

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 (Beguinet, 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 interdu-

ne 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-Martínez, 2005; Géhu, 2006; Biondi, 2011;

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 (*Vincetoxic-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 Aeschmann 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, Eurasian, 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 *Chrysopogon 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

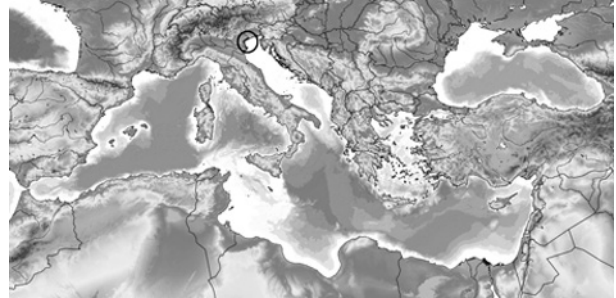


Fig. 1 - The study area in the Mediterranean context.

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 stueckii*, *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 miche-
lii*, *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, subordinatedly, 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..

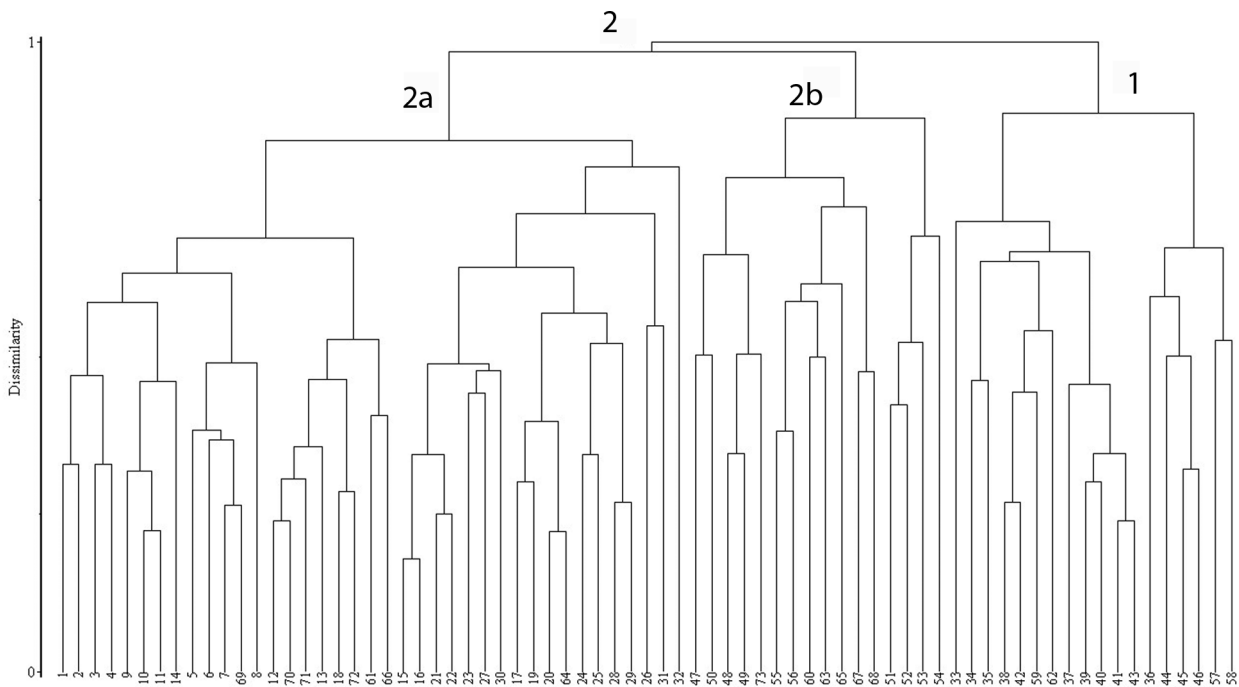


Fig. 2 - Dendrogram of the 73 relevés of the dry grasslands (complete link, similarity ratio, cover data).

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-Ilyric 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-Quercus 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 chamaephytes (*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-Corynepherea* (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-Corynepherea* 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 caryophylla La Tourr.	22	3	.
Scabiosa graminifolia 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 stueckii 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
Dasyphyrum villosus (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 Poir.	.	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
Centaureum 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-Corynepherea* seems to be in our opinion more convincing. This class, mainly distributed in the Atlantic and central European areas, includes pioneer hemicyrptophytic and therophytic dry grasslands, which develop on more or less stabilized sandy soils (Géhu, 2006). The attribution of the present relevés to *Koelerio-Corynepherea* 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 ramosissimum* 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 membranacea* 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-Corynepherea* (Pott, 1995; Rivas-Martinez *et al.*, 2002; Géhu, 2006).

