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# Phytocoenotic diversity of the N-Adriatic coastal sand dunes - The herbaceous communities of the fixed dunes and the vegetation of the interdunal wetlands

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**Abstract**
The hemicryptophytic, chamaephytic and therophytic communities which inhabit the fixed sand dunes of the N-Adriatic coast, along with those of the interdunal wetlands, have been studied from the phytosociological point of view. The floristic-sociological analysis focuses on the syntaxonomic discussion of the xerophilous communities; in this context, the following new syntaxa have been described: *Syntrichio ruraliformis-Lomelosion argenteae, Tortulo-Scabiosetum typicum* and *Sileno conicae-Avellinietum michelii*. In regards to the dune slack vegetation, the study points out the occurrence in the coastal area of two rare inland microtherm communities (*Plantagini altissimae-Molinietum caeruleae* and *Erucastro-Schoenetum nigricantis*). As already stated in previous papers, the originality of this sector of the Mediterranean basin is highlighted as a result of both bioclimatic and phytogeographic factors, which confer to this area a unique character in the European context.

Key words: biodiversity, N-Adriatic coast, phytosociology, sand dunes, syntaxonomy.

## Introduction

Following the previous papers about the woody vegetation and the *Stipa veneta*-rich herbaceous communities (Gamper *et al*., 2008; Sburlino *et al*., 2008), this study represents a further contribution to the description of the vegetation occurring in the areas of fixed dunes of the northern Adriatic coast, which corresponds to the northernmost part of the Mediterranean basin (Fig. 1).

As already explained in more detail in the previous papers, the northern Adriatic sedimentary system is characterized by Holocene sand dunes, consisting mainly of carbonate sands, in which formation took part some of the largest Italian rivers (Tagliamento, Piave, Brenta, Adige and Po). From the bioclimatic point of view, Rivas-Martínez (2004) shows that, besides a small sector near Genoa, the N-Adriatic dune system is the only one of the coastal areas of the Mediterranean basin to be included in the temperate region. In this particular area, climatic changes, especially between the third and the first millennium BC, led to important floristic migrations: in fact, montane, Mediterranean and eastern species reached the N-Adriatic coast (Beguinot, 1941; Lorenzoni, 1983; Gehu *et al*., 1984a). In this biogeographic and bioclimatic context, the conditions for the presence of xero-thermophilous species associated with the very draining substrate of the dunes still remain unchanged, while in the interdune lowlands hygrophilous and microthermic entities of montane origin may be found.

The above-mentioned biogeographic and climatic features, the depth of the dune system, its chemical composition, the quite good conservation status of some areas (above all the ones located at the mouths of the Tagliamento and Adige Rivers), make the N-Adriatic dune system rich in very peculiar and often endemic communities. The conservation value of these plant communities goes far beyond the one of the Habitat Directive EEC 92/43, as they show a floristic cortege often peculiar if compared to the one that may be observed in the rest of the Mediterranean basin and of the European Union.

In order to complete the detailed and, in some respects, exhaustive Pignatti's studies (Pignatti, 1952, 1953, 1959) we aimed to give a more modern phytosociological and syndinamic description (Biondi, 2011; Pott, 2011) of the plant communities that inhabit these areas. The study will focus only on the communities that develop on the inner grey dunes and on the interdunal lowlands; therefore the communities of foredunes and mobile dunes will not be considered.

## Materials and Methods

The analysis was carried out according to the phytosociological approach (Géhu & Rivas-Martínez, 1981; Rivas-Martinez, 2005; Géhu, 2006; Biondi, 2011;

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Pott, 2011). A total of 95 relevés, both published and unpublished had been used; the published data (18 relevés) come from the paper by Sburlino *et al.* (2008).

Only the communities present in the stabilized dunes, in which the series of the holm-oak wood (*Vincetoxico-Quercetum ilicis*) and of the common juniper scrub *(Junipero-Hippophaetum fluviatilis*) occur as well as those from the interdunal wetlands were analyzed.

The syntaxonomic attribution of the latter communities has been made directly on the basis of their floristic-sociological features, whilst the 73 relevés belonging to floristically more complex xerophilous-herbaceous coenoses, were analyzed on the basis of hierarchical classification using the package Syn-tax 2000 (Podani, 2001); data transformation was based on the method proposed by Van der Maarel (1979). The concepts of characteristic and differential taxa are in accordance with Westhoff & Van der Maarel (1978) and Mucina (1993).

The following symbols were adopted in the tables: d = differential species, tg = characteristic-transgressive species. The life forms follow Pignatti (1982) and Aeschimann *et al.* (2004); for the bryophytes, reference was made to Dierßen (2001). The bryophytic nomenclature follows Aleffi *et al.* (2008). In regards to the chorological spectra, for simplicity and clarity, the following main groups of chorotypes have been used: Alien, Circumboreal, Cosmopolitan and Subcosmopolitan, Endemic of N-Adriatic coast, Eastern, Eurasiatic, Eurimediterranean, European, Mediterranean-Atlantic, Stenomediterranean. The life form spectra were weighted on the coverage values of the species, while the chorological spectra were calculated on the basis of their frequencies. In regards to the soil typologies, we have referred to Bini *et al.* (2002a, 2002b) and Gamper (2002). The syntaxa correspondences with the Habitat codes of the 92/43/EEC Directive follow the Annex I of the European Interpretation Manual (European Commission, 2007) and Biondi *et al.* (2009, 2012a).

## Results

The dendrogram of the relevés of the dry grasslands highlights the presence of two main clusters (1 and 2 of Fig. 2).

Cluster 1: this group includes 18 relevés characterized by a high frequency of hemicryptophytes such as C*hrysopogon gryllus, Festuca rupicola, Koeleria pyramidata, Bromus erectus, Stipa veneta, Globularia punctata, Silene x pseudotites* etc., and by the chamaephytes *Teucrium chamaedrys, Chamaecytisus purpureus* and *Thymus longicaulis*.

Cluster 2: this group includes 55 stands which share the high frequency of *Cerastium semidecandrum, Phleum arenarium, Silene conica, Vulpia membranacea, Poa bulbosa* and *Medicago minima*; this group

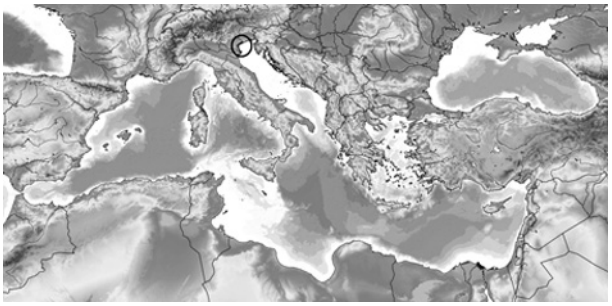

Fig. 1 - The study area in the Mediterranean context.

can be further divided into two subclusters (2a and 2b of Fig. 2). Subcluster 2a, which shares with cluster 1 the chamaephytes *Syntrichia ruralis* var. *ruraliformis*, *Fumana procumbens* and, to a lesser extent, *Helianthemum nummularium* ssp. *obscurum* and *Teucrium polium* ssp. *capitatum*, is differentiated by the high frequency of *Lomelosia argentea* (= *Scabiosa argentea* L.), *Lagurus ovatus, Oenothera stucchii, Petrorhagia saxifraga* and *Stachys recta* ssp. *subcrenata*. The second subcluster (2b) differs as it displays a low frequency of the chamaephytic component and a high presence of therophytes; in this group *Avellinia michelii, Cenchrus longispinus, Cynodon dactylon, Catapodium rigidum, Plantago arenaria, Bromus tectorum,* etc. are more frequent too.

Tab. 1 shows the floristic comparison between the three dendrogram groups.

The results of the cluster and floristic-sociological analysis of the relevés allow us to recognize three distinct dry grassland associations; their description, as well as that of other communities recorded during the current study, is given below.

## Description of the communities

### *The herbaceous communities of the fixed dunes*

#### *The xerophilous grasslands*

*TEUCRIO CAPITATI - CHRYSOPOGONETUM GRYLLI* Sburlino, Buffa, Filesi et Gamper 2008 [Tab. 1 in Sburlino *et al.* (2008); cluster 1 of the dendrogram of Fig. 2; Fig. 3].

***Physiognomy and structure***: dry grassland whose structure is mainly determined by hemicryptophytes (*Bromus erectus* ssp. *erectus, Chrysopogon gryllus, Stipa veneta, Festuca rupicola, Koeleria pyramidata, Sanguisorba minor* ssp. *muricata*, etc.) and, subordinately, by chamaephytes (*Fumana procumbens, Helianthemum nummularium* ssp. *obscurum, Teucrium polium* ssp. *capitatum*, etc.); a cryptogamic layer is always present, even if discontinuous, and is mostly formed by *Syntrichia ruralis* var. *ruraliformis* and *Cladonia* sp.pl..

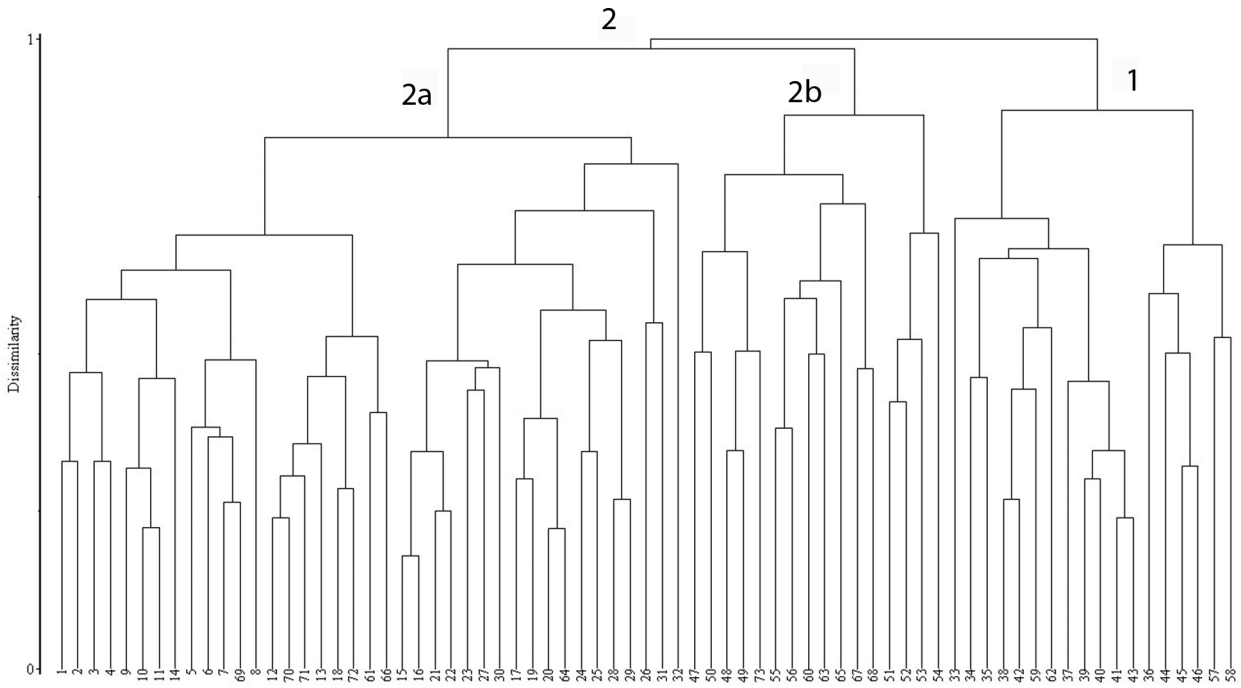


Fig. 2 - Dendrogram of the 73 relevés of the dry grasslands (complete link, similarity ratio, cover data).

Like other communities that inhabit the N-Adriatic dunes, the floristic composition shows an original mixture of Mediterranean, European, Eurasiatic, Eastern and demontane species. The association belongs to *Saturejion subspicatae*, an alliance of the SE-European-Illyric order *Scorzonero-Chrysopogonetalia* (*Festuco-Brometea*) (Sburlino *et al*., 2008). Differential species of *Teucrio-Chrysopogonetum* in comparison with the other communities of the above-mentioned alliance are: *Teucrium polium* ssp. *capitatum, Carex liparocarpos, Holoschoenus romanus* and the endemic *Stipa veneta*, a priority species of the European Community 92/43 ''Habitat'' Directive.

*Teucrio capitati-Chrysopogonetum grylli* is a secondary community of the holm-oak wood edaphoxerophilous series (*Vincetoxico-Querco ilicis sigmetum*) (Gamper *et al*. 2008).

***Synchorology***: it is an endemic association of the N-Adriatic coast where inhabits the Holocene paleodunes; it is present from the Tagliamento river mouth to the Cavallino peninsula and in the south of the Po Delta.

An exhaustive description of the association is provided in the original paper by Sburlino *et al*. (2008).

***Natura 2000 Habitat***: 62A0

*TORTULO-SCABIOSETUM* Pignatti 1952 (Tab. 2, rel. 1-39; Fig. 4)

***Physiognomy and structure***: perennial dry short-grassland whose structure is mainly determined by a thick carpet of bryochamaephytes (*Syntrichia ruralis* var. *ruraliformis* p. max p.) and, sometimes, of lichens (*Cladonia* sp. pl.) among which hemicryptophytes, therophytes and chamaephytes occur; the camaephytes (*Fumana procumbens, Teucrium polium* ssp. *capitatum, Helianthemum nummularium* ssp. *obscurum*, etc.) are particularly frequent in the subass. *fumanetosum* of which are the main physiognomic component.

***Biological spectrum***: bryochamaephytes 43.4%; chamaephytes 26.6%; hemicryptophytes 15%; therophytes 8.4%; geophytes 6.4%; phanerophytes 0.2%.

***Syntaxonomy***: the occurrence of this association on the N-Adriatic coast is well-documented (Pignatti, 1952, 1959, 1993; Pirola, 1974; Caniglia, 1978; Géhu *et al*., 1984a; Géhu & Biondi, 1996; Caniglia *et al*. 1999; Brullo *et al*., 2001; Marchesan *et al*., 2003; etc.). Although the syntaxonomic autonomy of this association is well recognized, its attribution to higher syntaxonomic ranks has been so far rather problematic, even at the class level: *Ammophiletea* (Pignatti, 1952, 1959; Brullo *et al*., 2001), *Festuco-Brometea* (Géhu *et al*., 1984a; Caniglia *et al*. 1999; Marchesan *et al*., 2003), *Koelerio-Corynephoretea* (Géhu & Biondi, 1996; Pellizzari *et al*., 2004; Biondi *et al*., 2009).

Without doubt the problem is caused by the quite broad spatial distribution of this association in the dunal system; indeed, it occurs both on the grey dunes close to the sea which are consequently enriched in *Ammophiletea* species, as well as on the inner more fixed ones where the *Festuco-Brometea* and *Koelerio-Corynephoretea* elements prevail on more strictly littoral species. It goes without saying that single individuals of species belonging to *Ammophiletea* may sporadically occur also in areas far from the shoreline, as in the ancient fossil dunes where they only represent biogeo-

Tab. 1 - Comparison between the three main groups of relevés of the dendrogram of Fig. 2 (frequency values)

