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COMPLUTENSE

Contribution to the phytosociological knowledge of rocky coastline of Corsica: description of five new plant associations

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Summary. In this article the authors study a few Corsican rocky coasts plant communities, within the framework of the development of the Prodrome vegetation of Corsica. This work is based on the analysis of 51 unpublished phytosociological relevés and their comparison with previous historical data. Five new plant associations and subassociations belonging to *Saginetea maritima* (*Catapodio marini-Hymenolobetum revelierii* and *Catapodio marini-Centaurietum tenuiflori*), *Crithmo maritimi-Limonietea* (*Loto cytisoidis-Juncetum acuti*), *Artemisietea vulgaris* (*Loto cytisoidis-Dactylidetum hispanicae crithmetosum maritime*) and *Helichryso italici-Crucianelletea maritima* (*Helichryso italici-Thymelaeetum tartonrairae*) are described on the coastal cliffs of Corsica. Their synecological and synfloristic characteristics are presented together to other environmental features.

Keywords: Corsica; seashore; halophilous vegetation; *Saginetea maritima*; *Crithmo maritimi-Limonietea*; *Artemisietea vulgaris*; *Helichryso italici-Crucianelletea maritima*.

[es] Contribución al conocimiento fitosociológico de la vegetación de acantilados costeros de Córcega: descripción de cinco asociaciones nuevas

Resumen. Las comunidades vegetales de los acantilados de Córcega han sido estudiadas en el marco del desarrollo del Pródromo de la vegetación de la isla de Córcega. Este trabajo presenta 51 inventarios fitosociológicos inéditos que han sido comparados con los datos históricos. Se describen como nuevas cinco asociaciones y subasociaciones de *Saginetea maritima* (*Catapodio marini-Hymenolobetum revelierii* and *Catapodio marini-Centaurietum tenuiflori*), *Crithmo maritimi-Limonietea* (*Loto cytisoidis-Juncetum acuti*), *Artemisietea vulgaris* (*Loto cytisoidis-Dactylidetum hispanicae crithmetosum maritime*) and *Helichryso italici-Crucianelletea maritima* (*Helichryso italici-Thymelaeetum tartonrairae*) para los acantilados de la costa de Córcega. Se presentan sus características florísticas y sinecológicas junto a otras más de tipo medioambiental.

Palabras clave: Córcega; comunidades vegetales costeras; vegetación halófila; *Saginetea maritima*; *Crithmo maritimi-Limonietea*; *Artemisietea vulgaris*; *Helichryso italici-Crucianelletea maritima*.

Introduction

Within the framework of the development of vegetation prodrome of Corsica coordinated by the national botanical conservatory of Corsica, several phytosociological synthesis and further work on new or relict vegetation reflecting the richness and originality of the corsican vegetations were undertaken.

Recent surveys have allowed us to study several original plant communities of the rocky coast of Corsica (Cap Corse region, Crovani, Revellata, Fango, Bonifacio). This work completes phytosociological works on corsican coastal vegetation (Paradis & Piazza 1991; Géhu & Biondi, 1994; Paradis & al. 1999; Paradis & al. 2010; Paradis & al., 2013; Paradis & al., 2014). Two therophytic plant

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communities, two halophilous perennial grass, one chasmo-halophilous vegetation and one chamaephytic low scrubland are described.

Materials and Methods

From 2009 to 2013, 52 phytosociological relevés were realized on physiognomic, floristic and ecological homogeneous areas, according to the sigmatist phytosociological method (Guinochet, 1973; Géhu, 1986; Géhu & Rivas-Martínez, 1981). Taxonomic nomenclature follows *Flora Corsica* (Jeanmonod & Gamisans, 2007).

Results and Discussion

Catapodio marini-Hymenolobetum revelierei
ass. nova hoc loco
(*holotypus*: Table 1, rel. 6).

Symphysiognomy. This therophytic vegetation looks very open, it is not higher than 10 cm being physiognomically dominated by *Hymenolobus procumbens* (L.) Nutt. subsp. *revelieri* (Jord.) Greuter & Burdet. Its phenological optimum corresponds to that of *Hymenolobus procumbens* subsp. *revelieri* that quickly dries up from May.

Synfloristic characteristics. This community is characterized by a floristic combination of several vernal therophytes: *Hymenolobus procumbens* subsp. *revelieri*, *Catapodium marinum* (L.) C.E. Hubb. and *Parapholis incurva* (L.) C.E. Hubb. *Limonium contortirameum* Erben and *Frankenia laevis* L. Other species of *Crithmo maritimi-Limonietea* Braun-Blanq. in Braun-Blanq., Roussine & Nègre 1952 are regularly present.

Synecology. This plant community develops on wind and salt spray exposed coastal cliffs. It grows on silty clay compacted depositions which regularly received humidity from seawater spraying. This freshness is also maintained by the shady situation of north or north-east facing cliffs, by the presence of overhanging rocks (Giraglia islet) and by the proximity to the sea (altitude ranging between 5 and 20

m). On the cliffs of Barcaggio, *Hymenolobus procumbens* subsp. *revelieri* vegetation preferentially develops under the protection of *Juniperus phoenicea* L. subsp. *turbinata* (Guss.) Nyman that provides it an almost permanent shade, preventing from a too rapid drying up in the spring.

