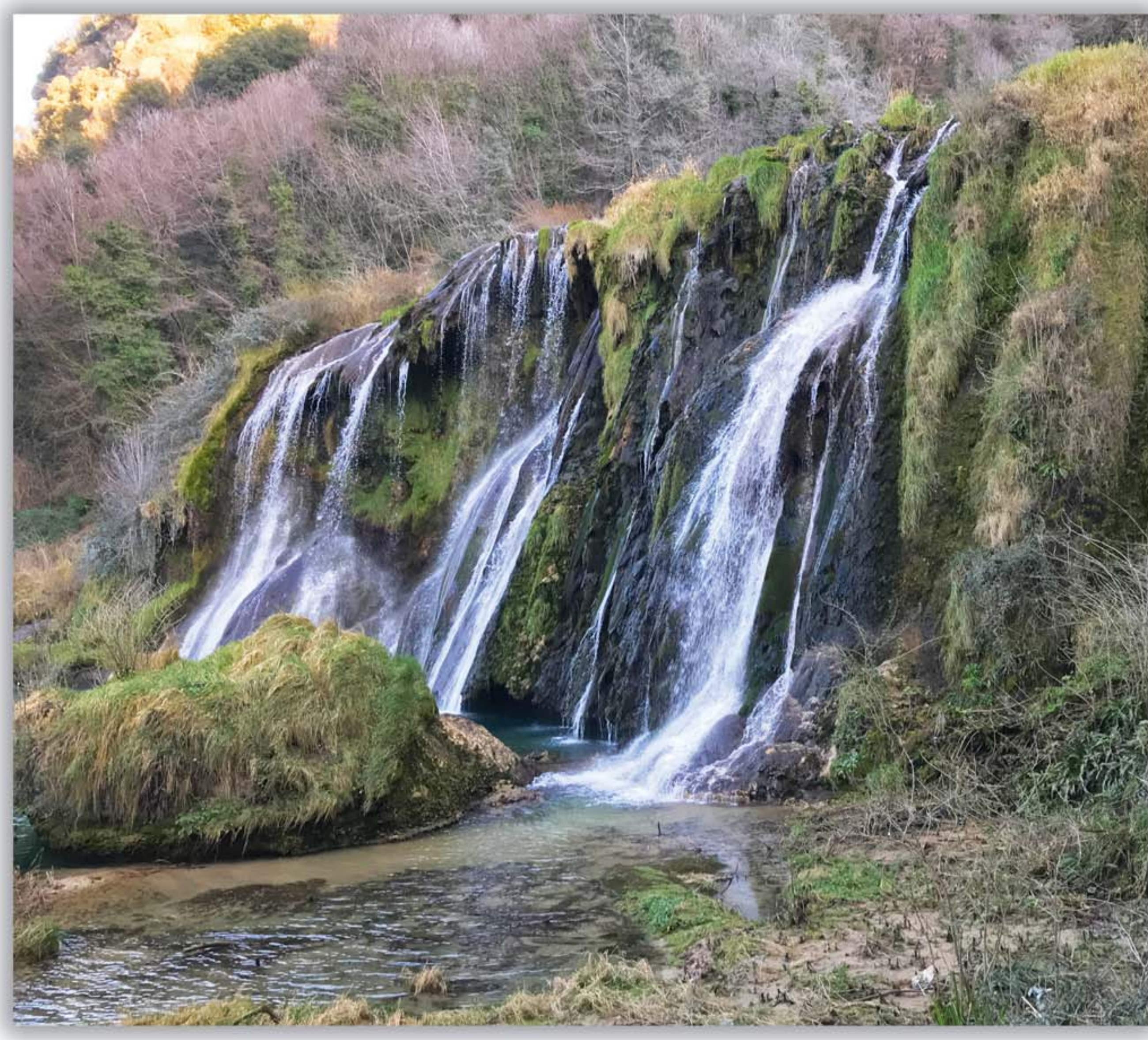
PLANT SOCIOLOGY

formerly FITOSOCIOLOGIA

Volume 55 (1) - June 2018

RIVISTA SEMESTRALE - POSTE ITALIANE S.P.A. - SPED. ABB. POST. - D.L. 353/2003 - (CONV. IN L. 27/02/2004 N. 46) ART. 1, COMMA 2, DCB ANCONA TASSA RISCOSSA-TAXE PERÇUE-CMPP AN
EDITO DALLA SOCIETA' ITALIANA DI SCIENZA DELLA VEGETAZIONE ONLUS - PAVIA - DIRETTORE RESPONSABILE PROF. E. BIONDI - VOLUME 1 - I° SEMESTRE 2018



Journal of the Italian Society for Vegetation Science

Plant Sociology, Vol. 55, No. 1, June 2018, pp. 21-29
DOI 10.7338/pls2018551/02

PLANT SOCIOLOGY
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The *Agrostion castellanae* Rivas Goday 1957 corr. Rivas Goday & Rivas-Martínez 1963 alliance in the southwestern Iberian Peninsula

R. Quinto-Canas[1,2], P. Mendes[3], C. Meireles[3], C. Mussarella[4], C. Pinto-Gomes[3]
[1]*Faculty of Sciences and Technology, University of Algarve, Campus de Gambelas, P-8005-139 Faro, Portugal.*
[2]*CCMAR – Centre of Marine Sciences (CCMAR), University of Algarve, Campus de Gambelas, P-8005-139 Faro, Portugal.*
[3]*Department of Landscape, Environment and Planning; Institute of Mediterranean Agricultural and Environmental Sciences (ICAAM), School of Science and Technology, University of Évora, Rua Romão Ramalho 59, P-7000-671 Évora, Portugal.*
[4]*Department of Agraria, "Mediterranea" University of Reggio Calabria, Località Feo di Vito, I-89122 Reggio Calabria, Italy.*