| Number of cluster | 1 | 2a | 2b |
|---|---|---|---|
| Number of relevés | 18 | 39 | 16 |
| Chrysopogon gryllus (L.) Trin. | 83 | . | . |
| Festuca rupicola Heuff. | 83 | . | . |
| Stipa veneta Moraldo | 78 | . | . |
| Chamaecytisus purpureus (Scop.) Link | 67 | . | . |
| Globularia punctata Lapeyr. | 67 | . | . |
| Aster linosyris (L.) Bernh. | 56 | . | . |
| Anthericum ramosum L. | 50 | . | . |
| Galium verum L. ssp. verum | 50 | . | . |
| Brachypodium rupestre (Host) R. et S. | 39 | . | . |
| Osyris alba L. | 39 | . | . |
| Schoenus nigricans L. | 39 | . | . |
| Teucrium montanum L. | 33 | . | . |
| Thesium divaricatum Jan | 33 | . | . |
| Scabiosa columbaria L. | 28 | . | . |
| Orchis coriophora L. ssp. fragrans (Pollini) K. Richter | 22 | . | . |
| Koeleria pyramidata (Lam.) Domin | 83 | 8 | . |
| Bromus erectus Hudson ssp. erectus | 83 | 3 | . |
| Thymus longicaulis (incl. Thymus x carstiensis (Velen.) Ronninger) | 72 | 5 | . |
| Silene x pseudotites Besser ex Reichenb. | 61 | 8 | . |
| Holoschoenus romanus (L.) Fritsch | 61 | 3 | . |
| Anacamptis pyramidalis (L.) L. C. Rich. | 56 | 3 | . |
| Polygonatum odoratum (Miller) Druce | 33 | 3 | . |
| Carex caryophyllea La Tourr. | 22 | 3 | . |
| Scabiosa gramuntia L. | 83 | 8 | 19 |
| Allium sphaerocephalon L. | 50 | 15 | 19 |
| Teucrium chamaedrys L. | 83 | 13 | . |
| Dactylis glomerata L. | 39 | 15 | . |
| Clematis flammula L. | 33 | 13 | . |
| Syntrichia ruralis (Hedw.) F. Weber et D. Mohr var. ruraliformis (Besch.) Delogne | 100 | 100 | 25 |
| Fumana procumbens (Dunal) G. et G. | 78 | 64 | 25 |
| Helianthemum nummularium (L.) Miller ssp. obscurum (Celak.) Holub | 94 | 49 | 31 |
| Teucrium polium L. ssp. capitatum (L.) Arcang. | 78 | 36 | . |
| Lomelosia argentea (L.) Greuter et Burdet | 6 | 79 | 38 |
| Lagurus ovatus L. | . | 79 | 38 |
| Oenothera stucchii Soldano | 11 | 64 | 31 |
| Petrorhagia saxifraga (L.) Link | 33 | 56 | 19 |
| Stachys recta L. ssp. subcrenata (Vis.) Briq. | 17 | 51 | 19 |
| Vicia pseudocracca Bertol. | . | 33 | 13 |
| Hypochoeris radicata L. | . | 31 | 13 |
| Artemisia campestris L. ssp. campestris | . | 28 | 6 |
| Centaurea tommasinii Kerner | 6 | 26 | 6 |
| Cerastium semidecandrum L. | 22 | 72 | 94 |
| Phleum arenarium L. | 11 | 67 | 94 |
| Silene conica L. | . | 56 | 100 |
| Vulpia membranacea (L.) Link | . | 64 | 94 |
| Poa bulbosa L. | 11 | 69 | 56 |
| Medicago minima (L.) Bartal. | . | 44 | 69 |
| Arenaria serpyllifolia L. | . | 31 | 31 |
| Dasypyrum villosum (L.) Borbás | . | 36 | 25 |
| Conyza canadensis (L.) Cronq. | . | 26 | 31 |
| Avellinia michelii (Savi) Parl. | . | 3 | 88 |
| Cenchrus longispinus (Hack.) Fernald | . | 8 | 69 |
| Cynodon dactylon (L.) Pers. | 11 | 26 | 56 |
| Catapodium rigidum (L.) Hubbard | 6 | 15 | 50 |
| Plantago arenaria Waldst. et Kit. | . | 8 | 38 |
| Bromus tectorum L. | . | 8 | 25 |
| Buglossoides arvensis (L.) Johnston | . | 3 | 25 |
| Ambrosia artemisiifolia L. | . | . | 25 |
| Sanguisorba minor Scop. ssp. muricata (Gremli) Briq. | 94 | 72 | 63 |
| Carex liparocarpos Gaudin | 72 | 62 | 44 |
| Equisetum ramosissimum Desf. | 33 | 36 | 25 |
| Plantago lanceolata L. var. sphaerostachya Mert. et Koch | 39 | 18 | 6 |
| Silene vulgaris (Moench) Garcke ssp. angustifolia (Miller) Hayek | 17 | 62 | 38 |
| Ambrosia coronopifolia Torr. et Gray | 6 | 36 | 13 |
| Asparagus acutifolius L. | 22 | 5 | 6 |
| Clypeola jonthlaspi L. | 11 | 8 | 19 |
| Euphorbia cyparissias L. | 22 | 18 | . |
| Bromus hordeaceus L. ssp. hordeaceus | . | 15 | 25 |
| Melilotus neapolitana Ten. | . | 13 | 25 |
| Elytrigia atherica (Link) Kerg. | 11 | 21 | . |
| Cyperus kalli (Forsskål) Murb. | . | 21 | 6 |
| Allium vineale L. | 17 | 8 | . |
| Bromus diandrus Roth | . | 18 | 6 |
| Erophila verna (L.) DC. | . | 3 | 19 |
| Polygala comosa Schkuhr | 17 | 3 | . |
| Silene colorata Poiret | . | 13 | 6 |
| Orchis tridentata Scop. | 11 | 3 | . |
| Erigeron annuus (L.) Pers. | 11 | 3 | . |
| Calamagrostis epigejos (L.) Roth | 6 | 8 | . |
| Arabidopsis thaliana (L.) Heynh. | . | 3 | 6 |
| Asperula cynanchica L. | . | 3 | 6 |
| Centaurium erythraea Rafn. ssp. erythraea | 6 | 3 | . |
| Hypochoeris glabra L. | . | 3 | 6 |

graphic evidence of past vegetation types that no longer exist. In our opinion the relatively high frequency of *Ammophiletea* species in a part of the relevés by Pignatti (1959) and Brullo *et al*. (2001) is therefore caused by catenal contacts rather than by a true ecologic affinity; these entities should be therefore considered as ingressive species (*sensu* Poldini & Oriolo, 1995). As a matter of fact, the littoral psammophytes are almost absent in our relevés, that were made in the inner fixed dunes. The attribution of *Tortulo-Scabiosetum* to *Festuco-Brometea* is somewhat questionable too; in the Pignatti's (1959) tables, even if limited to the facies that the author considered as the most developed, only *Fumana procumbens, Koeleria gracilis* s.l., *Helianthemum nummularium, Silene x pseudotites* and *Teucrium montanum* occur in more than 50% of the relevés; in the current stands, the species belonging to this class that show the same frequency value are even less represented (*Fumana procumbens, Sanguisorba minor* ssp. *muricata* and *Silene vulgaris* ssp. *angustifolia*); the feeble relationships between our relevés and the *Festuco-Brometea* class is also highlighted by the results of cluster analysis (Fig. 2; Tab. 1) that clearly separates the stands of the communities belonging to *Festuco-Brometea* (*Teucrio-Chrysopogonetum*) from the other examined coenoses.

The attribution of *Tortulo-Scabiosetum* to *Koelerio-Corynephoretea* seems to be in our opinion more convincing. This class, mainly distributed in the Atlantic and central European areas, includes pioneer hemicryptophytic and therophytic dry grasslands, which develop on more or less stabilized sandy soils (Géhu, 2006). The attribution of the present relevés to *Koelerio-Corynephoretea* is supported by the high frequency of entities being considered by many authors (Tüxen, 1937; Doing, 1993; Mucina & Kolbek, 1993; Pott, 1995; Dengler *et al*., 2003) as character or differential species of the class or of subordinated ranks, such as *Cerastium semidecandrum, Phleum arenarium, Silene conica, Poa bulbosa, Medicago minima, Petrorhagia saxifraga* and, to a lesser extent, *Equisetum ramosissum* and *Arenaria serpyllifolia*.

It must be said that some of the above-mentioned species are considered, in the Mediterranean area, as belonging to the therophytic class *Tuberarietea guttatae* of which *Laguro-Vulpion* entities (*Vulpia membranace*a and *Lagurus ovatus*) actually occur frequently in our relevés; *Tortulo-Scabiosetum* is yet an association structurally determined by perennial species and develops in a temperate bioclimate, in contrast with the characteristic features of the *Tuberarietea* class; this opinion is also sustained by the constant high cover of *Syntrichia ruralis* var. *ruraliformis*, a bryochamaephyte being considered as character-species of the dunal communities of *Koelerio-Corynephoretea* (Pott, 1995; Rivas-Martinez *et al*., 2002; Géhu, 2006).

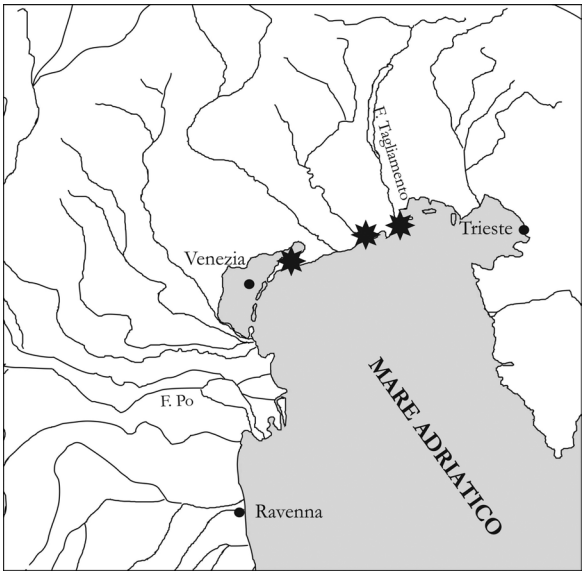


Fig. 3 - Sites of the relevés of *Teucrio capitati-Chrysopogonetum grylli*.

*Tortulo-Scabiosetum* was attributed by Pignatti (1952) to the contextually described *Psammo-Koelerion*, an alliance that has been so far considered as endemic of the N-Adriatic coast. Actually, Pignatti (1952, 1959) underlined the structural similarity and at least partially floristic affinities between *Tortulo-Scabiosetum* and *Tortulo-Phleetum arenarii*, this latter association having been originally described by Braun-Blanquet & De Leeuw (1936) for the sandy Dutch coasts; indeed, these two associations share the high frequency of *Cerastium semidecandrum, Phleum arenarium* and *Syntrichia ruralis* var. *ruraliformis* and Pignatti (1952, 1959) considered to include both these associations in the *Psammo-Koelerion* alliance.

Actually, the name "*Psammo-Koelerion* Pign. 1953" at p. 323 in Pignatti (1952) is a superfluous name (Art. 29c) for the name "*Koelerion albescentis* Tüxen 1937" (recte: *Koelerion arenariae* Tüxen 1937 corr. Gutermann et Mucina 1993) and a new name must be formed (Art. 39). Indeed, Pignatti considers explicitly the name "*Psammo-Koelerion*" as corresponding to the *Koelerion albescentis* Tüxen 1937 at a larger sense ("sensu latiori") and the unique association of the original diagnosis of the *Koelerion albescentis* Tüxen 1937, the "*Tortuleto-Phleetum* Br.-Bl. et De Leeuw (1936) Tx. 1937" is included in the diagnosis of the "*Psammo-Koelerion*" together with three other associations. Pignatti's paper "Introduzione allo studio fitosociologico della pianura veneta orientale con particolare riguardo alla vegetazione litoranea" was published in four parts, the first one in 1952 (Archivio Botanico 28: 265-329) and the rest in 1953 (Archivio Botanico 29: 1-25, 65-98, 129-174), and the bibliographic reference to Tüxen (1937) is given at p. 173 of volume 29. Pignatti's alliance "*Psammo-Koelerion*" containing the validly published new association "*Tortuleto-Scabiosetum*" being in the first part of his paper, the correct date of this name is 1952 and not 1953. As it does not appear that there is a later, validly published and legitimate name for the "*Psammo-Koelerion* Pignatti 1952", the new name *Syntrichio ruraliformis-Lomelosion argenteae* Biondi, Sburlino et Theurillat in Sburlino, Buffa, Filesi, Gamper et Ghirelli all. nova is published here as a replacing name, its *holotypus* being *Tortulo-Scabiosetum* Pignatti 1952.

*Syntrichio ruraliformis-Lomelosion argenteae* is endemic of the N-Adriatic coastal sand dunes where it replaces the atlantic and north-atlantic *Koelerion arenariae*; differential species of the alliance are the southern and south-eastern European *Lomelosia argentea, Carex liparocarpos, Stachys recta* ssp. *subcrenata* and the endemic *Centaurea tommasinii*. The above-mentioned entities are also considered as character species of *Tortulo-Scabiosetum*.

In our opinion, *Tortulo-Scabiosetum* and *Syntrichio-Lomelosion argenteae* can be attributed to *Artemisio-Koelerietalia albescentis*, an order that includes the atlantic and subatlantic short-grass and cryptogams-rich communities of the fixed coastal dunes (Sissingh, 1974; Géhu, 2006) and that Dengler *et al*. (2003) referred to *Koelerio-Corynephoretea*.

Pignatti (1952, 1959) recognized three subassociations of *Tortulo-Scabiosetum* (*apocynetosum*, *clematidetosum* and *fumanetosum*). In our opinion, the occurrence in some relevés of *Trachomitum venetum* (= *Apocynum venetum* L.), a species that in the study area shows a broad ecologic amplitude, is not sufficient to recognize a distinct subassociation and the *Trachomitum venetum*-rich stands by Pignatti (1959) should be simply attributed to a variant of the association. The *Clematis flammula* subassociation, as explained by

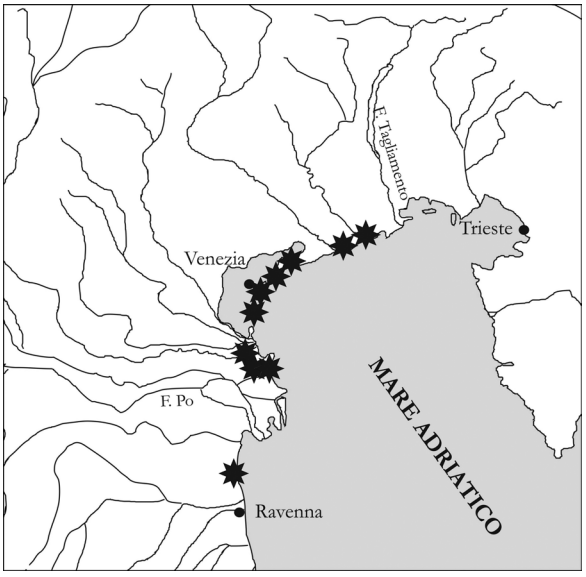


Fig. 4 - Sites of the relevés of *Tortulo-Scabiosetum*.

Tab. 2 - *Tortulo-Scabiosetum* - Rel. 1-21: *Tortulo-Scabiosetum fumanetosum*; rel. 22-39: *Tortulo-Scabiosetum typicum* subass. nova