This plant community is close to *Silene sedoidis-Hymenolobetum revelierii* Brullo & Giusso del Galdo 2003 that develops in very similar ecological conditions, on the Italian coast of Taranto region (Brullo & Giusso del Galdo, 2003). Floristically, it differs by the presence of *Catapodium marinum* replacing *Catapodium balearicum* (Willk.) H. Scholtz (in the Italian syntaxon) and by the absence of *Silene sedoides* Poir.

Syndynamic, catenal position. *Catapodio marini-Hymenolobetum revelierii* develops at the upper contact of perennial hyperhalophilous vegetation of *Crithmo maritimi-Limonietea*, represented in the Cap Corse by *Crithmo maritimi-Limonietum contortiramei* Géhu & Biondi 1994 *typicum* and *Crithmo maritimi-Limonietum contortiramei frankenietosum laevis* Géhu & Biondi 1994, and at the lower contact of the *Juniperus phoenicea* coastal scrubland belonging the *Juniperion turbinatae* Rivas-Mart. 1975. Due to stational ecological constraints, this association is stable from a dynamic point of view.

Synchorology. This association presents a very limited distribution, as it is observed on a few rocky sites of the northern end of the Cap Corse. Further surveys would complete the knowledge of its chorology, especially on the Finocchiarola islets where *Hymenolobus revelieri* was identified (Jeanmonod & Gamisans, 2007; Paradis & Piazza, 2002; Rivière & al., 2012), and on two islands of the Marseille archipelagoes (Pomègues (Frioul) and Riou), where one of us (FB) had the opportunity to observe two stations *Hymenolobus procumbens* subsp. *revelieri* in 2004.

Syntaxonomy. This plant community may be linked to *Saginetalia maritimae* and to *Saginion maritimae* because it develops on sandy cliffs shallow soils in halophilous conditions.

Table 1. *Catapodio marini-Hymenolobetum revelierii* ass. nova
(*Saginion maritimae*, *Saginetalia maritimae*, *Saginetea maritimae*)

Area (m ²)	0.25	1.5	0.25	0.5	0.25	0.75	0.25	1.5	1.5	.
Cover (%)	20	25	40	50	70	50	20	50	80	.
N. species	4	5	4	6	8	7	7	11	6	.
Mean N. species	.	.	.	.	.	.	.	.	.	6.4
Relevé N.	1	2	3	4	5	6	7	8	9	10
Characteristics:										
<i>Hymenolobus procumbens</i> subsp. <i>revelieri</i>	2	2	1	3	2	3	1	3	+	V
<i>Catapodium marinum</i>	+	.	2	1	3	2	.	1	+	IV
<i>Parapholis incurva</i>	1	+	1	1	+	1	.	+	.	IV
<i>Valantia muralis</i>	.	.	.	.	.	.	.	+	.	I
<i>Cerastium semidecandrum</i>	.	.	.	.	.	.	.	+	.	I
<i>Sagina maritima</i>	.	.	.	.	.	.	2	.	.	I
<i>Senecio transiens</i>	.	.	.	.	.	.	1	.	.	I
<i>Crithmo-Limonietea</i> characteristics:										
<i>Limonium articulatum</i>	.	1	.	1	1	+	1	1	3	IV
<i>Frankenia laevis</i> subsp. <i>laevis</i>	1	1	.	.	.	.	+	1	4	III
<i>Crithmum maritimum</i>	.	.	.	.	+	+	.	.	+	II
<i>Daucus carota</i> subsp. <i>hispanicus</i>	.	.	.	.	.	.	+	+	.	I
<i>Halimione portulacoides</i>	.	+	.	.	.	.	.	.	.	I
Other species:										
<i>Reichardia picroides</i>	.	.	+	.	2	+	.	+	.	III
<i>Plantago coronopus</i>	.	.	.	+	1	+	.	2	.	III
<i>Helichrysum italicum</i> subsp. <i>italicum</i>	.	.	.	+	.	.	.	.	1	II
Other species: <i>Dianthus sylvestris</i> subsp. <i>longicaulis</i> var. <i>godronius</i> 2 in 7; <i>Euphorbia pithyusa</i> + in 7; <i>Stellaria pallida</i> + in 9. All species I in 10.										
Localities: 1, 2: La Giraglia (September 2013); 3-6, 8, 9: Barcaggio (May 2013), rel. 6 <i>holotypus</i> ass.; 7: West of Cap Corse lighthouse (May 2013).										

Catapodio marini-Centaurietum tenuiflori
ass. nova hoc loco (*holotypus*: Table 2, rel. 1).

Symphysiognomy. This plant community is a therophytic short grassland, which height not exceed 10 cm, with low covers (not more than 50%). They are dominated by *Centaurium tenuiflorum* (Hoffmanns. & Link) Fritsch and *Catapodium marinum* (L.) C.E. Hubb.

Synecology. This heliophilous grassland develops on edges of coastal rocky cliffs highly exposed to salt spray, at an altitude ranging between 10 and 30 m, on crystalline substrates (Fango valley) or on schist substrates (Cap Corse). The substrate is an acidifline to acidiphile superficial lithosol, sandy gravel with a silty-sandy interstitial matrix.

