Botanical Journal of the Linnean Society (1992), *109:* 75–123. With 16 figures

The genus *Cynara* L. (Asteraceae-Cardueae)

ANNETTE WIKLUND, F.L.S.*

Universidad Complutense de Madrid, Facultad de Farmacia, Departamento de Biologia Vegetal II (Botánica), Ciudad Universitaria, 28040 Madrid, Spain

Received December 1989, accepted for publication May 1990

WIKLUND, A., 1992. **The genus *Cynara* L. (Asteraceae-Cardueae).** This study includes a taxonomic revision of the genus *Cynara*. Eight species and four subspecies are recognized, viz. *C. algarbiensis*, *C. auranitica*, *C. baetica* including subsp. *baetica* and subsp. *maroccana* (formerly known as *C. hystrix*), *C. cardunculus* including subsp. *cardunculus* and subsp. *flavescens*, *C. cornigera*, *C. cyrenaica*, *C. humilis* (formerly sometimes in the genus *Bourgaea*) and *C. syriaca*. The cultivated artichoke (formerly *C. scolymus*) and cardoon are both included in *C. cardunculus*. One species, *C. tournefortii*, is excluded from *Cynara*. A cladistic study of the genus is also undertaken and its morphology, anatomy and phytogeography are discussed.

ADDITIONAL KEY WORDS: Carduinae – Compositae – distribution maps – vicariance biogeography.

CONTENTS

INTRODUCTION

The mainly Mediterranean genus *Cynara* L., of the Asteraceae-Cardueae, is revised here. It contains eight species, including the well-known cultivated artichoke and the cardoon.

The most recent treatment of the genus to date is that of de Candolle in 1838. It covered what corresponds to three of the eight species accepted here. The main objects of this study were to define the genus and to produce a theory of its phylogeny using a cladistic approach. A further aim was to study the

*Present address: Swedish Natural Science Research Council, Wenner-Gren Center, Box 6711, S-113 85 Stockholm, Sweden.

0024-4074/92/050075+49 $03.00/0

relationship between the artichoke and the wild representatives of the genus. A paper on the morphological variation in *C. humilis* L. and *C. hystrix* (= *C. baetica* (Spreng.) Pau subsp. *maroccana* Wikl.) has already been published (Wiklund, 1989). *C. tournefortii* Boiss. & Reut., which is excluded here, will be treated in a following paper.

MATERIAL AND METHODS

This study is based mainly on herbarium specimens from the following herbaria (for abbreviations see Holmgren, Keuken & Schofield, 1981): BM, BEI, COI, FI, G, G-BOIS, GDA, JACA, K, LISE, LISU, MA, MAF, MO, MPU, P, S, SALAF, SEV, VF, and W. In addition photographs and photocopies of herbarium specimens were obtained from FI, G-DC, LINN, OXF and P-LA. Living material of four of the eight species was studied and collected during field trips in Portugal, Spain and Morocco, viz. of *C. algarbiensis* Coss. & Mariz, *C. baetica* (subsp. *baetica* and subsp. *maroccana*), *C. cardunculus* L. (subsp. *flavescens* Wikl. and escaped garden cultivars) and *C. humilis*. In addition, living material of cultivated varieties of the artichoke and the cardoon was studied in the Real Jardin Botánico, Madrid.

Stems and leaves were studied directly on the dried specimens whereas parts belonging to the capitula were previously softened in water. Drawings were prepared using a Wild stereo microscope. Measurements of the breadth of leaves, leaf rachides and involucral bracts were taken from their broadest parts. Anatomical preparations were made by sectioning with freezing microtome and embedding in Hoyer's solution (Anderson, 1954).

The data matrices for the cladistic treatment were analysed using Farris' (1988) program 'Hennig 86 version 1.5' with options 'ie+'. The consensus trees (Fig. 2) were calculated with the Nelson commando (for further details see Farris, 1988).

The terminology follows, as far as possible, that outlined in Stearn (1973). A complete list of examined collections is kept at the Swedish Museum of Natural History, Section for Phanerogamic Botany, in Stockholm.

CLADISTICS OF *CYNARA*

In this section a cladistic analysis of the genus *Cynara* is undertaken, according to the principles first outlined by Hennig (1966). For an overview of cladistic methodology see e.g. Humphries & Funk (1984).

Position, delimitation and outgroups

Bremer (1987 & MS) has recently shown that the tribe Cardueae is monophyletic. He characterized it, among other things, by its laterally compressed cypselas with palisade-shaped and lignified cells of the testa epidermis. The Centaureinae Dumort (Dittrich, 1977), one of the two subtribes of the Cardueae, has also been shown to be monophyletic (Bremer, personal communication). However, for the other subtribe, the Carduinae Dumort, to which *Cynara* belongs, no autapomorphy has been identified.

I consider the genus *Cynara*, as here circumscribed, to be monophyletic. It is

characterized by the thick coriaceous involucral bracts without discernible midrib and the long basal hairs ventrally on the inner pappus bristles. Morphologically similar involucral bracts were also seen in *Onopordum* L. *pro parte* and in *Myopordon pusillum* (Labill.) Dittrich (but not in *M. persicum* Boiss.). However, I did not find these taxa to be closely related to *Cynara* (see below). In addition, species with less thickly coriaceous middle involucral bracts with visible midribs were found in both these genera. The occurrence of similar bracts in *Myopordon pro parte* and *Onopordum pro parte*, I thus hypothesize to be parallelisms. Pappus bristles with long ventral hairs in the basal part were not observed in any other taxon investigated.

An additional possible apomorphy for *Cynara* is the apically rounded anthers. Very occasionally these were also found in *C. tournefortii*, which normally has apically acute anthers. However, *C. tournefortii* was found to show affinities to *Silybum* Adans. in characters of the involucral bracts. Because of this, since *C. tournefortii* does not share the two characters defining the other *Cynara* species and since it could not be shown that *C. tournefortii* is more closely related to the *Cynara* species than to any other taxon of the Cardueae it is here excluded from *Cynara*. A treatment on *C. tournefortii* will follow in a subsequent paper. *Cynara humilis*, which is sometimes placed in the separate genus *Bourgaea*, was found to share the apomorphies defining the other *Cynara* species and it is here retained within the genus.

Jeffrey (1968) suggested affinities between *Cynara* (and *Bourgaea* = *C. humilis*), *Onopordum* and *Silybum*. Dittrich (1970) noted similarities in fruit structure between *Cynara*, *Notobasis* (Cass.) Cass. and *Ptilostemon* Cass. No apparent sister-group to *Cynara*, to be used in the cladistic analysis, could here be identified amongst the above genera, however. A survey of the taxa in Cardueae was therefore undertaken. Thus at least the type species of 37 of 39 genera in the Carduinae (*sensu* Dittrich, 1977) were examined. The monophyletic Centaureinae was represented by its type species *Centaurea centaurium* L. The sister-group of the Cardueae, which Bremer (personal communication) has found to be the Carlineae Cass., was in this study represented by its type species *Carlina vulgaris* L.

The survey resulted in the identification of two apomorphies delimiting a group of taxa, within which the sister-group of *Cynara* was thought to be found. Thus, reduced inner columellae were found to occur in pollen grains of *Carduus* L. *pro parte*, *Cirsium* Mill. *pro parte*, *Cynara tournefortii*, *Galactites* Moench, *Lamyropsis* Adans., *Myopordon pro parte*, *Notobasis*, *Picnomon* Adans., *Silybum* and *Centaurea centaurium* (Belmonte, 1989; Dittrich, 1977; Gutierrez personal communication; Wagenitz, 1958). Dittrich (1977) reported that *Cynara* (and *Carduus pro parte*) differ from the other genera of the Cardueae–Carduinae through their completely reduced inner columellae. However, TEM studies made by Belmonte (1989) of *C. cardunculus* revealed that an inner layer of columellae is discernible, although reduced. This character has not been observed in *Carlina vulgaris* (representing the Carlineae), nor in the other taxa investigated of the Cardueae-Carduinae, where, in all instances, unreduced columellae have been seen (Belmonte, 1989). In the Cardueae–Centaureinae both reduced and unreduced columellae have been reported (Dittrich, 1977).

A second apomorphic character, long hairs growing from the pericarpic layer of the pappus ring, was observed in some of the above mentioned genera, viz. in

Cirsium, *Lamyropsis*, *Notobasis*, *Silybum* and rarely in *C. tournefortii*. They were also rarely found in *Tyrimnus* (Cass.) Cass. which, unlike the above genera, has well-developed inner columellae in the pollen grains. No hairs were seen in *Centaurea centaurium* (Cardueae-Carduinae), nor in *Carlina vulgaris* (Carlineae).

The two characters 'reduced inner columellae of the pollen grains' and 'pericarpic hairs on the pappus ring' are thus considered to be apomorphic in the Cardueae. The possibility that especially reduced inner columellae of the pollen grains occur as parallelisms is not excluded, however. This could explain the presence of both reduced and well-developed inner columellae in *Carduus*, *Centaurea*, *Cirsium* and *Myopordon*. In the cladistic treatment, the genera having both the above mentioned apomorphies were included, viz. *Cirsium*, *Lamyropsis*, *Notobasis* and *Silybum*. Because of its former inclusion in *Cynara*, *C. tournefortii* was also considered as a potential sister-group despite the absence of hairs on the pappus ring in the majority of specimens investigated.

It was found impossible to use all the above genera as a 'functional out-group' (Watrous & Wheeler, 1981) of *Cynara* because of the large amount of variation in character states within this group. To overcome this problem, each genus within the group was used separately as an out-group of *Cynara* and the cladograms thus produced were compared with one another.

Cirsium and *Lamyropsis* were each represented by a single species in the out-group analysis. The taxa used as out-groups were thus: *Cirsium vulgare* (Sav.) Ten. (belonging to section *Epitrachys* which, like *Cynara*, contains species with big capitula, coriaceous bracts and dark-coloured cypselas), *Cynara tournefortii*, *Lamyropsis sinuata* (Trautv.) Dittr., *Notobasis syriaca* (L.) Cass. (a monotypic genus) and *Silybum*, including *S. marianum* (L.) Gaertner and *S. eburneum* Coss. & Dur.

Since no apomorphy was identified defining any of the two subspecies of *C. baetica* these subspecies were not introduced in the analyses.

Only characters that were found in a majority (or in a few cases about half) of the specimens of a taxon were considered. Fourteen characters occurring in more than one *Cynara* species were used when *Cirsium*, *Lamyropsis*, *Notobasis* and Silybum were out-groups, whereas 15 characters could be included when the out-group was *Cynara tournefortii*. The data matrices thus produced were computed using the 'Hennig 86 version 1.5 Farris 1988' programme (see Material and Methods). The characters included in the out-group analyses and the autapomorphies defining the species and the subspecies are discussed below and listed in Table 1.

Characters

Habit. The *Cynara*-species are generally erect, stout perennial herbs (see e.g. Rechinger, 1979; Kupicha, 1975). Annuals have been reported to occur in wild (fide coll.) and cultivated (Foury, 1967, 'artichoke') *C. cardunculus*. Since it was not possible to ascertain the occurrence of annuals in *Cynara cardunculus* using herbarium specimens this character was not included in the data matrix.

The *Cynara* species range in height from less than 0.5 m in *C. cornigera* Lindl. to the almost 2 m sometimes attained by *C. auranitica* Post and *C. cardunculus*. Owing to the variability of this character within the species and the scant

TABLE 1. Plesiomorphic (0) and apomorphic (1) character states in *Cynara* with *Cirsium vulgare* as out-group. Numbers correspond to numbers in Table 2 and in the cladogram (Fig. 2B). Characters 1–15 are synapomorphies within *Cynara*, characters 15–20 are autapomorphies, and characters 21–22 are the automorphies characterizing the genus *Cynara*.

1. Stems with 2 layers of vascular bundles (0)
   Stems with 3 layers of vascular bundles (1)

2. Stems lacking secretory canals (0)
   Stems with secretory canals (1)

3. Longest leaf spines > 6 mm long (0)
   Longest leaf spines $\leqslant 6$ mm long (1)

4. Leaves lacking basal spine clusters (0)
   Leaves with basal spine clusters (1)

5. Leaves with distinctly revolute margins (0)
   Leaves with indistinctly revolute margins (1)

6. Leaves abaxially slightly to moderately woolly (0)
   Leaves abaxially densely woolly (1)

7. Leaves with flagelliform hairs (0)
   Leaves lacking flagelliform hairs (1)

8. Leaves abaxially slightly to moderately glandular (0)
   Leaves abaxially very densely glandular (1)

9. Leaf veins forming large arches (0)
   Leaf veins not forming large arches (1)

10. Middle involucral bracts usually without lateral constrictions (0)
    Middle involucral bracts usually with lateral constrictions (1)

11. Middle involucral bracts basally green (becoming straw-coloured) (0)
    Middle involucral bracts basally dark brown (1)

12. Middle involucral bracts abaxially slightly pubescent (0)
    Middle involucral bracts abaxially glabrous (1)

13. Epidermal cells of corolla-limbs with straight lateral walls (0)
    Epidermal cells of corolla-limbs with sinuate lateral walls (1)

14. Style-branches < 11.5 mm long (0)
    Style-branches > 12 mm long (1)

15. Leaves uniformly green (0)
    Leaves variegated (1)

16. Middle involucral bracts without horizontal fold (0)
    Middle involucral bracts with horizontal fold (1)

17. Middle involucral bracts without broad, dark-coloured scarious margins (0)
    Middle involucral bracts with broad, dark-coloured scarious margins (1)

18. Middle involucral bracts without broad apical yellowish margins (0)
    Middle involucral bracts with broad apical yellowish margin (1)

19. Filament colours whitish 0)
    Filament collars orange-brown (1)

20. Cypselas lacking wing-like ribs (0)
    Cypselas with wing-like ribs (1)

TABLE 1. *continued*

21. Middle involucral bracts with discernible midrib (0) Middle involucral bracts without discernible midrib (1)
22. Inner pappus bristles lacking long ventral hairs basally (0) Inner pappus bristles with long ventral hairs basally (1)

information available for some of the species, this character was omitted from the cladistic analysis.

Roots. Ordinary taproots occur in *C. algarbiensis*, *C. auranitica*, *C. baetica*, *C. cardunculus*, *C. cyrenaica* Maire & Weiller and *C. humilis*, whereas what appear to be swollen roots are found in *C. cornigera*. No roots were seen in *C. syriaca* Boiss. A confirmed occurrence of swollen roots in *C. cornigera* could give an additional autapomorphy defining this species. This character was not included in the data matrix.

Stem. Meinheit (1907) and Solereder (1908) reported an unusual arrangement of the vascular bundles in the stems of *C. cardunculus* and *C. scolymus* L. (= here included under *C. cardunculus*). They found that the vascular bundles were irregularly distributed in three indistinct rings, in cross-sections of the stems. In *Bourgaea humilis* (L.) Coss (= *C. humilis*) Meinheit (1907) found two rings of vascular bundles. In addition Meinheit (1907) found secretory canals in the stems of *C. cardunculus*, *C. horrida* Ait. and *C. scolymus* (all here included in *C. cardunculus*) whereas he found laticiferous ducts in *C. humilis*.

A survey of the stem anatomy in *Cynara* revealed that three layers of vascular bundles occurred in cross-sections of stems in *C. auranitica*, *C. cardunculus* and *C. syriaca* (character 1). In *C. algarbiensis*, *C. baetica*, *C. cornigera* and *C. humilis* only two layers were seen. No sections were made of stems of *C. cyrenaica* due to the scarcity of the material and it was coded '?' for this character. Secretory canals (character 2) were found only in *C. cardunculus* (including the 'artichoke').