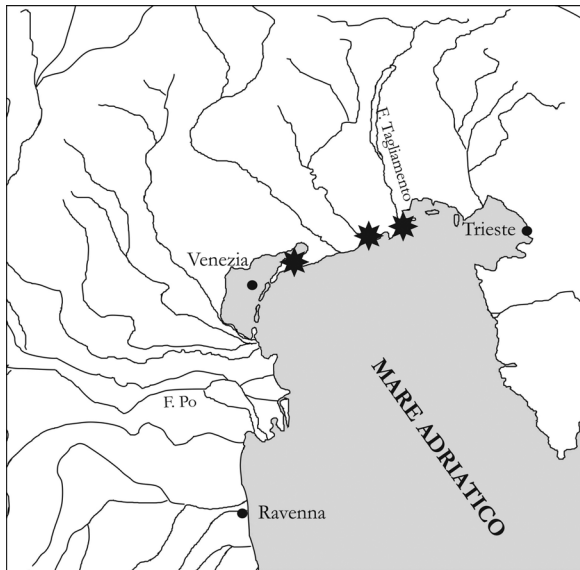


Fig. 3 - Sites of the relevés of *Teucrio capitati-Chrysopogon-nium grylli*.

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-Coryneporetea*.

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

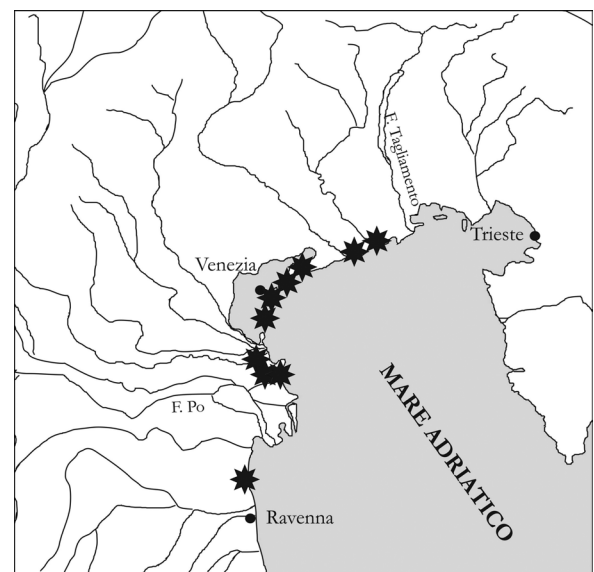


Fig. 4 - Sites of the relevés of *Tortulo-Scabiosetum*.

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 (m ²)	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
<i>Char. and diff. species of Tortulo-Scabiosetum and Syntrichio-Lomelosion argenteae</i>																						
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	+	+	.	.	.	.	.	.	.	.	.	.	.	.
<i>Diff. species of Tortulo-Scabiosetum fumanetosum</i>																						
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	.	.	.	.
<i>Artemisio-Koelerietalia and Koelerio-Corynephoretea</i>																						
<i>Syntrichia ruralis (Hedw.) F. Weber et D. Mohr var.</i>																						
Bryoch	Subatl.-Eurimedit.	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	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.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Other species</i>																						
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 stueckii Soldano	+	.	.	.	1	.	.	+	+	+	+	+	.	.	.	.	+	+	+	+
<i>Silene vulgaris (Moench) Garcke ssp. angustifolia (Miller)</i>																						
H scap	Eurimedit.	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 Poir.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	+
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 carnea-Osyridetum*, *Viburno-Phillyreum* 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	Presence	Frequency
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		
.	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	2	1	2	1	.	.	.	27	69
.	1	1	2	+	+	+	+	+	+	.	+	+	+	+	.	1	1	+	26	67
.	+	+	1	.	.	.	+	+	.	.	+	1	+	.	+	.	.	+	22	56
+	+	+	+	+	+	.	.	.	.	.	.	.	+	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-Scabio- setum* 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-Scabio- setum fumanetosum* can be divided in two distinct subassociations: *Tortulo-Scabio- setum fumanetosum* and *Tortulo-Scabio- setum 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-Scabio- setum*]. The chamaephytes-rich stands (*Tortulo-Scabio- setum 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 (Incepti- sols -Typic Haploxerepts) are more structured and richer in organic matter in comparison to sandy Entisols (Typic Xeropsamments), where the *Tortulo-Scabio- setum typicum* occurs (rel. 22-39 of Tab 2). In both subassociations the thick cryptogams layer significantly contribu- tes 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 crypto- gams-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 *Tor- tulo-Scabio- setum*; actually, *Bromo tectorum- Phleetum arenarii* is an inland community de- scribed for Central and Central-West Germany (Kornek, 1974), in which species such as *Ca- rex liparocarpos*, *Lagurus ovatus*, *Lomelosia argentea*, *Vicia pseudocracca*, *Vulpia membra- nacea*, *Teucrium polium* and *Stachys recta* are completely lacking.

