

Studies in the Aegean Flora XII

Cytologic and Morphologic Investigations in *Centaurea*

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ABSTRACT

The morphologic variation within *Centaurea argentea* L., *spinosa* L., and *urvillei* DC. is briefly discussed. The *Centaurea raphanina* complex is treated in detail. Two morphologically well distinguished form series in *C. raphanina* S. & S. are recognized, viz. ssp. *raphanina* restricted to Crete and Karpathos and ssp. *mixta* (DC.) RUN. stat. nov. occurring in the Greek mainland. In the Cyclades apparently a large scale introgression has taken place between the subspecies, resulting in an almost chaotic morphologic variation. A hybrid between *C. oliveriana* DC. and *C. raphanina* S. & S. has been obtained in cultivated material and a hybrid swarm has been observed in the field in Naxos. *C. halacsyi* DÖRFL. and *C. nigrotriangulata* RECH. f., are both interpreted as hybrids between *C. oliveriana* DC. and *C. raphanina* S. & S. A new species, *C. scyria* RUN. sp. nov., is described. It is endemic to Skiros and possibly related to *C. oliveriana* DC. Chromosome counts of 11 species are presented. Of these species *C. solstitialis* L. is the only one previously cytologically investigated. The chromosome numbers found are as follows:

| | | | |
|-------------------------------------|-------|---|-------|
| <i>C. argentea</i> L. | 2n=18 | <i>C. scyria</i> RUN. | 2n=20 |
| <i>C. spinosa</i> L. | 2n=36 | <i>C. oliveriana</i> DC. | 2n=22 |
| <i>C. solstitialis</i> L. | 2n=16 | <i>C. oliveriana</i> DC. × <i>raphanina</i> | |
| <i>C. cretica</i> (BOISS. & HELDR.) | | S. & S. | 2n=21 |
| NYM. | 2n=22 | <i>C. raphanina</i> S. & S. | |
| <i>C. exscapa</i> URV. | 2n=20 | ssp. <i>raphanina</i> | 2n=20 |
| <i>C. redempta</i> HELDR. | 2n=20 | ssp. <i>mixta</i> (DC.) RUN. | 2n=20 |
| <i>C. spruneri</i> BOISS. & HELDR. | | <i>C. urvillei</i> DC. | 2n=40 |
| ssp. <i>guicciardii</i> (BOISS.) | | | |
| HAY. | 2n=20 | | |

INTRODUCTION

The morphologic analyses are mainly based on the extensive material collected by HANS RUNEMARK, SVEN SNOGERUP, BERTIL NORDENSTAM, ARNE STRID, ROLAND VON BOTHMER, and JIMMY PERSSON during field investigations in 1957—1966.

The cytologically investigated individuals have been obtained from seeds of spontaneous material collected in the field. In most cases 4—6 individuals of each collection have been analysed. Cytologic observations have been made on root-tip sections (fixation in the Svalöf modification of Navashin-Karpechenko and staining in crystal violet, in some cases with the addition of aniline).

The material investigated and in most cases also the parents collected in the field have been dried and are preserved in the Botanical Museum, Lund, Sweden. The names of the exact localities have been taken from the detailed sea charts of the British Admiralty (cf. also maps in RUNEMARK et al. 1960).

***Centaurea argentea* L. [sect. *Acrolophus* (CASS.) DC.]**

$2n=18$ (Fig. 2 A)

Crete. Sfakia, 1—2 km N of the village of Sfakia 50—250 m SNOGERUP (R-3894).

Sitia, 1 km SE of Kavousi 300 m SNOGERUP (R-3895).

The chromosomes are very dissimilar to those of other Aegean *Centaurea* species investigated. A difference in the structure of one of the satellited chromosome pairs seems to exist between the two collections studied.

C. argentea is an obligate chasmophyte, endemic to the southern Aegean. It is known from c. 20 localities in eastern and western Crete, but in 1964 it was also discovered in the island of Kithera, S of Peloponnisos (RUNEMARK & SNOGERUP 20822). *C. argentea* is extremely variable in habit, leaf shape and shape of the apical part of the involucre scales (Fig. 1 A—F). The variation is probably the result of genetic drift in small, isolated cliff populations.

A detailed study of the morphologic variation within and between the populations and a thorough investigation of the chromosome morphology is planned.

***Centaurea spinosa* L. [sect. *Acrolophus* (CASS.) DC.]**

$2n=36$ (Fig. 2 B)

East-Aegean islands. Ikaria, Pharos RUNEMARK & SNOGERUP (R-1260, 1712).

Cyclades. Naxos, 2 km N of Mitria RUNEMARK & SNOGERUP (R-1511).

„ , 3 km S of Axapsis 30 m RUNEMARK & SNOGERUP (R-1545).

Paros, 2 km N of the peak of Prof. Elias 450 m RUNEMARK & SNOGERUP (R-1711).

