

## A new species of *Achillea* (Asteraceae: Anthemideae) from south-east Peloponnisos, Greece

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A new species of *Achillea* L., *Achillea occulta* Constantin. & Kalpoutz., from the summit area of Mount Koulochera in south-east Peloponnisos, Greece, is described and illustrated. It belongs to *A.* sect. *Ptarmica* and further, to a small group of taxa known under the illegitimate sectional name 'Anthemioideae'. In Greece, *A. occulta* has no close allies. The taxonomically related taxa, i.e. *A. barrelieri* (Ten.) Sch. Bip., *A. mucronulata* Bertol., *A. oxyloba* (DC.) Sch. Bip. and *A. schurii* Sch. Bip. are found in the Italian Peninsula, the Alps and the Carpathians. Phytogeographically, the finding of a species with such taxonomic connections in south-east Greece was unexpected. The new species grows in semi-shade, often hidden in suitable limestone rock hollows and the foot of rocks, together with several other Greek endemics. Its chromosome number of  $2n = 18$ , counted in root tips, is also reported and illustrated. © 2005 The Linnean Society of London, *Botanical Journal of the Linnean Society*, 2005, 147, 249–256.

**ADDITIONAL KEYWORDS:** chromosome number – Compositae – conservation – endemic species – Flora Hellenica – morphology – sect. *Ptarmica* – taxonomy.

### INTRODUCTION

Peloponnisos is the southern part of the Greek mainland and floristically, an area rich in endemic species. No complete flora of this area exists at the moment. Nevertheless, several new species originating from Peloponnisos have recently been described (Tan & Iatrou, 1999; Tan, Perdetzoglou & Raus, 2000; Vassiliades & Persson, 2002) and the endemic taxa of this region have been the subject of special work (Iatrou, 1986; Tan & Iatrou, 2001). The percentage of endemism in Peloponnisos, based on recent data, is estimated at around 12.3% at species level (Greek endemics) and 12.0% if subspecies are also included, but may reach a higher percentage on mountains (Tan & Iatrou, 2001).

Our botanical investigation of Peloponnisos is currently in progress. Special attention has been paid to the east and south-east parts of Peloponnisos, with Mount Paronias and its surrounding lower peaks

being the target of more extensive fieldwork. Our collections have already yielded several floristic novelties that still remain unpublished. While collecting plant specimens on the slopes of the relatively low Mount Koulochera (1126 m) to the south-east of Mount Paronias, some *Achillea* plants attracted our attention. After a more thorough examination these proved to belong to a remarkable new species that apparently has no close relatives in Greece. This new species is described and illustrated here.

### MATERIAL AND METHODS

Living plants of the new species were examined in the field and dry material was studied in the laboratory. Comparisons with relevant *Achillea* taxa were made using the specimens in the following herbaria: ACA, ATH, B, FI, UPA (the herbarium acronyms are according to Holmgren, Holmgren & Barnet, 1990). Ripe achenes of the new species were collected in the field during summer and sown in pots. To overcome the dormancy observed in seed germination, the achenes were stratified at low temperatures (c. 4 °C) for

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10 days. The cultivated plants provided fresh root tips that were used for karyological investigations. To check chromosome number and morphology, root tips were pretreated with an aqueous solution of 8-hydroxyquinoline (0.3 g/L) for 3–3.5 h at room temperature. For further procedure and chromosome nomenclature see Constantinidis, Kamari & Phitos (1997). Good quality metaphase plates were recorded using a Sony CyberShot DSC-S75 digital camera.

## RESULTS

### *ACHILLEA OCCULTA* CONSTANTIN. & KALPOUTZ. SP. NOV. (FIGS 1, 2)

*Type*: [Greece], Peloponnisos, Nomos Lakonias, Eparchia Epidavrou-Limiras, Mt Koulochera. The upper parts of the mountain, from the chapel of Profitis Ilias to the north-east upper parts. Mostly along the crest line and the north-east slopes. Steep calcareous rocks, slopes and thickets with *Acer sempervirens* and *Amelanchier*. Alt. c. 1000–1100 m, lat. 36°49'N, long. 22°59'E, 31.v.2003, leg. *Th. Constantinidis & E. Kalpoutzakis 10691*. Holotype ACA, isotypes B, FI, UPA.