Three layers of vascular bundles were not seen in any other taxon of the Cardueae-Carduinae investigated by Meinheit (1907). He found two layers in *Cirsium* Mill. *pro parte* (and in *Carduus hamulosus* Ehrb.). Within the Cardueae-Carduinae secretory ducts in the stems have been found to be rare. Of the genera considered for the cladistic analysis, Meinheit (1907) reported their occurrence in *Cirsium pro parte*. In most of the other taxa of the Carduinae that he investigated he found laticiferous ducts.

Leaves. The leaf segments terminate in a stiff yellowish spine in all species. The spines are long and pungent in *C. auranitica*, *C. baetica*, *C. cardunculus* and usually also in *C. syriaca*, whereas they are of moderate length in the rest of the *Cynara* species (character 3). In *C. auranitica*, *C. baetica*, *C. cardunculus* and *C. syriaca* the leaves have basal clusters of spines. In the other species the spines are more evenly distributed (character 4).

Some variation is found in the degree of revolution of the leaf-margins (character 5). Thus a broadly revolute margin is seen in *C. humilis* and to a slightly lesser extent in *C. cornigera*, *C. cyrenaica* and sometimes in *C. algarbiensis*. The latter species was coded '?' for this character. In the other *Cynara* species the leaf margins are less distinctly revolute.

Thin and soft hairs, consisting of a short, few-cellular, uniseriate base and a

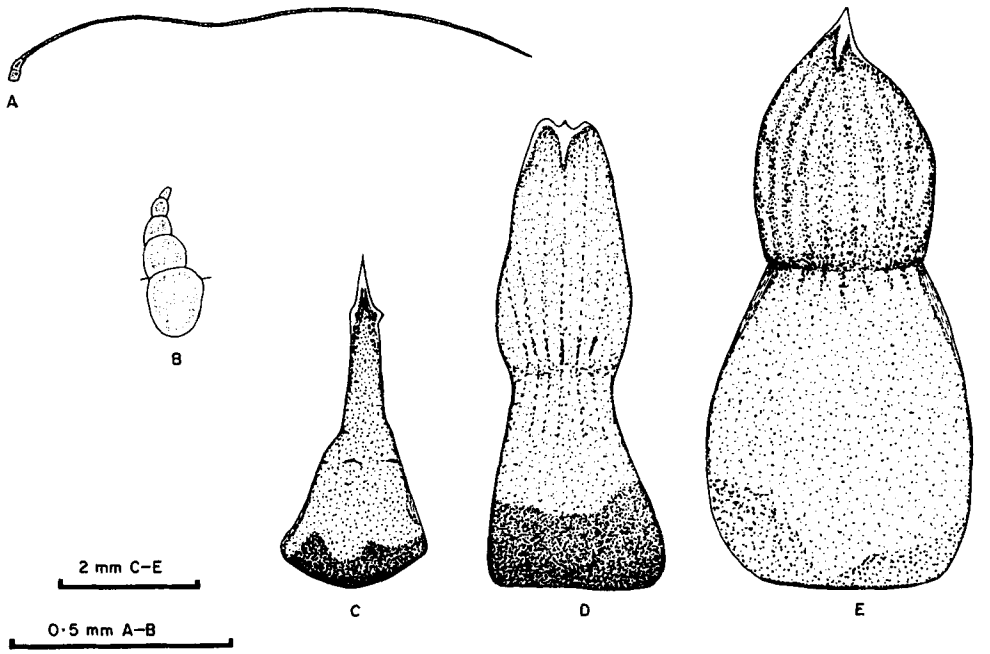

Figure 1. A. *Cynara algarbiensis*, soft hair from woolly leaf. B. *C. baetica* subsp. *baetica*, stiff multicellular leaf hair. C-E. Artichoke cultivars (*C. cardunculus*), morphological variation of middle involucral bracts. A. *Wiklund 102* (S). B. Spain, near the Alcalá "pignog", 1840, *herb. Fauché* (G). C. *Hort. Lee* (BM). D. *Howell 31961. (S)*. E. *S. Faustino, 1883, Fiori* (FI).

long unicellular apex (Fig. 1A) are found in the leaves of all *Cynara* species. On the abaxial side of the leaves these hairs form a woolly indumentum (character 6) which is particularly dense in *C. humulis*, *C. cyrenaica*, *C. algarbiensis* and *C. cornigera*. In *C. cardunculus* the situation is variable and *C. cardunculus* was therefore scored '?' for this character. In *C. auranitica*, *C. baetica*, *C. cornigera* and *C. syriaca* scattered, broad and stiff hairs (character 7) are also found, consisting of a few thick-walled uniseriate cells (Fig. 1B). These hairs are probably reduced 'whiplike' hairs (Solereder, 1908), the latter of which are very common in the Cardueae-Carduinae. Short stiff hairs were also seen in *C. tournefortii* (here excluded from *Cynara*).

Leaf glands, consisting of a globose head and a short and broad stalk, occur in all *Cynara* species. These are particularly frequent in *C. baetica*, *C. cardunculus* and *C. syriaca* and usually also in *C. auranitica* (character 8).

In *C. cornigera* the leaves are variegated along the venation (character 15) whereas in the rest of the *Cynara* species the leaves are uniformly green. This character, which is sometimes difficult to detect in herbarium specimens, was found to be an autapomorphy defining *C. cornigera*. Of the taxa considered as possible out-groups variegated leaves were encountered only in *Silybum marianum*.

The leaf venation (character 9) is forked to reticulate in *C. algarbiensis* and *C. cornigera*. In *C. humilis*, the leaf venation was interpreted to belong to this type even though it was difficult to ascertain due to the very narrow leaf segments and lobes and also because of the dense leaf indumentum. In *C. auranitica*, *C. baetica*,

C. cyrenaica and *C. syriaca* at least the upper leaves have a venation where large arches formed by the major veins enclose minor reticulate venation. A venation similar to the latter, although with all veins of about the same thickness, is found in *C. cardunculus*. It was coded as belonging to the same type as the latter group.

Involucres. The outer and middle involucral bracts in *Cynara* are thickly coriaceous without discernible midrib and without herbaceous part (character 21). In all species except *C. cyrenaica* and *C. humilis* a constriction may be seen, at least rarely, in some of the middle involucral bracts. This constriction is particularly frequent and well-developed in *C. cornigera* (Fig. 5D) and *C. syriaca* (Fig. 12C) in both of which a very broad apical appendage is clearly demarcated (character 10). A constriction usually occurs also in *C. auranitica* and *C. cardunculus* subsp. *flavescens*. In *C. cardunculus* subsp. *cardunculus* the situation is variable. This was indicated by '?' in the data matrix. In *C. syriaca* the appendage is separated from the basal part by a horizontal fold (character 16).

The margin of the middle involucral bracts is distinctive in *C. baetica*, where it is broadly scarious and dark-coloured (Fig. 11) (character 17). In *C. cardunculus* subsp. *flavescens* the middle involucral bracts have conspicuous yellowish rims (Fig. 15C) (character 18). In *C. auranitica* and usually in *C. cardunculus* the basal part of the involucral bract is dark brown (character 11).

The involucral bracts generally seem glabrous. However, a weak indumentum was found in all *Cynara* species except *C. algarbiensis* and *C. cornigera* (character 12).

Florets. The florets in *Cynara* are of the type generally found in the Cardueae (see e.g. Dittrich, 1977). Some variation was found in the shape of the lateral cell walls of the limb epidermis (character 13). These cells are elongate in all species. In *C. algarbiensis* and *C. cornigera* sinuate lateral cell walls were seen, whereas straight lateral cell walls were found in the other species.

Intraspecific variation in floret colour was found in *C. algarbiensis*, *C. baetica*, *C. cardunculus*, *C. cornigera* and *C. humilis*, where shades of lilac, purple and white occur. Owing to the great variability of this character and to the difficulty of studying its distribution in herbarium specimens, it was not included in the data matrix.

Stamens. In *C. auranitica* and in two specimens of *C. syriaca*, an orange-brown colouration of the stamens, especially the filaments were seen (character 19). For a further discussion of this character see under *C. syriaca*.

Styles. Particularly long style-branches are found in *C. auranitica* and *C. cardunculus* (character 14).

Cypselas. The cypselas in *Cynara*, with the exception of *C. humilis*, have a uniform structure. They are laterally compressed, obovate in outline and have a smooth and dull surface. The basal detachment area is round. In *C. humilis* Fig. 5C) the cypselas are 4-sided and broadly obovate in outline. The edges are demarcated by four wing-like ribs (character 20) and the basal detachment area is $\pm$4-sided.

Pappus. The pappus in *Cynara* is deciduous. The pappus bristles are held together in a ring by pericarpic tissue (Dittrich, 1970) and the pappus is detached as a unit. Long hairs, apparently growing from the base of the pericarpic tissue and the basal part of the pappus bristles (character 22), are found inside the pappus ring. These hairs, which are to 2.5 mm long, occur in all *Cynara* species. In some species they completely cover the basal part of the bristle

TABLE 2. Character distribution in *Cynara*. Characters 1–20 were polarized with *Cirsium vulgare* as out-group whereas characters 21–22, the apomorphies defining the genus *Cynara*, were polarized against the other genera of the Carduinae. Characters 1–14 were included in the computer analyses. Numbers correspond to numbers in Table 1 and to numbers along branches in the cladogram (Fig. 2B). Question mark '?' = both character states occur with about equal frequency or (*C. cyrenaica* only) character not seen. No cross-section of the stem of *Cirsium vulgare* was seen. However, the stems of *C. echinatum* DC. and *C. eriophorum* Scop. which both, like *C. vulgare*, belong to sect. *Epitrachys*, have been found to have two layers of vascular bundles (character 1) and to lack secretory canals (Meinheit 1907) (character 2). *Cirsium vulgare* is here hypothesized to have a similar stem anatomy

Character		123456789 etc		
Out-group		000?0000000000	000000	00
1.	*C. humilis*	00100110100000	000001	11
2.	*C. cyrenaica*	?0100110100000	000000	11
3.	*C. algarbiensis*	0010?110100110	000000	11
4.	*C. cornigera*	00100100110110	100000	11
5.	*C. baetica*	00011001000000	001000	11
6.	*C. syriaca*	10?1100101002?0	010000	11
7.	*C. auranitica*	1001100?011001	000010	11
8a.	*C. cardunculus* subsp. *cardunculus*	11011?110?1001	000000	11
8b.	*C. cardunculus* subsp. *flavescens*	11011?11011001	000100	11
'Artichoke' cultivars		1111?1101?0011	000100	11

whereas in others they occur more sparsely. In some specimens they are completely absent. However, they were found in a majority of the specimens in all species (in *C. syriaca* only two specimens with mature pappus were encountered, one with ventral hairs and the other without).

Results and conclusions

The most parsimonious tree in relation to the number of characters included in the analysis was obtained with *Cirsium* as outgroup. Two equally parsimonious, 17-step trees with a consistency index of 0.82 resulted.

The least parsimonious solution, five trees, all of 21 steps with a consistency index of 0.71, was produced with *Cynara tournefortii* as out-group. Four 19-step trees with a consistency index of 0.78 were produced with *Lamyropsis* as out-group. When *Notobasis* and *Silybum* were out-groups 18-step trees were obtained. In the case of *Notobasis* two trees with a consistency index of 0.83 resulted whereas only one tree with a consistency index of 0.77 was obtained with *Silybum* as out-group.

In Fig. 2A the consensus tree obtained with *Cirsium* as out-group is presented. One of the two equally parsimonious cladograms is shown in Fig. 2B.

As may be seen in Fig. 2B, character no. 7, "leaves lacking flagelliform hairs", occurs as a parallelism uniting *C. humilis* and *C. cyrenaica* on the one hand and defining *C. algarbiensis* and *C. cardunculus* respectively on the other. This character may be placed equally parsimoniously as a synapomorphy uniting the first four *Cynara*-species with a reversal in *C. cornigera*. This results in a trichotomy

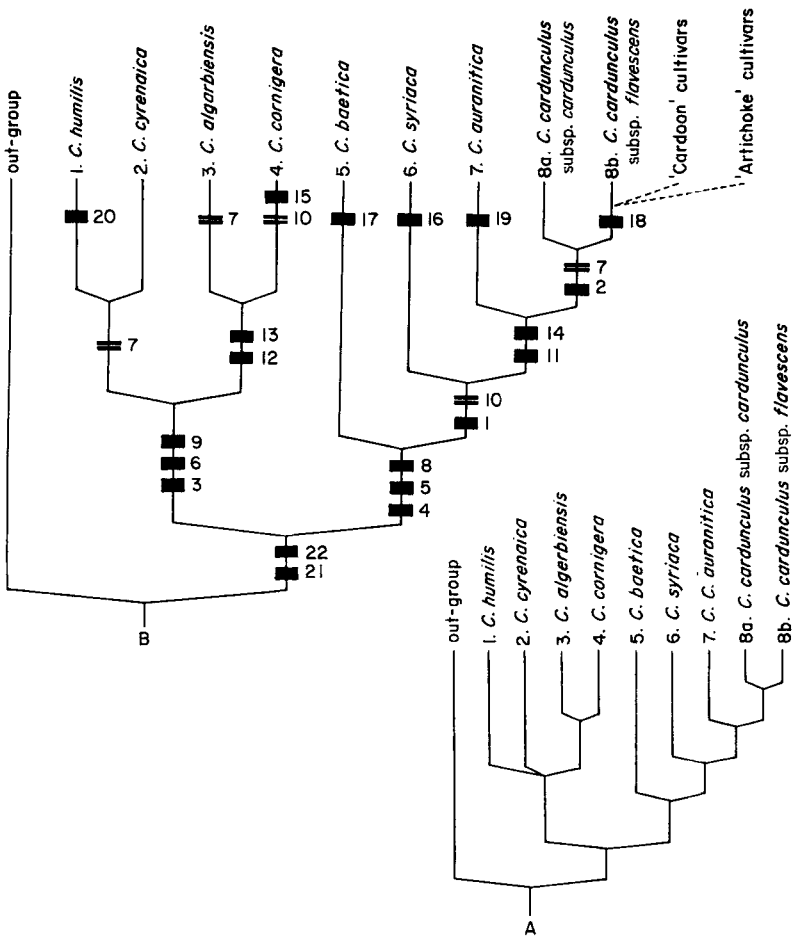

Figure 2. Cladistic relationships in the genus *Cynara* with *Cirsium vulgare* as out-group, based on data matrix in Table 2 (characters 1–14). A. Consensus tree. B. Cladogram showing one of the two equally parsimonious solutions. Numbers along branches correspond to apomorphic characters in Tables 1 and 2. Black bar = apomorphy. Two parallel lines = parallelism. The affinities of the cultivated 'cardoon' and the 'artichoke' are indicated by hatched lines.

with the positions of *C. humilis* and *C. cyrenaica* unresolved and a cladogram with the same configuration as the consensus tree.

Only one, fully resolved cladogram may be obtained if the parallelistic character no. 7 is reinterpreted. In the data matrix whip-lash hairs were coded as absent for *C. algarbiensis*. However, these hairs were seen rarely in this species, but not in the other three taxa where they were also recorded as absent. If *C. algarbiensis* is considered to have whip-lash hairs, or to have lost them independently, a single tree, resolved as that in Fig. 2B is obtained.

No autapomorphies were identified for *C. cyrenaica*, *C. algarbiensis*, *C. cardunculus* subsp. *cardunculus* and the two subspecies of *C. baetica*. The first three taxa may therefore be regarded as 'paraspecies' as defined by Ackery & Vane-Wright (1984). For a discussion of the subspecies of *C. baetica* see under this species. For species concept see Wiklund (1985).

