

## Bioclimate diversity and vegetation belts in Adriatic Archipelago

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**RÉSUMÉ:** Diversité bioclimatique et zones végétales de l'Archipel adriatique. Les climats insulaires adriatiques sont bien contrastés à minimums thermiques variant de +6° à -18°C, à précipitations moyennes de 150mm jusqu'à 1350mm et sécheresse durant 0 à 10 mois. C'est corrélé à 5 zones végétales: inframéditerranéenne à *Thymelaeion* des îles méridionales, puis thermoméditerranéenne à *Oleo-Cerastion*, euméditerranéenne à *Quercion ilicis*, subméditerranéenne à *Carpinetum orientalis* des îles septentrionales et supraméditerranéenne à *Seslerio-Ostryetum* des monts insulaires.

**INTRODUCTION.** Up to recently, the classical phytogeographical schemes presented the zonal vegetation of Adriatic Archipelago after its geographical position, but neglecting its bioclimates. Thus all islands, except the northernmost ones, presented an ideal homogeneous zone of eumediterranean evergreen climex *Orno-Quercetum ilicis*. The subsequent detailed bioclimatic stress of this big zone by BERTOVIĆ (1975) resulted by its considerable climatic diversity.

Climate zoning in Adriatic islands (data computed from KIRIGIN 1971)

Belts: SUBMEDITERRANEAN	EUMEDITER.	THERMOMEDITER.	INFRAMEDITER.
<b>TEMPERATURES</b>			
Winter XII-II	5.8-7.9°C	7.1-9.5°C	9.2-9.9°C
Absol. minime	-10.8 to -18°	-5.0 to -7.2°	-4.3 to -6.6°
Year amplitude	above 47.8°	41.5°-46.6°	38.5°-44.3°
Frosts in year	above 20 days	3 - 25 days	1 - 15 days
Possible frost	4 - 7 months	2 - 5 months	1 - 3 months
<b>PRECIPITATION</b>			
Year means	1057-1344mm	883-1209mm	566 - 702mm
Rainy days	above 105 d.	96 - 116 d.	93 - 107 d.
Summer rains	162-215 mm	78 - 179mm	50 - 87 mm
Dryness period	0 - 1 month	1-3 months	3-5 months
Snowy days	3 - 6 days	1 - 3 days	1 - 2 days
<b>EMBERGER'S</b>			
p/t quotient	122 to 213	100 to 170	87 to 159
LANG'S yearly rain factor	69-98mm/°C	63-89mm/°C	43-55mm/°C

**RESULTS.** The above confrontation of the long-term climatological data in 16 insular meteorological stations well discredited the ancient unique climex scheme. The recent detailed vegetation mapping in the field resulted by another complex zonation parallel to this bioclimate diversity, including even 5 different belts marked by specific zonal climaxes. Despite the marginal northern position of this archipelago (43-45°N) in relation to the Mediterranean, its zoning is more xerothermic than expectable one. Thus the Mediterranean zoning there reaches its northernmost limits, although in the same latitudes of NE Italy and E Balkans a temperate deciduous vegetation widely predominates.

1. Coolest supramediterranean belt is the wettest one in islands, with regular frosts and some snow. Its climax of major insular mounts are the temperate submontane woods of *Seslerio-Ostryetum carpinifoliae* Horv. & Hic. It includes the peaks of Cres, Lošinj, Krk, Brač, Hvar and Pelješac.

2. Cool submediterranean belt is marked by less frost and some dryness, and by a summergreen climex of xeric woods *Quercio-Carpinetum orientalis* Hic. It includes the lowlands of NE interior isles Cres, Krk, Pag and the high plateau of Brač.

3. Eumediterranean (mesomediterranean) belt is warmer than the precedent ones, with rare frost and more dryness. It is marked in Adriatic by semievergreen climex woods of the *Orno-Quercetum ilicis* Hic., including also some temperate deciduous ones. It covers many intermediate Adriatic islands, except the northern and southern ones.