Abstract
The water courses of southern Portugal are ecosystems subject to constant fluctuations between periods of flooding and desiccation associated with seasonal dryness. In these unstable ecological conditions, a considerable diversity of riparian plant communities occurs. The objective of this study, carried out in the Monchique Sierran and Andévalo Districts, is to compare the perennial grasslands community dominated by *Festuca ampla* Hack, using a phytosociological approach (Braun-Blanquet methodology) and numerical analysis (hierarchical cluster analysis and ordination). From these results, a new hygrophilous community of perennial grasslands type was identified, *Narcisso jonquillae-Festucetum amplae*, as a result of the floristic, ecological and biogeographical differences from other associations already described within the *Agrostion castellanae* alliance, in the southwestern Iberian Peninsula. The association occurs in the thermomediterranean to mesomediterranean belts under dry to sub-humid ombrotypes, on siliceous soils that have temporary waterlogging. This new association corresponds with priority 6220 Habitat - Pseudo-steppe with grasses and annuals of the *Thero-Brachypodietea*, under the Natura 2000 code.

Key words: Andevalese-Monchique Sierran territory, *Festuca ampla*, numerical analysis, perennial grasslands, phytosociology.

Introduction

The riparian plant communities have very distinct floristic compositions, reflecting important differences in ecology and with clear implications on the structure of their own phytocoenoses. Ecologically, what these communities have in common is the fact that they rely on the existence of superficial groundwater, to a greater or lesser physical and temporal extent (Vieira *et al.*, 2001). The seasonal fluctuation of the ground water together with the nature of the soils are determinant ecological factors in the occurrence and distribution of plant communities in a hygrophilous or temporihygrophilous catena (Rivas-Martínez, 2007; Vila-Viçosa, 2012). Given these environmental constraints, different types of plant communities are identified, including the hygrophilous perennial grasslands.

According to Rivas-Martínez (2011) and Rivas-Martínez *et al.* (1980; 2001; 2002) the Mediterranean West Iberian perennial grasslands communities that colonize deep acid soils with slight flooding length, have been sintaxonomically include in *Agrostion castellanae* alliance. The present paper, following the fieldwork undertaken for a doctoral thesis on the vegetation of the Caldeirão mountains (Quinto-Canas, 2014) and scientific work on vegetation of the Algarve and Monchique Sector (Quinto-Canas *et al.*, 2012; Pinto-Gomes *et al.*, 2012), aims to provide a phytosociological and syntaxonomical analysis of the hygrophilous perennial grasslands (*Agrostion castellanae*) from the southwestern Iberian Peninsula. Of particular interest are the perennial grasslands dominated by *Festuca ampla*, which occur on alluvial soils. This community is frequently found on deep siliceous (schist) soils that have a short period of flooding from the Mira, lower Guadiana, and Algarve streams basins over the biogeographical territories of the Andévalo and Monchique Sierran Districts. These southern Iberian watercourses present special features, such as a high average annual temperature and an extreme flow irregularity (Ferreira & Moreira, 1995). They are subjected to the annual alternation between the flooded (wet season) and dry phases (during summer drought or dry periods of greater than two months).

The combination of livestock grazing, forestry and agriculture has extensively altered riparian vegetation throughout the flood marginal areas in southern Portugal. However, in recent years, there has been a slight

Corresponding author: Ricardo Quinto-Canas. *Faculty of Sciences and Technology, University of Algarve, Campus de Gambelas, 8005-139 Faro, Portugal; e-mail: rjcanas@ualg.pt*

recovery of these riparian areas as result of land set-aside. The agricultural abandonment in the study area, combined with the absence of trees and shrub strata belonging to the serial progressive communities, have favoured the development of *Festuca ampla* communities.

The perennial grassland is relatively dense and high, usually up to 0.3 m (Franco & Rocha Afonso 1980; 1998). *Festuca ampla* is the dominant hemicryptophyte in all of the samples. Endemic to the Iberian Peninsula and North Africa, this tall graminoid is frequently found in Portugal (Fuente & Ortuñez, 1995) as well as in the western Spanish provinces, but becomes increasingly scarce towards the eastern part of the Iberian Peninsula due to the reduction of the influence of the Atlantic ocean (Silveira *et al.*, 2000). Typically, this species grows in parafluvial and floodplain watercourses, with clear adaptation to temporal hydromorphy conditions (Franco & Rocha Afonso, 1998; Aguiar, 2000; Meireles, 2010).

In order to perceive the floristic identity of this new community within the circle of the perennial grasslands, we have included a synthetic table with other associations already described within the alliance *Agrostion castellanae* in the southwestern Iberian Peninsula which may be found in Costa *et al.* (2012), Rivas-Martínez (2011) and in the checklist published by Rivas-Martínez *et al.* (2001; 2002).

