

Zeitschrift: Candollea : journal international de botanique systématique = international journal of systematic botany
Herausgeber: Conservatoire et Jardin botaniques de la Ville de Genève
Band: 42 (1987)
Heft: 2

Artikel: Armeria helodes, a new species from North-Eastern Italy
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DOI: <https://doi.org/10.5169/seals-879961>

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Armeria helodes, a new species from North-Eastern Italy

FABRIZIO MARTINI
&
LIVIO POLDINI

RÉSUMÉ

MARTINI, F. & L. POLDINI (1987). *Armeria helodes*, une nouvelle espèce de l'Italie nord-orientale. *Candollea* 42: 533-544. En anglais, résumés français et anglais.

On décrit *A. helodes*, nouvelle espèce, endémique du Frioul (Italie nord-orientale). Elle se rattache à *A. purpurea* et à *A. alpina*, mais elle diffère de la première entre autres à cause des feuilles glabres et des calices plus courts et de la deuxième à cause des plus grandes dimensions des feuilles et de la hampe et pour les calices et les bractées des fleurs plus petites. C'est une espèce caractéristique de l'*Erucastro-Schoenetum nigricantis*, une association végétale de tourbière basse et alcaline.

ABSTRACT

MARTINI, F. & L. POLDINI (1987). *Armeria helodes*, a new species from North-Eastern Italy. *Candollea* 42: 533-544. In English, French and English abstracts.

Armeria helodes, new species and endemic from the Friuli Region (North-Eastern Italy) is described. This species is closely related to *A. purpurea* and *A. alpina*; it differs from the former for the glabrous leaf margin, the shorter calyx and the smaller spikelet bracts; main differences from the latter are the bigger leaves and scapes, the shorter calyx and the smaller spikelet bracts. The species is characteristic of the association *Erucastro-Schoenetum nigricantis*, a relict community of alkaline flat bogs.

Introduction

The genus *Armeria* Willd. has been the object of several taxonomical studies revealing a high degree of polymorphism at species level and a considerable complexity in the phylogenetical relationships among species.

Besides the classical studies on the genus by KOCH (1823), GAMS (1927), LAWRENCE (1940), BERNIS (1950, 1953, 1954, 1956), and the recent systematic treatment by PINTO DA SILVA (1972), several contributions have appeared, which were centered on the solution of particular problems (CHRISTIANSEN, 1932; BAKER, 1954; LEFEBVRE, 1967, 1969; ARRIGONI, 1970; PINTO DA SILVA, 1971; PHILIPP, 1974).

Aim of the present paper is to clarify the taxonomical status of the *Armeria*-populations growing in Southern Friuli (North-Eastern Italy) and to specify their relationships with *Armeria purpurea* Koch ad *Armeria alpina* Willd.

Nomenclature

The occurrence of an *Armeria* species in the bogs of the Friulian Lowland was already known to PIRONA (1855), who mentioned it under the binomial *Statice elongata* Hoffm. Subsequent nomenclatural variations did not substantially alter its systematic position. FIORI (1902), followed by GORTANI (1906, 1981) calls it *Armeria vulgaris* W. α *elongata* Hoffm., a name that was simplified in *Armeria elongata* Hoffm. by PAMPANINI (1907). FIORI (1926), used the variety "pur-

purea“ to designate specimens with purple flowers collected in Friuli. The name “purpurea“ however, was applied in an improper and reductive way, since it referred to a simple form within *Armeria vulgaris* α *elongata*. The attribution of the Friulian populations of *Armeria* to *Armeria purpurea* has been maintained up to the present time by the following authors, as documented by POLDINI (1980) and BIANCHINI (1982), although the taxonomical status of this entity was still in need of being clarified by further and deeper studies.

Materials and methods

Around 100 specimens belonging to the Friulian populations of *Armeria* and to the two most closely related species, *Armeria purpurea* Koch and *Armeria alpina* Willd. have been examined and measured for a comparative statistical biomorphometrical analysis; the specimens included both living and exsiccated material; the latter was preserved in the Herbaria of the Institute of Botany of the Trieste University (TSB), and of the Friulian Museum of Natural History of Udine (UDM).

The results of the biometrical analysis are presented in tables that show, for each of the analyzed characters, the mean and maximum value, the range between them, the average, the standard error, the standard deviation and the total number of measures.

The statistical analysis was carried out on the basis of the method proposed by LAGONEGRO & FEOLI (1985), and includes the measure of the T of Student and its probability, the study of the trends in probability distribution, and Goodall's index.