Synfloristic characteristics. The species composition allows to differentiate this grassland from other syntaxa of the *Saginetea maritimae* present in Corsica (Géhu & Biondi,

1994; Paradis & al., 2014). It is characterized by a floristic combination of therophytic species regularly associated: *Centaurium tenuiflorum*, *Catapodium marinum*, *Filago minima* (Sm.) Pers. and *Trifolium scabrum* L. The presence of *Helichrysum italicum* (Roth) G. Don. subsp. *italicum* indicates the contact with short coastal shrublands.

Syndynamic, catenal position. This plant community develops at the upper contact of *Crithmo maritimi-Limonietea* Br.-Bl. in Br.-Bl., Roussine & Negro 1952, and at the lower contact of *Loto cytisoidis-Dactylidetum hispanicae* Biondi, Filigheddu & Farris 2001, *Euphorbio pithyusae-Helichrysetum italici* Paradis & Piazza, 1998 or *Thymelaea tartonraira* and *Helichrysum italicum* subsp. *italicum* community.

Synchorology. This association is rare on the coast of Corsica, where it has been observed in only three stations: north of Cap Corse, between Macinaggio and Tamarone (Rogliano) and north of Fango delta (Galéria).

Table 2. *Catapodio marini-Centaurietum tenuiflori* ass. nova
(*Saginion maritimae*, *Saginetalia maritimae*, *Saginetea maritimae*)

Area (m ²)	2	0.5	3	1	0.3	0.25	0.25	0.25	
Cover (%)	20	40	20	20	60	40	40	30	
N. species	6	4	6	7	9	6	6	4	
Mean N. species									6
Relevé N.	1	2	3	4	5	6	7	8	9
Characteristics:									
<i>Centaurium tenuiflorum</i>	2	1	3	1	2	1	2	2	V
<i>Catapodium marinum</i>	1	3	1	2	+	+	1	2	V
<i>Filago minima</i>	+		+	1	.	.	.	.	III
<i>Silene gallica</i>	+	+	+	.	.	.	.	.	III
<i>Parapholis incurva</i>	.	.	.	.	.	2	3	.	II
<i>Trifolium scabrum</i>	.	.	.	.	3	+	.	.	II
<i>Plantago coronopus</i>	.	.	.	1	+	.	.	.	II
<i>Centaurium maritimum</i>	.	.	.	+	.	.	.	.	II
Other species:									
<i>Dactylis glomerata</i> subsp. <i>hispanica</i>	+	2	+	.	.	.	2	.	III
<i>Linum trigynum</i>	+	.	.	+	+	.	+	.	III
<i>Sonchus tenerrimus</i>	.	.	.	.	+	.	.	+	II
<i>Lotus cytisoides</i>	.	.	.	.	+	.	.	+	II
<i>Plantago bellardii</i> subsp. <i>bellardii</i>	.	.	.	+	.	+	.	.	II
Other species: <i>Helichrysum italicum</i> subsp. <i>italicum</i> + in 3; <i>Daucus carota</i> subsp. <i>hispanicus</i> and <i>Gaudinia fragilis</i> + in 5; <i>Brachypodium distachyon</i> 1 in 6; <i>Romulea columnae</i> + in 7. All species II in 9.									
Localities: 1-4: North delta of Fango (2013), <i>holotypus</i> ass. rel 1; 5-8: between Macinaggio and Tamarone (Rogliano, 2009).									

Helichryso italicum-Thymelaeetum tartonrairae
Bioret, Delbosc, Panaïotis & Paradis ass. nova
hoc. loco (*holotypus*: Table 3, rel. 1).

Symphysiognomy. This chamephytic plant community corresponds to a short scrubland dominated by *Thymelaea tartonraira* L. All subsp. *tartonraira* and *Helichrysum italicum* (Roth) G. Don. subsp. *italicum*. The vegetation cover is more or less important, according to the topographic conditions and the nature of the substrate.

Synfloristic characteristics. This community is characterized by a regularly floristic combination of the two chamaephytes that named the association together to *Lotus cytisoides* L. subsp. *cytisoides*, *Reichardia picroides* (L.) Roth, *Dactylis glomerata* L. subsp. *hispanica* and *Daucus carota* L. subsp. *hispanicus* (Gouan) Thell.

Synecology. This shrubland occupies the upper part of the coastal cliffs, in semi-sheltered conditions, between 15 and 70 m in the Cap Corse and at much lower altitudes in the Fango region. It develops on shallow litho-soils, poor in nutrients, on a various geological substrates: peridotite (lustrous schists) in

the Cap Corse, rhyolite in the Scandola Nature Reserve or granodiorite in the Fango.

Because of its synecological characteristics, this group shows similarities with the *Thymelaeo hirsutae-Helichrysetum italicum* R. Molinier 1959 but differs from it because of the presence of *Thymelaea tartonraira* subsp. *tartonraira* and the absence of *Thymelaea hirsuta* L. From an ecological point of view, it develops on more basic geological substrates, whereas *Thymelaeo hirsutae-Helichrysetum italicum* seems associated to more acid crystalline substrates.