Study area

Located in the southwest of the Iberian Peninsula, the study area covers part of the southern territorial units of mainland Portugal. Geologically, the entire area is part of the meridional area of the "Southern Portuguese Zone" belonging to the Hesperian Massif, formed by pre-Mesozoic land characterized by a thick succession of schists and greywackes (Teixeira *et al.*, 1981). From a geomorphological point of view the study area presents two distinct situations: the vast peneplain of southern Alentejo, with an altitude of around 200 m a.s.l., rises gradually to the south and west forming a mountainous barrier. This mountain barrier is formed by tectonic sub-coastal reliefs of Caldeirão, Monchique, Cercal and Grândola mountains (Feio & Daveau, 2004). To the east, the boundary is marked by a deep groove down the Guadiana valley. In these territories the runoff erosion is intense, due to the altitude and the proximity of the base level. They form dense drainage networks, with convex-rectilinear steep slopes, which reach 150 m a.s.l. in height (Cruz, 1981; Manuppella *et al.*, 1992; Feio & Daveau, 2004). Within these mountain systems and in the flat areas there are alluvial soils with groundwater influence in valleys that can be flooded. According to the most recent study of mainland Portugal bioclimatic characterization by Monteiro-Henriques (2010), following Rivas-Martínez (2005; 2007) information classification, the study area presents a mediterranean pluviseasonal oceanic bioclimate, ranging from dry to sub-humid ombroclimates (Fig. 1) in the thermomediterranean to mesomediterranean belts. In a biogeographical context and following Rivas-Martínez *et al.* (2014; 2017), the study area is included in the Andévalo District (Lusitania and Extremadura Subprovince, West Iberian Mediterranean Province) and Monchique Sierran District (Cádiz and Sado Subprovince, Coastal Lusitania and West Andalusia Province).

Materials and methods

Field surveys were conducted between March 2009 and May 2012, following the phytosociologycal concepts of the Zurich-Montpellier landscape and "Sigmatist" school (Braun-Blanquet, 1965; Géhu & Rivas-Martínez, 1981; Rivas-Martínez, 2005; Biondi, 2011). Botanic nomenclature follows Coutinho (1939), Franco (1971; 1984), Franco & Rocha Afonso (1994; 1998; 2003), Castroviejo (1986-2010) and Valdés *et al.* (1987). The *Narcissus* genus was determined on the basis of the work undertaken by Vázquez *et al.* (2009). Bioclimatic typology follows Rivas-Martínez (2007) and Monteiro-Henriques (2010). The biogeographic classification was checked according to Costa *et al.* (1998), Rivas-Martínez (2007) and Rivas-Martínez *et al.* (2014). Sintaxonomical nomenclature followed Rivas-Martínez *et al.* (2001; 2002) and Rivas-Martínez (2011). For statistical data processing of the sample we first generated a data matrix, that included 23 relevés and 101 species. To clarify the differences between plant communities of *Agrostion castellanae* types, fifteen relevés were taken from the literature (Pinto-Gomes & Paiva-Ferreira, 2005; Rivas-Martínez

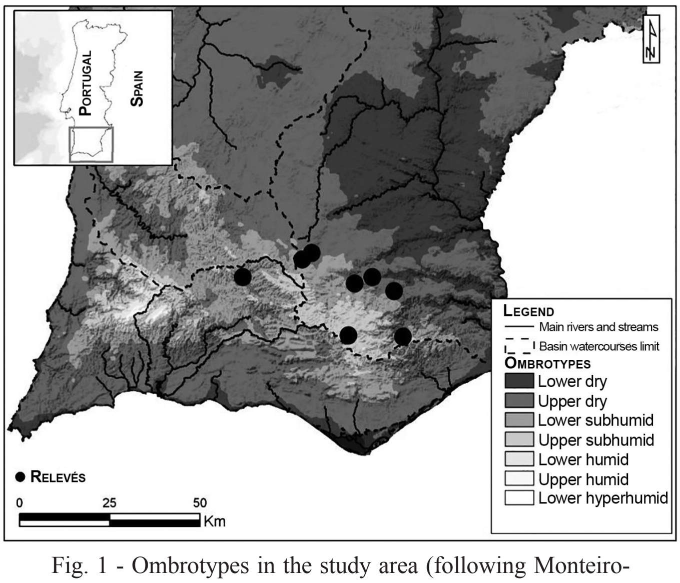

Fig. 1 - Ombrotypes in the study area (following Monteiro-Henriques 2010) and relevés locations.

et al., 1980; Rivas-Martínez & Belmonte, 1985). The matrix was subjected to multivariate analysis procedures (hierarchical cluster analysis obtained through Un-Weighted Pair-Group Method using Arithmetic Averages - UPGMA, with Bray-Curtis distance, and ordination by the method of Principal Component Analysis - PCA) using the software Primer 6 (version 6.1.5; Clarke, 1993; Clarke & Gorley, 2006).

Results and discussion

The dendrogram illustrate four main groups (Fig. 2) based on floristic dissimilarities, responding to different ecological gradients and representing the following syntaxonomical units (associations): (A_1) *Narcisso jonquillae-Festucetum amplae* (clusters 1-8); (A_2) *Narcisso willkommii-Festucetum amplae* (clusters 9-14); (B_1) *Gaudinio fragilis-Agrostietum castellanae* (cluster 23); (B_2) *Asphodelo aestivi-Armerietum gaditanae* (cluster 15-22).

The cluster analysis (Fig. 2) produces two main groups of associations (group A and group B). Group A includes relevés dominated by *Festuca ampla*, distributed in two relevés subgroups. Subgroup A_1, encompasses samples contained within in the association *Narcisso jonquillae-Festucetum amplae*, which is proposed here as new association for the Iberian southwest (Andevalese-Monchique Sierran territory). Subgroup A_2 also includes the *Festuca ampla* community *Narcisso willkommii-Festucetum amplae* Rosa-Pinto, Pinto-Gomes & Paiva-Ferreira in Pinto-Gomes & Paiva-Ferreira 2005, which has been described in the limestones of the Algarve District. The cluster analysis also shows a group of relevés clearly separated from the rest, which are included in the cluster group B, divided into two subgroups: the relevé cluster subgroup B_1 corresponds to the association *Gaudinio fragilis-Agrostietum castellanae* Rivas-Martínez & Belmonte 1985, which occurs in meso-supramediterranean bioclimatic areas of the West Iberian Mediterranean Province; and the subgroup B_2, of *Asphodelo aestivi-Armerietum gaditanae* Allier & Bresset 1977 corr. Rivas-Martínez, T.E. Díaz, Fernández González, Izco, Loidi, Lousã & Penas 2002, described by Rivas-Martínez *et al.* (1980) for the thermomediterranean Cádiz and Littoral Huelva Sector.