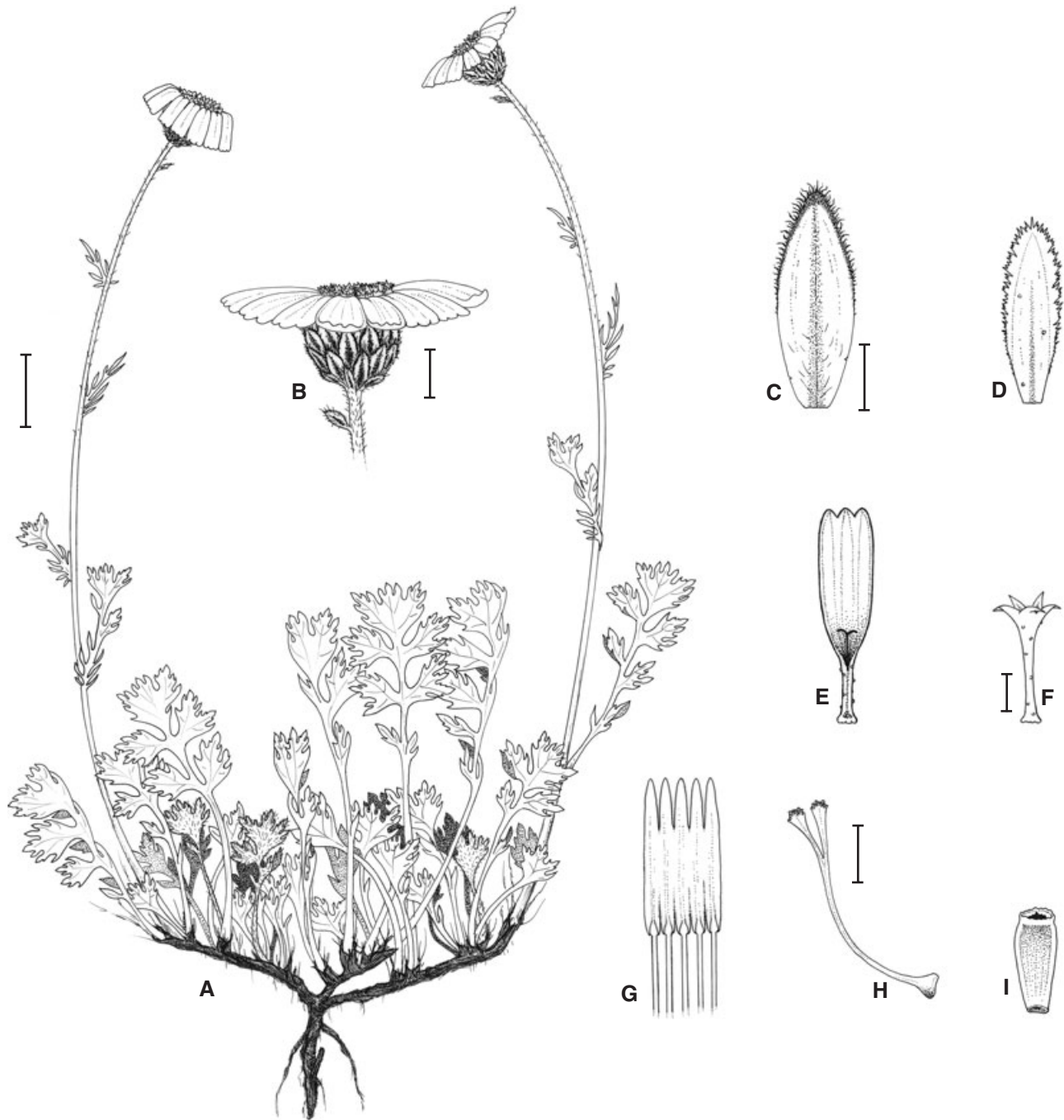
*Diagnosis*: Herba perennis, caespitosa, rosulas numerosas steriles et caules fertiles emittens. Caules simplices vel corymboso-oligocephali, erecti, 12–25 cm alti, sparsim villosi. Folia rosularia petiolata, subglabra, ambitu late obovata, 1- pinnatisecta, 25–80 × 20–30 mm, segmentis irregulariter et profunde incis; folia caulina media basalibus subsimilia, magnitudine decrescentia, sessilia. Involucrum 5–12 mm latum, phyllis obovatis vel ellipticis, 3.5–7 mm, sparsim pubescentibus vel subglabris, margine anguste scariosis, brunneolis. Flores radii 11–19, albae, late ellipticae, 6.5–11.5 × 3.5–5 mm, leviter 3–4-lobulatae; flores disci albi, tubo 3–3.5 mm, glanduloso. Achenia anguste obovata, brunneola, margine lutea, incrassata, 2.8–3.2 × 0.9–1.1 mm.

