Taylor & Francis
Taylor & Francis Group

Plant Biosystems - An International Journal Dealing with all Aspects of Plant Biology

Official Journal of the Societa Botanica Italiana

ISSN: 1126-3504 (Print) 1724-5575 (Online) Journal homepage: http://www.tandfonline.com/loi/tplb20

Syntaxonomy of Arundo stands along the eastern Adriatic coast

N. Jasprica, S. Bogdanović, K. Dolina, M. RušČić, M. Pandža & S. KovaČić

To cite this article: N. Jasprica, S. Bogdanović, K. Dolina, M. RušČić, M. Pandža & S. KovaČić (2016) Syntaxonomy of Arundo stands along the eastern Adriatic coast, Plant Biosystems - An International Journal Dealing with all Aspects of Plant Biology, 150:5, 887-903, DOI: 10.1080/11263504.2014.990942

To link to this article: https://doi.org/10.1080/11263504.2014.990942

Plant Biosystems, 2016
Vol. 150, No. 5, 887–903, http://dx.doi.org/10.1080/11263504.2014.990942

Taylor & Francis
Taylor & Francis Group

ORIGINAL ARTICLE

Syntaxonomy of *Arundo* stands along the eastern Adriatic coast

N. JASPRICA[1], S. BOGDANOVIĆ[2], K. DOLINA[1], M. RUŠČIĆ[3], M. PANDŽA[4], & S. KOVAČIĆ[5]

[1]*Institute for Marine and Coastal Research, University of Dubrovnik, Kneza Damjana Jude 12, PO Box 83, HR-20000 Dubrovnik, Croatia;* [2]*Department of Agricultural Botany, Faculty of Agriculture, University of Zagreb, Svetošimunska 25, HR-10000 Zagreb, Croatia;* [3]*Department of Biology, Faculty of Natural Sciences, Mathematics and Education, University of Split, Teslina 12, HR-21000 Split, Croatia;* [4]*Primary School Murterski Škoji, Put Škole 8, HR-22243 Murter, Croatia and* [5]*Botanical Garden, Department of Biology, Faculty of Science, University of Zagreb, Marulićev trg 9a, 10000 Zagreb, Croatia*

Abstract
Based on the diagnostic morphological characters of the *Arundo* taxa, and after both field and herbarium observation, three species (*A. micrantha*, *A. plinii* and *A. donax*) were found along the eastern Adriatic coast. Altogether, 50 phytocoenological relevés from *Arundo* stands were collected in Croatia, Montenegro and Albania between 2010 and 2013. Three associations with a predominance of *Arundo* species were determined: *Arundinetum plinianae*, *Arundinetum micranthae* and *Arundini donacis–Convolvuletum sepium*. Among them, *Arundinetum micranthae* is described and proposed as a new association, belonging to the *Artemisietea vulgaris* class. It occurs frequently along the coastal belt between the cities of Split and Dubrovnik in South Croatia. The syntaxonomy of the associations is discussed and comparison with similar communities from Italy is made. The vegetation and floristic structure of the associations is discussed as a potential basis for biodiversity conservation programmes and for evaluating the state of these ecosystems in the future.

Keywords: *Mediterranean, eastern Adriatic coast, nitrophilous communities, phytosociology, syntaxonomy, new syntaxon, distribution*

Introduction

According to recent molecular phylogenetic, biogeographic and morphological studies (Hardion et al. 2012a, 2012b), three distinct species of *Arundo* L. (Poaceae) are distributed along the eastern Adriatic coast and islands. These are: (1) *A. donax* L., the cosmopolitan Giant Reed imported from Subtropical Asia to the Mediterranean Basin and two circum-Mediterranean taxa: (2) *A. plinii* Turra and (3) *A. micrantha* Lam. In addition, in the Mediterranean Basin, *A. donaciformis* (Loisel.) Hardion has been reported and is considered as a rare taxon from southern France and Liguria in Italy (Hardion et al. 2012a).

A decade ago, the genus *Arundo* was reduced to only three species: *A. donax*, invasive in many warm regions; *A. formosana* Hack. from Taiwan and the Ryukyu Islands and the circum-Mediterranean *A. plinii s.l.* Danin (2004) divided the latter into three species: *A. plinii s.s.*, a taxon from northern Italy (*locus classicus* nearby Bologna) and southern France; *A. collina* Ten. (= *A. hellenica* Danin, Raus & Scholz; cf. Danin et al. 2002), an Apennine-Balkan species (*locus classicus* nearby Naples) and *A. mediterranea* Danin (= *A. mauritanica* Desf. *nom. illeg.*) found in Algeria, Cyprus, Greece and Palestine. In practice, many erroneous identifications among *Arundo* species have been attributed to the high variability of its morphological characters. Finally, Hardion et al. (2012a), using amplified fragment length polymorphisms (AFLPs), distinguished three distinct taxa within the *A. plinii s.l.* complex: (1) the Apennine-Balkan *A. plinii s.s.* (= *A. collina*, *A. hellenica*), (2) the Franco-Ligurian *A. donaciformis* and (3) the circum-Mediterranean *A. micrantha* (= *A. mauritanica*; *A. mediterranea*).

Although the presence of *A. plinii s.l.* has been previously reported in several localities in the southern Croatia (Adamović 1887; Rajevski 1969), Montenegro (Malý 1908; Sackl & Petras Sackl 2008) and Albania

Correspondence: K. Dolina, Institute for Marine and Coastal Research, University of Dubrovnik, Kneza Damjana Jude 12, PO Box 83, HR-20000 Dubrovnik, Croatia, Tel: +385 20324728, Fax: +385 20323872. Email: katija.dolina@unidu.hr

(Tutin 1980), no detailed data are available on *Arundo* chorology and their phytosociology from the eastern Adriatic coast. In addition, *A. plinii s.l.* is protected by statute in Croatia and some Mediterranean countries (e.g. France), and knowledge of its taxonomic delimitation and ecology is needed for conservation purposes (Callmander et al. 2005).

The aim of this paper is to: (i) investigate the presence of *A. plinii s.l.* on the eastern Adriatic coast, using the most reliable morphological features, according to key offered by Hardion et al. (2012a), (ii) contribute to the knowledge of the chorology and phytosociology of all *Arundo* taxa in the eastern Adriatic coast and (iii) highlight the affinities and differences among the eastern Adriatic and Italian *Arundo* associations.

Materials and methods

To determine the distribution of the *Arundo* species, we surveyed the eastern Adriatic coast, including some islands, from the island of Pag (Croatia) in the north to the city of Vlorë (Albania) in the south, which encompasses its entire length (ca. 800 km) (Online Supplement Figure S1). The taxonomical investigation was based on fresh material collected in 29 localities along the eastern Adriatic coast, published data (Danin 2004; Danin & Naenny 2008; Hardion et al. 2012a, 2012b) and herbarium specimens deposited in several herbaria (CAT, HUJ, PAL, ZA, ZAGR and ZAHO; Thiers 2014). All collected specimens were deposited in the Herbarium ZAGR (http://herbarium.agr.hr). Morphological characters (spikelet, lemma, upper glume and pilosity of nodes) for species delimitation in the revision of herbarium specimens of the genus *Arundo* in Croatia were used according to Hardion et al. (2012a).

The study was conducted according to the phytosociological method (Braun-Blanquet 1964) adopting the International Code of Phytosociological Nomenclature (Weber et al. 2000). Altogether, 50 phytocoenological relevés from the *Arundo* stands were collected in Croatia (33 relevés), Montenegro (13 relevés) and Albania (four relevés) in the period from 2011 and 2013 (Online Supplement Figure S1). Localities were selected according to precise information from the herbarium collections, published data and the authors' own surveys along the whole coastal area, ensuring that no particular portion of the sampling frame was favoured. In practice, the greatest number of sampling sites was taken in Croatia alongside the Adriatic Main Road or near major settlements. Only stands with at least the minimum area recommended for these types of vegetation were investigated (20–50 m^2, cf. Chytrý & Otýpková 2003).

The relevés were separated into three associations on the basis of the diagnostic and/or dominant species in line with the traditional syntaxonomic system of the communities. Constant species of *Arundinetum micranthae* were defined as those with a frequency $>30\%$ inside the association. Place, date of relevés and companions only present in one relevé (Tables I, IV and V) are listed in the Online Supplement Appendices 1 and 2.

In order to verify the traditional syntaxonomic system, the relevés were classified by numerical methods. The matrix consists of 181 species × 50 samples (relevés). Braun-Blanquet values were transformed according to van der Maarel (1979). An agglomerative, hierarchical clustering algorithm based on Euclidean distances and Ward's method for determination of group linkages was used (McCune & Mefford 2006). The program PC ORD ver. 5 (McCune & Mefford 2006) was employed. Differences between groups obtained in classification were tested by analysis of similarities in the PRIMERv6 software (Clarke & Gorley 2006).

Our relevés were compared with similar vegetation types previously investigated in Italy where *Arundo* species occur. Both the traditional associations and the results of the cluster analysis are summarized in synoptic table (Figure 1, Table VI). The final matrix consists of 78 species × 161 samples (relevés). Sporadic taxa (presence $\leq 5\%$) were omitted. The resulting table was rearranged slightly manually. The caption of each column contains the number of relevés used for the synthesis, the total and average number of species in a given association. For each taxon, the frequency class is given in Roman figures: $r = >5\%$, $+ = 6–10\%$, $\mathrm{I} = 11–20\%$, $\mathrm{II} = 21–40\%$, $\mathrm{III} = 41–60\%$, $\mathrm{IV} = 61–80\%$, $\mathrm{V} = 81–100\%$. If only four or fewer relevés were available, only the presence of taxa in a given association is indicated, in italics. Diagnostically important taxa of individual associations are marked in bold. The taxa with lower frequency values only ($\leq 20\%$) are listed in the Online Supplement Appendix 3.