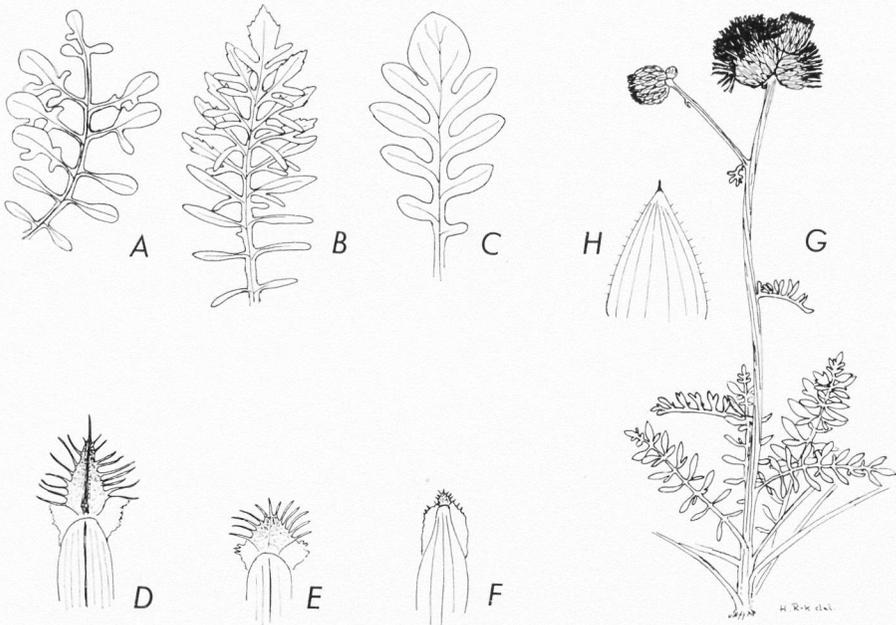


Fig. 1. A—F. *Centaurea argentea*. A—C leaves, D—E involucre scales from different populations (A and D: Crete, Sitia, Leopetra, B and E: Crete, Sfakia, C: Crete, Sitia, Kavousi, F: Kithera, near the town). — G, H. *Centaurea scyria*. G: a whole individual (only the petioles of the lowermost leaves are indicated), H: an involucre scale.

C. spinosa is a maritime, spinose shrub, endemic to the Aegean. It is a rather common species recorded from all parts of the Aegean (cf. map in RECHINGER 1947). It is very variable in leaf shape, pubescence and colour of the florets. Such differences observed in the field are maintained in cultivated material.

HAYEK (1928) and RECHINGER (1943) subdivided *C. spinosa* into two geographically vicarious subspecies: ssp. *tomentosa* (HAL.) HAY. with densely tomentose, silvery leaves and reddish florets and ssp. *cycladum* (HELDRE.) HAY. with almost glabrous, green leaves and yellowish florets. During the investigation of the material collected by me and my collaborators the following was found:

1. The subspecies described merely represent extreme forms within an apparently continuous variation series.

2. Material, which must be referred to ssp. *cycladum*, has been outside the Cyclades (e.g. in Ikaria).

3. Material, which must be referred to ssp. *tomentosa*, is common in the Cyclades.

4. Material referable to ssp. *tomentosa* and ssp. *cycladum* have the same chromosome number ($2n=36$).

A subdivision into geographically vicarious subspecies does not seem to be justified.

C. spinosa is rarely found in non-maritime localities (e.g., in the central part of Paros 450 m above sea level, RUNEMARK & SNOGERUP 12692). A closely related taxon, *C. tragacanthoides* RECH. f., occurs on loose schists above the timber line (1000—1200 m) on the mountain of Kerki, Samos. It is characterized by somewhat smaller capitula, weaker spines and dark purple florets. Possibly it ought to be included into *C. spinosa* as a distinct mountain ecotype.

***Centaurea solstitialis* L.** [sect. *Mesocentron* (CASS.) DC.]

$2n=16$ (Fig. 2 C)

Cyclades. Naxos, the chapel N of Zeus Oros 600 m RUNEMARK (R-1484).

The same chromosome number ($2n=16$) has been reported by GUI-NOCHET (1957) from North Africa and by HEISER and WHITAKER (1948) on introduced material from California.

C. solstitialis is widely distributed in the Mediterranean and in western and central Europe. In the Cyclades it is rare and probably occurs as an introduced weed only.

***Centaurea cretica* (BOISS. & HELDR.) NYM.** [sect. *Aegialophila* (BOISS. & HELDR.) HAY.]

$2n=22$ (Fig. 2 D)

Crete. Sitia, Cape Sidero SNOGERUP (R-3901).

C. cretica and the closely related *C. pumila* L. are both psammophytes occurring along the East-Mediterranean sea from Crete and Cyrenaica to Israel (cf. map in RECHINGER 1947). Because of the unique pappus structure the two species have been referred to a genus of its own, *Aegialophila* BOISS. & HELDR. WAGENITZ (1955) pointed out that in other morphologic characteristics (e.g. the shape of the involucre scales) they are similar to sect. *Acrocentron* in *Centaurea*. He also showed that they have the same pollen type (the *scabiosa* type) as in *Acrocentron*. He therefore referred them to a section within *Centaurea*, closely related to *Acrocentron*.

