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THE EPIPHYTIC LICHEN VEGETATION OF THE TRIESTE PROVINCE (NORTH EASTERN ITALY)

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Abstract
On the basis of a numerical classification of 85 phytosociological releves, 11 unions of epiphytic lichen vegetation are described for the Province of Trieste. Their ecology and dynamics are discussed. The results confirm the transitional character of the study area from the phytogeographical and phytosociological points of wiew.

Introduction

The knowledge of the lichen flora and vegetation in the Province of Trieste is rather poor and fragmentary. Previous lichenological papers regarding the study area are limited to a list of species collected by Tommasini and identified by Glowacki (1874), and scattered reports of a few species mentioned in monographical papers (Zahlbruckner, 1894, 1896, 1909; Redinger, 1937; Magnusson, 1935; Degelius, 1954). This situation reflects the generally very low standard of lichenological knowledge in Italy, particularly evident as far as lichen vegetation is concerned. A project for the study of lichen flora and vegetation in North Eastern Italy is under development at the Botanical Institute of the Trieste University: two papers concerning the Trieste area have already been published. The first (Nimis & De Faveri, 1981) is a revision of the epiphytic vegetation belonging to the *Xanthorion parietinae* in North Eastern Italy: three unions belonging to this foederatio are reported for the Trieste Province. The second (Nimis & Loi, 1982) contains a list of 121 epiphytic species from the Trieste Karst. The present paper presents the phytosociological description of the epiphytic lichen vegetation in the Province of Trieste.

Description of the study area

The study area is included within the political limits of the Province of Trieste. Its extension is about 160 Km^2. The elevation range goes from 0 to 680 m. The

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geomorphological system consists of a Karst Plateau with a steep scarp degrading towards the sea. The rocks are mainly limestones of the middle and upper Cretaceous. The lower margins of the plateau are sometimes covered by eocenic sandstones with neutral or weakly acid reaction.

The climate is transitional between the mediterranean and the continental climate types, with relatively strong differences between the coastal strip and the inner, more elevated portion of the area. Mean yearly precipitation in Trieste is 1079 mm, whereas on the Karst Plateau (Opicina), it is 1157 mm (Polli, 1961). Mean yearly temperature in Trieste is 14.1 C°, in Opicina 11.1°. The climatic diagram of Trieste (Fig. 1) shows a progressive increase in precipitations, with a maximum in Autumn. Noteworth is also the fact that the average lower temperature of the coldest month is never under 2.9 C°. The area is frequently subject to strong dry winds blowing from ENE (Bora); they are particularly frequent in winter, when the speed may reach up to 120 Km/h. A warm-humid wind blows from SW (Scirocco), normally bringing rainy wheather. The alternation of Bora and Scirocco characterizes the climatic conditions during winter. The prevailing action of the Bora-wind and the low water-holding capacity of the prevailing rock contribute to a low air humidity (average 65%, Poldini, 1980) throughout the year.

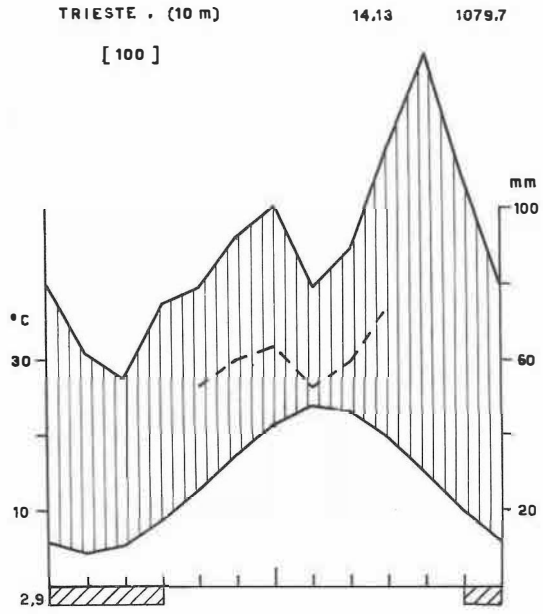

Fig. 1 — Climatic diagram of the town of Trieste.

The complex geomorphological situation is reflected in a corresponding variety of microclimates. Particularly important is the microclimate of the dolines. These are more or less circular depressions, with diameter varying from a few meters to 1 Km or more, and depth reaching (in the study area) 40 m. They are one of the most typical features of the Karst system, and originated as a consequence of the action of rain water on the underlying calcareous rock. The microclimate in the dolines differs from the prevailing climate on the Karst Plateau for higher relative air humidity, weaker wind action, and for a progressive decrease in temperatures from the upper to the lower portions of the doline. According to Polli (1961), an elevation drop of 30 m in a doline climatically corresponds to an elevation increase of 360 m (in January of 660 m).

The transitional character of the climatic conditions, the sharp differences between the coast and the inner upland, and the richness in microclimates are reflected in the floristic and vegetational characters of the study area. The flora is relatively rich in species (1600 macrophytes for the whole of the Trieste Karst, including the portion in Jugoslavian territory; Poldini, 1972), with a prevalence of the illyric and submediterranean elements; the central european element is mainly confined in mature woody stands, and the mediterranean element is present in relict stations mainly along the coast (Poldini, 1980). The principal associations dominated by trees are:

Seslerio-Ostryetum: a paraclimax association covering extensive areas on the Karst Plateau.

Seslerio-Quercetum petraeae: the climax association of the study area, scattered in relict stands in relatively undisturbed sites.

Asaro-Carpinetum: the most common woody association at the north exposed south side of deep dolines; it is charachterized by the presence of many *Fagetalia*-species.

Ostryo-Quercetum ilicis: an evergreen mediterranean wood, in relict stations along the coast.

Epiphytic lichens are abundant within the *Seslerio-Quercetum petraeae* and the *Asaro-Carpinetum*, rare in the *Seslerio-Ostryetum* and generally absent in the *Ostryo-Quercetum ilicis*. This gradient in the diversity of epiphytic lichen communities corresponds with a parallel gradient in average air humidity, from the humid *Asaro-Carpinetum* to the very dry *Ostryo-Quercetum ilicis*. A further habitat for epiphytic lichens is provided by isolated trees cultivated for ornamental or agricultural purposes. According to Nimis & Loi (1982) the epiphytic lichen flora of the Trieste Province is relatively weakly affected by air pollution.

Methods

Phytosociological releves have been performed according to the criteria presented by Braun-Blanquet (1964). The cover scale is the Braun-Blanquet scale as modified by Pignatti (1953). A systematic or random sampling design was not adopted, since too an high sampling intensity would have been required in order to include in the samples also rare and localized vegetation types.

The releves have been submitted to Average Linkage Clustering (Anderberg, 1973), based on Similarity Ratio (Westhoff & Van der Maarel, 1978). Aim of this elaboration was the detection of unions ("associations") by a numerical method. Considering that the unions should be defined by the presence of a set of differential or characteristic species, only presence-absence values have been considered for this elaboration, this procedure being more consistent with the logic of the phytosociological method.

The releves have been further submitted to an ordination program (SIPLO; Feoli Chiapella & Feoli, 1977) in order to detect eventual environmental gradients. In this case, the main interest being concentrated on ecological gradients, cover values were used in the analysis, considering that the species may react to ecological variations with corresponding variations in their relative abundances within a union.

The pH of the bark was measured with a potentiometric digital pH-meter: 2 gr of pulverized bark in 16 ml of destilled water have been used for each measure.

