

SOME NOTES ON *VACCINIUM ULIGINOSUM* L. SUBSP. *GAULTHERIOIDES* (BIGELOW) S.B. YOUNG, A NEW TAXON TO THE FLORA OF PORTUGAL

Jan Jansen¹, Hans C.M. den Nijs² & Jorge A.R. Paiva³

¹ University of Nijmegen, Department of Ecology, Section Experimental Plant Ecology, P.O. Box 9010, NL-6500 GL Nijmegen.

² University of Amsterdam, Institute for Systematics & Ecology, Kruislaan 318, NL-1098 SM Amsterdam.

³ Universidade de Coimbra, Museu, Laboratório e Jardim Botânico, Arcos do Jardim, P.O. Box 3011, P-3001-401 Coimbra

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A few specimens of *Vaccinium uliginosum* L. subsp. *gaultherioides* (Bigelow) Young were discovered in the Central Plateau of the Serra da Estrela. Taxonomic status of this new taxon to the flora of Portugal, as well as its ecology, origin and conservation are discussed.

Key words: *Vaccinium uliginosum* subsp. *gaultherioides*, taxonomy, ecology.

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Alguns exemplares de *Vaccinium uliginosum* L. subsp. *gaultherioides* (Bigelow) Young foram descobertos no Planalto Central da Serra da Estrela. O estatuto deste novo taxon da flora de Portugal, bem como a sua ecologia, origem e conservação, são discutidos.

Palavras chave: *Vaccinium uliginosum* subsp. *gaultherioides*, taxonomia, ecologia

INTRODUCTION

During phytosociological fieldwork on heathland and dwarf-juniper scrub in the Serra da Estrela (see JANSEN 1994), the

author discovered *Vaccinium uliginosum* L. subsp. *gaultherioides* (Bigelow) S.B. Young. Seven years later he found a second site.

This paper presents an analysis of some taxonomic, cytological, morphological and ecological aspects of this taxon.

MATERIAL AND METHODS

Relevés were made according to the French-Swiss school of Phytosociology (BRAUN-BLANQUET 1964, WESTHOFF & VAN DER MAAREL 1973).

Material was collected at site 1 (see Table 1) and cultivated in a greenhouse of the University of Amsterdam. Voucher material is deposited in herbarium AMD, nr. 114378.

For the counting of chromosomes the following technique was employed. Root tips from potted plants in the greenhouse were collected and pretreated for 2-3 hours in saturated alfabromonaphthalene-water suspension, followed by fixation in Carnoy (acetic acid/absolute ethanol 1:3) for c. 30 minutes. Materials were stored at -20 °C until further preparation. Upon chromosome examination root tips were macerated for 8' in 1N HCl at 60°C and stained in basic Fuchsin solution. After squashing the very root tips in 45% acetic acid, cells were examined under Phase Contrast conditions.

MORPHOLOGY, TAXONOMY AND DISTRIBUTION

In Flora Iberica, *Vaccinium uliginosum* L. is regarded as one taxon, including subsp. *uliginosum* and subsp. *microphyllum* (Lange) Tolm. (VILLAR 1993). The taxon occurs in the higher parts of the Pyrenees, Cordillera Cantábrica, Montañas de León, Sistema Ibérico and Central and in the Sierra Nevada (VILLAR *l.c.*). By far the largest and most vital populations occur in the northern parts of the Peninsula. The species reaches its southern limits in the high massive of the Sierra Nevada, where it was described by BOISSIER (1839-1845) as *Vaccinium uliginosum* f. *nanum*.

In Flora Europaea two subspecies of *Vaccinium uliginosum* have been recognised, namely subsp. *uliginosum* and subsp. *microphyllum* Lange (POPOVA 1972). The former refers to relatively large tetraploid specimens (n=24), the latter to relative small diploid specimens (n=12), which are assumed to be the ancestor (LÖVE & BOSCAIU 1966).

However, *Vaccinium uliginosum* is not restricted to Europe. According to YOUNG (1970) there are 5 subspecies throughout its range (*i.e.* circumpolar, extending southward into the temperate zone in coastal regions and mountainous areas mapped in YOUNG *l.c.*). Three subspecies would occur in Europe: *pubescens*, *uliginosum* and *gaultherioides*.

Vaccinium uliginosum subsp. *pubescens* (Wormsk. ex Hornem.) Young occurs in low arctic tundra and muskeg situations in northern Scandinavia and northern Russia. According to YOUNG (*l.c.*) all known chromosome counts refer to n=24. It is a diffuse, stoloniferous shrub with pubescent leaves.