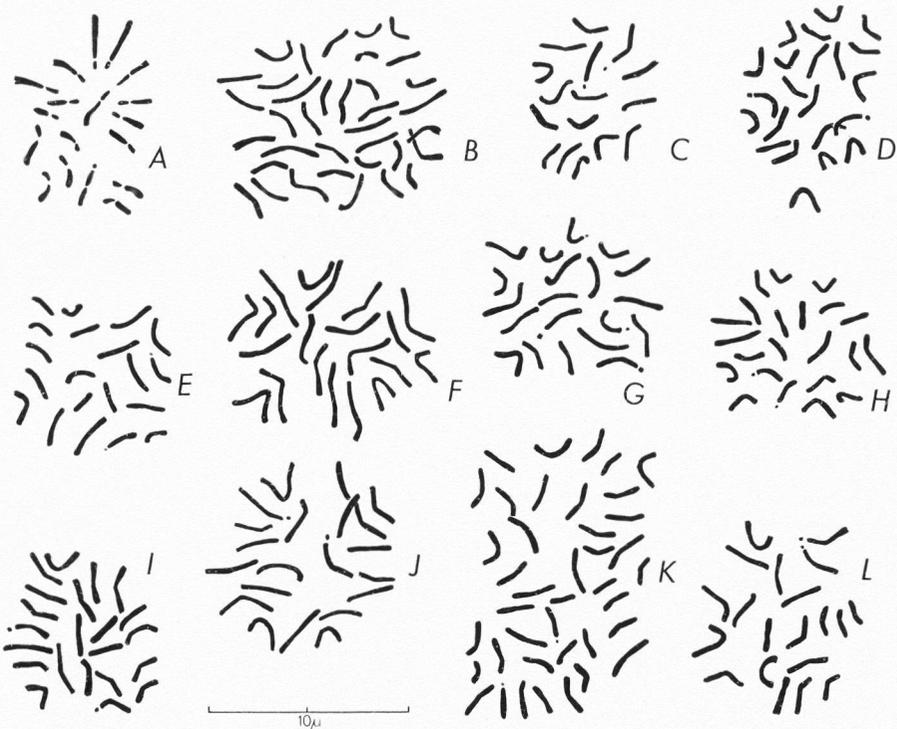


Fig. 2. Chromosome (somatic metaphase plates) in Aegean material of *Centaurea*. — A: *C. argentea* ($2n=18$). — B: *C. spinosa* ($2n=36$). — C: *C. solstitialis* ($2n=16$). — D: *C. cretica* ($2n=22$). — E: *C. exscapa* ($2n=20$). — F: *C. redempta* ($2n=20$). — G: *C. spruneri* ssp. *guicciardii* ($2n=20$). — H: *C. scyria* ($2n=22$). — I: *C. oliveriana* ($2n=22$). — J: *C. oliveriana* × *raphanina* ($2n=21$). — K: *C. urvillei* ($2n=40$). — L: *C. raphanina* ssp. *raphanina* ($2n=20$).

The chromosome morphology of *C. cretica* is similar to that found in Aegean *Acrocentron* species. Besides, the same chromosome number ($2n=22$) has been found in two Aegean *Acrocentron* species (*C. oliveriana* DC. and *C. scyria* RUN.).

***Centaurea exscapa* URV.** [sect. *Acrocentron* (CASS.) DC.]

$2n=20$ (Fig. 2 E)

East-Aegean islands. Simi, Nano Bay BOTHMER (R-3910).

C. exscapa is a mostly chasmophytic species, endemic to the islands along the Anatolian westcoast. It is closely related to the Anatolian species *C. chrysoleuca* BOISS. and *C. eriophylla* BOISS. & BAL. and to *C. acicularis* S. & S. from Cyprus.

Centaurea redempta HELDR. [sect. *Acrocentron* (CASS.) DC.]

2n=20 (Fig. 2 F)

Crete. Kissamos, 9 km SSE of Kastello, SE of Rocco 150 m SNOGERUP (R-3892).

C. redempta is a chasmophyte, endemic to western Crete. Besides the locality discovered by SNOGERUP the species has only been recorded from two localities. Together with *C. laconia* BOISS. (*C. subarachnoidea* BOISS. & HELDR.), a chasmophyte in central Peloponnisos, and a newly discovered chasmophytic species in the island of Kithera (RECHINGER, unpublished), it constitutes a small group of vicarious taxa without obvious affinities to other species in the section *Acrocentron*.

Centaurea spruneri BOISS. & HELDR. ssp. ***guicciardii*** (BOISS.) HAY. [sect. *Acrocentron* (CASS.) DC.]

