

***Cytisus scoparius* subsp. *maritimus* (Rouy) Heywood vegetation of the Armorican coastal cliffs: phytosociological and synphytosociological synthesis**

Erwan GLEMAREC⁽¹⁾ & Frédéric BIORET⁽¹⁾

(1) Laboratoire Géoarchitecture, University of Western Brittany. F-29200 Brest, France. E-mail: erwan.glemarec@univ-brest.fr, frederic.bioret@univ-brest.fr

Abstract

A synthesis of the *Cytisus scoparius* subsp. *maritimus* (Rouy) Heywood vegetation of the Armorican maritime cliffs, is based on a literature review and unpublished phytosociological and synphytosociological relevés. Within the context of global change in coastal practices and landscapes, the vegetation with *Cytisus scoparius* subsp. *maritimus* are characterized in their ecological and syndynamic context.

Keywords: conservatory management, *Cytisus scoparius* subsp. *maritimus* (Rouy) Heywood, ecology, phytosociology, synphytosociology.

Introduction

Maritime broom (or scotch/prostrate broom), *Cytisus scoparius* subsp. *maritimus*, is a species strictly related to Atlantic sea cliffs. In France, this rare taxon characterizes plant communities of grasslands, heathlands and thickets distributed over a few large coastal rocky headlands of the mainland and islands of the Armorican massif. As part of a research program in historical ecology of maritime cliffs (GLEMAREC ET BIORET, 2021), a phytosociological and synphytosociological synthesis of the maritime broom vegetation of the Armorican maritime cliffs is carried out. Maritime cliffs and particularly coastal heathlands were places of agro-pastoral uses until the mid-twentieth century. Coastal landscapes are evolving and the abandonment of these activities progressively favors the development of the maritime broom. It is proposed here to update the phytosociological approach of *Cytisus scoparius* subsp. *maritimus* vegetation and to place them in their syndynamic context, following the synphytosociological approach. This study is aimed on a better understanding of ecology and dynamics of these communities, for decision-making related to their conservation management and long-term monitoring.

The maritime subspecies of *Cytisus scoparius*

Maritime broom (Figure 1) is a prostrate ecotype of the common broom, *Cytisus scoparius* (L.) (lectotype in AUVRAY ET MALÉCOT, 2013)¹. According to AUVRAY ET MALÉCOT (2013) and the French taxonomic reference (Taxref 15, GARGOMINY ET AL., 2021)² the valid name of the taxon is *Cytisus scoparius* subsp. *maritimus* (Rouy) Heywood, *Bot. Soc. Brit. Isles Proc.*

3: 176 (1959)³, which lectotype is designated by EARL ET RICH (2001).

This prostrate form of *Cytisus scoparius* is described for the first time in 1868 on the coast of Lizard point in Cornwall (BAILEY 1868 IN GÉHU, 1963). In France, the flora of France of ROUY (volume 4, 1897: 204) mentions the maritime accommodation of *Cytisus scoparius* as *Genista scoparia* var. *maritima* (ROUY ET FOUCAUD, 1897). The works of TUTIN (1953) and BÖCHER ET LARSEN (1958) (GILL ET WALKER, 1971) demonstrated the maintenance of the prostrate character of this ecotype, which justifies its elevation to the rank of subspecies.

The maritime subspecies is characterized by short stature, procumbent, shaped by the wind, with silky-hairy young branches, densely pubescent (STACE 2010), with glabrous branches when mature. The leaves are generally unifoliolate (AUVRAY ET MALÉCOT, 2013; TISON ET DE FOUCAULT, 2014), which can differentiate it from *Cytisus scoparius* subsp. *scoparius* whose petiolate leaves, usually unifoliolate on young twigs, are trifoliolate, unifoliolate and sessile on higher twigs. According to COULOT ET RABAUTE (2016), the *maritimus* ecotype is different from the *scoparius* type only by its prostrate form; this ecotype is characterized by a sparse and applied hairiness, only on the young branches. As the criterion of leaves appears insufficient. COULOT ET RABAUTE (2016: 606) consider the maritime form as a coastal morphosis and favor the rank of a variety: var. *prostratus*. The main feature remains the prostrate form, which according to GILL ET WALKER (1971), can be determined by the ratio of size to average width. The authors propose that the height measured is the maximum height above ground level of the tallest stem and that the average width is



Figure 1. *Cytisus scoparius* subsp. *maritimus*: top left, prostrate form (Capucins, Roscanvel F-29), top right “ball form” to semi-erect form (Kastel koz, Beuzec Cap Sizun F-29), lower aged foot (Kadoran, Ouessant F-29).

the average of the largest and smallest diameter of the plant (\log_{10} Maximum height² / average width < 0,5 for *Cytisus scoparius* subsp. *maritimus*).

Various, sometimes contradictory, publications are dealing with the genetics of *Cytisus scoparius* subsp. *maritimus*. Last findings conclude that the number of chromosomes of subsp. *scoparius* and subsp. *maritimus* is the same $2n = 46$ and that hybridization is possible, with the maintenance of a strong influence of the procumbent character (MORTON, 1955; BÖCHER ET LARSEN 1955; ADAMS, 1957; GILL ET WALKER, 1971).

KAY ET JOHN (1995) have shown that maritime brooms from west England, southern Ireland and Jersey are genetically distinct from common brooms. There is also a high level of genetic variability in the subspecies *maritimus*, even in small populations, which may protect it against genetic erosion. They also specify that the "other prostrate forms" are to be considered as subsp. *maritimus*.

The heterogeneity of the results of genetic studies could be linked to the morphological diversity of *Cytisus scoparius* on coastal cliffs.

This is confirmed by the descriptions of GÉHU (1963) and GODEAU (1989) who distinguish two forms of the maritime ecotype. A first form, very prostrate, pressed to the ground, and a second form taller and in a “ball form” with trunks height can reach a meter, more or less arched and ramificated, with spreading and reflexed branches. GÉHU (1963) specifies that tran-

sition forms do exist between these two types of accommodations, especially on moderately exposed coasts. He considers these two morphologies to be characteristic of the maritime subspecies. GODEAU (1989) separates these two forms, considering a strictly prostrate maritime subspecies and a “ball form” whose characteristics are intermediate between the type subspecies and the maritime subspecies. He considers that this is either a hybridization between the two subspecies or the highlight of an evolution from the type subspecies to the maritime subspecies.

The stomata of plants of the two subspecies are differentially sensitive to an increase in wind speed. The reduced rate of transpiration in the subspecies *maritimus* allows an increase in the water potential of the stem. The adaptation of maritime broom to coastal cliffs is linked to its ability to maintain water under conditions of high evaporation demand and under conditions of water stress (DAVIS ET AL., 1978).

Maritime broom is a long-lived perennial which, on the evidence of counting growth rings, may live for more than 50 years⁴.

This taxon is found only on the sea cliffs most exposed to winds but not to heavy saltwater spray (KAY ET JOHN, 1995). It occupies the top part of the coastal cliffs, especially at the angle of fracture of the cliff top, on silty clad soils, eroded, arenas enriched in fine elements, also on rankoso ils on acid colluvium. In France, *Cytisus scoparius* subsp. *maritimus*

1→ *Cytisus scoparius* (L.) Link, Enum. Hort. Berol. Alt. 2: 241 (1822): problems on the typification of *Spartium scoparium* have been discussed by Auvray & Malécot (2011). The old lectotype has been replaced in favor of the specimen Burser XXII: 33 of Linnean collection because of the conflict with the protologue.

2→ https://inpn.mnhn.fr/espece/cd_nom/133645

3 = *Sarothamnus scoparius* var. *prostratus* C. Bailey, Proc. Manchester Lit. Soc. 6:49 (1866) = *Cytisus scoparius* var. *prostratus* (C. Bailey) F. Hand. ex A. B. Jacks., Gard. Chron. ser. 3, 105: 387 (1939). TYPE: C. Bailey s. n., 13-VII-1866, Cornwall, The Lizard (Lecto, MANCH designated by Rich and Earl, 2001). *Genista scoparia* var. *maritimus* Rouy, Fl. France 4: 204 (1897) = *Sarothamnus scoparius* subsp. *maritimus* (Rouy) Ulbrich, Mitt. Deutsch. Dendrol. Ges.: 135 (1921) = *Cytisus scoparius* subsp. *maritimus* (Rouy) Heywood, Bot. Soc. Brit. Isles Proc. 3: 176 (1959).

4→ Wigginton M.J. in Online Atlas of the British and Irish flora. <https://www.brc.ac.uk/plantatlas/plant/cytisus-scoparius-subsp-maritimus>

is recorded on the large rocky headlands of the Armorican coast, Manche (Cotentin), Finistère (Ouessant, Ploumoguier, Presqu'île de Crozon, Cap Sizun) and Morbihan (Presqu'île de Rhuys, Belle-Île-en-mer) (GÉHU, 1963; Godeau, 1985; LAHONDÈRE ET BIRET, 1997; HARDEGEN ET BIRET, 2000; GLEMAREC ET AL., 2015). The taxon is also known in the Channel Islands and the southwestern capes of Cornwall, Wales and southwest Ireland (Coombe & Frost, 1956; Gill & Walker, 1971; Alderney: Proctor, 1975; Jersey: Géhu, 2000; Scilly: French, 2009; Preston *et al.*, 2002; Pearman, 2017). According to Dupont (2015), the maritime subspecies may be looked for on the coast of northwestern Spain.

Described plant communities of *Cytisus scoparius* subsp. *maritimus*

Cytisus scoparius subsp. *maritimus* characterizes the coastal heathland of *Dactylido oceanicae-Ulicion maritimi* Géhu 1975. This alliance gathers the coastal cliffs and dunes heathlands, generally primary, prostrate and subject to spray, characterized by coastal accommodation of *Fabaceae*. This phytosociological rank is part of *Ulicetalia minoris* Quantin 1935, thermo- to hyper-, north- and sub- Atlantic heathlands and *Calluno vulgaris-Ulicetalia minoris* Braun-Blanquet & Tüxen ex Klika in Klika & Hadač 1944 (Atlantic heathlands).

Maritime broom heathland is described by GÉHU (1963): *Dactylido oceanicae-Cytisetum maritimi* Géhu 1963 *nom. invers.* (Bull. Soc. Bot. N. France 16 (4): 219) *nom. corr. hoc loco*⁵. This plant community have a dense phanerogamic covering (80-100%) with a physiognomy very marked by the sea winds which rounded scrubs, densely dominated by *Cytisus scoparius* subsp. *maritimus* and *Erica cinerea*, sometimes *Festuca rubra* subsp. *pruinosa*, in contact with halo- anemogenic grasslands. *Cytisus scoparius* subsp. *maritimus* is associated with *Dactylis glomerata* subsp. *oceanica*, strictly littoral and Atlantic species, with a low number of ears and a small panicle (GUIGNARD, 1985).

The phenological optimum is from late spring to early summer (May-June). This acidiphilic mesophilic vegetation is present on eroded silty veneers or to granitic arenas enriched in fine elements (lithosoils or thin rankosoils). It is most frequent near the crest of the cliff. It only appears in the most exposed part of the most of advanced rocky coastal headlands.

Three subassociations have been described:

Subass. *ericetosum cinereae* Géhu 1963 (Bull. Soc. Bot. N. France 16 (4): 220) (art. 5b in Theurillat *et al.*, 2020) [syn.: *scilletosum verna* Géhu & Géhu-Franck 1975 (Colloq. Phytosoc. II: 197)]

Differential species: *Scilla verna*, *Solidago virgaurea* s.l., *Pimpinella saxifraga*, *Calluna vulgaris*.