Nomenclature of *Arundo* species follows Hardion et al. (2012a), while other plant taxa were adjusted according to Flora d'Italia (Pignatti 1982). Biological form was verified in the field and denoted according to categories reported in Pignatti (1982), these being based on the classification of Raunkiaer (1934). The abbreviations of life forms (P, Phanerophytes; Ch, Chamaephytes; H, Hemicryptophytes; G, Geophytes; T, Therophytes) and chorological forms (CME, Circum-Mediterranean; EME, East Mediterranean; IME, Illyrian Mediterranean; MEAT, Mediterranean-Atlantic; WME, West Mediterranean; SEME, South European-Mediterranean; SEPO, South European-Pontic; EEP, East European-Pontic; CE, Central

Table I. *Arundinetum micranthae*, Jasprica, Bogdanović & Dolina *ass. nova*.

Life form	Floral element	No. of relevés	1	2	3	4	5	6	7	8	9	10	11[a]	12	Presence (%)
		Altitude (m a.s.l.)	8	7	20	18	10	21	6	10	15	6	1	56	
		Slope (o°)	5	5	10	10	15	50	40	55	60	35	–	5	
		Aspect	S	S	S	S	S	S	S	S	S	S	–	SE	
		Vascular plant cover (%)	100	100	100	100	100	100	100	100	100	100	100	100	
		Plot size (m^2)	25	25	25	25	25	25	25	25	25	25	25	25	
		No. of species	13	14	17	17	15	13	13	15	12	16	13	14	
		Characteristic and differential species of the association													
G	CME	*Arundo micrantha* Lam.	4	5	3	4	4	5	4	4	4	4	5	5	100
		Characteristic and differential species of the alliance, order and class													
H	CME	*Inula viscosa* (L.) Aiton	1	1	+	1	+	+	1	+	+	+	+	1	100
H	CME	*Foeniculum vulgare* Miller	1	+	1	1	1	+	1	+	+	+	.	.	83
G	WS	*Arundo donax* L.	.	+	+	+	+	.	+	+	+	+	+	.	75
T	CULT	*Aster squamatus* (Sprengel) Hieron.	+	+	.	+	.	.	.	.	.	+	.	.	33
H	EA	*Daucus carota* L.	+	.	.	.	.	.	.	.	.	.	.	+	17
G	CME	*Arundo plinii* Turra	.	+	.	.	.	.	.	.	.	.	.	.	8
		Other species													
		Quercetea ilicis													
P	CME	*Spartium junceum* L.	1	1	1	2	2	2	1	2	2	2	1	1	100
P	CME	*Rosa sempervirens* L.	.	.	+	+	.	.	.	.	.	.	.	.	17
P	CME	*Myrtus communis* L.	.	.	.	.	.	.	.	.	.	+	.	+	17
		Ammophiletea													
G	CME	*Agropyron pungens* (Pers.) R. et S.	2	2	1	2	1	+	2	2	1	1	+	.	92
		Festuco valesiacae–Brometea erecti													
H	CME	*Psoralea bituminosa* L.	.	.	+	+	1	+	1	+	2	2	+	+	83
H	SEME	*Oryzopsis miliacea* (L.) Asch. et Schweinf.	.	.	+	+	+	+	.	.	.	.	.	.	33
H	CME	*Cephalaria leucantha* (L.) Schrader	.	.	.	.	.	.	.	+	+	+	.	+	33
H	SEME	*Galium lucidum* All.	.	.	+	+	.	.	.	.	.	.	.	.	17
H	CME	*Dactylis hispanica* Roth	.	.	+	.	.	.	.	+	.	.	.	.	17
Ch	CME	*Helichrysum italicum* (Roth) Don	.	.	.	.	.	.	.	.	.	.	+	+	17
		Stellarietea mediae													
G	WS	*Convolvulus arvensis* L.	1	1	+	+	+	+	+	+	+	+	.	.	83
G	WS	*Cynodon dactylon* (L.) Pers.	1	1	+	.	+	.	.	.	.	.	.	.	33
G	WS	*Sorghum halepense* (L.) Pers.	.	.	+	+	+	.	.	.	.	.	.	+	33
		Nerio oleandri–Tamaricetea africanae													
P	MEAT	*Rubus ulmifolius* Schott	.	.	2	2	+	1	1	+	.	2	2	1	75
		Thero-Brachypodietea ramose													
H	CME	*Brachypodium ramosum* (L.) R. et S.	.	.	.	.	1	2	1	2	2	2	.	1	58
H	CME	*Reichardia picroides* (L.) Roth	+	+	.	.	+	.	.	+	+	+	.	.	50
H	WS	*Carex divulsa* Stokes	.	+	2	2	+	+	.	.	.	.	.	.	42
T	CME	*Pallenis spinosa* (L.) Cass.	.	.	.	.	.	.	+	+	+	+	.	.	33

		Crithmo-Limonietea													
Ch	MEAT	*Inula crithmoides* L.	+	+	.	.	.	.	+	+	.	1	+	.	50
		Quercetea pubescentis													
P	EURO	*Clematis vitalba* L.	.	.	.	+	1	2	+	.	.	.	.	.	33
P	EA	*Rubus caesius* L.	.	.	+	1	.	.	.	.	.	.	.	.	17
P	WS	*Rosa canina* L.	.	.	+	+	.	.	.	.	.	.	.	.	17
P	WME	*Coronilla valentina* L.	.	.	.	.	.	.	.	.	.	+	+	.	17
		Cakiletea maritimae													
T	WS	*Atriplex latifolia Wahlenb.*	+	+	.	.	.	.	.	+	.	.	.	.	25
H	MEAT	*Beta vulgaris* L. ssp. *maritima* (L.) Arcang.	+	+	.	.	.	.	.	.	.	+	.	.	25
		Erico-Cistetea													
Ch	EME	*Erica manipuliflora* Salisb.	.	.	.	.	.	.	.	.	.	.	+	+	17

[a] Holotypus.

European; EURO, European; EA, Eurasian; CH, Circum-Holartic; WS, cosmopolitan; CULT, cultivated and adventive plants) are given in Tables I–III, before the name of each species. Regarding chorological form, the division of the plants into floral elements and lower categories has been performed according to Horvatić (1963), Horvatić et al. (1967/1968) and Jasprica and Kovačić (1997). The syntaxonomic scheme follows Biondi et al. (2002, 2013) and Fici and Gianguzzi (2011). Syntaxonomic units mentioned in the text and tables, but not in the scheme, are shown (in alphabetical order) in the Online Supplement Appendix 4.

Results

According to the herbarium revision, all three taxa of *Arundo* (*A. micrantha*, *A. plinii*, *A. donax*) are found along the eastern Adriatic coast. The field surveyed showed that *A. plinii* is more common in the southern part but with some scattered localities in Istria, northern Croatian islands of Cres, Susak and Pag, while *A. micrantha* is frequent in the middle part of the investigated area (Online Supplement Figure S1).

The communities with *Arundo* on the eastern Adriatic coast belong to the nitrophilous vegetation occurring in the Mediterranean bioclimatic strata at 0–200 m a.s.l. (Tables I and IV–VI and Figure 1). According to these results, the syntaxonomic synopsis of the *Arundo* communities on the eastern Adriatic coast is as follows:

ARTEMISIETEA VULGARIS *Lohmeyer, Preising & Tüxen* ex *von Rochow, 1951*
+ Elytrigietalia repentis *Oberdorfer, Müller & Görs in Oberdorfer, Görs, Korneck, Lohmeyer, Müller, Philippi & Seibert, 1967 nom. mut. propos. Rivas-Martínez, Díaz, Fernández-González, Izco, Loidi, Lousã & Penas, 2002 [*Agropyretalia repentis *Oberdorfer, Müller & Görs in Oberdorfer, Görs, Korneck, Lohmeyer, Müller, Philippi & Seibert, 1967]*
*Inulo viscosae–Agropyrion repentis *Biondi & Allegrezza, 1996*
**Inulo viscosae–Agropyrenion repentis *Biondi & Pesaresi* ex *Biondi & Pesaresi, 2013*
Arundinetum micranthae *Jasprica, Bogdanović & Dolina, 2014,* ass. nova
Arundinetum plinianae *Biondi, Brugiapaglia, Allegrezza & Ballelli, 1992*
Galio APARINES–Urticetea DIOICAE *Passarge* ex *Kopecký, 1969*
+ Convolvuletalia sepium *Tüxen ex Mucina, 1993*
*Convolvulion sepium *Tüxen* ex *Oberdorfer, 1957*