The ancestry and the geographical origins of the 'cardoon' and the 'artichoke' have been discussed by various authors. These garden cultivars have generally been assumed to have originated from wild *C. cardunculus*, although Zohary & Basnizky (1975) suggest that '*C. syriaca*' (probably = *C. auranitica*) might also have been included in their ancestry. De Candolle (1886) stated that *C. cardunculus* was recorded by Theophrastus to occur in Sicily (Italy) but not in Greece. He also mentioned that only the 'cardoon' and not the 'artichoke' was known by ancient writers such as Athenaeus. Thomsen *et al.* (1986) propose a south-eastern European origin for the 'cardoon'. They furthermore suggest that the 'artichoke' arose from 'cardoon' varieties in medieval monastery gardens.

In this study wild *C. cardunculus* was found to share two characters with the 'cardoon' and the 'artichoke', viz. the occurrence of secretory canals in the stem (character no. 2) and the absence of whip-lash hairs (character no. 7). No apomorphy uniting these garden cultivars with any of the other *Cynara* species was found. This supports the idea that the cultivars have originated from *C. cardunculus*. They are united here into the single species *C. cardunculus* (for further discussion see under *C. cardunculus*).

A majority of the investigated specimens of cultivars of the 'cardoon' and the 'artichoke' were found to share the occurrence of a yellowish margin on the middle involucral bracts (character no. 18) with the westerly distributed *C. cardunculus* subsp. *flavescens*. It therefore appears probable that both cultivars have originated from this subspecies. A south-east European origin of the 'cardoon', as suggested by Thomsen *et al.* (1986), was not supported by this study. The fact that, in many specimens of 'artichoke' cultivars the yellowish margin was found only at the apex of the middle involucral bracts (Fig. 1C–E), and not along its whole upper margin as in wild subsp. *flavescens*, I consider due to reductions of the pungent apical part of the involucral bracts in these cultivars.

PHYTOGEOGRAPHY

The genus *Cynara* belongs to the Mediterranean flora element. It has a distribution very similar to that of the olive tree (*Olea europea*) (see e.g. Sunding, 1970), the distribution of which is often used to define the Mediterranean region. Other taxa with similar distributions are e.g. *Astericus spinosus*, *Nauplius aquaticus* (see e.g. Wiklund, 1985, 1987) and *Quercus ilex*. The occurrence of *C. cardunculus* outside the Mediterranean region, in areas such as California, South America and Australia, I hold to be a result of naturalization. These distributions are not considered further.

The most widely distributed of the *Cynara* species is *C. cardunculus* which is found in the N. and S.W. Mediterranean area and in Macaronesia (Fig. 13). More restricted distributions are found in all the other *Cynara* species. This is particularly the case for *C. cyrenaica* from Cyrenaica (Libya) and Crete (Greece) (Fig. 6), *C. algarbiensis* from S. Portugal and S.W. Spain (Fig. 8), *C. baetica* from S. Spain and N. Morocco (Fig. 9) *C. syriaca* from Syria and Lebanon (Fig. 13). Somewhat wider distributions are found in *C. humilis* from the S.W. part of the Iberian peninsula and N. Morocco (Fig. 6) and *C. cornigera* from the (mainly) Greek archipelago and the N.E. African coast (Fig. 9). Few collections were seen

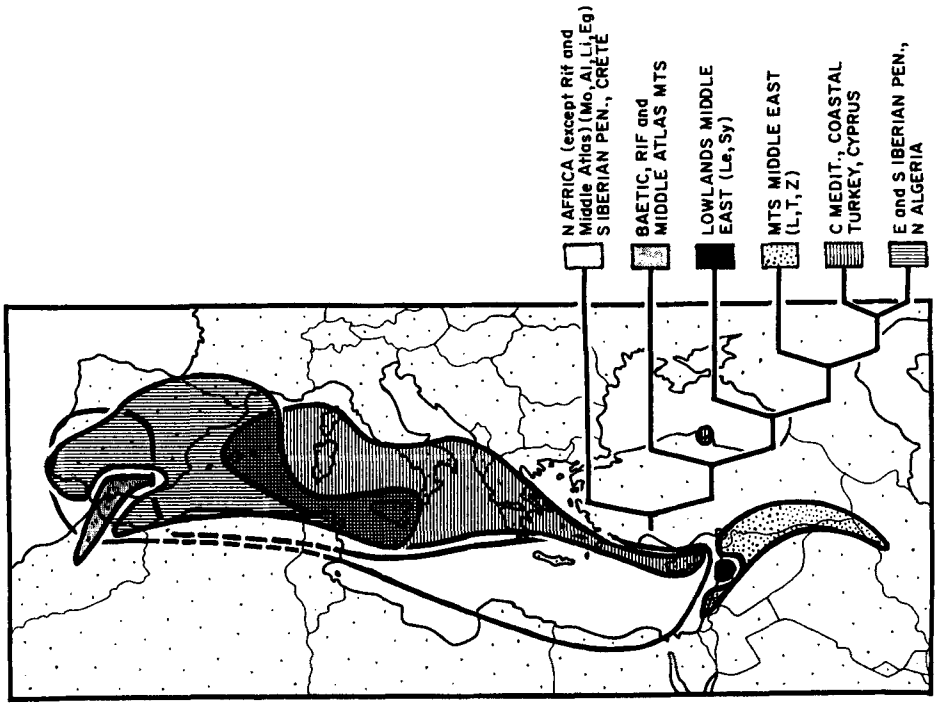

Figure 3. Area cladogram and approximate distributions of □ *Cynara humilis*, *C. algarbiensis*, *C. cyrenaica* and *C. cornigera*, ▨ *C. baetica*, ■ *C. syriaca*, ⊠ *C. auranitica*, ▥ *C. cardunculus subsp. cardunculus*, ▤ *C. cardunculus subsp. flavescens* (except Macaronesian distributions). Hatched lines indicate hypothesized link between distributions. C = Central, E = East, N = North, S = South, Medit. = Mediterranean region, Mt = Mountain, Pen. = Peninsula, Al = Algeria, Eg = Egypt, Le = Lebanon, Li = Libya, Mo = Morocco, Sy = Syria, L = Lebanon mountains, T = Taurus mountains (Turkey), Z = Zagros mountains (Iran).

of *C. auranitica*. This species has been reported from most Middle East countries and it seems possible that its distribution is wider than that suggested by the map (Fig. 13).

A disjunct distribution similar to that in *C. cyrenaica*, is also found, for example, in the genus *Ebenus*. According to Davis & Hedge (1971) the Cretan *E. cretica* is related to *E. armitagei* from Cyrenaica and the adjacent N.W. Egypt. A floristic link between Cyrenaica and lowland Crete has been noted, for example, by Sandwith & Simpson (1941), Rechinger (1950) and Greuter (1971). Disjunctions between S. Spain and N. Morocco like that in *C. baetica*, are also found in a number of taxa, e.g. *Abies pinsapo* and *Andryala aghardii* (Quezel, 1978).

Below an attempt is made to put the distributions of the *Cynara* species into a vicariance biogeographic context.

In a vicariance biogeographic study a cladogram of geographical areas is produced through substituting the taxa in the cladogram for their respective (vicariant) areas of distributions (for a recent treatment on vicariance biogeography see Humphries & Parenti, 1986).

In the consensus tree (Fig. 2A) the relationships between species one to four is partly unresolved. These species are therefore treated together as a group. A

map of the actual distribution of this species group and of the distributions of taxa five to eight is shown in Fig. 3.

In Fig. 3 a pattern of disjunct areas of distribution can be discerned, although overlaps are found at the margins of the areas, mainly in the S.W. part of the Iberian peninsula, in the W. Mediterranean basin and on Cyprus. A more detailed study showed that these overlapping distributions are found in connection with the most widely distributed of the *Cynara* species. They are particularly noticeable in relation to *C. cardunculus* and *C. humilis* respectively, but appear to occur also between *C. cornigera* and *C. cyrenaica* and possibly between *C. auranitica* and *C. syriaca*. The main part of the distribution of *C. humilis* in Morocco does not overlap that of *C. baetica*, however, since the two species usually occur at different altitudinal levels. Under an allopatric model of speciation, these overlaps must be considered due to secondary extension into once separate areas of distribution. Secondary extension would concur with the here accepted hypothesis that hybridization has occurred between *C. humilis* and *C. algarbiensis*, *C. humilis* and *C. baetica* subsp. *maroccana* and *C. auranitica* and *C. syriaca*.

The compound distribution of species one to four (Fig. 3) is not contiguous but shows a large gap, for which extinction is hypothesized as an explanation. Secondary dispersal and extinction makes it impossible to determine the exact boundaries of the original distributions of the taxa/groups of taxa in *Cynara*. However, a possible area cladogram based on the areas of distribution of the taxa in *Cynara* is shown in Fig. 3. This area cladogram indicates a common history between the mountainous regions of the Middle East and the N. Mediterranean region which is not shared with the Middle East lowlands in N.W. Lebanon and the adjoining coast of Syria. It also points to a historical relationship between the Baetic, Rif and Middle Atlas mountains and the N. Mediterranean/Middle East region which is not shared by the rest of N. Africa and the S. Iberian peninsula. However, this area cladogram is based on a single group of organisms and its generality has yet to be examined by future comparisons with area cladograms obtained from other groups of organisms from similar areas.

TAXONOMY

Cynara L.

Cynara Linnaeus, *Species plantarum:* 827 (1753).

TYPE: *C. cardunculus* L.

SYNONYM: *Bourgaea* Cosson, *Notes sur quelques plantes critiques, rares ou nouvelles, 2*: 39 (1849). TYPE: *C. humilis L.*

DESCRIPTION (excluding cultivars). Erect perennial (to annual) herbs with taproots (or swollen roots). STEMS richly branched to unbranched, leafy, ribbed, densely woolly to subglabrous, often with somewhat floccose indumentum, slightly to densely glandular, rarely with secretory canals. LEAVES basally rosulate, alternate and sparsely to densely set along stem, slightly folded along

midrib and along nerves of segments or flattened, (tri- to) bipinnatifid to pinnatifid, with ± pinnate base, with terminal segment, broadly lanceolate to lanceolate in outline, semiamplexicaul, sometimes slightly decurrent, basally spineless or with rows of short spines or with clustered long spines along margins; leaf-segments opposite to alternate, (broadly) ovate to narrowly triangular (to oblong) in outline, apically caudate or acute, with lobes and teeth terminating in a stiff yellowish spine, with ± distinctly revolute margins; abaxial side greyish-white to green, slightly pilose to densely woolly, sometimes scabrid on nerves, very densely to slightly glandular, rarely variegated along nerves, arachnoid to glabrous, sometimes scabrid, densely glandular to eglandular. Leaves pinnately nerved; abaxial side with midrib prominent and ribbed, with nerves and veins prominent and thickened below spines, with major secondary veins unbranched to forked to reticulate or forming large arches with reticulate and less prominent venation within them; adaxial side with midrib canaliculate in basal part, sometimes with midribs of segments basally sunken. CAPITULA solitary or in corymb-like groups, terminal, homogamous, sebsessile to pedunculate. INVOLUCRES squarrose, (broadly) cyathiform to (broadly) ovate. INVOLUCRAL BRACTS imbricate in 5–8 series, rarely containing secretory canals; outer (narrowly) triangular to ± oblong with an abruptly acuminate apex, entire, with an apical pungent yellowish spine, thick coriaceous, sometimes with subscarious margins, abaxially initially pale green, sometimes tinged with lilac, purple or greyish-pink, becoming beige to straw-coloured, woolly to glabrous, glandular or eglandular, adaxially yellow; middle basally ± oblong to ± ovate, with *either* an acuminate to abruptly acuminate apex *or* with an ovate to transverse-elliptic and apically acuminate appendage in upper part, entire, with a pungent yellowish apical spine, thick, coriaceous, with lateral margins in basal part usually narrowly scarious and colourless or reddish to purplish, with lateral margins in apical part rarely broadly scarious and dark-coloured or yellowish; initially pale green, rarely with a dark brown base, sometimes tinged with lilac, purple or greyish pink, becoming straw-coloured to beige, (woolly to) glabrescent, sometimes ciliate with short and apically acute unicellular hairs, glandular to eglandular, adaxially yellow; inner narrowly oblong to (narrowly) linear, apically acute to acuminate or with an ovate and apically acute to acuminate appendage, sometimes apically aristate, entire to apically irregularly serrate, subcoriaceous with scarious lateral margins, brownish yellow to pale yellow, sometimes tinged with pink or dark brown, often with minute, acute unicellular hairs marginally and abaxially, sometimes with minute abaxial glands. RECEPTACLES thick, concave to convex, apically smooth and densely covered with hygroscopic receptacular bristles. Receptacular bristles dorsiventrally flattened, entire, apically acute, white. FLORETS bisexual, somewhat curved to straight, ± distinctly divided into tube and limb, glabrous, eglandular; tube subterete to flattened, filiform, white, 5-veined, with cells containing crystals, limb 5-lobed, subactinomorphic with one corolla lobe more deeply incised than the other four, narrowly cyathiform to narrowly funnelshaped, in lowermost part white, in upper part lilac, purple or white, ± distinctly 5-veined below lobe incisions, with cells with straight to sinuate lateral walls; lobes deeply incised, adaxially canaliculate, entire, apically acute to subacute. ANTHERS narrowly linear to linear, tailed, apically sterile, stiff, flat and rounded (to subacute), ± white or reddish brown to brown; tails sterile, conspicuous, fimbriate;

filaments ventrally slightly canaliculate, linear, white or reddish brown to brown, dorsally with 8–70 μm long papillae in apical part; filament collar with smaller basal cells; endothecial tissue polarized. STYLES bifid, whitish or lilac; shaft tapering towards the flattened to ribbed base, apically ±terete, ribbed, with a ring of 3–150 μm long sweeping hairs; style-branches separating at tips, flattened to semiterete, linear, apically rounded (to acute), dorsally covered with minute and apically acute sweeping-hairs. CYPSELAS hard, lacking a distinct apical crown and an apical parenchymatous body, *either* somewhat laterally compressed, ±obovate in outline with basal detachment area flat and rounded, with a flat to convex apex, straw-coloured to brownish with dark brown and sometimes with whitish dots and short longitudinal lines *or* 4-sided and broadly obovate to broadly oblong in outline, with four wing-like ribs along the edges, with basal detachment area flat and ±4-sided, apically flat to slightly convex with ribs protruding, dark brown, with cells of ovary walls containing elongate oxalate crystals. PAPPUS deciduous as a unit, consisting of 3–7 series of bristles held together by pericarpic tissue; bristles flat (to ventrally slightly keeled), filiform, apically tapering into a point, subequal, slightly narrower in outer layers, marginally plumose, apically barbellate, with innermost bristles ventrally usually with long and soft hairs in basal part, pale straw-coloured.

KEY TO THE SPECIES

1	Cauline leaves with basal clusters of long spines, apically caudate, abaxially very densely glandular; longest leaf spines ⩾ 6 mm long	2
1′	Cauline leaves with basal rows of very short spines along margins or spineless, apically not caudate, dorsally slightly to moderately glandular; longest leaf spines < 6 mm long	5
2	Apical appendage of middle involucral bracts distinctly demarcated, reflexed, transverse-elliptic and apically acuminate	**6. *C. syriaca***
2′	Apical appendages of middle involucral bracts lacking or indistinct, appressed, ±ovate and apically acuminate	3
3	Plant slender; middle involucral bracts with broad, dark-coloured, scarious lateral margins, green, becoming beige	**5. *C. baetica***
3′	Plant stout; middle involucral bracts lacking broad scarious margins, basally dark brown	4
4	Leaves scabrid; major veins of cauline leaves forming large arches; florets ⩾ 54 mm long; pollen brownish red	**7. *C. auranitica***
4′	Leaves not scabrid; leaf venation uniformly reticulate; florets ⩽ 53 mm long; pollen yellow	**8. *C. cardunculus***
5	Leaves variegated; appendages of middle involucral bracts transverse-elliptic and apically abruptly acuminate	**4. *C. cornigera***
5′	Leaves uniformly green, appendages of middle involucral bracts lacking or indistinct, ovate to narrowly ovate	6
6	Leaves subbipinnate; receptacular bristles 5–18 mm long; cypselas 4-sided with winglike ribs along the edges	**1. *C. humilis***

6′ Leaves bipinnatifid, receptacular bristles 15–34 mm long; cypselas flattened, without winglike ribs 7

7 Leaves apically caudate, with distinctly revolute margins **2. *C. cyrenaica***

7′ Leaves apically acute, with indistinctly revolute margins **3. *C. algarbiensis***

1. *Cynara humilis* Linnaeus, *Species plantarum*, *2*: 828 (1753).