The cluster analysis was completed by ordering the inventories array by the method of PCA. Being an indirect gradient analysis (Capelo, 2007), the ordination diagram (Fig. 3) confirms the distinct of the clusters emerged through classification. Based on the interpretation of the ecological factors that influence the floristic composition of the communities, the ordination diagram suggests in the PC1 axis the separation of communities dominated by *Festuca ampla*, located on the right and communities of *Agrostis castellana* and

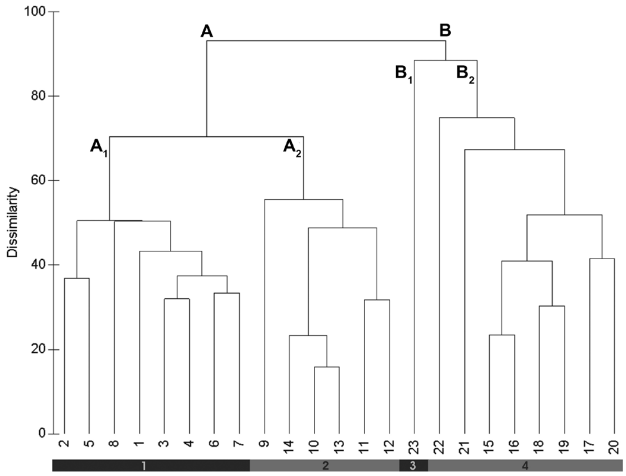

Fig. 2 - Classification analysis (UPGMA clustering dendrogram, with Bray-Curtis distance): Group A includes 1 - *Narcisso jonquillae-Festucetum amplae* (subgroup A_1; 1-8) and 2 - *Narcisso willkommii-Festucetum amplae* (subgroup A_2; 9-14); Group B includes 3 - *Gaudinio fragilis-Agrostietum castellanae* (subgroup B_1; 23) and 4 - *Asphodelo aestivi-Armerietum gaditanae* (subgroup B_2; 15-22).

Armeria gaditana, on the left. This distribution of the clusters along the PC1 suggests a distinction, moving negative to positive direction, from meso-higrophytic (clusters 15-22 and 23) to higrophytic (clusters 1-8 and 9-14) communities, correlated to an increase of waterlogging. In fact, in the positive values of PC1 are the well-differentiated associations *Narcisso jonquillae-Festucetum amplae* (clusters 1-8) and *Narcisso willkommii-Festucetum amplae* (clusters 9-14). Both communities are found on the banks of watercourses where the influence of temporary flooding is higher, when compared to the distinct position occupied by *Asphodelo aestivi-Armerietum gaditanae* (clusters 15-22) and *Gaudinio fragilis-Agrostietum castellanae* (cluster 23), on soils that are no longer exposed to waterlogging. Moreover, the distribution of the four perennial grasslands associations along the PC2 axis

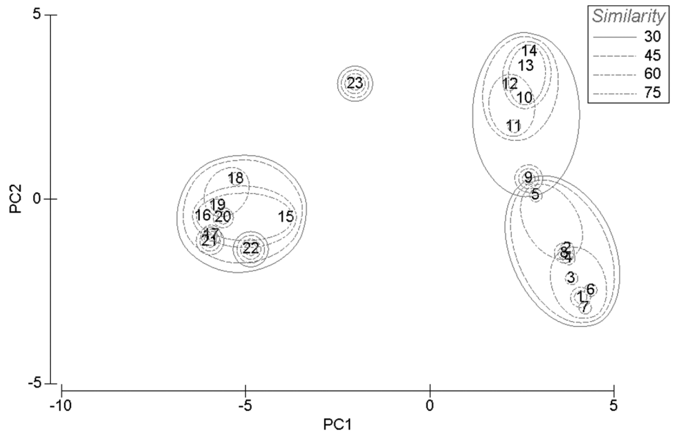

Fig. 3 - Ordination diagram (PCA).

can be correlated to soil nature, between silicicolous to neutro-calcicolous communities, where the neutrophilous to calcicolous association *Narcisso willkommii-Festucetum amplae* reaches the highest position along positive values of the PC2 axis.

In Table 1, the floristic composition of each group defined in the dendrogram, determined by the presence/absence of certain species, is highlighted. The different bioclimatic gradients, soil conditions and biogeographic distribution of the plant communities are briefly described below.

NARCISSO JONQUILLAE-FESTUCETUM AMPLAE ass. nova *hoc loco*
(*holotypus* rel.: 6 in Tab. 2; clusters 1-8, Fig. 2)

The relevés of the *Narcisso jonquillae-Festucetum amplae* have a high dissimilarity in relation to the other association. It is a hygrophilous community of perennial grasslands, dominated by *Festuca ampla*, which may be seen in the flood margins of the Mira and lower Guadiana basin watercourses and in the Algarve torrential rivers and streams. It grows on oligo to mesotrophic deep soils, with a frank-clayed to frank-sandy texture, that are often flooded during the wet season (Fig. 4), and subject to droughts during the dry season.