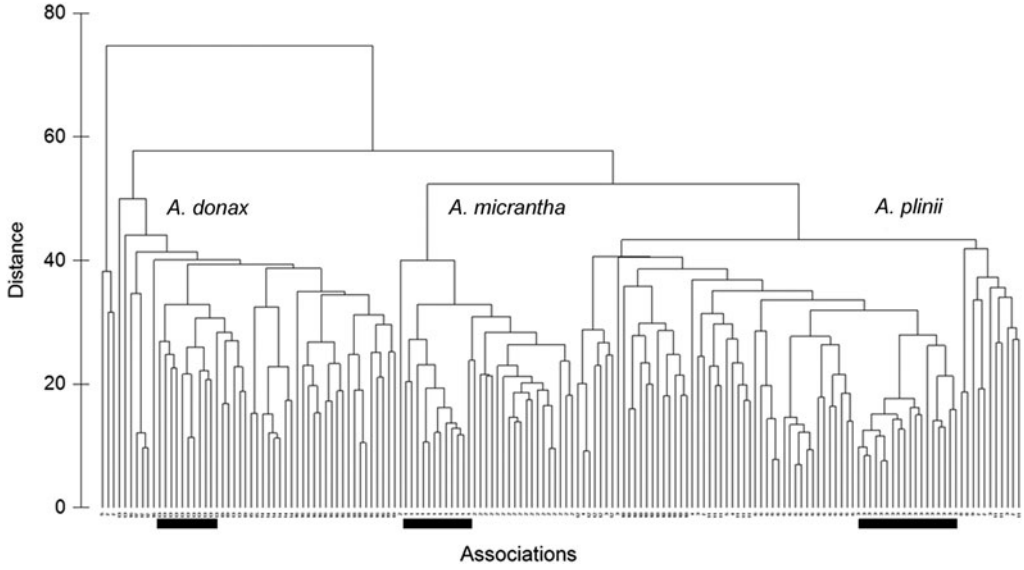

Figure 1. Dendrogram of the eastern Adriatic and Italian relevés. For data sources and references see the notes of Table VI. Position of the eastern Adriatic associations is labelled.

Table II. A comparison of life form spectra among three plant associations with *Arundo* species in the study area.

Life forms	*Arundinetum micranthae*	*Arundinetum plinianae*	*Arundini donacis–Convolvuletum sepium*
Phanerophytes	8 (22.86)	29 (37.18)	14 (26.92)
Chamaephytes	3 (8.57)	2 (2.56)	1 (1.92)
Hemicryptophytes	13 (37.14)	27 (34.62)	16 (30.77)
Geophytes	8 (22.86)	10 (12.82)	12 (23.08)
Therophytes	3 (8.57)	10 (12.82)	9 (17.31)
Total species	35 (100)	78 (100)	52 (100)

Note: Numbers of taxa and percentage contribution per life form are presented.

Table III. The spectrum of floral elements in three plant associations of *Arundo* species in the study area.

Floral elements	*Arundinetum micranthae*	*Arundinetum plinianae*	*Arundini donacis–Convolvuletum sepium*
1. Mediterranean	21 (60.00)	44 (56.41)	16 (30.77)
1.1. Circum-Mediterranean (CME)	16 (45.71)	36 (46.15)	13 (25.00)
1.2. East Mediterranean (EME)	1 (2.86)	2 (2.56)	1 (1.92)
1.3. Illyrian-Mediterranean (IME)	–	3 (3.85)	–
1.4.Mediterranean-Atlantic (MEAT)	3 (8.57)	3 (3.85)	2 (3.85)
1.5. West Mediterranean (WME)	1 (2.86)	–	–
2. South European	3 (8.57)	9 (11.54)	4 (7.69)
2.1. South European – Mediterranean (SEME)	3 (8.57)	6 (7.69)	3 (5.77)
2.2. South European – Pontic (SEPO)	–	3 (3.85)	1 (1.92)
3. East European - Pontic (EEP)	–	–	1 (1.92)
4. Central European (CE)	–	1 (1.28)	1 (1.92)
5. European (EURO)	1 (2.86)	3 (3.85)	1 (1.92)
6. Eurasian (EA)	2 (5.71)	4 (5.13)	7 (13.46)
7. Circum-Holartic (CH)	–	–	1 (1.92)
8. Cosmopolitan (WS)	7 (20.00)	13 (16.67)	17 (32.69)
9. Cultivated and adventive plants (CULT)	1 (2.86)	4 (5.13)	4 (7.69)
	35 (100.00)	78 (100.00)	52 (100.00)

Note: Numbers of taxa and percentage contribution per floral element are presented.

Table IV. *Arundinetum plinianae* Biondi, Brugiapaglia, Allegrezza & Ballelli, 1992.

Life form	Floral element	No of relevés	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Presence (%)
		Altitude (m a.s.l.)	20	20	20	20	20	180	60	10	5	31	32	62	112	20	5	10	10	10	40	45	10	10	200	
		Slope (°)	40	40	40	30	75	–	30	5	–	15	30	5	60	–	15	15	20	20	50	40	–	10	–	
		Aspect	S	S	SW	S	SE	–	SE	SE	–	S	S	S	S	–	SE	W	S	S	S	S	–	S	–	
		Vascular plant cover (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
		Plot size (m^2)	50	50	50	25	50	25	25	25	25	25	50	25	25	25	25	50	25	25	50	25	50	25	15	
		No. of species	10	14	14	10	17	8	14	10	22	19	13	16	12	19	13	12	12	18	13	17	7	8	14	
		Characteristic and differential species of the association																								
G	CME	*Arundo plinii* Turra	5	5	5	3	4	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	3	4	100
P	EURO	*Cornus sanguinea* L.	.	.	.	.	.	1	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	13
		Characteristic and differential species of the alliance, order and class																								
H	CME	*Inula viscosa* (L.) Aiton	1	1	+	1	+	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	2	+	+	100
H	EA	*Daucus carota* L.	.	.	.	+	+	.	+	+	+	1	1	+	+	1	1	+	1	+	1	1	2	.	+	78
T	CME	*Picris echioides* L.	.	.	.	.	.	.	+	.	+	.	.	.	.	+	+	.	.	+	+	+	.	.	.	30
H	CME	*Foeniculum vulgare* Miller	.	.	.	+	.	.	+	.	+	.	.	+	.	+	.	.	+	.	.	+	.	.	.	30
H	WS	*Cichorium intybus* L.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	+	13
G	WS	*Agropyron repens* (L.) Beauv.	.	.	.	1	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	13
H	WS	*Calystegia sepium* (L.) R. Br.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	+	.	.	.	13
T	CULT	*Conyza canadensis* (L.) Cronq.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	13
H	CME	*Verbascum sinuatum* L.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	9
H	WS	*Rumex crispus* L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	9
G	WS	*Arundo donax* L.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	9
T	CULT	*Aster squamatus* (Sprengel) Hieron.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	9
G	CME	*Arundo micrantha* Lam.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
G	CULT	*Helianthus tuberosus* L.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	4
T	CME	*Carthamus lanatus* L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	4
T	WS	*Xanthium italicum* Moretti	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	4
H	CME	*Onopordum illyricum* L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	4
		Other species																								
		Nerio oleandri–Tamaricetea africanae																								
P	MEAT	*Rubus ulmifolius* Schott	+	+	+	1	+	.	2	1	1	+	+	+	1	1	1	1	1	1	+	1	+	.	3	91
P	CME	*Vitex agnus-castus* L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	2	.	9
		Quercetea ilicis																								
P	CME	*Spartium junceum* L.	3	1	3	.	+	2	1	.	1	1	1	1	1	1	1	3	1	1	1	3	.	.	.	78
P	CME	*Clematis flammula* L.	+	.	.	.	.	.	.	.	.	+	+	+	+	+	+	+	+	+	.	.	.	.	.	43
P	CME	*Myrtus communis* L.	.	+	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	+	+	.	.	.	26
G	CME	*Asparagus acutoflius* L.	.	+	+	.	+	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	22
P	CME	*Rubia peregrina* L.	+	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	13
P	CME	*Calicotome spinosa* (L.) Link	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	13
P	CME	*Pistacia lentiscus* L.	.	.	+	.	+	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	13
P	CME	*Smilax aspera* L.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	9

		Festuco valesiacae–Brometea erecti																									
H	CME	*Psoralea bituminosa* L.	1	+	+	.	2	.	2	.	+	+	+	+	+	+	+	+	+	+	+	+	.	.	.	74
H	SEME	*Oryzopsis miliacea* (L.) Asch. Et Schweinf.	.	.	.	1	.	.	.	.	1	.	+	1	.	+	.	+	.	+	.	.	.	.	.	30
H	CME	*Dactylis hispanica* Roth	.	.	.	.	.	.	.	4	.	+	+	.	+	+	+	.	.	+	.	.	.	.	.	30
H	SEME	*Dorycnium pentaphyllum* Scop. ssp. *pentaphyllum*	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+	+	+	.	.	.	26
H	SEME	*Galium lucidum* All.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	9
		Ammophiletea																									
G	CME	*Agropyron pungens* (Pers.) R. et S.	.	.	.	.	+	.	.	.	1	+	+	1	+	1	+	+	1	+	+	+	.	.	.	57
		Quercetea pubescentis																									
P	SEME	*Fraxinus ornus* L.	+	.	.	.	.	+	.	.	.	+	+	.	+	+	+	+	+	+	+	+	.	.	.	52
P	EME	*Coronilla emerus* L. ssp. *emeroides* (Boiss.et Spruner) Hayek	+	+	+	.	.	.	.	.	+	.	+	+	+	.	.	+	.	+	.	.	.	.	.	39
P	EURO	*Clematis vitalba* L.	.	.	.	+	.	.	.	.	1	.	.	.	.	.	.	.	.	.	+	+	.	.	+	22
P	CME	*Colutea arborescens* L.	.	.	+	.	.	.	.	.	1	+	.	.	+	.	.	.	.	.	.	.	.	.	.	17
P	CME	*Sorbus domestica* L.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	9
		Thero-Brachypodietea ramosi																									
H	CME	*Brachypodium ramosum* (L.) R. et S.	3	3	4	2	4	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	26
H	CME	*Carlina corymbosa* L.	.	.	.	.	.	.	.	.	+	.	.	+	.	+	.	.	.	.	.	.	+	+	.	22
T	CME	*Pallenis spinosa* (L.) Cass.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	.	.	.	.	.	13
T	CME	*Trifolium stellatum* L.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	.	.	.	.	.	.	.	.	.	13
		Querco-Fagetea sylvaticae																									
P	WS	*Ulmus minor* Miller	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	+	.	.	+	.	.	.	17
G	WS	*Pteridium aquilinum* (L.) Kuhn	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	9
		Paliuretea																									
P	IME	*Paliurus spina-christi* Miller	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	9
		Chenopodietea																									
H	SEPO	*Centaurea solstitialis* L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	9
		Erico-Cistetea																									
Ch	CME	*Dorycnium hirsutum* (L.) Ser.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	9

Table V. *Arundini donacis–Convolvuletum sepium* Tüxen & Oberdorfer *ex* O. Bolòs, 1962.