2n=20 (Fig. 2 G)

Cyclades. Sifnos, Cape Khondropo RUNEMARK & SNOGERUP (R-1713).
Andros, 2 km SSE of Batsi SNOGERUP (R-3893).

The *C. spruneri* complex, occurring in the southern part of the Greek mainland, the western Cyclades, and Crete, is in urgent need of revision. The Cycladian material, usually treated as v. *lineariloba* (HAY. & DÖRFL.) HAY., occurs in natural habitats (garigue and rocky slopes) and seems rather distinct. The form series occurring as weeds in fields and vineyards in the Greek mainland are, however, extremely variable, e.g., in habit, leaf shape, and the development of involucrel spines.

Centaurea scyria RUN. sp. nov. [sect. *Acrocentron* (CASS.) DC.]

2n=22 (Fig. 2 H)

Skiros, Exo Diavathi RUNEMARK & NORDENSTAM (R-3705).

DIAGNOSIS. Habitu *Centaurea ragusinae* L. similis, sed differt involucreae squamae in mucrone brevi attenuatae et flores fuscis purpurei. — Graecia. Skiros (Skyros), in insula Exo Diavathi 26.7 1960 RUNEMARK et NORDENSTAM 16842 (Holotypus in Herb. Bot. Lund).

DESCRIPTION (cf. Fig. 1 H, G). 30—60 cm high, basally lignified, adpressedly tomentose, wholly white perennial. Leaves pinnatisect to bipinnatisect, (in juvenile plants entire, ovate); segments broadly lanceolate. Stem 5—10 mm in diam., striate, in upper part sometimes branched. Capitula sessile, 2—5 together, 1.5—2.5 cm in diam. Invo-

lucral scales greenish yellow, with indistinct parallel nerves, tapering from a rounded base into a c. 1 mm long, brownish red mucro, and in the margins with sparse c. 0.5 mm long, stiff, brownish red hairs. Florets brownish purple. Pollen of *scabiosa*-type (cf. WAGENITZ 1955). Achenes c. 5 mm, greyish brown with long, silky hairs. Pappus c. 5 mm with numerous setae of varying length.

ECOLOGY. In maritime limestone cliffs, c. 20 m above sea level.

DISTRIBUTION. Only known from a single collection on the small island of Exo Diavathi, W of Skiros in the northern Aegean.

AFFINITIES. *C. scyria* seems to be an isolated member of sect. *Acrocentron*. In habit it is similar to *C. ragusina* L. from the Dalmatian coast. It is, however, questionable if *C. scyria* is in fact related to this species, which has yellow florets and a very different type of involucral scales, with pectinately ciliate apex. *C. scyria* is similar to *C. oliveriana* DC. from the central Cyclades in the shape of the involucral scales, and also in the very special colour of the flowers (brownish purple) not found in any other Greek *Centaurea* species.

***Centaurea oliveriana* DC.** [sect. *Acrocentron* (CASS.) DC.]

2n=22 (Fig. 2 I)

Cyclades. Naxos, Mavrianos 200 m RUNEMARK & SNOGERUP (R-1211, R-1707).

„ , W-slope of Fanari Oros 750 m RUNEMARK & SNOGERUP (R-1320, R-1710).

„ , 2 km W of Hypsiliammos 240 m RUNEMARK & SNOGERUP (R-1449, R-1704).

„ , 2 km S of Ammomachis Oros 300 m RUNEMARK & SNOGERUP (R-1708).

Amorgos, 1 km S of Panagia 250 m BOTHMER (R-3907).

Centaurea oliveriana is a very characteristic, relatively invariable chasmophyte, endemic to the central Cyclades (see map in RUNEMARK et al. 1960). It has been regarded as an isolated member of sect. *Acrocentron*. Possibly it is related to the newly discovered *C. scyria* RUN., a chasmophyte from Skiros in the northern part of the Aegean. It also shows some similarities to *C. lactucaefolia* BOISS., another isolated species usually referred to sect. *Phalolepis* (CASS.) DC., which is a chasmophyte endemic to Rhodos and adjacent islands. — *C. oliveriana* and *C. scyria* are the only species within sect. *Acrocentron* known to have 2n=22. Also in chromosome morphology they are similar (Fig. 2 I, H).

***Centaurea oliveriana* DC. × *C. raphanina* S. & S. [sect. *Acrocentron* (CASS.) DC.]**

2n=21 (Fig. 2 J)

Cyclades. Naxos, 2 km W of Hypsiliammos 240 m RUNEMARK & SNOGERUP (R-1708-5).

This unexpected hybrid between the giant species *C. oliveriana* and the small acaulescent *C. raphanina* was obtained from a seed collection of *C. oliveriana*. The hybrid individual seems to be completely sterile.

When comparing herbarium material it became evident that *C. nigrotriangulata* RECH. f. and *C. halacsyi* DÖRFL., both known from a single collection in the Cycladian island of Amorgos, belong to this hybrid.

In material of *C. nigrotriangulata* from the original locality Panagia Chozoviotissa in Amorgos collected by SNOGERUP in 1964 a few relatively well developed seeds were found. One of these seeds germinated, but the seedling died after 10 days.