The examined samples were collected in the following stations:

Armeria helodes

Southern Friuli: Torsa, 24.5.1959, E. & S. Pignatti (TSB); *ibid.*, 19.4.1974, Poldini (TSB); sorgenti della Roggia Ribosa (Codroipo), 20 m, 25.4.1969, Armano (TSB); Bertiole, 25 m, 25.4.1972, Poldini (TSB); Flumignano-Torsa, loc. Roggia del Ponte, 19 m, 19.4.1974, Poldini (TSB); Flambro, risorgive dello Stella, 20 m, 1.5.1980, Martini (UDM); *ibid.*, 4.4.1986, Martini, in vivo.

Armeria purpurea

Bavaria: Benninger Ried bei Memmingen, 600 m, 16.6.1986, Martini & Poldini (TSB) et in vivo.

Armeria alpina

Friuli: M. Bivera, 1950 m, 21.7.1967, Bryce (TSB); M. Pramaggiore, presso Casone di Val d'Inferno, 1790 m, 31.8.1971, Poldini (TSB); Val Settimana: f. Ila Pregoiane, 1550 m, 3.9.1971, Poldini (TSB); Val Resia, M. Sart, 2020 m, 7.8.1971, Poldini (TSB); Val Cimoliana, Val del Frassin, 1750 m, 10.7.1986, Martini, in vivo. **Venetia:** Revolto, sopra Giazza (Verona), 1500 m, 7.7.1962, Pignatti (TSB); Passo Sella, 6.7.1961, Poldini (TSB); rifugio Lavaredo, 2000 m, 28.8.1965, Rizzi (TSB). **Trentino-Alto Adige:** strada per passo Grostè (Madonna di Campiglio), 2250 m, 2.8.1970; Chiapella (TSB); Valle d'Antermoia (Dolomiti di Fassa), 2250 m, 13.8.1970, Pignatti (TSB). **Slovenia:** Kamniške Alpe (Steiner Alpen), Brana, 2100 m, 11.8.1971, Poldini (TSB).

Analysis and discussion of qualitative diacritical characters

The qualitative characters selected for this study are: characteristics of leaf margin, of leaf base and of the outer spikelet bract, colour of the flower.

a) leaf margin

In *A. helodes* and in *A. alpina* the leaf margin is glabrous and hyaline for a thickness of (0.05-)1(-0.15) mm, whereas in *A. purpurea* it is regularly provided of cilia, that are ca. 0.1 mm long (Fig. 1).

b) leaf base

In *A. helodes* and *A. alpina* it is white, or greenish-white, whereas in *A. purpurea* it has almost always a clearly reddish colour. In the first case, when the rosette is observed from above, the centre appears whitish, whereas in the second case it is decidedly red. This character, however, is of little diagnostic value, since it is hardly observable in exsiccated material.

c) outer spikelet bract

The outer bract of the spikelet is the seat of primary diagnostic characters, both qualitative and quantitative. The general shape, that varies from obovate to obovate-spathulate, is common to the three entities, but the veining of the central part is anastomosed (net-like) in *A. purpurea*, whereas in the remaining two taxa the veins are just confluent towards the apex (Fig. 2). This character should be observed on abundant material.

d) colour of the flowers

According to the scale proposed by BIESALSKI (1957), the chromatical variation in the flowers of the three entities may be expressed on the basis of the following parameters:

- i *A. helodes*: 11:1:1-11.5:1:1 (pale pink or pale reddish white);
- ii *A. purpurea*: 11:2:1.5-11:3:2.5 (purple pink);
- iii *A. alpina*: 11.5:2:1.5-11.5:4:3 (purple).

The flowers of *A. helodes* are those with a paler tone, which becomes progressively darker passing to *A. alpina*. As all characters regarding a continuous chromatic variation, also this one can be verified only on fresh material, and it is of little diagnostic value if referred to the complex of the three entities as a whole. However, it may be useful, as we could verify, to distinguish *A. helodes* from *A. alpina* in the field.

Biometry, statistical analysis and discussion of the quantitative diacritical characters

The characters that have been selected for the biometrical analysis are the following: a) calyx length, b) length of the calyx limb, c) length of the outer spikelet bract, d) leaf length, e) height of the scape.

a) Calyx length (excluding the awns)

A. helodes has the lowest, *A. alpina* the highest mean value. The variability ranges of the two taxa are not overlapping, whereas the one of *A. purpurea* partially overlaps with them, although remaining outside the standard deviation (Fig. 4). The probability value of the T of Student is lower than 0.01% both in the comparison *A. helodes*-*A. purpurea* and in the one *A. helodes*-*A. alpina*.

b) Length of the calyx limb (excluding the awns) (Fig. 3)

The average length of the calyx limb is lowest in *A. helodes*, highest in *A. alpina*. The variability range of the former does not overlap with the one of the other two taxa (Fig. 5); the probability of the T of Student is lower than 0.01% in the two comparisons: *A. helodes*-*A. purpurea* and *A. helodes*-*A. alpina*.

c) Length of the outer spikelet bract (sensu Flora Europaea)

The lowest average value is found in *A. helodes*, the highest in *A. alpina*. The variability range of this character in *A. helodes* does not overlap with those of the other two taxa (Fig. 6). The probability of the T of Student, relative to the comparisons *A. helodes*-*A. purpurea* and *A. helodes*-*A. alpina*, has a value that is lower than 0.01%.

d) Leaf length

A. helodes has the highest average leaf length, *A. alpina* the lowest. The variability ranges of the two taxa are not overlapping (fig. 7), whereas a consistent overlap exist with the variability range of *A. purpurea*. For this reason we decided to consider leaf length as a discriminant character only in the former case, whose probability of the T of Student is lower than 0.01%.