| | | Number of relevé | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Number of relevé (dendrogram of Fig. 2) | 12 | 70 | 71 | 13 | 18 | 72 | 61 | 66 | 1 | 2 | 3 | 4 | 9 | 10 | 11 | 14 | 8 | 5 | 6 | 7 |
| | | Surface (m2) | 5 | 4 | 10 | 5 | 3 | 10 | 8 | 8 | 2 | 6 | 2 | 3 | 5 | 6 | 3 | 6 | 6 | 3 | 5 | 2 |
| | | Total cover (%) | 100 | 95 | 95 | 95 | 100 | 90 | 95 | 100 | 95 | 95 | 95 | 90 | 85 | 75 | 80 | 95 | 85 | 80 | 90 | 100 |
| | | Cryptogamic cover (%) | 80 | 70 | 70 | 65 | 85 | 80 | 70 | 80 | 50 | 80 | 85 | 70 | 50 | 40 | 60 | 40 | 45 | 75 | 70 | 90 |
| | | Exposure | N | N | NNW | N | N | W | NE | - | N | - | SW | - | NW | NW | - | - | - | NNW | - | SW |
| | | Slope (°) | 5 | 5 | 10 | 30 | 5 | 5 | 15 | - | 5 | - | 5 | - | 5 | 5 | - | - | - | 20 | - | 5 |
| | | Number of species | 17 | 24 | 23 | 23 | 24 | 28 | 23 | 29 | 14 | 22 | 17 | 21 | 18 | 18 | 15 | 22 | 20 | 16 | 18 | 20 |
| | | *Char. and diff. species of Tortulo-Scabiosetum* and *Syntrichio-Lomelosion argenteae* | | | | | | | | | | | | | | | | | | | | |
| H scap | S-Europ.-S-Siber. | Lomelosia argentea (L.) Greuter et Burdet (tg all.) | 1 | 1 | 1 | . | 1 | 2 | 2 | 1 | + | + | . | . | 1 | + | + | + | . | 1 | + | 2 |
| G rhiz | SE-Europ. | Carex liparocarpos Gaudin (tg all.) | 1 | 1 | 1 | + | + | 1 | 1 | 2 | . | + | 2 | 1 | + | 1 | 1 | 3 | . | . | + | . |
| H scap | SE-Europ. | Stachys recta L. ssp. subcrenata (Vis.) Briq. (tg all.) | 1 | . | + | . | . | + | . | + | . | + | . | . | . | + | + | + | . | . | + | + |
| T scap | Stenomedit. | Vicia pseudocracca Bertol. (d) | . | . | . | 1 | + | + | + | . | . | . | . | . | . | + | + | . | + | . | . | . |
| H bienn | End. N-Adr.coast | Centaurea tommasinii Kerner (tg all.) | . | . | 1 | . | 2 | 1 | + | + | . | . | . | . | . | . | . | . | . | . | . | . |
| | | Diff. species of *Tortulo-Scabiosetum fumanetosum* | | | | | | | | | | | | | | | | | | | | |
| Ch suffr | S-Europ.-SW-As. | Fumana procumbens (Dunal) G. et G. | 4 | 3 | 3 | 3 | 1 | + | 3 | 3 | 4 | 5 | 4 | 5 | 2 | 4 | 2 | 4 | 4 | 4 | 4 | 5 |
| Ch suffr | Europ.-Caucas. | Helianthemum nummularium (L.) Miller ssp. obscurum (Celak.) Holub | 2 | 1 | + | 1 | 1 | 2 | 2 | 3 | + | 1 | 1 | 1 | . | 1 | 1 | . | + | . | . | . |
| Ch suffr | Stenomedit. | Teucrium polium L. ssp. capitatum (L.) Arcang. | + | . | + | + | + | . | + | 2 | 3 | + | 3 | . | 3 | 2 | 5 | 3 | . | . | . | . |
| | | *Artemisio-Koelerietalia* and *Koelerio-Corynephoretea* | | | | | | | | | | | | | | | | | | | | |
| Bryoch | Subatl.-Eurimedit. | Syntrichia ruralis (Hedw.) F. Weber et D. Mohr var. ruraliformis (Besch.) Delogne | 5 | 4 | 4 | 4 | 5 | 5 | 4 | 5 | 3 | 5 | 5 | 4 | 3 | 3 | 4 | 3 | 3 | 4 | 4 | 5 |
| T scap | Cosmop. | Cerastium semidecandrum L. | . | + | 1 | + | 1 | + | . | 1 | + | + | . | + | + | . | . | 2 | + | + | . | . |
| H caesp | Paleotemp. | Poa bulbosa L. | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 3 | . | + | . | . | . | 1 | 1 | . | 1 | 2 | . | . |
| T scap | Atl.-Medit. | Phleum arenarium L. | . | . | . | + | + | + | . | + | + | . | 1 | 1 | + | . | . | . | 1 | . | + | . |
| H caesp | S-Europ. | Petrorhagia saxifraga (L.) Link | + | + | . | + | . | . | 1 | + | . | . | + | + | . | . | . | + | 1 | . | + | + |
| T scap | Europ.-W-As. | Silene conica L. | . | + | + | + | + | + | . | . | . | . | . | . | . | + | . | + | . | + | + | + |
| T scap | Eurimedit.-W-As. | Medicago minima (L.) Bartal. | . | . | + | . | . | + | + | . | . | . | + | 1 | . | . | . | . | . | . | + | 1 |
| G rhiz | Circumbor. | Equisetum ramosissimum Desf. | . | + | + | + | . | . | 2 | . | 1 | . | . | + | . | + | . | . | . | . | . | + |
| T scap | S-Europ. | Arenaria serpyllifolia L. | . | 1 | + | . | + | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| H ros | Cosmop. | Plantago lanceolata L. var. sphaerostachya Mert. et Koch | . | . | . | . | . | . | 1 | . | . | + | . | + | . | . | . | . | + | + | . | . |
| T scap | SE-Europ.-S-Siber. | Plantago arenaria Waldst. et Kit. | . | + | + | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| T scap | Eurimedit. | Alyssum alyssoides (L.) L. | . | . | . | . | . | + | . | + | . | . | . | . | . | . | . | . | . | . | . | . |
| T scap | W-Paleotemp. | Trifolium campestre Schreber | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2 | . | . | . |
| T scap | Circumbor. | Erophila verna (L.) DC. | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| T scap | Paleotemp. | Thlaspi perfoliatum L. ssp. perfoliatum | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . |
| T scap | Europ.-Caucas. | Myosotis ramosissima Rochel ex Schult. | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . |
| | | Other species | | | | | | | | | | | | | | | | | | | | |
| T scap | Eurimedit. | Lagurus ovatus L. | + | . | . | + | + | . | + | + | . | . | . | + | + | + | + | 1 | 1 | + | . | + |
| H scap | Subcosmop. | Sanguisorba minor Scop. ssp. muricata (Gremli) Briq. (d) | 1 | 1 | + | 2 | 1 | 1 | . | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | + | + | . | + | . |
| T caesp | Medit.-Atl. | Vulpia membranacea (L.) Link | . | . | . | . | + | . | 1 | + | + | + | + | 1 | + | . | + | + | + | . | . | + |
| H bienn | Europ. | Oenothera stucchii Soldano | + | . | . | . | . | 1 | . | . | + | + | + | + | . | . | . | . | + | + | + | + |
| H scap | Eurimedit. | Silene vulgaris (Moench) Garcke ssp. angustifolia (Miller) Hayek | . | + | . | + | 1 | + | + | + | . | . | . | + | + | . | . | + | 1 | . | . | + |
| G rhiz | N-Amer. | Ambrosia coronopifolia Torr. et Gray | . | . | . | . | . | . | 1 | . | . | + | . | . | . | . | . | 1 | 2 | . | . | . |
| T scap | Euri-Medit.-Turan. | Dasypyrum villosum (L.) Borbás | . | . | . | . | + | + | . | 1 | . | . | . | . | + | 1 | 1 | . | . | + | . | + |
| H ros | Europ.-Caucas. | Hypochoeris radicata L. | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | + | + | . | . | . |
| Ch suffr | Circumbor. | Artemisia campestris L. ssp. campestris | 2 | 2 | 2 | 2 | 1 | 2 | . | + | . | . | . | . | 2 | 2 | 1 | . | . | . | . | . |
| G rhiz | Thermo-Cosmop. | Cynodon dactylon (L.) Pers. | . | . | . | . | + | . | . | + | . | . | . | . | . | . | . | . | . | . | + | 1 |
| T scap | Cosmop. | Conyza canadensis (L.) Cronq. | . | + | . | + | . | + | . | . | . | . | . | + | . | . | . | . | . | + | + | . |
| H scap | Europ.-Caucas. | Hieracium florentinum All. | + | + | . | 1 | . | . | . | . | . | . | . | . | . | . | . | . | + | + | . | + |
| G rhiz | Stenomedit. | Cyperus kalli (Forsskål) Murb. | . | . | . | . | . | . | + | . | . | + | . | . | . | . | . | . | . | 1 | + | . |
| G rhiz | Eurimedit. | Elytrigia atherica (Link) Kerg. | + | + | . | . | . | . | . | . | . | + | + | + | . | . | . | . | . | . | + | . |
| H scap | C-Europ. | Euphorbia cyparissias L. | + | + | + | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . |
| H scap | Eurimedit.-Subatl. | Diplotaxis tenuifolia (L.) DC. | . | . | + | . | . | + | . | . | . | . | + | . | . | . | . | . | . | . | + | + |
| T scap | Eurimedit. | Bromus diandrus Roth | . | . | . | . | + | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| T scap | Eurimedit. | Catapodium rigidum (L.) Hubbard | . | . | . | . | + | . | . | . | . | . | + | + | . | . | . | . | . | . | . | . |
| G bulb | Eurimedit. | Allium sphaerocephalon L. | + | + | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | + | . |
| T scap | Subcosmop. | Bromus hordeaceus L. ssp. hordeaceus | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | + | . | . | . | + |
| H caesp | Paleotemp. | Dactylis glomerata L. | . | . | . | + | . | . | + | . | . | + | . | . | + | . | . | . | . | . | . | . |
| T scap | Stenomedit. | Silene colorata Poiret | . | . | . | . | . | . | . | . | + | + | . | . | . | . | . | . | . | . | . | + |
| Ch suffr | Eurimedit. | Teucrium chamaedrys L. | . | + | + | . | . | . | . | 1 | . | . | . | . | + | 1 | . | . | . | . | . | . |
| T scap | Stenomedit. | Melilotus neapolitana Ten. | . | . | 1 | + | . | . | + | + | . | . | . | . | . | . | . | . | . | . | . | . |
| P lian | Eurimedit. | Clematis flammula L. | . | . | . | . | 1 | 1 | + | + | . | . | . | . | . | + | . | . | . | . | . | . |
| T scap | Eurimedit. | Blackstonia perfoliata (L.) Hudson | . | + | . | + | . | + | + | . | . | . | . | . | . | . | . | . | . | . | . | . |
| G rhiz | SE-Europ.-S-Siber. | Trachomitum venetum (L.) Woodson | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | 1 |
| H bienn | Eurimedit.-Subatl. | Crepis vesicaria L. ssp. taraxacifolia (Thuill.) Thell. | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| | | No. of accidental species | 0 | 2 | 2 | 1 | 1 | 3 | 0 | 4 | 2 | 3 | 3 | 3 | 2 | 0 | 1 | 6 | 2 | 2 | 1 | 1 |

Pignatti (1952, 1959), actually corresponds to a seral stage that shows the dynamic contacts between *Tortulo-Scabiosetum* and the nanophanerophytic and phanerophytic communities (*Erico carneae-Osyridetum, Viburno-Phillyreetum* and *Vincetoxico-Quercetum*).

*Tortulo-Scabiosetum fumanetosum* is instead an ecologically and structurally well-defined community. It was originally described by Pignatti (1952) by means of a synthetic table; the author later gave a detailed description of this subassociation and published an analytic table of 47 relevés (Pignatti, 1959). Actually, Pignatti's table includes relevés in which dwarf shrubs (*Fumana procumbens, Teucrium polium, Helianthemum nummularium*, etc.) play an important role as

| 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 69 | 15 | 16 | 21 | 22 | 23 | 27 | 30 | 17 | 19 | 20 | 64 | 24 | 25 | 28 | 29 | 26 | 31 | 32 | | |
| 4 | 5 | 10 | 6 | 3 | 3 | 5 | 6 | 5 | 4 | 2 | 5 | 5 | 3 | 3 | 2 | 6 | 5 | 5 | | |
| 95 | 85 | 95 | 80 | 85 | 80 | 95 | 85 | 95 | 90 | 100 | 95 | 95 | 100 | 85 | 95 | 80 | 85 | 80 | | |
| 90 | 75 | 90 | 40 | 80 | 20 | 85 | 85 | 80 | 85 | 95 | 70 | 85 | 50 | 80 | 85 | 45 | 70 | 50 | | |
| - | - | - | S | ESE | - | SE | NNW | N | - | - | - | - | - | - | SW | - | - | - | | |
| - | - | - | 5 | 5 | - | 5 | 15 | 5 | - | - | - | - | - | - | 5 | - | - | - | | |
| 17 | 18 | 16 | 17 | 10 | 19 | 19 | 19 | 20 | 19 | 18 | 26 | 16 | 13 | 14 | 20 | 15 | 21 | 22 | Presence | Frequency |
| . | 2 | 3 | 3 | 2 | 3 | 1 | 3 | 2 | + | 2 | 2 | 1 | + | 1 | . | . | . | + | 31 | 79 |
| . | . | . | . | . | . | 1 | . | 1 | 2 | 3 | 2 | 2 | + | . | . | . | 2 | . | 24 | 62 |
| 1 | . | . | . | . | . | . | + | 1 | + | 2 | + | . | . | + | 1 | . | + | + | 20 | 51 |
| . | . | . | + | . | . | . | . | . | + | . | + | + | . | . | . | + | . | + | 13 | 33 |
| . | . | . | . | . | . | + | . | 1 | . | . | + | . | . | . | . | . | + | + | 10 | 26 |
| 5 | . | . | . | . | . | . | + | . | . | + | . | . | . | + | + | . | . | . | 25 | 64 |
| . | . | . | . | . | . | . | . | 1 | 1 | . | . | . | . | . | . | . | + | 1 | 19 | 49 |
| . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | 14 | 36 |
| 5 | 4 | 5 | 3 | 5 | 2 | 5 | 5 | 5 | 5 | 5 | 4 | 5 | 3 | 5 | 5 | 3 | 4 | 3 | 39 | 100 |
| + | . | . | 1 | 1 | + | 1 | + | + | 1 | + | 1 | 1 | 2 | + | 1 | 2 | . | . | 28 | 72 |
| 1 | . | + | + | . | 3 | 1 | 2 | 3 | 2 | 1 | 2 | 1 | 1 | 2 | 1 | . | . | . | 27 | 69 |
| . | 1 | 1 | 2 | + | + | + | + | + | + | . | + | + | + | + | . | 1 | 1 | + | 26 | 67 |
| . | + | + | 1 | . | . | . | + | + | . | + | + | 1 | + | . | + | . | . | + | 22 | 56 |
| + | + | . | + | + | + | . | . | . | + | . | . | + | 1 | + | 1 | . | + | + | 22 | 56 |
| + | + | + | + | . | 2 | 1 | + | . | + | . | . | + | . | . | + | . | . | . | 17 | 44 |
| 1 | . | . | . | . | . | 1 | . | . | . | . | + | . | . | 1 | + | . | . | + | 14 | 36 |
| . | + | . | . | . | + | + | . | . | + | + | + | . | . | . | . | + | + | . | 12 | 31 |
| . | + | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | 7 | 18 |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 3 | 8 |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2 | 5 |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1 | 3 |
| . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | 1 | 3 |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1 | 3 |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1 | 3 |
| + | 1 | 1 | + | 1 | 2 | 1 | 2 | + | + | + | 1 | 1 | 2 | + | + | 3 | 1 | . | 31 | 79 |
| . | + | 1 | . | . | 1 | 1 | . | 2 | 1 | 1 | 1 | . | . | . | + | . | + | 1 | 28 | 72 |
| + | 1 | 2 | + | 1 | 2 | . | + | + | . | . | . | + | + | . | + | 3 | 1 | . | 25 | 64 |
| + | + | + | + | 1 | + | 1 | 1 | . | . | + | + | . | . | + | + | + | + | + | 25 | 64 |
| + | + | + | + | + | 1 | . | . | 1 | . | + | + | . | + | . | . | + | 1 | + | 24 | 62 |
| . | 2 | 2 | + | 1 | 1 | + | . | . | . | . | . | 2 | + | . | . | 1 | 1 | . | 14 | 36 |
| + | . | + | . | . | . | . | + | + | 1 | . | . | . | . | . | . | . | . | + | 14 | 36 |
| . | 1 | + | . | . | + | . | . | . | . | . | + | + | + | . | . | . | 1 | + | + | 12 | 31 |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1 | 11 | 28 |
| 1 | . | . | . | . | . | + | . | . | . | . | + | + | . | . | + | 1 | . | . | . | 10 | 26 |
| . | . | . | . | . | . | . | 1 | + | . | . | . | . | . | . | + | + | . | . | . | 10 | 26 |
| . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | + | + | 9 | 23 |
| . | + | + | . | . | . | . | 1 | . | . | . | . | . | . | . | . | . | . | + | . | 8 | 21 |
| . | . | . | . | . | . | . | . | . | . | . | + | + | . | . | . | . | . | . | . | 8 | 21 |
| . | . | . | . | . | . | . | . | + | + | . | . | . | . | . | . | . | . | . | + | 7 | 18 |
| . | . | . | . | . | . | . | . | + | . | . | + | . | . | . | . | . | . | . | . | 7 | 18 |
| + | + | . | . | . | + | + | . | . | . | . | . | . | . | . | . | 2 | . | . | . | 7 | 18 |
| . | . | . | + | . | 1 | + | . | . | . | . | . | . | . | . | . | . | . | . | . | 6 | 15 |
| . | . | . | . | . | . | . | 1 | . | . | . | + | . | . | . | . | . | . | . | . | 6 | 15 |
| + | . | . | . | . | . | . | . | + | . | . | . | . | . | . | + | . | . | . | . | 6 | 15 |
| . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | + | 6 | 15 |
| . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . | . | . | 5 | 13 |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 5 | 13 |
| . | . | . | . | . | . | . | . | . | . | . | . | . | 2 | . | . | . | . | . | . | 5 | 13 |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 5 | 13 |
| . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 4 | 10 |
| . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | + | . | . | . | . | 4 | 10 |
| . | . | . | . | . | + | + | . | . | . | + | + | . | . | . | . | . | . | . | . | 4 | 10 |
| 1 | 0 | 1 | 2 | 0 | 1 | 0 | 2 | 1 | 2 | 1 | 2 | 1 | 0 | 1 | 2 | 3 | 4 | 3 | | |

well as ones in which the chamaephytic component is poor or lacking. The occurrence of two structurally well-distinct communities has been confirmed during the present study; indeed, the cluster analysis of the current relevés divides the stands of *Tortulo-Scabiosetum* into two groups (rel. 1-66 and rel. 15-32 of the dendrogram of Fig. 2), respectively differentiated by the chamaephytic abundance and poorness. Therefore, we consider that *Tortulo-Scabiosetum fumanetosum* can be divided in two distinct subassociations: *Tortulo-Scabiosetum fumanetosum* and *Tortulo-Scabiosetum typicum* subass. nova [*holotypus* rel. 141 of Tab. 5 in Pignatti (1959), the same relevé being considered also as the *neotypus* of the association *Tortulo-Scabiosetum*]. The chamaephytes-rich stands (*Tortulo-Scabiosetum fumanetosum*) (rel.1-21 of Tab 2) correspond to more evolved samples as indicated by soil major development; yet, in this case, the target soils (Inceptisols -Typic Haploxerepts) are more structured and richer in organic matter in comparison to sandy Entisols (Typic Xeropsamments), where the *Tortulo-Scabiosetum typicum* occurs (rel. 22-39 of Tab 2). In both subassociations the thick cryptogams layer significantly contributes to soil stabilization and to the development of the phanerogamic vegetation (Ronnot, 1975; Ellenberg, 1988; Turetsky, 2003; Provoost *et al*., 2004; Esposito & Filesi, 2007).

Finally, in our opinion at least the cryptogams-rich relevés that Gerdol & Piccoli (1984) and Piccoli & Merloni (1989) referred to a different association belonging to *Koelerio-Corynephoretea* (*Bromo tectorum-Phleetum arenarii*) should instead be attributed to *Tortulo-Scabiosetum*; actually, *Bromo tectorum-Phleetum arenarii* is an inland community described for Central and Central-West Germany (Kornek, 1974), in which species such as *Carex liparocarpos, Lagurus ovatus, Lomelosia argentea, Vicia pseudocracca, Vulpia membranacea, Teucrium polium* and *Stachys recta* are completely lacking.

***Syndinamic***: *Tortulo-Scabiosetum* belongs both to the holm-oak wood edaphoxerophilous series (*Vincetoxico-Querco ilicis sigmetum*) and to the common juniper scrub edaphoxerophilous series (*Junipero-Hippopho fluviatilis sigmetum*).

***Synchorology***: it is an endemic association of the N-Adriatic coast where inhabits the inner grey dunes and the paleodunes of Emilia-Romagna and Veneto; the occurrence of the association in Friuli has been recorded by Tomasella *et al*. (2007). As well as *Teucrio-Chrysopogonetum*, *Tortulo-Scabiosetum* is a threatened community due to the human alterations of the dunal systems (tourism, trampling, forestry) and to the development of shrub and woody vegetation (Géhu *et al*., 1984a; Buffa *et al*., 2005, 2007, 2012; Prisco *et al*., 2012).

***Chorological spectrum***: Eurimediterrane-

an 20.6%, Eurasiatic 17.2%, Mediterranean-Atlantic 13.4%, Cosmopolitan and Subcosmopolitan 12.1%, Eastern 11.2%, European 10.5%, Stenomediterranean 6.9%, Circumboreal 3.9%, Alien 2.8%, Endemic of N-Adriatic coast 1.3%.

***Natura 2000 Habitat***: 2130*

***Nomenclatural note***: since the name *Tortulo-Scabiosetum fumanetosum* has not been so far typified, the rel. 161 of Tab. 5 in Pignatti (1959) is indicated as neotypus of this subassociation (Art. 21).

*SILENO CONICAE-AVELLINIETUM MICHELII* ass. nova (Tab. 3, rel. 1-16; Fig. 5)

***Physiognomy and structure***: spring discontinuous community dominated by annual short herbs and grasses (*Avellinia michelii, Vulpia fasciculata, Cerastium semidecandrum, Phleum arenarium, Silene conica*) whose physiognonomy is neverthless determined even by some perennial species (*Carex liparocarpos, Poa bulbosa, Sanguisorba minor* ssp. *muricata, Cynodon dactylon*).

***Biological spectrum***: therophytes 74.6%; hemicryptophytes 16.6%; geophytes 5.7%; bryochamaephytes 1.7%; chamaephytes 1.4%.