Syndinamic: *Tortulo-Scabio- setum* belongs both to the holm-oak wood edaphoxerophilous series (*Vincetoxico-Quercu ilicis sigmetum*) and to the common juniper scrub edaphoxero- philous 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-Scabio- setum* is a threatened community due to the human altera- tions 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 physiognomy is nevertheless 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 *Vulpia 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-

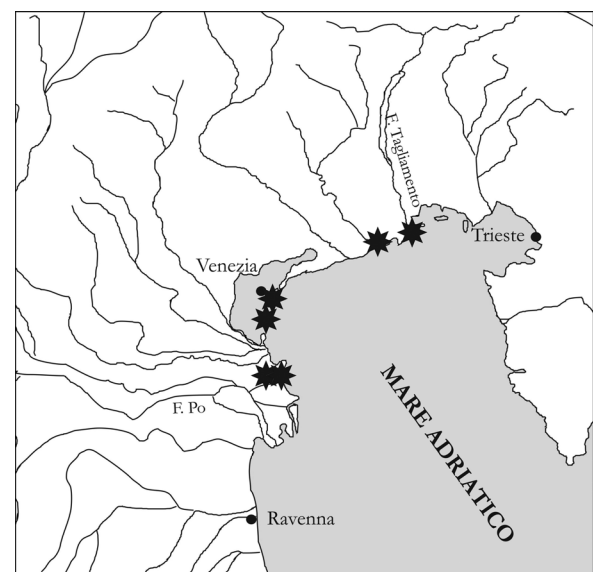


Fig. 5 - Sites of the relevés of *Sileno conicae-Avellinietum michelii*.

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	Presence	Frequency
		Number of relevé (dendrogram of Fig. 2)	47	50	48	49	73	55	56	60	63	65	67	68	51	52	53	54		
		Surface (m ²)	2	2	2	3	2	2	3	3	3	2	3	2	2	1	4	2		
		Total cover (%)	50	40	30	35	40	30	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 <i>Sileno conicae-Avellinietum michelii</i>																		
T scap	Stenomedit.	<i>Avellinia michelii</i> (Savi) Parl.	+	+	2	1	2	1	2	+	.	.	+	+	1	1	2	2	14	88
T scap	Europ.-W.As.	<i>Silene conica</i> L.	+	1	+	+	+	+	1	+	1	+	+	+	+	+	+	+	16	100
H scap	Subcosmop.	<i>Sanguisorba minor</i> Scop. ssp. <i>muricata</i> (Gremli) Briq.	.	+	.	+	.	+	1	.	.	.	+	.	1	+	+	+	10	63
H caesp	Paleotemp.	<i>Poa bulbosa</i> L.	2	+	.	.	+	2	1	+	1	2	+	.	.	.	.	.	9	56
G rhiz	SE-Europ.	<i>Carex liparocarpos</i> Gaudin	.	.	.	1	.	.	+	1	.	+	.	+	+	+	.	.	7	44
		Char. species of <i>Laguro ovati-Vulpion</i> , <i>Malcomietalia</i> and <i>Tuberarietea guttatae</i>																		
T caesp	Medit.-Atl.	<i>Vulpia membranacea</i> (L.) Link	2	2	+	1	+	1	2	2	1	.	2	1	2	1	+	+	15	94
T scap	Eurimedit.	<i>Catapodium rigidum</i> (L.) Hubbard	.	.	+	+	1	.	.	1	+	.	.	+	+	.	.	2	8	50
T scap	Eurimedit.	<i>Lagurus ovatus</i> L.	.	.	.	.	+	+	.	.	+	+	1	1	.	.	.	.	6	38
T scap	Stenomedit.	<i>Clypeola jonthlaspi</i> L.	.	.	.	.	.	.	+	+	+	+	.	.	.	.	.	.	3	19
T scap	Stenomedit.	<i>Silene colorata</i> Poiret	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	1	6
		Other species																		
T scap	Atl.-Medit.	<i>Phleum arenarium</i> L.	+	2	2	2	+	+	1	2	2	+	+	.	+	+	+	+	15	94
T scap	Cosmop.	<i>Cerastium semidecandrum</i> L.	1	+	+	1	+	1	2	1	2	2	2	2	+	.	+	+	15	94
T scap	Eurimedit.-W.As.	<i>Medicago minima</i> (L.) Bartal.	+	+	+	+	1	1	+	+	+	+	.	.	.	.	+	.	11	69
T scap	N-C-Amer.	<i>Cenchrus longispinus</i> (Hack.) Fernald	.	.	1	+	.	+	1	1	1	+	.	.	+	+	1	+	11	69
G rhiz	Thermo-Cosmop.	<i>Cynodon dactylon</i> (L.) Pers.	.	.	+	2	+	1	+	+	.	+	.	.	.	1	+	.	9	56
H scap	S-Europ.-S-Siber.	<i>Lomelosia argentea</i> (L.) Greuter et Burdet	.	.	+	+	2	+	1	.	+	.	.	.	.	.	.	.	6	38
T scap	SE-Europ.-S-Siber.	<i>Plantago arenaria</i> Waldst. et Kit.	1	.	.	.	+	1	.	.	.	.	.	.	+	+	3	.	6	38
H scap	Eurimedit.	<i>Silene vulgaris</i> (Moench) Garcke ssp. <i>angustifolia</i> (Miller) Hayek	.	.	.	+	.	+	+	+	.	.	+	.	.	+	.	.	6	38
Ch suffr	Europ.-Caucas.	<i>Helianthemum nummularium</i> (L.) Miller ssp. <i>obscurum</i> (Celak.) Holub	.	.	.	+	.	.	.	+	.	.	.	.	1	+	+	.	5	31
T scap	S-Europ.	<i>Arenaria serpyllifolia</i> L.	+	.	+	+	.	.	.	.	+	.	.	.	.	.	.	.	5	31
H bienn	Europ.	<i>Oenothera stuechii</i> Soldano	+	.	.	.	.	.	+	+	1	.	.	.	.	.	.	+	5	31
T scap	Cosmop.	<i>Conyza canadensis</i> (L.) Cronq.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	+	5	31
Ch suffr	S-Europ.-SW-As.	<i>Fumana procumbens</i> (Dunal) G. et G.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	1	+	4	25
Bryoch	Subatl.-Eurimedit.	<i>Syntrichia ruralis</i> (Hedw.) F. Weber et D. Mohr var. <i>ruraliformis</i> (Besch.)	1	.	.	.	.	.	1	.	1	.	.	.	1	.	.	.	4	25
G rhiz	Circumbor.	<i>Equisetum ramosissimum</i> Desf.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	+	4	25
T scap	Euri-Medit.-Turan.	<i>Dasypyrum villosus</i> (L.) Borbás	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	4	25
T scap	Subcosmop.	<i>Bromus hordeaceus</i> L. ssp. <i>hordeaceus</i>	+	.	+	+	.	.	+	.	.	.	.	.	.	.	.	.	4	25
T scap	Stenomedit.	<i>Melilotus neapolitana</i> Ten.	+	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	4	25
T scap	Paleotemp.	<i>Bromus tectorum</i> L.	1	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	4	25
T scap	Eurimedit.	<i>Buglossoides arvensis</i> (L.) Johnston	.	.	.	.	.	.	+	+	.	+	+	.	.	.	.	.	4	25
T scap	N-Amer.	<i>Ambrosia artemisiifolia</i> 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 (*Vincetoxic-Quercu ilicis sigmetum*) and to the common juniper scrub edaphoxerophilous series (*Junipero-Hippopho fluvialis 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*).