	<i>Mean value</i>	<i>Max. value</i>	<i>Range</i>	<i>Average</i>	<i>Standard error</i>	<i>Standard deviation</i>	<i>Number measures</i>
<i>A. helodes</i>	4.9	7.1	2.2	6.14	0.055	0.496	80
<i>A. purpurea</i>	6.8	8.6	1.8	7.619	0.044	0.395	80
<i>A. alpina</i>	7.5	9.0	1.5	8.295	0.0341	0.305	80

a) Calyx length (excluding the awns, measures in mm).

	<i>Mean value</i>	<i>Max. value</i>	<i>Range</i>	<i>Average</i>	<i>Standard error</i>	<i>Standard deviation</i>	<i>Number measures</i>
<i>A. helodes</i>	2.3	4.0	1.7	3.176	0.04	0.357	80
<i>A. purpurea</i>	4.0	5.5	1.5	4.76	0.038	0.342	80
<i>A. alpina</i>	4.4	6.0	1.6	5.43	0.033	0.291	80

b) Length of the calyx limb (excluding the awns, measures in mm).

	<i>Mean value</i>	<i>Max. value</i>	<i>Range</i>	<i>Average</i>	<i>Standard error</i>	<i>Standard deviation</i>	<i>Number measures</i>
<i>A. helodes</i>	5.0	8.0	3.0	7.0	0.121	0.768	40
<i>A. purpurea</i>	8.0	11.5	3.5	9.75	0.141	0.892	40
<i>A. alpina</i>	8.5	12.0	3.5	10.05	0.121	0.967	64

c) Length of the outer spikelet bract (sensu *Flora Europaea*, measures in mm).

	<i>Mean value</i>	<i>Max. value</i>	<i>Range</i>	<i>Average</i>	<i>Standard error</i>	<i>Standard deviation</i>	<i>Number measures</i>
<i>A. helodes</i>	116	208	92	163.65	3.913	24.75	40
<i>A. purpurea</i>	88	178	90	124.7	3.665	23.18	40
<i>A. alpina</i>	21	95	74	60.7	2.35	16.62	50

d) Leaf length (measures in mm).

	<i>Mean value</i>	<i>Max. value</i>	<i>Range</i>	<i>Average</i>	<i>Standard error</i>	<i>Standard deviation</i>	<i>Number measures</i>
<i>A. helodes</i>	320	580	260	428.03	12.645	69.26	30
<i>A. alpina</i>	80	320	240	194.7	8.672	61.32	50

e) Height of the scape (measures in mm).

e) *Height of the scape*

This character allows a significant discrimination only between *A. helodes* and *A. alpina*, with non overlapping variability ranges (Fig. 8); the value of the probability of the T of Student is lower than 0.01%.

The results may be summarized as follows: calyx length, the length of the calyx limb and the length of the outer spikelet bract may be considered as primary discriminant characters between *A. helodes* and the other two taxa. Leaf length and height of the scape can be utilized to distinguish *A. helodes* from *A. alpina*.

The characteristic character combinations for the three species are summarized in the following table:

	<i>A. helodes</i>	<i>A. purpurea</i>	<i>A. alpina</i>
<i>Leaf</i> length (mm)	(116-)139-188(-208)	(88-)102-148(-178)	(21-)44-77(-95)
margin (mm)	glabrous, hyaline (0.05-)0.1(-0.15)	ciliate (cilia length 0.1)	like <i>A. helodes</i>
base	whitish	reddish	whitish
<i>Scape</i> height (mm)	(320-)360-520(-580)	like <i>A. helodes</i>	(80-)133-256(-320)
<i>Outer bract</i> length (mm)	(5-)6.2-7.8(-8)	(8-)8.9-10.6(-11.5)	(8.5-)9.1-11(-12)
central veins	confluent towards the apex	anastomosed	confluent towards the apex
<i>Calyx</i> length (without awns) (mm) .	(4.9-)5.6-6.6(-7.1)	(6.8-)7.2-8(-8.6)	(7.5-)8-8.6(-9)
length of limb (without awns) (mm)	(2.3-)2.8-3.5(-4)	(4-)4.4-5.1(-5.5)	(4.4-)5.1-5.7(-6)
<i>Flower</i> colour	pale pink or pale reddish white	purple pink	purple

Description and diagnosis

Armeria helodes Martini & Poldini, **spec. nov.** (Fig. 9).