SYNONYMS: *Bourgaea humilis* (L.) Cosson, *Notes sur quelques plantes critiques, rares ou nouvelles*, *2*: 39 (1849).—*Cynara humilis* L. var. *typica* Maire in Jahandiez & Maire, *Catalogue des plantes du Maroc*, *3*: 801 (1934); *nomen not rite public.* LECTOTYPE selected here: Herb. Linnaeus 969.2 (LINN).

SYNONYM: *Cynara humilis* var. *lacinulata* Brotero, *Flora lusitanica*, *1*: 340 (1804). LECTOTYPE selected here: Herb. Casströmii (S).

SYNONYM: *Bourgaea humilis* (L.) Coss. var. *cyanea* Cosson, *Notes sur quelques plantes critiques, rares ou nouvelles*, *2*: 39 (1849). LECTOTYPE selected here: *Bourgeau 259*, Pl. d'Espagne. Dans les lieux incultes avec le *Chamaerops humilis* à Puerto Santa Maria, 19 Mai 1849 (P-CO lectotype, G, K, P isolectotypes).

SYNONYMS: *Bourgaea humilis* (L.) Coss. var. *leucantha* Cosson, *Notes sur quelques plantes critiques, rare ou nouvelles*, *2*: 39 (1849).—*Cynara humilis* L. var. *leucantha* (Coss.) Coutinho *fide* Jahandiez & Maire, *Catalogue des plantes du Maroc*, *3*: 801 (1934). LECTOTYPE selected here: *Bourgeau 260*, Pl. d'Espagne. Coteaux incultes à Castijo Blanco près Ronda, 5 juillet 1849 (P lectotype, BM, G, MPU isolectotypes).

SYNONYM: *Cynara humilis* var. *reflexa* Battandier ex Jahandiez & Maire, *Catalogue des plantes du Maroc*, *3*: 801 (1934). LECTOTYPE selected here: *Maire & Wilczek*, Iter Maroccanum XXIII. In pascuis inter Fes & Meknes, 22/4 1933 (MPU).

NOMENCLATURAL NOTE: Brotero (1804) did not cite a specimen when he described his new variety *C. humilis* var. *lacinulata*, nor was any of Brotero's specimens of *C. humilis* found at LISU or MO, where, according to Stafleu & Cowan (1976), his collections are kept. However, a specimen labelled "Cynara humilis laciniata Brotero" with the additional annotations "Brotero scripsit" and "Prof. Brotero misit" was found at S and this specimen is here chosen as lectotype.

ILLUSTRATIONS: Figs 1A–C, 4.

Perennial herb with taproot to 6.5 (– 8) dm high, unbranched to basally slightly branched. STEM 3.5–10 (–15) mm wide, slightly to densely floccose-woolly, slightly to moderately glandular, 8–22-ribbed. LEAVES basally rosulate, sparsely to ±densely set along stem, lanceolate in outline, with ±pinnate base and subpinnatifid apex, with 11–32 segments, not distinctly folded along midrib or along nerves of segments, 16–69 × 4–17 cm (rosulate leaves) to 11–33 × 3.5–11.5 cm (cauline leaves), sometimes slightly decurrent; base to 14 mm wide, entire, sometimes with a few small marginal spines; rachis 1.5–4 (–5) mm wide; leaf segments ±ovate in outline, pinnatifid, apically ±acute, 22–70 × 15–38 mm, with a 1–3 mm wide rachis, with basal lobes large and

Figure 4. *Cynara humilis*, habit. Cáceres, Casatejada, 1982, *Belmonte* (MAF).

sometimes pinnatifid; with lobes and teeth terminating in a 2–4.5 mm long spine, with distinctly revolute margins; abaxial side greyish-white, densely woolly, moderately glandular; adaxial side green, glabrescent, slightly glandular to eglandular. Leaves adaxially with nerves and major veins protruding, with minor venation concealed by the indumentum; adaxially with midribs of segments sunken almost to the apex, very slightly thickened below spines. CAPITULA solitary or in groups with a large central capitulum and a couple of smaller ones on lateral branches, sessile to very shortly pedunculate. INVOLUCRES (broadly) cyathiform to (broadly) ovate, 35–67 × 23–85 (−110) mm, with middle bracts protruding 7–19 mm. Involucral bracts *c.* 70–190, in 5–8 series;

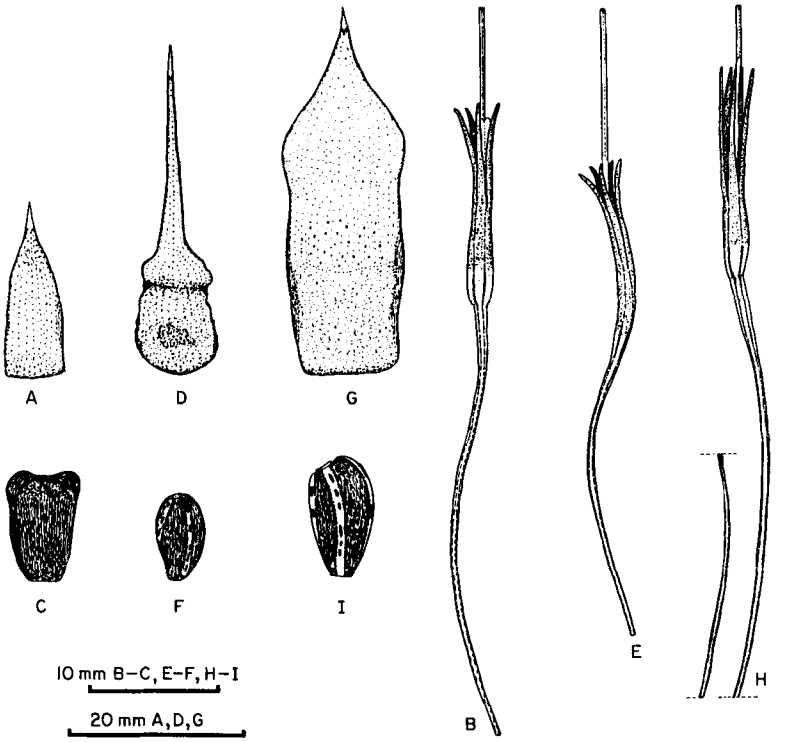

Figure 5. A–C. *Cynara humilis*. D–F. *C. cornigera*. *G–I. C. auranitica*. A, D, G. Middle involucral bracts. B, E, H. Corollas with styles. C, F, I. Cypselas. A–C. Spain: Málaga, Valle de Abdalajis, 4/6 1969, *Borja* (MAF). D–F. *Rechinger 12975* (BM) G. *Handel-Mazzetti 1949* (W). H–I. *Guest 4040* (K).

outer narrowly triangular to narrowly oblong with acuminate apex, entire, 8–19 × 1.5–5 mm, with narrow, ±scarious margins, greenish with lilac margins, densely to moderately (to slightly) pilose; middle narrowly ovate and apically acuminate to oblong and apically abruptly acuminate, 21–48 × (7–)8–10(–15) mm, with a 1.5–4.5 mm long spine, basally green with very narrow, ±scarious and purple to lilac margins, abaxially ±tinged with purple or lilac, slightly pilose to glabrescent, glandular; inner narrowly oblong to linear, apically acute, 23–55 × 2–7 mm, with reddish tip, abaxially with minute glands, marginally rarely ciliate. RECEPTACLES *c.* 3–6 mm thick, apically slightly concave to slightly convex. Receptacular bristles 5.5–18 mm long. FLORETS 40–160, corolla 33–55 × 1.2–2.5 mm; limb 13–17 mm long, bright lilac or whitish, with cells with straight lateral walls. ANTHERS apically rounded to subacute, 8.5–11.5 mm long, ±white. STYLES 43–61 mm long, bright lilac or whitish; style-branches 9–11.5 mm long. CYPSELAS 4-sided, broadly obovate to broadly oblong in outline with ±4-sided basal scar, with 4 wing-like ribs along edges, ±striate between edges, apically flat to slightly convex with ribs protruding, 4.5–9.3 × 3.2–6.7 mm, dark brown. PAPPUS consisting of 31–133 flat bristles in 3–7 series, 22–48 mm long; outer 0.18–0.22 mm wide; inner 0.29–0.40 mm wide; innermost with basal ventral part densely covered with hairs to glabrous.

CHROMOSOME NUMBER: $2n = 34$ (Fernandes & Queiros, 1971).

FLOWERING PERIOD: Mainly May to July, although occasional flowering specimens were seen also in March, April and August.

NOTES: *C. humilis* is easily recognized by its finely dissected leaves and the 4-sided cypselas with wing-like ribs.

Some variability was found in the shape and size of the lobes of the leaf segments and of the involucres, as well as in the colour of the florets. No geographical correlation of these characters was seen, however, and the variability is here ascribed to a morphological plasticity of the species. It is not considered to merit any taxonomic recognition.

Hybrids between *C. humilis* and *C. algarbiensis* have been reported by Talavera (1987) from the Huelva district in S.W. Spain. One possible hybrid specimen from this area was examined (*Talavera & Valdés*, Huelva, between Calañas and Villanueva, 20/6 1978 (SEV)). This specimen is morphologically quite similar to *C. humilis* but has, like *C. algarbiensis*, a thicker adaxial leaf indumentum, a broader rachis of the leaf segments, longer leaf spines and receptacular bristles and fewer pappus bristles. Because this specimen is morphologically intermediate between *C. humilis* and *C. algarbiensis*, and since of the *Cynara* species only *C. humilis* and *C. algarbiensis* were found in the Huelva region, I consider it very likely that it is indeed a hybrid of *C. humilis* and *C. algarbiensis*.

A morphologically deviating specimen from Serpa in Portugal was also seen (*Rivas Goday et al.*, Portugal, Serpa, banks of Guadiana, 17/6 1972 (VF)). It is morphologically similar to the here excluded *C. tournefortii* through its short stem, long capitula, shape and length of involucral bracts and length of florets. However, the leaves of this specimen differ from *C. tournefortii* in their very distinctly revolute margins, their absence of short stiff hairs and their unbranched to forked leaf veins. In the Serpa area *C. algarbiensis*, *C. cardunculus* and *C. humilis* have also been collected. Of these species the above mentioned deviating characters agree best with *C. humilis*. Specimens of *C. humulis* and *C. tournefortii* but not of *C. algarbiensis* nor of *C. cardunculus*, have also been collected on the banks of the Guadiana river where the deviating specimen was found. Furthermore, a few small apical knobs on the cypselas were found in the deviating specimen. These occur in *C. humilis* but not in the other *Cynara* specimens, nor in *C. tournefortii*. It thus appears possible that the specimen is a hybrid between *C. humilis* and *C. tournefortii*.

In the Serpa area a specimen with morphological characteristics similar to those of *C. humilis*, belonging to the same collection as the intermediary discussed above, was also found (*Rivas Goday et al.*, Portugal, Serpa, banks of Guadiana, 17/6 1972 (MAF)). This specimen differs from *C. humilis* in its slightly broader rachis and lobes of the leaf segments, its longer leaf spines and its $\pm$longer receptacular bristles. It seems possible that this specimen too is of hybrid origin, possibly involving *C. algarbiensis*. Yet another deviating specimen, probably of hybrid origin, was seen from the surroundings of Setubal (*Passos 1016*, June 1926, Alcacer do Sal, Herdade de Arouca (LISE)). This specimen agrees morphologically mainly with *C. algarbiensis*. However, in a few characters such as its strongly revolute leaves, its short involucral bracts and its straight lateral walls of the floret-limbs it approaches *C. humilis*.

Figure 6. Known distribution of *Cynara humilis* (●) and *C. cyrenaica* (▲). Large dots indicate ten collections, white triangles indicate localities taken from literature.

In Morocco a wide array of morphological intermediaries between *C. humilis* and *C. baetica* subsp. *maroccana* was encountered. This variability was interpreted in a previous article (Wiklund, 1989) to be the result of hybridization.

GEOGRAPHICAL DISTRIBUTION AND HABITAT: Fig. 6.
Cynara humilis is found mainly in the south-western sector of the Iberian peninsula and in northern Morocco, where it extends eastwards into Algeria. One collection was also seen from Mauritania (not on the map). It has been collected at altitudes between 25 and 1450 m in waste grounds and at the roadside as well as in fields, pastures and forest plantations. It has been reported to grow on a wide variety of substrates including calcareous, alkaline, siliceous and slightly saline soils and also limestone, slate, gravel, clay and sand.

REPRESENTATIVE COLLECTIONS (234 collections examined):
PORTUGAL: Beira Litoral; Coimbra, Santa Clara, June 1866, *De Barros e Cunha 906* (BM, COI, LISU)—Algarve, Silves, 1853, *Bourgeau 1928* (G, K, MA, MPU, P). SPAIN: Albacete; Kingdom of Murcia, near Yeste, 1891, *Porta & Rigo 603* (BM, P, S, W)—Sevilla; Castilblanco de los Arroyos, Hacienda de los Melonares, 1968, *Galiano & Valdés 1763/68* (MA, SEV). MOROCCO: Near Tetuán, at the mouth of Ibn Hanesh river, 1851, *Ball* (K)—Near Targuist, 1927, *Font Quer 692* (BM, G, MA).

2. *Cynara cyrenaica* Maire & Weiller in Maire, *Bulletin de la société d'histoire naturelle d'Afrique du Nord 30*: 286 (1939).

LECTOTYPE selected here: *Maire & Weiller 908*, Iter Libycum 1938, die aprilis 22, Cyrenaica in humosis supra Apolloniam, 200–300 m, solo calcareo (MPU).

SYNONYM: *Cynara sibthorpiana* Boiss. & Heldr. var. *mauginiana* Pampanini in Maugini, Appunti sulla vegetazione della Cirenaica e sulla sua utilizzazione

agraria. *Agricoltura coloniale A.15:* 378 (1921). *C. cardunculus* L. f. mauginiana (Pampanini) Pampanini, *Arch. Bot., 12*: 49 (1936). TYPE: not seen.

SYNONYM: *Cynara cardunculus* L. var. *elata* Cavara, Di alcune piante nuove o rare della Cirenaica, *Bollentino della societá botanica italiana N.1–2*: 12 (1923). TYPE: not seen.

NOMENCLATURAL NOTE: The above mentioned synonyms are only tentatively placed under *C. cyrenaica* since their type specimens were not encountered and because the original descriptions are too incomplete for a conclusive decision to be made. *Cynara sibthorpiana* var. *mauginiana* is reported by Pampanini (1921) to differ from *C. sibthorpiana (= C. cornigera)* through its narrow, 20–30 mm wide and ovate capitula. This description fits *C. cyrenaica* but not *C. cornigera.* Furthermore, var. *mauginiana* was collected in Cyrenaica (Merg) where *C. cyrenaica* but not *C. cornigera* has been collected.

Cavara (1923) expressed some doubts concerning the rank and affinity of his new taxon *C. cardunculus* var. *elata.* Later it was placed by Pampanini (1930) as a synonym of *C. sibthorpiana* Boiss. & Heldr. var. *elata* Béguinot & Vacc. (= *C. cornigera*). It is described by Cavara (1923) to have adaxially green leaves and smaller capitula than those of *C. cardunculus.* This could fit *C. cyrenaica* which (like *C. cardunculus*) has green leaves without the variegation found in *C. cornigera. C. cyrenaica* also generally has smaller capitula than both *C. cardunculus* and *C. cornigera.* Furthermore *C. cardunculus* var *elata* is recorded by Cavara (1923) to occur near Cyrene, where *C. cyrenaica* has been found, but not *C. cornigera*, nor *C. cardunculus.*

ILLUSTRATIONS: Fig. 7.