*Description*: Caespitose perennials. Creeping basal parts of stem give rise to several leaf rosettes and a few flowering stems. FLOWERING STEMS simple, ascending to erect, 12–25 cm long, sparsely villous, hairs apparently flagelliform, with a dilated base. Young leaves greyish-villous, becoming sparsely hairy to subglabrous at maturity; MATURE LEAVES of non-flowering shoots and lower cauline leaves 1- pinnatisect, 25–80 × 20–30 mm (at widest point), Petiole about as long as lamina; lamina broadly obovate in outline, with 2 pairs of broadly obovate primary lobes and 1–3 much smaller elliptic lobes or teeth below them; primary lobes 8–20 × 7–18 mm (at widest part), shallowly and irregularly dentate to incised; upper-

most lobes occasionally divided up to c. half into three parts; teeth ending in a yellowish spinule; MIDDLE CAULINE LEAVES sessile, obovate to broadly elliptic in outline, 22–42 × 12–24 mm (at widest point), rather similar to basal ones or with 7–11 lobes decreasing in size towards stem (but often 2–3 lowest ones again increasing their length); lobes entire to dentate, uppermost one often more deeply divided; upper cauline leaves smaller, with a couple of lanceolate lobes or entire. CAPITULA 1 or sometimes up to 4, the latter on 40–65 mm peduncles; INVOLUCRE 5–12 mm wide; involucre bracts 3.5–7 mm, ovate to elliptic, very sparsely hairy to subglabrous, with a median green stripe reaching bract tip and narrow, scarious, pale brownish margins. Paleae elliptic, transparent, curved, erose, glabrous but sparsely glandular, 5–6 × 1.5 mm. RAY FLORETS female, 11–19 per capitulum, limbs white, broadly elliptic, shallowly 3–4-lobed, 5.5–9.5 × 3.5–5 mm, tube 1.5–2.0 mm, glandular, slightly expanding at base and covering top of achene. DISC FLORETS hermaphrodite, white, with 5 triangular lobes 0.8–1.1 mm, tube 3–3.5 mm, glandular, clearly widening at base and enveloping top of achene. Anthers 5, coherent along most of their length and forming a c. 2 mm tube around style, filaments c. 0.8 mm, inserted c. 0.5 mm above tube expansion. Style of ray florets 2.6–3.1 mm, longer than tube, bifid (rarely trifid), branches 0.6–0.8 mm, slightly expanded at tip; style of disk florets 2.7–3.2 mm, usually shorter to as long as floret. ACHENES narrowly obovate, flattened, brownish, margins yellow and thickened, 2.8–3.2 × 0.9–1.1 mm, epappose, indistinctly coronate, not mucilaginous when wet.