Subass. *armerietosum maritimae* Géhu & Géhu-Franck 1975 (Colloq. Phytosoc. II: 197) [corresp.: *Sarothamno-Dactyletum maritimae* Géhu 1963 *ericetosum cinereae* Géhu 1963 «var. with *Fes-*

tuca rubra var. *littoralis*» Géhu 1963 (Bull. Soc. Bot. N. France 16 (4): 220)

Comments: Halophilic variation, of higher contact of halo- anemogenic grasslands, differentiated by taxa of *Armerio maritimae-Festucetea pruinosae*. Subass. *pteridietosum aquilini* Géhu 1963 (Bull. Soc. Bot. N. France 16 (4): 219), rel. 1 of tab. (single relevé) "Ass. with *Sarothamnus scoparius* subsp. *maritimus* and *Dactylis glomerata* subsp. *maritima*" in Géhu (1963, Bull. Soc. Bot. N. France 16 (4): h.t.),

Differential species: *Pteridium aquilinum*, *Teucrium scorodonia*, *Viola riviniana*, which presents preforest affinities.

This syntaxon is recorded on the Breton coast in Finistère and Morbihan (GÉHU, 1963; GÉHU ET GÉHU-FRANCK, 1975; CLÉMENT 1981; BIRET, 1989, 1994; LAHONDÈRE ET BIRET, 1997; GLEMAREC ET AL., 2015), in Normandy, on the exposed points of the Cotentin (Nez de Jobourg: DE FOUCAULT, 1995; COLASSE, 2011) in the Channel Islands (GÉHU, 2000) and to the west of Cornwall and Wales (BRIDGEWATER, 1980).

GÉHU (1963) individualizes a variation of a halo-anemogenic grassland to *Cytisus scoparius* subsp. *maritimus: sarothamnetosum maritimi* Géhu 1963 (Bull. Soc. Bot. N. France 16 (4): 220, rel. 10-15 tab. 1, from "association with *Armeria maritima* and *Daucus gummifer*"). This syntaxon marks the transition between the grassland of *Festuca rubra* subsp. *pruinosa* and the *Dactylido oceanicae-Cytisetum maritimi* heathland. The status of this subassociation, absent from the recent synthesis of *Armerio maritimae-Festucetea pruinosae* (BIRET ET GÉHU, 2008) remains to be studied, in particular because of the invalid syntax of "association with *Armeria maritima* and *Daucus gummifer*" in the original publication.

According to RODWELL ET AL. (1991), the *Calluna-Scilla* heath (H7: 434-448) provides one locus for prostrate ecotypes of *Cytisus scoparius* subsp. *maritimus*.

Human uses on sea cliffs and their influences on *Cytisus scoparius* subsp. *maritimus*

The history of maritime cliffs heathlands can be organized in five major periods:

- 1) The first clearings in prehistoric times (MARGUERIE ET HUNOT, 2007).
- 2) The collective agro-pastoral management of large spaces in the Middle Ages.
- 3) The establishment of cadastres and the privatization of plots in the end of the nineteenth century (SÉE, 1926; CLOUT, 1979; ANTOINE, 2001).
- 4) The agronomic revolution and the disappearance of the peasantry, the development of the coasts during the twentieth century, until the recent development of tourism and sports outdoors.

The vegetation of the coastal cliffs, in particular grasslands, heathlands and thickets, where *Cytisus scoparius* subsp. *maritimus* can be found, result from strong ecological constraints (wind, salt spray, drought,

5→ syn. syntax.: *Sarothamno-Dactyletum maritimae* Géhu 1963 (Bull. Soc. Bot. N. France 16 (4): 219, 'Sarothamneto...', art. 41b, 43, 45 [Theurillat *et al.*, 2020]) ; *Dactylo marinae-Sarothametum maritimi* Géhu 1963 (Bull. Soc. Bot. N. France 16 (4): 219) *nom. invers.* (Colloq. Phytosoc. II: 195). Nomenclatural type: rel. 5 du tab. « Ass. à *Sarothamnus scoparius* subsp. *maritimus* et *Dactylis glomerata* subsp. *maritima* » in Géhu (1963, Bull. Soc. Bot. N. France 16 (4): h.t.), lectotype by Glemarec *et al.* (2015, Les landes du Massif armoricain...: 49).

oligotrophy and shallow soils) which sometimes impose them stability, some heathlands being considered as primary or (sub / plagio) climax (GÉHU, 1975; CLÉMENT, 2003; FAGÚNDEZ, 2013). However, several dynamic trajectories can be identified for some of these coastal heathlands, while being blocked at the scrub vegetation stage (GÉHU, 2007; DEMARTINI ET AL., 2017).

The remains of anthropogenic uses, omnipresent on the coastal heathlands (low walls, paths, mounds, ditches, barred spurs, Neolithic remains, seaweed ovens...) testify that these environments have been grazed, harvested, sometimes sown. The vegetation of the maritime cliffs was integrated into peasant life until the end of the nineteenth century and these activities continued in some areas, with a multi-livestock activity, until the middle of the twentieth century. While knowledge of the ecological determinism of coastal heathlands provides part of the elements for understanding coastal landscapes, it must be supplemented by the historical and social dimensions.

Historically, the broom were harvested for firewood. GÉHU (1963) specifies “*It is probably only because of these ecological aptitudes to live on the most abrupt cliffs (...) and of the facility with which it rejects stump, that this broom was able to resist of cuts and to peat cuttings, carried out until the very last few years. In Ouessant, for example, where, as in all the islands and coasts of Finistère, the harvest of firewood is intense, we observed many old broom stumps cut at ground level, even in the cliffs. On the other hand, the gradual abandonment of these ancestral practices, depopulation and agricultural recession, are leading, in this same island, especially in Kadoran, to the rapid expansion of the maritime broom populations*”. GESTIN ET AL. (1982) confirm these remarks by indicating that, almost two centuries ago, in September 1790 in Ouessant, the rector Yves Loat, complaining about the drop in these incomes and the necessity in which he finds himself to obtain large firewood to the continent, specifies that the “*Isle of Ouessant does not produce firewoods, only gorse and broom which we pay quite dearly to heat the oven*”. It is therefore “*a scarce and therefore precious resource and therefore reserved for an elite at that time*”. The first interviews with former farmers as part of a research program in historical ecology of cliffs and coastal heathlands (GLEMAREC ET BIORET, 2021) confirm the systematic harvesting of broom for firewood on the coastal cliffs until the beginning of the twentieth century.

It should also be noted that on the southern exposed points of Cap Sizun (south Finistère), the activity of burning drift seaweeds continued until the twentieth century. As specified by DOARÉ (2012) “*The burning of seaweed was practiced at the end of the summer and took place in several stages: The fire was first lit in each compartment with bundles of broom or gorse, then it was gradually filled with handfuls of dry seaweed*”.

Coastal vegetation structured by *Cytisus scoparius*

subsp. *maritimus* were therefore probably historically constrained by grazing and firewood cuttings. The consequence of abandonment of these uses is the recent development of coastal maritime broom thickets. They are different in species composition and ecology from the *Dactylido oceanicae-Cytisetum maritimi*.

The maritime broom in heathlands can be considered as the result of pioneer vegetations thickets. The maritime broom is most often absent from stable heathlands with *Ulex europaeus* var. *maritimus* or *Ulex gallii* var. *humilis*. The maritime broom can also replace the littoral grasslands (Gloaguen, 1988) and also seems to appreciate the eroded soils linked to human activities or natural erosion. KAY ET JOHN (1995) indicate that “*Fires, severe droughts or cliff falls might, however provide opportunities for seedling establishment if an adequate seed bank were present*”. We have noticed that the maritime broom is developing in such pioneering natural conditions and in areas disturbed by human activity: paths (pointe du Van, pointe du Raz – Cap Sizun), rock quarry (cap de la Chèvre in Crozon, pointe de Brezellec in Cléden Cap Sizun), storage of materials or access to the sea.

Phytosociological approach of *Cytisus scoparius* subsp. *maritimus* communities

Phytosociological relevés were carried out between 2010 and 2021, following the sigmatist phytosociology method (GUINOCHET, 1973; GÉHU ET RIVAS-MARTÍNEZ, 1981; GÉHU, 1987). The phytosociological method, a descriptive and predictive tool (VIGO, 2008), allows the study of plant communities, based on the indicator and integrator character of ecological, dynamic and historical factors of plant species. A plant association is a plant community determined by floristic composition, presenting a physiognomy and uniform ecological conditions (FLAHAULT ET SCHRÖTER, 1910; GÉHU, 2006), which can be part of a progressive or regressive series of associations (ALLORGE, 1922). The nomenclature of taxa followed is Taxref 15.

About 100 relevés have been realized. The sites studied (Figure 2) are Belle-Île-en-mer (pointe de Cardinal), Rhuys peninsula (Grand Mont), coast of Aven and Belon (coast of Riec-sur-Belon), Cap Sizun (Lenac'h to Esquibien, from Bestrée to pointe du Raz in Plogoff, pointe du Van, Brezellec and Castel Meur in Cléden Cap Sizun, Kastel a roc'h in Goulien, Kastel Koz in Beuzec Cap Sizun), Crozon peninsula (cap de la Chèvre in Crozon, Capucins to Trez rouz in Roscanvel, Penhir in Camaret), Ouessant (Kadoran, Stiff) and Ploumoguier (between Ilien and pointe de Brentec'h).

Four large groups of vegetation stand out. The ecological preferences of *Cytisus scoparius* subsp. *maritimus* vegetations is presented in Figure 3, and are illustrated by pictures (Figure 4).

1 / *Dactylis glomerata* subsp. *oceanica* and *Cytisus scoparius* subsp. *maritimus* heathland

The relevés presented in Table 1 characterize a significantly landicolous vegetation by the presence

of Ericaceae (*Erica cinerea*, less frequently *Calluna vulgaris*) and Fabaceae (*Ulex europaeus* subsp. *europaeus* and *Ulex gallii* subsp. *gallii*), and *Dactylis glomerata* subsp. *oceanica*⁶ which contribute to the structuration of this open heathland. This heathland with *Cytisus scoparius* subsp. *maritimus* corresponds to *Dactylido oceanicae-Cytisetum maritimi* Géhu 1963. Our relevés (rel. 7 to 20, Tab.1) confirm a halophilic variation with transgressive characteristic plants of *Armeria maritima*-*Festucetea pruinosa* Bioret & Géhu 2008: *Armeria maritima*, *Festuca rubra* subsp. *pruinosa*. They can be analyzed as corresponding to the subassociation *armerietosum maritima* Géhu & Géhu-Franck 1975, linked to the halo- anemogenic grassland located at the lower contact. The other group of the relevés (rel. 1 to 6, Tab.1) corresponds to the subassociation *ericetosum cinerea* Géhu 1963, characterized by *Erica cinerea*, *Calluna vulgaris*, *Festuca huonii*, *Ulex europaeus* subsp. *europaeus* var. *maritimus*.

The subassociation *pteridietosum aquilini* Géhu 1963 is characterized by a typus without Ericaceae. This is not the case for the relevés presented by GÉHU & GÉHU-FRANCK (1975: 196). However, we do not have relevés with a simultaneous high abundance of preforest plants and the presence of Ericaceae. The explanation can be that the dynamics anti-

cipated by the authors are confirmed and these vegetations noted in 1963 and 1975 have today evolved towards dense thickets. We suggest that this subassociation corresponds to a *Cytisetea scopario-striati* preforest thicket described in this article (*Lonicero periclymeni-Cytisetum maritimi*).

2 / *Cytisus scoparius* subsp. *maritimus* halo-anemogenic grassland

Relevés of Table 2 characterize a subassociation of a halo-anemogenic grassland with *Festuca rubra* subsp. *pruinosa* and *Armeria maritima* where *Cytisus scoparius* subsp. *maritimus* is abundant. This grassland corresponds to the *Armeria maritima*-*Festucetum pruinosa* Géhu 2008, a dense halo-anemogenic perennial vegetation, developed on fairly deep rankosol, mesophilic, present on the Armorican coast, with an optimum on the north and west Brittany (BIORET ET GÉHU, 2008).