The new *Festuca ampla* perennial grasslands proposed here, is a dense hemicryptophyte community, characterized by the dominance of *Festuca ampla*, accompanied by *Narcissus jonquilla*, an endemic geophyte from Iberian Peninsula. As shown in Table 2 (rels. 1 to 8), the floristic composition of these perennial grasslands also contains other characteristic species from the *Stipo giganteae-Agrostietea castellanae* class (such as *Dactylis lusitanica*, *Agrostis castellana*, among others), from the *Agrostietalia castellanae* order (*Thapsia villosa*, *Carex divisa* subsp. *chaetophylla* and *Serapias parviflora*) and from the *Agrostion castellanae* alliance (*Asphodelus aestivus*). In the companion species group, the consistent presence of hygrophilous plants, such as *Scirpoides holoschoenus* subsp. *australis*, *Oenanthe crocata*, *Rubus ulmifolius*, *Mentha suaveolens*, *Cynodon dactylon*, *Holcus lanatus*, *Dorycnium rectum* and *Juncus rugosus*, is closely related to the edaphic compensation. The temporary flooding character is emphasized by the presence of *Isoëto-Nanojuncetea* elements, such as *Juncus tenageia*, *Pulicaria paludosa* and *Mentha pulegium*. The presence of differential plants, with high conservational value, including *Lavandula viridis* and *Salix salviifolia* subsp. *australis*, must also be highlighted.

Both floristic patterns and ecological features define it as an original phytocoenoses, which we propose under the name of *Narcisso jonquillae-Festucetum amplae*. Its optimum is found in mediterranean pluviseasonal oceanic bioclimate, thermomediterranean lower mesomediterranean belts under dry to subhumid

Tab. 1 - Synthetic analysis of the *Agrostion castellanae* alliance in the southwestern Iberian Peninsula.

Association no.	1	2	3	4
Characteristics and differentials of association				
Narcissus jonquilla L.	III	.	.	.
Dactylis hispanica subsp. lusitanica (Stebbins & Zohary) Rivas Mart. & Izco	III	.	.	.
Thapsia villosa L.	II	.	.	.
Serapias parviflora Parl.	I	.	.	.
Linum bienne Mill.	I	.	.	.
Carex divisa subsp. chaetophylla (Steud.) Nyman	II	.	.	I
Festuca ampla Hack.	V	V	.	II
Narcissus willkommii (Samp.) A. Fern.	.	III	.	.
Agrostis castellana Boiss. & Reut.	II	III	4	.
Gaudinia fragilis (L.) P. Beauv.	I	.	2	IV
Rumex acetosella subsp. angiocarpus (Murb.) Murb.	.	.	+	I
Asphodelus aestivus Brot.	IV	.	.	II
Armeria gaditana Boiss.	.	.	.	V
Centaurea exarata Coss.	.	.	.	IV
Silene laeta (Aiton) Godr.	.	.	.	I
Serapias lingua L.	.	.	.	I
Companions				
Scirpoides holoschoenus subsp. australis (Murray) Soják	V	.	.	.
Nerium oleander L.	IV	.	.	.
Lavandula viridis L'Hér.	IV	.	.	.
Ranunculus bulbosus subsp. aleae var. adscendens (Brot.) Pinto da Silva	IV	.	.	.
Scrophularia canina L.	IV	.	.	.
Flueggea tinctoria (L.) G.L. Webster	II	.	.	.
Rumex induratus Boiss. & Reut.	II	.	.	.
Fraxinus angustifolia Vahl	II	.	.	.
Brachypodium phoenicoides (L.) Roem. & Schult.	II	.	.	.
Cynodon dactylon (L.) Pers.	II	.	.	.
Pulicaria paludosa (L.) Rchb.	II	.	.	.
Ononis spinosa L.	II	.	.	.
Thymus mastichina (L.) L.	II	.	.	.
Rorippa nasturtium-aquaticum (L.) Hayek	II	.	.	.
Aristolochia paucinervis Pomel	II	.	.	.
Salix salviifolia subsp. australis Franco	II	.	.	.
Thapsia transtagana Brot.	II	.	.	.
Arrhenatherum album (Vahl) W.D. Clayton	II	.	.	.
Allium paniculatum L.	II	.	.	.
Briza minor	I	II	1	.
Cynodon dactylon (L.) Pers.	II	V	.	IV
Holcus lanatus L.	I	.	1	II
Oenanthe crocata L.	V	I	.	.
Mentha suaveolens Ehrh.	IV	I	.	.
Campanula rapunculus L.	II	I	.	.
Dittrichia viscosa subsp. revoluta (Hoffmanns. & Link) P. Silva & Tutin	I	I	.	.
Plantago lanceolata L.	I	V	.	.
Lotus subbiflorus Lag.	I	.	.	II
Mentha pulegium L.	I	.	.	II
Blackstonia perfoliata (L.) Huds.	.	IV	.	.
Centaurium pulchellum (Sw.) Druce	.	IV	.	.
Juncus articulatus L.	.	III	.	.
Carex flacca Schreb.	.	II	.	.
Achillea ageratum L.	.	II	.	.
Scirpoides holoschoenus (L.) Soják subsp. holoschoenus	.	V	.	I
Vulpia bromoides (L.) S.F. Gray	.	.	2	.
Anthoxanthum aristatum Boiss.	.	.	1	.
Tolpis umbellata Bertol.	.	.	1	.
Chamaemelum mixtum (L.) All.	.	.	1	II
Logfia gallica (L.) Coss. & Germ.	.	.	1	I
Agrostis stolonifera L.	.	.	.	II
Chaetopogon fasciculatus (Link) Hayek	.	.	.	IV
Briza maxima L.	.	.	.	IV
Juncus striatus Schousb. ex E.H.F. Meyer	.	.	.	II
Anthoxanthum ovatum Lag.	.	.	.	II
Leontodon taraxacoides (Vill.) Merat	.	.	.	II
Senecio jacobea L.	.	.	.	II
Kickxia cirrhosa (L.) Frisch	.	.	.	II
Lythrum baeticum Gonz.-Albo	.	.	.	II
Vulpia membranacea (L.) Dumort.	.	.	.	II
Other taxa	26	12	5	10