Life form	Floral element	No. of relevés	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Presence (%)
		Altitude (m a.s.l.)	18	20	23	13	1	1	1	1	5	8	0.5	0.5	1	2	2	
		Slope (°)	5	5	–	–	–	–	5	5	2	2	–	–	–	–	–	
		Aspect	SW	S	–	–	–	–	SW	S	S	SE	–	–	–	–	–	
		Vascular plant cover (%)	100	100	100	100	100	100	100	90	100	100	100	100	100	100	100	
		Plot size (m^2)	25	25	25	25	25	25	20	20	25	25	60	100	100	100	25	
		No. of species	7	8	6	6	13	17	11	13	26	25	6	9	7	12	7	
		Characteristic and differential species of the association																
G	WS	*Arundo donax* L.	5	5	5	5	5	5	5	4	4	5	5	4	5	4	5	100
H	WS	*Calystegia sepium* (L.) R. Br.	.	1	+	3	4	+	2	.	2	4	.	+	.	4	4	73
P	WS	*Cynanchum acutum* L.	.	.	.	.	.	4	+	2	.	.	.	.	.	1	+	33
		Characteristic and differential species of the alliance, order and class																
G	WS	*Convolvulus arvensis* L.	.	.	.	.	.	+	+	+	+	+	.	.	.	+	2	47
P	WS	*Solanum dulcamara* L.	.	.	.	.	.	+	.	+	.	.	.	.	.	+	2	27
G	SEPO	*Aristolochia clematitis* L.	.	.	.	.	.	+	.	.	+	.	.	.	.	+	.	20
H	WS	*Althaea officinalis* L.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	13
P	WS	*Vitis vinifera* L. ssp. *sylvestris*(Gmelin) Hegi	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	13
T	WS	*Galium aparine* L.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	13
G	EEP	*Glycyrrhiza echinata* L.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	7
P	EA	*Humulus lupulus* L.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	7
H	EA	*Eupatorium cannabinum* L.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	7
		Other species																
		Nerio oleandri–Tamaricetea africanae																
P	MEAT	*Rubus ulmifolius* Schott	1	1	1	1	1	1	+	+	2	2	.	+	.	+	4	87
P	CME	*Vitex agnus-castus* L.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	13
H	CME	*Erianthus ravennae* (L.) Beauv.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	13
		Artemisietea vulgaris																
H	CME	*Inula viscosa* (L.) Aiton	1	.	.	.	.	+	1	2	.	1	+	.	.	.	.	40
T	WS	*Sonchus oleraceus* L.	.	.	.	.	.	+	1	1	1	1	.	.	.	+	.	40
H	EA	*Daucus carota* L.	.	.	.	.	+	.	+	1	+	+	.	.	.	.	1	40
T	CME	*Picris echioides* L.	.	.	.	.	+	.	+	1	1	+	.	.	.	.	.	33
T	CULT	*Aster squamatus* (Sprengel) Hieron.	.	.	.	.	+	+	.	+	+	+	.	.	.	.	.	33
T	CULT	*Conyza canadensis* (L.) Cronq.	.	.	.	.	+	.	.	.	+	+	.	.	.	.	.	20
G	WS	*Agropyron repens* (L.) Beauv.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	13
H	EA	*Picris hieracioides* L.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	13
		Phragmito-Magno-Caricetea																
G	WS	*Phragmites australis* (Cav.) Trin.	.	.	.	.	+	+	.	+	1	+	.	.	.	+	.	40
G	CH	*Equisetum palustre* L.	.	.	.	.	+	.	.	.	+	+	.	.	.	.	.	20
		Quercetea ilicis																
P	CME	*Rubia peregrina* L.	+	+	.	.	.	.	.	.	+	.	.	+	1	.	.	33
G	CME	*Asparagus acutoflius* L.	.	.	+	.	.	.	.	.	.	.	.	+	+	.	.	20

P	CME	*Clematis flammula* L.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	13
G	MEAT	*Arum italicum* Miller	.	.	.	.	.	.	.	.	1	+	.	.	.	.	.	13
		Festuco valesiacae–Brometea erecti																
H	CME	*Dactylis hispanica* Roth	+	.	.	+	+	.	.	.	.	+	+	+	.	.	.	40
		Quercetea pubescentis																
P	EURO	*Clematis vitalba* L.	+	1	.	.	.	+	.	.	1	+	.	.	.	.	.	33
P	WS	*Rosa canina* L.	.	+	+	.	.	.	.	.	.	.	.	+	.	.	.	20
		Molinio-Arrhenatheretea																
G	CME	*Holoschoenus vulgaris* Link	.	1	.	.	.	.	.	.	+	+	.	.	.	.	.	20
H	SEME	*Ranunculus neapolitanus* Ten.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	13
H	EA	*Galium mollugo* L.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	13
H	WS	*Potentila reptans* L.	.	.	.	.	.	.	.	.	1	+	.	.	.	.	.	13
H	EA	*Cirsium palustre* (L.) Scop	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	13
		Cakiletea maritimae																
T	WS	*Atriplex latifolia* Wahlenb.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	20
		Querco-Fagetea sylvaticae																
P	EA	*Prunus spinosa* L.	4	.	.	.	.	.	.	.	.	.	.	3	.	.	.	13
		Chenopodietea																
T	WS	*Solanum nigrum* L.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	13
		Ammophiletea																
G	CME	*Agropyron pungens* (Pers.) R. et S.	.	.	.	.	.	.	.	.	.	.	2	+	.	.	.	13
		Parietarietea judaicae																
H	SEME	*Parietaria diffusa* M. et K.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	13

Table VI. Synoptic table of the associations with *Arundo* on the eastern Adriatic coast and in Italy.