This grassland developed on the lower and middle parts of the coastal cliffs, at the lower contact with the low heathland. Characteristic species are *Armeria maritima*, *Festuca rubra* subsp. *pruinosa*, *Daucus carota* subsp. *gummifer* and *Cytisus scoparius* subsp. *maritimus*. *Ulex* and Ericaceae are absent.

This vegetation corresponds to the subassocia-

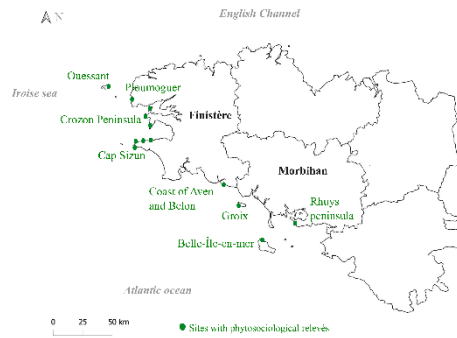


Figure 2. Localization of phytosociological relevés

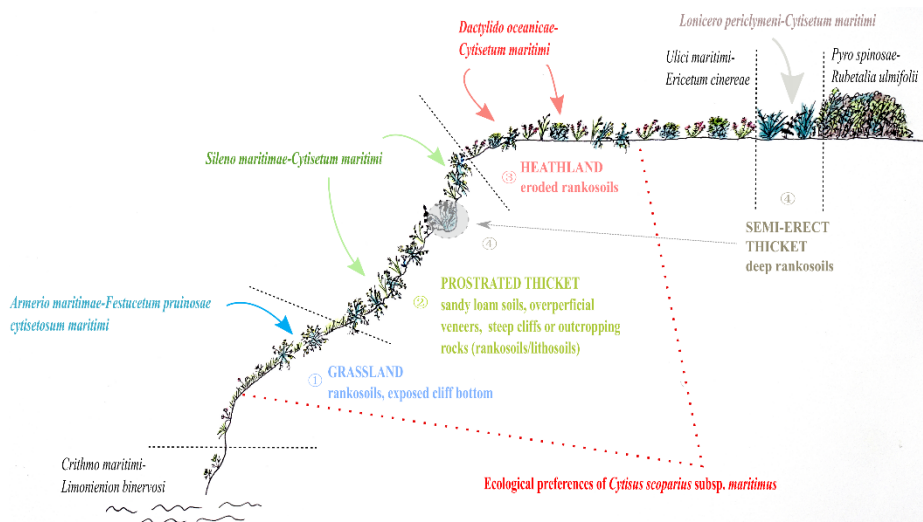


Figure 3. Ecological preferences of *Cytisus scoparius* subsp. *maritimus*

6→ *Dactylis glomerata* var. *maritimi* in Géhu (1963), in fact corresponds to *Dactylis glomerata* L. subsp. *oceanica* G. Guignard [1986, Bull. Soc. Bot. France, Lettres Bot., 132 (4-5): 346], strictly Atlantic taxon, different from *Dactylis glomerata* subsp. *marina* (Borrill) Greuter [1983, Willdenowia, 13 (1): 72], strictly Mediterranean taxon. Due to the morphological variability of *Dactylis glomerata* that we have identified, we have grouped the subspecies under the name *Dactylis glomerata* s.l.



Halo-anemogenic grassland: *Armerio maritimae-Festucetum pruinosaeyctisetosum maritimi* (pointe de Cardinal, Belle-Île-en-mer F-56)



Prostrate coastal heathland: *Dactylido oceanicae-Sarothamnetum maritimi* (pointe du Raz, Plogoff F-29)



Prostrate coastal thicket: *Sileno maritimae-Cytisetum maritimae* (pointe du Raz, Plogoff F-29)



Semi-erect thicket: *Lonicero perichlymeni-Cytisetum maritimi* (Beger Vir, Roscanvel F-29)

Figure 4. Pictures of plant communities with *Cytisus scoparius* subsp. *maritimus*

Table 1. *Dactylido oceanicae-Cytisetum maritimi* Géhu 1963

N° relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Surface (m ²)	10	10	10	25	15	5	3	15	4	12	15	20	5	15	30	30	15	20	7	15
Recovery (%)	100	100	100	100	90	100	100	100	100	100	25	100	100	100	95	100	100	90	100	100
Height (cm)	50	50	30-50	60-80	30-90	20-80	30-50	50	20-60	50-70	50	20-40	20-40	20-50	10-40	30-40	50	30	50	50
Characteristic plants of association																				
<i>Cytisus scoparius</i> subsp. <i>maritimus</i>	45	44	55	12	23	33	55	45	45	45	33	33	33	45	45	23	33	45	44	55
<i>Dactylis glomerata</i> s.l. (including subsp. <i>oceanica</i>)	11	+	11			22	12		12	23	11	12	+	11	12	11	12			
<i>Erica cinerea</i>	23	22		45	45	33	23	+	12	22	23	33	33	23	22	23	33	33	12	23
<i>Calluna vulgaris</i>	12	11	11		12			12					23			45				34
<i>Cuscuta epithymum</i> subsp. <i>epithymum</i>												12								
<i>Festuca huonii</i>	+	22			11			11		+		+		12	33			11	11	
<i>Ulex europaeus</i> subsp. <i>europaeus</i> var. <i>maritimus</i>			23	33	23	33				+			33	33			33	23	33	
<i>Ulex gallii</i> var. <i>humilis</i>													33		33					
armerietosum maritimae																				
<i>Silene vulgaris</i> subsp. <i>maritima</i>							12	12	11	12	12								+	
<i>Armeria maritima</i>												11	+	11		r	22	11	+	+
<i>Festuca rubra</i> subsp. <i>pruinosa</i>										23	33		+			12			22	
<i>Daucus carota</i> subsp. <i>gummifer</i>											22	+		+	22	+				
<i>Euphorbia segetalis</i> subsp. <i>portlandica</i>										+	11		+							
<i>Leucanthemum vulgare</i>										11									11	
Rahmno – Prunetea																				
<i>Hedera helix</i>				11								33								
<i>Lonicera periclymenum</i>					+															
<i>Pteridium aquilinum</i>	+	12		+								12								
<i>Teucrium scorodonia</i>				12	22		22	+		11										
<i>Rubus</i> sp. (cf. <i>ulmifolius</i>)	12	+	12							35										+
<i>Prunus spinosa</i>								23			+						+			
<i>Rubia peregrina</i>			11																	
Associated plants																				
<i>Brachypodium rupestre</i> subsp. <i>rupestre</i>												+								
<i>Asphodelus macrocarpus</i> subsp. <i>arrondeauii</i>												33								
<i>Hieracium</i> gr. <i>umbellatum</i>												11								
<i>Digitalis purpurea</i>				+																
<i>Polypodium interjectum</i>				+																
<i>Cochlearia danica</i>																			+	
<i>Lotus corniculatus</i>																	r			
<i>Holcus lanatus</i>															12					
<i>Thymus drucei</i>																				
<i>Potentilla erecta</i>														+	+					11
<i>Rumex acetosa</i>	+											+							+	
<i>Sedum anglicum</i>					+						+								+	
<i>Jasione montana</i>					+	+					+	+								
<i>Leontodon saxatilis</i>												+							+	+
<i>Rosa spinosissima</i>																		11	+	
<i>Viola riviniana</i>												11								+
<i>Anthoxanthum odoratum</i>							11					11								
<i>Agrostis capillaris</i>												12								
<i>Hyacinthoides non-scripta</i>				+								11								
<i>Hypochaeris radicata</i>												r								
<i>Raphanus raphanistrum</i> subsp. <i>landra</i>							+								+	+				
<i>Plantago lanceolata</i>																	r	+		

Localities: 1: Kadoran Est, Ouessant (15/04/21); 2: Kadoran Est, Ouessant (15/04/21); 3: Cap de la Chèvre, Crozon (08/06/21); 4: Ancien fort du Stiff, Roscanvel (05/05/21); 5: Est de la pointe du Guern (Treboul), Telgruc (29/07/21); 6: Cap de la Chèvre, Est du sémaphore, Crozon (02/06/21); 7: Est de la pointe du Guern (Treboul), Telgruc (29/07/2021); 8: Est Fort Robert, Roscanvel (07/05/21); 9: Penhir sud, Camaret (02/06/21); 10: Kastel Koz, Beuzec Cap Sizun (17/06/21); 11: Pointe de Cardinal, Sauzon (24/08/16); 12: Chapelle St They Point du Van, Cléden Cap Sizun (17/06/21); 13: Brezellec, Cléden Cap Sizun (01/04/21); 14: Chapelle St They, pointe du Van, Cléden Cap Sizun (17/06/21); 15: Kastel ar Roc'h, Goulien (25/06/21); 16: Pointe du Raz, Plogoff (15/10/2021); 17: Pointe des Capucins, Roscanvel (09/05/21); 18: Pointe des Capucins, Roscanvel (10/05/21); 19: Baie de Kadoran, Ouessant (17/04/21); 20: Baie de Kadoran, Ouessant (17/04/21).

Table 2. *Armerio maritimae-Festucetum pruinosaе cytisetosum maritimi subass. nova hoc loco*

N° relevé	1	2	3	4	5	6
Surface (m ²)	15	5	10	10	5	6
Recovery (%)	100	100	100	100	90	100
Height (cm)	10-25	10-30	5-25	10-40	20-50	30
Characteristic plants of association						
<i>Armeria maritima</i>	12	22	12		+	
<i>Festuca rubra</i> subsp. <i>pruinosa</i>	55	45	12	45	23	22
<i>Daucus carota</i> subsp. <i>gummifer</i>	11		22	11		11
<i>Silene vulgaris</i> subsp. <i>maritima</i>	11	12	11	12	+	12
<i>Rumex acetosa</i>	11	11		+	11	
<u>cytisetosum maritimi</u>						
<i>Cytisus scoparius</i> subsp. <i>maritimus</i>	34	34	23	35	35	35
<i>Dactylis glomerata</i> s.l. (including subsp. <i>oceanica</i>)	11	11	+	+	12	12
Associated plants						
<i>Plantago lanceolata</i>	11	12	+	11		
<i>Lotus corniculatus</i>	11		+	+		
<i>Anthoxanthum odoratum</i>		+				11
<i>Sedum anglicum</i>	+			+		
<i>Jasione montana</i>			+	+		
<i>Leontodon saxatilis</i>	+			+		
<i>Allium sphaerocephalon</i>	11			+		
<i>Senecio discolor</i>	+	+				
<i>Hyacinthoides non-scripta</i>		+		12		
<i>Hedera helix</i>		+				
<i>Agrostis stolonifera</i> subsp. <i>arenaria</i>						+
<i>Euphorbia segetalis</i> subsp. <i>portlandica</i>						+
<i>Cuscuta epithymum</i> subsp. <i>epithymum</i>					+	
<i>Festuca huonii</i>			13			
<i>Rosa spinosissima</i>					23	
<i>Umbilicus rupestris</i>		+				
<i>Asphodelus macrocarpus</i> subsp. <i>arrondeauii</i>				12		
<i>Hieracium</i> gr. <i>Umbellatum</i>				+		
<i>Hypochaeris radicata</i>		+				
<i>Crithmum maritimum</i>	+					
<i>Holcus lanatus</i>			+			

Localities: 1,2 & 4: Pointe de Cardinal, Sauzon (18/05/21); 3: Chapelle St They, pointe du Van, Cleden Cap Sizun (17/06/21); 5: Kastel ar roc'h, Goulien (25/06/21); 6: Pointe du Raz, Plogoff (15/07/2021).

tion *sarothamnetosum maritimi* Géhu 1963 (*Bull. Soc. Bot. N. France* 16 (4): 220) of the "association with *Armeria maritima* and *Daucus gummifer*". In accordance with the phytosociological nomenclature code (THEURILLAT ET AL., 2020), it is proposed to transfer the *Cytisus scoparius* subsp. *maritimus* sub-association to a subassociation of the *Armerio maritimae-Festucetum pruinosaе* (art. 26), the name of the association which the subassociation is attached not having a clearly established correspondence. To adapt the name to the current taxonomy (art. 45), we propose the following name: *Armerio maritimae-Festucetum pruinosaе* Bioret & Géhu 2008 *cytisetosum maritimi* (Géhu 1963) *subass. nov. hoc loco* (*holotypus hoc loco*: rel. 1 Tab.2), subassociation of halo-anemogenic grasslands on eroded soils or linked to rocky outcrops.