***Syntaxonomy and nomenclature***: the community shows a rather close floristic affinity with the "Ass. a *Vulpia fasciculata* e *Silene sericea*" described by Pignatti (1953) on the basis of a synthetic table (8 relevés in all). Indeed, both communities show a high frequency of V*ulpia membranacea, Silene conica, Poa bulbosa, Cynodon dactylon* and *Phleum arenarium* and the presence, even if not always with similar frequency values, of several other species such as *Cerastium semidecandrum, Lomelosia argentea, Equisetum ramosissimum, Catapodium rigidum, Silene vulgaris* ssp. *angustifolia*, etc.; the cryptogamic cover is in both cases reduced or absent. By contrast, *Silene colorata* occurs in our relevés only sporadically and other strictly littoral species (*Medicago litoralis* Rohde and *Ammophila arenaria* (L.) Link) are completely absent; the current stands are also differentiated by the high frequency of *Avellinia michelii, Sanguisorba minor* ssp. *muricata* and, secondly, *Carex liparocarpos* and *Plantago arenaria*, that do not occur in the table by Pignatti (1953). In spite of the complexity of Pignatti's table, which clearly includes samples collected both in the white and in the grey dune sectors, in a first time we agreed to refer our relevés to the above-mentioned association; some doubts nevertheless arised, especially in regards to later syntaxonomic interpretations of the Pignatti's association proposed by some authors. In fact, Géhu & Scoppola in Géhu *et al.* (1984a) corrected the name in *Sileno coloratae-Vulpietum membranaceae* and designated as the nomenclatural *typus* (*neotypus*) a relevé lacking many of the species quoted in the original table by Pignatti (1953) and evidently made in contact with the *Ammophiletea* communities, in the same way as the remaining stands of their association table. Also the reports of this community in different sectors of the Italian coast (Pirone, 1983; Stanisci & Conti, 1990; Corbetta *et al.*, 1992, 2004; Vagge & Biondi, 1999; Blasi *et al.*, 2002; Maiorca *et al.*, 2002) actually refer to coenoses in which the strictly littoral floristic element largely prevails over the one of fixed inner dunes; however, the attribution of these communities to *Sileno coloratae-Vulpietum* must be considered correct and in accordance with the Art. 15 of the International Code of Phytosociological Nomenclature (Weber *et al.*, 2000).

For reasons of syntaxonomic clarity and for the above-mentioned remarks, the association described by Pignatti (1953) may be conveniently divided in two distinct associations. The first (*Sileno coloratae-Vulpietum membranaceae*) corresponds to the samples closest to the shore line and retains the *typus* designated by Géhu & Scoppola in Géhu *et al.* (1984a); it is widely distributed along the Italian coast and in the N-Adriatic sector occurs both in the white and grey dunes which are close to the sea. The second, named *Sileno conicae-Avellinietum michelii* ass. nova (*holotypus*: rel. 8 of Tab. 3, this paper), develops only on the inner N-Adriatic fixed dunes and is differentiated by species coming from *Tortulo-Scabiosetum* or *Teucrio-Chrysopogonetum* (*Carex liparocarpos, Poa bulbosa, Sanguisorba minor* ssp. *muricata*), showing the spatial and seral relationships between these communities; *Silene conica*, which in this context seems to replace *S. colorata*, may be also considered as a differential species of *Sileno-Avellinietum*. The presence, mostly with high frequency values, of the stenomediterra-

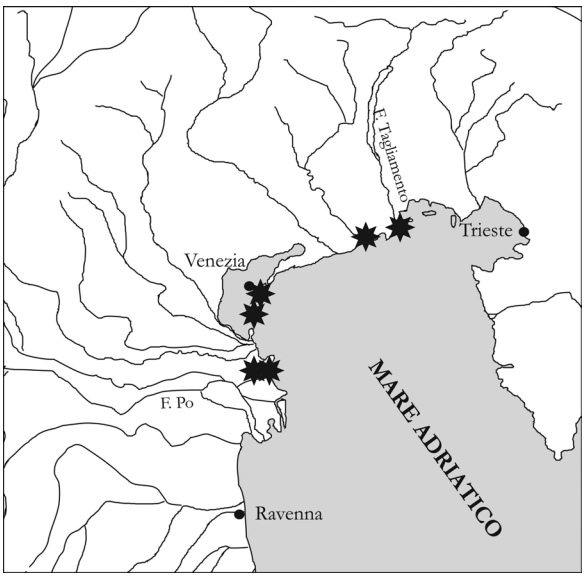


Fig. 5 - Sites of the relevés of *Sileno conicae-Avellinietum michelii*.

Tab. 3 - *Sileno conicae-Avellinietum michelii* ass. nova

| | | Number of relevé | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Number of relevé (dendrogram of Fig. 2) | 47 | 50 | 48 | 49 | 73 | 55 | 56 | 60 | 63 | 65 | 67 | 68 | 51 | 52 | 53 | 54 | | |
| | | Surface (m2) | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 4 | 2 | Presence | Frequency |
| | | Total cover (%) | 50 | 40 | 30 | 35 | 40 | 30 | 40 | 40 | 50 | 45 | 40 | 25 | 40 | 25 | 40 | 30 | | |
| | | Cryptogamic cover (%) | 5 | - | - | - | - | - | 5 | - | 10 | - | - | - | 5 | - | - | - | | |
| | | Exposure | - | - | - | - | - | - | ENE | - | - | W | - | - | - | - | - | - | | |
| | | Slope (°) | - | - | - | - | - | - | 5 | - | - | 5 | - | - | - | - | - | - | | |
| | | Number of species | 21 | 13 | 15 | 21 | 18 | 18 | 19 | 20 | 19 | 16 | 12 | 11 | 18 | 13 | 14 | 18 | | |
| | | Diff. species of *Sileno conicae-Avellinietum michelii* | | | | | | | | | | | | | | | | | | |
| T scap | Stenomedit. | Avellinia michelii (Savi) Parl. | + | + | 2 | 1 | 2 | 1 | 2 | + | . | . | + | + | 1 | 1 | 2 | 2 | 14 | 88 |
| T scap | Europ.-W-As. | Silene conica L. | + | 1 | + | + | + | + | 1 | + | 1 | + | + | + | + | + | + | + | 16 | 100 |
| H scap | Subcosmop. | Sanguisorba minor Scop. ssp. muricata (Gremli) Briq. | . | + | . | + | . | + | + | 1 | . | . | + | . | 1 | + | + | + | 10 | 63 |
| H caesp | Paleotemp. | Poa bulbosa L. | 2 | + | . | . | + | 2 | 1 | + | 1 | 2 | + | . | . | . | . | . | 9 | 56 |
| G rhiz | SE-Europ. | Carex liparocarpos Gaudin | . | . | . | 1 | . | . | + | 1 | . | + | . | + | + | + | . | . | 7 | 44 |
| | | Char. species of *Laguro ovati-Vulpion, Malcomietalia* and *Tuberarietea guttatae* | | | | | | | | | | | | | | | | | | |
| T caesp | Medit.-Atl. | Vulpia membranacea (L.) Link | 2 | 2 | + | 1 | + | 1 | 2 | 2 | 1 | . | 2 | 1 | 2 | 1 | + | + | 15 | 94 |
| T scap | Eurimedit. | Catapodium rigidum (L.) Hubbard | . | . | + | + | 1 | . | . | 1 | + | . | . | + | + | . | . | 2 | 8 | 50 |
| T scap | Eurimedit. | Lagurus ovatus L. | . | . | . | . | + | + | . | . | + | + | 1 | 1 | . | . | . | . | 6 | 38 |
| T scap | Stenomedit. | Clypeola jonthlaspi L. | . | . | . | . | . | . | . | + | + | + | . | . | . | . | . | . | 3 | 19 |
| T scap | Stenomedit. | Silene colorata Poiret | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | 1 | 6 |
| | | Other species | | | | | | | | | | | | | | | | | | |
| T scap | Atl.-Medit. | Phleum arenarium L. | + | 2 | 2 | 2 | + | + | 1 | 2 | 2 | + | + | . | + | + | + | + | 15 | 94 |
| T scap | Cosmop. | Cerastium semidecandrum L. | 1 | + | + | 1 | + | 1 | 2 | 1 | 2 | 2 | 2 | 2 | + | . | + | + | 15 | 94 |
| T scap | Eurimedit.-W-As. | Medicago minima (L.) Bartal. | + | + | + | + | 1 | 1 | + | + | + | + | . | . | . | . | + | . | 11 | 69 |
| T scap | N-C-Amer. | Cenchrus longispinus (Hack.) Fernald | . | . | 1 | + | . | + | 1 | 1 | 1 | + | . | . | + | + | 1 | + | 11 | 69 |
| G rhiz | Thermo-Cosmop. | Cynodon dactylon (L.) Pers. | . | . | + | 2 | + | 1 | + | + | . | + | . | . | . | 1 | + | . | 9 | 56 |
| H scap | S-Europ.-S-Siber. | Lomelosia argentea (L.) Greuter et Burdet | . | . | + | + | 2 | + | 1 | . | + | . | . | . | . | . | . | . | 6 | 38 |
| T scap | SE-Europ.-S-Siber. | Plantago arenaria Waldst. et Kit. | 1 | . | . | + | 1 | . | . | . | . | . | . | . | + | + | 3 | . | 6 | 38 |
| H scap | Eurimedit. | Silene vulgaris (Moench) Garcke ssp. angustifolia (Miller) Hayek | . | . | . | + | . | + | + | + | . | . | + | . | . | + | . | . | 6 | 38 |
| Ch suffr | Europ.-Caucas. | Helianthemum nummularium (L.) Miller ssp. obscurum (Celak.) Holub | . | . | . | + | . | . | . | + | . | . | . | . | 1 | + | + | . | 5 | 31 |
| T scap | S-Europ. | Arenaria serpyllifolia L. | + | . | + | + | + | . | . | . | + | . | . | . | . | . | . | . | 5 | 31 |
| H bienn | Europ. | Oenothera stucchii Soldano | + | . | . | . | . | . | + | + | 1 | . | . | . | . | . | . | + | 5 | 31 |
| T scap | Cosmop. | Conyza canadensis (L.) Cronq. | + | + | + | . | + | . | . | . | . | . | . | . | . | . | . | + | 5 | 31 |
| Ch suffr | S-Europ.-SW-As. | Fumana procumbens (Dunal) G. et G. | . | . | . | . | . | + | . | . | . | . | . | . | + | . | 1 | + | 4 | 25 |
| Bryoch | Subatl.-Eurimedit. | Syntrichia ruralis (Hedw.) F. Weber et D. Mohr var. ruraliformis (Besch.) | 1 | . | . | . | . | . | 1 | . | 1 | . | . | . | 1 | . | . | . | 4 | 25 |
| G rhiz | Circumbor. | Equisetum ramosissimum Desf. | . | . | . | . | + | . | . | + | . | + | . | . | . | . | . | + | 4 | 25 |
| T scap | Euri-Medit.-Turan. | Dasypyrum villosum (L.) Borbás | . | + | + | + | + | . | . | . | . | . | . | . | . | . | . | . | 4 | 25 |
| T scap | Subcosmop. | Bromus hordeaceus L. ssp. hordeaceus | + | . | + | + | . | . | . | + | . | . | . | . | . | . | . | . | 4 | 25 |
| T scap | Stenomedit. | Melilotus neapolitana Ten. | + | + | . | + | + | . | . | . | . | . | . | . | . | . | . | . | 4 | 25 |
| T scap | Paleotemp. | Bromus tectorum L. | 1 | + | + | + | . | . | . | . | . | . | . | . | . | . | . | . | 4 | 25 |
| T scap | Eurimedit. | Buglossoides arvensis (L.) Johnston | . | . | . | . | . | . | + | + | . | + | + | . | . | . | . | . | 4 | 25 |
| T scap | N-Amer. | Ambrosia artemisiifolia L. | . | . | . | . | . | . | . | . | . | . | . | . | + | 1 | 1 | 1 | 4 | 25 |
| | | No. of accidental species | 6 | 1 | 0 | 1 | 1 | 4 | 3 | 1 | 4 | 4 | 2 | 4 | 4 | 1 | 1 | 5 | | |

nean *Avellinia michelii* and of *Vulpia membranacea, Catapodium rigidum* and *Lagurus ovatus* suggests the attribution of the association to *Tuberarietea guttatae* (*Laguro-Vulpion, Malcomietalia*); even the community structure, characterized by the absence or by a very low cover of a cryptogamic layer, has in our opinion an important role in favor of the attribution to *Tuberarietea* rather than to *Koelerio-Corynephoretea*. Although, the remarkable significance of the species belonging to this latter class in the differentiation of this community if compared to *Sileno coloratae-Vulpietum* is undeniable.

The community develops as a result of the destructuration of *Tortulo-Scabiosetum* and of *Teucrio-Chrysopogonetum* caused by wind erosion or, more frequently, by trampling as shown by the high frequency in the relevés of *Cynodon dactylon* and *Cenchrus longispinus*. It develops on soils that correspond to Typic Xeropsamments, less developed, more shallow and permeable if compared to the ones of *Tortulo-Scabiosetum typicum*. In our opinion, some of the relevés with low or no cryptogamic cover that Gerdol & Piccoli (1984) and Piccoli & Merloni (1989) ascribed to *Bromo tectorum-Phleetum arenarii* actually correspond to *Sileno conicae-Avellinietum*; in the same way, the report of *Sileno conicae-Cerastietum semidecandri* for the Friulian coast by Tomasella *et al*. (2007) should be attributed to the here described association (L. Poldini *in verbis*).

***Syndinamic:*** *Sileno-Avellinietum* belongs both to the holm-oak wood edaphoxerophilous series (*Vincetoxico-Querco ilicis sigmetum*) and to the common juniper scrub edaphoxerophilous series (*Junipero-Hippopho fluviatilis sigmetum*).

***Synchorology:*** it is an endemic association of the N-Adriatic coast where inhabits the inner grey dunes and the paleodunes of Emilia-Romagna, Veneto and Friuli.

***Chorological spectrum:*** Eurasiatic 19.9%, Cosmopolitan and Subcosmopolitan 18%, Eurimediterranean 14.7%, Mediterranean-Atlantic 13.5%, Stenomediterranean 9.8%, Eastern 8.3%, Alien 6.4, European 6%, Circumboreal 3%, Endemic of N-Adriatic coast 0.4%.

***Natura 2000 Habitat***: 2230

### *The chamaephytic fringes of the common juniper coast scrub*

*HELICHRYSUM ITALICUM* SSP. *ITALICUM* community (Tab. 4, rel. 1-4; Fig. 6)

The community corresponds to the chamaephytic fringe of the common juniper scrub (*Junipero-Hippophaetum fluviatilis*); the structure is determined by the dominance of *Helichrysum italicum* ssp. *italicum* and, subordinately, by *Teucrium chamaedrys, Helianthemum nummularium* ssp. *obscurum* and by climbing evergreens (*Rubia peregrina* and *Asparagus acutifolius*). The hemicryptophytes *Silene vulgaris* ssp. *angustifolia* and *Petrorhagia saxifraga* are also very frequent. The chamaephytic structure, the significance of the Mediterranean element and the syntaxonomic role of the dominant species suggest to refer this coenosis to *Helichryso-Crucianelletea*.

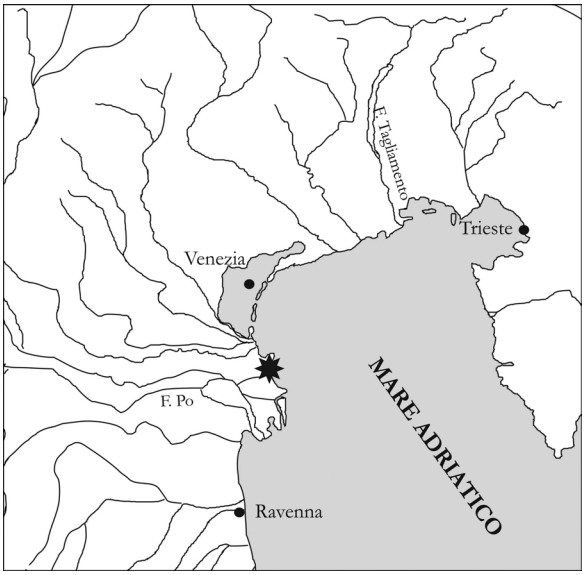


Fig. 6 - Site of the relevés of the *Helichrysum italicum* community.

Tab. 4 - *Helichrysum italicum* community

| | | Number of relevé | 1 | 2 | 3 | 4 | |
|---|---|---|---|---|---|---|---|
| | | Surface (m2) | 2 | 2 | 3 | 1,5 | |
| | | Total cover (%) | 90 | 100 | 100 | 90 | |
| | | Exposure | E | - | SSE | - | Presence |
| | | Slope (°) | 15 | - | 5 | - | |
| | | Number of species | 11 | 13 | 12 | 10 | |
| Ch suffr | S-Europ. | Helichrysum italicum (Roth) Don ssp. italicum | 4 | 4 | 5 | 5 | 4 |
| G rhiz | Steno-Medit. | Asparagus acutifolius L. | 1 | 2 | 1 | + | 4 |
| P lian | Steno-Medit. | Rubia peregrina L. | 2 | + | 2 | + | 4 |
| Ch suffr | Euri-Medit. | Teucrium chamaedrys L. | 1 | 1 | 1 | 1 | 4 |
| H scap | Euri-Medit. | Silene vulgaris (Moench) Garcke ssp. angustifolia (Miller) Hayek | 1 | + | + | + | 4 |
| G rhiz | Euri-Medit. | Elytrigia atherica (Link) Kerg. | + | + | 1 | + | 4 |
| Ch suffr | Eur.-Caucas. | Helianthemum nummularium (L.) Miller ssp. obscurum (Celak.) Holub | 1 | 1 | . | 1 | 3 |
| H caesp | S-Europ. | Petrorhagia saxifraga (L.) Link | + | + | + | . | 3 |
| NP | Euri-Medit. | Rubus ulmifolius Schott | . | 1 | 1 | . | 2 |
| P caesp | Steno-W-Medit. | Phillyrea angustifolia L. | 1 | . | . | + | 2 |
| T scap | Euri-Medit. | Lagurus ovatus L. | + | . | + | . | 2 |
| G rhiz | SE-Europ. | Carex liparocarpos Gaudin | + | . | . | + | 2 |
| G rhiz | Circumbor. | Equisetum ramosissimum Desf. | . | + | + | . | 2 |
| NP | Europ.-W-As. | Ligustrum vulgare L. | . | + | + | . | 2 |
| P lian | Euri-Medit. | Lonicera etrusca Santi | . | . | 1 | . | 1 |
| P lian | Euri-Medit. | Clematis flammula L. | . | + | . | . | 1 |
| H caesp | Paleotemp. | Dactylis glomerata L. | . | + | . | . | 1 |
| G rhiz | N-Amer. | Ambrosia coronopifolia Torr. et Gray | . | . | . | + | 1 |

This *Helichrysum italicum*-rich community belongs to the common juniper scrub edaphoxerophilous series (*Junipero-Hippopho fluviatilis sigmetum*) and only occurs in the southern sector of the study area, at the northern limit of the Italian distribution of *Helichrysum italicum*.