4. Warm thermomediterranean belt is marked by very rare and mild frost and few rains, and by the evergreen climex meso-issues of *Oleo-Cerastion* Br.-Bl. including *Cerastion*, *Myrtus*, *resium*, *Pistacia lentiscus*, *Phillyrea angustifolia*, *Pinus halepensis*, *Juniperus phoenicea* etc. It covers the external isles Iafiti, Vis, Lestovo, Peklani, Šolta, Kornati, Premuda, Unije etc.

5. Warmest inframediterranean (xeromediterranean) belt is marked by hot-dry subtropic climate, any frost nor snow, a long dryness, and by the summer-deciduous (wintergreen) scrubs of *Thymelaeion hirsutae* Tadr. of ultra-xerothermic Sindo-Seherian type (Euphorbia dendroidea, Artemisia arborescens, Juniperus lycia, cium intricatum, Capparis sicula, Sueda pruinosa etc). It covers a remote Mid-Adriatic isles Jabuka, Sušac, Pelegruža, Lestovci etc.

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## Synecology of forest lichens and bryophytes in Adriatic Islands

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**RESUME:** Synecologie des lichens et bryophytes silvatiques des îles adriatiques. La microvégétation lichénique des îles adriatiques est très diversifiée, présentant de nombreuses communautés pétricoles et arboricoles à plusieurs taxons endémiques. La végétation muscinale y est plus pauvre et bien développée seulement sur le sol des forêts. Les alliances lichéniques épiphytes sont *Xanthoria parietinae* des arbres méditerranéens et *Lecanorion subfuscae* de ceux subméditerranéens.

**INTRODUCTION.** The cliffs and forests of Adriatic islands include an interesting microvegetation of lichens and bryophytes, so far few known phytocenologically, and never correlated to well defined forest phytocenoses, except the lichen communities of Adriatic insular cliffs precised by LOVRIC (1981). Due to the predominating peculiar habitats of calcareous karst, and to the frequent stormy winds, the cryptogamic microvegetation of Yugoslav coasts and islands has a rather deviating composition. The bryocenoses there are poorer in comparison with other surrounding countries, but the lichen vegetation there is probably the richest one within the Europe, concerning especially the considerable lichen endemism. The insular forests present an interesting distribution model of this microvegetation: the bryophytes predominate only in the forest soil and sometimes in the very bases of trunks. Otherwise on the tree bark the lichen vegetation widely predominates, and the bryophytes there are often absent, or rare and subordinated within the arboreal lichenocenoses. Only in the wet laureisilvae (*Arbuto-Quercetum ballotae*) of SE islands, occur also the well developed epiphytic bryophytes on the trees. A comparable distribution model occurs also in insular cliffs where the bryophytes are nearly lacking or are subordinated within the luxuriant lichens. Both anomalies are probably provoked by the strong and frequent aerosaline storms across the Adriatic Archipelago (Bora, Sirocco, etc.) that prevent the development and expansion of the generally hygrophilic bryophytes on trees and open cliffs. Thus they are successful only in the sheltered and shaded forest soils, and in caves and ravines. The used nomenclature of lichens is after KUŠAN (1953) and this one of bryophytes after PAVLETIC (1955).

**RESULTS:** Characteristic bryophytes in insular forest soil. The mediterranean evergreen forests and maquis (*Quercetalia ilicis* Br.-Bl.) across the Adriatic islands are marked by the next collective soil bryophytes: *Riccia spec. div.*, *Bryum caesiense* Brid., *Cephalozella baumgarteni* Schif., *Cololejeunea rossettiana* (Mass.) Schif., *Sphaerocarpos texanus* Aust. and *Grimmia anodon* Br. eur. The ascertaining forest communities include also other specific indicating bryophytes as follows.

1. *Arbuto-andrachnes-Quercetum ballotae* Lov., the laurissilvae of SE Adriatic ravines and karst sinkholes: *Gongylanthus excrucior* (Raddi) Nees, *Grimmia sarodes* De Not., *Fossombronina lottiesbergeri* Schif., *Riccia reddiana* Lev. & Jack. and *R. levierei* Schif.