Results

Numerical classification of releves

The results of the numerical classification of releves are in Fig. 2. By cutting the dendrogram at the fusion level of 0.47, 11 releve groups are formed. They are characterized by the following species:

Releve Group 1: *Hyperphyscia adglutinata.*
Releve Group 2: *Physcia biziana.*
Releve Group 3: *Parmelia acetabulum, Parmelia glabra.*
Releve Group 4: *Parmotrema perlatum.*
Releve Group 5: *Ramalina fastigiata, Lecanora symmicta.*
Releve Group 6: no differential species.
Releve Group 7: *Lecania cyrtella, Lecanora hageni.*
Releve Group 8: *Lecanora chlarotera.*
Releve Group 9: *Lecanora expallens, Lepraria candelaris.*
Releve Group 10: *Graphis scripta, Phlychtis argena* (the latter also present with low cover also in Releve Group 4).
Releve Group 11: *Pertusaria hemisphaerica, Pertusaria amara* (Both also present in Releve Group 4).

By cutting the dendrogram at the fusion level of 0.3, 4 clusters are formed, as follows:

Cluster A (Releve Group 1, 2, 3): *Candelaria concolor, Xanthoria parietina, Physcia adscendens, Physcia orbicularis, Physconia pulverulacea, Physconia grisea.* (High-frequency differential species).
Cluster B (Releve Groups 7, 8): *Lecidella elaeochroma, Lecanora carpinea, Caloplaca cerina.*
Cluster C (Releve Groups 4, 5, 6): *Parmelia subaurifera, Pseudoparmelia caperata, Parmelia sulcata, Hypogymnia physodes, Evernia prunastri, Usnea hirta.*
Cluster D (Releve Groups 9, 10, 11): no high frequency differential species.

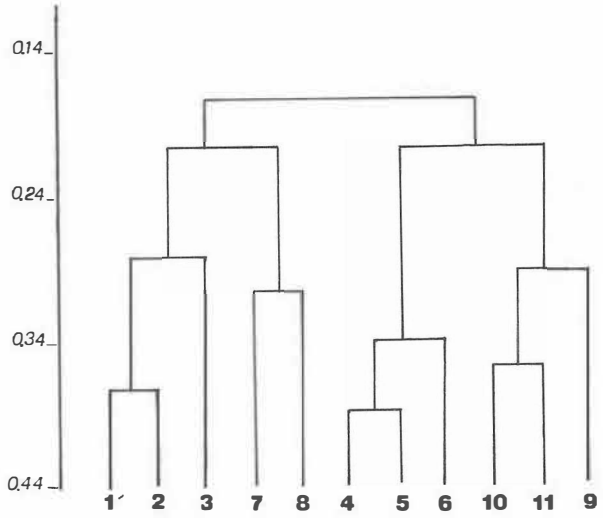

Fig. 2 — Dendrogram of the releve groups. Numbers as in text.

By comparing these results with the syntaxonomical units described in the literature, the epiphytic lichen vegetation of the Trieste Province may be ordered in the following syntaxonomical system:

Cluster A: *Physcietea adscendentis* Wirth (1980)
Physcietalia adscendents Hadaĉ (1944) em. Barkman (1958).
Xanthorion parietinae Ochsner (1928)
Releve Group 1: *Physcietum elaeinae* Barkman (1958) *candelariosum concoloris* Nimis & De Faveri (1981).
Releve Group 2: *Physcietum adscendentis* Frey & Ochsner (1928) *physciosum bizianae* Nimis & De Faveri (1981).
Releve Group 3: *Parmelietum acetabulae* Ochsner (1928) *glasbrosum* Barkman (1958).
Cluster B: *Lecanorion carpineae* Ochsner 1928 em. Barkman (1958).
Releve Group 7: *Lecanoretum sambuci* Wirth (1980)
Releve Group 8: *Lecanoretum carpineae* Galle (1930) s.l.
Cluster C: *Hypogymnietea physodis* Follmann (1974).
Hypogymnietalia physodo-tubulosae Barkman 1958.
Releve Group 4: *Parmelietum caperato- perlatae* Delzenne & Gehu (1977).
Releve Group 5: *Ramalinetum fastigiatae* Duvigneaud (1942) *hypogymnietosum physodis* Barkman (1958).
Releve Group 6: *Parmelia* spp.vv. sociation *nova*.
Cluster D: the releves of this cluster cannot be included in the same syntaxonomical units at higher level.

Leprarietea candelaris Wirth (1980).
Leprarietalia candelaris Wirth (1980).
Releve Group 9: *Calicion hyperelli* Hadač (1944) em. Barkman (1958).
Arthonietea radiatae Wirth (1980).
Arthonietalia radiatae Barkman (1958).
Graphidion scriptae Ochsner (1928).
Releve Group 10: *Pyrenuletum nitidae* Hilitzer (1925).
Releve Group 11: *Pertusarietum amarae* Hilitzer (1925) em. Barkam (1958).

In the following pages a brief description of the various unions is given, with a discussion on their occurrence in the study area. Growth-forms and life-forms are as in Barkman (1958).

Physcietum elaeinae Barkm. *candelariosum concoloris* Nimis & De Faveri (Tab 1; Rell. 1-9).

The *Physcietum elaeinae* is a south european-mediterranean union, extending northwards along the atlantic coast. Barkman (1958) subdivided it into two variants, the typical one, truly mediterranean, and the variant *buelliosum canescentis,* prevalent in subatlantic northwestern Europe. Nimis & De Faveri (1981), in their revision of the *Xanthorion* vegetation in north eastern Italy, described a third variant, characterized by the high cover degree of *Candelaria concolor* and *Physcia orbicularis,* and the absence of *Physcia hirsuta* and *Physcia clementi.* The two latter species are restricted, in north eastern Italy, to the high friulian plains and to prealpine valleys with suboceanic climate being completely absent in the Province of Trieste. The variant *candelariosum concoloris* is the most common lichen synusia on isolated trees throughout the low plains of north eastern Italy, with a fairly constant floristic composition.

The synusia is dominated by *Candelaria concolor* and *Physcia orbicularis. Hyperphyscia adglutinata (=Physcia elaeina)* is constant. Two facies may be distinguished: the first (Rell. 1-5) is characterized by the presence of *Physcia adscendens*, and mainly occurs at the basis of *Quercus* species near human settlements, the second by the codominance of *Physconia grisea*, mainly at the basis of *Ulmus* and *Tilia.*

The synusia is two-layered, with the crustaceous layer much more developed than the foliaceous one. The taxonomical spectrum shows an evident prevalence of *Physciaceae.* Main growth-form is Pa, followed by P. The most frequent life-form is by far rapresented by Atmophyta. Most of the species reproduce by means of soredia.

The synusia is clearly nitrophylous, occurring at the basis of isolated trees near farms, villages and dusty roads, where nitrogen supply is high. The facies with *Physcia adscendens* is subacidophytic to neutrophytic (pH from 5.9 to 6.8, average 6.0, 8 measures), probably less nitrophytic than the facies with *Physconia grisea*, that is clearly neutro to basiphytic, preferring trees with rich, subneutral bark (pH from 6.2 to 7.9, average 7.5, 7 measures). The synusia is relatively toxitolerant,

occurring also near the center of small villages and on high-traffic roads, and being one of the types whose distribution more extends into the town of Trieste. Single specimens of *Physcia adscendens* and *Physcia orbicularis*, although severely damaged, are the only macrolichens that have been found inside the industrial zone.

Physcietum adscendentis Frey & Ochsner *physciosum bizianae* Nimis & De Faveri.