*Specimens examined (other than the type)*: Nomos Lakonias, Eparchia Epidavrou-Limiras, Mt Koulochera. The upper parts of the mountain, along the crestline. Also its north-east upper slopes. Calcareous rocks in thickets of *Acer sempervirens*, *Phillyrea latifolia* and *Amelanchier* sp. Alt. 1000–1100 m, lat. 36°49'N, long. 22°59'E, 12.vi.2003, leg. *Th. Constantinidis & E. Kalpoutzakis 10738* (ACA, E, GB, UPA, WU). Nomos Lakonias, Eparchia Epidavrou-Limiras. The area known as Barbaria, to the west-south-west of Mt Koulochera. Steep limestone rocks and the foot of rocks. Alt. c. 800 m, lat. 36°49'N, long. 22°59'E, 03.i.2004, leg. *E. Kalpoutzakis s.n.* (rosette leaves, ACA).

*Habitat and ecology*: *Achillea occulta* inhabits the uppermost parts of Mount Koulochera, a mountain of average altitude (highest point at 1126 m), which can also be considered as a continuation of Mount Parnonas (1935 m) to the south-east. The plants are predominantly adapted to the rocky slopes and cliffs of the north-eastern and eastern parts of the mountain,



**Figure 1.** *Achillea occulta* Constantin. & Kalpoutz. **sp. nov.** A, habit. B, capitulum. C, middle involucre bract. D, palea. E, ray floret. F, disk floret. G, cylinder of anthers. H, style. I, achene. Drawn from *Th. Constantinidis* & *E. Kalpoutzakis* 10691 and 10738. Scale bars: A = 10 mm, B = 5 mm, C–E, I = 2 mm, F = 1.5 mm, G–H = 0.7 mm.

the only places that locally retain remnants of a tall scrub or tree formation. Most common woody species of this area are (Greek endemic taxa marked with an asterisk) *Acer sempervirens* L., *\*Amelanchier parviflora* Boiss. ssp. *chelmea* (Halácsy) Ziel., *Fraxinus ornus* L. ssp. *ornus* and *Phillyrea latifolia* L., while on

the cliffs grows *\*Rhamnus sibthorpiana* Schult. *Achillea occulta* prefers shady or semi-shady places that are protected from the blazing sun by the woody vegetation or any protruding rock faces. It is often hidden in suitable limestone hollows and the foot of rocks that retain some moisture, at least during spring and early