3 / *Silene vulgaris* subsp. *maritima* and *Cytisus scoparius* subsp. *maritimus* thicket

The relevés of Table 3 correspond to a low halo-anemorphosed thicket, dominated by *Cytisus scoparius* subsp. *maritimus*, dense to semi-open, the interstices between maritime brooms allowing the development of *Dactylis glomerata* s.l. (including subsp. *oceanica*) and *Silene vulgaris* subsp. *maritima*⁷ which can cover maritime brooms. Species of the

Armerio maritimae-Festucetea pruinosaе can discretely complement the characteristic combination. The Ericaceae are absent.

The optimum of this vegetation corresponds to steep slopes, less often on slope breaks, on coastal cliffs very exposed to wind, on silty, sandy, veneered, shallow and eroded soils, also on the edges of outcropping rocks. The soils are shallow (<20 cm) eroded lithosoils or rankosoils.

This vegetation presents a pioneering character and a primary dynamic, on substrates eroded naturally (cliff erosion) or linked to the presence of populations of vertebrates (rabbit warrens, seabird rockeries) and human activities (quarries...). Maritime brooms are prostrated, pressed close to the ground, or have a very anemorphosed "ball form".

Taking into account its synecological and synfloristic originality, this vegetation can be considered as a new plant association that we proposed to name *Sileno maritimae-Cytisetum maritimi* ass. nov. *hoc loco* (*holotypus hoc loco* rel. 13, Table 3a).

On more stabilized rankosoils, with more moderate exposure to wind and salt spray, most often around rocky outcrops, these maritime brooms thickets are possibly structured with the co-presence of mari-

7→ *Silene vulgaris* (Moench) Garcke subsp. *maritima* (With.) Á.Löve & D.Löve 1961 = *Silene uniflora* subsp. *uniflora* Roth, 1794 (Flora Gallica (Tison & de Foucault, 2014): 696) = *Silene bastardii* Boreau ex J.Lloyd, 1877. (https://inpn.mnhn.fr/espece/cd_nom/141211).

time gorses, *Ulex europaeus* subsp. *europaeus* var. *maritimus*. This variation can be observed at the lower contact of the *Dactylido oceanicae-Ulicion maritimi* heathland or of the *Rhamno catharticae-Prunetea spinosae* Rivas Goday & Borja ex Tüxen 1962 low thickets.

Two subassociations can be differentiated:

- *typicum* subass. nov. *hoc loco*, corresponds to the type of association;
- *ulicetosum maritimi* subass. nov. *hoc loco* (holotypus *hoc loco* rel. 13, Tab. 3b), corresponds to thickets developed on more stabilized substrates, sometimes in contact with the coastal heathlands of *Dactylido oceanicae-Ulicion maritimi*, characterized by the presence of *Ulex europaeus* subsp. *europaeus* var. *maritimus*; this subassociation marks the transition to coastal heathlands and scrublands.

The variation with *Brachypodium rupestre* corresponds to altered substrates, rich in arenas, with marine sandy eolian deposits. It is observed on the metamorphic coastal cliffs of southern Brittany: littoral of Riec-sur-Belton and Saint-Gildas-de-Rhuys.

This association belongs to the *Cytisetalia scopario-striati* Rivas-Martínez 1975, which corresponds of Atlantic to thermo-Atlantic thickets on acidic soils poor in nutrients (DE FOUCAULT ET AL., 2013). It could be attached to the *Ulici europaei-Cytisium striati* Rivas-Martínez, Báscones, T.E. Díaz, Fernández González & Loidi 1991. For the southern Atlantic retamoid scrublands, this alliance is characterized by *Ulex europaeus* subsp. *europaeus* and does not integrate the maritime ecotypes of scrubs. We propose to create a new alliance *Ulici maritimi-Cytisium maritimi* all. nov. *hoc loco* (typus nominis: *Sileno maritimae-Cytisetum maritimi* Glemarec & Bioret ass. nov. *hoc loco*) which is differentiated by strong maritime conditions which influence the structure and composition of the vegetation.

- 4 / *Lonicera periclymenum* and *Cytisus scoparius* subsp. *maritimus* thicket

The relevés of Table 4 correspond to a semi-erect or prostrate thicket dominated by *Cytisus scoparius* subsp. *maritimus*. Maritime brooms are mixed with *Rhamno catharticae-Prunetea spinosae* species to form dense or semi-open thickets in which *Pteridium aquilinum*, *Hedera helix*, *Lonicera periclymenum* and *Teucrium scordonia* develop. *Ericaceae* are absent. *Ulex europaeus* subsp. *europaeus* var. *maritimus* is occasionally present.

This vegetation is found in the ledges of the slopes of the coastal cliffs and on the plateau, on small surfaces, on silty, sandy, veneered, rather deep soils (about 25-40cm). Exposure to wind and salt spray is more moderate than for *Sileno maritimae-Cytisetum maritimi* anemorphic thicket. This vegetation may be present in the ledges of the cliffs, sheltered from the rocks, with deep soil.

This broom thicket seems to correspond to the *pteridietosum aquilini* Géhu 1963 (Bull. Soc. Bot. N. France 16 (4): 219), rel.1 (single relevé) of tab. "Ass. with *Sarothamnus scoparius* ssp. *maritimus* and *Dactylis glomerata* ssp. *maritima*".

This thicket seems different from *Sileno maritimae-*

Cytisetum maritimi, as it grows on deeper substrates, in semi sheltered conditions from prevailing winds. Floristically, *Armerio maritimae-Festucetea pruinosa* species are very rare, while species with forest affinities are present.

This vegetation can be observed at the upper contact to *Sileno maritimae-Cytisetum maritimi* or *Dactylido oceanicae-Ulicion maritimi*. A dynamic link between this broom thicket and *Sileno maritimae-Cytisetum maritimi* cannot be established for the moment, the distance from the sea and the thickness characterizes an ecological differentiation and not a dynamic link. Further investigations could confirm this hypothesis. The brooms have a coastal character but they are not, however, prostrate and mainly look like the "ball form". A doubt could be cast on the systematic presence of subsp. *maritimus* or low-growing variants of subsp. *scoparius* and phenotypically dwarfed. The vegetation height is sometimes less than 50 cm, but can reach 150 cm in the most sheltered sectors. We propose to relate these brooms to the maritime subspecies. This choice is also made from a synphytosociological perspective, in order to define the serial envelopes of the minoriserie under maritime influence.

Considering its synecological and synfloristic originality, this vegetation can be considered as a new plant association which it is proposed to name *Lonicero periclymeni-Cytisetum maritimi* ass. nov. *hoc loco* (holotypus *hoc loco* rel. 9, Tab.4), in the alliance *Ulici maritimi-Cytisium maritimi*.

Phytosociological synoptic of the vegetation with *Cytisus scoparius* subsp. *maritimus*

ARMERIO MARITIMAE-FESTUCETEA PRUINOSAE Bioret & Géhu 2008

Crithmo maritimi-Armerietalia maritimae Géhu 1964

Crithmo maritimi-Armerion maritimae Géhu 1968

Sileno maritimae-Festucion pruinosa (Géhu & Géhu-Franck 1984) Bioret & Géhu 2008

Armerio maritimae-Festucetum pruinosa Géhu 2008

Cytisetosum maritimi (Géhu 1963) subass. nov. *hoc loco*

CALLUNO VULGARIS-ULICETEA MINORIS Braun-Blanquet & Tüxen ex Klika in Klika & Hadač 1944

Ulicetalia minoris Quantin 1935

Dactylido oceanicae-Ulicion maritimi Géhu 1975

Dactylido oceanicae-Cytisetum maritimi Géhu 1963 nom. corr. *hoc loco*.

CYTISETEA SCOPARIO-STRIATI Rivas-Martínez 1975

Cytisetalia scopario-striati Rivas-Martínez 1975

Ulici maritimi-Cytisium maritimi all. nov. *hoc loco*

Sileno maritimae-Cytisetum maritimi ass. nov. *hoc loco*

cytisetosum maritimi typicum

ulicetosum maritimi subass. nov. *hoc loco*

Lonicero periclymeni-Cytisetum maritimi ass. nov. *hoc loco*

Table 3a. *Sileno maritimae-Cytisetum maritimi* ass. nova hoc. loco

N° de relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Surface (m ²)	10	30	10	8	12	10	4	8	15	5	5	5	5	20	8	10	8
Recovery (%)	90	100	100	100	100	95	100	100	90	90	100	100	100	100	100	100	100
Height (cm)	5-20	50	40	50	40-90	20-40	20-40	20-50	15-40	20-30	30	80	40-80	50	40	50	5-110
Characteristic plants of association																	
<i>Cytisus scoparius</i> subsp. <i>Maritimus</i>	45	45	45	45	55	45	55	55	55	55	55	45	55	55	45	45	45
<i>Silene vulgaris</i> subsp. <i>maritima</i>	33	44	12	12	22	33	12	12	23	23	12	12	12	12	+	23	13
<i>Dactylis glomerata</i> s.l. (including subsp. <i>oceanica</i>)	12	12	23	12	22	33	+	12	23	23	+		23	+	23	12	12
<i>Armerio maritimae-Festucetea pruinosa</i>																	
<i>Pteridium aquilinum</i>	12				11			23				12		11		11	
<i>Armeria maritima</i>	+		+		+	+	+	+	+	11	+						
<i>Daucus carota</i> subsp. <i>gummifer</i>	+			+	+	12		+	12	+							
<i>Festuca huonii</i>	+					+						11	+				
<i>Umbilicus rupestris</i>	+								+			+			+		
<i>Sonchus oleraceus</i>	+																
<i>Euphorbia segetalis</i> subsp. <i>portlandica</i>		11															
<i>Agrostis stolonifera</i> subsp. <i>arenaria</i>		11															
<i>Rumex acetosa</i>	+		11			+										+	
<i>Leucanthemum</i> (cf.) <i>vulgare</i>	+			11	+									+	+	+	
<i>Rubus</i> sp. (cf. <i>ulmifolius</i>)	+			+													23
<i>Prunus spinosa</i>	+									+							
<i>Sedum anglicum</i>			+									13	+				+
<i>Raphanus raphanistrum</i> subsp. <i>Landra</i>			+													+	
<i>Aira praecox</i>			+														
<i>Cochlearia danica</i>			+														
<i>Teesdalia nudicaulis</i>			+														
<i>Hedera helix</i>				13	13							+				+	12
<i>Jasione montana</i>				+		+			+								
<i>Leontodon saxatilis</i>				+													
<i>Festuca rubra</i> subsp. <i>pruinosa</i>					+			+	+								
<i>Holcus lanatus</i>						12	11		12								
<i>Cuscuta epithymum</i> subsp. <i>epithymum</i>						+			+								
<i>Potentilla erecta</i>							+										
<i>Plantago lanceolata</i>								+		+							
<i>Thymus drucei</i>									+								
<i>Senecio sylvaticus</i>												11			r		
<i>Lonicera periclymenum</i>											+						
<i>Salix atrocinerea</i>											+						
Associated plants																	
<i>Teucrium scorodonia</i>												23	11			+	11
<i>Rubus</i> sp.												22					
<i>Rosa spinosissima</i>														11			
<i>Viola riviniana</i>																	
<i>Agrostis capillaris</i>												r					
<i>Hyacinthoides non-scripta</i>												+					
<i>Ruscus aculeatus</i>																	+

Localities: 1: 25/05/21, pointe au sud d'Illien, Ploumoguier ; 2: 15/04/21, Arlan Ledenez, Ouessant ; 3: 09/05/21, Fort des Capucins, Roscanvel ; 4: 08/06/21, cap de la Chevre, Crozon ; 5: 17/06/21, Kastel Koz, Beuzec Cap Sizun ; 6: 25/06/21, Kastel ar Roc'h, Goulien ; 7: 17/06/21, chapelle St They Point du Van, Cleden Cap Sizun ; 8: 25/06/21, Kastel ar Roc'h, Goulien ; 9: 25/06/21, entre le Vorlen et la pointe du Van, Cleden Cap Sizun ; 10: 30/07/21, Treuz rouz nord, Roscanvel ; 11: 30/07/21, Beg ar vir sud, Roscanvel ; 12: 05/05/21, ancienne batterie du Pourjoint, Roscanvel ; **13: 29/07/21, Est de la pointe du Guern (Treboul), Telgruc** ; 14: 29/09/20, cap de la Chevre, Crozon ; 15: 30/07/21, Beg ar vir, expo sud, Roscanvel ; 16: 06/05/21, Fort Robert, Roscanvel & 17: 02/06/21, Penhir sud, Camaret.