***Natura 2000 Habitat***: 2210

### *The communities of the interdunal wetlands*

#### *The herbaceous communities*

*CYPERETUM FLAVESCENTIS* Koch ex Aichinger 1933 (Tab. 5; Fig. 7)

This association inhabits trampled areas within the purple moorgrass meadows and the freshwater saw sedge swamps, on sandy soils rich in undecomposed organic matter. The community is dominated by therophytes with the participation of perennials tolerant to trampling (*Plantago major* ssp. *intermedia, Juncus articulatus, Cynodon dactylon*). The floristic composition and the ecology of the single relevé of Tab. 5 well correspond to the original description of the association by Koch (1926) and to the samples collected by Piccoli & Merloni (1989) in neighbouring areas of the N-Adriatic coast.

***Synchorology***: the association has so far only been identified in the northern and southern sectors of the study area.

***Natura 2000 Habitat***: 3130

*PLANTAGINI ALTISSIMAE - MOLINIETUM CAERULEAE* Marchiori et Sburlino 1982 (Tab. 6, rel. 1-6; Fig. 8)

Hygrophilous grassland whose physiognomy is determined by *Molinia caerulea* and, subordinately, by *Schoenus nigricans*. This community mainly occurs in inland areas of the eastern Po plain (Marchiori & Sburlino, 1982; Sburlino *et al*., 1995, 1996) and has been recently recognized also in western Slovenia (Zelnik & Čarni, 2008; Šilc & Čarni, 2012). This peculiar kind of litter meadow has at present almost disappeared due to the abandonment of traditional agricultural methods, in particular mowing with the removal of the straw from the meadow (Buffa *et al*., 1997).

In the study area, two distinct subassociations may be recognized: the more hygrophilous *Plantagini-Molinietum cladietosum marisci*, which was described by Sburlino *et al*. (1995) in the spring area of the Venetian and Friulian plains, and the *Plantagini-Molinietum chrysopogonetosum grylli* subass. nova (*holotypus*: rel. 5 of Tab. 6, this paper). This latter subassociation inhabits areas that are subjected to more prolonged aridity and is differentiated by species such as *Chrysopogon gryllus, Erica carnea* and *Galium verum* (rill. 4-6); these stands correspond to the *Eu-Molinietum caeru-*

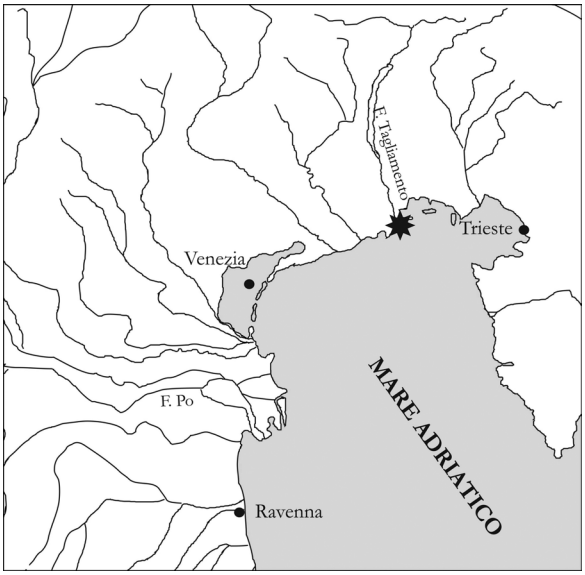


Fig. 7 - Site of the relevé of *Cyperetum flavescentis*.

Tab. 5 - *Cyperetum flavescentis*

| | | | |
|---|---|---|---|
| | | Number of relevé | 1 |
| | | Surface ($m^2$) | 1 |
| | | Total cover (%) | 40 |
| | | Number of species | 10 |
| | | Char. species of *Cyperetum flavescentis* | |
| T caesp | Subcosmop. | Cyperus flavescens L. (tg All.) | 3 |
| | | Char. species of *Nanocyperion, Nanocyperetalia* and *Isoeto-Nanojuncetea* | |
| T caesp | Cosmop. | Juncus bufonius L. | 1 |
| T scap | Paleotemp. | Centaurium pulchellum(Sw.) Druce | + |
| | | Other species | |
| H ros | Euras. | Plantago major L. ssp. intermedia (Godr.) Lange | 1 |
| G rhiz | Circumbor. | Juncus articulatus L. | 1 |
| G rhiz | Thermo-Cosmop. | Cynodon dactylon (L.) Pers. | + |
| H scap | Euras. | Potentilla erecta (L.) Räuschel | + |
| H caesp | Cosmop. | Samolus valerandi L. | + |
| G rhiz | Europ.-Caucas. | Juncus subnodulosus Schrank | + |
| T scap | Eurimedit. | Blackstonia perfoliata (L.) Hudson | + |

*leae andropogonetosum* that Pignatti (1953) described for the eastern Venetian plain as a provisional syntaxon.

This purple moorgrass meadows develop on Mollisols (Typic Endoaquolls and Oxyaquic Hapludolls) with subalkaline reaction and enriched in organic matter.

***Synchorology***: the association only occurs in small areas near the mouth of the Tagliamento River, where the freshwater-table is close to the surface(Buffa *et al*., 2007).

***Natura 2000 Habitat***: 6410

*ERUCASTRO - SCHOENETUM NIGRICANTIS* Poldini 1973 (Tab. 6, rel. 7; Fig. 8)

This rare neutro-alkaline fen association usually occurs in inland spring areas of the eastern Po plain (Poldini, 1973; Sburlino & Ghirelli, 1995; Sburlino *et al*., 1996; Sarzo *et al*., 1999) but may be observed even in very narrow areas of the Venetian coast (Bini *et al*., 2002a; Buffa *et al*., 2007).

If compared with other *Schoenus nigricans*-rich communities belonging to *Caricion davallianae, Erucastro-Schoenetum* is differentiated by rare endemic species such as *Erucastrum palustre* (Pirona) Vis., *Centaurea forojuliensis* Poldini and *Armeria helodes* Martini et Poldini (Poldini, 1977; Martini & Poldini, 1986, 1987) and by *Euphrasia marchesettii*, whose distribution area includes eastern Lombardy, Veneto, Friuli and south-west Slovenia (Ghirelli *et al*., 1995; Wraber, 2006). The relevé of Tab. 6 represents the unique sample so far known for the N-Adriatic coast and was made in a small depression within the *Plantagini-Molinietum*; the presence in this stand of demontane species (*Primula farinosa, Parnassia palustris, Tofieldia calyculata*) and of *Anagallis tenella*, an Atlantic entity which reaches in this area the eastern limit of distribution, is particularly noteworthy.

***Synchorology***: the association only occurs in a small area near the mouth of the Tagliamento River.

***Natura 2000 Habitat***: 7230

*MARISCETUM SERRATI* Zobrist 1935 (Tab. 7, rel. 1-2; Fig. 9) and S*ONCHO MARITIMI-CLADIETUM MARISCI* (BR.-BL. et O. Bolòs 1958) Cirujano 1980 (Tab. 7, rel. 3-6; Fig. 9)

*Mariscetum serrati* is a freshwater association that inhabits hydromorphic, carbonate-rich and nutrient-poor areas near springs or along the banks of ponds and lakes (Bálatová-Tuláčková *et al*., 1993; Sburlino *et al*., 1996; Venanzoni *et al*., 2003). The reported samples develop on soils that accumulate large amounts of slightly decomposed organic matter at surface (Histosols - Hydric Haplofibrists). This Submediterranean-Subatlantic community (Bálatová-Tuláčková,

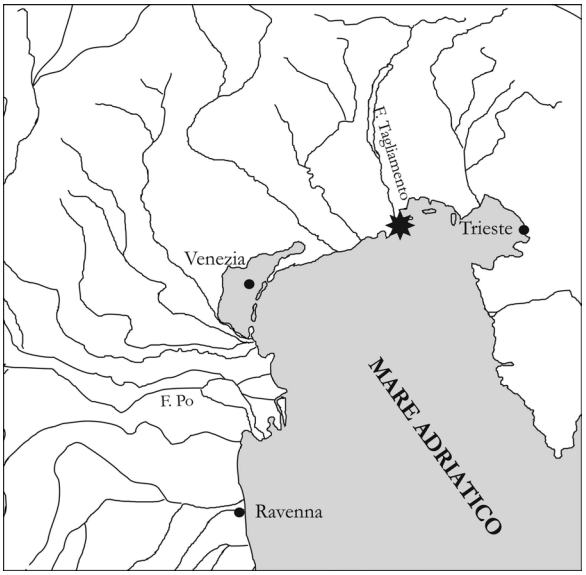


Fig. 8 - Sites of the relevés of *Plantagini altissimae-Molinietum caeruleae* and *Erucastro-Schoenetum nigricantis*.

Tab. 6 - Rel. 1-6: *Plantagini altissimae-Molinietum caeruleae* (rel. 1-3: *Plantagini altissimae-Molinietum caeruleae cladietosum marisci*, rel. 4-6: *Plantagini altissimae-Molinietum caeruleae chrysopogonetosum grylli* subass. nova); rel. 7: *Erucastro-Schoenetum nigricantis*

| | | Number of relevé | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Surface (m2) | 30 | 35 | 40 | 20 | 30 | 20 | 4 | |
| | | Total cover (%) | 100 | 100 | 90 | 100 | 100 | 100 | 80 | |
| | | Number of species | 23 | 28 | 25 | 18 | 16 | 19 | 15 | Presence |
| | | Char. species of *Plantagini altissimae-Molinietum caeruleae* | | | | | | | | |
| H caesp | Circumbor. | Molinia caerulea (L.) Moench (tg All.) | 4 | 4 | 3 | 3 | 4 | 2 | + | 7 |
| H ros | SE-Europ. | Plantago altissima L. | 2 | + | + | . | . | . | . | 3 |
| | | Diff. species of *Plantagini altissimae-Molinietum caeruleae cladietosum marisci* | | | | | | | | |
| G rhiz | Subcosmop. | Cladium mariscus (L.) Pohl | 1 | 2 | 2 | . | . | . | 2 | 4 |
| | | Diff. species of *Plantagini altissimae-Molinietum caeruleae chrysopogonetosum grylli* | | | | | | | | |
| H caesp | S-Europ.-S-Siber. | Chrysopogon gryllus (L.) Trin. | . | . | . | 3 | 2 | 3 | . | 3 |
| Ch suffr | Oroph. S-Europ. | Erica carnea L. | . | . | . | 2 | 2 | 3 | . | 3 |
| H scap | Euras. | Galium verum L. ssp. verum | + | . | . | 2 | 1 | 1 | . | 4 |
| | | Char. species of *Molinion caeruleae* and *Molinietalia caeruleae* | | | | | | | | |
| H scap | Eurosib. | Serratula tinctoria L. | 1 | 1 | 1 | + | + | 1 | . | 6 |
| G rhiz | Circumbor. | Epipactis palustris (Miller) Crantz | 1 | + | + | . | + | . | + | 5 |
| G bulb | C-Europ. | Gladiolus palustris Gaudin | + | + | + | + | . | + | . | 5 |
| Ch suffr | Euras. | Genista tinctoria L. | + | . | . | + | + | + | . | 4 |
| G bulb | SE-Europ. | Allium suaveolens Jacq. | 1 | + | + | . | . | . | . | 3 |
| H scap | Eurosib. | Gentiana pneumonanthe L. | + | + | 1 | . | . | . | . | 3 |
| H scap | Europ.-Caucas. | Inula salicina L. | . | + | . | . | + | 1 | . | 3 |
| H scap | Circumbor. | Sanguisorba officinalis L. | . | + | . | . | . | . | + | 2 |
| | | Char. species of *Molinio-Arrhenatheretea* | | | | | | | | |
| H caesp | Paleotemp. | Dactylis glomerata L. | + | + | + | + | + | + | . | 6 |
| H scap | Cosmop. | Lotus corniculatus L. | + | + | . | + | + | + | . | 5 |
| H scap | SE-Europ. | Centaurea nigrescens Willd. ssp. nigrescens | + | + | 1 | . | . | . | . | 3 |
| H scap | Euri-Medit. | Pulicaria dysenterica (L.) Bernh. | . | + | 1 | . | . | . | . | 2 |
| H ros | Europ.-Caucas. | Leontodon hispidus L. | . | + | + | . | . | . | . | 2 |
| H rept | Circumbor. | Agrostis stolonifera L. | . | . | + | . | . | . | . | 1 |
| | | Char. species of *Erucastro-Schoenetum nigricantis* | | | | | | | | |
| T scap | SE-Europ. | Euphrasia marchesettii Wettst. | . | + | . | . | . | . | 1 | 2 |
| H scap | End. E-Po plain | Centaurea forojuliensis (Poldini) Poldini | . | . | . | . | . | . | + | 1 |
| | | Char. species of *Caricion davallianae*, *Caricetalia davallianae* and *Scheuchzerio-Caricetea fuscae* | | | | | | | | |
| G rhiz | Europ.-Caucas. | Juncus subnodulosus Schrank | . | 1 | + | . | . | . | 1 | 3 |
| H ros | Euras. | Primula farinosa L. | . | + | . | . | . | . | 1 | 2 |
| H scap | Atl. | Anagallis tenella (L.) L. | . | . | . | . | . | . | + | 1 |
| H scap | Eurosib. | Parnassia palustris L. | . | . | . | . | . | . | + | 1 |
| H scap | C-Europ. | Tofieldia calyculata (L.) Wahlenb. | . | . | . | . | . | . | + | 1 |
| | | Other species | | | | | | | | |
| H caesp | Subcosmop. | Schoenus nigricans L. | 2 | 2 | 2 | 3 | 3 | 2 | 4 | 7 |
| H scap | Euras. | Potentilla erecta (L.) Räuschel | 1 | + | 1 | + | . | + | 1 | 6 |
| H bienn | Paleotemp. | Centaurium erythraea Rafn. ssp. erythraea | . | + | 1 | + | . | + | + | 5 |
| H scap | Subcosmop. | Mentha aquatica L. ssp. aquatica | + | + | 1 | . | . | . | + | 4 |
| P caesp | C-Europ.-Caucas. | Frangula alnus Miller ptl. | + | + | + | . | . | . | . | 3 |
| H caesp | Subatl. | Brachypodium rupestre (Host) R. et S. | . | . | 1 | + | 1 | . | . | 3 |
| H scap | Paleotemp. | Eupatorium cannabinum L. | . | + | + | . | . | . | . | 2 |
| H scand | Paleotemp. | Calystegia sepium (L.) R. Br. | + | . | + | . | . | . | . | 2 |
| H scap | Subcosmop. | Lythrum salicaria L. | 2 | . | 1 | . | . | . | . | 2 |
| G rhiz | Eurimedit.-Subatl. | Anthericum ramosum L. | . | . | . | . | 1 | 2 | . | 2 |
| G rhiz | Europ. | Carex flacca Schreber ssp. flacca | . | + | . | + | . | . | . | 2 |
| Ch suffr | C-Europ. | Genista germanica L. | . | . | . | . | 1 | 1 | . | 2 |
| P scap | Illyric | Pinus nigra Arnold ptl. | . | . | . | + | . | + | . | 2 |
| H ros | Europ. | Viola hirta L. | . | . | . | . | 1 | + | . | 2 |
| | | No. of accidental species | 4 | 3 | 2 | 3 | 1 | 2 | 0 | |

1991; Pott, 1995) has been widely recorded among inland areas of Italy (Poldini, 1989; Andreis *et al*., 1995; Biondi *et al*., 1997; Sarzo *et al*., 1999; Venanzoni & Gigante, 2000; Venanzoni *et al*., 2003; etc.); the current relevés confirm its occurrence even on the N-Adriatic coast where the community had already been found by Piccoli & Gerdol (1984) and Merloni & Piccoli (2001).

***Synchorology***: the association has so far been identified in the northern and southern sectors of the study area.

***Natura 2000 Habitat***: 7210*

*Soncho maritimi-Cladietum marisci* replaces *Mariscetum serrati* where a slightly saline water-table influences the soil (Cirujano, 1980), as indicated by the presence of sub-alophilous species (*Sonchus maritimus, Juncus maritimus* and *Plantago cornuti*) in the relevés 3-6 of Tab. 7. This Mediterranean community (Cirujano, 1980) has already been recorded in different sectors of the Italian coast (Vagge & Biondi,1999; Bini *et al*., 2002b; Pavone *et al*., 2007; Di Pietro *et al*., 2009; Biondi *et al*., 2012b). The current stands were collected on soils belonging to the same *Mariscetum serrati* tipology.