Recently, in an unpublished report requested by the national botanical Conservatory of Corsica (Paradis, 2010), the author proposed the name *Thymelaeo tartonrairae-Helichrysetum italicum* which is not valid (art. 2, Weber & al., 2000). *Thymelaea tartonraira* subsp. *tartonraira* appears more abundant than *Helichrysum italicum* subsp. *italicum* being the structural element of such scrubland.

This plant community presents three ecological variations considered as distinct subassociations:

typicum.

schoenetosum nigricantis subass. nova *hoc. loco* (*holotypus*: Table 3, rel. 9). Mesohygrophilous

variation on steepy north facing slopes. Paradis (2010) considered it as a facies at *Schoenus nigricans*.

dianthetosum siculi subass. nova hoc. loco (*holotypus*: Table 3, rel. 20). Halophilous variation on the edges of the upper part of cliffs, exposed to salt spray, on relatively gentle slopes, differentiated by *Dianthus sylvestris* subsp. *siculus*. Géhu & Biondi (1994, Table 59, p. 108) considered it as a *Dianthus sylvestris* and *Thymelaea tartonraira* community).

Syndynamic, catenal position. The *Helichrysoitalici-Thymelaeetum tartonrairae* develops at the upper contact to halo-anemophilous grassland of *Loto cytisoidis-Dactylidetum hispanicae* Biondi, Filigheddu & Farris 2001 and at the lower contact of *Juniperus phoenicea* L. subsp. *turbinata* Guss. Nyman scrubland (*Oleo sylvestris-Juniperetum turbinatae* Arrigoni, Bruno, De Marco & Veri 1985 *corr.* Biondi & Mossa 1992). The presence of several species of nanophanerophytes (*Erica arborea* L., *Arbutus unedo* L., *Myrtus communis* L.) characterize the contact with the *Juniperion turbinatae* Rivas-Mart. 1975.

Synchorology. This association remains localized in a few points of the rocky coast of Corsica: north of Cap Corse (near Barcaggio), southwest of the lighthouse near the Punta di Corno di Becco (Paradis, 2010) and north of Nonza. In 2013, it has been identified above

the stream Grotta alle Piane, and on the north-west slope near the Monte Grande, close to the lighthouse. We discovered two additional stations in the Scandola Nature Reserve and on the rocky coastline north of the Fango delta (Galéria). Table 3 includes 10 relevés recorded, 6 relevés of G. Paradis (2010), and 6 of Géhu & Biondi (1994).

Heritage Value. This plant association is closely linked to the presence of *Thymelaea tartonraira* subsp. *tartonraira*, protected species at the national level and fairly rare in Corsica. Too frequent fires represent the main threat for this high valuable syntaxon.

Syntaxonomy. Biondi & al. (2001) include the *Rosmarino officinalis-Thymelaeetum tartonrairae* (whose physiognomy and floristic composition are very similar to this new association) in *Rosmarinetea officinalis*, *Rosmarinetales officinalis* and *Cisto eriocephali-Ericion multiflorae*. *Rosmarinetea officinalis* corresponds to short calcicolous west Mediterranean scrubs (matorral, garrigue, tomillar). However we think *Helichrysoitalici-Thymelaeetum tartonrairae* could be better integrated in *Helichrysetalia italici* Géhu & Biondi 1994, *Euphorbion pithusae* Géhu & Biondi 1994 that correspond to chamaephytic vegetation dominated by *Helichrysum italicum* on rocky coasts.

Loto cytisoidis-Juncetum acuti *ass. nova hoc loco* (*holotypus*: Table 4, rel. 7).

Symphysiognomy. This herbaceous plant community represents the chasmo-halophilous vegetation of fissures in wet coastal rocks. It is characterized by the dense clumps of *Juncus acutus* L. subsp. *acutus*, which can reach one meter of height.

Synecology. This group colonizes cracks of rocks or the lower parts of the cliffs, close to the sea, exposed to frequent alt spray and sea water projections and where rain water can accumulate. It usually develops on hyperacid crystalline substrates such as porphyritic monzogranite or at medium grain and granodiorite at medium grain (Rossi & Rouire, 1980a, b).

Synfloristic characteristics. The floristic composition is characterized by a combi-

nation associating regularly *Juncus acutus* L. subsp. *acutus* and *Lotus cytisoides* L. subsp. *cytisoides*, accompanied by *Crithmum maritimum* L.

Syndynamic, catenal position. Considering the very constraining environmental conditions, it should be considered as permanent vegetation. It develops at the upper contact of chasmo-halophilous vegetations of *Crithmo maritimi-Staticetea* Br.-Bl. in Br.-Bl., Roussine & Nègre 1952 and is at the lower contact of *Euphorbio pithyusae-Helichrysetum italicum* Paradis & Piazza 1998.

Synchorologie. This plant community is present in most of the Corsican coast from the west coast (Crovani) to the southeast (Fautea). It can be considered as geosynvicariant of the atlantic *Crithmo maritimi-Juncetum acuti* Bioret 2008 present along the western coast of the Massif armoricain (Bretagne).