ombrotypes. These perennial grasslands are frequently observed along watercourses where the receptor basins are situated in siliceous (schist) substrata of the Carbonic age, extending over the biogeographic territories of the Andévalo and Monchique Sierran Districts. We place this new *Festuca ampla* community, at syntaxonomic level, within the *Agrostion castellanae* alliance, which comprises the perennial grasslands growing on acid siliceous soils, with a possible slight waterlogging period, of the Mediterranean Iberian Atlantic biogeographical territory.

The presence of elements from the mature, stage such as *Fraxinus angustifolia*, *Salix salviifolia* subsp. *australis*, *Nerium oleander*, *Flueggea tinctoria*, and *Tamarix africana* reveals the catenal and dynamic relationship of this association, which represents a regression stage of *Ranunculo ficariiformis-Fraxinetum angustifoliae* Rivas-Martínez & Costa in Rivas-Martínez, Costa, Castroviejo & E. Valdés 1980 corr. Rivas-Martínez 2011, *Salicetum atrocinereo-australis* J.C. Costa & Lousã in J.C. Costa, Lousã & Paes 1998, and *Tamaricetalia africanae* brushwoods from the southwest of Iberian Peninsula.

NARCISSO WILLKOMMII-FESTUCETUM AMPLAE Rosa-Pinto, Pinto-Gomes & Paiva-Ferreira in Pinto-Gomes & Paiva-Ferreira 2005 (clusters 9-14, Fig. 2)

Festuca ampla grasslands of stream margins that are periodically flooded in temporary watercourses, under a thermomediterranean thermotype of the Algarve limestone (Barrocal algarvio) (Pinto-Gomes & Paiva-Ferreira, 2005). It is a perennial grassland dominated by *Festuca ampla*, growing on neutro basic deep soils, with sandy-limey texture, along torrential streams running through calcareous deposits of the Jurassic and Cretaceous age, always in the Algarve's streams basin. Leaching and limestone decarbonation phenomena affecting flooded soils, might be responsible for the presence of typical acidophilous species in this community, such as *Agrostis castellana*. In accord with Pinto-Gomes & Paiva-Ferreira (2005) *Narcisso willkommii-Festucetum amplae* is a neutro-basophilous community exclusive of the Algarve District, and is present only on calcareous soils, in contrast with the silicicolous *Narcisso jonquillae-Festucetum amplae* community. The two communities are distinct due to *Narcissus willkommii*, *Galium concatenatum*, *Carex flacca*, *Scilla peruviana*, *Potentilla reptans*, among others, which are included in the *Narcisso willkommii-Festucetum amplae* and are absent in the *Narcisso jonquillae-Festucetum amplae*. Consequently, *Narcissus jonquilla*, *Dactylis lusitanica*, *Lavandula viridis*, *Salix salviifolia* subsp. *australis* and *Flueggea tinctoria*, among others, are lacking in the neutro-basophilous community (Tab. 1).

Tab. 2 - *Narcisso jonquillae-Festucetum amplae* ass. nova *hoc loco* (*Agrostion castellanae*, *Agrostietalia castellanae*, *Stipo giganteae-Agrostietea castellanae*).

Relevé no.	1	2	3	4	5	6	7	8	
Surface (m^2)	40	20	50	70	10	80	60	80	
Altitude (m)	350	305	360	220	405	250	290	305	
Cover rate (%)	90	80	80	90	80	90	90	85	
Average height of veg. (m)	0.5	0.4	0.6	0.4	0.5	0.5	0.5	0.5	
Orientation	SE	NE	S	NE	E	-	E	-	
Slope (%)	2	2	2	2	2	-	2	-	
No. of species	16	15	19	13	15	29	14	19	Presences
Characteristic of association and higher units									
Festuca ampla	5	4	5	5	4	5	5	5	V
Asphodelus aestivus	+	.	+	+	.	1	1	+	IV
Narcissus jonquilla	.	.	.	+	.	+	+	+	III
Dactylis hispanica subsp. lusitanica	.	+	.	.	+	+	.	+	III
Agrostis castellana	.	.	.	+	1	r	.	.	II
Thapsia villosa	.	.	.	.	.	+	+	.	II
Carex divisa subsp. chaetophylla	.	.	+	.	.	+	.	.	II
Gaudinia fragilis	.	.	.	.	+	.	.	.	I
Serapias parviflora	.	.	.	.	.	+	.	.	I
Linum bienne	.	.	.	.	.	.	.	+	I
Companions									
Oenanthe crocata	2	+	1	1	+	2	1	+	V
Scirpoides holoschoenus subsp. australis	2	+	1	1	.	1	2	1	V
Nerium oleander	+	.	+	+	.	+	+	+	IV
Lavandula viridis	.	+	+	+	+	+	.	+	IV
Ranunculus bulbosus subsp. adscendens	1	.	+	+	.	1	1	+	IV
Mentha suaveolens	1	.	+	+	.	+	+	.	IV
Scrophularia canina	.	+	+	+	+	.	.	+	IV
Flueggea tinctoria	.	.	+	.	.	.	1	+	II
Rumex induratus	.	+	.	.	+	.	+	.	II
Salix salviifolia subsp. australis	.	+	+	.	.	.	.	.	II
Fraxinus angustifolia	.	+	.	.	.	.	+	.	II
Brachypodium phoenicoides	.	+	.	.	+	.	.	.	II
Cynodon dactylon	.	+	.	.	+	.	.	.	II
Thapsia transtagana	.	.	+	.	.	+	.	.	II
Arrhenatherum album	.	.	.	+	+	.	.	.	II
Allium paniculatum	.	.	.	.	.	+	.	+	II
Pulicaria paludosa	.	+	.	.	.	+	.	.	II
Ononis spinosa	.	.	.	.	.	+	+	.	II
Thymus mastichina	.	.	.	.	.	+	1	.	II
Rorippa nasturtium-aquaticum	+	.	+	.	.	.	.	.	II
Campanula rapunculus	.	.	+	.	.	+	.	.	II
Aristolochia paucinervis	.	.	.	+	.	1	.	.	II
Other taxa	8	3	4	-	4	7	-	6	