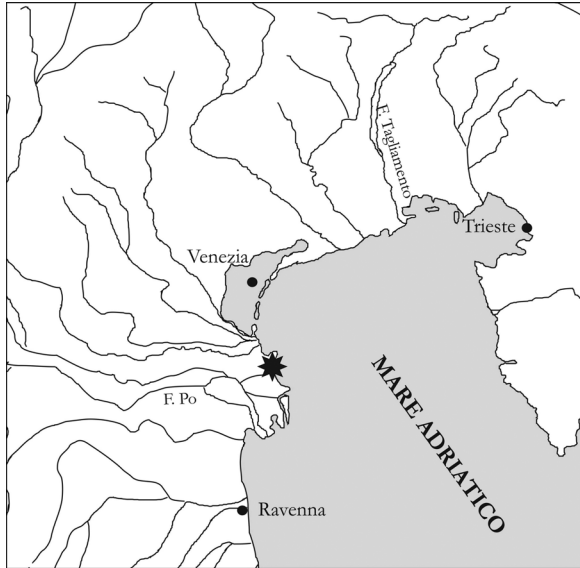


Fig. 6 - Site of the relevés of the *Helichrysum italicum* community.

Tab. 4 - *Helichrysum italicum* community

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

lius). 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*.

This *Helichrysum italicum*-rich community belongs

to the common juniper scrub edaphoxerophilous series (*Junipero-Hippophae 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.

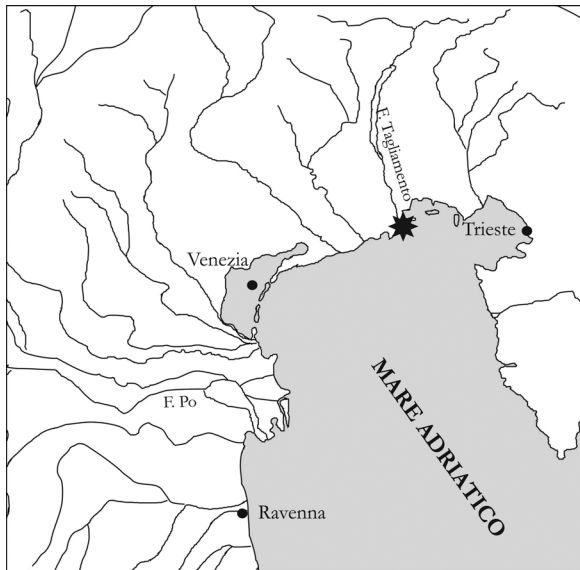
Synchorology: the association has so far only been identified in the northern and southern sectors of the study area.