Typus speciei: Flora Italiae: Province of Udine, flat bogs near the village of Flambro (Udine), locality Roggia dei Molini.

The holotype is deposited at the Herbarium of the Institute of Botany of the Trieste University (TSB), the isotype is at the Erbario Centrale Italiano of Florence (FI).

Hemikryptophyton rosulatum. Radix lignescens, orthotropa, longa, radice secundariis instructa, caule plerumque extra solum partito, ad basin folioso. Folia similia, carnulosa, apetiolata, rosulata, patentia vel erecto-patentia, superne incurva, 140-200 mm longa, (1.3-)1.5-2.8(-3) mm lata, linearia, uninervia, canaliculata, raro plana, iuxta marginem vix jalina (0.05-)0.1(-0.15) mm, glaberrima. Scapi erecti, (320-)360-520(-580) mm longi, simplices, aphylli, glabri, vagina praediti paulo longiore vel subaequali involucri. Capituli modici, 22-28 mm, hemisphaerici coacti. Involucrum bratteis externis praeditum ovato-lanceolatis, exacutis, scariosis, mucronulatis, internis paulo longioribus, obovatis vel obovato-lanceolatis, plerumque muticis, scariosis. Bratteae florales externae herbaceae, ad marginem scariosae et jalinae, obovatae vel obovato-spathulatae, (5-)6.2.-7.8(-8) mm longae. Bratteae interflorales mensura varia, herbaceae, totae jalinae. Spiculae breviter pediculatae, 3-florae; calyx pedicellatus, (4.9-)5.6-6.6(-7.1) mm longus, tubo brevi praeditus, costis lanuginosis; lobi triangulares, in aristam exeuntes 0.2-0.5 mm. Corolla roseoalba. Floret Majo-Junio. Quoad habitum ad *A. purpurea* accedit, sed ab ea differt essentialiter foliis margine glabris et calycibus brevioribus.

Rosulate hemicryptophyte. Root woody, orthotropical, long, provided with secondary rootlets; culm normally ramified above the ground, leafy at the base. Leaves all alike, slightly fleshy, sessile, rosetted, spreading, erecto-patent, curved at the apex, 140-200 mm long, (1.3-)1.5-1.8(-3) mm broad, linear, one ribbed, channelled, rarely plane, glabrous, with hyaline margin (0.05-)0.1(-0.15) mm broad. Scapes erect, (320-)360-520(-580) mm long, simple, aphyllous, glabrous, provided with a sheath that is a little longer or almost equal to the involucre. Capitula 22-28 mm broad, hemispheric, dense. Involucre with ovate-lanceolate, acuminate, scarious, mucronate outer involucral bracts; the inner involucral bracts are slightly longer, obovate or obovate-lanceolate, mostly mucinous, scarious. Spikelet bracts herbaceous, scarious, with hyaline margin, obovate or obovate-spathulate, (5.0-)6.2-7.8(-8) mm long. Flower bracteolae of various size, herbaceous, completely hyaline. Spikelets shortly pedunculate, 3-flowered; calyx pedunculate, (4.9-)5.6-6.6(-7.1) mm long, with a short tube, hirsute only at the ribs; calyx lobes triangular, ending with a 0.2-0.5 mm long awn. Corolla pale pinkish. Flowering: May-June. Similar in habitus to *A. purpurea*, but differing for the glabrous leaf margin and for the shorter calyx.

Distribution and ecology

Armeria helodes is endemic of the Risorgive area of the Friuli Region (Fig. 10). Its range includes an area of trapezoidal shape, with an average length of ca. 30 km, and a width between 2.3 and 6.3 km; the elevation goes between 15 and 30 m above sea level. Its total area can be estimated in ca. 120 ha.

In the Risorgive belt of Friuli, the ground water comes to the soil surface, because of the sudden presence of an impermeable water — bearing layer in the contact zone between the coarse sandy — gravelly alluvial deposits of the high plain and the scarcely permeable silty clayey sediments of the low plain. The habitat of *Armeria helodes* is a flat bog of the Anmoortype. The vegetation belongs to the association *Erucastro-Schoenetum nigricantis* Poldini, 1973 (*Caricion davallianae*), of which *A. helodes* can be considered as a characteristic species. This association is a community characterized by the presence of several interesting and rare species, such as the absolute endemics *Erucastrum palustre* (Pir.) Vis. and *Centaurea forojuliensis* Poldini, together with relict circum-boreal and arctic-alpine species (20%) such as *Drosera rotundifolia* L., *Pinguicula alpina* L., *Primula farinosa* L., *Gentianella pilosa* (Wettst.) Holub, *Tofieldia calyculata* (L.) Wahlenb.; among the dominant species we mention *Schoenus nigricans* L., *Carex davalliana* Sm., *Sesleria uliginosa* Opiz and *Molinia caerulea* (L.) Moench.