2. *Pico-Quercetum dalmaticae* Lov., the relict semisemipervient premaquis of sinkholes and ravines in northern islands: *Fabronia sendtneri* Schpr., *Fossombronina husenotii* Corb. and *Cololejeunea minutissima* (Sm.) Spr.

3. *Alaterno-myrtifoliae-Fraxinetum argentense* Lov., the stormy rockwoods in coastal escarpments of NE islands: *Grimaldia dichotoma* Raddi, *Lunularia cruciata* (L.) Dum. and *Fossombronina echinata* Masv.

4. *Myrto-Pistacietum lentisci* (Hic.) R. Mart., the lower and drier sclerophyllic maquis widespread along the shores of Dalmatian islands: *Southbya nigrella* (Not.) Spr., *Riccia michelii* Raddi and *R. nigrella* DC.

5. *Myrto-tarentinae-Pinetum pinense* (Anic) Lov., acidophilic pinewoods restricted to the flysch and dunes of SE Adriatic: *Weisia dalmatica* Letz., *Pottia illyrica* Letz. and *Cephalozella letzeliana* Schif.

The xeric deciduous woods (*Orno-Ostryetalia* Jak.) of the submediterranean belt in northern islands and insular mounts, include another group of the collective soil bryophytes: *Scapania aspera* Bern., *Fleurochaete squarrosa* (Brid.) Lindb., *Trichostomum brachyodontium* Bruch., *Scorpiurium circinnatum* (Brid.) Fleisch. and *Tortella tortuosa* (L.) Limp. One studied 3 related forests:

6. *Quercio pubescentis-Carpinetum orientalis* Hic., a zonal submediterranean climax in lowlands of northern islands: *Entodon schleicheri* (Br. eur.) Both., *Leptodon smithii* (Dicks) Mohr. and *Dicranum muehlenbeckii* Br. eur.

7. *Seslerio-Ostryetum carpinifoliae* Horv., the supramediterranean climax in major insular mounts: *Scapania calcicola* (Arn. & Pers.) Ingh., *Cololejeunea calcarea* (Lindb.) Spr. and *Tortella caespitosa* (Schw.) Limp.

8. *Castaneo-Quercetum pubescentis* (Anic) Lov., acidophilic submediterranean chestnut-woods in flysch of northern islands: *Pterogonium ornithopodioides* (Huds.) Lindb., *Fissidens taxifolius* (L.) Hedw. and *Hedwigia ciliata* Ehrh.

9. Out of both precedent groups are the pinewoods *Pinetum dalmaticae* Horv. (alliance *Orno-Pinion*) in the insular stormy peaks and rocky ridges: *Barbula adriatica* Baum., *Grimmia tergestina* Tomm., *Bryum torquescens* Br. eur., *Cheilanthes chloropus* Lindb.

The bark lichenocenoses on trees (*Lobarietalia* (Matt.) Bark.) include two groups. *Lecanorion subfuscae* Ochs occurs in the submediterranean trees of insular mounts, including the *Blastenietum viperae* Lov. in pines (*Pinetum dalmaticae*). *Blastenietum viperae* Zahl. and *Lecanora piniperda* Krb. *Xanthoria parietinae* (Ochs.) Klem. occurs in evergreen mediterranean trees with 3 lichenocenoses. *Parthocarpus-Bacidietum flumensis* Lov. occurs in N islands on *Pico-Quercetum*: *Bacidia flumensis* Zahl., *Pertusaria ficorum* Zahl. and moss *Cryphaea arbores* Lind. *Dirinor-Remalinetum dalmaticae* Lov. occur on maquis (*Myrto-Pistacietum*): *Remalina dalmatica* Zahl., *Dirina cerastionae* (Ach.) Fr., *Physcia rugosa* Zahl. and *Lecidea perexigua* Zahl. *Artothelium* as nov. occurs in Euphorbium dendroideis: *Artothelium adriaticum* Zahl.

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