Association no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Number of relevés	12	19	23	3	2	18	6	2	1	12	9	5	15	6	2	14	3	4	5
Total number of species	35	61	80	21	20	70	43	9	13	69	49	28	53	12	27	40	12	15	11
Average number of species per relevé	14.7	16.4	14.0	10.7	10.0	18.0	12.0	5.5	13.0	16.2	13.9	9.4	11.6	8.7	20.5	8.4	8.7	9.0	6.6
Character–taxa of association																			
Arundo micrantha Lam.	**V**	**V**	*r*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aristolochia navicularis E. Nardi	**.**	**III**	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Arundo plinii Turra	+	.	**V**	***3***	***2***	**V**	**V**	***2***	***1***	**V**	**V**	**V**	.	.	.	.	.	.	.
Cornus sanguinea L.	.	.	**I**	***2***	***1***	**.**	**II**	**.**	**.**	**.**	**III**	**II**	.	.	.	.	.	*1*	.
Euphorbia ceratocarpa Ten.	.	.	.	.	.	**V**	.	.	.	.	.	.	.	.	.	.	.	.	.
Rubus ulmifolius Schott	IV	IV	V	*1*	.	III	I	.	.	IV	.	**V**	V	IV	*2*	II	*3*	.	III
Arundo donax L.	IV	IV	+	.	.	.	.	.	.	+	.	.	**V**	**V**	***2***	**V**	***3***	***4***	**V**
Calystegia sepium (L.) R. Br.	.	III	I	.	.	.	.	.	.	.	.	I	**IV**	**.**	**.**	**.**	**.**	***4***	**V**
Calystegia sylvatica (Kit.) Griseb.	.	.	.	.	.	II	.	.	.	III	.	.	**.**	**V**	***2***	**II**	**.**	**.**	**.**
Cynanchum acutum L.	.	.	.	.	.	.	.	.	.	.	.	.	**II**	**.**	**.**	**.**	**.**	**.**	**II**
Arum italicum Miller	.	II	.	.	.	.	.	.	.	.	.	I	**I**	**.**	**.**	**II**	***3***	***3***	**.**
Symphytum bulbosum Schimper	.	.	.	.	.	.	.	.	.	.	.	.	**.**	**.**	**.**	**.**	***3***	**.**	**.**
Artemisietea vulgaris																			
Inula viscosa (L.) Aiton	V	II	V	.	.	IV	II	.	.	.	III	.	II	V	*1*	.	.	.	.
Daucus carota L.	I	III	IV	.	.	II	.	.	*1*	+	II	.	II	IV	.	.	.	.	.
Agropyron repens (L.) Beauv.	.	.	I	.	*1*	.	III	.	.	I	II	.	I	.	.	+	.	.	.
Picris hieracioides L.	.	.	.	.	.	II	.	.	.	+	IV	.	I	V	.	.	.	.	II
Foeniculum vulgare Miller	V	II	II	.	.	.	.	.	.	IV	.	I	+	.	.	.	.	.	
Aster squamatus (Sprengel) Hieron.	II	.	+	.	.	.	.	.	.	.	.	.	II	V	.	.	.	.	III
Picris echioides L.	.	III	II	.	.	+	.	.	.	.	I	.	II	.	.	.	.	.	.
Silene alba (Miller) Krause	.	.	.	.	.	.	.	*2*	.	V	.	I	.	.	.	IV	.	*1*	.
Pulicaria dysenterica (L.) Bernh.	.	.	.	.	.	.	II	.	.	.	I	.	+	.	.	.	.	.	.
Blackstonia perfoliata (L.) Hudson	.	.	.	.	.	.	I	.	*1*	.	II	.	.	.	.	.	.	.	.
Sambucus ebulus L.	.	.	.	.	.	.	.	*2*	.	II	.	.	.	.	.	I	.	.	.
Lactuca serriola L.	.	II	.	.	.	.	.	.	.	II	.	.	.	.	.	I	.	.	.
Verbena officinalis L.	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sonchus oleraceus L.	.	IV	.	.	.	.	.	.	.	I	.	.	II	.	.	+	.	.	.
Conyza canadensis (L.) Cronq.	.	.	I	.	.	.	.	.	.	.	.	.	I	.	.	+	.	.	III
Galactites tomentosa Moench	.	I	.	.	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.
Sonchus asper (L.) Hill	.	.	.	.	.	.	.	.	.	III	I	.	.	.	.	+	.	.	.
Tussilago farfara L.	.	.	.	.	.	I	IV	.	.	.	.	.	.	.	.	.	.	.	.
Rumex obtusifolius L.	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hypericum majus (A.Gray) Britton	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.
Bellevalia romana (L.) Sweet	.	.	.	.	.	.	III	.	.	.	.	.	.	.	.	.	.	.	.
Erigeron sp.	.	.	.	.	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.
Conium maculatum L.	.	.	.	.	.	.	.	.	.	II	.	.	.	.	.	+	.	.	.
Arctium minus (Hill) Bernh.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	*2*	.	.
Bryonia dioica Jacq.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	*2*	.

Galio aparines–Urticetea dioicae																			
Galium aparine L.	.	.	.	.	.	.	.	.	.	V	.	.	I	IV	*2*	IV	*2*	*3*	III
Urtica dioica L.	.	.	.	.	.	.	.	.	.	II	.	I	.	.	*2*	IV	*3*	*4*	II
Eupatorium cannabinum L.	.	.	.	.	*1*	II	.	.	.	.	III	.	+	.	.	.	.	.	.
Artemisia verlotorum Lamotte	.	.	.	.	.	.	.	.	.	III	.	I	.	.	.	II	.	*1*	.
Allium triquetrum L.	.	III	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ballota nigra L. ssp. *uncinata* (Fiori et Bég.) Patzak	.	III	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Melissa romana Miller	.	*r*	.	.	.	.	.	.	.	.	.	IV	.	.	.	.	.	.	.
Humulus lupulus L.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	*2*	.
Rumex conglomeratus Murray	.	.	.	.	.	.	.	.	.	.	.	.	.	.	*2*	.	.	.	.
Rhamno catharticae–Prunetea spinosae																			
Lavatera olbia L.	.	IV	.	.	.	I	.	.	.	.	.	.	.	.	.	.	.	.	.
Prunus spinosa L.	.	.	.	.	.	.	III	.	.	.	.	.	I	.	.	.	.	.	.
Rubus fruticosus L.	.	.	.	.	.	.	.	.	.	.	IV	.	.	.	.	.	.	*4*	.
Robinia pseudacacia L.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	*2*	.
Dorycnium rectum (L.) Ser.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	*2*	.	.	.	.
Quercetea ilicis																			
Asparagus acutifolius L.	+	III	II	*3*	.	III	.	.	.	.	II	I	I	.	*1*	.	.	.	.
Rubia peregrina L.	.	II	I	*2*	*1*	II	.	.	.	.	II	II	II	.	*2*	.	.	.	.
Spartium junceum L.	V	.	IV	*3*	*1*	III	III	.	*1*	.	IV	.	.	.	.	.	.	.	.
Rosa sempervirens L.	I	.	*r*	*1*	*1*	.	.	.	.	.	.	I	.	.	*2*	.	.	.	.
Clematis flammula L.	.	.	III	*1*	.	.	.	.	.	.	II	I	I	.	.	.	.	.	.
Smilax aspera L.	.	.	+	.	.	.	.	.	.	.	II	.	+	.	*1*	.	.	.	.
Lonicera etrusca Santi	.	.	.	*2*	.	.	.	.	.	.	II	I	.	.	.	.	.	.	.
Teucrium flavum L.	.	.	.	*1*	.	I	.	.	.	.	II	.	.	.	.	.	.	.	.
Myrtus communis L.	I	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Arisarum vulgare Targ.-Tozz.	.	I	.	.	.	.	.	.	.	.	.	.	.	.	*2*	.	.	.	.
Acanthus mollis L.	.	.	.	.	.	III	.	.	.	.	.	.	.	.	*2*	.	.	.	.
Bupleurum fruticosum L.	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.
Ampelodesmos mauritanicus (Poiret) Dur. et Sch.	.	.	.	.	.	III	.	.	.	.	.	.	.	.	.	.	.	.	.
Calicotome villosa (Poiret) Link	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.
Querco-Fagetea sylvaticae																			
Clematis vitalba L.	II	.	II	.	.	.	I	.	.	.	II	V	II	.	.	I	*3*	*3*	.
Ulmus minor Miller	.	III	I	*1*	*1*	I	.	.	.	.	I	.	.	.	.	.	.	.	.
Pteridium aquilinum (L.) Kuhn	.	.	+	*1*	.	.	.	.	.	.	II	I	.	.	.	.	.	.	.
Lathyrus sylvestris L.	.	.	.	.	.	.	I	.	.	.	II	.	.	.	.	.	.	.	.
Equisetum telmateja Ehrh.	.	.	.	.	.	.	.	.	.	.	II	.	.	.	.	.	*1*	.	.
Populus alba L.	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Solanum dulcamara L.	.	.	.	.	.	.	.	.	.	.	.	.	II	.	.	.	.	.	.
Quercetea pubescentis																			
Fraxinus ornus L.	.	.	III	.	*1*	.	.	.	*1*	.	.	.	.	.	.	.	.	.	.
Rosa canina L.	I	.	.	.	.	.	II	.	.	.	I	.	I	.	.	.	.	.	.
Rubus caesius L.	I	.	.	.	.	.	.	.	.	III	.	.	.	.	.	IV	.	.	.
Coronilla emerus L. ssp. *emeroides* (Boiss.et Spruner) Hayek	.	.	II	*1*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tamus communis L.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	*2*	.	.	.	.
Quercus virgiliana (Ten.) Ten.	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.
Peucedanum verticillare (L.) Koch	.	.	.	.	.	.	IV	.	.	.	.	.	.	.	.	.	.	.	.