The soil mostly consists of black raw humus enriched by partially decomposed organic remains (average pH = 7.1), overlaying a layer of gravel. The soil is constantly wet by water saturated by CaCO₃.

Conclusions

In assigning a species rank to *Armeria helodes* we followed the systematic model proposed by EHRENDORFER & al. (1973), in which *Armeria maritima* is considered as a “collective species” (Aggregat), that includes a swarm of “microspecies” (Kleinarten), among which there are also *Armeria alpina* Willd. and *Armeria purpurea* Koch.

We preferred such an arrangement to the one proposed by PINTO DA SILVA (1972), where the above mentioned entities are considered as subspecies of *Armeria maritima* (Miller) Willd. Actually, the latter model better represents the problematic complex of *Armeria maritima* in the Baltic area (subsp. *maritima*, subsp. *elongata* (Hoffm.) Bonnier, subsp. *sibirica* (Turcz. ex Boiss.) Nyman), whose populations show a clinal variation of diacritical characters (LEFEBVRE, 1969), similar ecology, pronounced overlapping of the ranges and presence of hybrid or intermediate forms (PHILIPP, 1974). Such a model, however, does not fit well with the situation characteristic of the populations of the Alps, whose evolutionary history is completely different: they are characterized by allopatric distributions, complete geographical isolation, well defined ecological niches that favoured genetical drift, and consequently by the absence of hybrid forms. The existence of a complex of diacritical characters, together with the previous considerations, induced us to consider

Armeria helodes as a good species. This hypothesis is further corroborated by the comparison of Goodall's probabilistic indexes (Fig. 11), whose values underline the existence of sharp separation within a complex of phenetically and probably also cladistically closely related species. In particular, we think that the probable origin of *A. helodes* is related to the descent of populations belonging to *A. alpina* into the Friulian plains during the Würm phase of glacial expansion. The climatical changes of the Postglacial period are responsible of the isolation of the *Armeria* populations in the bogs of Southern Friuli, where the colder microclimate due to the rising of the ground water allowed their survival in stations that were completely isolated from those of the alpine populations.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. P. Ganis for the collaboration in the analysis of the data, and Prof. G. Philippi (Karlsruhe) for the useful floristic data.