Perennial herb with taproot, slightly to moderately branched to 8 dm high (*fide* coll.). STEM 6–9 mm wide, floccose-woolly with short hairs, glandular; ribs 14–20. LEAVES basally rosulate, sparsely to ± densely set along stem, lanceolate in outline, with pinnate base and pinnatifid apex, with *c.* 19–33 segments, slightly folded along midrib and along nerves of larger segments, 12–33 × 6.5–10 cm (cauline leaves), not decurrent; base to 13 mm wide, with marginal fringes of small spines; rachis 3–5 mm wide, leaf segments narrowly ovate to broadly ovate in outline, narrowly triangular-lobed, with lobe margins entire or with single basal teeth or lobes, apically caudate, 35–70 × 12–45 mm, with 4–9 mm wide rachis, with lobes and teeth terminating in a 3–6 mm long spine; with distinctly revolute margins; abaxial side whitish grey, densely woolly, slightly glandular; adaxial side green, glabrescent, sometimes slightly glandular; major veins of leaf segments unbranched to forked or forming loose arches, distinctly thickened below spines, adaxially ±sunken in basal part of segments. CAPITULA solitary, subsessile to sessile. INVOLUCRES broadly ovate, 32–36 × (20–) 25–28 mm, with middle involucral bracts protruding 24–50 mm. Involucral bracts *c.* 60–70, in 5–7 series; outer triangular to ovate with acuminate apex, 6–8 × *c.* 3 mm, moderately pilose, coriaceous, ±lilac; middle broadly oblong with an abruptly acuminate apex, 29–40 × 8–9.5 mm with a 4–6 mm long spine, basally green, with margins subcoriaceous and ±lilac, ±tinged with greyish pink or greyish lilac, slightly pilose to glabrous; inner sublinear, apically acute, 28–31 × 3–3.5 mm, tinged with brown or red, with scattered minute glands abaxially. RECEPTACLES not seen. Receptacular bristles 21–31 mm long. FLORETS

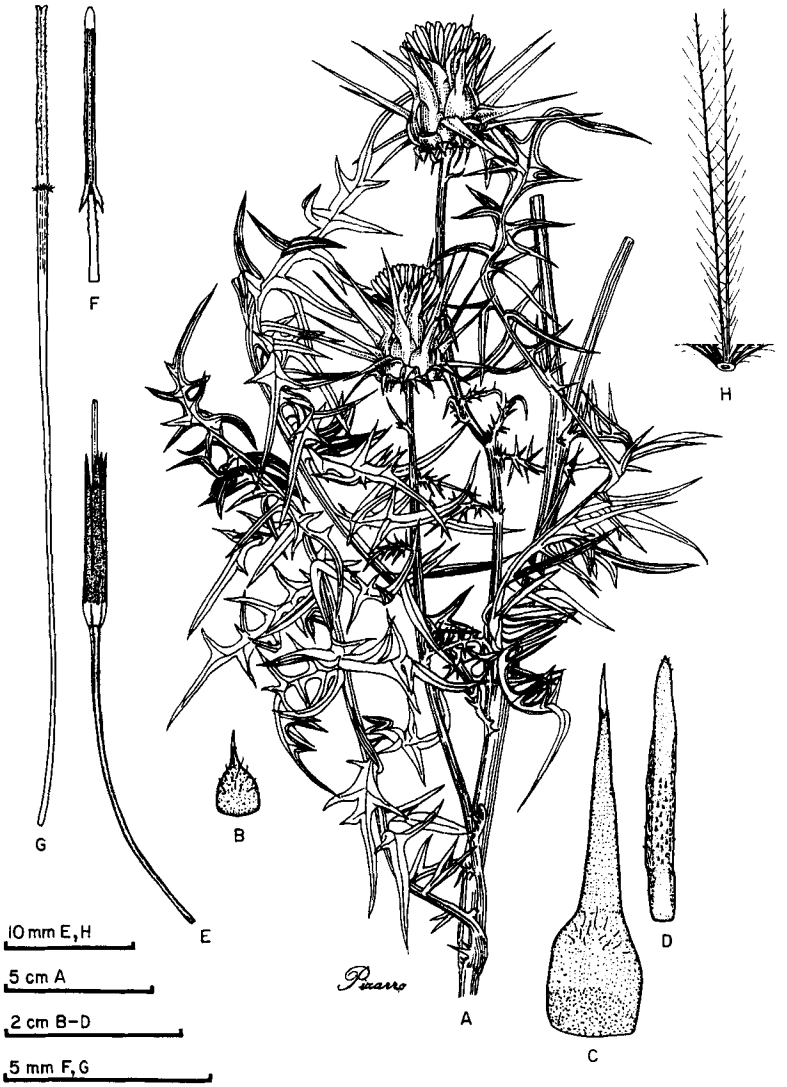

Figure 7. *Cynara cyrenaica*. A. Habit. B–D. Involucral bracts. E. Corolla with style. F. Stamen. G. Style. H. Part of pappus. A–H. *Barclay 3208* (K).

c. 70–80; corolla 29.3–38.6 × 1.1–1.4 mm; limb 10.0–13.2 mm long, purple or lilac blue (*fide* coll.), with cells with straight lateral walls. ANTHERS apically rounded, 6.7–7.7 mm long, ±white. STYLES 37.7–40.9 mm long, lilac; style-branches 6.6–8.1 mm long. CYPSELAS: ripe cypselas not seen. PAPPUS consisting of 116–144 flat bristles in 3–5 series, 21–29 mm long; outer *c.* 0.14 mm wide; inner 0.18–0.25 mm wide; innermost with adaxial basal part covered with hairs.

FLOWERING PERIOD: Flowering specimens seen from May, June and August.

NOTES: *C. cyrenaica* has, like *C. humilis*, non-scabrid leaves with distinctly revolute margins and middle involucral bracts lacking a central constriction. It may be

distinguished from the latter by its leaves which are apically caudate and usually have a broader rachis. It also has smaller capitula and laterally compressed cypselas. Only three well-developed and flowering specimens of *C. cyrenaica* were seen.

GEOGRAPHICAL DISTRIBUTION AND HABITAT: Fig. 6. *Cynara cyrenaica* occurs in the Cyrenaica region of Libya. According to Maire & Weiller (1939) it is frequent in "la Montagne Vert". One collection was also seen from Crete, where (*fide* coll.) it is infrequent. It is recorded to have been collected at altitudes between 25 and 500 m on calcereous soil and clay loam.

COLLECTIONS: GREECE. *Crete*: Lassithi Province, *c.* 22 km from Agios Nicolaos? near Meseleri on Kalamaptea? road, *Barclay 3208* (K). LIBYA. *Cyrenaica*: 20 km W of Benghazi, −61, *Khalifa el Karamanli 889* (K); Along road between Cyrene x road and Lamluda, −57, *Guichard CYR/57/21* (BM); Above Apollonia, *Maire & Weiller 980* (MPU); El Ghegab SE of Cyrene at Poterium, 1934, *Pampanini & Pichi-Sermolli 8761* (K); road to Talonota [untraced], 1956, *Park 572* (K).

3. *Cynara algarbiensis* Coss. ex Mariz, *Boletim da sociedade broteriana, 10*: 235–236 (1893).

SYNONYM: *Cynara algarbiensis* Coss. ex Nyman, *Conspectus florae europaeae, 2*: 403 (1879); *nom. nud.*

LECTOTYPE selected here: *Bourgeau 2075*, Pl. d'Espagne et de Portugal, 1853, Serra de la Folla près Monchique, Algarve. 24 juin (COI lectotype, G, K, P isolectotypes).

SYNONYM: *Cynara humilis* L. var. *sinuata* Brotero, *Flora lusitanica, 1*: 340 (1804). TYPE: not seen.

SYNONYM: *Cynara algarbiensis* Coss. ex Mariz f. *albiflora* J. Paiva, *Anuário da sociedade broteriana, 27*: 19 (1961). HOLOTYPE: *Fernandes A., Fernandes, R. & Matos 7518*, a 39 km de Beja, na estrada da Mértola-Beja, nos incultos, 13/6 1960 (COI).

NOMENCLATURAL NOTE: Brotero (1804) described the variety *sinuata* of *C. humilis* from "Transtaganae inter Pacem Juliam [= Beja] et Myrtilem [= Mertola]". Believing that one species could be transformed into another he included his variety in *C. humilis* since he had found that it changed into the latter species ("*C. humilis* var. *lacinulata*") after being cultivated for several years in the Botanical Garden of Coimbra.

No material of the genus *Cynara* was found in Brotero's herbarium at LISU, where according to Stafleu & Cowan (1976), Brotero's types are kept. In addition, no material matching Brotero's description was found in the Bernhardi herbarium at MO, where some of Brotero's specimens are to be found (Stafleu & Cowan, 1976) nor in the de Valorado herbarium at LISU, the specimens of which Brotero is assumed to have studied (Rodrigues, personal communication). However, since the description given by Brotero for his var. *sinuata* does fit *C. algarbiensis* and because Cosson places it as a synonym of *C. algarbiensis* it is here tentatively included as such.

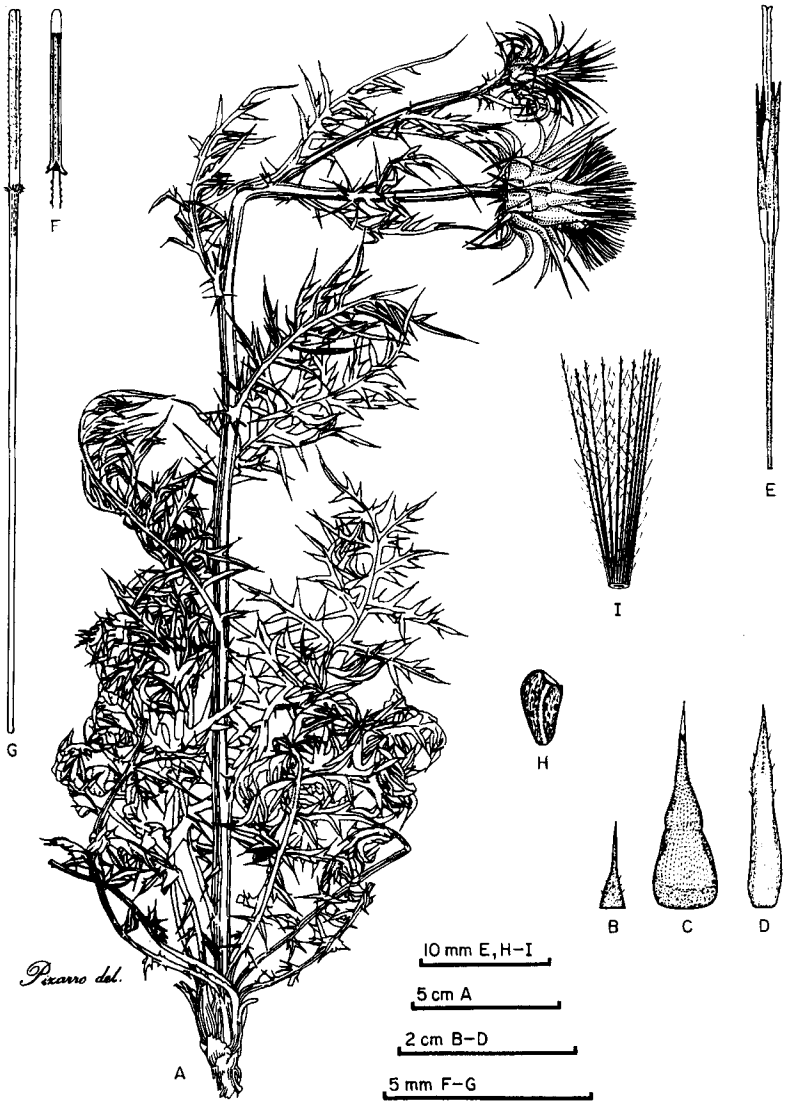

Figure 8. *Cynara algarbiensis*. A. Habit. B–D. Involucral bracts. E. Corolla with style. F. Stamen. G. Style. H. Cypsela. I. Pappus. A–G, I. *Fernandes, Fernandes & Matos 7517* (COI). H. Spain, Huelva: between San Bartolomé de la Torre and Alosno, 20.6 1978. *Valdés & Talavera* (SEV).

ILLUSTRATIONS: Fig. 8.

Perennial herb with taproot, to 7 dm high, unbranched or in apical part moderately branched. STEM 5–12 mm wide, floccose-woolly, glandular, 10- to 20-ribbed. LEAVES basally rosulate, ±sparsely set along stem, broadly lanceolate to lanceolate in outline, laciniate-pinnatifid, often with subpinnate to pinnate base, with 15–29 segments, very slightly folded along midrib and along nerves of segments, (10.5–) 15.0–29.0 × 4.5–9.6 cm (rosulate leaves), 10.0–20.0 × 3.8–11.5 cm (cauline leaves), not decurrent; base to 13 mm wide, entire and brownish (rosulate leaves) or green with small marginal spines or

spine-tipped lobules (cauline leaves); rachis 3–9 (–17) mm wide; leaf segments ± ovate in outline, narrowly triangular- to triangular-lobed, with lobes with entire to basally serrate to slightly lobed margins, apically ±acute, 30–45 (–60) × 12–31 (–36) mm, with a 5–15 mm wide rachis, with lobes and teeth terminating in a 3–8 mm long spine; with revolute margins, abaxial surface greyish white, densely woolly, moderately glandular; adaxial side dark green, slightly to moderately pilose, slightly glandular to eglandular; major veins of leaf segments forked to laxly reticulate, slightly broader below spines. CAPITULA solitary or in few-headed corymb-like groups, sessile to shortly pedunculate. INVOLUCRES ±ovate, 25–56 × 23–38 (–45) mm, with middle bracts protruding 15–37 mm. Involucral bracts *c.* 30–70, in 5–7 series; outer narrowly triangular to ±ovate with acute apex, 10–21 × 1–7 mm, centrally slightly woolly to glabrous, slightly glandular, coriaceous, greyish green, becoming beige, middle ovate to oblong with an acuminate apex or oblong with an ovate to narrowly ovate and apically acuminate appendage, 24–51 × 7–13 mm, with a 2–6 mm long spine, basally with narrow subscarious and purple to incolour margins, sometimes tinged with purple, glabrous, with margins sometimes slightly and shortly ciliate, eglandular; inner narrowly oblong to linear, with acuminate apex, 27–47 × 3–6.5 mm. dorsally glabrous, sometimes with minute glands, sometimes slightly ciliate. RECEPTACLES 2–6 mm thick, apically flat. Receptacular bristles 15–34 mm long. FLORETS *c.* 60–105, 29.0–35.2 × 0.9–1.8 mm; limb 13–17 mm long, bright lilac, pale lilac or white, with cells with sinuate lateral walls. ANTHERS apically rounded, 5.8–9.9 mm long, ±white. STYLES 25.5–50.0 mm long, lilac, pale lilac or white; style-branches 5.0–9.5 mm long. CYPSELAS (unripe) somewhat laterally compressed, subobovate in outline, with rounded basal scar, ±distinctly 5-ribbed, apically flat, 5.7–6.1 × 3.0–3.3 mm, yellowish brown with dark brown dots and short longitudinal lines. PAPPUS consisting of 51–107 flattened to dorsally faintly keeled bristles in 3–5 series, 17–36 mm long; outer 0.05–0.14 mm wide; inner 0.14–0.27 mm wide; innermost with adaxial basal part with hairs (to glabrous).