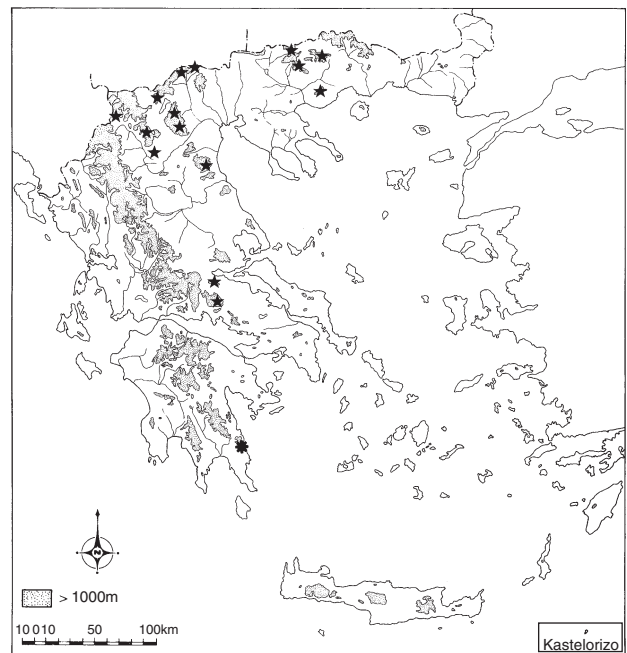


**Figure 2.** Flowering plants of *Achillea occulta* in their natural habitat.

summer. Strictly speaking, *A. occulta* is not a true chasmophyte, but it often grows in proximity to other chasmophytes or endemic and uncommon plant taxa such as *Aubrieta deltoidea* (L.) DC., *Campanula* sp., \**Cerastium illyricum* Ard. ssp. *brachiatum* (Lonsing) Jalas, *Crepis fraasii* Sch. Bip., \**Cymbalaria microcalyx* (Boiss.) Wettst. ssp. *microcalyx*, *Festuca* sp., \**Minuartia pichleri* (Boiss.) Maire & Petitm., \**Melica rectiflora* Boiss. & Heldr., \**Stachys chrysantha* Boiss. & Heldr., *Thalictrum orientale* Boiss., etc. *Achillea occulta* may be gregarious and may be the dominant species in protected rock cracks where fertile soil has accumulated. It was not found on the open, dry and slightly inclined slopes of the summit area that mostly face south and west, the only exception being the south-easternmost and highest peak of Koulochera where the species takes advantage of the microhabitats provided by cracks on south-west-facing rocks.

**Distribution:** A local endemic species, *Achillea occulta* is currently only known from two neighbouring localities in south-east Peloponnisos, i.e. the summit area of Mount Koulochera and the area known as Barbaria to the west-south-west of Mount Koulochera (Fig. 3). These two localities are separated by a distance of c. 1 km and are represented by a single symbol in the distribution map.

**Conservation status:** The species is characterized as Vulnerable VU (criteria B1a, D2) according to IUCN Red List Categories (IUCN, 2001). Its populations should nevertheless be closely monitored for any status change in the future.



**Figure 3.** Distribution of *Achillea occulta* (hexagram) and *A. ageratifolia* s.l. (stars) in Greece. These two species are the only representatives of the ‘Anthemoideae’ group in Greece but are not closely related.

The total number of individuals found in the three rocky outcrops of Mount Koulochera is difficult to estimate. The species often roots at its lowermost parts and emits new stems and several leaf rosettes that continue vegetative propagation. A rough estimation

suggests that over 2500 flowering plants were seen in 2003. Some populations of the species are close to the telecommunications antennae mounted on the top of the mountain and are therefore easy to reach, but other populations grow in steep or inaccessible places, and these are protected from both grazing pressure and human activities.

The mountain vegetation on Koulochera is heavily grazed by domestic herbivores, mostly goats and sheep, in late spring and summer. A narrow earth road leading to the antennae at the top of the mountain enables vehicle transportation of people and animals. It is presumed that existing animal pressure will not severely affect the survival of the populations of *A. occulta* for the foreseeable future, because the animals eat the flowering stems and leaves, usually leaving the lower parts and vegetative buds untouched. The latter often exist deep in rock hollows and cracks and cannot be reached by large herbivores.

The plants of *A. occulta* found in Barbaria were estimated to number around 400–500 by the second author. In this locality the species is prone to the same threats as on Mount Koulochera.

Mount Koulochera has been selected for inclusion in the Natura 2000 net of ecologically important areas in Greece, and this will have a beneficial effect on the future survival of *A. occulta*.

## TAXONOMIC DISCUSSION

### POSITION OF *ACHILLEA OCCULTA* WITHIN SECT.

#### *PTARMICA*

*Achillea occulta* clearly belongs to *A. sect. Ptarmica* because of its capitula with 11–19 long, white ray florets and its divided leaves, whose segments are neither transverse nor imbricate (Huber-Morath, 1975). This whole section has been revised only by Heimerl (1884), who distinguished three illegitimate 'sections' within sect. *Ptarmica*: sect. *Anthemoideae*, sect. *Montanae* and sect. *Euptarmicae*. Heimerl's segregation may reflect a natural delimitation of section *Ptarmica* but his classification scheme used inappropriate taxonomic ranks and cannot be accepted.