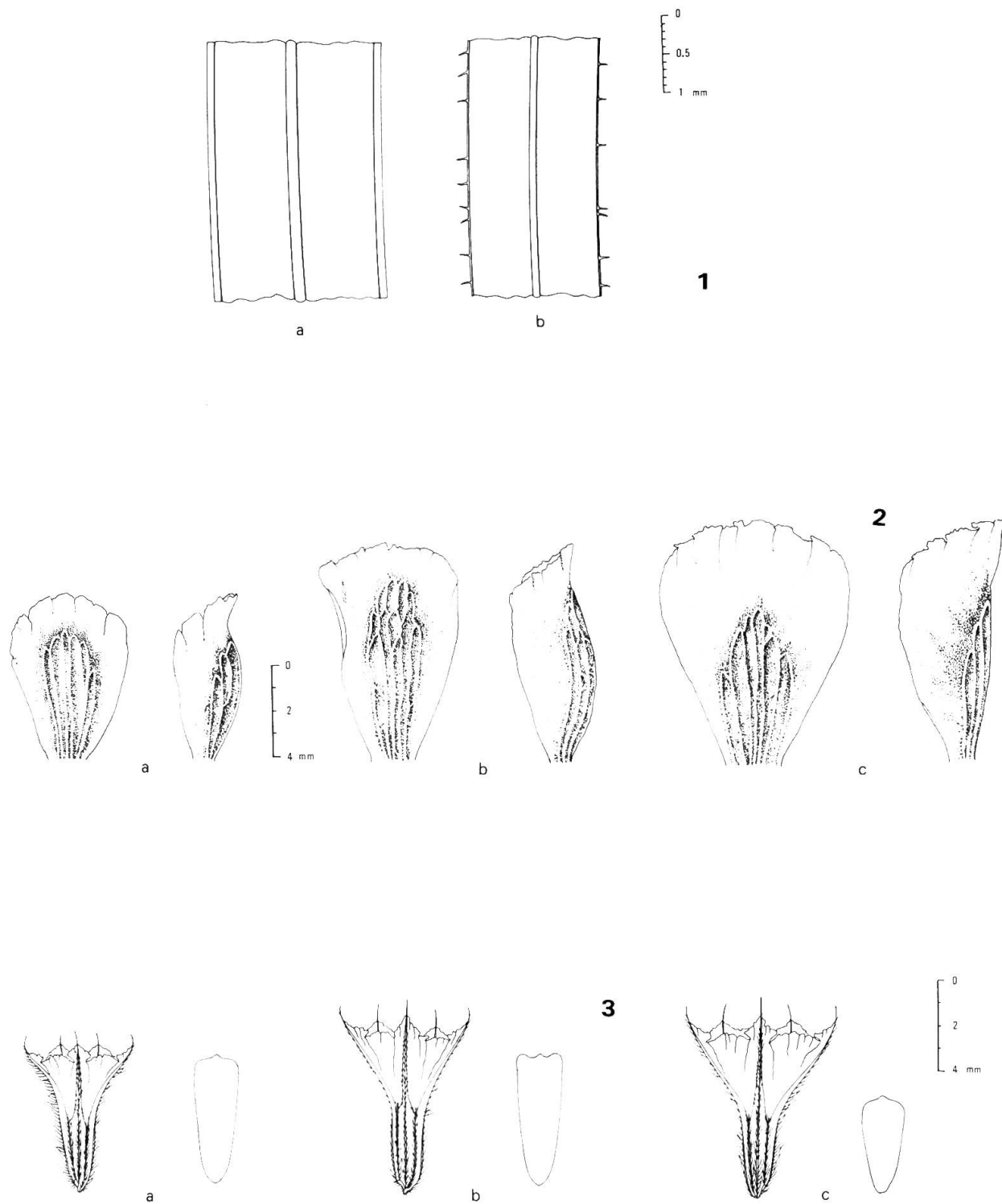
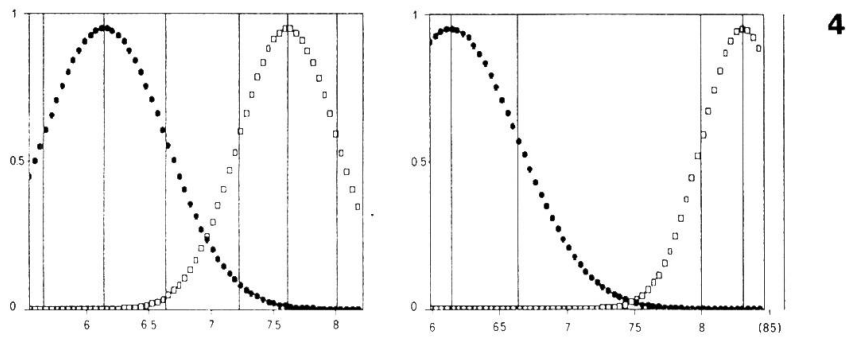


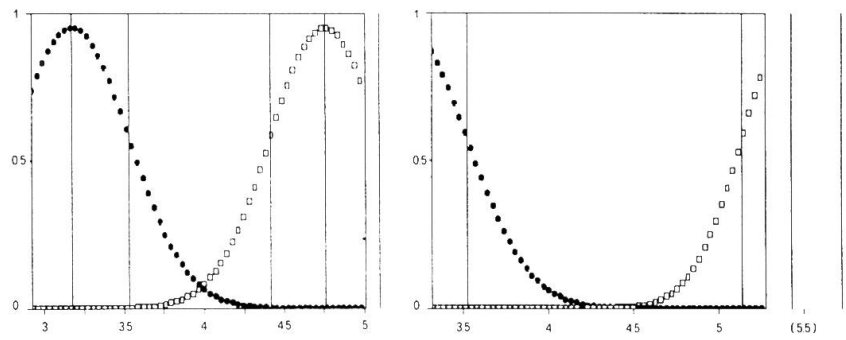
Fig. 1. — Leaf morphology. **a**, *A. helodes*; **b**, *A. purpurea*.

Fig. 2. — Morphology of the outer spikelet bract. **a**, *A. helodes*; **b**, *A. purpurea*; **c**, *A. alpina*.

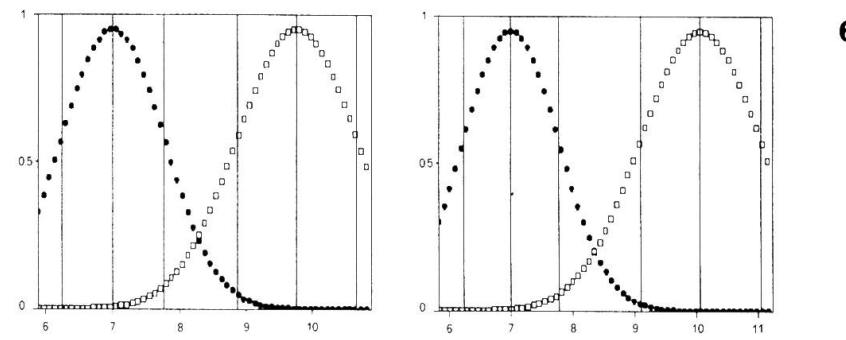
Fig. 3. — Morphology of the calyx and ratio calyx/ovary. **a**, *A. helodes*; **b**, *A. purpurea*; **c**, *A. alpina*.