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
T caesp	Subcosmop.	Char. species of <i>Cyperetum flavescentis</i> <i>Cyperus flavescentis</i> L. (tg All.)	3
T caesp	Cosmop.	Char. species of <i>Nanocyperion</i> , <i>Nanocyperetalia</i> and <i>Isoeto-Nanojuncetea</i>	
T scap	Paleotemp.	<i>Juncus bufonius</i> L.	1
		<i>Centaurium pulchellum</i> (Sw.) Druce	+
		Other species	
H ros	Euras.	<i>Plantago major</i> L. ssp. <i>intermedia</i> (Godr.) Lange	1
G rhiz	Circumbor.	<i>Juncus articulatus</i> L.	1
G rhiz	Thermo-Cosmop.	<i>Cynodon dactylon</i> (L.) Pers.	+
H scap	Euras.	<i>Potentilla erecta</i> (L.) Räuschel	+
H caesp	Cosmop.	<i>Samolus valerandi</i> L.	+
G rhiz	Europ.-Caucas.	<i>Juncus subnodulosus</i> Schrank	+
T scap	Eurimedit.	<i>Blackstonia perfoliata</i> (L.) Hudson	+

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

This purple moorgrass meadows develop on Mollicsols (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).

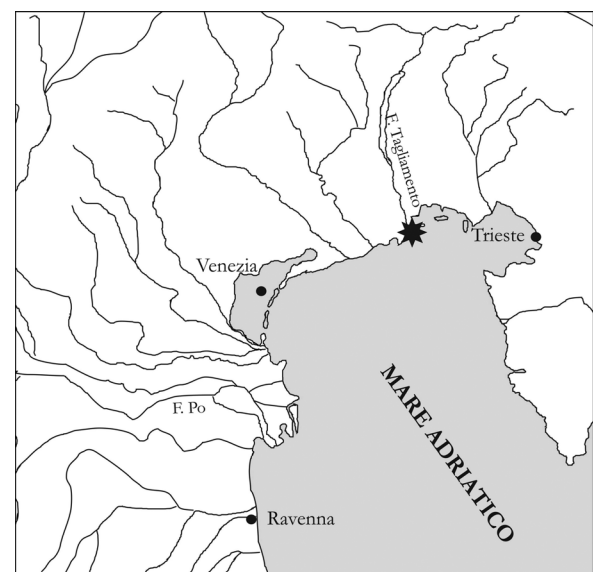
If compared with other *Schoenus nigricans*-rich communities belonging to *Caricion davallianae*, *Erucastrum-Schoenetum* is differentiated by rare endemic species such as *Erucastrum palustre* (Pirona) Vis., *Centaurea forojuliensis* Poldini and *Armeria helodes* Martini et Poldini (Poldini, 1977; Martini & 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 **SONCHO 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 *Erucastrum-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	Presence
			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	
			Char. species of <i>Plantagini altissimae-Molinietum caeruleae</i>								
H caesp	Circumbor.		<i>Molinia caerulea</i> (L.) Moench (tg All.)	4	4	3	3	4	2	+	7
H ros	SE-Europ.		<i>Plantago altissima</i> L.	2	+	+	.	.	.	.	3
			Diff. species of <i>Plantagini altissimae-Molinietum caeruleae cladietosum marisci</i>								
G rhiz	Subcosmop.		<i>Cladium mariscus</i> (L.) Pohl	1	2	2	.	.	.	2	4
			Diff. species of <i>Plantagini altissimae-Molinietum caeruleae chrysopogonetosum grylli</i>								
H caesp	S-Europ.-S-Siber.		<i>Chrysopogon gryllus</i> (L.) Trin.	.	.	.	3	2	3	.	3
Ch suffr	Oroph. S-Europ.		<i>Erica carnea</i> L.	.	.	.	2	2	3	.	3
H scap	Euras.		<i>Galium verum</i> L. ssp. verum	+	.	.	2	1	1	.	4
			Char. species of <i>Molinia caeruleae</i> and <i>Molinietalia caeruleae</i>								
H scap	Eurosib.		<i>Serratula tinctoria</i> L.	1	1	1	+	+	1	.	6
G rhiz	Circumbor.		<i>Epipactis palustris</i> (Miller) Crantz	1	+	+	.	+	.	+	5
G bulb	C-Europ.		<i>Gladiolus palustris</i> Gaudin	+	+	+	+	.	+	.	5
Ch suffr	Euras.		<i>Genista tinctoria</i> L.	+	.	.	+	+	+	.	4
G bulb	SE-Europ.		<i>Allium suaveolens</i> Jacq.	1	+	+	.	.	.	.	3