The *Physcietum adscendentis* is one of the most thoroughly studied unions of the *Xanthorion parietinae*. At least 5 variants have been described (Barkman, 1958). According to Nimis & De Faveri (1981) in nort-eastern Italy the typical variant is most common in alpine valleys with subcontinental climate, whereas the variant *physciosum bizianae* is restricted to the Province of Trieste.

Faithful species are *Physconia pulverulacea* (= *Ph. pulverulenta*) and *Physcia biziana*. The former also occurs within the *Parmelietum acetabulae*, even if with reduced cover and vitality, the latter has been considered by Nimis & De Faveri (1981) as differential of a new variant, that I suspect to be fairly common in the mediterranean and submediterranean parts of Istria and Dalmatia. *Physcia biziana* has never been found in the region of Friuli, a few Km north of the Trieste Province, but should be common further south in Dalmatia, from where it was first described. The Province of Trieste should correspond to the northern distributional limit of this mediterranean species. The two characteristic species are both dominant, together with *Xanthoria parietina*, so that the synusia is easily recognized in the field by the prevalent colours: pale grey and orange. Mean number of species is 7.4.

The taxonomical spectrum is characterized by the prevalence of *Physciaceae* and *Caloplacaceae*. Pa is the prevalent growth-form (48%), followed by Cr (29%). Apothecia are present in half of the species, the rest reproduces by means of soredia. The synusia is common throughout the whole of the studyarea, particularly near the coast, on isolated trees with neutral to subacid bark (pH from 6.4 to 7.6, average 6.9, 7 measures). It is clearly heliophytic, preferring the south side of boles receiving direct sunlight. Only along the coast it is restricted to the North-Northeastern side, probably as a consequence of the strong light reflection by the sea. It seems to be aeroxerophytic and only slightly nitrophylous, being replaced by the *Physcietum elaeinae* at the basis of the boles or on dunged trees.

Parmelietum acetabulae Ochsner *glabrosum* Barkman (Tab. 1; Rell. 21-28).

Faithful species are: *Parmelia acetabulum,, Parmelia exasperata, Parmelia glabra, Parmelina quercina* and *Anaptychia ciliaris*. The latter three species differentiate the variant *glabrosum*, in which all of our releves can be included. *Bacidia rubella*, although rare in the study area, has been always found within this union, so that it could be considered as a local characteristic species for the *Parmelietum acetabulae*. Among the species of the *Xanthorion*-foederatio, *Physconia pulverulacea* is constant, although with lower cover degree than in the *Physcietum adscendentis*. Bryophytes such as *Tortula laevipila* and *Frullania dilatata* are frequent: they mainly occur along deep fissures of the bark and

rapresent transgressive species from the *Tortulion laevipilae* (Gerdol, 1982). The union is the richest in species among *Xanthorion*-synusiae, with an average of 11 species for releve.

The synusia is two-layered, with a foliaceous layer dominated by the large thalli of *Parmelia acetabulum* and *Parmelia glabra*, and a crustaceous layer mainly composed by *Caloplacaceae*. A third, fruticose layer is sometimes present, constituted by *Anaptychia ciliaris*. Growth-form Pa is prevalent (41.6%), followed by Cr (22.9%). 84% of the species are Atmophyta. Most of the species are fertile, and bear apothecia (72%), 15% reproduce by soredia and 8% by isidia.

The synusia occurs on old isolated trees (mean circumference 125 cm), in the more elevated portions of the Karst Plateau. It avoids the very acid bark of *Quercus cerris*, and smooth-barked trees such as *Ostrya*, *Carpinus* and young *Fraxinus*, being most frequent on *Quercus pubescens*, *Tilia* and old *Fraxinus excelsior*. It is best developed from the middle part part of the boles up to the first ramifications of the crown (0.5-3 m). In one case it was also observed at the basis of the bole. It occurs around the whole bole, but the vitality of the foliaceous species is normally higher in a south-southeast exposure. The pH (7 measures), ranges from 5.6 to 6.7, with an average of 6.4.

The *Parmelietum acetabulae* can be considered as subacidophytic and photophytic in the study area. Its distribution, limited to wind-swept areas on the Karst Plateau, outside the dolines and closed woods, reflects a preference for more continental climatic conditions in respect with other synusiae dominated by species of the genus *Parmelia* s.l.

Parmelietum caperato-perlatae (Barkm.) Delzenne & Gehu (Tab. 2; Rell. 29-36).

Faithful species is *Parmotrema perlatum (= Parmelia perlata)*, that is often also dominant. *Pseudoparmelia caperata* is codominant in most of the releves and tends to cover most of the bole on trees where light intensity is higher, for example along trails or at the upper margin of the dolines. Other high-frequency species are *Parmelia subaurifera*, *Parmelia sulcata* and *Hypogymnia physodes (Hypogymnietalia*-species) and a group of species that are to be considered as transgressives from the *Graphidion scriptae* such as *Phlychtis argena*, *Pertusaria amara*, *Pertusaria hemisphaerica* and *Pertusaria albescens*. Noteworth is the presence within this union of a group of montane species normally occurring within associations of the *Fagetalia*, such as *Hypogymnia tubulosa*, *Menegazzia terebrata* and *Pseudevernia furfuracea*. The incidence of bryophytes in the *Parmelietum caperato-perlatae* is the highest among all of the epiphytic lichen synusiae present in the study area. *Normandina pulchella* is a good local differential species for the union: it is an epiphyte on the hepatic *Frullania dilatata*. Mean number of species is 14.

The *Parmelietum caperato-perlatae* has been first described by Barkman (1958) under the name of *Parmelietum trichotero-scorteae;* he included this union in the *Parmelion saxatilis* in spite of the lack of characteristic species for this foederatio (and even of the Order *Parmelietalia*) in the releves of his table. Delzenne & Gehu (1977), on the basis of a larger number of releves, proposed a new articulation of the

synusia. The *Parmelietum trichotero-scroteae* is considered as synonimous of the subassociation *Parmelietosum scorteae* of a new union called *Parmelietum caperato-perlatae.* The latter is included in a new foederatio, the *Parmelion caperatae,* including unions that have their optimum within associations of the *Carpinion* and *Quercion robori-petraeae.* The foederatio is characterized by *Pseudoparmelia caperata* as faithful species, and *Parmotrema perlatum* as differential species towards the *Parmelion saxatilis.*

The synusia is two-layered, with a foliaceous layer dominated by *Parmotrema* and *Pseudoparmelia,* and a well-developed crustaceous layer in which species of *Pertusaria* are prevalent. A scarcely developed fruticose layer is sometimes present, with *Hypogymnia tubulosa, Pseudevernia furfuracea* and *Ramalina farinacea.* This latter species has been found only once, on a *Salix* hanging over a small pond in the doline of Percedol, the largest doline in the Trieste Karst. Amphyphyta are the prevalent life-form type, but Atmophyta and Ombrophyta are also well rapresented. The latter are mainly bryophytes. With the exception of *Parmelina tiliacea,* all of the lichen species reproduce by means of soredia.

The *Parmelietum caperato-perlatae* is best developed in regions characterized by a warm-atlantic climate: in southwestern France it replaces the more northern *Parmelietum revolutae* (Delzenne & Gehu, 1977). In the study area the synusia is restricted to the bottom and lower portions of large dolines, always inside the *Asaro-Carpinetum betuli,* where athmospheric humidity is higher. Preferred are rough barked trees such as *Quercus petraea* and more rarely *Quercus cerris* . It has been observed a few times on old *Carpinus* and on *Tilia.* It is most common on the middle part of the bole and no particular exposure seems to be preferred. It needs diffuse light, being absent or scarcely developed outside closed tree stands. The synusia is very toxiphobous: severely damaged (decorticated) specimens of *Parmotrema perlatum* and *Pseudoparmelia caperata* have been found several times, probably as a consequence of a recent increase in air pollution. The pH varies between 5.0 and 6.2, with an average of 5.5 (8 measures). The synusia is clearly acidiphytic.