Vaccinium uliginosum subsp. *uliginosum* occurs in bogs in western and northern Europe (chromosomes: n=24). It is an erect or spreading shrub with relative large leaves.

Vaccinium uliginosum subsp. *gaultherioides* (Bigelow) S.B. Young is common in alpine and high arctic areas. All chromosome counts refer to n=12. It is a dwarf, tufted, matted, or procumbent subshrub with relative small leaves, usually less than 10 mm long.

The type material of *Vaccinium gaultherioides* described by BIGELOW (1816) was from Mount Washington, U.S.A.. Apparently unaware of this description, LANGE (1880) distinguished a similar Greenlandic taxon as *Vaccinium uliginosum microphyllum*. According to LÖVE & BOSCAIU (1966) *Vaccinium microphyllum* is identical and synonymous with *Vaccinium gaultherioides* as stated earlier by AVRORIN (AVRORIN 1959, cited in LÖVE & BOSCAIU 1966). Since the former has been published later, *Vaccinium gaultherioides* should be regarded as the correct name. LÖVE & BOSCAIU (*l.c.*) consider *Vaccinium gaultherioides* a species. We tend to follow

YOUNG (1970) who considers it a subspecies of *Vaccinium uliginosum*, because most of the races of the *Vaccinium uliginosum* complex intergrade more or less freely in zones of range overlap, even though they differ cytologically. In this study, we use the subspecies name *gaultherioides* (for a list of synonyms see Taxonomic Appendix).

VILLAR (1993) agrees with VAN DER KLOET (1988) that different levels of polyploidy (2x, 4x, 6x) do not correlate with morphological characteristics, reason why it does not seem reasonable to admit intraspecific taxa. However, as far as *Vaccinium uliginosum* is concerned, the monographic work of VAN DER KLOET (*l.c.*) is based on American material, and in addition on information from YOUNG (1970). VAN DER KLOET (*l.c.*) states that, on a worldwide basis, YOUNG (*l.c.*) could not find a clear-cut morphological discontinuity among the races of *Vaccinium uliginosum*, because there were not enough chromosome data to base these correlations on. Indeed, YOUNG (*l.c.*) had only very few chromosome data from Europe at his disposal (see also HESS *et al.* 1972, p.775). These few data only refer to material from northern areas: Iceland, Sweden and arctic Russia. We believe that at least chromosome counts on material from Central and southern Europe should be included in a survey of *Vaccinium uliginosum* on a worldwide basis.

LÖVE & BOSCAIU (1966) did not carry out cytological investigations, but by aid of morphological and biometrical comparisons, they did examine a large number of herbarium specimens from many sites throughout the range of the species, including Spain, France and parts of eastern Europe. The same authors assume that almost all reports on *Vaccinium uliginosum* from stations of dry and rocky habitats in the alpine zone of the Alps, Jura, the Pyrenees, Sierra Nevada, the Apeninnes, the Balkans, Caucasus, the Urals, Baikal, Altai and other high mountains may primarily refer to the diploid *Vaccinium gaultherioides* rather than the tetraploid *Vaccinium uliginosum sensu stricto*. Since there is no fundamental cytological research of

European material of *Vaccinium uliginosum sensu lato*, we prefer to distinguish subspecies on the basis of morphological characteristics with additional ecological and cytological data. The specimens concerned here correspond to *Vaccinium uliginosum* subsp. *gaultherioides* (Bigelow) S.B. Young, because their height is less than 15 cm, their leaves mostly have a width of less than 1 cm. Up to now, we observed only one flower (site 2) which nevertheless confirmed another characteristic feature (*i.e.* mostly one single flower instead of 2-3 together, with stalks with length of 1-3 mm instead of 3-10 mm, according to HESS *et al.* 1970).

All 14 studied metaphase cells from the specimen collected at site 1 showed a tetraploid chromosome set ($2n=24$). We conclude that this Portuguese specimen of *Vaccinium uliginosum* subsp. *gaultherioides* is a diploid, as discussed above, and is an *a posteriori* confirmation of the pertaining claim by LÖVE & BOSCAIU (1966). The basic chromosome set known so far, $n=12$, being the lowest found in the complex, leads to this conclusion. However, since this basic gamete number is relatively high, it may well reflect an old polyploid development, however, a putative ancestral taxon at the "palaeo-diploid" level is as yet unknown in the genus *Vaccinium* (LEWIS 1980)

Now two taxa of the genus *Vaccinium* are known to occur in Portugal: *Vaccinium uliginosum* subsp. *gaultherioides* from the Serra da Estrela (Beira Alta) and *Vaccinium myrtillus* from the northern serras and the Serra da Estrela (Minho, Trás-os-Montes, Beira Alta). The former can easily be distinguished from the latter: its twigs are round and rapidly browning, its leaves are entire, blue-green. *Vaccinium myrtillus* has angular, green twigs and its leaves are toothed, bright green.