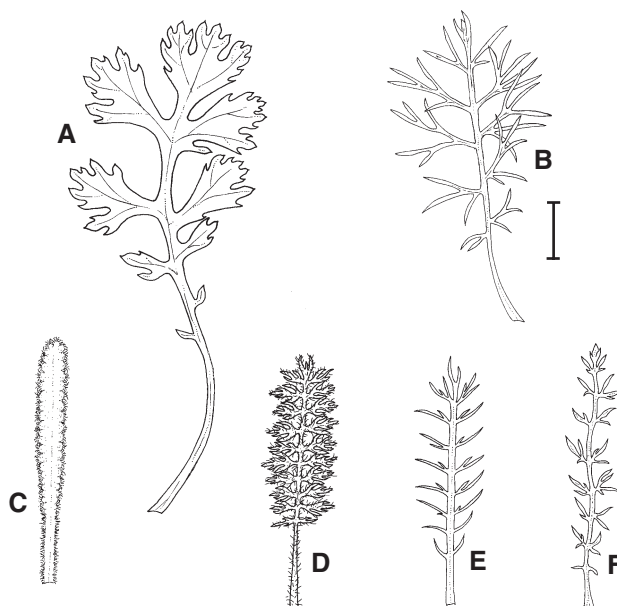
Within sect. *Ptarmica* a small group of taxa is formed with predominately single and large capitula (rarely up to five per stem and then forming a lax corymb), with 12–25 long ray florets per flowering head and glabrous but occasionally glandular paleae or inner scales. This corresponds to Heimerl's 'sectio' *Anthemoideae*, and *A. occulta* fits well in this group, together with *A. barrelieri* (Ten.) Sch. Bip., *A. mucronulata* Bertol., *A. oxyloba* (DC.) Sch. Bip. and *A. schurii* Sch. Bip. Heimerl (1884) placed a fifth species in this group, *A. ageratifolia* (Sm.) Boiss., from the Balkan Peninsula. *Achillea ageratifolia* has been the subject

of a taxonomic revision by Franzén (1986), where the subspecific classification proposed by Heimerl is given formal recognition and three subspecies are distinguished. All the subspecies are morphologically so different from *A. occulta* (being often suffruticose, with a distinct villous indumentum, thick, mostly undivided, serrate leaves and mucilaginous achenes) that any actual taxonomic proximity to it is not supported.

### TAXONOMIC COMPARISONS WITH RELATED SPECIES

Having examined all the *Achillea* taxa growing in Greece (c. 32 species and subspecies), which belong either to sect. *Ptarmica* or to different sections, we have found no species closely related to *A. occulta*. We therefore conclude that the 'Anthemoideae' group of Heimerl (1884) includes species that should be examined for proper taxonomic consideration. The most important morphological differences between *A. occulta* and each of the related species are presented in Table 1.

*Achillea occulta* clearly differs from all its relatives by the morphology of the leaves (Fig. 4). Its basal and lower cauline leaves have two pairs of broadly obovate lobes; these and the wide uppermost lobe may sometimes be divided up to c. half into three parts. One or two smaller lobes or teeth are also found below the larger ones. Furthermore, its upper cauline leaves may be of a different shape, with numerous narrow



**Figure 4.** Rosette or lower cauline leaves of *Achillea occulta* and related species of the 'Anthemoideae' group. A, *A. occulta*. B, *A. mucronulata*. C, *A. ageratifolia*. D, *A. barrelieri*. E, *A. oxyloba*. F, *A. schurii*. Scale bar = 15 mm.