Ramalinetum fastigiatae Duvigneaud *Parmelietosum physodis* Barkman (Tab. 2, Rell. 37-43).

Faithful species are *Ramalina fastigiata* and *Ramalina fraxinea. Evernia prunastri* and *Hypogymnia physodes* are differential species of the subassociation. *Lecanora symmicta* is a good local characteristic species.

The synsistematic position of this union is rather ambiguous: according to Barkman (1958) it should be included in the *Xanthorion parietinae,* Wirth (1980) states that this attribution is uncertain. In our table the *Xanthorion* species are practically absent, whereas strong affinities with the *Hypogymnietalia* are evident. These are the dominance of *Hypogymnia physodes,* the presence of *Usnea hirta* and the strong acidity of the bark. The subassociation *Parmelietosum physodis* is thus in an intermediate position between *Physcietalia adscendentis* and *Hypogymnietalia.* Taking into consideration also the results of the numerical classification, in this paper it has provisorely been assigned to the latter Order.

The synusia is three-layered: the fruticose layer is dominated by *Evernia prunastri* and *Hypogymnia physodes*. The two species of *Ramalina*, and particularly *Ramalina fraxinea* are always very small in comparison with their normal shape, attaining a maximal lenght of 4 cm. *Parmelia subaurifera* is dominant in the foliose layer, *Lecanora symmicta* in the crustose layer. Ra is the dominant growt form type (25%), followed by Cr (23%). Atmophyta are the prevalent life form type.

The synusia is rare and localized on the acid bark of *Crataegus* or *Juniperus* at the bottom of deep dolines. The twigs are first colonized by *Protococcus viridis*, that is followed by *Lecanora symmicta*, *Parmelia subaurifera*, and later on by *Evernia* and *Hypogymnia*.

The synusia is moderately aerohygophytic, and according to Barkman (1958) nitro and toxiphobous. It needs diffuse light and stands protected from wind, at least in the study area. This latter fact seems to be in contradiction with the normal ecological requirements of the synusia in western Europe, where it is best developed on wind — exposed trees (Barkman, 1958). The reason is probably due to the fact that the prevailing winds in the study area are too dry to provide a sufficient degree of atmospheric humidity, so that the synusia tends to be confined inside deep dolines. The particular microclimate of the dolines is responsible for the lack of *Xanthorion* species and for the abundance of species characteristic of the order *Hypogymnietalia*.

Parmelia spp.vv. sociation *nova* (Tab. 2; Rell. 44-53).

This synusia is defined by a characteristic species combination that includes the following species: *Pseudoparmelia caperata*, *Parmelia subaurifera*, *Parmelina tiliacea*, *Parmelia sulcata*, *Usnea hirta* and *Hypogymnia physodes*. The most common bryophytes are *Frullania dilatata* and *Tortula laevipila*. Releves 44-48 represent the sociation in its typical form, releves 49-53 represent a variant characterized by the presence of *Xanthorion*-species. The former occurs in woody stands without preferential exposure, the latter is common at the North side of isolated wayside trees, the south side being occupied by the *Physcietum adscendentis*. The syntaxonomical status of this vegetation type is rather controversial: there is no species that could be considered as characteristic for the union. Our releves correspond fairly well with the five last releves of the *Parmelietum trichoteroscorteae* published by Barkman (1958). This union has been revised by Delzenne et Gehu (1977) and renamed *Parmelietum caperato-perlatae*, the *Parmelietum trichotero-scorteae* being synonimous with the subunion *Parmelietosum scorteae* of the former type. One could by tempted to consider the releves of our table as an impoverished facies of the *Parmelietum caperato-perlatae parmelietosum scorteae*, characterized by the absence of *Parmotrema perlatum*. In my opinion, however, there are sufficient floristical, ecological and syndinamical differences to separate the releves of our table from the *Parmelietum caperato-perlatae*. They are: i) *Parmotrema perlatum* is a clear indicator of air humidity, it is a suboceanic species and as such its distribution in the study area is restricted to the bottom of deep

dolines. ii) The *Parmelietum caperato-perlatae* is normally preceded in the successional series by the *Pertusarietum amarae,* whereas the *Parmelia* spp.vv. sociation is always preceded by communities of the *Physcietalia*, or by no community at all. This is clearly evident in Tab. 2, where *Graphidion* species can be taken as differentials between the *Parmelietum caperato-perlatae* and the other *Hypogymnietalia* unions. iii) In the study area the *Parmelietum caperato-perlatae* occurs only within the *Asaro-Carpinetum*, and has therefore an azonal character, whereas the *Parmelia* spp.vv. sociation is the most common lichen synusia in the zonal *Quercus* woods of the Karst plateau, being the expression of a weakly subcontinental temperate climate. Consequently, I prefer to consider the releves of our table as a separate unit, defined by a fairly constant characteristic species combination, but lacking true characteristic species (sociation). It should be included in the *Parmelion caperatae.*

The synusia is two-layered, with a well developed foliaceous layer dominated by *Parmelia* species, and a crustaceous layer in which both elements of the *Lecanoretum* carpineae and (rarely) of the *Xanthorion* foederatio are present. A third, fruticose layer is sometimes present, composed by *Hypogymnia physodes, Usnea hirta* and *Evernia prunastri.* These species are frequent, but never attain a high cover degree, being normally only a few cm high and very scattered on the boles.

The *Parmelia* spp.vv. sociation is one of the most common lichen synusiae in the study area: it is widespread on *Quercus pubescens* and *Quercus petraea* in closed woody stands (and in this case it does not show any preferential exposure), and it also occurs on isolated trees (*Acer, Aesculus, Ulmus, Tilia, Fraxinus* etc.) with large circumference. In this latter case the synusia is restricted to the north side of the bole, the south side being occupied by communities belonging to the *Physcietalia.*

It is moderately photophytic, but clearly heliophobous, being always absent in direct sunlight. The pH varies from 5.7 to 6.7, with an average of 5.9 (9 measures), the synusia clearly being subacidophytic. On isolated trees the synusia tends to become rather ombrophytic, being mostly confined to large rain tracks. It is present from the basis of the boles (in woody stands only) up to the first ramification of the crown (maximal observed height: 5.8 m). It should be considered as a stable community.

Lecanoretum sambuci Wirth (Tab. 3; Rell. 54-59).

Faithful species are *Lecania cyrtella, Lecanora hageni* and *Lecanora sambuci. Lecania fuscella* is rather rare, but has been found only within this union in the study area. The name *Lecanoretum sambuci* is a *nomen nudum:* it has been published by Wirth (1980) without a direct indication of any species (except for *Lecanora sambuci* itself). However, from the sociological indications reported in Wirth's flora, it results that all of our differential species are characteristic of the *Lecanoretum sambuci,* or at least have their optimum there. According to Wirth, the syn-sistematic position of the *Lecanoretum sambuci* is uncertain: he attributed it provisorely to the *Xanthorion parietinae. Xanthorion*-species being extremely rare in our table, we have provisorely ordered the union in the *Lecanorion carpineae.*

The synusia is one layered, the only crustose layer being well developed. It is also rather poor in species, mean species number being 5.2. It is very rare in the study area, where it occurs exclusively on *Sambucus* bark in the Karst plateau. The pH is remarkably high, ranging from 7.5 to 8.8 (average 7.9), the synusia clearly being basiphytic. The *Lecanoretum sambuci* is replaced in the successional series by the *Physcietum adscendentis*.