***Synchorology***: the association is distributed throughout the study area.

***Natura 2000 Habitat***: 7210*

*SCHOENO-ERIANTHETUM RAVENNAE* Pignatti 1953 (Tab. 8, rel. 1-6; Fig. 10)

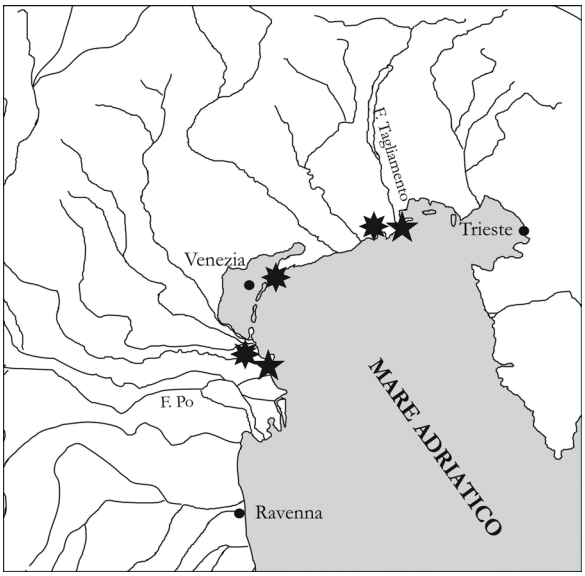


Fig. 9 - Sites of the relevés of *Mariscetum serrati* ★ and *Soncho maritimi-Cladietum marisci* ✸

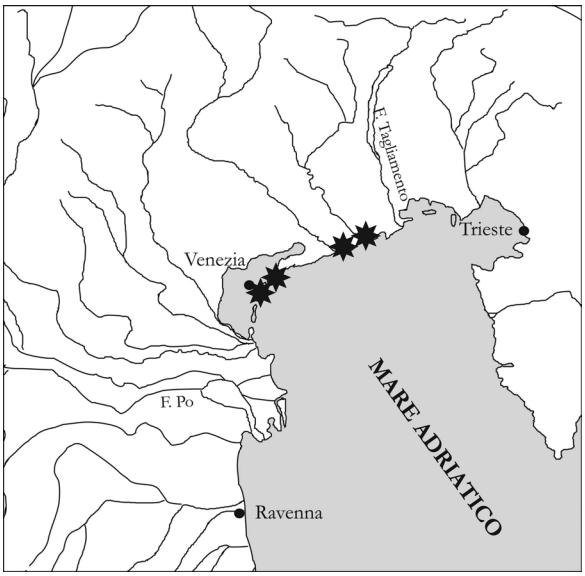


Fig. 10 - Sites of the relevés of *Schoeno-Erianthetum ravennae*.

Tab. 7 - Rel. 1-2: *Mariscetum serrati*; rel. 3-6: *Soncho maritimi-Cladietum marisci*

| | | Number of relevé | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|---|---|
| | | Surface (m2) | 30 | 10 | 20 | 15 | 30 | 10 | |
| | | Total cover (%) | 90 | 85 | 100 | 90 | 100 | 100 | |
| | | Number of species | 11 | 8 | 5 | 9 | 9 | 11 | Presence |
| G rhiz | Subcosmop. | Cladium mariscus (L.) Pohl | 5 | 3 | 5 | 5 | 4 | 4 | 6 |
| | | Diff. species of *Soncho maritimi-Cladietum marisci* | | | | | | | |
| G rhiz | Subcosmop. | Juncus maritimus Lam. | . | . | + | + | + | 2 | 4 |
| H scap | Euri-Medit. | Sonchus maritimus L. | . | . | . | . | 3 | 1 | 2 |
| H ros | C-As.-N-Medit. | Plantago cornuti Gouan | . | . | . | . | + | . | 1 |
| | | Char. species of *Magnocaricion elatae, Phragmitetalia* and *Phragmito Magnocaricetea* | | | | | | | |
| G rhiz | Subcosmop. | Phragmites australis (Cav.) Trin. | 1 | 1 | + | 1 | 2 | + | 6 |
| H scap | Subcosmop. | Lythrum salicaria L. | + | + | . | + | . | . | 3 |
| H scap | Euras. | Lysimachia vulgaris L. | 1 | 2 | . | . | . | . | 2 |
| H scap | Subcosmop. | Mentha aquatica L. ssp. aquatica | + | . | . | . | . | 1 | 2 |
| G rhiz | Cosmop. | Typha latifolia L. | . | + | 1 | . | . | . | 2 |
| H scap | Circumbor. | Lycopus europaeus L. | . | + | . | . | . | . | 1 |
| | | Other species | | | | | | | |
| H caesp | Subcosmop. | Schoenus nigricans L. | + | 1 | . | + | . | + | 4 |
| H scand | Paleotemp. | Calystegia sepium (L.) R. Br. | + | . | . | . | 2 | + | 3 |
| H scap | Euri-Medit. | Pulicaria dysenterica (L.) Bernh. | . | . | . | . | + | 2 | 2 |
| NP | Euras. | Rubus caesius L. | . | . | . | 2 | . | + | 2 |
| P caesp | C-Eur.-Caucas. | Frangula alnus Miller ptl. | + | 1 | . | . | . | . | 2 |
| G rhiz | Euri-Medit. | Asparagus officinalis L. | . | . | . | + | + | . | 2 |
| | | No. of accidental species | 3 | 0 | 1 | 2 | 1 | 2 | |

Hygrophilous and sub-alophilous community whose physiognomy is mainly determined by *Schoenus nigricans* and by the large tufts of *Erianthus ravennae*.

The association is widely distributed in the Mediterranean area (Géhu *et al*., 1984b; Biondi, 1999) and its occurrence on the N-Adriatic coast is well known and recorded (Pignatti, 1953, 1959; Caniglia, 1978; Piccoli *et al*., 1983; Piccoli & Gerdol, 1984; Géhu *et al*., 1984a, 1984b; Poldini *et al*., 1999; Merloni & Piccoli, 2007). The relevés of Tab. 8 correspond to samples collected in sites where this community's occurrence wasn't yet known; the presence (rel. 4) of *Kosteletzkya pentacarpos*, a critically endangered species (CR) that in Italy occurs only in a few coastal localities of Veneto and Emilia-Romagna (Ercole *et al*., 2013) is particularly noteworthy. The association occurs on strongly calcareous, redoxymorphic and periodically waterlogged soils, coarse-textured and with a generally deep humus layer at the surface (Entisols -Typic Psammaquents).

***Synchorology***: *Schoeno-Erianthetum* is largely distributed along the N-Adriatic coast; however, the human alterations of the dunal systems caused its disappearance from many sites.

***Natura 2000 Habitat***: 6420

***Nomenclatural note***: the form of the name *Eriantho-Schoenetum nigricantis* (Pign. 1953) Géhu in Géhu *et al*. 1984 is incorrect. Indeed, although Géhu (in Géhu *et al*.,1984b) includes in this community the association *Schoeno-Molinietum altissimae*, the Articles 25 and 47 of the International Code of Phytosociological Nomenclature (Weber *et al*., 2000) state that in this case the original citation of the author remains unaltered; in addition, the inversion of the name (*Eriantho-Schoenetum nigricantis*) is unnecessary (Art. 10b).

### *Shrub and wood plant communities*

Natural shrubs and woods rarely occur in the interdunal depressions where the local presence of tree species is usually caused by artificial plantations (*Populus* sp. pl., *Pinus* sp. pl, *Alnus cordata* (Loisel.) Desf., etc.). The "Bosco della Mesola" (Po Delta, Ferrara Province) where the *Fraxinus angustifolia* ssp. *oxycarpa* hygrophilous wood (*Cladio-Fraxinetum oxycarpae*) is well-developed, is an exception; this association, which was described in detail by Piccoli *et al*. (1983, 1991), Piccoli & Gerdol (1984) and Merloni & Piccoli (2001), was initially referred by its authors to *Populetalia albae* (*Querco-Fagetea*), and later attribu-

Tab. 8 - *Schoeno-Erianthetum ravennae* Pignatti 1953

| | | Number of relevé | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|---|---|
| | | Surface (m2) | 50 | 40 | 50 | 25 | 40 | 50 | Presence |
| | | Total cover (%) | 90 | 95 | 95 | 100 | 100 | 100 | |
| | | Number of species | 17 | 19 | 25 | 20 | 21 | 14 | |
| | | Char. species of *Eriantho-Schoenetum nigricantis* | | | | | | | |
| H caesp | Medit.-Turan. | Erianthus ravennae (L.) Beauv. | 3 | 3 | 3 | 4 | 2 | 2 | 6 |
| H caesp | Medit.-Turan. | Juncus litoralis C.A. Meyer | + | 1 | . | . | 1 | . | 3 |
| | | Char. species of *Molinio-Holoschoenion, Holoschoenetalia* and *Molinio-Arrhenathereteа* | | | | | | | |
| H scap | Euri-Medit. | Sonchus maritimus L. | 1 | + | + | + | + | + | 6 |
| H caesp | Paleotemp. | Dactylis glomerata L. | 2 | + | + | + | . | + | 5 |
| G rhiz | Circumbor. | Epipactis palustris (Miller) Crantz | . | . | 2 | 1 | + | + | 4 |
| H scap | Euri-Medit. | Pulicaria dysenterica (L.) Bernh. | . | + | + | + | + | . | 4 |
| G rhiz | Steno-Medit. | Holoschoenus romanus (L.) Fritsch | . | + | . | . | + | + | 3 |
| G bulb | SE-Europ. | Allium suaveolens Jacq. | . | 1 | . | . | . | . | 1 |
| H scap | Paleotemp. | Lotus tenuis W. et K. | + | . | . | . | . | . | 1 |
| H scap | Medit.-Atl. | Oenanthe lachenalii Gmelin | . | . | + | . | . | . | 1 |
| H caesp | Euri-Medit. | Carex distans L. | . | . | . | . | . | + | 1 |
| | | Other species | | | | | | | |
| H caesp | Subcosmop. | Schoenus nigricans L. | 4 | 4 | 4 | 3 | 5 | 5 | 6 |
| H scap | Paleotemp. | Eupatorium cannabinum L. | + | 1 | + | 1 | 1 | . | 5 |
| H caesp | Eurosib. | Calamagrostis epigejos (L.) Roth | 1 | . | 1 | + | + | + | 5 |
| G rhiz | Euri-Medit. | Elytrigia atherica (Link) Kerg. | . | + | + | + | + | . | 4 |
| H scap | Eurimedit.-Subatl. | Diplotaxis tenuifolia (L.) DC. | . | + | + | . | + | + | 4 |
| G rhiz | Subcosmop. | Phragmites australis (Cav.) Trin. | 1 | 2 | + | . | . | . | 3 |
| G rhiz | Subatlant. | Spartina juncea (Michx.) Willd. | . | + | 2 | . | + | . | 3 |
| P caesp | N-Amer.. | Amorpha fruticosa L. | + | . | 1 | + | . | . | 3 |
| H scap | S-Europ.-SW As. | Sanguisorba minor Scop. ssp. muricata (Gremli) Briq. | . | . | + | + | . | + | 3 |
| H scap | Eurosib. | Picris hieracioides L. | . | . | + | + | + | . | 3 |
| H bienn | Paleotemp. | Centaurium erythraea Rafn. ssp. erythraea | + | + | . | + | . | . | 3 |
| H scap | Euri-Medit. | Silene vulgaris (Moench) Garcke ssp. angustifolia | + | + | . | . | + | . | 3 |
| G rhiz | SE-Europ.-S-Siber. | Trachomitum venetum (L.) Woodson | . | . | 2 | + | . | . | 2 |
| G rhiz | Subcosmop. | Juncus maritimus Lam. | . | . | + | 1 | . | . | 2 |
| H scap | Europ.-Caucas. | Hieracium florentinum All. | . | . | . | . | + | + | 2 |
| G rhiz | Circumbor. | Equisetum x moorei Newman | . | . | + | . | + | . | 2 |
| G rhiz | Euri-Medit. | Asparagus officinalis L. | . | . | + | . | + | . | 2 |
| G rhiz | N-Amer. | Ambrosia coronopifolia Torr. et Gray | . | . | + | . | + | . | 2 |
| NP | Euri-Medit. | Rubus ulmifolius Schott | . | . | + | + | . | . | 2 |
| | | No. of accidental species | 5 | 4 | 3 | 4 | 3 | 3 | |

ted to *Alnetea glutinosae* by Pedrotti & Gafta (1996) and Merloni & Piccoli (2001) because of its ecological features and frequency both of entities belonging to this class (*Thelypteris palustris, Frangula alnus*) and to *Phragmito-Magnocaricetea*.

The present study still allows us to recognize the occurrence of communities belonging to the *Alnetea glutinosae* class in some localized sites of the Venetian sector of the N-Adriatic coast (Tab. 9 rel. 1-2). The first relevé corresponds to a *Frangula alnus*-rich community in which *Salix cinerea* plays only a subordinate role; this stand may be considered as a seral stage that, starting from *Mariscetum serrati*, leads to the *Salix cinerea* shrub (*Frangulo-Salicetum cinereae*); by contrast, the second relevé represents a more structured community and can be attributed without a doubt to *Frangulo-Salicetum cinereae*. The *Alnus glutinosa* swamps are even more rare along the coast and the

Tab. 9 - Rel. 1: *Frangula alnus* community; rel. 2: *Frangulo-Salicetum cinereae*.

| | | Number of relevé | 1 | 2 |
|---|---|---|---|---|
| | | Surface (m2) | 20 | 25 |
| | | Cover of shrubs (%) | 55 | 85 |
| | | Cover of herbs (%) | 90 | 60 |
| | | Height of shrubs (cm) | 250 | 600 |
| | | Height of herbs (cm) | 100 | 50 |
| | | Number of species | 10 | 11 |
| | | Char. species of *Salicion cinereae*, *Salicetalia auritae* and *Alnetea glutinosae* | | |
| P caesp | Paleotemp. | Salix cinerea L. | + | 5 |
| P caesp | C-Eur.-Caucas. | Frangula alnus Miller | 3 | + |
| G rhiz | Subcosmop. | Thelypteris palustris Schott | 5 | 3 |
| | | Other species | | |
| G rhiz | Subcosmop. | Cladium mariscus (L.) Pohl | 2 | 1 |
| NP | Euras. | Rubus caesius L. | + | 1 |
| H scap | Euras. | Lysimachia vulgaris L. | + | + |
| G rhiz | Euras. | Carex acutiformis Ehrh. | . | 2 |
| P caesp | S-Europ.-Pont. | Rhamnus catharticus L. | . | 1 |
| NP | SE-Europ. | Salix rosmarinifolia L. | 1 | . |
| H scap | Subcosmop. | Lythrum salicaria L. | + | . |
| H scap | Circumbor. | Sanguisorba officinalis L. | + | . |
| P scap | Paleotemp. | Populus alba L. ptl. | + | . |
| H scap | Europ. | Valeriana officinalis L. | . | + |
| G rhiz | Circumbor. | Equisetum palustre L: | . | + |
| H caesp | Eurimedit. | Carex distans L: | . | + |

only sample so far known comes from the Tagliamento River mouth (*Carici elatae-Alnetum glutinosae*, rel. 12 of Tab. II in Sburlino *et al*., 2011).

***Natura 2000 Habitat***: 91E0* (limited to *Cladio-Fraxinetum oxycarpae* and *Carici elatae-Alnetum glutinosae*).

***Nomenclatural note***: the name *Cladio-Fraxinetum oxycarpae* was invalidly published by Piccoli *et al*. (1983); this name was later validated by Piccoli (1995) by the indication of its nomenclatural *typus*. The typification by Brullo & Spampinato (1999) is therefore superfluous.

**Syntaxonomic scheme**

ISOËTO-NANOJUNCETEA Br.-Bl. et Tüxen ex Westhoff, Dijk et Passchier 1946
*NANOCYPERETALIA FLAVESCENTIS* Klika 1935
**Nanocyperion flavescentis** Koch 1926
*Cyperetum flavescentis* Koch ex Aichinger 1933

PHRAGMITO-MAGNOCARICETEA Klika in Klika et Novák 1941
*PHRAGMITETALIA COMMUNIS* Koch 1926
**Magnocaricion elatae** Koch 1926
*Mariscetum serrati* Zobrist 1935
*Soncho maritimi-Cladietum marisci* (Br.-Bl. et O. Bolòs 1958) Cirujano 1980
SCHEUCHZERIO-CARICETEA FUSCAE Tüxen 1937
*CARICETALIA DAVALLIANAE* Klika 1934
**Caricion davallianae** Klika 1934
*Erucastro-Schoenetum nigricantis* Poldini 1973

TUBERARIETEA GUTTATAE (Br.-Bl. in Br.-Bl., Roussine et Nègre 1952) Rivas-Goday et Rivas-Martínez 1963 *nom. mut. propos*. in Rivas-Martínez, Díaz, Fernández-González, Izco, Loidi, Lousã & Penas 2002 [*Helianthemetea guttati* (Br.-Bl. in Br.-Bl., Roussine et Nègre 1952) Rivas Goday et Rivas-Martínez 1963]
*MALCOMIETALIA* Rivas-Goday 1958
**Laguro ovati-Vulpion membranaceae** Géhu et Biondi 1994
*Sileno conicae-Avellinietum michelii* ass. nova ("Ass. a *Vulpia fasciculata* e *Silene sericea*" Pignatti 1953 p.p.; pseudonym: *Bromo tectorum-Phleetum arenarii sensu* Gerdol et Piccoli 1984 p.p. and Piccoli et Merloni 1989 p.p. non Korneck 1974)

KOELERIO-CORYNEPHORETEA Klika in Klika et Novák 1941
*ARTEMISIO-KOELERIETALIA ALBESCENTIS* Sissingh 1974
***Syntrichio ruraliformis-Lomelosion argenteae*** Biondi, Sburlino et Theurillat in Sburlino, Buffa, Filesi, Gamper et Ghirelli all. nova
*Tortulo-Scabiosetum* Pignatti 1952 (pseudonym: *Bromo tectorum-Phleetum arenarii sensu* Gerdol et Piccoli 1984 p.p. and Piccoli et Merloni 1989 p.p. non Korneck 1974)
*Tortulo-Scabiosetum fumanetosum* Pignatti 1952
*Tortulo-Scabiosetum typicum* subass. nova (*Tortulo-Scabiosetum fumanetosum* Pignatti 1952 p.p.)