Thero-Brachypodietea ramosi + Lygeo sparti–Stipetea tenacissimae																				
Pallenis spinosa (L.) Cass.	II	II	I	*1*	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Reichardia picroides (L.) Roth	III	.	*r*	.	.	II	.	.	.	.	I	.	.	.	.	.	.	.	.	.
Avena sterilis L.	.	.	*r*	.	.	I	.	.	.	III	.	.	.	.	.	I	.	.	.	.
Convolvulus elegantissimus Miller	.	II	*r*	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Brachypodium ramosum (L.) R. et S.	III	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex divulsa Stokes	III	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carlina corymbosa L.	.	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Asphodeline liburnica (Scop.) Rchb.	.	.	.	*2*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Foeniculum vulgare Miller ssp. *piperitum* (Ucria) Coutinho	.	.	.	.	.	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eryngium campestre L.	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ferula communis L.	.	.	.	.	.	IV	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hypericum perfoliatum L.	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lathyrus articulatus L.	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Opopanax chironium (L.) Koch	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Festuco valesiacae–Brometea erecti																				
Dactylis hispanica Roth	I	.	II	.	.	III	.	.	*1*	.	.	.	II	.	.	.	.	.	.	.
Psoralea bituminosa L.	V	.	IV	*2*	.	III	.	.	.	.	I	.	.	.	.	.	.	.	.	.
Oryzopsis miliacea (L.) Asch. et Schweinf.	II	.	II	.	.	II	.	.	.	.	.	I	.	.	.	+	.	.	.	.
Brachypodium rupestre (Host) R. et S.	.	.	.	.	.	.	I	.	*1*	.	II	.	.	.	.	.	.	.	.	.
Cephalaria leucantha (L.) Schrader	II	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scabiosa maritima L.	.	.	.	.	.	II	.	.	.	.	I	.	.	.	.	.	.	.	.	.
Leucanthemum vulgare Lam.	.	.	.	.	.	.	II	.	.	.	I	.	.	.	.	.	.	.	.	.
Bromus erectus Hudson	.	.	.	.	.	.	.	.	*1*	.	II	.	.	.	.	.	.	.	.	.
Dorycnium pentaphyllum Scop. ssp. *pentaphyllum*	.	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Centaurium erythraea Rafn ssp. *majus* (Hoffmgg. et Link) Melderis	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Linum viscosum L.	.	.	.	.	.	.	IV	.	.	.	.	.	.	.	.	.	.	.	.	.
Lotus ornithopodioides L.	.	.	.	.	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.	.
Carex flacca Schreber	.	.	.	.	.	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.
Centaurea scabiosa L.	.	.	.	.	.	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.
Dorycnium pentaphyllum Scop.	.	.	.	.	.	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.
Centaurium erythraea Rafn	.	.	.	.	.	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.
Euphorbia cyparissias L.	.	.	.	.	.	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.
Nerio oleandri–Tamaricetea africanae																				
Nerium oleander L.	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tamarix africana Poiret	.	.	.	.	.	.	.	.	.	.	.	.	.	IV	.	.	.	.	.	.
Stellarietea mediae																				
Convolvulus arvensis L.	V	III	.	.	.	.	III	*1*	.	+	.	.	III	.	.	+	.	.	.	.
Vicia sativa L.	.	I	.	.	.	.	.	.	.	II	.	.	.	II	.	I	.	.	.	.
Cynodon dactylon (L.) Pers.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	*2*	+	.	.	.	.
Torilis arvensis (Hudson) Link	.	.	.	.	.	.	.	.	.	IV	.	.	.	.	.	III	.	.	II	
Sorghum halepense (L.) Pers.	II	.	*r*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Borago officinalis L.	.	II	.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.
Bromus sterilis L.	.	.	.	.	.	.	.	.	.	IV	.	.	.	.	.	+	.	.	.	.
Silybum marianum (L.) Gaertner	.	.	.	.	.	.	.	.	.	II	.	.	.	.	.	I	.	.	.	.
Anagallis arvensis L.	.	.	.	.	.	.	.	.	.	II	.	.	.	.	.	I	.	.	.	.
Cynoglossum creticum Miller	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxalis pes-caprae L.	.	IV	.	.	.	.	.	.	.	.	.	.	.	.	*2*	.	.	.	.	.

Scolymus grandiflorus Desf.	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fumaria capreolata L.	.	.	.	.	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.	.
Centaurea napifolia L.	.	.	.	.	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.	.
Melilotus indica (L.) All.	.	.	.	.	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.	.
Molinio-Arrhenatheretea																				
Dactylis glomerata L.	.	.	.	*1*	.	.	II	.	.	+	IV	I	.	.	.	+	.	.	.	
Rumex crispus L.	.	III	+	.	.	.	.	.	.	.	.	II	.	.	.	.	.	.	.	
Lythrum salicaria L.	.	.	.	.	.	.	.	*2*	.	.	.	.	.	.	.	+	.	.	.	
Cakiletea maritimae																				
Atriplex latifolia Wahlenb.	II	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	
Beta vulgaris L. ssp. *maritima* (L.) Arcang.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Parietarietea judaicae																				
Parietaria diffusa M. et K.	.	II	.	.	.	.	.	.	.	.	.	II	I	.	*1*	+	.	.	III	
Centranthus ruber (L.) DC.	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	
Papaveretea rhoeadis																				
Galium verrucosum Hudson	.	III	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Stipo-Trachynetea dystachiae																				
Linum trigynum L.	.	.	.	.	.	.	.	.	.	.	III	.	.	.	.	.	.	.	.	
Crithmo-Limonietea																				
Inula crithmoides L.	III	.	*r*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Phragmito-Magno-Caricetea																				
Phragmites australis (Cav.) Trin.	.	.	.	.	.	.	.	*2*	.	.	.	.	II	IV	.	.	.	.	.	
Erico-Cistetea																				
Dorycnium hirsutum (L.) Ser.	.	.	+	.	.	.	I	.	.	.	III	.	.	.	.	.	.	.	.	
Ammophiletea																				
Agropyron pungens (Pers.) R. et S.	V	.	III	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	

Notes: 1. *Arundinetum micranthae*, *ass. nova hoc loco* (this study); 2. *Aristolochio navicularis-Arundetum micranthae*, Mascia et al. 2013, Table 3; 3. *Arundinetum plinianae* (this study); 4. *Arundinetum plinianae*, Biondi et al. 2002, Table 3; 5. *Arundinetum plinianae*, Angiolini et al. 2005, Table 13; 6. *Euphorbio ceratocarpae-Arundinetum collinae*, Brullo et al. 2010, Table 19; 7. *Arundinetum plinianae*, Zitti et al. 2013, table 14; 8. *Arundinetum plinianae*, Ceschin & Salerno 2008, Table 15; 9. *Arundinetum plinianae*, Maccherini et al. 1998, table 8; 10. *Arundinetum plinianae*, Battisti et al. 2008, Table 15; 11. *Arundinetum plinianae*, Biondi et al. 1992, table 14; 12. *Arundo plinii-Rubetum ulmfolii*, Biondi et al. 2014, Table 4; 13. *Arundini donacis-Convolvuletum sepium* (this study); 14. *Calystegio silvaticae-Arundinetum donacis*, Brullo & Sciandrello 2006, Table 14; 15. *Calystegio sylvaticae-Arundinetum donacis*, Fici & Gianguzzi 2011, Table 6; 16. *Arundini donacis-Convolvuletum sepium*, Battisti et al. 2008, Table 16; 17. *Clematido vitalbae-Arundinetum donacis*, Biondi & Allegrezza 2004, Table 8; 18. *Arundini donacis-Convolvuletum sepium*, Baldoni & Biondi 1993, Table 25; 19. *Arundini donacis-Convolvuletum sepium*, Brullo & Marcenò 1985, Table 46.

Arundini donacis–Convolvuletum sepium *Tüxen & Oberdorfer* ex *O. Bolòs, 1962*

Description of the associations

Arundinetum micranthae *Jasprica, Bogdanović & Dolina, 2014,* ass. nova hoc loco *(Table I, relevés 1–12)*

Nomenclatural type: Relevé 11 in Table I (*holotypus*).

Site: Village of Rogotin (43°02′10.2″N, 17°29′28.1″E), the Neretva River delta, South Croatia, eastern Adriatic coast.

Date: 25 August 2010 (N. Jasprica).

Diagnostic and dominant species: *Arundo micrantha*.

Constant species: *Inula viscosa*, *Foeniculum vulgare*, *Arundo donax*, *Aster squamatus*, *Agropyron pungens*, *Spartium junceum*, *Psoralea bituminosa*, *Oryzopsis miliacea*, *Cephalaria leucantha*, *Convolvulus arvensis*, *Sorghum halepense*, *Clematis vitalba*, *Inula crithmoides*, *Carex divulsa*, *Pallenis spinosa*, *Brachypodium ramosum*, *Reichardia picroides*, *Cynodon dactylon* and *Rubus ulmifolius*.

Arundo micrantha appears along the coastal belt between the cities of Split and Dubrovnik in southern Croatia. In this association, *A. micrantha* has the highest cover. It is considered as the characteristic and dominant species of the proposed plant association. This nitrophilous community has developed as a low (2–4 m) and dense shrub formation between 1 and 56 m a.s.l. (Table I). It is frequently found on clayey soils that remain humid for most of the year and appear exclusively on the southern slopes between 0° and 60° with the vegetation cover of almost 100%. In total, 35 species have been recorded in the relevés sampled in the association. Among them, 28 were companions. The number of species in the relevés was between 11 and 18 (average 14.7). Of these, 37% were hemicryptophytes, and 23% each of phanerophytes and geophytes (Table II). Most of the species (60%) belong to the Mediterranean floral types, mostly circum-Mediterranean chorological type (46%, Table III). In addition to *A. micrantha*, three other species displayed the greatest (>90%) presence: *Inula viscosa*, *Spartium junceum* and *Agropyron pungens*. Among characteristic species of the *Artemisietea vulgaris* class and lower syntaxa, *A. plinii* had the lowest frequency. Most of the companions were treated as characteristic species of the *Festuco valesiacae–Brometea erecti* (6), following the *Quercetea pubescentis*, *Stellarietea mediae*, *Thero-Brachypodietea ramosi* and *Quercetea ilicis* classes (with four taxa in each class).

Arundinetum plinianae *Biondi, Brugiapaglia, Allegrezza & Ballelli, 1992 (Table IV, relevés 1–23)*

Arundo plinii mostly appears along the coastal belt from the Pelješac Peninsula (southern Croatia) southwards to central Albania. It is the characteristic and dominant species of the association. This community has developed as a dense shrub formation between 5 and 200 m a.s.l. (Table IV). Generally, it prefers the southern slopes with a gradient between 0° and 75° with a vegetation cover of 100%. In total, 80 species have been recorded in the relevés sampled in the association. The number of species in the relevés was between 8 and 23 (average 14.0). Of these, 37% were phanerophytes and 35% hemicryptophytes (Table II). Most of the species (56%) belong to the Mediterranean floral types; usually circum-Mediterranean chorological type (46%, Table III). Among companions (61 taxa), the greatest number belongs to the species of *Quercetea ilicis* (14 taxa), *Quercetea pubescentis* and *Thero-Brachypodietea ramosi* (12). The habitats are exposed to disturbances.