GAUDINIO FRAGILIS - AGROSTIETUM CASTELLANAE Rivas-Martínez & Belmonte 1985 (cluster 23, Fig. 2)

According to Rivas-Martínez *et al.* (1980), this association is dominated by *Agrostis castellana* and co-dominated by *Gaudinia fragilis*. It occupies deep fresh soils from siliceous substrata (Rivas-Martínez & Belmonte, 1985), with sandy, frank-clayed texture, supporting temporal hydromorphism, allied to summer drought. This association tends to be located in meso-hygrophilous environments ranging from mesomediterranean to supramediterranean of the West Iberian Mediterranean Province. The difference when compared with *Narcisso jonquillae-Festucetum amplae*, consists in the dominance of species such as *Agrostis castellana*, *Gaudinia fragilis*, *Rumex acetosella* subsp. *angiocarpus*, and the absence of *Festuca ampla*, *Narcissus jonquilla*, *Lavandula viridis*, *Salix salviifolia* subsp. *australis*, among others (Tab. 1).

Fig. 4 - *Narcisso jonquillae-Festucetum amplae* on torrential streams flood margins in the Monchique Sierran District (Azilheira stream).

ASPHODELO AESTIVI-ARMERIETUM GADITANAE Allier & Bresset 1977 corr. Rivas-Martínez, T.E. Díaz, Fernández González, Izco, Loidi, Lousã & Penas 2002 (clusters 15-22, Fig. 2)

This is a community that was described as belonging to the sandy soils of the ponds and marshes margins of the Doñana area, in Cádiz and Littoral Huelva Sector (Rivas-Martínez *et al.*, 1980) and has extended into Portuguese southern coast – Algarve District (Costa, 1991). It occurs under a lower thermomediterranean belt, and grows on oligo to mesotrophic soils with a possible temporal hidromorphy. According to Rivas-Martínez *et al.* (1980), this community is dominated by *Armeria gaditana*, *Gaudinia fragilis* and *Centaurea exarata*, among others (Tab. 1).

Conclusions

In accordance with the numerical and phytosociological analysis of 23 relevés we propose a new perennial grasslands association, namely: *Narcisso jonquillae-Festucetum amplae*, for the thermomediterranean to mesomediterranean belts under dry to sub-humid areas of the Andevalese-Monchique Sierran territory. In fact, this new association has an original floristic pattern and specific ecological gradients that segregates chorologically this association from the remaining perennial grasslands of *Agrostion castellanae* alliance. This community should be classified as priority habitat under the Natura 2000 code: 6220* (pseudo-steppe with grasses and annuals of the *Thero-Brachypodietea*), from Annex I of Council Directive 92/43/EEC. According to San Miguel (2008) and Sector Plan for Natura 2000 implementation on mainland Portugal (ALFA, 2006), the conservation of this habitat is favoured by traditional management schemes, particularly regular scrub clearing on small to medium-size irregular plots, low to moderated grazing intensity (preferentially sheep grazing), reduce herbicides and fertilizers application and control or eradicate non-native plants. Therefore, both the intensification of agricultural or pastoral activities on Mediterranean perennial grasslands and their abandonment usually reduce biodiversity levels (Hodgson *et al.*, 2005). The abandonment of traditional landscape activities will result in the reactivation of natural succession and therefore substitution of those communities by shrub communities (San Miguel, 2008). Besides, the consequence of overgrazing (mainly cattle grazing) and soil mobilization on this new community is usually negative, since they promote the presence of nitrophilous or subnitrophilous communities of *Stellarietea mediae*.

Syntaxonomic scheme

STIPO GIGANTEAE-AGROSTIETEA CASTELLANAE Rivas-Martínez, Fernández-González & Loidi 1999
AGROSTIETALIA CASTELLANAE Rivas-Martínez in Rivas-Martínez, Costa, Castroviejo & Valdés-Bermejo 1980
Agrostion castellanae Rivas Goday 1957 corr. Rivas Goday & Rivas-Martínez 1963
Asphodelo aestivi-Armerietum gaditanae Allier & Bresset 1977 corr. Rivas-Martínez, T.E. Díaz, Fernández González, Izco, Loidi, Lousã & Penas 2002
Gaudinio fragilis-Agrostietum castellanae Rivas-Martínez & Belmonte 1985
Narcisso willkommii-Festucetum amplae Rosa Pinto, Pinto Gomes & Paiva Ferreira in Pinto Gomes & Paiva Ferreira 2005
Narcisso jonquillae-Festucetum amplae Quinto-Canas, Mendes, Meireles, Mussarella & Pinto-Gomes ass. nova *hoc loc*

Other syntaxa quoted in the text

Isoëto-Nanojuncetea Br.-Bl. & Tüxen ex Westhoff, Dijk & Passchier 1946; *Ranunculo ficariiformis-Fraxinetum angustifoliae* Rivas-Martínez & Costa in Rivas-Martínez, Costa, Castroviejo & E. Valdés 1980 corr. Rivas-Martínez 2011; *Salicetum atrocinereo-australis* J.C. Costa & Lousã in J.C. Costa, Lousã & Paes 1998; *Tamaricetalia africanae* Br.-Bl. & O. Bolòs 1958 em. Izco, Fernández-González & A. Molina 1984.