FLOWERING PERIOD: Mainly June, although flowering specimens were seen between May and August.

NOTES: This species may usually be distinguished from the other *Cynara* species through its leaf segments with their short acute tips. It has, like *C. cornigera*, glabrous middle involucral bracts but may be distinguished from the latter by its green leaves without variegation, its ±ovate involucres and its only weakly constricted middle involucral bracts.

Cynara algarbiensis was found to exhibit a certain variation in the degree of incision of the leaf margins and in the colour of the florets. *Fernandez et al.* (*fide* coll.) report purplish violet, pinkish lilac and white florets in specimen from the same locality (*Fernandez et al. 7516*, *7517*, *7518* (COI)). They found that purplish violet florets dominated whilst specimens with paler, pinkish lilac florets formed a small but well-delimited population within the former. Paiva (1961) suggests that the pale pinkish lilac florets might have resulted from crossings between the purplish violet and the white specimens.

It was difficult to ascertain the frequency of the various colour morphs from the herbarium specimens. However, it appears that white florets occur only rarely and in scattered localities. They appeared to be found in a collection from

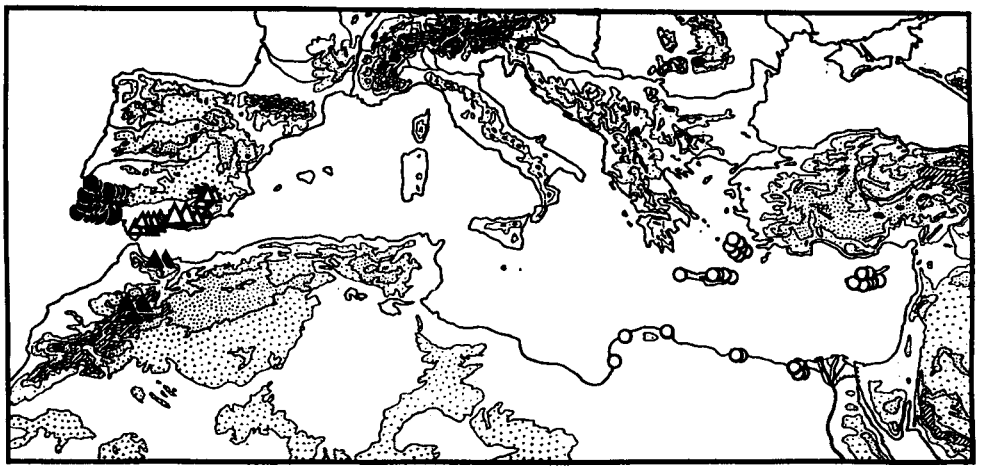

Figure 9. Known distributions of *Cynara algarbiensis* (●), *C. baetica* subsp. *baetica* (△), *C. baetica* subsp. *maroccana* (▲) and *C. cornigera* (○). Large dots and large triangles indicate 10 collections.

the Huelva province in Spain (*Gibbs et al. 14381/79* (VF)) and in Foia and Silves in the Monchique mountains in S. Portugal (*Guimarães* (COI); *Moller* (COI)). A majority of the specimens seemed to have lilac or pale lilac florets. Specimens with bright lilac florets were seen in the Monchique mountains (*Wiklund 102*).

Since the colour morphs, as far as could be judged from the herbarium specimens, were not found to be correlated with any other morphological characters, nor with separate geographical areas, it was not found necessary to recognize them taxonomically.

Hybrids between *C. algarbiensis* and *C. humilis* have been reported to occur frequently, together with their parental species, in the Andévalo in south-west Spain (Talavera, 1987). For a further discussion of possible hybrids see under *C. humilis*.

GEOGRAPHICAL DISTRIBUTION AND HABITAT: Fig. 9.

Cynara algarbiensis is endemic to the S.W. sector of the Iberian peninsula. It occurs in the Portuguese province Baixo Alentejo extending into the bordering regions of Andalucía in Spain, and in the mountainous regions of Algarve in Portugal.

It has been collected at altitudes ranging from sea-level up to *c.* 500 m. It has been found in fields and wastelands as well as in garrigue and thickets and along the roadside. It has been reported (*fide* coll.) to grow on calcareous, clayey, schistose and siliceous substrates. According to Talavera (1980) it grows on acid soils, preferably on slate.

REPRESENTATIVE COLLECTIONS (45 collections examine): PORTUGAL. Baixo Alentejo, Odemira, 1962, *Rainha 5546* (G, LISE); Baixo Alentejo, Mértola-Beja road, 39 km from Beja, 1960, *Fernandez et al. 7516, 7517, 7518* (COI); Algarve, Serra de la Folla, near Monchique, 1853, *Bourgeau 2075* (COI, G, K, P); Algarve, Monchique, road from Foia, 1924, *Palhinha* (BM). SPAIN. Huelva, Puebla de Guzmán-Villanueva de los Castillejos, 1979, *Gibbs et al. 4381/79* (MA, SEV, VF); Huelva, between San Bartolomé de la Torre and Alosno, slate, 1978, *Valdés & Talavera* (SEV).

4. *Cynara cornigera* Lindley in Sibthorp & Lindley, *Flora graeca, 10*: 74 (1840) [description by Lindley in Sibthorp & Lindley, *Florae graeca, 9*: 25 (1837), sub. *C. humilis*.]

SYNONYM: *Cynara sibthorpiana* Boissier & Heldreich in Boissier, *Diagnoses plantarum orientalium novarum Ser. 1(10)*: 94 (1849); *nom. superfl. illegit.*

LECTOTYPE selected here: Herb. Sibthorp (OXF lectotype, BM isolectotype).

SYNONYM: *Cynara sibthorpiana* Boiss. & Heldr. var. *elata* Béguinot & Vaccari, *Annali di botanica (Rome) 12*: 122 (1913). TYPE: not seen.

ILLUSTRATIONS: Fig. 1G–I, 10.

Perennial herb with swollen root, to 5 dm high, unbranched to slightly branched. STEM 4–10 mm wide, short-woolly to glabrous, slightly glandular, 16 to 22-ribbed. LEAVES basally rosulate, ±sparsely set along stem, broadly lanceolate to lanceolate in outline, usually with pinnate base and laciniate-pinnatifid apex, with 19–28 segments, slightly folded along midrib and along nerves of segments, 25–50 × 8–22 cm (rosulate leaves), 12–46 × 4–17 cm (cauline leaves), not decurrent; base to 20 mm wide, usually with fringes of small spines; rachis 3–19 mm wide; leaf segments ovate to oblong in outline, deeply serrate to narrowly triangular-lobed, with lobes entire or basally dentate, apically shortly caudate, 21–97 × 14–49 (–58) mm, with rachis 4.5–30 mm wide, with lobes and teeth terminating in a 2–7 mm long spine; with distinctly revolute margins, abaxial surface whitish grey, densely woolly, sometimes scabrid on nerves, ±densely glandular; adaxially variegated along venation, very slightly pilose to glabrous, eglandular. Major veins of leaf segments forked to laxly reticulate, distinctly thickened below spines. CAPITULA solitary or sometimes in few-headed corymblike groups, subsessile to sessile. INVOLUCRES broadly cyathiform to cyathiform, 32–60 × 33–70 mm, with middle bracts protruding 24–50 mm. Involucral bracts *c.* 60–100, in 5–8 series; outer (narrowly) triangular to oblong and apically abruptly acuminate, entire, 8–20 × 3–8.5 mm, with narrow scarious margins, becoming straw-coloured to brownish, glabrous or basally slightly pilose, eglandular; middle (broadly) ablong to (broadly) ovate and usually with a distinct transverse-elliptic and apically abruptly acuminate apical appendage, 27–59 × 8–15 mm, with a 3–7 mm long spine, with narrow scarious margins, becoming straw-coloured, ±tinged with purple, sometimes centrally pale brown, glabrous, eglandular; inner narrowly oblong to linear, sometimes with an ovate appendage, apically acute, 24–43 × 2.5–5.5 mm, subcoriaceous with scarious margins, glabrous or with scattered minute hairs dorsally and marginally. RECEPTACLES *c.* 2.5 mm thick, apically flat. Receptacular bristles 16–32 mm long. FLORETS *c.* 100–150, corolla 29.3–59.9 × 1.3–2.5 mm; limb 10.0–14.8 mm long, pale yellow to magnolia-white (*fide* coll.) or lilac, with cells with sinuate lateral walls. ANTHERS apically rounded, 6.7–11.1 mm long, ±white. STYLES 30.2–56.0 mm long, whitish or lilac; style-branches 6.6–11.1 mm long. CYPSELAS somewhat laterally compressed, obovate in outline, with rounded basal scar, apically flat, 7.0 × 3.6 mm, yellowish brown and pale yellow with dark brown longitudinal lines. PAPPUS consisting of (62–) 110–149 flat bristles in (3–) 4–6 series, 19–31 mm long; outer 0.11–0.22 mm wide; inner 0.14–0.29 mm wide; innermost with basal ventral part usually densely covered by hairs.

Figure 10. *Cynara cornigera*, habit. *Meikle 2597* (K).

FLOWERING PERIOD: Mainly April to May.

NOTES: This species is most easily recognized by its variegated leaves.

The presence of variegated leaves appears to be constant within the species, although it is sometimes difficult to distinguish in old herbarium specimens. A further distinctive character is the usually clearly demarcated, transverse-elliptic apical appendages of the middle involucral bracts. Similar appendages were also found in *C. syriaca*. However, in the latter species they are reflexed.

A wide range of variation in the height is found in *C. cornigera*. Individual

specimens may be almost stemless or reach heights of up to 0.5 m. Relatively tall specimens (0.25–0.35 m) from Libya have been recognized by Béguinot & Vaccari (1913) as the separate variety *elata*. However, although high-growing specimens do seem to occur more frequently in N. Africa and in Cyprus, both short and tall specimens were found in all the major areas of distribution of *C. cornigera*. Furthermore, since it was not possible to correlate the height with any ecological or other factor a taxonomical recognition of taller specimens was not found warranted.

The florets are either magnolia-white/pale yellow (*fide* coll.) or of some lilac shade. Although the colour 'morphs' and their respective geographical distributions were difficult to ascertain from the herbarium sheets, it appears that they are not geographically separated. Whitish florets do seem to be more common than the lilac ones.

GEOGRAPHICAL DISTRIBUTOIN AND HABITAT: Fig. 9. *Cynara cornigera* is an E. Mediterranean species. It is found in the Greek archipelago as well as in Cyprus and along the coasts of Libya and Egypt. According to Kupicha (1975), it also occurs rarely on the islands of Turkey. It has been collected at altitudes from sea-level to *c.* 450 m in wastelands and mountainous and rocky or stony areas on calcareous soils.

REPRESENTATIVE COLLECTIONS (31 collections examined): GREECE. Crete, Kissamos district, Karykos peninsula, W. shore, Petronia, 1942, *Rechinger 12140* (S); Crete, Sitia district, Dionysades island, Dragonara island, 1942, *Rechinger 12901* (BM, G, K). LIBYA. Cyrenaica, Derna, near Kenissieh, 1887, *Taubert 533* (BM, K. P); EGYPT. Wadi Scheik Fayez, 20 km W of Mersa Matruh, 2 km SE of the village Om el Rakham, 1969, *Wanntorp & Sjödin* (S). CYPRUS. Pergamos, –55, *Merton 2214* (K).

5. *Cynara baetica* (Spreng.) Pau *emend. nov.* Wikl.; Pau, *Cinara baetica*, combinación nueva. *Boletín de la real sociedad española de historia natural, 23*: 245 (1923).

SYNONYMS: *Cirsium horridum* Lagasca, Caracteres diferenciales de once especies nuevas de plantas y de otras poco conocidas. *Variedades de ciencias, literatura y artes 2(4)*: 214 (1805) ("*Cistus horridum*", err. typogr., *Circsium horridum* in Lagasca, *Genera et species plantarum*: 24 (1816); *non Cynara horrida* Aiton, *Hortus kewensis, 3*: 148 (1811)).

Lamyra pinnatifida Cassini, *Dictionnaire des sciences naturelles, 25:* 222 (1822); *nom. illeg.*

Cirsium baeticum Sprengel, *Systema vegetabilium, 3*: 377 (1826).

Chamaepeuce horrida (Lagasca) de Candolle, *Prodromus systematis naturalis regni vegetabilis, 6*: 660 (1838).

LECTOTYPE selected here: Entre Alama y Velez Málaga, setiembre, *Lagasca* (MA).

NOMENCLATURAL NOTE: Lagasca (1805) did not cite any specimens in his original description of *Cirsium horridum* (= *Cynara baetica* (Spreng.) Pau). His original herbarium was later destroyed and his remaining types are believed to be kept mainly at MA and FI. (Stafleu & Cowan, 1979). A collection made by Lagasca

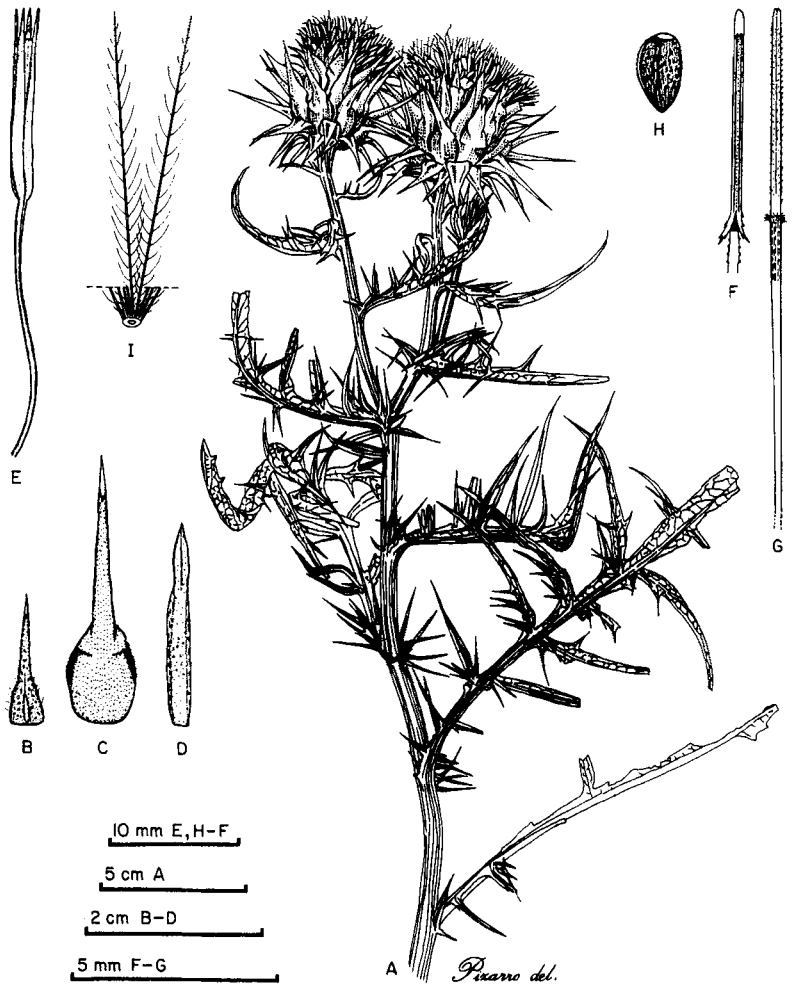

Figure 11. *Cynara baetica* subsp. *baetica*. A. Habit. B–D. Involucral bracts. E. Corolla. F. Stamen. G. Style. H. Cypsela. I. Part of pappus. A. Spain, Córdoba: Priego de Córdoba, El Chaparral, Sierra de Horconera, 14.8 1977, *Devesa* (SEV). B–I. *Herb. Boissier 124* (W).

of *C. baetica* labelled "*Carduus silyboides*" was found at MA. This specimen is here selected as lectotype of *C. baetica*.