Table 1. Most important diagnostic characters between *Achillea occulta* and its relatives of the 'Anthemioideae' group

Characters	<i>A. occulta</i>	<i>A. oxyloba</i>	<i>A. schurii</i>	<i>A. barrelieri</i>	<i>A. mucronulata</i>
Stems	Sparsely villous	Sparsely villous	Sparsely villous	Densely villous	Mostly sparsely villous
Basal/lower leaves	1-pinnatisect, sparsely villous to subglabrous	Mostly 1-pinnatisect, subglabrous	1-2-pinnatisect, subglabrous	1-2-pinnatisect, densely villous to villous	2-pinnatisect, sparsely villous to subglabrous
Outline	Broadly obovate	Narrowly obovate to lanceolate	Obovate to obovate-oblong	Narrowly obovate to elliptic-oblong	Obovate to obovate-oblong
Petiole	About as long as lamina	Shorter than lamina to absent	Shorter than lamina	Shorter to as long as lamina	About as long as lamina
Size (length × width, mm)	25-80 × 20-30	12-110 × 4-25	12-94 × 4-27	14-60 × 6-16	40-160 × 15-35
Primary lobes	3-4 pairs, broadly obovate, irregularly dentate to incise	6-9 pairs, linear to lanceolate, entire to deeply lobed	5-8 pairs, linear-lanceolate, entire to pinnatisect	6-13 pairs, ovate-elliptic to lanceolate, entire to pinnatisect	6-10 pairs, linear, entire to pinnate
Size (length × width, mm)	8-20 × 6-18	3-10 × 0.2-1.1	3-12 × 0.3-1.0	2-8 × 0.5-3	5-18 × 0.5-1
Involucral bracts	Ovate to elliptic, outer less than half as long as inner	Narrowly ovate to oblong-elliptic, outer more than half as long as inner	Ovate to elliptic, outer more than half as long as inner	Ovate to narrowly ovate, outer less than half as long as inner	Ovate to elliptic, outer less than half as long as inner
Size (length, mm)	3.5-7	4-8	4-7	3.5-6	3.5-6
Apical margins	Light brown, 0.2-0.7 mm wide	Dark brown, 0.4-1.3 mm wide	Dark brown, 0.4-1.2 mm wide	Brown, 0.4-1.2 mm wide	Brown to light brown, 0.5-1.2 mm wide

segments. All the other species in its group have five or more pairs of linear to ovate-elliptic lobes in their basal or lower cauline leaves, which themselves may be further divided, especially in the case of *A. mucronulata* and *A. schurii*.

*Achillea occulta* also differs from *A. oxyloba* and *A. schurii* in having ovate to ovate-elliptic involucre bracts with pale brownish margins. Its outer involucre bracts are usually less than half as long as the inner involucre bracts. Both *A. oxyloba* and *A. schurii* have involucre bracts with dark brown to blackish margins that contrast with their pale inner parts. Also, their outer involucre bracts are usually more than half as long as the inner involucre bracts. Further, the shape of the involucre bracts, especially in *A. oxyloba*, is different from *A. occulta* (Table 1). Compared with *A. barrelieri*, *A. occulta* differs in being a more robust plant with a fresh green colour, and in the fact that it lacks the distinct tomentose indumentum on mature leaves, stems and upper part of involucre bracts that gives *A. barrelieri* a characteristic greyish-brownish appearance. The most obvious difference between *A. occulta* and *A. mucronulata* is the shape, width and dissection of primary leaf lobes. The latter species differs further in generally having dark and wider brown margins on the apex of its involucre bracts. Judging from overall morphological similarity, *A. mucronulata* could perhaps be the closest relative of *A. occulta*.

It is worth mentioning that forms intermediate between *A. oxyloba*, *A. mucronulata*, *A. schurii* and *A. barrelieri* have been observed, and some authors consider *A. mucronulata*, *A. schurii* and *A. barrelieri* at subspecific rank, under various combinations (Heimerl, 1884; Richardson, 1976; Conti, 1998). However, hybridization is rather common in *Achillea*, especially among taxa growing sympatrically, and it may be interesting to study whether these are fertile and to what extent.