In Naxos, 2 km WSW of Liona (RUNEMARK & SNOGERUP 9130, 9148) a variable hybrid swarm between *C. oliveriana* and *C. raphanina* consisting of 10—20 individuals (Fig. 3) has been found. At least part of the material represents backcrossings to the parents.

***Centaurea raphanina* S. & S. [sect. *Acrocentron* (CASS.) DC.]**

Ssp. *raphanina*

2n=20 (Fig. 2 L)

Crete. Sitia, S of Turloti 300 m RUNEMARK & SNOGERUP (R-3889).

Sitia, the valley W of Maronia 400 m RUNEMARK & SNOGERUP (R-3890).

Ssp. *mixta* (DC.) RUN.

2n=20

Attica. Porto Rafti 100 m SNOGERUP (R-3897).

Euboea. 3 km WSW of Akr. Kafirevs RUNEMARK & SNOGERUP (R-1705).

East-Aegean islands. Ikaria, Cape Papas RUNEMARK & SNOGERUP (R-1334).

Intergrades between ssp. *raphanina* and ssp. *mixta*

2n=20

Cyclades. Koufonisi, the islet of Kopria RUNEMARK & SNOGERUP (R-1706).

Naxos, Stavros Keramotis 600 m RUNEMARK (R-33, 74).

Naxos, Akr. Ag. Ioannis RUNEMARK (R-1143).

Fig. 3. Some individuals of the hybrid swarm between *C. oliveriana* and *C. raphanina* found in Naxos. The largest individual is similar to that in cultivation (×0.4).



Fig. 3.

As far as can be observed in chromosome plates obtained in root-tip sections no differences in chromosome structure occur between ssp. *raphanina* and ssp. *mixta*.

Within the *raphanina* complex six species have been described, viz. *C. raphanina* S. & S. (1817), *C. mixta* DC. (1837) = *C. hellenica* BOISS. (1843), and the four endemic, Cycladian species: *C. myconia* BOISS. & SART. (1859), *C. halacsi* DÖRFL. (1901), *C. eriopoda* RECH. f. (1934) and *C. nigrotriangulata* RECH. f. (1934). RECHINGER (1943) showed that the endemic, Cycladian species do not occupy different geographic areas, and that intermediates between them are very common, and therefore reduced them to varieties of *C. mixta*. RECHINGER later (1947 and 1950) drew attention to the chaotic variability of *C. mixta* in the Cyclades, according to him partly caused by ecologic differentiation (chasmophytic and colline series).

According to RECHINGER (1950) two well delimited, strictly vicarious species of the *raphanina* complex occur in the Aegean, viz. *C. mixta* on the Greek mainland and in the central Aegean islands, *C. raphanina* in Crete and Karpathos, both replaced by *C. urvillei* in the East-Aegean islands. According to him the boundaries between the species wholly coincide to the oldest fault zones in the Aegean area.

A renewed analysis, also including cultivated material, can now be carried out as extensive collections have been made in southern Greece (mainly in the Cyclades) by the author and his collaborators in 1957—1966.

MORPHOLOGIC ANALYSIS

As mentioned already by RECHINGER (1943) the material of *C. mixta* from the Greek mainland is fairly homogeneous. A morphologic analysis of *C. raphanina* from Crete and Karpathos has shown that also this material is relatively invariable. A comparison between material of *C. mixta* from the Greek mainland and *C. raphanina* revealed a number of differences (cf. Fig. 4).

1. Pronounced differences

| <i>mixta</i> | <i>raphanina</i> |
|--|---|
| At least largest leaf segments with scattered, small teeth. | All leaf segments lacking teeth. |
| Small, stiff hairs in leaf margin, but no hairs on leaf surface. | Small stiff hairs in leaf margin and on leaf surface. |
| Leaves glossy on upper side. | Leaves matt on upper side. |
| Longest spines of involucre 10—20 mm. | Longest spines of involucre 2—8 mm. |