Table 3b. *Sileno maritimae-Cytisetum maritimi* ass. nova hoc. loco

N° de relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Surface (m ²)	3	8	6	15	20	35	10	9	6	7	20	15	5	20	7
Recovery (%)	100	100	100	100	100	100	100	100	100	100	95	100	90	100	100
Height (cm)	15-40	40-60	25-60	50	50	50	50	80-110	50	20-70	20-50	10-40	30-80	30-70	20-50
Characteristic plants of association															
<i>Cytisus scoparius</i> subsp. <i>Maritimus</i>	55	45	33	34	55	44	45	55	55	55	55	55	33	45	45
<i>Silene vulgaris</i> subsp. <i>maritima</i>	+	+	23	23		12	12	23	+	22	12	+	12	23	
<i>Dactylis glomerata</i> s.l. (including subsp. <i>oceanica</i>)	+	+	11	+	+	+	11	23	+	+	23	23	12	23	+
<i>ulicetosum maritimi</i>															
<i>Ulex europaeus</i> subsp. <i>europaeus</i> var. <i>maritimus</i>				33	12	23	+	12	11	11	12	12	33	45	23
<i>Erica cinerea</i>							+				+	+		+	+
Variation															
<i>Brachypodium rupestre</i> subsp. <i>rupestre</i>		22	45		12	22									
<i>Rubia peregrina</i>	22	22		22		11									
<i>Armerio maritimae-Festucetea pruinosa</i>															
<i>Festuca rubra</i> subsp. <i>pruinosa</i>	+		13									+			
<i>Euphorbia segetalis</i> subsp. <i>portlandica</i>	+		+												
<i>Armeria maritima</i>											+				+
<i>Daucus carota</i> subsp. <i>gummifer</i>									+	+	+		+	+	+
<i>Festuca huonii</i>										+	+				
<i>Scilla verna</i>															
Associated plants															
<i>Pteridium aquilinum</i>	+	+					12	11							
<i>Hedera helix</i>		11	22			11		13			23				33
<i>Lonicera periclymenum</i>		11													
<i>Rubus</i> sp.		+	+		12		12			+					+
<i>Prunus spinosa</i>		+		23											
<i>Hyacinthoides non-scripta</i>			11												
<i>Asphodelus macrocarpus</i> subsp. <i>arrondeauii</i>			12												
<i>Achillea millefolium</i>				+											
<i>Rumex acetosa</i>						+		+	+		12	11	+		
<i>Viola riviniana</i>						+									
<i>Agrostis capillaris</i>												+	+		
<i>Anthoxantum odoratum</i>											+				
<i>Holcus lanatus</i>											+				
<i>Jasione montana</i>															
<i>Leucanthemum</i> (cf.) <i>vulgare</i>								+							
<i>Potentilla erecta</i>															
<i>Rosa spinosissima</i>													11		
<i>Rubus</i> sp. (cf. <i>ulmifolius</i>)								+			+	+			
<i>Sedum anglicum</i>										+					
<i>Sonchus oleraceus</i>										+				+	
<i>Teucrium scorodonia</i>							12								
<i>Umbilicus rupestris</i>										+					+

Localities: 1: 11/05/21, pointe de Penquerno, Riec sur Belon ; 2: 11/05/21, pointe de Penquerno, Riec sur Belon ; 3 : 18/05/21, pointe de Cardinal, Sauzon ; 4 : 23/04/15, pointe de Grand Mont, St Gildas de Rhyus ; 5: 24/07/17, Dotchot, Bangor ; 6: 23/04/15, pointe de Grand Mont (presqu'île de Rhuys), St Gildas de Rhyus ; 7: 06/05/21, Est Fort Robert, Roscanvel ; 8: 17/06/21, Kastel Koz, Beuzec Cap Sizun ; 9: 15/07/21, pointe du Raz, Plogoff ; 10: 02/06/21, cap de la Chevre, est du semaphore, Crozon ; 11: 25/06/21, Vorlen, Cleden Cap Sizun ; 12-13: 25/06/21, **Kastel ar Roc'h, Goulien** ; 14: 17/06/21, Kastel Koz, Beuzec Cap Sizun & 15: 25/05/21, pointe au sud d'Illien, Ploumoguer.

Table 4. *Lonicero periclymeni-Cytisetum maritimi* ass. nov. hoc loco

N° relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Surface (m ²)	6	10	5	15	15	20	10	8	10	30	30	12	25	20	15	20
Recovery (%)	100	100	100	100	100	100	100	100	100	95	95	100	100	95	100	100
Height (cm)	5-60	60	50-100	60	60	40-80	30-50	100	20-45	50	120	160	150	15-50	60-120	60
<u>Characteristic plants of association</u>																
<i>Cytisus scoparius</i> subsp. <i>maritimus</i>	55	34	45	44	55	55	55	55	55	45	55	55	45	55	45	45
<i>Lonicera periclymenum</i>		33			+			12	23	+	23	12		11	+	13
<i>Pteridium aquilinum</i>		22	12		33				+		12	23	35	11	11	
<i>Hedera helix</i>				22		33	11	13			12	23	33		45	22
<i>Prunus spinosa</i>			12	23		22		12						+	45	23
<i>Dactylis glomerata</i> s.l. (including subsp. <i>oceanica</i>)	22		+			11	33	+	+	33				12		
<i>Rubus</i> sp. (cf. <i>ulmifolius</i>)	23			34	22	+	+		22	12			23			22
<i>Ulex europaeus</i> subsp. <i>europaeus</i> var. <i>maritimus</i>				+					+					12	+	
<i>Rubia peregrina</i>			23			+		12				+			11	22
<i>Teucrium scorodonia</i>						+	11			11	23	+	12			
<u>Armerio maritimae-Festucetea pruinosa</u>																
<i>Silene vulgaris</i> subsp. <i>maritima</i>											+				+	
<i>Daucus carota</i> subsp. <i>gummifer</i>	11														+	
<i>Armeria maritima</i>		12							+							
<i>Leucanthemum</i> (cf.) <i>vulgare</i>							11									
<i>Festuca rubra</i> subsp. <i>pruinosa</i>			+													
<i>Festuca huonii</i>											+					
<i>Agrostis stolonifera</i> subsp. <i>maritima</i>					+											
<u>Associated plants</u>																
<i>Raphanus raphanistrum</i> subsp. <i>landra</i>						11	+		11					12		
<i>Brachypodium rupestre</i>				+											+	11
<i>Sonchus oleraceus</i>			+	r												
<i>Rumex acetosa</i>								+				+	+			
<i>Anthoxanthum odoratum</i>									+						+	
<i>Umbilicus rupestris</i>	r									+						
<i>Sedum anglicum</i>										+	+					
<i>Jasione montana</i>									r					r		
<i>Plantago lanceolata</i>								+							+	
<i>Senecio sylvaticus</i>	+									+						
<i>Orobancha rapum-genistae</i>										+	+					
<i>Holcus lanatus</i>							22									
<i>Lagurus ovatus</i>	r															
<i>Solidago virgaurea</i>													+			
<i>Rosa</i> sp. (cf. <i>canina</i>)													+			

Localities: 1: 15/07/21, entre Bestree et la pointe du Raz, Plogoff; 2: 15/04/21, Kadoran Est, Ouessant; 3: 19/10/20, Lenac'h, Esquibien; 4: 23/04/2015, pointe de Grand Mont, St Gildas de Rhyus; 5: 17/04/21, Kadoran Est, Ouessant; 6: 02/06/21, cap de la Chevre, Est du semaphore, Crozon; 7: 02/06/21, cap de la Chevre, Est du semaphore, Crozon; 8: 19/10/20, Lenac'h, Esquibien; **9: 15/07/21, Bestree, Plogoff**; 10: 29/07/21, pointe du Guern (Treboul), Telgruc; 11: 29/07/21, pointe du Guern (Treboul), Telgruc; 12: 30/07/21, entre ancienne batterie et Beg ar Vir, Roscanvel; 13: 30/07/21, Beg ar vir, Nord, Roscanvel; 14: 15/07/21, Bestree, Plogoff; 15: 11/05/21, pointe de Penquerno, Riec sur Belon; 16: 23/04/2015, pointe de Grand Mont, St Gildas de Rhyus.

Synphytosociological approach of *Cytisus scoparius* subsp. *maritimus* communities

The aim of synphytosociology is the study of the relationships between associations, from the pioneer ones to the climatic one, within a homogeneous ecological envelop corresponding to a tessela (BIORET *ET AL.*, 2019). Phytosociology constitutes the association level, synphytosociology is the second level of landscape analysis. It spatially studies the sets of dynamically linked plant groups within series of vegetation (sigmetum or synassociation) (GÉHU, 1987; 1991). The vegetation series is the fundamental unit of synphytosociology (BIONDI, 2011; GÉHU, 2006). Vegetations whose dynamics are blocked by constraining ecological conditions, such as certain coastal vegetation, can be considered as permaseries (a single dynamic stage) or minoriseris (several dynamic stages blocked at the thicket stage) (LAZARE, 2009; DEMARTINI *ET AL.*, 2017). Synphytosociological relevés are presented in table 5. The physiognomy, structuring species, position on the cliff, soils and progressive dynamic of *Cytisus scoparius* subsp. *maritimus* communities, in Armorican coast, are synthesized in table 7.

- 1 / Edaphoxerophilic permaseris of the coastal ranksoils of the west Armorican maritime cliffs with *Festuca rubra* subsp. *pruinosa* and *Cytisus scoparius* subsp. *maritimus*: *Armerio maritimae-Festuco pruinosa cytisetosum maritimi* permasigmetum (*typus*: synrelevé 1, Tab. 5)

The halo-anemogenic grassland of *Armerio maritimae-Festucetum pruinosa cytisetosum maritimi* constitutes an edaphoxerophilic permaseris on ranksoils (sometimes with thin humus) of the West Armorican sea cliffs. It belongs of the *Armerio maritimae-Festuco pruinosa geopermasigmetum*⁸ characterized by the following associations: *Spergulario rupicola-Crithmetum maritimi* (Roux & Lahondère 1960) Géhu 1962 *nom. inv.*, *Armerio maritimae-Festucetum pruinosa* Géhu 2008, *Sedo anglici-Festucetum huonii* Bioret, Géhu & Demartini 2014, *Dactylido oceanicae-Sedetum anglici* Géhu, Géhu-Franck & Caron 1978 *corr.* Géhu 2008 and the communities of *Saginion maritimae* Westhoff, C. Leeuwen & Adriani 1962.