Acknowledgements

We wish to acknowledge Dr. Jonh Azinheira for his constructive and helpful translation revisions.

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Appendix I: Other taxa

Tab. 1 – N. 1: Tamarix africana Poir., Erica lusitanica Rudolphi, Rubus ulmifolius Schott, Dorycnium rectum (L.) Ser., Juncus acutus L., Juncus rugosus Steud., Juncus tenageia L.f., Brachypodium sylvaticum (Huds.) P. Beauv., Ornithogalum orthophyllum subsp. baeticum (Boiss.) Zahar., Hypericum perfoliatum L., Allium ampeloprasum L., Corrigiola litoralis subsp. perez-larae Chaudhn, Muñoz Garmendia & Pedrol, Baldellia ranunculoides (L.) Parl., Gratiola linifolia Vahl, Solenopsis laurentia (L.) C. Presl, Rosa canina L., Tamus communis L., Lythrum salicaria L., Lathyrus clymenum L., Bellis annua L., Lathyrus annuus L., Ranunculus peltatus subsp. saniculifolius (Viv.) C.D.K. Cook, Lotus pedunculatus Cav., Myosotis welwitschii Boiss. & Reut., Veronica anagallis-aquatica L., Polygonum equisetiforme Sibth. & Sm. I; n. 2: Poa trivialis subsp. sylvicola (Guss.) H. Lindb., Delphinium pentagynum Lam., Galium concatenatum Cosson, Gastridium ventricosum (Gouan) Schinz & Thell., Phalaris coerulescens Desf., Plantago albicans L., Polypogon monspeliensis (L.) Desf., Piptatherum miliaceum (L.) Coss., Potentilla reptans L., Scabiosa atropurpurea L., Sonchus asper (L.) Hill., Scilla peruviana L. I; n. 3: Hypochoeris radicata L., Leontodon longirostris (Finch & P.D. Sell) Talavera, Trifolium angustifolium L., Ranunculus paludosus Poir., Sesamoides interrupta (Boreau) G. López, +; n. 4: Lythrum junceum Banks & Sol., Juncus maritimus Lam., Polypogon maritimus Willd., Panicum repens L., Spergularia purpurea (Pers.) G. Don f., Tolpis barbata (L.) Gaertn., Leucojum autumnale L., Tuberaria guttata (L.) Fourr., Logfia gallica (L.) Coss. & Germ., Ornithopus sativus Brot. I.

Tab. 2 – Rel. 1: + Rubus ulmifolius, + Holcus lanatus, + Dorycnium rectum, + Ranunculus peltatus subsp. saniculifolius, + Lotus uliginosus, + Myosotis welwitschii, + Veronica anagallis-aquatica, + Polygonum equisetiforme; rel. 2: + Dittrichia viscosa subsp. revoluta, + Corrigiola litoralis subsp. perez-larae, + Saponaria officinalis; rel. 3: + Brachypodium sylvaticum, + Ornithogalum orthophyllum subsp. baeticum, + Rosa canina, + Tamus communis; rel. 5: + Phlomis purpurea, + Hypericum perfoliatum, 1 Plantago lanceolata, + Allium ampeloprasum; rel. 6: + Mentha pulegium, + Juncus rugosus, + Juncus tenageia, + Baldellia ranunculoides, + Gratiola linifolia, + Solenopsis laurentia, + Briza minor; rel. 8: + Juncus acutus, + Lythrum salicaria, + Lathyrus clymenum, + Tamarix africana, + Erica lusitanica, + Bellis annua.

Appendix II: Localities of the relevés

Tab. 2 – Rel. 1: Rib.ª Azilheira (near Azilheira); rel. 2: Rib.ª Fronteira (near Cerro do Maroiço); rel. 3: Rib.ª da Corte (near Ameixial); rel. 4: Rib.ª de Curvatos; rel. 5: B.co do Vale Formosil (near Barranco do Velho); rel. 6: Rib.ª de Curvatos; rel. 7: Rib.ª da Foupana (near Martimlongo); rel. 8: Rib.ª da Foupana (near Cachopo).

Appendix III: Origin of the studied syntaxa

Tab. 1 – N. 1: *Narcisso jonquillae-Festucetum amplae* (synthetic table from table 2 of this paper, 8 rels.); N. 2: *Narcisso willkommii-Festucetum amplae* Rosa Pinto, Pinto Gomes & Paiva Ferreira 2005 (Pinto Gomes & Paiva Ferreira, 2005: 234, Tab. 56, 6 rels.); N. 3: *Gaudinio fragilis-Agrostietum castellanae* Rivas-Martínez & Belmonte 1985 (Rivas-Martínez & Dolores Belmonte, 1985: 419, 1 rel.); N. 4: *Asphodelo aestivi-Armerietum gaditanae* Allier & Bresset 1977 corr. Rivas-Martínez, T.E. Díaz, Fernández González, Izco, Loidi, Lousã & Penas 2002 (Rivas-Martínez, Costa, Castroviejo & E. Valdés, 1980: 106, Tab. 57, 8 rels.).