Table 4. *Loto cytisoidis-Juncetum acuti* *ass. nova* (*Crithmo-Limonion articulati*, *Crithmo-Limonietalia*, *Crithmo-Limonietea*)

Area (m ²)	3	3	3	2	3	4	1	1	2	.
Cover (%)	80	100	90	100	75	100	95	80	90	.
N. species	6	3	4	3	4	4	2	3	3	.
Mean number species	.	.	.	.	.	.	.	.	.	3.6
Relevé N.	1	2	3	4	5	6	7	8	9	10
Characteristics:										
<i>Juncus acutus</i> subsp. <i>acutus</i>	5	5	5	3	4	5	4	3	5	V
<i>Lotus cytisoides</i>	1	2	1	2	.	1	1	3	1	V
Differential sub-association:										
<i>Crithmum maritimum</i>	2	2	1	3	2	.	.	.	.	IV
Other species:										
<i>Dactylis glomerata</i> subsp. <i>hispanica</i>	1	.	.	.	.	.	.	1	.	II
Other species: <i>Helichrysum italicum</i> subsp. <i>italicum</i> 2, <i>Euphorbia pithyusa</i> + in 1; <i>Erodium corsicum</i> + in 3; <i>Sporobolus pungens</i> 1, <i>Dittrichia viscosa</i> subsp. <i>viscosa</i> + in 5; <i>Cynodon dactylon</i> 1, <i>Convolvulus arvensis</i> 2 in 6; <i>Phragmites australis</i> + in 9. All species II in 10.										
Localities: 1: north of Fango delta (2013); 2, 5, 7, 8: North of Argentella beach (2012), rel. 7 <i>holotypus</i> <i>ass.</i> ; 6: Sant' Amanza beach (2013) ; 3, 9: Capicciolu (2012); 4: Chiuni beach (2014).										

Loto cytisoidis-Dactylidetum hispanicae Biondi, Filigheddu & Farris 2001 (Table 5)

Symphysiognomy. This dense maritime grassland is dominated by *Crithmum maritimum*, *Daucus carota* subsp. *hispanicus*,

Lotus cytisoides and *Dactylis glomerata* subsp. *hispanica*.

Synecology. It is present on steep slopes of hyperventilate cliffs, exposed to salt spray, in fresh conditions, always corresponding to the north or northeast facing condition, often

reinforced by the geomorphological configuration of the coastline. The substrate corresponds to less stable clay-stony shallow soils, sometimes enriched with gravels.

Synfloristic characteristics. This grassland is dominated by *Daucus carota* subsp. *hispanicus*, *Lotus cytisoides* and *Dactylis glomerata* subsp. *hispanica*. Our relevés showed in Table 5 correspond to a halophilous variation, differentiated by *Crithmum maritimum*, which can be considered an original sub-association: *crithmetosum maritimi* subass. nov. *hoc loco* (holotypus: Table 5, rel. 7).

Table 6 shows the comparison of summary tables of salt-tolerant grasslands with *Daucus carota* subsp. *hispanicus*. *Loto cytisoidis-Dactyletum hispanicae* Biondi, Filigheddu & Farris 2001 *crithmetosum maritimi* differs from *Dauco hispanici-Asteriscetum maritimus* Wojterski 1988 *crithmetosum maritimi*, by the absence of aerohaline species such as *Plantago macrorhiza*, *Sporobolus arenarius* or *Parapholis incurvus* and the presence of more salt-tolerant species such as *Euphorbia pithuysa* or *Frankenia laevis* and nitrophilous ones (*Carlina corymbosa*, *Cynodon dactylon*, *Gaudinia fragilis*).

In Algeria, a halophilous vegetation of rock crevices in calcareous sandstone with *Asteriscus maritimus* and *Daucus carota* subsp. *hispanicus* was analysed by Géhu & al. (1992) as being the *Dauco hispanici-Asteriscetum maritimus* Wojterski 1988. These authors described a subassociation *crithmetosum maritimi* of rocky cracks in the most salt sprayed sites. This syntaxon recorded on the Mediterranean southern shores, can be considered as geosynvicariant of the *Loto cytisoidis-Dactyletum hispanicae* Biondi, Filigheddu & Farris 2001 *crithmetosum maritimi* in Corsica. Furthermore, from a synecological and phytogeographical perspective, this grasslands presents similarities with the *Dactylo oceanicae-Daucetum gummiferi* Géhu 2008 on the Atlantic cliffs of the Massif armoricain (Bretagne).

Syndynamic, catenal position. This grassland is a permanent vegetation which develops at the lateral contact of the *Euphorbio pithuysae-Helichrysetum italici* Paradis & Piazza 1998.

Synchorology. This syntaxon observed in Corsica on the cliffs of Scandola Nature Reserve (islet of Gargalu) and on the cliffs of *Cap Corse* is probably present in others localities.