FESTUCO-BROMETEA Br.-Bl. et Tüxen in Br.-Bl. 1949
*SCORZONERO-CHRYSOPOGONETALIA* Horvatić et Horvat in Horvatić 1958
***Saturejion subspicatae*** (Horvat 1962) Horvatić 1973
***Centaureenion dicroanthae*** (Pignatti 1953) Poldini et Feoli Chiapella in Feoli Chiapella et Poldini 1994
*Teucrio capitati-Chrysopogonetum grylli* Sburlino, Buffa, Filesi et Gamper 2008
*Teucrio capitati-Chrysopogonetum grylli typicum* Sburlino, Buffa, Filesi et Gamper 2008
*Teucrio capitati-Chrysopogonetum grylli schoenetosum nigricantis* Sburlino, Buffa, Filesi et Gamper 2008

MOLINIO-ARRHENATHERETEA Tüxen 1937
*MOLINIETALIA CAERULEAE* Koch 1926
***Molinion caeruleae*** Koch 1926
*Plantagini altissimae-Molinietum caeruleae* Marchiori et Sburlino 1982
*Plantagini altissimae-Molinietum caeruleae cladietosum marisci* Sburlino, Bracco, Buffa et Andreis 1995
*Plantagini altissimae-Molinietum caeruleae chrysopogonetosum grylli* subass. nova (*Eu-Molinietum caeruleae* W.

Koch 1926 subass. *andropogonetosum* Pignatti 1953 provv. nom. inval., Art. 3b)
*HOLOSCHOENETALIA* Br.-Bl. ex Tchou 1948
***Molinio-Hoschoenion*** Br.-Bl. ex Tchou 1948
*Schoeno-Erianthetum ravennae* Pignatti 1953

HELICHRYSO-CRUCIANELLETEA MARITIMAE (Sissingh 1974) Géhu, Rivas-Martinez et Tüxen in Géhu 1975 em. Géhu et Biondi 1994
*Helichrysum italicum* ssp. *italicum* community

ALNETEA GLUTINOSAE Br.-Bl. et Tüxen ex Westhoff, Dijk et Passchier 1946
*SALICETALIA AURITAE* Doing ex Steffen 1968
***Salicion cinereae*** Müller et Görs ex Passarge 1961
*Frangulo-Salicetum cinereae* Graebner et Hueck 1931
*Frangula alnus* community
*ALNETALIA GLUTINOSAE* Tüxen 1937
***Alnion glutinosae*** Malcuit 1929
*Carici elatae-Alnetum glutinosae* Franz ex Sburlino, Poldini, Venanzoni et Ghirelli 2011
*Cladio-Fraxinetum oxycarpae* Piccoli, Gerdol et Ferrari ex Piccoli 1995

**List of the syntaxa not quoted in the syntaxonomic scheme**

*Ammophiletea* Br.-Bl. et Tüxen ex Westhoff, Dijk et Passchier 1946
*Erico carneae-Osyridetum albae* Gamper, Filesi, Buffa et Sburlino 2008
*Junipero-Hippophaetum fluviatilis* Géhu et Scoppola in Géhu, Scoppola, Caniglia, Marchiori et Géhu-Franck 1984
*Koelerion albescentis* Tüxen 1937
*Koelerion arenariae* Tüxen 1937 corr. Gutermann et Mucina 1993
*Populetalia albae* Br.-Bl. ex Tchou 1948
*Psammo-Koelerion* Pignatti 1952 *nomen superfluum*
*Querco-Fagetea* Br.-Bl. et Vlieger in Vlieger 1937
*Schoeno-Molinietum altissimae* Pignatti 1953
*Sileno coloratae-Vulpietum membranaceae* Pignatti 1953 corr. Géhu et Scoppola in Géhu, Scoppola, Caniglia, Marchiori et Géhu-Franck 1984
*Sileno conicae-Cerastietum semidecandri* Korneck 1974
*Tortulo-Phleetum arenarii* Br.-Bl. et De Leeuw 1936
*Tortulo-Scabiosetum apocynetosum* Pignatti 1952
*Tortulo-Scabiosetum clematidetosum* Pignatti 1959 (*Tortulo-Scabiosetum clematidetosum* Pignatti 1952 *nomen nudum*)
*Viburno lantanae-Phillyreetum angustifoliae* Gamper, Filesi, Buffa et Sburlino 2008
*Vincetoxico-Quercetum ilicis* Gamper, Filesi, Buffa et Sburlino 2008

**References**

Aeschimann D., Lauber K., Moser D.M. & Theurillat J.P., 2004. Flora alpina. Zanichelli, Bologna.

Aleffi M., Tacchi R. & Cortini Pedrotti C., 2008. Check-list of the Hornworts, Liverworts and Mosses of Italy. Bocconea 22: 1-255.

Andreis C., Lazzaroni L., Rodondi G. & Zavagno F. 1995. La vegetazione delle torbiere del Sebino e le direttive del piano di gestione. Coll. Phytosoc. 21 (1993): 511-546.

Bálatová-Tuláčková E., 1991. Das *Cladietum marisci*. The *Cladietum marisci*. Veröff. Geobot. Inst. Rübel 106: 7-34.

Bálatová-Tuláčková E., Mucina L., Ellmauer T. & Wallnöfer S., 1993. *Phragmiti-Magnocaricetea*. In Grabherr G. & Mucina L. (Eds.). Die Pflanzengesellschaften Österreichs 2, Natürliche waldfreie Vegetation: 79-130. G. Fischer, Jena.

Béguinot A., 1941. La Laguna di Venezia. 3, parte V, tomo IX, fascicolo II. C. Ferrari. Venezia.

Bini C., Buffa G., Gamper U., Sburlino G. & Zilocchi L., 2002a. Soils and vegetation of coastal and wetlands areas in Northern Adriatic (NE-Italy). 7th International Meeting on Soils with Mediterranean Type Climate (Selected Papers). Options Méditerrarénéennes, Ser. A 50: 31-36.

Bini C., Buffa G., Gamper U., Sburlino G. & Zuccarello V., 2002b. Alcune considerazioni sui rapporti tra Fitosociologia e Pedologia. Fitosociologia 39 (1): 71-80.

Biondi E, 1999. Diversità fitocenotica degli ambienti

costieri italiani. Boll. Mus. Civ. St. Nat. Venezia 49 (suppl.) (1998): 39-105.

Biondi E., 2011. Phytosociology today: Methodological and conceptual evolution. Plant Biosystems 145 (Suppl.): 19-29.

Biondi E., Blasi C., Burrascano S., Casavecchia S., Copiz R., Del Vico E., Galdenzi D., Gigante D., Lasen C., Spampinato G., Venanzoni R., Zivkovic L., 2009. Manuale Italiano di interpretazione degli habitat della Direttiva 92/43/CEE. Società Botanica Italiana. Ministero Ambiente Tutela Territorio e Mare, D.P.N. [available online at http://vnr.unipg.it/habitat/]

Biondi E., Burrascano S., Casavecchia S., Copiz R., Del Vico E., Galdenzi D., Gigante D., Lasen C., Spampinato G., Venanzoni R., Zivkovic L., Blasi C., 2012a. Diagnosis and syntaxonomic interpretation of Annex I Habitats (Dir. 92/43/ EEC) in Italy at the alliance level. Plant Sociology, 49 (1): 5-37.

Biondi E., Gubellini L., Pinzi M. & Casavecchia S., 2012b. The vascular flora of Conero Regional Nature Park (Marche, Central Italy). Fl. Medit. 22: 67-167.

Biondi E., Vagge I., Baldoni M. & Taffetani F., 1997. La vegetazione del Parco fluviale regionale del Taro (Emilia-Romagna). Fitosociologia 34: 69-110.

Blasi C., Filesi L., Stanisci A., Frondoni R., Di Pietro R. & Carranza M.L., 2002. Excursion to the Circeo National Park. Fitosociologia 39 (1) Suppl. 3: 91-130.

Braun-Blanquet J. & De Leeuw W.C., 1936. Vegetationsskizze von Ameland. Nederl. Kruidk. Arch. 46: 359-393.

Brullo S., Giusso Del Galdo G.P., Siracusa G. & Spampinato G., 2001. Considerazioni fitogeografiche sulla vegetazione psammofila dei litorali italiani. Biogeographia 22: 93-137.

Brullo S. & Spampinato G., 1999. Syntaxonomy of hygrophilous woods of the *Alno-Quercion-roboris*. Ann. Bot. 57: 133-146.

Buffa G., Fantinato F. & Pizzo L., 2012. Effects of Disturbance on Sandy Coastal Ecosystems of N-Adriatic Coasts (Italy). In Lameed G.A. (Ed.). Biodiversity Enrichment in a Diverse World: 339-372. InTech, DOI: 10.5772/48473. (available online at: http://www.intechopen.com/books/biodiversity-enrichment-in-a-diverse-world/effects-of-disturbance-on-sandy-coastal-ecosystems-of-n-adriatic-coasts-italy-)

Buffa G., Filesi L., Gamper U. & Sburlino G., 2007. Qualità e grado di conservazione del paesaggio vegetale del litorale sabbioso del Veneto (Italia settentrionale). Fitosociologia 44 (1): 49-58.

Buffa G., Ghirelli L., Bracco F., Sburlino G., 1997. Conservazione e biodiversità nella progettazione ambientale dell'area A.M.A.G. di Villaverla (VI). Quad. I.A.E.D. 8 (3): 56-58.

Buffa G., Mion D., Gamper U., Ghirelli L. & Sburlino G., 2005. Valutazione della qualità e dello stato di conservazione degli ambienti litoranei: l'esempio del S.I.C. "Penisola del Cavallino: biotopi litoranei" (Venezia, NE-Italia). Fitosociologia 42 (2): 3-13.

Caniglia G., 1978. Tracce di vegetazione spontanea in un settore del litorale del Cavallino (VE). Boll. Civ. St. Nat. Venezia 29 (suppl.): 169-192.

Caniglia G., Sanità N. & Balasso A., 1999. Gli scanni del Delta del Po. Aspetti della vegetazione e del suo dinamismo. Boll. Mus. Civ. St. Nat. Venezia 49 (suppl.) (1998): 107-117.

Cirujano S., 1980. Las lagunas manchegas y su vegetación. I. An. Jard. Bot. Madrid 37 (l):155-192.

Corbetta F., Gratani L., Moriconi M. & Pirone G., 1992. Lineamenti vegetazionali e caratterizzazione ecologica delle spiagge dell'arco jonico da Taranto alla foce del Sinni. Coll. Phytosoc. 19 (1989): 461-521.

Corbetta F., Pirone G., Frattaroli A.R. & Ciaschetti G., 2004. Lineamenti vegetazionali del parco Nazionale del Cilento e Vallo di Diano. Braun-Blanquetia 36: 1-61.

Dengler J., Berg C., Eisenberg M., Isermann M., Jansen F., Koska S., Löbel M., Manthey J., Päzolta A., Spangenbenberg A., Timmermann T. & Wollert H., 2003. New descriptions and typifications of syntaxa within the project 'Plant communities of Mecklenburg-Vorpommernand their vulnerability' - Part I. Feddes Repertorium 114 (7-8): 587-631.

Di Pietro R., Dibitonto P., Garziano G., Sciandrello S., Wagensommer R.P., Medagli P. & Tomaselli V., 2009. Preliminary results of floristic and vegetation surveys in three coastal humid areas in the Puglia region (southern Italy). Lazaroa 30: 99-107.

Dierßen K., 2001. Distribution, ecological amplitude and phytosociological characterization of European bryophytes. Bryophytorum Biblioteca 56: 1-289.

Doing H., 1993. Het *Sileno-Tortuletum* (ass. nov.), een karakteristieke associatie van het zeedorpenlandschap. Stratiotes 6: 40-52.

Ellenberg H., 1988. Vegetation ecology of central Europe. 4th ed. Cambridge Univesity Press, Cambridge

Ercole S., Giacanelli G., Bertani G., Brancaleoni L., Croce A., Fabrini F., Gerdol R., Ghirelli L., Masin R., Mion D., Santangelo A., Sburlino G., Tomei P.E., Villani M. & Wagensommer R.P., 2013. *Kosteletzkya pentacarpos* (L.) Ledeb. Inform. Bot. Ital. 45 (1): 159-162.

Esposito A. & Filesi L., 2007. Caratterizzazione di comunità a *Crucianella maritima* e relazioni con la componente briofitica. Fitosociologia 44 (2) suppl. 1: 255-261.

European Commission, 2007. Interpretation Manual of European Union Habitats. Eur 27. DG Environment.

Gamper U., 2002. Caratteristiche ecologiche della vegetazione a carattere mediterraneo presente sul litorale sedimentario nord adriatico (Veneto–NE-Italia), con particolare riguardo alle problematiche di conservazione della biodiversità fitocenotica. Ph. D. thesis, Univ. Catania, Italy.

Gamper U., Filesi L., Buffa G. & Sburlino G., 2008. Diversità fitocenotica delle dune costiere nord-adriatiche 1 - Le comunità fanerofitiche. Fitosociologia 45 (1): 3-21.

Géhu J.-M., 2006. Dictionnaire de sociologie et synécologie végétales. Cramer, Berlin-Stuttgart.

Géhu J.-M. & Biondi E., 1996. Synoptique des associations végétales du littoral adriatique italien. Giorn. Bot. Ital. 130 (1): 257-270.

Géhu J.-M., Costa M., Scoppola A., Biondi E., Marchiori S., Peris J.B., Franck J. & Caniglia G., 1984b. Essai synsistematique et synchorologique sur les vegetations littorales italiennes dans un but conservatoire. 1 - Dunes et vases salees. Doc. Phytosoc., n.s., 8: 393-474.

Géhu J.-M. & Rivas-Martínez S., 1981. Notions fondamentales de phytosociologie. In: Dierschke H. (Ed.). Syntaxonomie. Ber. Intern. Symposium IV–V: 5–53. J. Cramer, Vaduz.

Géhu J.-M., Scoppola A., Caniglia G., Marchiori S. & Géhu- Franck J., 1984a. Les systèmes végétaux de la côte nordadriatique italienne, leur originalité à l'échelle européenne. Doc. Phytosoc., n.s., 8: 485-558.

Gerdol R. & Piccoli F., 1984. Sand dune vegetation in the Po Delta (N-Italy). Ecologia Mediterranea 10 (3-4): 121-131.

Ghirelli L., Marcucci R. & Sburlino G., 1995 - Osservazioni sulla distribuzione di *Euphrasia marchesettii* Wettst. e sulla sua posizione sintassonomica. Fitosociologia 29: 59-65.

Koch W., 1926. Die Vegetationseinheiten der Linthebene unter Berücksichtigung der Verhältnisse in der Nordostschweiz. Jb. St. Gall. Naturwiss. Ges. 61: 1-144.

Korneck D., 1974. Xerothermvegetation in Rheinland-Pfalz und Nachbargebieten. Schriftenreihe Vegetationskunde. 7: 1-196.

Lorenzoni G.G. 1983. Il paesaggio vegetale nord Adriatico. Atti Mus. civ. St. nat. Trieste 35: 1-34.

Maiorca G., Spampinato G. & Caprio A., 2002. Flora e vegetazione dei laghi costieri La Vota (Calabria centro-occidentale). Fitosociologia 39 (1): 81-108.

Marchesan L., Sanità N. & Caniglia G., 2003. Un ambiente relitto del Delta del Po: aspetti della vegetazione delle dune fossili di Donada (Porto Viro - Rovigo). Lavori Soc. Ven. Sc. Nat. 28: 55-64.

Marchiori S. & Sburlino G., 1982. I prati umidi dell'anfiteatro morenico del Tagliamento (Friuli-Italia nord-orientale). Doc. Phytosoc., n.s., 7: 199-222.

Martini F. & Poldini L., 1986. Distribuzione ed ecologia di *Erucastrum palustre* (Pir.) Vis.. Gortania 8: 221-242.

Martini F. & Poldini L., 1987. *Armeria helodes*, a new species from North-Eastern Italy. Candollea 42: 533-544.

Merloni N. & Piccoli F., 2001. La vegetazione del complesso Punte Alberete e Valle Mandriole (Parco Regionale del Delta del Po - Italia). Braun-Blanquetia 29: 1-17.

Merloni N. & Piccoli F., 2007. Comunità vegetali rare e minacciate delle stazioni ravennati del Parco del Delta del Po (Regione Emilia-Romagna). Fitosociologia 44 (1): 67-76.

Mucina L., 1993. Nomenklatorische und syntaxonomische Definitionen, Konzepte und Methoden. In Mucina L., Grabherr G. & Ellmauer T. (Eds.). Die Pflanzengesellschaften Österreichs 1, Anthropogene Vegetation: 19-28. G. Fischer, Jena.

Mucina L. & Kolbek J., 1993. *Koelerio-Corynephoretea*. In Mucina L., Grabherr G. & Ellmauer T. (Eds.). Die Pflanzengesellschaften Österreichs 1, Anthropogene Vegetation: 493-521. G. Fischer, Jena.

Pavone P., Spampinato G., Tomaselli V., Minissale P., Costa R., Sciandrello S. & Ronsisvalle F., 2007. Cartografia degli habitat della Direttiva CEE 92/43 nei biotopi della Provincia di Siracusa (Sicilia orientale). Fitosociologia 44 (2) suppl.1: 183-193.

Pedrotti F. & Gafta D., 1996. Ecologia delle foreste ripariali e paludose dell'Italia. L'Uomo e l'Ambiente 23: 1–165.

Pellizzari M., Sala G. & Ferioli A., 2004. Linee guida per una banca dati delle aree sensibili: il ruolo dell'analisi fitosociologica. Fitosociologia 41 (1) suppl. 1: 117-123.

Piccoli F., 1995. Elementi per una carta della vegetazione del Parco Regionale del Delta del Po (Regione Emilia-Romagna). Fitosociologia 30: 213-219.

Piccoli F. & Gerdol R., 1984. Typology and dynamics of a wood in the Po plane (N-Italy): the "Bosco della Mesola". Coll. Phytosoc. 9 (1980): 161-170.

Piccoli F., Gerdol R. & Ferrari C., 1983. Carta della vegetazione del Bosco della Mesola (Ferrara). Atti Ist. Bot. Lab. Critt. Univ. Pavia 3 (23) ser. 7 (2):3-23.

Piccoli F., Gerdol R. & Ferrari C., 1991. Vegetation map of S. Vitale Pinewood (Northern Adriatic Coast-Italy). Phytocoenosis 3 (N.S.), Suppl. 2: 337-342.

Piccoli F. & Merloni N., 1989. Vegetation dynamics in coastal wetlands. An example in Northern Italy: the Bardello. Ecologia Mediterranea 15 (1/2): 81-95.