Lecanoretum carpineae atlanticum Barkman (Tab. 3; Rell. 60-66).

Constant species are: *Lecidella elaeochroma, Lecanora carpinea* and *Lecanora chlarotera. Rinodina pyrina, Caloplaca cerina* and *Caloplaca holocarpa (= C. pyracea)* are frequent. The whole set of faithful species of the *Lecanoretum carpineae atlanticum* as defined by Barkman (1958) is present in the releves of Tab. 3.

The synusia is tipically one-layered, the only crustose layer being well developed; some foliaceous species such as young *Physcia adscendens, Candelaria concolor, Xanthoria parietina* and *Physconia pulverulacea* are sometimes present (Rell. 60-62).

The synusia is rarely well developed in the study area: it mostly forms mosaics with the *Physcietum adscendentis*; well developed stands have been found only a few times on smooth barked trees such as young *Fraxinus*. Growth form Cr is by far the most frequent (96%), and consequently the most common life-form is rapresented by Amphyphyta. With the exception of *Hyperphyscia adglutinata* and *Physcia tenella*, all of the species are fertile, and dispersal mainly occurs by means of spores.

The synusia occurs on smooth barked trees such as *Fraxinus* , or on the smooth scales of the bark of *Quercus* and *Acer* throughout the study area. It seems to be fairly toxitolerant, being also present inside the town of Trieste. The pH varies from 6.3 to 7.0, with an average of 6.8 (7 measures). The synusia has a pioneer character, and is normally replaced by the *Physcietum adscendentis:* this explains the high frequency of mosaics between the two unions. The synusia is neutrophytic, heliophytic and rather xerophytic. Its frequent occurrence near human settlements and dusty roads suggest that it could be considered as nitrophytic, or at least nitrotolerant.

Calicion — fragments (Tab. 4; Rell. 67—71).

These releves have been taken on the bark of old *Quercus cerris,* mostly in dolines and within the *Asaro-Carpinetum.* Faithful species are *Lecanora expallens* and *Lepraria candelaris. Hysterium* cfr. *pulicare* is frequent, *Schismatomma decolorans, Ochrolechia pallescens* and *Arthonia impolita* are very rare in the study area. *Trentepohlia umbrina* has been frequently found in the same habitat, mostly in fissures of the bark.

The releves are very poor in species (Average 4.4) and cannot be assigned to any described union for lack of characteristic species. They evidently rapresent a very impoverished facies of a community-type that I suspect to be far better developed in

the high Karst of Jugoslavia. The ecological requirements are as follows: very acid pH (from 3.8 to 4.9, average 4.5, 5 measures), high air humidity, abundant diffuse light. The *Calicion*-fragments are most common in the middle and lower portions of the boles, where the runoff of rain water is very scarce or absent. They evidently rapresent relict stands confined to dolines owing to the particular microclimatic conditions.

Pyrenuletum nitidae Hilitzer (Tab. 4; Rell. 72-77).

This community-type is dominated in the study area by *Graphis scripta* and *Plychtis argena,* both of which are constant. Noteworth is the presence in our table of *Pyrenula nitida,* a species that has been found only once in the study area. Our releves can be considered as an impoverished facies of the *Pyrenuletum nitidae*, a union hiterto known for Southern Scandinavia (Almborn, 1948), Holland (fragmentary, Barkman, 1958) and Bohemia (Hilitzer, 1925). The synusia occurs on the smooth bark of *Carpinus* at the bottom of deep dolines, sometimes at the north-exposed south side, always within the *Asaro-Carpinetum,* being completely absent outside this association.

Growth forms Cr and Lp are by far the most frequent, so that Atmophyta and Amphyphyta are the principal life-Forms. The synusia is very poor in species (average 4.0). According to Barkman (1958), the synusia is more skio- and aerohygrophytic than the *Pertusarietum amarae*. In the study area it is always absent outside closed tree stands. It does not seem to have a preferential exposure, and is present from the basis of the bole up to 5.5 m. The pH ranges from 5.0 to 5.8, average 5.4 (8 measures). The *Pyrenuletum nitidae* is clearly a pioneer community, followed either by the *Pertusarietum amarae* or by the *Parmelietum caperato-perlatae* when the bark gets rough as a consequence of the increasing age of the porophyte.

Pertusarietum amarae Hilitzer em. Barkman (Tab. 4; Rell. 78-85).

Faithful species are *Pertusaria haemisphaerica* and *Pertusaria amara. Pertusaria albescens* is frequent. *Parmelia subaurifera* and *Menegazzia terebrata* are present in mature stands developing towards the *Parmelietum caperato-perlatae. Graphis scripta* is occasional on the smooth scales of rough-barked trees.

In the study area the synusia is poor in species and fragmentary. Most of the species are crustose lichens; reproduction mainly occurs by means of soredia. The synusia occurs at the basis and lower portions of rough barked trees (*Quercus pubescens, Q. petraea, Q. cerris)* at the bottom of deep dolines, always within the *Asaro-Carpinetum.* According to Barkman (1958), the *Pertusarietum amarae* is photophytic in the Netherlands and in Scandinavia, preferring light and relatively dry woods. In the study area the ecology of the synusia is apparently different, since it never occurs outside dense tree stands in the most aerohygrophyc sites of the Karst plateau. The probable reason lies in the fact that the synusia has its optimum in oceanic western Europe, whereas in the study area it is clearly azonal, being

restricted to dolines the particularly humid microclimate. This explains also the because of relative poorness in species, when compared with analogous stands described for Western Europe. The pH varies from 4.8 to 5.6, average 5.2 (5 measures), the synusia clearly being acidophytic.

The *Pertusarietum amarae* is a pioneer community on rough — barked trees, it follows the *Pyrenuletum nitidae* on *Carpinus*, and is always followed by the *Parmelietum caperato-perlatae*. This is well in accordance with the data provided by Delzenne & Gehu (1977), on the syndinamical relations of this synusia.

Ordination of releves

The results of the ordination method are in Fig. 3. The releves are disposed along a semicircular line with center roughly located at the origin of the axes. At the left side of the half circle are releves of unions confined to the dolines, and mostly present within the *Asaro-Carpinetum betuli* (sometimes in the *Seslerio-Quercetum petraeae* in very dense stands). At the left side are releves of unions mostly occurring on isolated wayside trees outside the natural vegetation. In the central portion of the half-circle are releves of unions occurring either in secundary woods (*Seslerio-Ostryetum*, young stands of the *Seslerio-Quercetum petraeae*), or on old trees on the Karst plateau, far from human settlements and cultivated areas. In order to enhance the ecological interpretation, the half-circle has been informally stretchened and considered as an axis. The centroids of each releve group have been projected on the axis, and the value of the average pH for each group has been plotted in correspondance with the position of the centroids on the new axis. The

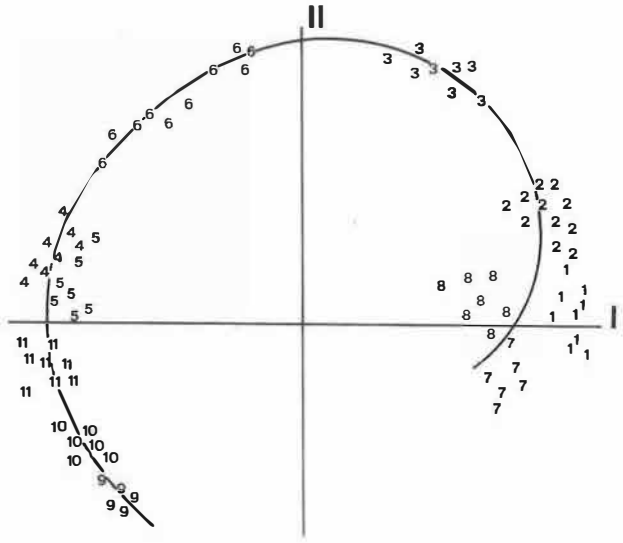

Fig. 3 — Ordinations of the releves. Releve Groups are numbered as in text.