- 2 / Edaphoxerophilic permaseris of the thin ranksoils of the north and west Armorican maritime cliffs with *Dactylis glomerata* subsp. *oceanica* and *Cytisus scoparius* subsp. *maritimus*: *Dactylido oceanicae-Cytiso maritimi* permasigmetum (Demartini, 2016).

Heathland with *Dactylis glomerata s.l.* and *Cytisus scoparius* subsp. *maritimus* constitutes an edaphoxerophilic permaseris of the north and west *Armorican maritime* cliffs, present on eroded ranksoils, preferentially at the top of the coastal cliffs, from the break in the slope of the cliff to the first meters of the plateau. The presence of maritime broom may have been facilitated by past human use or natural erosion. It can establish itself permanently in a coastal heathland, for example *Ulici maritimi-Ericetum cinerea*. It could then be considered as a “derived permaseris”. This heathland is observed in mosaic with

grasslands permaseris, in particular of *Armerio maritimae-Festucetum pruinosa*. A *Festuca huonii* grassland may be present in the gaps in the thicket cover. Permaseris associated on outcropping rocks complete the geopermaseris, characterized by *Dactylido oceanicae-Sedetum anglici* or *Saginion maritimae* plant communities.

- 3 / Edaphoxerophilic minoriseris of eroded ranksoils or lithosoils of the west and south Armorican maritime cliffs with *Silene vulgaris* subsp. *maritima* and *Cytisus scoparius* subsp. *maritimus*: *Sileno maritimae-Cytiso maritimi minorisigmetum* (*typus*: relevé 15, Tab.5)

The anemorphic thicket of *Sileno maritimae-Cytisetum maritimi* constitutes the mature vegetation of an edaphoxerophilic minoriseris on thin ranksoils or lithosoils, eroded, with arenas, of the west and south Armorican maritime cliffs. It is associated with a grassland/edge with *Dactylis glomerata s.l.*, *Teucrium scorodonia* and *Silene vulgaris* subsp. *maritima* (Figure 5), which may have a primary or secondary character, by degradation following modification of the substrate by erosion or modification caused by zoogenic disturbances (rabbit warrens, seabird colonies). This original vegetation, *Sileno maritimae-Dactylidetum glomeratae ass. nov. hoc loco* (*holotypus* rel. 7, Tab.6) (including in *Conopodium majoris-Teucrium scorodoniae* Julve ex Boulet & Rameau in Bardat *et al.* 2004) occurs on small surfaces, especially on rocky outcrops, but sometimes covers larger areas on eroded and exposed cliff faces, also on sandy, eroded, silty soils with an alteration of the bedrock. Soil erosion is due to the slope, the nature of the soil, exposure to winds, or the long-standing presence of vertebrate populations. The abundance of *Dactylis glomerata s.l.* varies with the grazing pressure of the rabbits. The vegetation cover is often open. Synrelevés are presented in Table 6, with a dynamic diagram in Figure 6. This vegetation can be observed in contact with coastal scrubs with maritime gorses.

- 4 / Edaphoxerophilic series of the deep ranksoils of the Armorican maritime cliffs with *Lonicera periclymenum* and *Cytisus scoparius* subsp. *maritimus*

This maritime broom thicket, rich in preforest species, is part of an edaphoxerophilic minoriseris, on ranksoils on Armorican maritime cliffs. This vegetation seems to develop in two different contexts. The first context is a secondary dynamic due past uses or disturbances that still need to be studied, throughout an approach in historical ecology of maritime cliffs. The second context is induced by a sheltered mode, with accumulation of soils, allowing the development of the *Rhamno catharticae-Prunetea spinosa* species, with a possible evolution towards *Ulici maritimi-Prunetea spinosa* scrubs. The associated edge-vegetation corresponds to a *Pteridium aquilinum* and *Hedera helix* community.

For this last context, we lack perspective on the

8→ A geopermaserie (geopermasigmetum) groups vegetation belonging to several series into an homogeneous geomorphological unit, called catena (Rivas-Martínez, 2005).

Table 5. Synrelevés of *Cytisus scoparius* subsp. *maritimus* associations

Series	<i>Armerio maritima</i> - <i>Festuco pruinosa</i> - <i>permasigmetum</i>			<i>Dactylo oceanica</i> - <i>Cytiso maritimi</i> - <i>permasigmetum</i>				<i>Sileno maritima</i> - <i>Cytiso maritimi</i> - <i>minorisigmetum</i>								<i>Lonicero peryclimeni</i> - <i>Cytiso maritimi</i> - <i>minorisigmetum</i>										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21					
N° synrelevé	500	500	200	40	30	100	80	100	200	200	50	150	100	80	300	150	50	200	300	150	300					
Surface (m²)	100	85	100	100	100	95	80	70	90	100	80	80	90	80	60	100	80	80	90	100	60					
Recovery of phanerogamic vegetation (%)	N	W	S	W	W	SW	W	SW	SW	SW	S	W	SW	W	S	S	S	W	SW	SW	S					
Exposition	18/05/21	15/07/21	15/07/21	01/04/21	17/06/21	15/07/21	15/07/21	29/09/20	19/10/20	01/04/21	08/06/21	17/06/21	25/06/21	15/07/21	15/07/21	11/05/21	11/05/21	19/10/20	29/09/20	02/06/21	15/07/21					
Date	Pointe de Cardinal	Pointe du Van	Pointe du Raz sud	Brezellec	Kastell Koz	Pointe du Raz	Pointe du Van	Cap de la Chèvre	Cap de la Chèvre	Porzan	Cap de la Chèvre	Kastell Koz	Entre le Vorlen et St They	Pointe du Van	Beg er vir sud	Pointe de Penquerno	Pointe de Penquerno	Lenac'h	Cap de la Chèvre	Pen hir	Beg er vir nord					
Localization	Sauzon	Clédén Cap Sizun	Plogoff	Clédén Cap Sizun	Beuzec Cap Sizun	Plogoff	Clédén Cap Sizun	Crozon	Crozon	Plogoff	Crozon	Beuzec Cap Sizun	Clédén Cap Sizun	Clédén Cap Sizun	Roscanvel	Riec-sur-Belton	Riec-sur-Belton	Esquibien	Crozon	Camaret	Roscanvel					
City																										
Halo-chasmophilic vegetation																										
<i>Spergulario rupicola</i> - <i>Critometum maritimi</i> (associated permaseries)	/+																									
<i>Armerio maritima</i> - <i>Cochlearietum officinalis</i> (associated permaseries)		-																								
Halo-anemogenic grassland vegetation																										
<i>Armerio maritima</i> - <i>Festucetum pruinosa</i> <i>typicum</i>	O1	O2	o1	V													O1	I								
<i>Armerio maritima</i> - <i>Festucetum pruinosa</i> (secondary succession ?)								O1																		
<i>Armerio maritima</i> - <i>Festucetum pruinosa</i> <i>cytisetosum maritimi</i>	O4	O2	O5	V																						
<i>Festucetum huonii</i> (associated permaseries)				/1 O1				III			/o1	+					V									
Vegetations of coastal cliffs and rocky outcrops																										
<i>Dactylo marina</i> - <i>Cytisetum maritima</i>				O5	04	O4	O5	V																		
<i>Sileno maritima</i> - <i>Cytisetum maritimi</i> <i>typicum</i>								O2	oO4	O3	O3	oO4	O5	O5	O4	O2	V									
<i>Sileno maritima</i> - <i>Cytisetum maritimi</i> <i>ulicetosum maritimi</i>								o02 o1								II										
<i>Dactylo oceanica</i> - <i>Sedetum anglici</i> (associated permaseries)	o+	.1								/+								.+								
<i>Thero-Airion</i> (associated permaseries)								.1								.1										
<i>Saginton maritima</i> (associated permaseries)	.r	/-								.1								.1								
<i>Sedo anglici</i> - <i>Festucetum huonii</i> (associated permaseries)								.+								.+										
Lonicero peryclimeni - <i>Cytisetum maritimi</i>																										
<i>Lonicero peryclimeni</i> - <i>Cytisetum maritimi</i>																O5	oO2	O3	O4	oO2	V					
Vegetations of thicket-edge and thicket/scrub																										
Edge vegetation with <i>Brachypodium rupestre</i> subsp. <i>rupestre</i> and <i>Silene vulgaris</i> subsp. <i>maritima</i>																O3										
<i>Ulici maritimi</i> - <i>Prunetum spinosae</i>																O4										
<i>Sileno maritima</i> - <i>Dactylidetum glomeratae</i>								O4	/O2				O1					O02	III							
Group with <i>Pteridium aquilinum</i> and <i>Hedera helix</i>								oO1																		
Group with <i>Ruscus aculeatus</i> (pioneer form)																.+										
Scrub with <i>Pyrus cordata</i>																o1										

Table 6. *Sileno maritimae-Dactylidetum glomeratae* ass. nov. hoc loco

N° relevé	1	2	3	4	5	6	7	8	9	10	11	12	13
Surface (m ²)	10	15	4	10	5	8	5	4	10	5	5	5	10
Recovery (%)	100	70	95	90	60	80	60	70	70	90	95	80	100
Height (cm)	30	30	35	30	35	30	10	30	25	50	50	20-60	30
Characteristic plant of association													
<i>Silene vulgaris</i> subsp. <i>maritima</i>	4	+	3	3	2	4	3	2	3	4	4	2	4
<i>Dactylis glomerata</i> s.l.	2	4	4	5	3	3	3	4	3	3	2	4	2
<i>Teucrium scorodonia</i>	1				2	1	1		+		1		1
Coastal thickets transgressive plants													
<i>Ulex europaeus</i> subsp. <i>europaeus</i> var. <i>maritimus</i>			+	+		1	+						
<i>Cytisus scoparius</i> subsp. <i>maritimus</i>	1	+						+					+
Transgressive halo-anemogenic grassland plants													
<i>Daucus carota</i> subsp. <i>Gummifer</i>		+		+		1	+		+			+	
<i>Festuca rubra</i> subsp. <i>pruinosa</i>			+	1							1		
<i>Armeria maritima</i>		+				1			1	+			
<i>Rumex acetosa</i>	1										+	+	1
<i>Leucanthemum</i> (cf.) <i>vulgare</i>		+									+	1	
<i>Festuca huonii</i>									+				
Pioneer grasslands plants													
<i>Umbilicus rupestris</i>	+		+										+
<i>Plantago coronopus</i>		+			+				+				
<i>Sedum anglicum</i>		+	+		+		+						
<i>Jasione montana</i>		+	+		+	+						+	
<i>Coachelaria danica</i>	+												+
<i>Polypodium interjectum</i>			+										
Associated plants													
<i>Plantago lanceolata</i>				+			1			+			
<i>Rubus</i> sp.	+			1		+							+
<i>Gnaphalium uliginosum</i>		+											+
<i>Hedera helix</i>											+		+
<i>Quercus robur</i> (j)	+												+
<i>Raphanus raphanistrum</i> subsp. <i>landra</i>		1											
<i>Hyacinthoides non-scripta</i>			+										
<i>Lotus corniculatus</i>				1									
<i>Pyrus cordata</i> (j)				+									
<i>Lonicera periclymenum</i>							1						
<i>Pteridium aquilinum</i>									2				
<i>Galium aparine</i>											+		
<i>Solanum dulcamara</i>												1	
<i>Ceratocarpus claviculata</i>													+

Localities: 1: 04/05/21, Fort Kerviniou, Roscanvel ; 2: 29/07/21, Beg er vir, Roscanvel ; 3: 11/08/21, Ile Goret, Carantec ; 4: 11/08/21, Ile Goret, Carantec ; 5: 19/08/21, Beg ar Vechen, Plonevez Porzay ; 6: 27/08/20, pointe du Grouin, Cancale ; 7: 27/08/20, pointe du Grouin, Cancale ; 8: 29/08/21, Trez rouz, Roscanvel ; 9: 29/09/20, cap de la Chevre, Crozon ; 10: 19/10/21, Porz loubous, Plogoff ; 11: 18/11/21, pointe de Kermor, Plouezec ; 12: 17/06/21, Kastel Koz, Beuzec Cap Sizun ; 13: 04/05/21, Est Fort Bernard, Roscanvel.