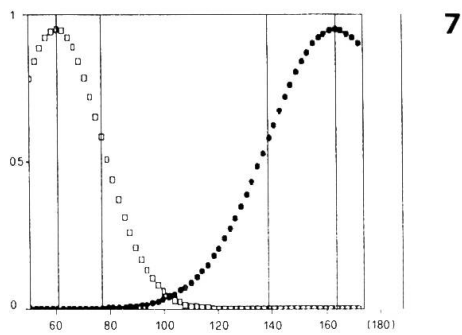
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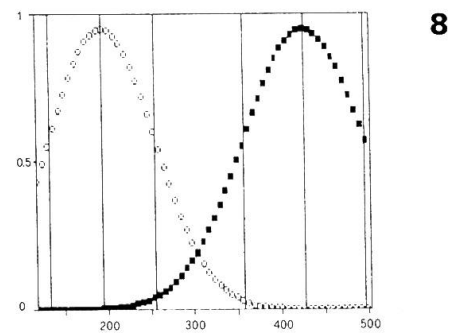
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Fig. 4. — Probability distribution of the character “calyx length” (excluding the awns) in the pairs *A. helodes* ■ — *A. purpurea* □ (left), and *A. helodes* ■ — *A. alpina* □.

Fig. 5. — Probability distribution of the character “length of the calyx limb” (excluding the awns) in the pairs *A. helodes* ■ — *A. purpurea* □ (left), and *A. helodes* ■ — *A. alpina* □.

Fig. 6. — Probability distribution of the character “length of the outer spikelet bract” in the pairs: *A. helodes* ■ — *A. purpurea* □ (left), and *A. helodes* ■ — *A. alpina* □.

Fig. 7. — Probability distribution of the character “leaf length” in the pair: *A. helodes* ■ — *A. alpina* □.

Fig. 8. — Probability distribution of the character “height of the scape” in the pair: *A. helodes* ■ — *A. alpina* (□).