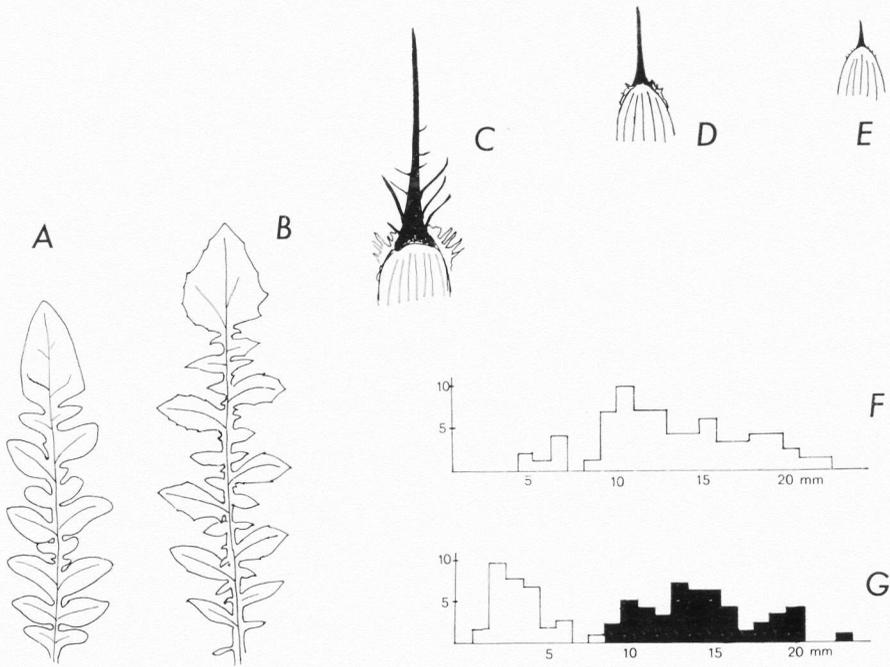


Fig. 4. *Centaurea raphanina*. — A: leaf of *ssp. raphanina*, B: leaf of *ssp. mixta*, C: involucral scale of *ssp. mixta*, D, E: involucral scales of *ssp. raphanina*. — F, G. The length of the longest spine in a capitulum. The number of individuals is indicated on the vertical axis, the length of the spine on the horizontal one. F: Cycladian material, G: *ssp. raphanina* from Crete (white) and *ssp. mixta* from the Greek mainland (black).

Thin, lateral spinelets on lower part of spine.

Involucral scales rather broad, with rounded apex.

Capitula rounded, with truncate base.

2. Less pronounced differences

mixta

Leaves dark green, of firm texture.

Terminal lobe of leaf normally small.

Flowering stem very short.

No thin, lateral spinelets on lower part of spine.

Involucral scales narrow, with tapering apex.

Capitula elongated, with tapering base.

raphanina

Leaves light green to green, rather soft.

Terminal lobe of leaf large.

Flowering stem often elongated (5—20 cm).

An analysis of the material from the Cyclades gave the following result (cf. Fig. 5).

Table 1. *Centaurea raphanina*. — The frequencies (in %) of ssp. *raphanina* and ssp. *mixta* characteristics in 6 populations in the Astipalea area in the south-eastern Cyclades. In the comparisons made the *mixta* characteristics are placed to the left. — The material from Ofidousa coincides in all respects with ssp. *mixta* from the Greek mainland. — The analyses were made in the field in 1966.

| | Leaves | | | | Involucral spines | | | | number of individuals | |
|--------------------|----------|-------|---------|-------------|-------------------|---------------|-------|-------------------------------------|-----------------------|-------|
| | glabrous | hairy | dentate | non-dentate | long | inter-mediate | short | lateral spinelets present absent | | |
| Astipalea | | | | | | | | | | |
| Maltesana . . . | 85 | 15 | 30 | 70 | 5 | 30 | 65 | 70 | 30 | 20 |
| Panermo . . . | 60 | 40 | 55 | 45 | 35 | 55 | 10 | 80 | 20 | 20 |
| Kounoupia . . | 90 | 10 | 60 | 40 | 85 | 15 | — | 90 | 10 | 20 |
| Sirina | 6 | 94 | 12 | 88 | 48 | 52 | — | 55 | 45 | 33 |
| Levitha | 90 | 10 | 40 | 60 | 50 | 50 | — | 45 | 55 | 20 |
| Ofidousa | 100 | — | 100 | — | 100 | — | — | 100 | — | c. 50 |

A. Material in all details coinciding with *C. mixta* from the Greek mainland occurs sparingly in the whole area. It is remarkable that in the SE Cyclades it is found exclusively on small, isolated islands (Anidros, Ofidousa and Levitha).

B. Material in all details coinciding with *C. raphanina* is found on some islands south of Naxos (Ios, Iraklia, Koufonisi). Only certain individuals within a population coincide completely with *C. raphanina*. It is doubtful whether populations exist, in which all individuals are of the *raphanina* type.

C. Material showing a mixture of morphologic characteristics from *C. raphanina* and the mainland form of *C. mixta* constitutes the main part of the collections from the central, south-western and south-eastern Cyclades. However, two characteristics (the narrow involucral scales and the small spines) occur only in the area (Iraklia, Koufonisi, Ios) where individuals indistinguishable from *C. raphanina* have been found. Other *raphanina* characteristics, such as narrow capitula with a tapering base, lack of lateral spinelets, hairy surface of the leaves and non-dentate leaves seem to be evenly distributed over the area. In the characteristics mentioned there is a wide variation within most populations. Single individuals within a population can thus be characterized by 1, 2, 3 or more of the *raphanina* characteristics. Also morphologically transitional forms occur, e.g., in leaf-shape and shape of the involucral spines (cf. Fig. 4 F, G). — Population analyses from the Astipalea area in the south-eastern Cyclades are presented in Tab. 1.