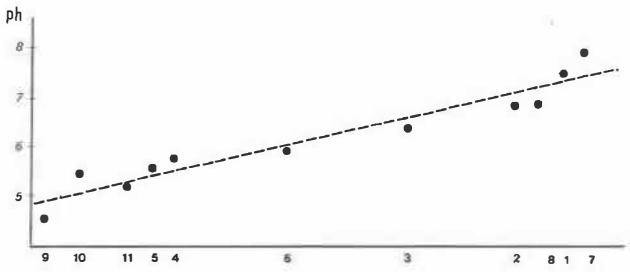

Fig. 4 — Ordination of releves: pH gradient. Explanation in text.

results are in Fig. 4: a pH gradient is evident, from the acid conditions at the left side of the figure, to the basic pH of the unions located at the right side of the axis. This gradient runs parallely with a gradient in light intensity: at the left side of the figure are unions occurring in dense woody stands inside deep dolines. In the center are releves of unions occurring in semi-open or open woody stands outside the dolines, and at the right side are releves of unions occurring on isolated trees, mainly at the south side of the boles. A further gradient in air humidity can be postulated, from the very aerohygrophytic *Calicion*-fragments at the extreme left to the relatively aeroxerophytic *Xanthorion* — unions at the right. All of the gradients correspond to a gradient in the naturality of the woody stands, from unions occurring in natural and semi-natural woods at the left to unions occurring on trees growing in a strongly anthropogenous environment at the right.

Dynamics

The only way to reconstruct in an objective way the syndinamical relations between the various community-types is the direct observation in permanent quadrats. Such a task goes beyond the limits of the present paper. Here I shall give only a schematic rapresentation of the most probable successional pathways, as they have been reconstructed from indirect observations. The scheme is in Fig. 5. It seems that in the study area two principal successional series are present: the fist, reported at the left side of Fig. 5, regards the succession of unions growing on porophytes occurring within associations of the *Quercetalia pubescentis* and their degradation stages; the second includes unions growing on porophytes occuring within the *Asaro-Carpinetum (Fagetalia)*.

The *Physcietum adscendentis* may develop either from the *Lecanoretum sambuci* or from the *Lecanoretum carpineae*. It is not to be excluded, however, that the *Physcietum adscendentis* might colonize the bark without being preceded by the two latter unions. If nitrogen accumulation takes place, the *Physcietum adscendentis* gives way to the *Physcietum elaeinae*. The transition from the *Physcietum adscendentis* to the *Parmelietum acetabuli* is mainly hypothetic: if such a transition really occurs, it should be linked to increasing diameter of the porophyte, since the *Parmelietum acetabulae* seems to be restricted to old porophytes, whereas the

Physcietum adscendentis is most common on younger trees.

The *Parmelia* spp.vv. sociation directly colonizes the bark of trees in closed woody stands. In the case of isolated trees, it may develop from the *Physcietum adscendentis* in connection with a decrease in light intensity, f. example as a consequence of the closing up of the tree canopy or the construction of a house intercepting direct sunlight. The second successional series is much simpler: the ideal case is the succession on *Carpinus:* the smooth bark of young trees is colonized by the *Pyrenuletum nitidae,* this is replaced by the *Pertusarietum amarae* when the bark gets rough as a consequence of increasing age of the porophyte. The *Parmelietum caperato-perlatae* closes the successional series. On *Quercus petraea* the series is reduced to the two last passages, the bark of this tree being rough also when the tree is young. A transition from the *Calicion* — fragments to the *Pertusarietum amarae* on *Quercus cerris* has been often observed, but in this case both the *Pertusarietum amarae* and the following *Parmelietum caperato-perlatae* are scarcely developed because of the too high acidity of *Quercus cerris'* bark.

A general observation could be made as far as the factors involved in the successional processes are concerned: in the dynamics of epiphytic lichen communities the exogenous factors tend to prevail on the endogenous ones. In other words, the dynamic processes are mainly governed by factors such as the passage from smooth to rough bark, the accumulation of nitrates, the decrese in light intensity consequent to the closing up of the tree canopy etc. This is a main difference with the prevailing successional modes in associations of phanerogames, where succession is mostly a consequence of the variation of ecological parameters induced by the vegetation itself. The consequence is the difficulty in tracing precise successional pathways, since most of the unions may colonize the bark without being preceded by other unions. The scheme of Fig. 5 therefore mainly rapresents an ideal rapresentation of the successional changes more commonly occurring in connection with the most common variations in the environmental conditions affecting epiphytic lichen communities. Strictly speaking, in most cases these are not true successions, but mere chronosequences of different unions that occur in connection with the dynamics of the phanerogamic vegetation or with the independent variation of some ecological factors.

Discussion

The present discussion is mainly centered on the contribution that the knowledge of the epiphytic lichen vegetation can give to the phytogeographical characterization of the study area.

A first point concerns the epiphytic vegetation within the *Asaro-Carpinetum:* all of the described unions exclusively occurring within this association have their optimum in Western Europe, under oceanic or suboceanic climatic conditions. In the study area they occur, although very impoverished and sometimes fragmentary, only inside deep dolines. They are sometimes characterized by the presence of some species normally restricted to montane beechwoods, such as *Hypogymnia tubulosa, Menegazzia terebrata, Ramalina farinacea* etc. The whole "successional

series'' from the *Pyrenuletum nitidae* to the *Parmelietum caperato-perlatae* is further restricted to *Asaro-Carpinetum* stands. From these facts it can be concluded that the dolines could be considered as enclaves of a suboceanic-montane climate in the Karst plateau. The presence of epiphytic synusiae having their optimum within *Fagetalia* associations is well in accordance with the phytogeographical-phytosociological characterization of the *Asaro-Carpinetum* as derived from the study of its phanerogamic component.

A second point concerns the lack of characteristic species for the most common lichen synusia in the zonal *Quercus*-woods of the Karst plateau, i.e. the *Parmelia* spp.vv. sociation. This could be interpreted as a consequence of the transitional character of the local macroclimate between oceanic and continental climate types. Most of the characteristic species of unions having their optimum in Western Europe, such as f.ex. the *Parmelietum revolutae,* do not reach the study area, or, if they are present in the Province of Trieste, like *Parmotrema perlatum,* characteristic of the *Parmelietum caperato-perlatae,* they are confined to azonal woody stands in the dolines. On the other side, species that are characteristic for unions having their optimum in continental eastern Europe, such as *Parmelia andraeana* for the *Parmelietum caperatae,* have their western outposts east of the study area. The result is that the most typical lichen synusia in the zonal *Quercus* woods of the study area lacks true characteristic species, and is characterized by a set of species with broader ecological amplitude, considered as characteristic of higher units.