H scap	Eurosib.		<i>Gentiana pneumonanthe</i> L.	+	+	1	.	.	.	.	3
H scap	Europ.-Caucas.		<i>Inula salicina</i> L.	.	+	.	.	+	1	.	3
H scap	Circumbor.		<i>Sanguisorba officinalis</i> L.	.	+	.	.	.	.	+	2
			Char. species of <i>Molinio-Arrhenatheretea</i>								
H caesp	Paleotemp.		<i>Dactylis glomerata</i> L.	+	+	+	+	+	+	.	6
H scap	Cosmop.		<i>Lotus corniculatus</i> L.	+	+	.	+	+	+	.	5
H scap	SE-Europ.		<i>Centaurea nigrescens</i> Willd. ssp. nigrescens	+	+	1	.	+	.	.	3
H scap	Euri-Medit.		<i>Pulicaria dysenterica</i> (L.) Bernh.	.	+	1	.	.	.	.	2
H ros	Europ.-Caucas.		<i>Leontodon hispidus</i> L.	.	+	+	.	.	.	.	2
H rept	Circumbor.		<i>Agrostis stolonifera</i> L.	.	.	+	.	.	.	.	1
			Char. species of <i>Erucastro-Schoenetum nigricantis</i>								
T scap	SE-Europ.		<i>Euphrasia marchesettii</i> Wettst.	.	+	.	.	.	.	1	2
H scap	End. E-Po plain		<i>Centaurea forojuliensis</i> (Poldini) Poldini	.	.	.	.	.	.	+	1
			Char. species of <i>Caricion davallianae</i> , <i>Caricetalia davallianae</i> and <i>Scheuchzeria-Caricetea fuscae</i>								
G rhiz	Europ.-Caucas.		<i>Juncus subnodulosus</i> Schrank	.	1	+	.	.	.	1	3
H ros	Euras.		<i>Primula farinosa</i> L.	.	+	.	.	.	.	1	2
H scap	Atl.		<i>Anagallis tenella</i> (L.) L.	.	.	.	.	.	.	+	1
H scap	Eurosib.		<i>Parnassia palustris</i> L.	.	.	.	.	.	.	+	1
H scap	C-Europ.		<i>Tofieldia calyculata</i> (L.) Wahlenb.	.	.	.	.	.	.	+	1
			Other species								
H caesp	Subcosmop.		<i>Schoenus nigricans</i> L.	2	2	2	3	3	2	4	7
H scap	Euras.		<i>Potentilla erecta</i> (L.) Räuschel	1	+	1	+	.	+	1	6
H bienn	Paleotemp.		<i>Centaureum erythraea</i> Rafn. ssp. erythraea	.	+	1	+	.	+	+	5
H scap	Subcosmop.		<i>Mentha aquatica</i> L. ssp. aquatica	+	+	1	.	.	.	+	4
P caesp	C-Europ.-Caucas.		<i>Frangula alnus</i> Miller ptl.	+	+	+	.	.	.	.	3
H caesp	Subatl.		<i>Brachypodium rupestre</i> (Host) R. et S.	.	.	1	+	1	.	.	3
H scap	Paleotemp.		<i>Eupatorium cannabinum</i> L.	.	+	+	.	.	.	.	2
H scand	Paleotemp.		<i>Calystegia sepium</i> (L.) R. Br.	+	.	+	.	.	.	.	2
H scap	Subcosmop.		<i>Lythrum salicaria</i> L.	2	.	1	.	.	.	.	2
G rhiz	Eurimedit.-Subatl.		<i>Anthericum ramosum</i> L.	.	.	.	.	1	2	.	2
G rhiz	Europ.		<i>Carex flacca</i> Schreber ssp. flacca	.	+	.	+	.	.	.	2
Ch suffr	C-Europ.		<i>Genista germanica</i> L.	.	.	.	.	1	1	.	2
P scap	Illyric		<i>Pinus nigra</i> Arnold ptl.	.	.	.	+	.	+	.	2
H ros	Europ.		<i>Viola hirta</i> 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 in-

fluences the soil (Cirujano, 1980), as indicated by the presence of sub-allophilous 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)

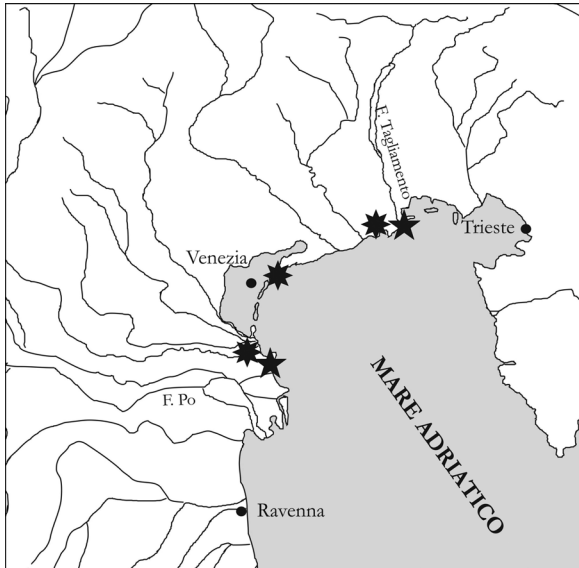


Fig. 9 - Sites of the relevés of *Mariscetum serrati* ★ and *Soncho maritimi-Cladietum marisci* *