Pignatti S., 1952. Introduzione allo studio fitosociologico della pianura veneta orientale con particolare riguardo alla vegetazione litoranea. Arch. Bot. 28 (4): 265-329.

Pignatti S., 1953. Introduzione allo studio fitosociologico della pianura veneta orientale con particolare

riguardo alla vegetazione litoranea. Arch. Bot. 29 (3): 129-174.
Pignatti S., 1959. Ricerche sull'ecologia e sul popolamento delle dune del litorale di Venezia. Il popolamento vegetale. Boll. Mus. civ. St. Nat. Venezia 12: 61-142.
Pignatti S., 1982. Flora d'Italia. Edagricole, Bologna.

Pignatti S., 1993. Dry coastal ecosystems of Italy. In Van der Maarel E. (Ed.), Ecosystems of the world 2A. Dry coastal ecosystems. Polar regions and Europe: 379-390. Elsevier, Amsterdam, London, New York, Tokyo.
Pirola A., 1974. La vegetazione psammofila e il primo cordone dunale. In: Influenza di insediamenti industriali sul circostante ambiente naturale. Studio sulla Pineta di San Vitale di Ravenna. Compositori, Bologna: 93-103.
Pirone G., 1983. La vegetazione del litorale pescarese (Abruzzo). Not. Fitosoc. 18: 37-62.
Podani, J. 2001. SYN-TAX 2000. Computer Programs for Data Analysis in Ecology and Systematics. Scientia Publishing, Budapest.
Poldini L., 1973. Die Pflanzendecke der Kalkflachmoore in Friaul (Nordostitalien). Veröff. Geobot. Inst. Rübel 51: 166-178.
Poldini L., 1977. *Centaurea forojuliensis*, della sect. *Jacea* DC. s.str., nuova entità del Friuli. Giorn. Bot. Ital. 111: 303-309.
Poldini L., 1989. La vegetazione del Carso Isontino e Triestino. LINT, Trieste.
Poldini L. & Oriolo G., 1995. La vegetazione dei prati da sfalcio e dei pascoli intensivi (*Arrhenatheretalia* e *Poo-Trisetetalia*) in Friuli (NE Italia). Studia Geobotanica 14, Suppl. 1 (1994): 3-48.
Poldini L., Vidali M. & Fabiani M.L., 1999. La vegetazione del litorale sedimentario del Friuli-Venezia Giulia (NE Italia) con riferimenti alla regione altoadriatica. Studia Geobotanica 17: 3-68.
Pott R., 1995. Die Planzengesellschaften Deutschlands. Ulmer, Stuttgart.
Pott R., 2011. Phytosociology: A modern geobotanical method. Plant Biosystems 145 (Suppl.): 9-18.
Prisco I., Acosta A.T.R., Ercole S., 2012. An overview of the Italian dune EU Habitats. Ann. Bot. (Roma) 2: 39-48.
Provoost S., Ampe C., Bonte D., Cosyns E. & Hoffmann M., 2004. Ecology, management and monitoring of grey dunes in Flanders. Journal Coastal Conservation 10: 33-42.
Rivas-Martínez S., 2004. Global Bioclimatics (Clasificación Bioclimática de la Tierra). Versión 27-08-04. Phytosociological Research Center, Los Negrales, Madrid.
Rivas-Martínez S., 2005. Notions on dynamic-catenal phytosociology as a basis of landscape science. Plant Biosystems 139: 135–144.
Rivas-Martínez S., Diaz T.E., Fernández-González F., Izco J., Loidi J., Lousã M. & Penas A., 2002. Vascular plant communities of Spain and Portugal. Addenda to the syntaxonomical checklist of 2001. Part II. Itinera Geobot. 15 (2): 433-922.
Ronnot E.-J., 1975. Sur la place et le rôle des bryophytes dans la végétation des dunes. Coll. Phytosoc. 1 (1971): 149-158.
Sarzo A., Prosser F. & Frisinghelli M., 1999. Flora e vegetazione della zona umida di Bolzonella (Provincia di Padova - Italia settentrionale). Arch. Geobot. 3 (2) (1997): 179-200.
Sburlino G., Bracco F., Buffa G. & Andreis C., 1995. I prati a *Molinia caerulea* (L.) Moench della Pianura padana: sintassonomia, sincorologia, sinecologia. Fitosociologia 29: 67-87.
Sburlino G., Bracco F., Buffa G. & Ghirelli L., 1996- Rapporti dinamici e spaziali nella vegetazione legata alle torbiere basse neutro-alcaline delle risorgive della Pianura padana orientale (Italia settentrionale). Coll. Phytosoc. 24: 285-294.
Sburlino G., Buffa G., Filesi L. & Gamper U., 2008. Phytocenotic originality of the N-Adriatic coastal sand dunes (Northern Italy) in the European context: The *Stipa veneta*-rich communities. Plant Biosystems 142 (3): 533-539.
Sburlino G. & Ghirelli L., 1995 - Le cenosi a *Schoenus nigricans* del *Caricion davallianae* Klika 1934 nella Pianura padana orientale (Veneto-Friuli). Studia Geobotanica 14 (1994): 63-68.
Sburlino G., Poldini L., Venanzoni R. & Ghirelli L. 2011. Italian black alder swamps: Their syntaxonomic relationships and originality within the European context. Plant Biosystems 145 Suppl. 1: 148–171.
Šilc U. & Čarni A., 2012. Conspectus of vegetation syntaxa in Slovenia. Hacquetia 11 (1): 113-164.
Sissingh G., 1974. Comparaison du *Roso-Ephedretum* de Bretagne avec des unités des végétation analogues (Contribution à la systématique des associations de dunes grises atlantiques et méditerranéennes). Doc. Phytosoc. 7-8: 95-106.
Stanisci A. & Conti F., 1990. Aspetti vegetazionali di un settore costiero molisano-abruzzese. Ann.Bot. (Roma) 48, Studi sul Territorio, Suppl.7: 85-94.
Tomasella M., Vidali M., Oriolo G., Poldini L., Comin S. & Giorgi R., 2007. Valutazione della qualità degli habitat della costa sedimentaria (Laguna di Marano e Grado) e della costa a falesie (Costiera triestina): applicazione del metodo EsAmbI. Fitosociologia 44 (1): 17-31.
Turetsky M. R., 2003. The Role of Bryophytes in Carbon and Nitrogen Cycling. The Bryologist 106 (3): 395-409.
Tüxen R., 1937. Die Pflanzengesellschaften Nordwestdeutschlands. Mitt. Florist.-soziolog. Arbeitsgem. 3:

1-170. Engelhard & Co., Hannover.
Vagge I. & Biondi E., 1999. La vegetazione delle coste sabbiose del Tirreno settentrionale italiano. Fitosociologia 36 (2): 61-95.
Van der Maarel E., 1979. Transformation of cover-abundance values in phytosociology and its effect on community similarity. Vegetatio 39: 97–114.
Venanzoni R., Apruzzese D., Gigante G., Suanno G. & Vale F., 2003. Contributo alla conoscenza della vegetazione acquatica e igrofitica dei Laghi di Monticchio. Inf. Bot. Ital. 35 (1): 69-80.
Venanzoni R. & Gigante D., 2000. Contributo alla conoscenza della vegetazione degli ambienti umidi dell'Umbria (Italia). Fitosociologia 37 (2): 13-63.
Weber H.E., Moravec J. & Theurillat J.-P., 2000. International Code of Phytosociological Nomenclature. J. Veg. Sci. 11: 739–768.
Westhoff V. & Maarel Van der E., 1978. The Braun-Blanquet approach. In Whittaker R.H. (Ed.), Classification of Plant Communities: 287-399. W. Junk, The Hague.
Wraber T., 2006. Notulae ad floram Sloveniae 78. *Euphrasia marchesettii* Wettst. in Marchesetti. Hladnikia 19: 69 71.
Zelnik I. & Čarni A., 2008. Wet meadows of the alliance *Molinion* and their environmental gradients in Slovenia. Biologia, Sect. Botany, 63 (2): 187-196.

**Appendix 1: Locations of the relevés**

Tab. 2: Rel. 1, 2, 3, 4, 5, 14, 15, 29, 30: Donada (Porto Viro, Rovigo); rel. 6, 39: between Rosolina and Volto (Rovigo); rel. 7, 17, 24, 33, 34: Porto Caleri (Rosolina Mare, Rovigo); rel. 8, 13: Sant'Anna (Chioggia, Venezia); rel. 9, 10: Ca' Ballarin (Cavallino-Treporti, Venezia); rel. 11, 12: Brussa (Caorle, Venezia); rel. 16: Casal Borsetti (Ravenna); rel. 18, 19, 28, 31, 32: Alberoni (Venezia); rel. 20, 21, 22, 23, 35, 36: San Nicolò al Lido (Venezia); rel. 25, 26, 27, 37: Ca' Roman (Venezia); rel. 38: Laguna del Mort (Eraclea, Venezia)
Tab. 3: Rel. 1, 3, 4, 5: Donada (Porto Viro, Rovigo); rel. 2: between Rosolina and Volto (Rovigo); rel. 6, 7, 11: Ca' Roman (Venezia); rel. 8: Brussa (Caorle, Venezia); rel. 9, 12: Alberoni (Venezia); rel. 10: Porto Caleri (Rosolina Mare, Rovigo); rel. 13, 14, 15, 16: Valle Grande di Bibione (San Michele al Tagliamento, Venezia)
Tab. 4: Rel. 1, 2, 3, 4: Porto Caleri (Rosolina Mare, Rovigo)
Tab. 5: Bibione (San Michele al Tagliamento, Venezia)
Tab. 6: Rel. 1, 4, 5, 6, 7: Bibione (San Michele al Tagliamento, Venezia); rel. 2, 3: Valle Grande di Bibione (San Michele al Tagliamento, Venezia)
Tab. 7: Rel. 1, 6: Valle Grande di Bibione (San Michele al Tagliamento, Venezia); rel. 2: Porto Caleri (Rosolina Mare, Rovigo); rel. 3: near the estuary of the Adige River (Rosolina Mare, Rovigo); rel. 4: Ca' Savio (Cavallino-Treporti, Venezia); rel. 5: Bibione (San Michele al Tagliamento, Venezia)
Tab. 8: Rel. 1: Laguna del Mort (Eraclea, Venezia); rel. 2: Brussa (Caorle, Venezia); rel. 3, 4: Punta Sabbioni (Cavallino-Treporti, Venezia); rel. 5: Ca' Savio (Cavallino-Treporti, Venezia); rel. 6: Alberoni (Venezia)
Tab. 9: Rel. 1: Valle Grande di Bibione (San Michele al Tagliamento, Venezia); rel. 2: near the estuary of the Adige River (Rosolina Mare, Rovigo).

**Appendix 2: Accidental species**

Tab. 2: Rel. 2: Carex caryophyllea La Tourr., Quercus pubescens Willd. (ptl.). Rel. 3: Quercus pubescens Willd. (ptl.), Scabiosa gramuntia L.. Rel. 4: Hieracium umbellatum L.. Rel. 5: Clypeola jonthlaspi L.. Rel. 6: Asparagus officinalis L., Orchis tridentata Scop., Senecio inaequidens DC.. Rel. 8: Calamagrostis epigejos (L.) Roth, Clypeola jonthlaspi L., Lamium amplexicaule L., Ophrys fuciflora (Crantz) Moench. Rel. 9: Koeleria pyramidata (Lam.) Domin (2), Silene x pseudotites Besser ex Reichenb.. Rel. 10: Koeleria pyramidata (Lam.) Domin (2), Polygala comosa Schkuhr (2), Silene x pseudotites Besser ex Reichenb.. Rel. 11: Asperula cynanchica L., Koeleria pyramidata (Lam.) Domin, Thymus longicaulis (incl. Thymus x carstiensis (Velen.) Ronninger) (2). Re. 12: Avellinia michelii (Savi) Parl., Scabiosa gramuntia L., Thymus longicaulis (incl. Thymus x carstiensis (Velen.) Ronninger). Rel. 13: Anacamptis pyramidalis (L.) L.C. Rich., Serapias sp.. Rel. 15: Bromus tectorum L.. Rel. 16: Allium vineale L., Asparagus acutifolius L., Bromus erectus Hudson ssp. erectus, Bupleurum baldense Turra ssp. baldense, Crataegus monogyna Jacq.( ptl.), Helianthemum apenninum (L.) Miller (1). Rel. 17: Helichrysum italicum (Roth) Don ssp. italicum, Juniperus communis L.. Rel. 18: Allium vineale L., Cenchrus longispinus (Hack.) Fernald. Rel. 19: Cenchrus longispinus (Hack.) Fernald. Rel. 20: Verbascum sinuatum L.. Rel. 21: Daucus carota L.. Rel. 23: Erigeron annuus (L.) Pers.. Rel. 24: Calamagrostis epigejos (L.) Roth, Rubus ulmifolius Schott. Rel. 26: Geranium rotundifolium L.. Rel. 28: Buglossoides arvensis (L.) Johnston, Cenchrus longispinus (Hack.) Fernald. Rel. 29: Bromus tectorum L.. Rel. 30: Bromus tectorum L. (1), Hypochoeris glabra L.. Rel. 31: Aristolochia clematitis L.. Rel. 32: Arabidopsis thaliana (L.) Heynh., Geranium purpureum Vill.. Rel. 33: Calamagrostis epigejos (L.) Roth. Rel. 35: Verbascum sinuatum L.. Rel. 36: Daucus carota L., Verbascum sinuatum L.. Rel. 37: Asparagus acutifolius L., Eleagnus angustifolia L. (ptl.), Senecio inaequidens DC.. Rel. 38: Allium vineale L., Clypeola jonthlaspi L., Scabiosa gramuntia L., Silene x pseudotites Besser ex Reichenb.. Rel. 39: Centaurium erythraea Rafn. ssp. erythraea, Holoschoe

nus romanus (L.) Fritsch (3), Polygonatum odoratum (Miller) Druce

Tab. 3: Rel. 1: Artemisia campestris L. ssp. campestris, Erodium cicutarium (L.) L'Hér, Geranium molle L., Hypochoeris glabra L. (1), Veronica arvensis L., Vicia pseudocracca Bertol.. Rel. 2: Centaurea tommasinii Kerner. Rel. 4: Vicia pseudocracca Bertol.. Rel. 5: Petrorhagia saxifraga (L.) Link. Rel. 6: Cyperus kalli (Forsskål) Murb., Erophila verna (L.) DC., Hypochoeris radicata L., Plantago lanceolata L. var. sphaerostachya Mert. et Koch. Rel. 7: Bromus diandrus Roth, Erophila verna (L.) DC., Saxifraga tridactylites L.. Rel. 8: Allium sphaerocephalon L.. Rel. 9: Allium sphaerocephalon L., Ambrosia coronopifolia Torr. et Gray (1), Erophila verna (L.) DC., Stachys recta L. ssp. subcrenata (Vis.) Briq.. Rel. 10: Arabidopsis thaliana (L.) Heynh., Asparagus acutifolius L., Erodium moschatum (L.) L'Hér, Petrorhagia saxifraga (L.) Link. Rel. 11: Ambrosia coronopifolia Torr. et Gray, Papaver rhoeas L.. Rel. 12: Allium sphaerocephalon L., Diplotaxis tenuifolia (L.) DC., Hieracium florentinum All., Stachys recta L. ssp. subcrenata (Vis.) Briq.. Rel. 13: Hypochoeris radicata L., Petrorhagia saxifraga (L.) Link, Scabiosa gramuntia L. (1), Tragus racemosus (L.) All.. Rel. 14: Scabiosa gramuntia L.. Rel. 15: Leontodon hispidus L.. Rel. 16: Asperula cynanchica L. (2), Diplotaxis tenuifolia (L.) DC., Leontodon hispidus L., Scabiosa gramuntia L., Stachys recta L. ssp. subcrenata (Vis.) Briq.

Tab. 6: Rel. 1: Calamagrostis epigejos (L.) Roth, Dorycnium pentaphyllum Scop. ssp. herbaceum (Vill.) Rouy, Galium palustre L., Lysimachia vulgaris L. (2). Rel. 2: Aster squamatus (Sprengel) Hieron., Polygala comosa Schkuhr, Ranunculus nemorosus DC.. Rel. 3: Phragmites australis (Cav.) Trin., Thesium divaricatum Jan. Rel. 4: Diplotaxis tenuifolia (L.) DC., Equisetum x moorei Newman, Teucrium montanum L. (1). Rel. 5: Teucrium chamaedrys L.. Rel. 6: Chamaecytisus purpureus (Scop.) Link (1), Globularia punctata Lapeyr.

Tab. 7: Rel. 1: Fraxinus ornus L. ptl., Molinia caerulea (L.) Moench, Potentilla erecta (L.) Räuschel. Rel. 3: Amorpha fruticosa L.. Rel. 4: Salix rosmarinifolia L., Trachomitum venetum (L.) Woodson. Rel. 5: Serratula tinctoria L.. Rel. 6: Agrostis stolonifera L., Elytrigia atherica (Link) Kerg.

Tab. 8: Rel. 1: Aster tripolium L., Juncus acutus L., Molinia arundinacea Schrank (1), Oenothera biennis s.l., Scabiosa columbaria L.. Rel. 2: Aster linosyris (L.) Bernh. (1), Aster squamatus (Sprengel) Hieron., Inula viscosa (L.) Aiton (1), Lythrum salicaria L.. Rel. 3: Cynodon dactylon (L.) Pers., Mentha aquatica L. ssp. aquatica, Rubus caesius L.. Rel. 4: Dorycnium pentaphyllum Scop. ssp. herbaceum (Vill.) Rouy, Kosteletzkya pentacarpos (L.) Ledeb., Populus alba L. ptl., Scabiosa gramuntia L.. Rel. 5: Euphrasia marchesettii Wettst., Hypericum perforatum L., Koeleria pyramidata (Lam.) Domin. Rel. 6: Clematis vitalba L., Stachys recta L. ssp. subcrenata (Vis.) Briq., Teucrium chamaedrys L.