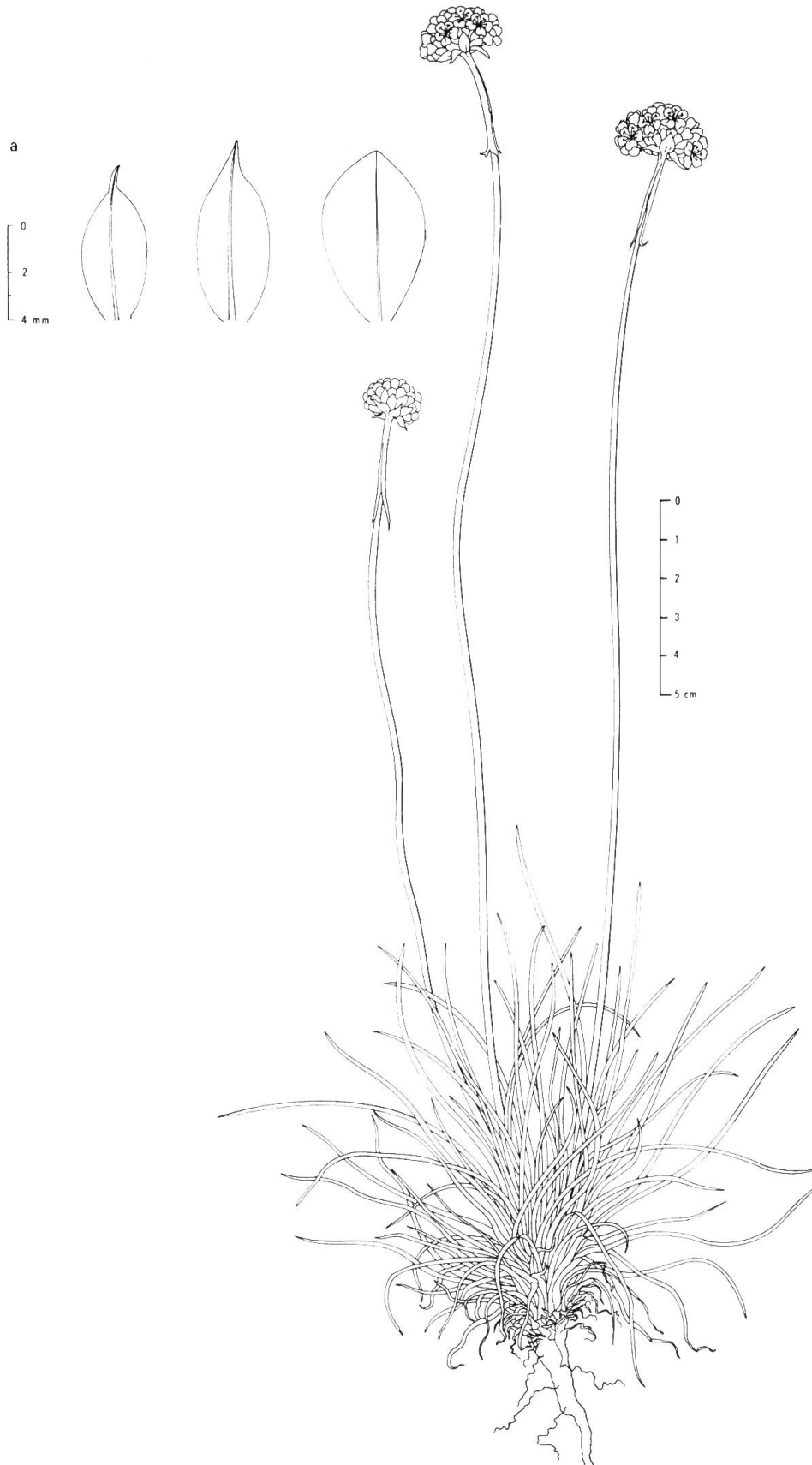
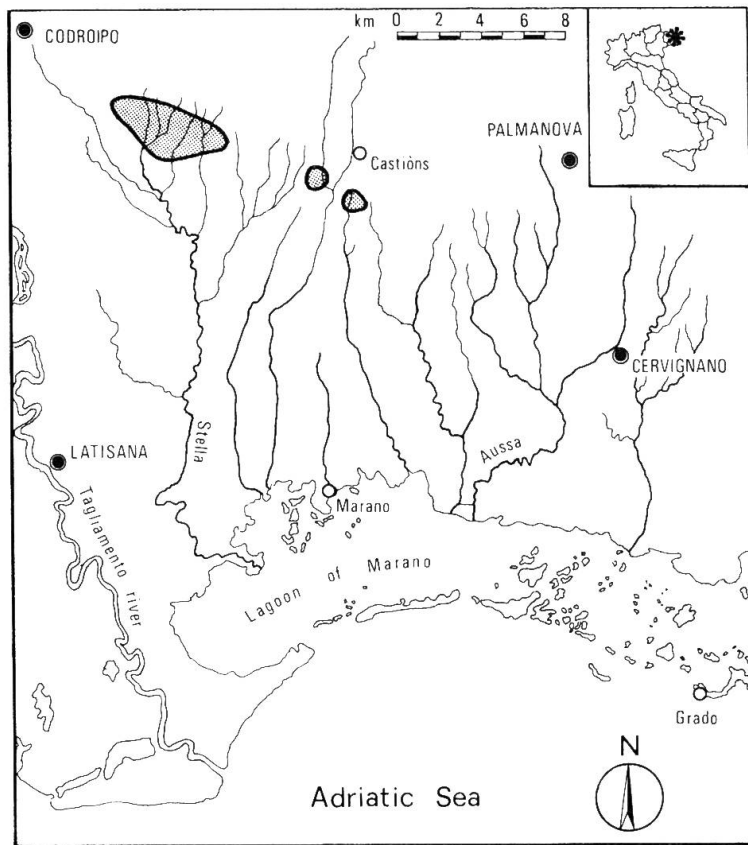
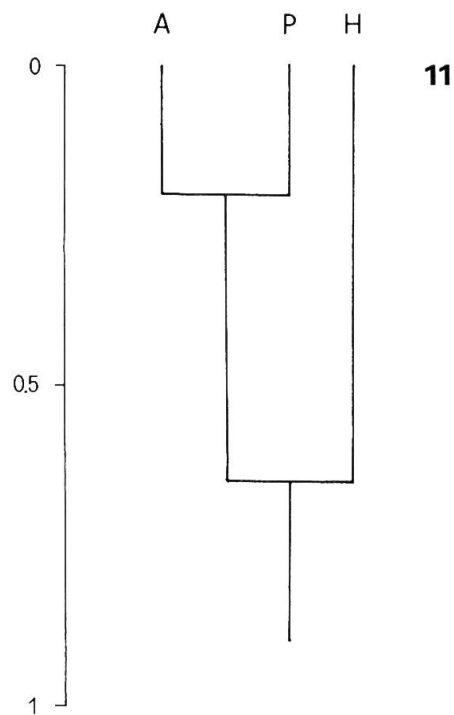


Fig. 9. — *Armeria helodes*: a, particular of the involucre bracts.



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Fig. 10. — Distribution of *A. helodes*.

Fig. 11. — Dendrogram of the distances between *A. helodes* (H), *A. alpina* (A) and *A. purpurea* (P), based upon the qualitative and quantitative diacritical characters (Goodall's probabilistic index).

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