Intermediate forms from the Cyclades have been cultivated by the

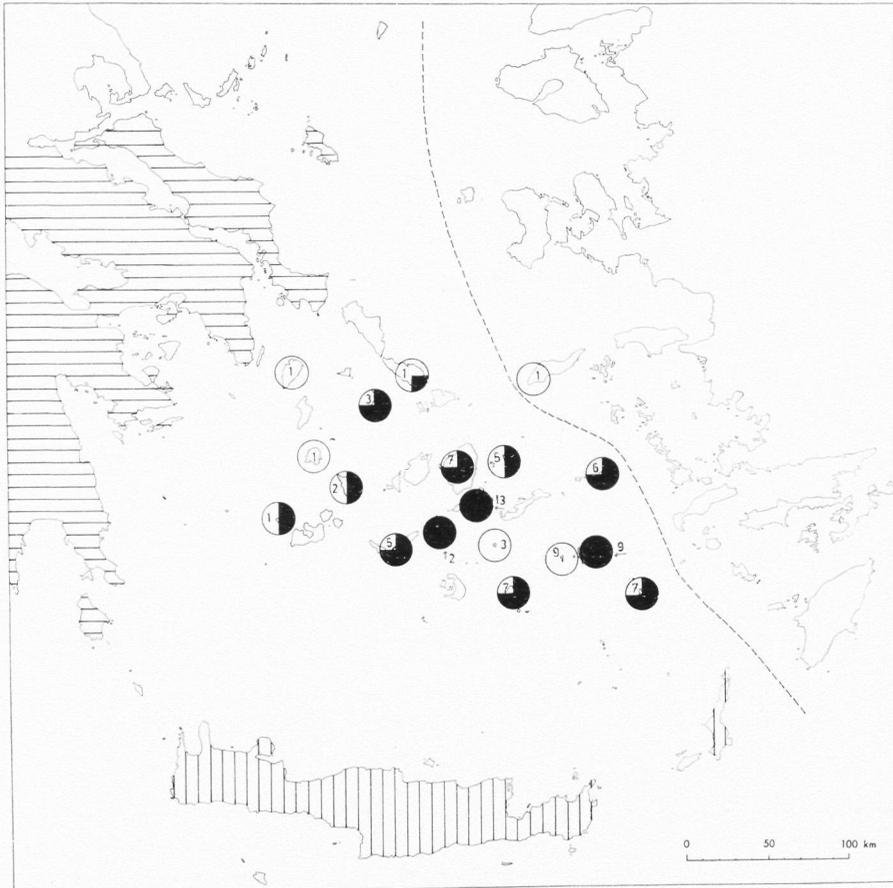


Fig. 5. The distribution in the Aegean of *C. raphanina* ssp. *raphanina* (vertical lines) and *C. raphanina* ssp. *mixta* (horizontal lines and open circles). — The solid circles indicate that intermediates have been found in the area covered by the circle, having 1, 2, 3 or 4 (wholly black circles) of the following ssp. *raphanina* characteristics: (A) spines less than 8 mm, (B) no lateral spinelets, (C) leaf surface hairy, and (D) leaf segments non-dentate. — The figures given are the numbers of collections (usually of 2–10 individuals) studied.

author for several years. The morphologic characteristics discussed do not seem to be influenced by the environment. Individuals originating from the same collection show different combinations of *raphanina* characters.

It is hardly possible that the *raphanina*-like material from the islands S of Naxos has developed from *C. mixta* by convergent evolution, as

it coincides with Cretan material of *C. raphanina* in a considerable number of morphologic characteristics.

Apparently a large scale introgression between *C. mixta* and *C. raphanina* has taken place in the Cyclades. Such an introgression will be a natural explanation for the non-regular combination of characteristics in the Cycladian material observed already by RECHINGER. As the typical mainland form of *C. mixta* is still found on small isolated islands in the SE Cyclades, it seems probable that the introgression has not taken place until *C. mixta* was established all over the Cyclades.

A case which is in some respects parallel occurs in *Phagnalon*. *Ph. graecum* BOISS. et HELDR. is distributed all over the Aegean. The closely related *Ph. rupestre* L. (West- and East-Mediterranean with a gap in the Aegean) is found in its typical form on a few, small, isolated islands (e.g., Anidros). The main part of the material from the southern Cyclades is, however, intermediate between *Ph. rupestre* and *Ph. graecum*.

As most of the material from the Cyclades is intermediate in one or several characteristics it seems inappropriate to keep *C. mixta* and *C. raphanina* as separate species. As they are vicarious to a large extent they will, in accordance with GUGLER (1909), be treated as subspecies.

TAXONOMIC TREATMENT

Centaurea raphanina SIBTHORP and SMITH 1813

C. myconia BOISSIER & SARTOR in BOISSIER 1859. — *C. hellenica* BOISSIER & SARTOR, in BOISSIER 1845, nom. illeg. — *C. mixta* DE CANDOLLE 1837 p.p. — *C. eriopoda* RECHINGER f. 1934.