A third point concerns the scarcity of epiphytes on *Ostrya:* this tree is mostly devoid of lichens throughout the study area. The *Seslerio-Ostryetum* is therefore a sort of lichen-desert in comparison with all of the other associations dominated by trees in the study area. This fact corresponds with an evident scarcity of the illyric-east european element in the lichen flora of the Province of Trieste, in contrast with the abundant presence of illyric-balcanic elements in the phanerogamic flora of the area. The only epiphytic lichen with illyric-submediterranean distribution is *Caloplaca viperae,* that is confined to *Xanthorion*-associations. The reasons for this fact are probably to be found in the difficult ecological conditions rapresented by the smooth bark of *Ostrya,* in connection with the relatively low air humidity, for the establishment of an epiphytic vegetation.

All of these facts confirm the transitional character of the Province of Trieste, from the phytogeographical and phytosociological points of wiew.

Table 1 - Xanthorion parietinae

Releve No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Tree species	Q	Q	Qp	T	T	U1	T	T	T	T	Ap	Qp	Qp	T	T	U1	U1	U1	U1	Rp	Q	Q	Fe	Fe	Qp	Qp	Qp	Qp
Height above ground (cm)	10	10	10	20	10	10	10	10	10	15	18	15	15	15	10	25	20	20	20	15	15	30	35	20	20	25	25	20
Exposure	S	S	S	NE	S	S	SW	E	SE	S	S	SE	SW	SE	S	S	S	S	SE	SW	SE	SW	NE	NE	SW	S	S	S
Cover (%)	70	85	85	85	85	65	65	70	90	70	70	80	70	60	90	70	80	80	90	60	99	99	90	90	90	90	80	90
Surface (dm^2)	3	2	2	2	2	3	3	2	2	2	3	3	4	3	2	2	3	3	2	3	3	5	6	5	5	4	5	5
Char.sp.of Physcietum elaeinae																												
Hyperphyscia adglutinata	4	4	1	1	1	+	1	1	2			+																
Char.sp. of Physcietum adscendentis																												
Physcia biziana										2	1	3	3	1	2	2	3	2	3	2								
(Physconia pulverulacea)										1	1	1	+	+	4	1	+	2	2		+	+	+	1	+	+	+	+
Char.sp.of Parmelietum acetabulae																												
Parmelia acetabulum																					3	3	3	3	3	1	3	2
Parmelia glabra																					3	2	1	+	1	+	2	1
Parmelina quercina																					+	1	+		+	2	3	
Parmelia exasperata																								+	+	+	+	+
Anaptychia ciliaris																						+	1					
Bacidia rubella																											+	+
Char.sp. of Physcietalia																												
Candelaria concolor	2	3	3	3	2	3	3	4	4	+	+	+	1	+	+				+	+	+	+	+					
Xanthoria parietina				+				+	+	1	1	1	+		+	2	1	+		+				+	1		+	2
Physcia adscendens	+	1	1	1	1					+	+	1	+		1	+	+		+		+	+					+	+
Physcia orbicularis			+	1	1	2	2	1	1		+			+				+	+		+				+			
Caloplaca cerina	+									+	+			+			+			+				(+)			
Physconia grisea						1	2	2	2						1			+										
Parmelia subrudecta																1				1	+	+						
Physcia tenella													+														+	+
Xanthoria fallax																			1	1						2		
Caloplaca viperae									+	+																		
Caloplaca aurantiaca											+																	
Companions																												
Lecidella elaeochroma	+	+		1						1	+							1	+	+	2		+			1		
Lecanora carpinea		+		+							+								+	+	+					+		
Lecanora chlarotera		+								+									+	+	+		1					
Caloplaca holocarpa			+	+					+	+									+			+	+					
Caloplaca ferruginea																			+			+	+	+	+	+	+	
Rinodina exigua													+											+	+			
Parmelina tiliacea																				1		1				+		
Parmelia sulcata																				+	+							
Ochrolechia subviridis																								+	+			
Mycomicrothelia atomaria																									1	1		
Rinodina roboris																										+		
Physcia leptalea																											+	
Fragments of Tortulion laevipilae																												
Tortula laevipila	+	1	+	1		+	+							+	+				+	+		+	+	+				
Frullania dilatata				+											+	+	+					+	1	1	+			
Ortotrichum affine	+		+	+										+				+				+	+					
Tortula papillosa					1					1	+																	
Radula complanata																						+		+				
No.of species	7	7	7	11	5	5	5	5	7	11	11	6	7	7	8	6	6	10	10	11	12	15	13	12	11	13	11	8

Table 2 - Hypogymnietea physodis

Releve No.	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
Tree species	Q	Q	Qc	Qc	Q	Qc	Q	Q	Cm	Cm	Cm	Jc	Jc	Jc	Qp	Qp	Q	Q	Q	Q	T	T	Q	U1	U1
Height above ground (dm)	I5	20	I8	I8	I8	I5	I5	I5	IO	5	5	5	5	5	I5	I5	I8	I8	20	20	I5	20	20	I5	I8
Exposure	N	NE	SW	NE	NW	SE	S	SW	-	-	-	-	-	-	NE	SE	SW	SW	N	N	NW	N	N	N	N
Cover (%)	80	80	80	90	80	70	80	80	90	90	90	90	90	90	70	80	75	75	70	80	80	90	80	80	80
Surface (dm^2)	4	4	4	3	3	4	3	4	1	1	1	1	1	1	3	3	3	4	3	3	3	3	3	3	3
Char.sp.of Parmelietum caperato-perlatae																									
Parmotrema perlatum	1	1	2	1	3	1	2	4																	
Diff.sp.of Parmelietum caperato-perlatae																									
Phlychtis argena	+		+	+	+	+	+																		
Cladonia coniocraea	r		r	r	r			r																	
Pertusaria amara		+		+	+	+		+																	
Pertusaria haemisphaerica			+	+	+	1		+																	
Pertusaria albescens		+			+	+	+																		
Normandina pulchella	+		+	+																					
Char.and Diff. sp.of Ramalinetum fastigiatae hypogymnietosum																									
Ramalina fastigiata									1	2	2	2	2	3	+										
Lecanora symmicta									1	2	1	1	1		+										
Ramalina fraxinea													r°	r°	r°										
Char.sp. of Hypogymnietea																									
Parmelia subaurifera	+	1	+	3	1	1	1	+	1	1	1	2	1	2	2	1	1	1	+	1	1	+	+	1	+
Pseudoparmelia caperata	2	2	+	+	1	+°	2	r			+	+		2	2	2	2		2	3	4	3	3	2	+
Parmelia sulcata	1	+	+	+			+	+						2	1	2	2	3	3	1	1	1	2	1	1
Hypogymnia physodes	+	+	+		+				3	3	2	1	3	2	+	1		+	+			+			+
Evernia prunastri					+		+		2	2	2	2	2	1	+	+	+		+		+		+	+	+
Usnea hirta				+					+	1				+	+	+		+		+		+			
Hypogymnia tubulosa						1	+	+								1									
Menegazzia terebrata						+	+	+							+										
Pseudevernia furfuracea						+																			
Transgressive sp. from Physcietalia																									
Candelaria concolor																					+	+	+	+	+
Physcia adscendens																	+				1		+	+	+
Parmelia subrudecta																					1	1	1	1	+
Caloplaca cerina																					+	+			+
Physcia orbicularis																		+						+	+
Xanthoria parietina																						+	+		
Parmelia exasperatula																								+	
Companions																									
Candelariella xanthostigma	+	+		+			+	+		+			+	+	+		+	+		+		+		+	+
Parmelina tiliacea		+	1°										1	1	1	1			1	1	+		+	+	
Lecidella elaeochroma					+	+							+		+		+	+			1		1	+	+
Lecanora carpinea					+											+		+			+		+		
Caloplaca ferruginea							1							r		r		+				+	+		
Lepraria candelaris	+		+	+																					
Lecanora expallens		r	r																						
Schismatomma decolorans					1																				
Graphis scripta						+°																			
Hysterium sp.				2																					
Fragments of Tortulion laevipilae																									
Frullania dilatata	1	1	1	1	1	1	1	+								+	1	1				+	+	+	
Ortotrichum affine	+	1	+	+	+		+											+							
Leucodon sciuroides			2		+	+		+									+								
Radula complanata		+		+	+	+																			
Hypnum cupressiforme				+			+	+						+											
Tortula laevipila																				+4	+4	+4		+	
Neckera complanata			+	+																					
Cfr.Metzgeria furcata						+																			
No.of species	I2	I3	I6	I8	I7	I6	I4	I3	6	7	6	6	9	I2	I3	II	9	II	6	7	I2	I3	I3	I4	II