Figure 5: Grassland/edge vegetation with *Dactylis glomerata* s.l. et *Silene vulgaris* subsp. *maritima* (Roscanvel F-29)

evolution of these neo-thickets linked to the abandonment, for several decades, and about the agro-pastoral use of maritime cliffs.

Conservatory management

The maritime broom thickets are either perma-series or mature stage of minoriseriers. They do not seem to evolve into other progressive dynamic stages. However, dynamic trajectories of *Lonicero*

periclymeni-Cytisetum maritimi remains to be studied. The general stability of *Cytisus scoparius* subsp. *maritimus* communities leads to recommend not intervening by mowing or grazing for their maintenance. However, recent changes in landscapes and agro-pastoral decline confirm the resilience capacity of these vegetation. The inaccessibility of certain communities, on very steep cliffs, naturally ensures their conservation.

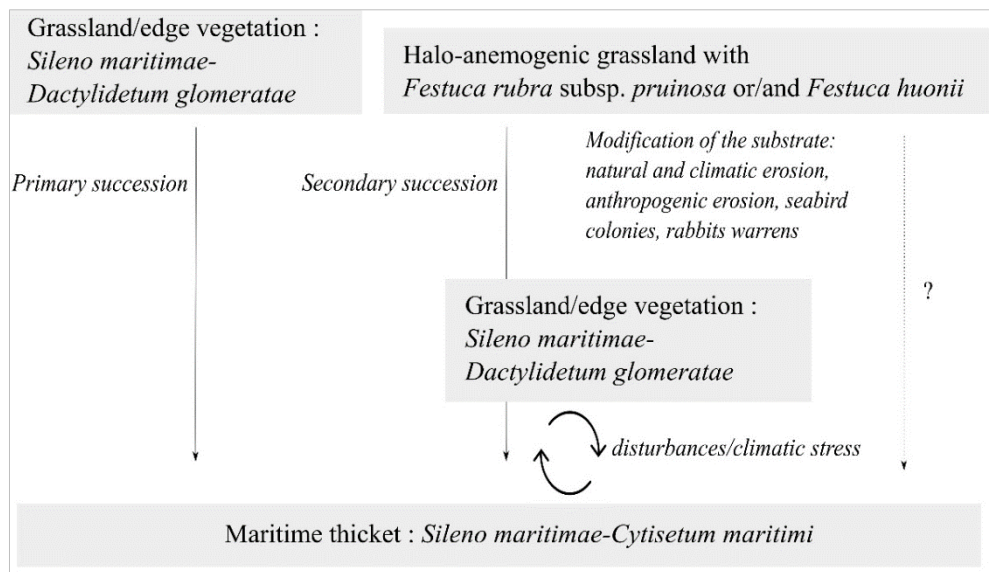


Figure 6. Dynamic diagram of *Sileno maritimae-Cytisum maritimi minorisigmetum*

On frequented sites, *Cytisus scoparius* subsp. *maritimus* vegetations can be subject to erosion due to trampling. In this case, the protection of vegetation, by controlling frequenting, should be encouraged.

Due to the possible genetic introgression between the two subspecies *Cytisus scoparius* subsp. *scoparius* and subsp. *maritimus*, it could be considered to limit, in certain sectors managed for conservation, the development of secondary thicket of common broom, behind the headlands of the maritime cliffs. We recommend, as KAY ET JOHN (1995), that neither common broom or its cultivars should be planted or introduced to the neighbourhood of existing colonies of maritime broom.

The establishment of long-term survey of this vegetation would aim to assess and monitor the state of conservation of the taxon and the communities it characterizes, but also to help to measure the evolution of landscapes and the consequences of changes in practices on vegetation of maritime cliffs.

Conclusion

Cytisus scoparius subsp. *maritimus* is a rare taxon at the European scale and the vegetation it characterizes is confined to the rocky headlands exposed to wind and salt spray. This gives to *Cytisus scoparius* subsp. *maritimus* and his plant communities a strong heritage value.

The ecotypes have developed particular characters, genetically fixed, by natural selection which is imposed by one or more ecological factors. Coastal ecotypes, such as the maritime broom, have great value in understanding the ecological properties of coastal habitats and vegetation in which they develop. For this reason, they are indicator micro taxa, useful for describing the ecological and physiognomic characteristics of phytosociological associations (BIORET ET GÉHU, 1999).

The study of heathlands and thickets with mari-

time brooms, by comparing the writings of the beginning of the second half of the twentieth century and the surveys carried out within the framework of this study, contributes to the understanding of their typology and evolution. It also makes the link between vegetations, changes in societal and agro-pastoral activities and their influences on the landscapes of the Atlantic sea cliffs.

Ulici maritimi-Cytisum maritimi, a new alliance of *Cytisetalia scopario-striati*, gathers the Channel and Atlantic coastal thickets. Two new plant associations belonging to this new alliance are described: *Sileno maritimae-Cytisetum maritimi*, very exposed to winds and salt spray on thin and eroded soils; *Lonicero perichlymeni-Cytisetum maritimi* on deeper ranksoils, moderately exposed to maritime conditions or in secondary conditions related to human activities. In the Iberian Peninsula, vegetations with *Cytisus insularis*, endemic species of the islands of Provincia de Pontevedra and A Coruña in Galicia (ORTIZ ET AL., 2001), are characterized in particular by halo-anemogenic species such as *Crithmum maritimum*, *Armeria pubigera*, *Angelica pachycarpa*, *Silene vulgaris* subsp. *maritima*, *Leucanthemum merinoi* (ORTIZ ET AL., 2004; ROMERO BUJÁN, 2005). They could be integrated in the *Ulici maritimi-Cytisum maritimi*.

The phytosociological method, by carrying out new surveys in communities described more than fifty years ago, is useful to understand the changes in the *itimum*, *Armeria pubigera*, *Angelica pachycarpa*, *Silene vulgaris* subsp. *maritima*, *Leucanthemum merinoi* (ORTIZ ET AL., 2004; ROMERO BUJÁN, 2005). They could be integrated in the *Ulici maritimi-Cytisum maritimi*.

The phytosociological method, by carrying out floristic structure of vegetation, for example the aging and densification of coastal heathlands or the appearance and development of maritime thickets.

The abandonment of agro-pastoral activity (gra-

Table 7. Physiognomy, structuring species, position on the cliff, soils and progressive dynamic of *Cytisus scoparius* subsp. *maritimus* communities in Armorican coast

Association	Physiognomy	Structuring species	Position on the cliff	Soils	Progressive dynamic	Type of series
<i>Armerio maritimae</i> – <i>Festucetum pruinosae</i> – <i>Cytisetum maritimi</i>	Grassland	<i>Cytisus scoparius</i> subsp. <i>maritimus</i> , <i>Festuca rubra</i> subsp. <i>pruinosa</i> , <i>Armeria maritima</i>	Bottom of the cliff on slopes, crest of the most exposed cliffs	Rankosoils	blocked	permaseries
<i>Dactylido oceanicae</i> – <i>Cytisetum maritimi</i>	Prostrate heathland	<i>Cytisus scoparius</i> subsp. <i>maritimus</i> , <i>Erica cinerea</i> , <i>Calluna vulgaris</i> , <i>Festuca huonii</i>	Plateau, low slope of the cliff tops	Thin rankosoils	blocked	permaseries
<i>Sileno maritimae</i> – <i>Cytisetum maritimi</i>	Prostrate thicket	<i>Cytisus scoparius</i> subsp. <i>maritimus</i> , <i>Dactylis glomerata</i> s.l., <i>Silene vulgaris</i> subsp. <i>maritima</i>	Eroded steep slope, crest of cliffs	Silty, eroded, sandy, shallow soils / lithosoils ou thin rankosoils	blocked	mature stage of minoriseries
<i>Lonicero periclymeni</i> – <i>Cytisetum maritimi</i>	Prostrate to semi-erect thicket	<i>Cytisus scoparius</i> subsp. <i>maritimus</i> , <i>Pteridium aquilinum</i> , <i>Rubus ulmifolius</i>	Plateau, rocky ledge with accumulation of soil	Silty, eroded, sandy, shallow soils / rankosoils	blocked or evolution to <i>Prunus spinosa</i> shrubs	mature stage of minoriseries / stage of minoriseries ?

zing) and the absence of firewood harvesting are favorable changes that allowed the development of maritime broom thickets on the top of the cliffs.

The example of the study of *Cytisetea scopariostricati* on maritime cliffs confirms the interest of updating the phytosociological descriptions and sharing them with a landscape approach. Synphytosociology is useful to understand the plant dynamics linked to abiotic ecological conditions but also to integrate past and current uses. It is essential to consider changes in landscapes and changes in vegetation in the decision-making process dealing with conservation actions or the choose between active or passive management.

More studies on *Cytisus scoparius* subsp. *maritimus* can also reveal the age and vitality of communities, as written by PEARMAN (2017), analyzing individuals as seedlings, young mature plants, old mature plants and senescent plants of *Cytisus scoparius* subsp. *maritimus* can be useful for monitoring and managing coastal vegetation but also for analyzing the reactivity of plants to climate changes (on droughts or heavy rain).

The phytosociological work has to be continued in different directions:

- a) realizing new relevés of *Lonicero periclymeni-Cytisetum maritimi*;
- b) monitoring the dynamic evolution of *Sileno maritimae-Cytisetum maritimi* considered blocked under restrictive ecological conditions;
- c) studying the broom grassland/edge vegetations, which seem to be common to several coastal minoriseries.

We encourage field investigations and study of the maritime broom and broom coastal thickets in the British Isles and in the north-west of the Iberian Peninsula.

References

Allorge P., 1922 - Les associations végétales du Vexin français, Nemours, Lesot, Faculté des sciences de Paris, Thèse, faculté des sciences de Paris. 335 p.

Antoine A., 2001 - La fabrication de l'inculte. Landes et friches en Bretagne avant la modernisation agricole du XIX^e siècle. *Mémoire de la société d'histoire et d'archéologie de Bretagne*, 79: 205-228.

Auvray, G., Malécot, V., 2011 - Revised lectotypification of *Spartium scoparium* L. (Fabaceae). *Taxon* 60 : 1480–1481.

Auvray, G., Malécot, V., 2013 - A revision of *Cytisus* sections *Alburnoides*, *Spartopsis* and *Verzinum* (Genisteae, Fabaceae). *Edinburgh Journal of Botany*, 70(1): 61–120.

Biondi E., 2011 - Phytosociology today: methodological and conceptual evolution. *Plant Biosystems*, 145: 19-29.

Bioret F., 1989 - Contribution à l'étude de la flore et de la végétation de quelques îles et archipels ouest et sud armoricains. Thèse de doctorat: Université de Nantes. 480 pp.

Bioret F., 1994 - Essai de synthèse de l'intérêt du patrimoine phytocoenotique des îles bretonnes. *Colloq. Phytosoc.*, XXII: 125-144.

Bioret F., Boulet V., Choynet G., Roux C., Thébaud G., Panaïotis C., Chalumeau A., Delbosc P., Demartini C., Gauberville C., Cianfaglione K., Bensedetti F. & Lallanne A., 2019 - Landscape phytosociology concepts and definitions applied to serial and catenal vegetation mapping. *Contributii Botanice*, LIV: 47-53.