Table 5. *Loto cytisoidis-Dactyletum hispanicae* Biondi, Filigheddu & Farris 2001
crithmetosum maritimae subass. nova (1-7)
 (*Reichardia maritimae-Dactylion hispanicae*, *Brachypodio*
ramosi-Dactyletalia hispanicae, *Artemisietea vulgaris*)

Area (m ²)	30	100	30	10	10	5	3	20	6	3	10	5	10	5	10	5	.
Cover (%)	95	60	95	100	75	90	70	100	100	90	90	50	100	80	90	80	.
N. species	9	12	10	7	11	7	6	7	6	5	10	8	5	8	10	10	.
Mean N. species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8.2
Relevé N.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Characteristics:																	
<i>Daucus carota</i> subsp. <i>hispanicus</i>	2	2	2	3	2	2	1	4	3	3	2	2	3	3	4	3	V
<i>Lotus cytisoides</i>	2	2	1	.	1	3	1	3	+	.	3	2	3	3	3	3	V
<i>Dactylis glomerata</i> subsp. <i>hispanica</i>	3	2	2	.	2	+	1	2	3	1	1	.	3	2	3	2	V
<i>Frankenia laevis</i> subsp. <i>laevis</i>	.	+	1	.	1	.	.	.	2	1	.	.	.	.	.	.	III
<i>Erodium corsicum</i>	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	II
<i>Limonium corsicum</i>	.	.	.	.	.	2	2	.	.	.	.	2	.	.	.	.	II
Differentials of subass.																	
<i>Crithmum maritimum</i>	3	1	2	3	3	4	5	.	.	.	.	.	.	.	.	.	III
Other species:																	
<i>Senecio transiens</i>	1	2	3	+	+	.	.	2	2	2	1	.	.	.	.	.	IV
<i>Euphorbia pithyusa</i>	+	.	.	.	+	.	.	+	.	.	+	+	.	.	2	.	III
<i>Catapodium marinum</i>	+	2	1	.	.	.	.	.	.	.	+	+	.	.	.	.	III
<i>Sonchus oleraceus</i>	.	.	.	.	+	.	.	+	.	.	2	.	.	.	.	.	II
<i>Crepis bellidifolia</i>	+	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	II
<i>Gaudinia fragilis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	II
<i>Parapholis strigosa</i>	.	.	.	.	.	.	.	.	.	.	.	+	.	.	1	.	II
<i>Mesembryanthemum nodiflorum</i>	.	.	.	+	.	.	.	.	.	.	.	3	.	.	.	.	II
<i>Atriplex prostrata</i>	.	.	.	.	.	.	.	1	+	.	.	.	.	.	.	.	II
<i>Glebionis segetum</i>	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	II
<i>Hordeum murinum</i> subsp. <i>leporinum</i>	.	+	.	.	.	.	.	.	.	.	1	.	.	.	.	.	II
<i>Sonchus bulbosus</i>	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	II
<i>Carduus cephalanthus</i>	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II
Other species: <i>Reichardia picroides</i> + in 3; <i>Sonchus asper</i> +, <i>Parietaria judaica</i> 1 in 4; <i>Pancratium illyricum</i> + in 5; <i>Matthiola incana</i> + in 6; <i>Fumaria capreolata</i> + in 7; <i>Allium commutatum</i> + in 8; <i>Lobularia maritima</i> 2 in 11; <i>Vulpia sp.</i> + in 12; <i>Allium roseum</i> +, <i>Senecio cineraria</i> subsp. <i>cineraria</i> 2 in 13; <i>Cynodon dactylon</i> + in 15; <i>Carlina corymbosa</i> 1, <i>Dianthus sylvestris</i> subsp. <i>siculus</i> 2 in 16. All species II in 17.																	
Localities: 1-3: Capense islet (Paradis & Piazza, 2002); 4, 8-11: Gargalo (2008); 5: Northern of Centuri (2008); 6, 7, 12, 13: halophilous steepy corridor Northern Gargalo coast (2006), rel. 7 <i>holotypus</i> subass., rel.12,13 western tip (2006); 14-16: Macinaggio (Cap Corse, 2008).																	

Dauco hispanici-Asteriscetum maritimi Wojterski 1988 (Table 7).

Symphysiognomy. This calcicolous halophilous grassland is dominated by *Asteriscus maritimus* and *Daucus carota* subsp. *hispanicus*.

Synecology. This salt-tolerant grassland develops in crevices and rocky edges of limestone cliffs of Bonifacio (lower and middle Miocene: bioclastic limestone (Rossi & Rouire, 1980a, b) with a sandy-silty interstitial matrix. It is present in micro-valleys facing the sea, hyperventilated and regularly

exposed to salt spray. It was also observed in a situation of rocky ledge at the cliff top.

Synfloristic characteristics. The floristic composition is characterized by *Pallenis maritimus* and *Daucus carota* subsp. *hispanicus*, associated with hyperhalophilous species: *Limonium obtusifolium*, *Lotus cytisoides* and *Sporobolus pungens*.

Due to its synfloristical and synecological characteristics, this grassland may correspond to the *Dauco hispanici-Asteriscetum maritimi* Wojterski 1988 (Wojterski, 1988), mentioned on the coast of Kabylia and the

Alger region (Géhu & *al.*, 1992; Khelifi & *al.*, 2008). The ecological singularity of the relevé 3 realized on rocky ledge at the top of the cliff hyperexposed at sea spray, represents a halophilous variation characterized

by the abundance of *Crithmum maritimum*: this relevé 3 correspond to the *Daucus hispanici-Asteriscetum maritimi* Wojterski 1988 *crithmetosum maritimi* Géhu, Kaabeche & Gharzouli 1992.