Arundini donacis-Convolvuletum sepium *Tüxen & Oberdorfer* ex *O. Bolòs, 1962 (Table V, relevés 1–15)*

Arundo donax, *Calystegia sepium* and *Cynanchum acutum* are the characteristic and dominant species of the association. This community has developed as high (mostly between 4 and 6 m) and dense shrub formations between 0.5 and 23 m a.s.l. (Table V). It occupies level surfaces along permanent watercourses with the vegetation cover of 100%. Altogether, 53 species have been recorded in the relevés sampled in the association, while the number of species in the relevés was between 4 and 26 (average 11.6). Of these, 31% were hemicryptophytes and 27% phanerophytes (Table II). Most of the species belong to the cosmopolitan (33%) and Mediterranean (31%) chorological types (Table III). Among companions (43 taxa), the greatest number belongs to the species of *Artemisietea vulgaris* (12 taxa), following the *Quercetea ilicis* and *Molinio-Arrhenatheretea* (with five taxa in each class). These habitats are also exposed to disturbances.

Discussion

This investigation revealed the presence of *A. micrantha*, *A. plinii*, *A. donax* along the eastern Adriatic coast (Online Supplement Figure S1).

The *Arundinetum micranthae* and *Arundinetum plinianae* associations occupy similar habitats subject to human disturbance. Our study showed that *Arundinetum micranthae* grows exclusively in a Mediterranean context, while *Arundinetum plinianae* occurs indifferently in both Mediterranean and Temperate bioclimates. In this regard, the current data are not consistent with those of Mascia et al. (2013), who found *A. plinii* exclusively in the Temperate zone. The associations are developed on clay substrata subjected to frequent landslides, and

they are important for the control of superficial waters due to a thick network of roots and rhizomes that are able to bind the soil to a depth of 40–50 cm or more (Biondi et al. 2002). Some relevés from both associations were collected along small temporary watercourses in Croatia, but in our case, associations could not be considered as riparian communities or related to the stream dynamics. This also agrees with findings of Biondi et al. (1992, 2002) and Mascia et al. (2013).

Generally, *A. plinii* has a wide ecological range in relation to soil moisture. It colonizes clayey or sandy soils of fluvial riverbeds and humid depressions within the *Imperato cylindricae–Erianthion ravennae* alliance (*Phragmito-Magno-Caricetea*; Braun-Blanquet & Bolòs 1958). Brullo et al. (2010) included *A. plinii* (= *A. collina*) – dominant coenoses from Italy, Greece and Crete in a new syntaxon *Arundion collinae* (*Lygeo sparti–Stipetea tenacissimae*), while Biondi et al. (2014) studied populations from the Central Adriatic coast and subordinated them to the *Arundo plinii–Rubion ulmifolii* alliance (*Rhamno catharticae–Prunetea spinosae*). Indeed, it is very clear that *Arundo plinii* communities can occur in different vegetation typologies of which one is mainly herbaceous (*Inulo viscosae–Agropyrion repentis*) even if some shrubs occur in its composition, as is shown in our case, and another typology, more rich in shrubs, in which *Arundo plinii* and other reed species play a secondary role (cf. Allegrezza et al. 2006). Others have commented on the presence of *A. plinii* within some communities of *Quercetea ilicis* in Croatia (Jasprica & Ruščić 2013) and in Italy (Brullo et al. 2008).

The floristic and ecological characterization of the new association *Arundinetum micranthae* is in line with the biological and chorological spectra. Hemicryptophytes prevailed, which is generally consistent with the *Arundinetum plinianae* association in Italy (cf. Zitti et al. 2013). *A. micrantha* and *A. plinii* are large rhizomatous hemicryptophytes that are well adapted to synanthropic or human disturbed sites. The chorological spectrum highlights a clear dominance of the steno-Mediterraneans. These data confirm the peculiarity of the surveyed area from the phytogeographic point of view.

In this study, the floristic composition of the new association does not markedly differ from the eastern Adriatic *Arundinetum plinianae* association. Generally, both the eastern Adriatic associations showed close similarities to those found in Italy: they had a great variabilty of number of taxa and similar floristic composition (e.g. Biondi et al. 1992, 2002; Zitti et al. 2013). According to the results of cluster analysis, the close relationship between the eastern Adriatic *Arundinetum plinianae* association and the *Euphorbio ceratocarpae–Arundinetum collinae* association from Sicily (Brullo et al. 2010) could be largely ascribed to the high frequency and cover of characteristic species of *Artemisietea vulgaris* and companions (mostly from the *Quercetea ilicis*, *Thero-Brachypodietea ramosi* or *Lygeo sparti–Stipetea tenacissimae* classes). In our study, *Spartium junceum*, among some other companions (e.g. *Inula viscosa*, *Rubus ulmifolius*, *Brachypodium ramosum*), had a high frequency. This agrees with the findings of Biondi et al. (1992) who predominantly described shrub coenoses and referred to the *Spartium junceum* variant in areas where there are suitable conditions for shrubs penetration. *Agropyron pungens* appeared within these associations with a relatively high frequency (57–92%) and this confirms their common presence near the coastline.

The comparison between our new proposed association and related *Aristolochio navicularis–Arundetum micranthae* from Sardinia (Mascia et al. 2013) must be stressed. Regarding diversity, the Sardinian association is a species-richer community and contains more ruderals and hygrophytes. Some nitrophilous (*Calystegia sepium*, *Allium triquetrum*, etc.) or hygrophilous taxa (*Ulmus minor*, *Arum italicum*, etc.) occur exclusively in the Sardinian association. The latter group of taxa at least partly suggests its syndinamic relationship with the riparian habitats of the *Populetalia albae* order. On the contrary, taxa with the highest frequency in the Croatian association (e.g. *Spartium junceum*, *Agropyron pungens*, *Inula crithmoides, Brachypodium ramosum*) are missing in the Sardinian stands or have a significant lower frequency (*Inula viscosa*). Indeed, this association is related to the dry habitats of the *Quercetealia ilicis* order. Regarding life forms, associations with *A. micrantha* in Sardinia are dominated by geophytes and secondarily by hemicryptophytes. This can be attributed to the local ecological conditions. A common characteristic of both associations is a predominance of Mediterranean taxa (>60%), a low proportion of no-native plants (≤5%) and a great number of companions from different syntaxa. In both associations, *A. micrantha* and *A. donax* have a relatively high presence (63% vs. 75%).

Our results showed that associations with Mediterranean native *Arundo* species are floristically differentiated from the community dominated by potentially invasive *A. donax* (Mack et al. 2000; Mariani et al. 2010; Aguiar & Ferreira 2013). The mostly riparian association *Arundini donacis–Convolvuletum sepium*, optimal for thermo-Mediterranean and lower meso-Mediterranean zones (Salazar et al. 1997), is characterized by a smaller number of species and a significant presence of ruderals and taxa from thermo-Mediterranean riparian galleries with higher cover levels. This agrees with the findings

of Bolòs et al. (1988) and Mascia et al. (2013). In addition, this association is closely related to the *Calystegio silvaticae–Arundinetum donacis* association from southern Italy (Brullo et al. 2001; Brullo & Sciandrello 2006; Fici & Gianguzzi 2011) or the *Clematido vitalbae–Arundinetum donacis* association from the Central Italian Adriatic coast which has been observed on clay, wet and organic matter-rich soils, but not directly linked to water flow (Biondi & Allegrezza 2004).

Regarding syntaxonomy, we subordinated *Arundo* stands to nitrophilous vegetation of *Artemisietea vulgaris* and *Galio aparines–Urticetea dioicae* classes. We agree with Mascia et al. (2013) that further investigations are needed in order to clarify the syntaxonomy of these phytocoenoses.

In conclusion, the eastern Adriatic associations are an ecologically analogous group of communities to those reported from the western Adriatic coast and other Italian regions. The present findings contribute essential baseline information that should assist in future evaluations of *Arundo* stands along the eastern Adriatic coast. Stands with *Arundo* are widespread in southern Croatia and Montenegro, but due to the increasing coastal development, they may become endangered. Nevertheless, these stands are an important part of the region's natural heritage, in need of conservation measures, to ensure their survival. Management plans must ensure that these types of land are used in a sustainable way. Those included in the "NATURA 2000" network, in fact, must be protected according to international obligation.

Acknowledgements

We would like to thank three anonymous reviewers and the editors for their efforts in improving this paper. Many thanks also to Steve Latham (UK) for helpful comments and improving the English.

Supplemental data

Supplemental data for this article can be accessed doi:10.1080/11263504.2014.990942.

References

Adamović L. 1887. Građa za floru dubrovačku I [Contribution to the flora of Dubrovnik I]. Glasnik Hrvatskog naravoslovnog družtva 2: 161–167.

Aguiar FCF, Ferreira MT. 2013. Plant invasions in the rivers of the Iberian Peninsula, south-western Europe: A review. Plant Biosyst 147(4): 1107–1119.

Allegrezza M, Biondi E, Felici S. 2006. A phytosociological analysis of the vegetation of the Central Adriatic sector of the Italian peninsula. Hacquetia 5: 135–175.

Angiolini C, Landi M, Boddi M, Frignani F. 2005. La vegetazione dell'alveo fluviale del Sito d'Importanza Regionale Torrente Trasubbie (Grosseto, Toscana meridionale) [The vegetation of the river bed of the regional importance site of Torrente Trasubbie (Grosseto, southern Tuscany)]. Atti Soc Tosc Sci Nat Mem Ser B 112: 127–151.