Bioret F., Géhu J.-M., 1999 - Les microtaxons, enjeu majeur de la typologie phytocoenotique et de la conservation du patrimoine végétal du littoral atlantique français. *Bulletin de la Société Botanique du Centre-Ouest*, N.S. n° sp. 19 «Plantes menacées de France»: 171-188.

Böcher, T. W. & Larsen, K., 1955 - Chromosome studies on some European Flowering Plants. *Botanisk Tidsskrift*, 52: 125-131.

Bridgewater P., 1980 - Phytosociological studies in the British heath formation; I-Heaths of the *Ulicetalia minoris* (P. Duvign. 1944) J.M. Géhu 1973. *Phytocoenologia*, 8 (2): 191-235.

Clément B., 2003 - Landes et pelouses, 40 ans de connaissances et de conservation du patrimoine naturel en Bretagne. *Ecobio-Rennes* 1. 9 p.

Clément B., 1981 - Compte rendu de la session de l'Amicale internationale de phytosociologie en Bretagne du 22 au 29 juillet 1979. *Doc. Phytosoc.*, NS, V: 467-501.

Clout H., 1979 . Land use change in Finistère during the Eighteenth and Nineteenth Centuries. *Études rurales*, 7: 69-96.

- Colasse V., 2011 – Typologie des habitats du site Natura 2000 «Récifs et landes de la Hague». Feder/DREAL Basse Normandie. Conservatoire botanique national de Brest. 32 p.
- Coombe D. E., Frost L. C., 1956 - The Heaths of the Cornish Serpentine. *The Journal of Ecology*, 44(1): 226-256.
- Coulot P., Rabaute P., 2016 - Monographie des *Leguminosae* de France, tome 4 : Tribus des *Fabeae*, des *Cicereae* et des *Genisteae*. *Bull. Soc. Bot. Centre-Ouest*, NS, n° sp. 46 : 1-903.
- Davies W.J., Gill K., Halliday G., 1978 - The influence of wind on the behavior of stomata of photosynthetic stems of *Cytisus scoparius* (L.). *Link. Ann Bot* 42: 1149-1154.
- Demartini C., 2016. Les végétations des côtes Manche-Atlantique françaises : essai de typologie et de cartographie dynamique-caténales. Thèse doctorat: Université de Bretagne Occidentale – Brest. 675 p.
- Demartini C., Bioret F., Lazare J.-J., 2017 – Typologie et cartographie des géopermaséries et des géocurtaséries des végétations littorales des côtes Manche-Atlantique françaises. *Doc. Phytosoc.* Série 3, 6: 316-332.
- Doaré J.-J., 2012 - Plouhinec autrefois. Tranches de vie d'une commune du Finistère. Tome 1. 376 p.
- Dupont P., 2015 - Les plantes vasculaires atlantiques, les pyrénéo-cantabriques et les éléments floristiques voisins dans la péninsule ibérique et en France. *Bull. Soc. Bot. Centre-Ouest*, NS 45. 494 p.
- Earl D. P., Rich T. C. G., 2001 - Prostrate broom (*Cytisus scoparius* subsp. *maritimus*) at Tubby's Head, St Agnes, Cornwall (v.c. 1). *Bot. Corn.*, 10: 18–20.
- Fagúndez J., 2013- Heathlands confronting global change: drivers of biodiversity loss from past to future scenarios. *Ann. Bot., London*, 111(2): 151–172.
- Flahault C., Schröter C., 1910 - Nomenklatur. Berichte und Vorschläge. 3 Congr. Inter. Bot. Albert de Boeck. Bruxelles-Zürich: 1-28.
- French C., 2009 - Check-list of the Flowering Plants and Ferns of the Isles of Scilly. Botanical Society of the British Isles. 92 p.
- Foucault B. (de), 1995 - Contribution à une monographie phytosociologique de la Hague (Manche, France). *Bull. Soc. Bot. N. France*, 48 (4): 45-90.
- Foucault B. (de), Lazare J.-J., Bioret F., 2013 - Contribution au prodrome des végétations de France : les *Cytisea scopario-striati* Rivas-Mart. 1975. *J. Bot. Soc. Bot. France*, 64: 69-90.
- Gargominy, O., Tercerie, S., Régner, C., Ramage, T., Dupont, P., Daszkiewicz, P., Poncet, L., 2021 - TAXREF v15, référentiel taxonomique pour la France : méthodologie, mise en œuvre et diffusion. Muséum national d'Histoire naturelle, Paris. Rapport UMS PatriNat (OFB-CNRS-MNHN). 63 p.
- Géhu J.-M., 1963 - *Sarothamnus scoparius* ssp. *maritimus* dans le Nord-Ouest français. Observations morphologiques, phytogéographiques et écologiques. *Bull. Soc. Bot. N. France*, 16 (4): 211-222.
- Géhu J.-M., 1975 - Essai pour un système de classification phytosociologique des landes atlantiques françaises. *Colloq. Phytosoc.*, II: 361-378.
- Géhu J.-M., 1987 - Des complexes de groupements végétaux à la phytosociologie paysagère contemporaine. *Inf. Bot. Ital.* 18 (1-2-3): 53-83.
- Géhu J.-M., 1991 - L'analyse symphytosociologique et géosymphytosociologique de l'espace. Théorie et méthodologie. *Colloq. Phytosoc.*, XVII: 11-45.
- Géhu J.-M., 2000 - Observations phytosociologiques préliminaires sur le littoral occidental de l'île de Jersey (anglonormande). *Colloq. Phytosoc.*, XXVII: 169-196.
- Géhu J.-M., 2006 - Dictionnaire de sociologie et synécologie végétales. Éd. J. Cramer, Berlin, Stuttgart. 899 p.
- Géhu J.-M., Géhu-Franck J., 1975 - Apport à la connaissance phytosociologique des landes littorales de Bretagne », *Colloq. Phytosoc.*, II: 193-212.
- Géhu J.-M., Rivas-Martínez S., 1981 - Notions fondamentales de Phytosociologie. Ber. Intern. Symp., Syntaxonomie: 1-33.
- Gestin F., Quéré A., Simon J.F., Touzeau P., 1982 - Ouessant. Structures du parcellaire et évolution de la société insulaire. Société d'ethnologie bretonne. 206 p.
- Gill J. J. B., Walker S., 1971 - Studies on *Cytisus scoparius* (L.) Link with particular reference to the prostrate forms. *Watsonia*, 8: 345-356.
- Gloaguen J.-C., 1988 - Étude phytosociologique des landes bretonnes (France). *Lejeunia*, 124: 1-47.
- Glemarec E., Delassus L., Goret M., Guitton H., Hardegen M., Juhel C., Lacroix P., Lieurade A., Magnanon S., Reimringer K., Thomassin G., Zambettakis C., 2015 - Les landes du Massif armoricain. Approche phytosociologique et conservatoire. Brest: Conservatoire botanique national de Brest. 277 p.
- Glemarec E., Bioret F., 2021 - Historical ecology of the Armorican sea cliffs: methodological approach to the origins and the dynamics of coastal heathlands. Poster. *Historical Ecology for the Future, International conference*, Metz, France, 24-28 May 2021.
- Guignard G., 1985 – *Dactylis glomerata* ssp. *oceanica*, taxon nouveau du littoral atlantique. *Bull. Soc. Bot. Fr.*, 132. Lettres bot. (4/5): 341-346.
- Guignard G., Huon A., 1983 - Variations phenotypiques et échanges géniques chez *Dactylis glomerata* L. (Poacées) tetraploïde du massif Armoricain. *Bulletin Soc. Sc. Bretagne* 55, 1-4: 35-46.
- Godeau M., 1985 - Contribution à la connaissance du microendémisme de la flore du Massif armoricain: recherches sur la valeur systématique de quelques taxons. Thèse de doctorat: Université de Nantes. 368 pp.
- Guinochet M., 1973 - Phytosociologie. Collection d'Écologie I. Masson Ed. Paris, 227 p.
- Hardegen M., Bioret F., 2000 - Contribution à l'étude phytosociologique des landes littorales du Finistère (Bretagne, France): le cap de la Chèvre (presqu'île de Crozon) et l'île d'Ouessant ». *Colloq. Phytosoc.*, XXVII: 155-167.
- Kay, Q.O.N. & John, R.F., 1995 - The Conservation of Scarce and Declining Species in Lowland Wales: Population Genetics, Demographic Ecology and Recommendations for Future Conservation in 32 Species of Lowland Grassland and Related Habitats. CCW Science Report No. 110, CCW, Bangor. 154 p.
- Lahondère C., Bioret F., 1997 - Quelques aspects de la végétation littorale du Morbihan continental. *Bull. Soc. Bot. Centre-Ouest*, NS, 28: 351-376.
- Lazare J.-J., 2009 - Phytosociologie dynamique-caténales et gestion de la biodiversité. *Acta Botanica Gallica*, 156(1): 49–61
- Marguerie D., Hunot J.-Y., 2007 - Charcoal analysis and dendrology: data from archaeological sites in north-western France. *Journal of Archaeological Science*, Elsevier, 34 (9):1417-1433.
- Ortiz S., Pilgar I., Iglesias I., 2001 - A new species of *Cytisus* Desf. (Fabaceae) from islands off the west coast of Galicia (north-west Iberian Peninsula). *Botanical Journal of the Linnean Society*, Volume 136, Issue 3: 339–344.

- Ortiz S., Pilgar I., Iglesias I., 2004 – *Cytisus insularis* in Bañares Á., Blanca G., Güemes J., Moreno J.C., Ortiz S., eds. Atlas y Libro Rojo de la Flora Vasca Amenazada de España. Dirección General de Conservación de la Naturaleza. Madrid 666-667.
- Pearman, D. A., 2017 - The population dynamics of rare annual plants on the Lizard Peninsula, Cornwall, UK, 2009–2016. *New Journal of Botany*, 7(1): 11–24.
- Preston C.D., Pearman D.A., Dines T.D., 2002 - New atlas of the British & Irish flora: An atlas of the vascular plants of Britain, Ireland, the Isle of Man and the Channel Islands. Oxford University Press. 912 p.
- Rivas-Martínez S., 2005. - Notions on dynamic-catenal phytosociology as a basis of landscape science. *Plant Biosystems*, 139(2): 135–144.
- Rodwell (editor) J.S. et al., 1991 - British plant communities Vol.2, Mires and heaths. U.K. Joint Nature Conservation Committee. Cambridge University Press. 628 p.
- Romero Buján M.I., 2005 - Flora endémica amenazada del litoral de Galicia: una visión actual. *Recursos Rurais*, (ser. Cursos) 2: 1-10.
- Rouy G., Foucaud J., 1897 - Flore de France ou Description des Plantes qui croissent spontanément en France, En Corse et en Alsace-Lorraine. Tome 4. 313 p.
- Sée H., 1926 – Landes, biens communaux et défrichements en Haute Bretagne dans la première moitié du XIX^e siècle. *Mémoire de la Société d'histoire et d'archéologie de Bretagne*, Vol.7: 179-205.
- Stace C. A., 2010 - New Flora of the British Isles. 1266 p.
- Theurillat J.-P., Willner W., Fernández-González F., Bültmann, H., Carni, A., Gigante D., Mucina L., Weber H., 2020 - International Code of Phytosociological Nomenclature. 4th edition. *Applied Vegetation Science*, 24(2). 62 p.
- Tison J.-M., de Foucault B. (coord.), 2014 - Flora Gallica-Flore de France, Ed. Biotope (Mèze), 1196 p.
- van der Maarel E., 1979 - Transformation of cover-abundance values in phytosociology and its effects on community similarity. *Vegetatio*, 39: 97-114.
- Vigo J., 2008 – Quelques considérations sur la Phytosociologie. *Bull. Soc. Bot. Centre-Ouest*, 39: 334-336.