Table 6. Synoptic table of *Daucus carota* subsp. *hispanicus* halophilous communities.

Loto cytisoidis-Dactyletum hispanicae Biondi et al. 2001, pag. 53 (1)

Loto cytisoidis-Dactyletum hispanicae, hispanicae crithmetosum maritimae.

Crithmetosum maritimae table 5 (2)

Daucus hispanici-Asteriscetum maritimi Wojterski 1988, pag. 320 (3)

(*Reichardio maritimae-Dactylion hispanicae, Brachypodio ramosi-Dactyletalia hispanicae, Artemisietea vulgaris*)

N. relevés	8	16	7
Mean N. species	14.3	8.2	5.7
Relevé N. / Syntaxon	1	2	3
<i>Daucus carota</i> subsp. <i>hispanicus</i>	V	V	V
<i>Lotus cytisoides</i>	V	V	IV
<i>Dactylis glomerata</i> subsp. <i>hispanica</i>	V	V	III
<i>Catapodium marinum</i>	.	III	II
<i>Crithmum maritimum</i>	.	III	III
<i>Pallenis maritima</i>	.	.	V
Other species:			
<i>Euphorbia pithyusa</i>	IV	III	.
<i>Frankenia laevis</i> subsp. <i>laevis</i>	IV	III	.
<i>Carlina corymbosa</i>	IV	II	.
<i>Cynodon dactylon</i>	IV	II	.
<i>Gaudinia fragilis</i>	IV	II	.
<i>Reichardia picroides</i>	V	II	.
<i>Pancratium illyricum</i>	II	II	.
<i>Crocus minimus</i>	IV	.	.
<i>Helichrysum italicum</i> subsp. <i>microphyllum</i>	IV	.	.
<i>Iris sisyrinchium</i>	IV	.	.
<i>Limonium acutifolium</i>	IV	.	.
<i>Lagurus ovatus</i>	IV	.	.
<i>Avena fatua</i>	III	.	.
<i>Beta vulgaris</i> subsp. <i>maritima</i>	III	.	.
<i>Carex flacca</i> subsp. <i>serrulata</i>	III	.	.
<i>Centaureum erythraea</i>	III	.	.
<i>Convolvulus althaeoides</i>	III	.	.
<i>Orobanche sp.</i>	III	.	.
<i>Senecio transiens</i>	.	IV	.
<i>Plantago macrorrhiza</i>	.	.	IV
<i>Hyoseris radiata</i>	.	.	III
<i>Sporobolus arenarius</i>	.	.	III
<i>Plantago crassifolia</i>	.	.	III
<i>Plantago lanceolata</i> subsp. <i>sphaerostachya</i> , <i>Matthiola tricuspidata</i> and <i>Inula viscosa</i> II in 1; <i>Sonchus bulbosus</i> , <i>Allium commutatum</i> , <i>Allium roseum</i> , <i>Atriplex prostrata</i> , <i>Carduus cephalanthus</i> , <i>Glebionis segetum</i> , <i>Crepis bellidifolia</i> , <i>Dianthus sylvestris</i> subsp. <i>siculus</i> , <i>Erodium corsicum</i> , <i>Fumaria capreolata</i> , <i>Hordeum murinum</i> subsp. <i>leporinum</i> , <i>Limonium corsicum</i> , <i>Lobularia maritima</i> , <i>Matthiola incana</i> , <i>Mesembryanthemum nodiflorum</i> , <i>Parapholis strigosa</i> , <i>Parietaria judaica</i> , <i>Senecio cineraria</i> , <i>Sonchus asper</i> , <i>Sonchus oleraceus</i> and <i>Vulpia sp.</i> II in 2; <i>Imperata cylindrica</i> , <i>Laurentia michelii</i> , <i>Linum strictum</i> , <i>Parapholis incurvus</i> , <i>Schoenus nigricans</i> , <i>Sedum caeruleum</i> II in 3.			

Syndynamic, catenal position. The *Dauco hispanici-Asteriscetum maritimi* is situated in the upper contact of *Crithmo maritimi-Limonietum obtusifolii* Géhu & al. 1987 and at the lower of *Helichryso microphylli-Astragaletum massiliensis* Géhu & al. 1987. When the substrate is more mineral, the *Dauco hispanici-Asteriscetum maritimi* develops at the lower contact of *Helichryso microphylli-Asteriscetum maritimi* (Gamisans 1990) Géhu & Biondi, 1994.

Synchorology. In Corsica, this vegetation was observed on the limestone plateau of Bonifacio, more precisely in micro-valleys to the north and southeast, near Pertusato lighthouse. In the Mediterranean, this association is present in Algeria, on Numidia sandstone and at the west of Djijel coast, where it develops on red sandstone type calcareous substrates (Géhu & al., 1992).