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.	<i>Cladium mariscus</i> (L.) Pohl	5	3	5	5	4	4	6
		Diff. species of <i>Soncho maritimi-Cladietum marisci</i>							
G rhiz	Subcosmop.	<i>Juncus maritimus</i> Lam.	.	.	+	+	.	2	4
H scap	Euri-Medit.	<i>Sonchus maritimus</i> L.	.	.	.	.	3	1	2
H ros	C-As.-N-Medit.	<i>Plantago cornuti</i> Gouan	.	.	.	.	+	.	1
		Char. species of <i>Magnocaricion elatae</i> , <i>Phragmitetalia</i> and <i>Phragmito Magnocaricetea</i>							
G rhiz	Subcosmop.	<i>Phragmites australis</i> (Cav.) Trin.	1	1	+	1	2	+	6
H scap	Subcosmop.	<i>Lythrum salicaria</i> L.	+	+	.	+	.	.	3
H scap	Euras.	<i>Lysimachia vulgaris</i> L.	1	2	.	.	.	.	2
H scap	Subcosmop.	<i>Mentha aquatica</i> L. ssp. <i>aquatica</i>	+	.	.	.	.	1	2
G rhiz	Cosmop.	<i>Typha latifolia</i> L.	.	+	1	.	.	.	2
H scap	Circumbor.	<i>Lycopus europaeus</i> L.	.	+	.	.	.	.	1
		Other species							
H caesp	Subcosmop.	<i>Schoenus nigricans</i> L.	+	1	.	+	.	+	4
H scand	Paleotemp.	<i>Calystegia sepium</i> (L.) R. Br.	+	.	.	.	2	+	3
H scap	Euri-Medit.	<i>Pulicaria dysenterica</i> (L.) Bernh.	.	.	.	.	+	2	2
NP	Euras.	<i>Rubus caesius</i> L.	.	.	.	2	.	+	2
P caesp	C-Eur.-Caucas.	<i>Frangula alnus</i> Miller pfl.	+	1	.	.	.	.	2
G rhiz	Euri-Medit.	<i>Asparagus officinalis</i> 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

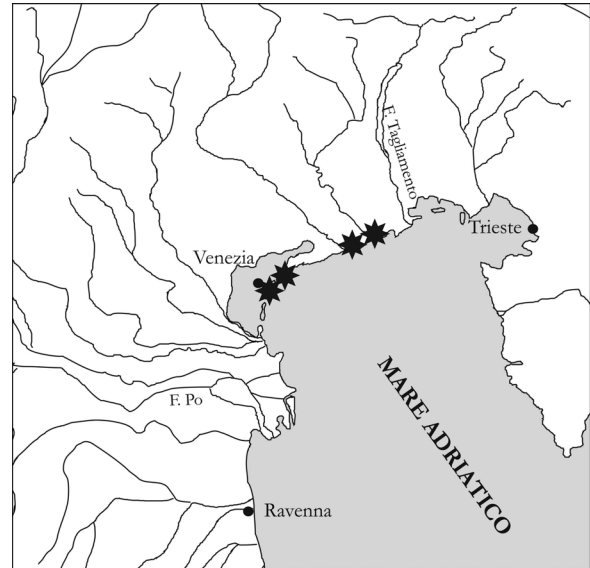


Fig. 10 - Sites of the relevés of *Schoeno-Erianthetum ravennae*.

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* (*Quercio-Fagetea*), and later attribu-