For further nomenclature notes, see under the subspecies.

ILLUSTRATIONS: Fig. 11.

Perennial herb with taproot, to 7.5(−10) dm high, unbranched or in upper part moderately branched. STEM 3.5–8 mm wide, slightly to moderately short-woolly, moderately to densely glandular, 14 to 29-ribbed. LEAVES basally rosulate, ±sparsely set along stem, ±lanceolate to broadly lanceolate in outline, pinnatifid, sometimes with pinnate base, with 8–21 segments, slightly folded along midrib and along nerves of segments, 8–32 × 4.5–12 cm, usually slightly decurrent; base to 12 mm wide, marginally with long and ±clustered spines; rachis 5–16 mm wide; leaf segments narrowly ovate to narrowly triangular in

outline, narrowly triangular-lobed to deeply serrate to entire, apically caudate, with lobes basally sometimes slightly serrate or with a few spines, 30–83 × 9–32 mm, with rachis 3.5–10 mm wide, with lobes and teeth terminating in a 6–16 mm long spine; with revolute margins; abaxial surface green (slightly pilose to) slightly to moderately woolly, slightly scabrid along nerves, very densely glandular; adaxial side green, (moderately woolly to) arachnoid to glabrous, scabrid, moderately to densely glandular; major secondary veins of leaf segments and rachis joined in a series of large arches with reticulate and less prominent venation within them, slightly thickened below spines. CAPITULA solitary or sometimes in few-headed corymb-like groups, subsessile to shortly pedunculate. INVOLUCRES ±broadly ovate and apically constricted, 32–50 × 28–50 mm, with middle bracts protruding 17–32 mm. Involucral bracts *c.* 45–90, in 5–7 series; outer narrowly triangular to oblong and apically abruptly acuminate, 9–22 × 2.5–8 mm, coriaceous, pale green, slightly pilose to moderately woolly; middle broadly oblong to ovate with acuminate (to abruptly acuminate) apex, sometimes with an indistinct ±ovate and apically acuminate appendage, 26–48 × 9–14 mm, with a 2.5–10 mm long spine, with margins usually broadly scarious, irregular and blackish to dark brown, initially pale green, sometimes with a tinge of pinkish purple, becoming pale brown, glabrescent, eglandular; inner narrowly oblong to linear, apically acute or sometimes with an ovate and apically acute appendage, 22–44 × 1.5–5 mm, sometimes apically pinkish and/or ciliate, abaxially with scattered minute glands. RECEPTACLES 2–10 mm thick, apically flat. Receptacular bristles 14–32 mm long. FLORETS *c.* 60–130, corolla 34–44 × 1.4 × 1.8 mm; limb 14.1–17.9 mm long, bright lilac or whitish, with cells with straight lateral walls. ANTHERS apically rounded, 9.6–11.7 mm long, ±white. STYLES 37.0–49.3 mm long, lilac or white: style-branches 7.0–10.1 mm long. CYPSELAS somewhat laterally compressed, narrowly obovate to obovate in outline, with rounded basal scar, faintly 4-ribbed, apically convex, 6.0–6.7 × 2.5–3.6 mm; yellowish brown with dark brown and/or straw-coloured dots and short longitudinal lines. PAPPUS consisting of 60–136 flat bristles in (3–) 4–5 series, 21–35 mm long; outer 0.11–0.22 mm wide; inner 0.21–0.36 mm wide; innermost in basal adaxial part usually with hairs.

FLOWERING PERIOD: July to September.

NOTES: *Cynara baetica* as here circumscribed comprises the two former species *C. baetica* (syn. *C. alba*) and *C. 'hystrix'*. It is defined by the dark-coloured, broad scarious rims on the middle involucral bracts.

The two species united here differ from each other in the pigmentation of florets and involucral bracts. They also differ sometimes in the length of the protrusion of the involucral bracts and in the length of the spines of the involucral bracts. Apart from the difference in pigmentation, they are not always morphologically distinguishable. In view of the above, since intraspecific colour variations are common in *Cynara* (see *Morphology and anatomy*) and because it was not possible to identify any of the colour morphs as an autapomorphy for either of the two former species, they are united here in a single species. However, since the two colour morphs are distinct and geographically separated, one in Spain and the other in Morocco, they are maintained at subspecific level.

The Spanish subsp. *baetica* is a morphologically not-very-variable taxon,

although some variation is found in the degree of incision and width of the leaf segments. It is distinguished from the Moroccan subsp. *maroccana* by the whitish florets and the green involucral bracts. In addition, the involucral bracts often protrude less and have shorter spines than in subsp. *maroccana*.

Subsp. *maroccana* (*C.* '*hystrix*') has lilac florets and purple-tinged involucral bracts. An apparent great morphological variability in this subspecies was ascribed in a previous article (Wiklund, 1989) to hybridization/introgression with *C. humilis*.

GEOGRAPHICAL DISTRIBUTION AND HABITAT. Fig. 9. Subsp. *baetica* has been collected in the mountainous regions of southern Spain, 500–1700 m (*fide* coll.). It is recorded as growing in fields and along the roadside on clayey, calcareous and acid soils.

Subsp. *maroccana* occurs in the Rif and Middle Atlas mountains of north and north-central Morocco. It has been found at altitudes of 1000–1900 m (*fide* coll.) in fields and meadows on calcareous soils.

5a. *Cynara baetica* (Spreng.) Pau **subsp. *baetica*.**

SYNONYM: **Cynara alba** Boissier ex de Candolle, *Prodromus systematis naturalis regni vegetabilis*, *7*: 304 (1838).

SYNONY: *Cynara lamyroides* Webb, *Iter hispaniense*: 34 (1838); *pro syn.*

LECTOTYPE selected by Burdet *et al.* (1983): Supra Alhama regni Granatensis et in argillosis Sa Nevada loco dicto Pulche, 3000'–4000', 1838, *Boissier* (G–DC).

For type and further synonyms see under the species.

Involucral bracts protruding 17–30 mm, pale green, with a 2.5–6 mm long spine. Florets white.

CHROMOSOME NUMBER: $2n = 34$ (Talavera, 1981 *C. alba*).

REPRESENTATIVE COLLECTIONS (36 collections examined): SPAIN. Albacete, Riópar, 1850, *Bourgeau 733* (G, K, P); Cádiz, Algodonales, Sierra de Lijar, 500–700 m, 1980, *Aparicio* (SEV); Granada, Sierra Nevada, Puihe, 1700 m, 1891, *Porta & Rigo 478* (BM, S, W).

5b. *Cynara baetica* (Spreng.) Pau **subsp. *maroccana*** Wikl., **subsp. nov.**

HOLOTYPE: Maroc: Targuist, champs, vers 1000 m, 7-VIII *Sennen & Mauricio 7897* (1931-Plantes d'Espagne.—F. Sennen) (BM holotype, G, MAF, MPU, W isotypes).

NOMENCLATURAL NOTE: *Cynara baetica* subsp. *maroccana* occurs in taxonomic literature under the name '*C. hystrix*' Ball (syn. *C. algarbiensis* Coss. var. *hystrix* (Ball) Pau). However, it was here found that the name *C. hystrix* Ball (Ball 1873) is based on a specimen that is morphologically intermediate between *C. baetica* subsp. *maroccana* and *C. humilis* (see also Wiklund, 1989). The name *C. hystrix*, with the type specimen "J. Ball, Iter Maroccanum 1871, Ex regione inferiore Atlantis Mayoris, Distr. Reraya, alt. 1000–1200 m, Majo 11–12 (K)" should therefore be applied to these intermediate morphs.

Since no taxonomic synonyms were found for the 'pure' morph, a new name is here provided together with a typification and a latin diagnosis.

The name *C. senneni* Pau ex Sennen, *nom. nud.*, (Sennen, 1936) is not suggested here since, according to Sennen (1936), it is doubtful whether it was applied by Pau to the above taxon, and since no type specimen was found.

Bracteae involucrales mediae (20–) 28–32 mm protrudentes, pallidae virides, purpuratae, spina 5–10 mm longa. Flosculi vividi lilacini.

Middle involucral bracts protruding (20–) 28–32 mm, pale green and tinged with purple, with a 5–10 mm long spine. Florets bright lilac.

COLLECTIONS: MOROCCO. *Rif*: Targuist, 1931, *Sennen & Mauricio 7879* (BM, G, MAF, MPU, W); Between Targuist and Sok-et-Tnin, Beni Hadifa (Beni Uriaguel), 1929, *Font Quer 460* (BM, G, MA, MAF, S). *Middle Atlas*: Ito, 1921, *Maire* (MPU); Ifrane, n'Treten high plain, 1937, *Gattefossé 1283* (G, K, P, S); Ifrane, around Biological Station, 1960, *Höpflinger* (G); Halfway between Azrou and Timhadite, road 21, roadside, 1988, *Wiklund 158* (S).

6. *Cynara syriaca* Boissier, *Diagnoses plantarum orientalium novarum, 1(10)*: 94 (1849).

TYPE: selected by Rechinger (1979): Syria, entre Tripoli et Latakié, Mai–Jul, 1846 *Boissier* (G-BOIS).

NOMENCLATURAL NOTE: Boissier (1849) in his original description of *C. syriaca*, reports that it was collected "in pinguibus Syriae littoralis prope Tartous" in July 1846. One specimen from Syria, collected by Boissier between Tripoli and Latakié (= Latakhie) in May to July 1846 was found in Boissier's herbarium at G where, according to Stafleu & Cowan (1976), his types are kept. This specimen is labelled "*Cynara* sp. nov." and "*C. syriaca*" and carries a small diagnosis. In view of this and because Tartous is situated between Tripoli and Latakhie it seems very likely that this specimen was studied by Boissier when he described *C. syriaca*.

Rechinger (1979) in Flora Iranica indicates a specimen in G-BOIS collected by Boissier in "Syria, Tartous, VII. 1885 [should be 1846 according to Dittrich pers. comm.]" as type for *C. syriaca*. Since no other specimen was encountered at G-BOIS, it appears probable that the type indicated by Rechinger (1979) is the specimen studied here. Because many duplicates of Boissier's collections usually exist (Stafleu & Cowan, 1976) the specimen is best regarded as a lectotype. The specimens cited by Rechinger (1979) under *C. syriaca* (excluding the type) appear to belong to *C. auranitica*.

ILLUSTRATIONS: Fig. 12.

Perennial herb to 7 dm high, moderately- to well-branched (roots not seen). STEM 6–13 mm wide, slightly to moderately short-woolly, glandular, 16 to 30-ribbed. LEAVES ±sparsely set along stem (basal leaves not seen), ±broadly lanceolate in outline, pinnatifid with subpinnate base, with *c.* 9–11 segments, somewhat folded along midrib and long nerves of segments, 12–35 × 14–27 cm, sometimes slightly decurrent; base to 10 mm wide, with ±clustered long spines; rachis 8–17 mm wide; leaf segments narrowly triangular in outline, triangular-

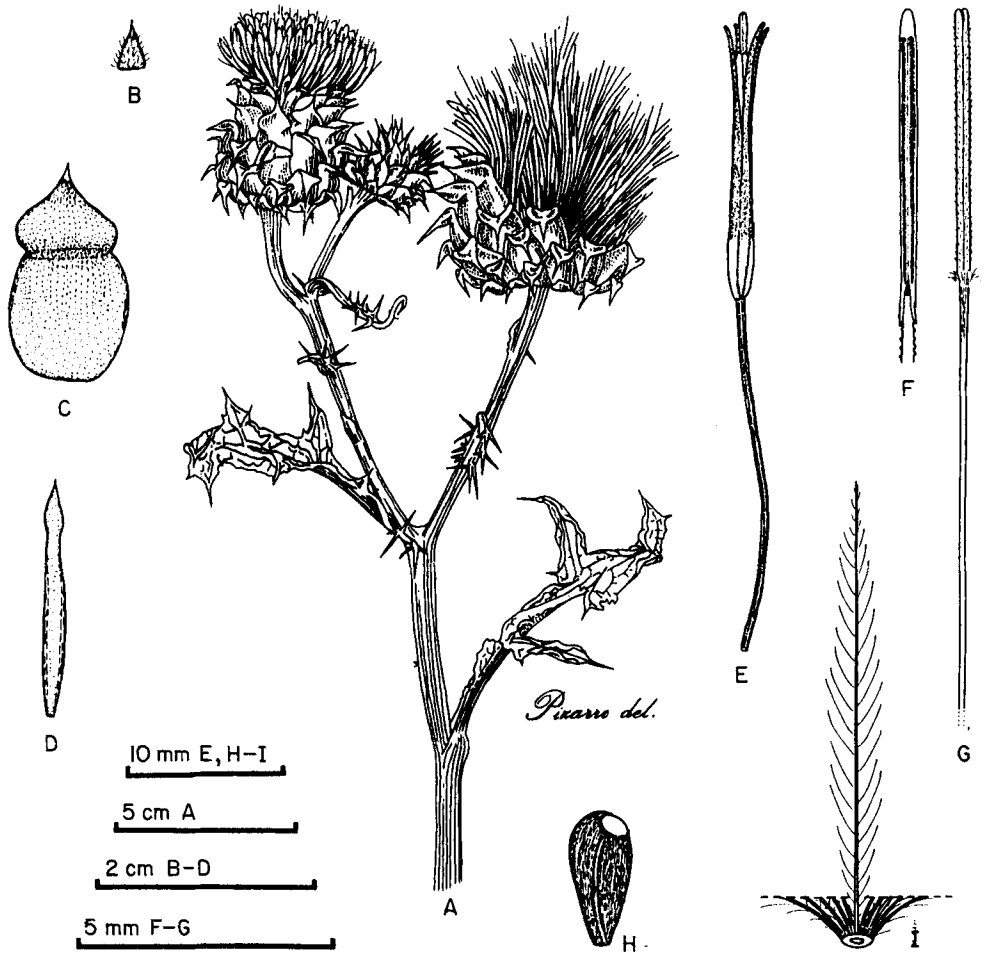

Figure 12 *Cynara syriaca*. A. Habit. B–D. Involucral bracts. E. Corolla with style. F. Stamen. G. Style. H. Cypsela. I. Part of pappus. A–I. Syria, Kleyya, airfield, 1963, *herb, Mouterde FT12* (G).

lobed to entire, apically caudate, 65–140 × 6–65 mm, with a 4–20 mm wide rachis, with lobes and teeth terminating in a 4–10 mm long spine, with revolute margins; abaxial surface greyish green, moderately woolly, very densely glandular; adaxial surface green, slightly pilose, scabrid, glandular; major secondary veins of leaves joined in a series of large arches enclosing less prominent reticulate venation, distinctly thickened below spines. CAPITULA often in corymb-like groups, subsessile to ±pedunculate. INVOLUCRES broadly ovate, 39–50 × 36–53 mm, with middle bracts protruding 8–18 mm. Involucral bracts *c.* 70–100, in 6–8 series; outer triangular to ovate, apically acute to rounded, 9–11 × 3–5 mm, coriaceous with narrow subscarious margins, moderately pilose, glandular; middle basally subelliptic to broadly oblong to oblong, apically with a transverse-elliptic and apically abruptly acuminate appendage, 25–44 × 12–15 mm, with a 1.5–5.0 mm long spine, with narrow scarious margins, becoming beige, apically often with a tinge of greyish pink, glabrescent,

eglandular; inner narrowly oblong to linear, often with an ovate and apically acuminate apex, 22–37 × 1.5–4 mm, apically sometimes pink, with scattered minute hairs dorsally and marginally. RECEPTACLES *c.* 2 mm thick, apically flat. Receptacular bristles 20–43 mm long. FLORETS *c.* 60–90, corolla 37.0–49.8 × 1.1–1.6 mm; limb 15.0–19.1 mm long, violet (*fide* Boissier, 1849) or purple (*fide* Post, 1893), with cells around lobe incisions with ±straight lateral walls. ANTHERS apically rounded, 10–11 mm long, ±white (or orange brown). STYLES 43–54 mm long, lilac; style branches 8–10.5 mm long. CYPSELAS somewhat laterally compressed, ±obovate in outline, with rounded basal scar, faintly 4-ribbed, apically flat, 7.5–9.6 × 3.0–5.7 mm, light brown to greyish brown, with scattered dark brown dots and short longitudinal lines, with whitish ribs. PAPPUS consisting of 111–114 flattened or dorsally slightly keeled bristles in 4–5 series, 27–40 mm long; outer 0.11–0.25 mm wide; inner 0.27–0.32 mm wide; innermost in basal ventral part with long hairs to glabrous.