Table 7. *Dauco hispanici-Asteriscetum maritimi* Wojterski 1988 *crithmetosum maritimae* Géhu & al. 1992 (*Asteriscion maritimi*, *Crithmo-Limonietalia*, *Crithmo-Limonietea*)

Area (m ²)	3	10	10	.	.
Cover (%)	60	70	100	.	.
N. species	5	7	8	.	.
Mean N. species	.	.	.	.	9.2
Relevé number	1	2	3	4	5*
Characteristics:					
<i>Pallenis maritima</i>	2	3	+	3	V
<i>Daucus carota</i> subsp. <i>hispanicus</i>	+	+	2	3	V
<i>Lotus cytisoides</i>	.	2	3	2	V
<i>Helichrysum italicum</i> subsp. <i>microphyllum</i>	1	+	.	2	III
<i>Dactylis glomerata</i>	.	.	.	.	V
<i>Hyoseris radiata</i>	.	.	.	.	V
<i>Reichardia picroides</i>	.	.	.	.	IV
<i>Hedypnois cretica</i>	.	.	.	.	III
<i>Convolvulus althaeoides</i>	.	.	.	.	III
<i>Plantago serraria</i>	.	.	.	.	III
<i>Sonchus oleraceus</i>	.	.	.	.	III
<i>Lagurus ovatus</i>	.	.	.	.	III
<i>Centaurea sphaerocephala</i>	.	.	.	.	III
Characteristics: <i>Limonium obtusifolius</i> 2, <i>Senecio leucanthemifolius</i> + in 1; <i>Lobularia maritima</i> 1, <i>Sporobolus pungens</i> and <i>Sonchus bulbosus</i> + in 2; <i>Crithmum maritimum</i> 3, <i>Anthemis maritima</i> and <i>Plantago coronopus</i> 1, <i>Camphorosma monspeliaca</i> and <i>Allium commutatum</i> + in 3; all species 1 in 4; <i>Ammophila arenaria</i> , <i>Rumex tingitanus</i> , <i>Silene glauca</i> , <i>Hypochoeris achyrophorus</i> , <i>Smilax aspera</i> and <i>Avena sterilis</i> II in 5.					
Localities: 1, 3: Southwest Pertusato lighthouse; 2: Northwest Pertusato lighthouse (2013). (Asterics refers to the original table by Wojterski, 1988).					

Conclusion

This work allowed us to describe five new syntaxa of *Saginetea maritimae*, *Crithmo maritimi-Limonietea* and *Helichryso italici-Crucianelletea maritimae* Géhu, Rivas-Martínez & Tüxen in Géhu 1975 and to identify a

new syntaxon for Corsica, the *Dauco hispanici-Asteriscetum maritimi*. It completes the knowledge of the vegetation of the rocky coast of Corsica, and of *Saginetea maritimae* and *Crithmo maritimi-Limonietea* associations (de Foucault & Bioret, 2010; Paradis, 2010; Paradis & al., 2013; Paradis & al., 2014).

These coastal vegetation is scarce and do not appear directly threatened because of their particular ecological conditions. However, their limited geographical distribution provides them a consequent heritage value.

Following partially Bardat & *al.* (2004), Géhu & Biondi (1994) and Mucina & *al.* (2016) the vegetation studied in this work is adscribed to the next syntaxa:

SAGINETEA MARITIMAE Westhoff, Van Leeuwen & Adriani 1962

Saginetalia maritimae Westhoff, Van Leeuwen & Adriani 1962

Saginion maritimae Westhoff, Van Leeuwen & Adriani 1962

Catapodio marini-Hymenolobetum revelierii *ass. nova*

Catapodio marini-Centaurietum tenuiflori *ass. nova*

CRITHMO MARITIMI-LIMONIETEA Braun-Blanq. in Braun-Blanq., Roussine & Nègre 1952

Crithmo maritimi-Limonietalia Molinier 1934

Crithmo maritimi-Limonion articulati Paradis, Panaïotis, Piazza & Pozzo di Borgo 2013

Loto cytisoidis-Juncetum acuti *ass. nova*

Asteriscion maritimi Géhu, Kaabeche & Gharzouli 1992

Dauco hispanici-Asteriscetum maritimi Wojterski 1988

crithmetosum maritimi Géhu, Kaabèche & Gharzouli 1992

ARTEMISIETEA VULGARIS W. Lohmeyer, Preising & Tüxen ex von Rochow 1951

Brachypodio ramosi-Dactyletalia hispanicae Biondi, Filigheddu & Farris 2001

Reichardio maritimae-Dactylion hispanicae Biondi, Filigheddu & Farris 2001

Loto cytisoidis-Dactylidetum hispanicae Biondi, Filigheddu & Farris 2001

crithmetosum maritimi subass. nova

HELICHRYSO ITALICI-CRUCIANELLETEA MARITIMAE Géhu, Rivas-Mart. & R. Tüxen in Bon et Géhu 1973) Sissingh 1974 em. Géhu & Biondi 1994

Helichrysetalia italici Biondi & Géhu 1994

Euphorbion pithuysae Biondi & Géhu 1994

Helichryso italici-Thymelaeetum tartonrairae Bioret, Delbosc, Panaïotis & Paradis *ass. nova*

typicum

schoenetosum nigricantis *subass. nova*

dianthetosum siculi *subass. nova*

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