#### PHYTOGEOGRAPHY

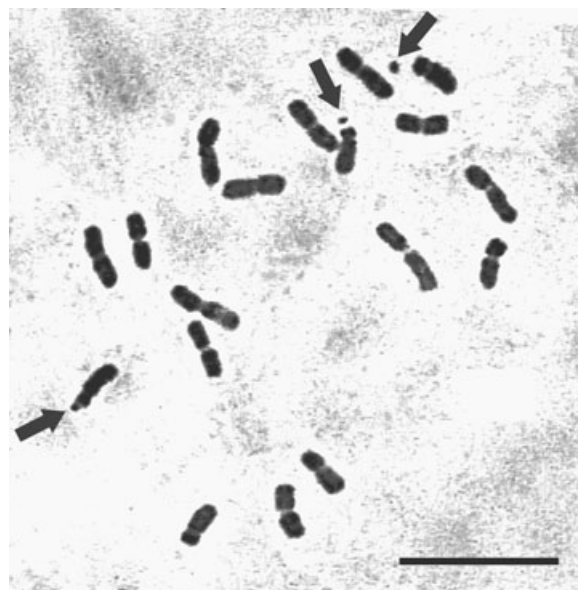
Compared with *Achillea occulta*, a single mountain endemic, all the related members of the 'Anthemoideae' group definitely have a wider and more western and northern distribution. They are known from the Apennines, the Alps and the Carpathians, with three of them (*A. barrelieri*, *A. mucronulata*, *A. oxyloba*) found in central and northern Italy. *Achillea occulta* is also geographically well isolated from the group of *A. ageratifolia*, which comprises Balkan taxa having the mountains of central Greece as their southernmost border (Fig. 3).

The discovery of a new, localized species in south-east Peloponnisos whose relatives are remotely distributed in central Europe and the Italian Peninsula is

unexpected and noteworthy. There are only a few examples of central European taxa that reach south Peloponnisos, and these are mostly found in woods (e.g. *Galium rotundifolium* L., *Monotropa hypopitys* L., *Potentilla micrantha* Ramond ex DC.). Furthermore, the Italian floristic element is rather weakly represented in the mountains of Peloponnisos, and only two or three native species of the Italian flora reach Peloponnisos and/or Kriti without being found on other Greek mountains, especially Pindos to the north-west (Strid, 1993). On Mount Parnonas in particular, the floristic category of species found in the Balkans and Italy accounts for c. 4.5% of its flora (Tan & Strid, 1999), but this percentage refers to a more general category that also includes many widespread species. It should also be added here that Mt Koulochera is poorly known botanically, and the percentage of the various phytogeographical categories in its flora cannot currently be estimated.

#### KARYOLOGY

Twelve plants of *Achillea occulta* were used for chromosome studies. The constant chromosome number found in all metaphase plates is  $2n = 18$  (Fig. 5). The species is therefore diploid, based on  $x = 9$ . Most of the chromosomes are metacentric, a few are submetacentric while the two acrocentric chromosomes are marked with satellites. The karyotype formula is given as  $2n = 2x = 12m + 3sm + 1sm-SAT + 2st-SAT = 18$ .



**Figure 5.** A metaphase chromosome plate of *Achillea occulta* with  $2n = 18$ . The satellites observed on the short arm of three chromosomes are marked with arrows. Scale bar = 10  $\mu$ m.

The same diploid chromosome number has been reported in the Italian relatives of *A. occulta*, namely *A. barrelieri*, *A. oxyloba* and *A. mucronulata* (Maffei, Deirino & Codignola, 1986; Baltisberger, 1990; Brullo *et al.*, 1991), although there is also an older report of  $2n = 32$  for *A. mucronulata* (see Brullo *et al.*, 1991). All the species of this group seem to share the predominance of metacentric chromosomes in their complements, with submetacentric chromosomes being few. The acrocentric chromosome couple and the satellites may even be completely missing in some species, such as *A. oxyloba* (Maffei *et al.*, 1986), where they are replaced by a submetacentric couple.

The observed chromosome morphology of *A. occulta* strengthens its taxonomic relationships with that particular group of *Achillea* reported as 'Anthemoideae' by Heimerl (1884). However, the clear morphological differentiation and the remote geographical distribution give *A. occulta* a rather isolated position within the group.

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