliceous dunes in the south, such as those on the Mljet Islands, are typical of other Mediterranean dunes, but also include natural dune pinewoods in their hinterlands. These support a rich flora dominated by *Pinus pinea* and *Myrtus communis* subsp. *tarentina*, while among the many field layer species are endemics such as *Lupinus lacromensis* (Fabaceae).

Adriatic *Juniperus phoenicea* Macchia

On many Adriatic islands, such as Hvar, Lopod, Mljet, Murter, Unije and Veliki, there is a macchia belt between the coastal halophytic vegetation and the coastal forest of holm oak or aleppo pine. It is typically dominated by *Juniperus phoenicea* and *Pistacia lentiscus* and seems to be a successional stage in the development of evergreen forest. This is borne out by the fact that it develops in the wake of man on abandoned pasture, olive groves and vineyards. Associated species include *Allium subhirsutum*, *Asparagus acutifolius*, *Cistus salviifolius*, *Ephedra fragilis*, *Galium corrudifolium*, *Juniperus oxycedrus*, *Myrtus communis*, *Rhamnus alaternus* and several endemic taxa such as *Rhamnus intermedium* (Rhamnaceae), *Sesleria autumnalis* (Poaceae) and *Tanacetum cinerariifolium* (Asteraceae).

Adriatic Coastal Forests

In the upper most coastal zones, rich sub Mediterranean forests have developed dominated by endemic taxa. These include pine forests dominated by the endemic *Pinus nigra* subsp. *croatica* (Pinaceae). Other trees include *Acer opalus* and *Quercus dalechampii*, but the dendroflora can include up to 56 species of trees and shrubs. The field layer includes endemic or near endemic taxa such as *Centaurea diversicolor*, *Hieracium vratnikense* (Asteraceae) and *Viola vilaensis* (Violaceae). On the cliff tops and uppermost shelves sub-mediterranean fir-forests predominate. These are characterized by the endemic *Abies pardei* (Pinaceae), while other common dendroflora include *Acer carpinifolia* and *Ostrya carpinifolia*, but with 62 different species of trees and shrubs these represent the richest forests in Europe. Among the many endemic or near endemic taxa are shrubs such as *Lonicera alschingeri* (Caprifoliaceae), *Petteria alschingeri* (Caesalpiniaceae), *Sorbus baldaccii* (Rosaceae) and the herbaceous species *Aconitum adriaticum* (Ranunculaceae).

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