Baldoni M, Biondi E. 1993. La vegetazione del medio e basso corso del fiume Esino (Marche – Italia centrale) [The vegetation of the middle and lower reaches of the river Esino (Marche - Italy Central)]. Stud Bot 11: 205–257.

Battisti C, Rosati L, Sorace A, Teofili C. 2008. Progetto Campo da golf nella Tenuta di Ponte Galeria (Roma) [Project of the golf course in the area of Ponte Galeria (Rome)]. Roma: Tenuta di Ponte Galeria.

Biondi E, Allegrezza M. 2004. Lettura e modellizzaziones in fitosociologica del paesaggio vegetale del Bacino del Fosso della Selva [Reading and modeling of the synphytosociological landscape basin of the Fosso della Selva]. I Quadernidella Selva 2: 36–57.

Biondi E, Allegrezza M, Casavecchia S, Galdenzi D, Gasparri R, Pesaresi S, Vagge I, Blasi C. 2014. New and validated syntaxa for the checklist of Italian vegetation. Plant Biosyst 148(2): 318–332.

Biondi E, Allegrezza M, Casavecchia S, Galdenzi D, Gigante D, Pesaresi S. 2013. Validation of some syntaxa of Italian vegetation. Plant Biosyst 147(1): 186–207.

Biondi E, Brugiapaglia E, Allegrezza M, Ballelli S. 1992. La vegetazione del litorale marchigiano (Adriatico centro-settentrionale) [The coastal vegetation of the Marche (north-central Adriatic)]. Colloq Phytosociol 19: 429–460.

Biondi E, Casavecchia S, Pinzi M, Bagella S, Calandra R. 2002. Excursion to the Conero regional natural park. Fitosociologia 39(1 Suppl. 3): 5–32.

Bolòs O, Montserrat JM, Romo AM. 1988. Comunitats vegetals higronitròfiles de la Catalunya pirinenca i de les terres properes [The higronitrophilous plant communities of the Catalonia Pyrenees and its surrounding area]. Acta Bot Barc 37: 33–44.

Braun-Blanquet J. 1964. Pflanzensoziologie. Grundzüge der Vegetationskunde [Plant sociology. Basic course of Vegetation Science]. 3rd ed., Wien-New York: Springer-Verlag.

Braun-Blanquet J, Bolòs O. 1958. Les groupements végétaux du bassin moyen de l'Ebre et leur dynamisme [The plant communities of the middle basin of the Ebro river and their dynamism]. Anales Estac Exp Aula Dei 5(1-4): 1–266.

Brullo C, Brullo S, Giusso del Galdo G, Guarino R, Minissale P, Scuderi L, et al. 2010. The *Lygeo-Stipetea* class in Sicily. Ann Bot (Roma) 0: 57–84.

Brullo S, Gianguzzi L, La Mantia A, Siracusa G. 2008. La classe *Quercetea ilicis* in Sicilia [The *Quercetea ilicis* class in Sicily]. Boll Acc Gioenia Sci Nat 41: 1–80.

Brullo S, Marcenò C. 1985. Contributo alla conoscenza della vegetazione nitrofila della Sicilia [Contribution to the knowledge of the nitrophilous vegetation of Sicily]. Colloq Phytosociol 12: 23–148.

Brullo S, Scelsi F, Spampinato G. 2001. La vegetazione dell'Aspromonte [The vegetation of the Aspromonte. Phytosociological study]. Studio fitosociologico. Reggio Calabria: Laruffa.

Brullo S, Sciandrello S. 2006. La vegetazione del bacino lacustre "Biviere di Gela" (Sicilia meridionale) [The vegetation of the Lake Biviere di Gela (southern Sicily)]. Fitosociologia 43: 21–40.

Callmander MW, Schatz GE, Lowry PP. 2005. IUCN red list assessment and the global strategy for plant conservation: Taxonomists must act now. Taxon 54: 1047–1050.

Ceschin S, Salerno G. 2008. La vegetazione del basso corso del fiume Tevere e dei suoi affluenti [The vegetation of the lower

course of the Tiber River and its tributaries (Lazio, Italy)]. Fitosociologia 45(1): 39–74.
Chytrý M, Otýpková Z. 2003. Plot sizes used for phytosociological sampling of European vegetation. J Veg Sci 14: 563–570.
Clarke KR, Gorley RN. 2006. PRIMER v6: User manual/tutorial. PRIMER-E, Plymouth.
Danin A. 2004. *Arundo* (Gramineae) in the Mediterranean reconsidered. Willdenowia 34: 361–369.
Danin A, Naenny W. 2008. Contribution to the recognition of reeds by their rhizome anatomy. Flora Mediterranea 18: 385–392.
Danin A, Raus T, Scholz H. 2002. Contribution to the flora of Greece: A new species of *Arundo* (Poaceae). Willdenowia 32: 191–194.
Fici S, Gianguzzi L. 2011. Aspetti vegetazionali e paesaggistici di Settefrati (Cefalù, Sicilia settentrionale), biotopo meritevole di conservazione [Vegetation and landscape aspects of Settefrati (Cefalù, north Sicily), biotope worthy of preservation]. Naturalista Sicil S. IV 35(2): 233–255.
Hardion L, Verlaque R, Baumel A, Juin M, Vila B. 2012a. Revised systematics of Mediterranean *Arundo* (Poaceae) based on AFLP fingerprints and morphology. Taxon 61: 1217–1226.
Hardion L, Verlaque R, Callmander MW, Vila B. 2012b. *Arundo micrantha* Lam. (Poaceae), the correct name for *Arundo mauritanica* Desf. and *Arundo mediterranea* Danin. Candollea 67: 131–135.
Horvatić S. 1963. Vegetacijska karta otoka Paga s općim pregledom vegetacijskih jedinica Hrvatskog primorja [Vegetation map of the island of Pag with survey of the plant communities of Hrvatsko Primorje]. Prirodoslovna istraživanja JAZU 33: 1–187.
Horvatić S, Ilijanić LJ, Marković-Gospodarić LJ. 1967–1968. Biljni pokrov okolice Senja [Vegetation of village of Senj and its surroundings]. Senjski zbornik 3: 298–322.
Jasprica N, Kovačić S. 1997. Vascular flora of the central part of Pelješac peninsula. Nat Croat 6: 349–456.
Jasprica N, Ruščić M. 2013. Flora i vegetacija otočića Supetra (Cavtat, južna Hrvatska) [Flora and vegetation of the small islet of Supetar (Cavtat Archipelago, South Croatia]. Hrvatska Misao (Sarajevo) 46: 111–134.
Maccherini S, Chiarucci A, De Dominicis V. 1998. Relationship between vegetation and morphology in the Radicofani Calanchi (southern Tuscany). Atti Mus Stor nat Maremma 17: 91–108.
Mack RN, Simberloff D, Lonsdale WM, Evans H, Clout M, Bazzaz FA. 2000. Biotic invasions: Causes, epidemiology, global consequences, and control. Ecol Appl 10: 689–710.
Malý K. 1908. Beitrage zur Kenntnis Der Illyrischen Flora [Contribution to the knowledge of the Illyrian flora]. Magyar Bot Lapok 7: 203–240.
Mariani C, Cabrini R, Danin A, Piffanelli P, Fricano A, Gomarasca S, et al. 2010. Origin, diffusion and reproduction of the giant reed (*Arundo donax* L.): A promising weedy energy crop. Ann Appl Biol 157: 191–202.
Mascia F, Fenu G, Angius R, Bacchetta G. 2013. *Arundo micrantha*, a new reed species for Italy, threatened in the freshwater habitat by the congeneric invasive *A. donax*. Plant Biosyst 147: 717–729.
McCune B, Mefford MJ. 2006. PC-ORD: Multivariate analysis of ecological data. Version 5.14. Version. Gleneden Beach, OR: MJM Software Design.
Pignatti S. 1982. Flora d'Italia [Flora of Italy]. Bologna: Edagricole.
Rajevski L. 1969. Prilog poznavanju flore južnodalmatinskog primorja [Contribution to the knowledge of the flora in South Dalmatia]. Acta Bot Croat 28: 459–465.
Raunkiaer C. 1934. The life forms of plants and statistical plant geography. Oxford: Clarendon Press.
Sackl P, Petras Sackl T. 2008. Some notes on the winter diet and feeding behaviour of the rock bunting *Emberiza cia* in southern Montenegro. Acrocephalus 29: 105–107.
Salazar C, Bocio I, Valle F. 1997. Habitats of E.U. interest affected by a river-damming project (Otívar dam) in Almijara mountains, Granada, S.E. Spain. Lagascalia 19: 759–768.
Thiers B. 2014. Index Herbariorum: A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. Available: http://sweetgum.nybg.org/ih
Tutin TG. 1980. *Arundo* L.. In: Tutin TG, Heywood VH, Burges NA, Moore DM, Valentine DH, Walters SM, Webb DA, editors. Flora Europaea 5. Cambridge: University Press. pp. 252–253.
van der Maarel E. 1979. Transformation of cover-abundance values in phytosociology and its effects on community similarity. Vegetatio 39: 97–114.
Weber HE, Moravec J, Theurillat JP. 2000. International code of phytosociological nomenclature. 3rd ed J Veg Sci 11: 739–768.
Zitti S, Rismondo M, Taffetani F. 2013. Vegetation of the Onferno Nature Reserve (Rimini – Central Italy) and management problems of secondary grasslands. Hacquetia 12: 87–131.