ORIGIN

Vaccinium uliginosum is generally regarded as a glacial relict in the high mountains of Central Europe (OBERDORFER 1990) and South-West Europe (BRAUN-BLANQUET 1945). The specimens in the Serra da Estrela belong probably to a relict population from

the Quaternary. Relatively recent dispersal by migratory birds (*i.e.* endozoochory) is not very likely, because of the short retention time of seeds within birds (in general by far less than one hour, see LEVEY 1986) in combination with the distance (> 250 km) to cross to the nearest possible metapopulations (*i.e.* in northern direction Montañas de León; in eastern direction Somosierra, Sierra de Ayllón, both part of the Sistema Central).

As a result of the long tradition of cutting, burning and pasturing, many species are rare in the Serra da Estrela. We assume that populations of plant species were lost or diminished, especially species at the limits of their distribution areas, *i.e.* glacial relics like *Vaccinium uliginosum* subsp. *gaultherioides*. For instance, *Lycopodium clavatum* must have been a relative common species *c.* 4000 years ago, at least locally near Lagoa Comprida 2 (see Fig. 6 in: VAN DER KNAAP & VAN LEEUWEN 1994), assuming that no other *Lycopodium* species with similar spores existed (JONES & BLACKMORE 1988). Nowadays the only known specimen of *Lycopodium clavatum* in Portugal is found at one location in the Serra da Estrela. During or directly after the last glaciation, there may have been communities with *Vaccinium uliginosum*, comparable to the present *Juniperion nanae* communities of northern Spain. We notice the presence of the arctic-alpine lichen *Cetraria commixta* and the alpine *Plantago alpina* L. at site 1 (Table 1, relevé 2). The latter is also new to the Portuguese flora (JANSEN *et al.* 1999b).

ECOLOGY AND CONSERVATION

The Serra da Estrela has a mountain climate with oceanic and Mediterranean influence. Climatic data are available from the weather station in Penhas Douradas (alt. 1383 m a.s.l.), which lies *c.* 3 km north of the sites with *Vaccinium uliginosum* subsp. *gaultherioides* (see TORMO MOLINA *et al.* 1992). From these data it can be derived that the sites are situated in the oro-temperate thermoclimatic belt with a hyperhumid ombroclimate (RIVAS-MARTINEZ *et al.* 1987). The Atlantic climate is expressed in the

high precipitation (assumed mean annual precipitation > 2000mm); the Mediterranean climate in the high annual insolation (>2500 h) and a dry period in summer.

Vaccinium uliginosum s.l. multiplies by layering or sprouting from rhizomes, self pollination or crossbreeding through insects (BRAUN-BLANQUET 1975). Specimens may reach up to 80 years (FOURNIER 1961) or even more (BRAUN-BLANQUET *l.c.*). So, in general, once a specimen is settled, there is time for reproduction and dispersion.

Vaccinium uliginosum subsp. *gaultherioides* grows *in situ* on a gentle slope with north-western aspect (site 1, alt. 1875 m a.s.l.), and some 500 m further north in the fissures of a north-faced rock-outcrop (site 2, alt. 1850 m a.s.l.).

The specimen at site 1 shows clear clonal growth, covering *c.* 1 m². It grows in the understorey of *Juniperus communis* subsp. *alpina* stretching out into adjacent *Nardus* grassland (see Table 1). Up to now, neither flowers nor fruits could be observed. This may be mainly correlated with herbivores. Observations in July 1990-1994 and August 1994 showed severe damage as a result of browsing. At site 2 one specimen showed one flower in 1998, perhaps because it grows in a rock-fissure hardly accessible to grazers.

We suppose that summer drought is the major climatic factor limiting the distribution of the arctic-alpine *Vaccinium uliginosum* subsp. *gaultherioides* in the Serra da Estrela. Only locally there may be compensation through favourable microclimatic conditions which are assumed to rule in the localities where the specimens were found. Both sites may be covered with snow during some periods in winter. The best developed parts of the specimens are situated under the dwarf-juniper and in the rock-fissures. There is less radiation, a relative high atmospheric humidity and better protection against browsing.

We suggest the setting of an enclosure in order to prevent possible nuisance from heavy grazing and trampling (sheep, goats, cattle). This may enhance the production of flowers and fruits and

this in turn may eventually lead to extension into few favourable places, by additional means of seed dispersal. For protection against plant hunters the enclosure should be camouflaged.