Tab. 3 - Lecanorion carpineae

Releve No.	54	55	56	57	58	59	60	61	62	63	64	65	66
Tree species	Sn	Sn	Sn	Sn	Sn	Sn	Ap	Fe	Qp	Qp	Fe	Ap	Ap
Height above ground (dm)	10	10	15	9	9	10	20	25	20	30	20	15	15
Exposure	-	-	-	-	-	-	NE	NE	NW	N	SE	S	S
Surface (dm^2)	1	1	1	1	1	1	2	3	2	1	2	2	2
Char. and Diff.sp. of Lecanoretum sambuci													
Lecania cyrtella	2	2	3	2	3	1							
Lecanora hageni	1	1	1	+		+							
Lecanora sambuci		+	+		1	+							
Lecania fuscella				+		+							
Char. and Diff.sp. of Lecanoretum carpineae													
Lecanora chlarotera							2	1	+	+	+	1	1
Rinodina pyrina								+	+				+
Rinodina exigua											+		+
Arthopyrenia punctiformis											r	+	
Arthonia radiata												+	+
Transgressives sp. from Xanthorion parietinae													
Physcia adscendens							1	+	+			+	
Candelaria concolor							+	+	+		+		
Hyperphyscia adglutinata							+		+				
Xanthoria parietina								+	+				
Physconia pulverulenta									+	+			
Physcia tenella								+					
Char.of higher units and Companions													
Lecidella elaeochroma	1	1	2	2	2	2	3	2	3	4	4	1	1
Lecanora carpinea	-		1		+		1	1	2	1	1	2	3
Caloplaca cerina	1	1	2	+		+		1	1		+	+	+
Caloplaca holocarpa					+			+		+			1
Caloplaca aurantiaca									+		+		
Caloplaca haematites						+							
Candelariella xanthostigma								+					
Lecanora atra										+			
Lecanora subfuscata													+
Buellia punctata													+
No.of species	5	5	6	5	5	7	6	11	11	6	8	7	10

Table 4 – Calicion hyperelli and Graphidion scriptae

Releve No.	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85
Tree species	Qc	Qc	Qc	Qc	Qc	Qc	Cb	Cb	Cb	Cb	Cb	Qp	Q	Q	Qp	Qc	Q	Q	Q
Height above ground (dm)	10	15	10	10	15	10	20	20	15	20	20	10	?	?	15	10	15	18	8
Exposure	N	NE	SE	S	SW	SW	NE	NW	S	S	S	SE	SW	N	X	S	W	SE	SW
Surface (dm2)	4	4	5	5	4	5	3	3	3	3	3	4	2	3	2	3	3	3	3
Char. and Diff. sp. of Calicion-fragments																			
Lecanora expallens	3	3	2	2	3														
Lepraria candelaris		2	1	+	+														
Schismatomma decolorans	+		+	1															
Ochrolechia pallescens (loc.)			r	r															
Arthonia impolita					r														
Char.and Diff. sp. of Pyrenuletum nitidae																			
Graphis scripta						2	2	3	3	3	3			+					
Phlyctis argena			+			2	3	3	3	2	2		+						
Pyrenula nitida						+													
Char. and Diff.sp. of Pertusarietum amarae																			
Pertusaria hemisphaerica												2	1	+	+	1	1	1	2
Pertusaria amara				+					+			3	2	+		1	+		1
Pertusaria albescens													+	+	1			2	
Pertusaria pertusa												+	+						
Transgressives from Tortulion and Hypogymnietalia																			
Hysterium sp.	+	+		+								+			+	+	+		+
Frullania dilatata			+°									+	+		1	+			+
Leucodon sciuroides	+°											1	+	+		+	+	+	
Parmelia subaurifera						+		+		1	1		1	1	1		+		
Lecanora subfuscata									+	+	+	+		+			+		+
Menegazzia terebrata										r				r	r				
Lecanora pulicta									+							r			
Lecidella elaeochroma											+							+	
No. of species	5	3	4	4	3	4	2	3	5	5	5	7	8	8	6	6	6	3	5

Riassunto

Sulla base di una classificazione numerica di 85 rilievi fitosociologici, 11 unioni di licheni epifiti sono state individuate per la Provincia di Trieste. Esse sono:

— *Physcietum elaeinae* Barkm. *Candelariosum concoloris* Nimis & De Faveri: su alberi isolati con accumulo di nitrati, per lo più alla base del tronco.

— *Physcietum adscendentis* Frey & Ochsner *Physciosum bizianae* Nimis & De Faveri: su alberi isolati, lontano dalla base, in esposizione prevalentemente nel quadrante Sud.

— *Parmelietum acetabulae* Ochsner var. *glabrosum* Barkm.: su vecchi alberi isolati sull'altipiano carsico.

— *Parmelietum caperato-perlatae*(Barkm.) Delz. et Gehu.: su alberi a scorza rugosa nell'*Asaro-Carpinetum.*

— *Ramalinetum fastigiatae* Duvigneaud *Parmelietosum physodis* Barkm.: su rametti di *Crataegus* e *Juniperus* sul fondo di profonde doline.

— Sociazione a *Parmelia* spp.vv., *nova:* su scorza rugosa, per lo più di *Quercus,* nel *Seslerio-Quercetum petraeae,* o al lato Nord di alberi isolati.

— *Lecanoretum sambuci* Wirth: su rametti di *Sambucus.*

— *Lecanoretum carpineae* Galle: su alberi a scorza liscia, più raramente rugosa; spesso precede il *Physcietum adscendentis.*

— Frammenti di *Calicion hyperelli:* esclusivamente su scorza di *Quercus cerris* in doline profonde.

— *Pyrenuletum nitidae* Hilitzer: esclusivamente sulla scorza liscia di *Carpinus* nell'*Asaro-Carpinetum.*

— *Pertusarietum amarae* Hilitzer: esclusivamente su alberi a scorza rugosa nell'*Asaro-Carpinetum.*

I rilievi sono stati sottoposti ad un programma di ordinamento che ha permesso di individuare un gradiente di pH, luminosità ed umidità atmosferica, da raggruppamenti di tipo suboceanico limitati alle doline sino ad aggruppamenti eliofili e nitrofili legati all'azione antropica. La discussione di alcune caratteristiche fitogeografiche della vegetazione studiata ha portato alla conferma del carattere transizionale della Provincia di Trieste dal punto di vista fitogeografico e fitoclimatico.

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