Perennial herb with a fleshy taproot, 1—2 cm in diam. stem very short (0.5—5 cm). Leaves rosulate, pinnatisect, with small, rounded, oblong or broadly lanceolate segments with stiff hairs in the margins. Capitula \pm sessile, 1—4 together, rounded or elongated, 1—2 cm in diam. Involucral scales elliptic or broadly lanceolate with an apical spine, 2—25 mm long. Florets red.

Ssp. *raphanina*

C. mixta ssp. *raphanina* (S. & S.) GUGLER 1909, nomen illeg.

Leaves with a matt, hairy surface, segments non-dentate, usually oblong. Capitula elongate with a tapering base. Involucral scales broadly lanceolate, tapering towards the apex. Apical spine simple, 2—8 mm. Chromosome number $2n=20$.

DISTRIBUTION. Crete, Karpathos.

Ssp. *mixta* (DC.) RUN. stat. nov.

C. mixta DC. 1837 — *C. mixta* ssp. *eu-mixta* GUGLER 1909, nomen illeg.

Leaves glossy, glabrous except in margins, at least large segments dentate. Capitula rounded, with a truncate base. Involucral scales elliptic with a rounded apex. Apical spine 10—25 mm, in lower part with lateral spinelets. Chromosome number $2n=20$.

DISTRIBUTION. Southern Greece, Kerkira (Corfu), Skiros, Ikaria and scattered localities in the Cyclades.

Intergrades between ssp. *raphanina* and ssp. *mixta*

DISTRIBUTION. Central, south-western and south-eastern Cyclades.

Taxa described in the *C. raphanina* complex.

1. *C. myconia* BOISS. et SART. is a form of *mixta* with long spines. The species was reduced to synonymy already by BOISSIER in Flora Orientalis (1875).

2. *C. hellenica* BOISS. The material mentioned in the original description of *C. mixta* includes both Greek plants (= *mixta* in present sense) and plants from Turkey (= *C. urvillei*). Because of the heterogeneity of the original material BOISSIER withdrew the name *mixta*, which was substituted by *hellenica*. According to the present code of nomenclature such a treatment is incorrect.

3. *C. eriopoda* RECH. f. The species is based on material from Siros in the Cyclades, belonging to intergrades between ssp. *raphanina* and ssp. *mixta*. It is characterized mainly by its elongated capitula and relatively small spines. Its resemblance to *C. raphanina* from Crete was noticed already by RECHINGER.

4. *C. halacsyi* DÖRFL. The type material is a hybrid between *C. oliveriana* and *raphanina*, cf. p. 168.

5. *C. nigrotriangulata* RECH. f. The type material is a hybrid between *C. oliveriana* and *C. raphanina*, cf. p. 168.

PLANTGEOGRAPHIC NOTE

The perfect coincidence between the oldest fault zones in the Aegean and the distribution of *C. urvillei*, *C. raphanina* ssp. *raphanina* and ssp. *mixta* stressed by RECHINGER (1950) is now somewhat obscured, because of the introgression in the Cyclades between ssp. *raphanina* and ssp. *mixta* and by the discovery of ssp. *mixta* in an East-Aegean island (Ikaria, Cape Papas RUNEMARK & SNOGERUP 11034).

***Centaurea urvillei* DC.** [sect. *Acrocentron* (CASS.) DC.]

$2n=40$ (Fig. 2 K)

East-Aegean islands. Rhodos, 5 km E of Ag. Issidoros 450 m BOTHMER (R-3909).

C. urvillei is similar to *C. raphanina* S. & S. and replaces it in the East-Aegean area. It is most easily distinguished from *C. raphanina* by the occurrence of an arachnoid indumentum on stems and young leaves.

Within the *urvillei* complex at least 5 species have been described, viz. *C. urvillei* DC., *C. Lydia* BOISS., *C. chiosicola* BEAUV., *C. czezottae* HAY. and *Aegialophila longispina* CAND. RECHINGER (1943, 1947, 1950) treated *C. chiosicola* and *Aegialophila longispina* as merely synonyms to *C. urvillei*. He also drew attention to the close relationship between *C. urvillei* and other Anatolian species, especially *C. Lydia* and *C. czezottae*. BORN-MÜLLER (1944) stressed the extreme variability of *C. urvillei* and mentioned the difficulty of a subdivision as different morphologic forms often are found growing together. He also questioned the separation of *C. czezottae* from *C. urvillei*. MEIKLE (1954) presented the hypothesis, that the small-headed material from Chios "may be at least locally distinct variants of the variable *C. urvillei*". However, small-headed specimens, comparable to those from Chios, have also been collected in Paphlagonia on the northern coast of Turkey.

The cytologically investigated material from Rhodos has very large capitula, large leaves and stout, 10—20 cm long flowering stems. Besides the normally developed achenes, very narrow, cylindric ones were found in the same capitulum. However, these achenes did not germinate.

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