We propose including the taxon on the preliminary red list for Portugal (LOPES & CARVALHO 1990). The specimens are threatened by climatic change, heavy grazing and trampling and genetic erosion (exchange with metapopulations is unlikely, as stated earlier).

SYNTAXONOMY

For the Iberian Peninsula only a survey of syntaxa on the alliance level exists and moreover without mentioning characteristic species (MOLINA ABRIL 1993). In the western Pyrenees *Vaccinium uliginosum* subsp. *uliginosum* is considered a character-species of the *Betulion pubescentis* (class: *Vaccinio-Piceetea*) and *Vaccinium uliginosum* subsp. *microphyllum* (= *gaultherioides*) is considered a character-species of the class *Vaccinio-Piceetea* (RIVAS-MARTINEZ *et al.* 1991). The latter mainly occurs in communities of the *Rhododendro-Vaccinion* and *Loiseleurio-Vaccinion*, but it may occasionally occur in the *Juniperion nanae*, an alliance which nowadays is assigned to the *Pino-Juniperetea* (RIVAS-MARTINEZ *et al. l.c.*)

In the western Cordillera Cantábrica and in the province of León *Vaccinium uliginosum s.l.* can be considered a character-species of the *Juniperion nanae* (FERNANDEZ PRIETO *et al.* 1987, PENAS MERINO *et al.* 1990).

In the Sistema Central *Vaccinium uliginosum s.l.* is very rare, only occurring in the easternmost part, namely Somosierra and Sierra de Ayllón (LUCENÑO & VARGAS 1991).

We do not have information from the Iberian system and the Sierra Nevada.

In the Serra da Estrela, *Vaccinium uliginosum* subsp. *gaultherioides* grows relatively best in dwarf-juniper scrub (see Table 1). This scrub has been assigned to the *Juniperion nanae* (BRAUN-BLANQUET *et al.* 1952) or *Pino-Cytision* (RIVAS-

MARTINEZ *et al.* 1987). The controversial synsystematic position of this scrub will be elucidated in the near future (see also JANSEN *et al.* 1999a). For the moment we assign relevé 1 (see Table 1) to the *Lycopodio clavati-Juniperetum nanae* RIVAS-MARTINEZ 1981 and relevé 2 to the *Galio saxatilis-Nardetum* BR.-BL., P.SILVA, ROZEIRA & FONTES 1952 (see also JANSEN 1999). of this scrub will be elucidated in the near future (see also JANSEN *et al.* 1999a).

Table 1. Relevés with *Vaccinium uliginosum* subsp. *gaultherioides* from site 1, Beira Alta, Distrito de Guarda, Serra da Estrela, UTM grid 29TPE184-661.

<p>Relevé 1, author J. Jansen (nr. JJ1027). 9th of July 1990. Alt. 1875 m. Dwarf-juniper scrub at the border of <i>Nardus</i> grassland, on gentle slope. Aspect NNE, inclination 5°. Soil depth (5)-25-(50)cm. Ao: 0-5 cm undecomposed litter (mainly needles of <i>Juniperus</i>), mixed with raw humus, A1: fine and coarse organic material mixed with sand, C: granite rock. Sample plot 60 m². Shrub cover 70%, height 25-(50) cm. Herb cover 50%, height 5-(15) cm. Cryptogams 8%.</p> <p>Relevé 2, author J. Jansen (nr. JJ27). 9th of July 1990. Alt. 1875 m. <i>Nardus</i> grassland on gentle slope. Aspect NNE, inclination 5°. Soil depth 1 m. Ao: 0-1 cm undecomposed litter (mainly <i>Nardus</i> straw), mixed with raw humus, A1: fine, blackish and humid organic material mixed with sand, well-rooted up to 30 cm, and in the deeper layer from c. 70 cm mixed with greyish quartzitic grains C: granite rock. Sample plot 40 m². Herb cover 50%, height 5-(10) cm. Cryptogams 10%.</p>