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

			Number of relevé	1	2	3	4	5	6	Presence
			Surface (m2)	50	40	50	25	40	50	
			Total cover (%)	90	95	95	100	100	100	
			Number of species	17	19	25	20	21	14	
			Char. species of <i>Eriantho-Schoenetum nigricantis</i>							
H caesp	Medit.-Turan.		<i>Erianthus ravennae</i> (L.) Beauv.	3	3	3	4	2	2	6
H caesp	Medit.-Turan.		<i>Juncus litoralis</i> C.A. Meyer	+	1	.	.	1	.	3
			Char. species of <i>Molinio-Holoschoenion</i> , <i>Holoschoenetalia</i> and <i>Molinio-Arrhenatheretea</i>							
H scap	Euri-Medit.		<i>Sonchus maritimus</i> L.	1	+	+	+	+	+	6
H caesp	Paleotemp.		<i>Dactylis glomerata</i> L.	2	+	+	+	.	+	5
G rhiz	Circumbor.		<i>Epipactis palustris</i> (Miller) Crantz	.	.	2	1	+	+	4
H scap	Euri-Medit.		<i>Pulicaria dysenterica</i> (L.) Bernh.	.	+	+	+	+	.	4
G rhiz	Steno-Medit.		<i>Holoschoenus romanus</i> (L.) Fritsch	.	+	.	.	+	+	3
G bulb	SE-Europ.		<i>Allium suaveolens</i> Jacq.	.	1	.	.	.	.	1
H scap	Paleotemp.		<i>Lotus tenuis</i> W. et K.	+	.	.	.	.	.	1
H scap	Medit.-Atl.		<i>Oenanthe lachenalii</i> Gmelin	.	.	+	.	.	.	1
H caesp	Euri-Medit.		<i>Carex distans</i> L.	.	.	.	.	.	+	1
			Other species							
H caesp	Subcosmop.		<i>Schoenus nigricans</i> L.	4	4	4	3	5	5	6
H scap	Paleotemp.		<i>Eupatorium cannabinum</i> L.	+	1	+	1	1	.	5
H caesp	Eurosib.		<i>Calamagrostis epigejos</i> (L.) Roth	1	.	1	+	+	+	5
G rhiz	Euri-Medit.		<i>Elytrigia atherica</i> (Link) Kerg.	.	+	+	+	+	.	4
H scap	Eurimedit.-Subatl.		<i>Diplotaxis tenuifolia</i> (L.) DC.	.	+	+	.	+	+	4
G rhiz	Subcosmop.		<i>Phragmites australis</i> (Cav.) Trin.	1	2	+	.	.	.	3
G rhiz	Subatlant.		<i>Spartina juncea</i> (Michx.) Willd.	.	+	2	.	+	.	3
P caesp	N-Amer.		<i>Amorpha fruticosa</i> L.	+	.	1	+	.	.	3
H scap	S-Europ.-SW As.		<i>Sanguisorba minor</i> Scop. ssp. <i>muricata</i> (Gremli) Briq.	.	.	+	+	.	+	3
H scap	Eurosib.		<i>Picris hieracioides</i> L.	.	.	+	+	+	.	3
H bienn	Paleotemp.		<i>Centaurium erythraea</i> Rafn. ssp. <i>erythraea</i>	+	+	.	+	.	.	3
H scap	Euri-Medit.		<i>Silene vulgaris</i> (Moench) Garcke ssp. <i>angustifolia</i>	+	+	.	.	+	.	3
G rhiz	SE-Europ.-S-Siber.		<i>Trachomitum venetum</i> (L.) Woodson	.	.	2	+	.	.	2
G rhiz	Subcosmop.		<i>Juncus maritimus</i> Lam.	.	.	+	1	.	.	2
H scap	Europ.-Caucas.		<i>Hieracium florentinum</i> All.	.	.	.	.	+	+	2
G rhiz	Circumbor.		<i>Equisetum x moorei</i> Newman	.	.	+	.	+	.	2
G rhiz	Euri-Medit.		<i>Asparagus officinalis</i> L.	.	.	+	.	+	.	2
G rhiz	N-Amer.		<i>Ambrosia coronopifolia</i> Torr. et Gray	.	.	+	.	+	.	2
NP	Euri-Medit.		<i>Rubus ulmifolius</i> 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 <i>Salicion cinereae</i> , <i>Salicetalia auritae</i> and <i>Alnetea glutinosae</i>		
P caesp	Paleotemp.		<i>Salix cinerea</i> L.	+	5
P caesp	C-Eur.-Caucas.		<i>Frangula alnus</i> Miller	3	+
G rhiz	Subcosmop.		<i>Thelypteris palustris</i> Schott	5	3
			Other species		
G rhiz	Subcosmop.		<i>Cladium mariscus</i> (L.) Pohl	2	1
NP	Euras.		<i>Rubus caesius</i> L.	+	1
H scap	Euras.		<i>Lysimachia vulgaris</i> L.	+	+
G rhiz	Euras.		<i>Carex acutiformis</i> Ehrh.	.	2
P caesp	S-Europ.-Pont.		<i>Rhamnus catharticus</i> L.	.	1
NP	SE-Europ.		<i>Salix rosmarinifolia</i> L.	1	.
H scap	Subcosmop.		<i>Lythrum salicaria</i> L.	+	.
H scap	Circumbor.		<i>Sanguisorba officinalis</i> L.	+	.
P scap	Paleotemp.		<i>Populus alba</i> L. ptl.	+	.
H scap	Europ.		<i>Valeriana officinalis</i> L.	.	+
G rhiz	Circumbor.		<i>Equisetum palustre</i> L.	.	+
H caesp	Eurimedit.		<i>Carex distans</i> 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 Sbrulino, 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 Sbrulino 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*
Quercu-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 Sbrulino 2008
Vincetoxico-Quercetum ilicis Gamper, Filesi, Buffa et Sbrulino 2008

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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 caryophyllaea* 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). Rel. 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: *Centaureum 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, Do-

rycnium 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.