relevé 1:	relevé 2:
4 <i>Juniperus communis</i> subsp. <i>alpina</i>	4 <i>Nardus stricta</i>
+ <i>Deschampsia flexuosa</i> subsp. <i>iberica</i>	3 <i>Juncus squarrosus</i>
+ <i>Vaccinium uliginosum</i> subsp. <i>gaultherioides</i>	+ <i>Narcissus bulbocodium</i> var. <i>nivalis</i>
+ <i>Nardus stricta</i>	+ <i>Gentiana pneumonanthe</i>
3 <i>Juncus squarrosus</i>	+ <i>Festuca henriquesii</i>
+ <i>Festuca henriquesii</i>	+ <i>Galium saxatile</i>
+ <i>Galium saxatile</i>	+ <i>Vaccinium uliginosum</i> subsp. <i>gaultherioides</i>
+ <i>Agrostis truncatula</i> subsp. <i>truncatula</i>	+ <i>Arenaria quereioides</i>
+ <i>Arenaria quereioides</i>	+ <i>Agrostis truncatula</i> subsp. <i>truncatula</i>
+ <i>Calluna vulgaris</i> (juv.)	+ <i>Calluna vulgaris</i> (juv.)
+ <i>Erica arborea</i>	+ <i>Calluna vulgaris</i> (seedl.)
+ <i>Erica arborea</i> (juv.)	+ <i>Juniperus alpina</i> (juv.)
+ <i>Plantago alpina</i>	+ <i>Minuartia recurva</i> subsp. <i>juressi</i>
+ <i>Potentilla erecta</i> var. <i>herminii</i>	+ <i>Plantago alpina</i>
+ <i>Rumex acetosella</i> subsp. <i>pyrenaicus</i>	+ <i>Potentilla erecta</i> var. <i>herminii</i>
cryptogams	+ <i>Sedum brevifolium</i>
+ <i>Cephaloziella divaricata</i>	cryptogams
+ <i>Ceratodon purpureus</i>	+ <i>Ceratodon purpureus</i>
+ <i>Cetraria islandica</i>	+ <i>Cetraria commixta</i>
+ <i>Cladonia coccifera</i> s.s.	+ <i>Cetraria islandica</i>
+ <i>Cladonia gracilis</i>	+ <i>Cladonia cervicornis</i>
+ <i>Cladonia merochlorophaea</i>	+ <i>Cladonia coccifera</i> s.s.
+ <i>Dicranum scoparium</i>	+ <i>Cladonia merochlorophaea</i>
+ <i>Lophozia bicrenata</i>	+ <i>Dicranum scoparium</i>
+ <i>Pleurozium schreberi</i>	+ <i>Hypnum cupressiforme</i> s.l.
+ <i>Pohlia nutans</i>	1 <i>Pohlia nutans</i>
+ <i>Polytrichum juniperinum</i>	+ <i>Polytrichum juniperinum</i>
1 <i>Polytrichum piliferum</i>	1 <i>Polytrichum piliferum</i>
+ <i>Trapeliopsis granulosa</i>	1 <i>Sphagnum compactum</i>
	+ <i>Trapeliopsis granulosa</i>

TAXONOMIC APPENDIX

The following species list contains names used in this paper with references which do not follow Flora Iberica, nor Nova Flora de Portugal, or Flora Europaea; in addition synonyms regarding *Vaccinium uliginosum* (only including subspecies reported from Europe) are listed.

Agrostis truncatula Parl. subsp. *truncatula* Romero García in Ruiza 7: 137, (1988).

Deschampsia flexuosa (L.) Trin. subsp. *iberica* Rivas-Martínez in Anal. Inst. Bot. Cavanilles 21: 297, (1963).

Narcissus bulbocodium L. var. *nivalis* (Graells) P. Coutinho in Flora de Portugal (2^a ed.): 167 (1974).

Potentilla erecta (L.) Rausch. var. *herminii* Fic. In Flora de Portugal (2^a ed.): 367 (1974).

Vaccinium uliginosum L. subsp. *gaultherioides* (Bigelow) Young in *Rhodora* 72: 449 (1970) = *V. gaultherioides* Bigelow (pro parte) in *New Engl. Journ. Medic. & Surg.* 5: 335 (1816) = *V. uliginosum* var. *gaultherioides* (Bigelow) Bigelow (pro parte) in *Fl. Bostoniensis*, ed. 2: 183 (1824) = *V. uliginosum* var. β *nanum* in *Voyage botanique dans le midi de l'Espagne pendant l'année 1837*, Vol. 1-2 (1839-1845) = *V. uliginosum microphyllum* Lange in *Meddel. om Grönl.* 3: 91 (1880) = *V. uliginosum* subsp. *microphyllum* (Lange) Tolm. In *Arctica* (Leningrad) 4: 154 (1936) = *V. microphyllum* (Lange) Hagerup ex A. Löve in *Bot. Not.* 103: 49 (1950).

Vaccinium uliginosum L. subsp. *pubescens* (Wormsl. ex Hornem.) Young in *Rhodora* 72: 449 (1970).

Vaccinium uliginosum L. (*sensu stricto*) = *V. uliginosum* subsp. *Uliginosum*

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