FLOWERING PERIOD: Flowering specimens seen from May and July. According to Post (1893) the flowering period is in July and August.

NOTES: *C. syriaca* is distinguished by the reflexed, transverse-elliptic and apically abruptly acuminate appendages of the middle involucral bracts. The appendages are distinctly demarcated from the lower part of the bract by a horizontal fold. Similar appendages are found in *C. cornigera*. However, in the later species the bracts do not have a distinct fold and their protruding parts are much longer than in *C. syriaca*. In addition, the appendages are not reflexed in *C. cornigera*.

Cynara syriaca has sometimes been treated as conspecific with *C. aurantica* (Feinbrun-Dothan, 1978; Mouterde, 1983). Some morphological affinity between the two species was also noted in this study. Thus, the three collections seen of *C.aurantica*, from localities close to those of *C. syriaca*, were found to have more distinctly appendaged involucral bracts that the other *C. auranitica* collections. These collections were also found to have a narrower dark-brown band at the base of the midddle involucral bracts than is common in *C. auranitica*. The three deviating collections thus approach *C. syriaca* with its distinctly demarcated appendages and its absence of a dark-brown colour on the involucral bracts. Furthermore, the two northernmost collections of *C. syriaca* were seen to have ±orange-brown anthers, a character which is otherwise found only in *C. auranitica*.

However, in this study it was always possible to separate *C. syriaca* from *C. auranitica* through its shorter involucres, florets and pappus bristles and through the absence of the dark brown colour at the base of the involucral bracts. In addition, *C. syriaca* was usually found to have a higher number of pappus bristles than *C. auranitica*. Since it was possible to separate the two taxa, and because they were found not be each others closest relatives cladistically, they are maintained here as two species. The morphological variability observed in the meeting zone between the two species is possibly due to hybridization.

GEOGRAPHICAL DISTRIBUTION AND HABITAT: Fig. 13. This species has been collected in the southern part of coastal Syria and the adjoining north western part of Lebanon. According to the scanty information on the herbarium labels, it appears to occur in lowland areas.

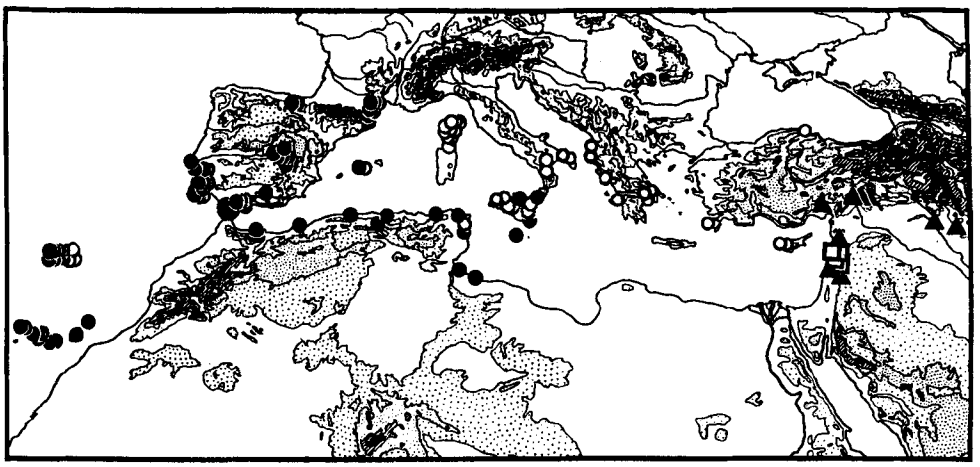

Figure 13. Known distributions of *Cynara cardunculus* subsp. *flavescens* (●), *C. cardunculus* subsp. *cardunculus* (○), *C. auranitica* (▲) and *C. syriaca* (□). Large dots indicate ten collections. Exact locations not found for any collections of *C. cardunculus* from Albania, Cyprus and Libya. These collections were included anyway to show the approximate range of distribution of the species.

COLLECTIONS: SYRIA: Between Tripoli and Latakié, 1846, *Boissier* (G-BOIS); S. of Safita, not far from the border, −55, *Pabot* (G); Kleyya, airfield, 1963, *herb. Mouterde FT12* (G). LEBANON: Road from Tripoli to Igorta [= Zghorta?], summit of the St. Juen[?] hills, 1854, *Manty*[?] *1308* G-BOIS).

7. *Cynara auranitica* Post in Post & Autran, *Bulletin de l'herbier Boissier, 1(8):* 400 (1893).

LECTOTYPE selected here: Gaulonitis & Auranitis. Ex herb. Postian apud Colleg. Syriens Protest. Prope Nawa, 28 Juillet, 1892, *Post 224*, (BEI lectotype, G isolectotype).

SYNONYM: *Cynara kurdica* Handel-Mazzetti, *Annalen des K.K. naturhistorischen Hofmuseums, 27*: 445 (1913). HOLOTYPE: Mesopotamien-Expedition des naturwissenschaftl. Orientvereinis in Wien. Kurdistania occidentalis: In altiplanitie ad meridiem vici Kjachta districtus Mamuret-ül-Asis ad Euphratem versus, in declivibus siccis prope vicum Karamuhara, substrato calcareo, *c.* 650 m, 9/7 1910 *Handel-Mazzetti 1949* (W holotype, WU isotype (not seen)).

NOMENCLATURAL NOTE: See under *C. syriaca.*

ILLUSTRATIONS: Figs 1G–I, 14

Perennial herb to 10.5 (–20) dm (*fide* coll.) high, unbranched to somewhat branched with a thickened and woody taproot. STEM 6–19 mm wide, slightly short-woolly, glandular, 21–48-ribbed. LEAVES basally ±rosulate, ±sparsely set along stem, lanceolate to broadly lanceolate in outline, pinnatifid with ±pinnate base or completely pinnatifid, with *c.* 12–17 segments, somewhat folded along midrib and along nerves of segments; 24–60 × 19–27 cm, cauline leaves sometimes slightly decurrent; base to 23 mm wide, with long and ±clustered

Figure 14. *Cynara auranitica*, habit. *Guest 4040* (K).

spines; rachis 9–28 mm wide; leaf segments ±narrowly ovate to narrowly triangular in outline, (narrowly) triangular-lobed to serrate, apically ±caudate, 60–*c.* 230 × 30–140 mm, with rachis 18–33 mm wide; lobes sometimes with 1 to a few basal teeth or lobes; with lobes and teeth terminating in a 5–14 mm long spine; with slightly revolute margins; abaxial surface greyish to greyish green, moderately woolly, densely glandular; adaxial surface green, arachnoid to slightly pilose, scabrid, densely glandular; major secondary veins forked to forming ±indistinct arches with minor reticulate venation within the arches, somewhat thickened below spines. CAPITULA solitary, ±distincly pedunculate to

subsessile. INVOLUCRES cyathiform to subovate, 65–78 × 43–70 mm, with middle bracts protruding 14–31 (–42) mm. Involucral bracts *c.* 55–80, in 6–8 series; outer narrowly triangular to triangular to broadly oblong with abruptly acuminate apex, 10–25 × 4–16 mm, coriaceous, ± tinged with greyish pink to reddish, dorsally slightly pilose and glandular; middle basally oblong, apically ± abruptly acuminate or with an ovate to broadly ovate and apically acuminate appendage, 35–70 × 15–25 mm, with a 3–8 mm long spine, coriaceous, sometimes with narrow scarious margins, ± tinged with greyish pink, basally dark brown, initially slightly pilose and glandular, becoming ± glabrous and eglandular; inner (narrowly oblong to) linear to narrowly linear, sometimes with ± ovate appendage, ± entire, apically acute, 36–68 × 2–8 mm, with minute hairs abaxially and marginally. RECEPTACLES 2–6 mm thick, apically flat. Receptacular bristles 35–70 mm long. FLORETS *c.* 60–100, corolla 54.1–63.4 × 1.4–2.4 mm; limb 17.0–20.0 mm long, bright lilac, with cells with straight tangential walls. ANTHERS apically rounded, 11.3–12.7 mm long, usually brownish to orange-brown. STYLES 52–73 mm long, lilac; style-branches 13.5–17.7 mm long. CYPSELAS somewhat compressed, ± obovate in outline, with rounded basal scar, faintly 4(–5)-ribbed, apically flat, 7.7–10.5 × 4.3–6.0 mm, greyish brown to pale brown to dark brown and sometimes with whitish dots and short longitudinal lines, with ribs whitish. PAPPUS consisting of (34–) 67–111 flattened (to dorsally faintly keeled) bristles in (3–)4–5 series, 0.29–0.43 mm wide; innermost in basal ventral part usually with hairs.

FLOWERING PERIOD: mainly July to August.

NOTES: *C. auranitica*, which reaches heights of 1 to 2 m (*fide* coll.) is characterized by the ± reddish brown colour of the filaments of the stamens. In addition, it may usually be recognized by its broad middle involucral bracts and its long receptacular bristles. However, long receptacular bristles may also be found in *C. syriaca* and both the above mentioned characters are occasionally found in *C. cardunculus*.

Two specimens from S.W. Syria (Hauran (S. of Sanameine), 18/6 –53 *Pabot* (G) and *Herb. Peyron 1890*, Hauran, Sunamen, 14/5 1898 & 2/6 1898 (G)), both collected before flowering, were found to be morphologically similar to *C. auranitica*. Their involucres look like those of *C. auranitica*, although they are slightly more transverse-elliptic in outline. Their bracts protrude up to 43 mm and lack the basal dark-brown colour and the tinge of greyish-pink usually found in *C. auranitica*. Their receptacular bristles are very short. However, since these specimens were not flowering and it was not possible therefore to obtain all the necessary information, no taxonomic decision was taken concerning their affinities.

GEOGRAPHICAL DISTRIBUTION AND HABITAT. Fig. 13. This species has been collected in S.E. Turkey, N. Iraq, coastal and S.W. Syria and S. Lebanon at altitudes ranging from (25–) 350 to 1000 m. According to Rechinger (1979) and Feinbrun-Dothan (1978), it also occurs in W. Iran and in Israel. *Cynara auranitica* has been found in fields, pastures, waste ground and steppes. Mouterde (1983) suggests a preference for soils of volcanic origin. According to Feinbrun-Dothan (1978), it occurs on heavy alluvial soils.

COLLECTIONS: TURKEY: E. Turkey, E. Cilician plain, Misis to Sis, 1906, *Post 462* (G); W Kurdistan, high plain S Kjachta village, Mamurel-ül-Asis district, near Karamuhara village, 1910, *Handel-Mazzetti 1949* (W); Kurdistan, Diarbekir, 1914, *Handel-Mazzetti* (W); Kurdistan, Diarbekir, Tayya[?] from Kiabi, −88, *Sintenis* (K). SYRIA: towards Massyaf, 1931, *herb. Mouterde* (G); Gaulonitis & Auranitis, near Nawa, 1892, *Post 224* (BEI, G). LEBANON: "Palestinae Saronae", Ras el-Ain, 1912, *Meyers & Dinsmore 2184* (G). IRAQ: 51 km NW of Mosul, near Filda police station, 1951, *Raur* [?] *22943* (K); N Iraq, along Sulaimaniya-Dokan road, 1979, *Hossain* (K); Chemchemae, on bank at side of Chemchemae--Dokan Rd, 1959, *Wheeler-Haines W1513* (K). UNIDENTIFIED LOCALITIES: E. Turkey, Bismid to Korky, 1906, *Post 300* (G); Syria & Lebanon, 10 km N Kumeitra, −53, *Pabot* (G); Iraq, Rustam Experimental Farm, Ain Sifni, 1933, *Guest 4040* (K, S); Iraq [Iran?], Susa, −72, *Karim 39277* (K).

8. *Cynara cardunculus* Linnaeus, *Species plantarum, 2*: 827 (1753).

SYNONYMS: *Cynara sylvestris* Lam. var. *spinosus* de Lamarck, *Encyclopédie méthodique. Botanique, 1:* 277 (1783). *Cynara cardunculus* L. var. *typica* Fiori in Fiori & Béguinot, *Flora analitica d'Italia, 3*: 380 (1904); *non. non rite public.*
Cynara cardunculus L. var. *eu-cardunculus* Hayek, *Prodromus florae peninsulae balcanicae*, in Fedde, *Repertorium specierum novarum regni vegetabilis, Beihefte 30*: 728 (1931); *nom. non rite public.*

LECTOTYPE selected here: Illustration of 'Scolymus aculeatus' (= *Cynara cardunculus*), *Tabernaemontanus*: 696(1590).

SYNONYMS: *Cynara scolymus* Linnaeus, *Species plantarum, 2:* 827 (1753); *Cynara esculenta* Salisbury, *Prodromus stirpium in horto ad Chapel Allerton vigentium*: 185 (1796); nom. illegit. superfl.; *Cynara cardunculus* L. var. *scolymus* (L.) Fiori in Fiori & Béguinot, *Flora analitica d'Italia, 3:* 380 (1904). LECTOTYPE selected by Kupicha (1975): Herb. Linnaeus 969.1 (LINN).

SYNONYM: *Cynara hortensis* Miller, *The gardener's dictionary*, ed. 8 (1768). TYPE: not seen.

SYNONYMS: *Cynara sylvestris* de Lamarck, *Encyclopédie méthodique. Botanique, 1*: 277 (1783). *Cynara cardunculus* L. α *typica* Willkomm ex Mariz "1" [= f.?] *silvestris* (Lam.) Mariz, *Boletim da sociedade broteriana, 10*: 235 (1892). LECTOTYPE selected here: Herb. de Lamarck (P-LA).

SYNONYMS: *Cynara scolymus* L. var. *major* Brotero, *Flora lusitanica, 1*: 338 (1804); *Cynara cardunculus* L. var. *sativa* Moris "1" [= f.?] *major* (Brotero) Mariz, *Boletim da sociedade broteriana, 10*: 235 (1892). TYPE: not seen.

SYNONYMS: *Cynara scolymus* L. var. *minor* Brotero, *Flora lustanica, 1*: 338 (1804); *Cynara cardunculus* L. var. *sativa* Moris "2" [= f.?] *minor* (Brotero) Mariz, *Boletim da sociedade broteriana, 10*: 235 (1892). TYPE: not seen.

SYNONYM: *Cynara cardunculus* L. var. *sylvestris* Brotero, *Flora lusitanica, 1*: 339 (1804). TYPE: not seen.

SYNONYMS: *Cynara cardunculus* L. var. *hortensis* Brotero, *Flora lusitanica, 1*: 339 (1804); *Cynara cardunculus* L. α *typica* Willkomm ex Mariz, & "2" [= f.] *hortensis* (Brotero) Mariz, *Boletim da sociedade broteriana, 10*: 235 (1892). TYPE: not seen.

SYNONYMS; *Cynara horrida* Aiton, *Hortus kewensis, 3*: 148 (1811); *Cynara cardunculus* L. var. *ferocissima* Lowe, *A manual flora of Madeira, 1:* 498 (1868). LECTOTYPE: selected here: habitat in insula Porto Santo prope Maderam, *Masson* (S).

SYNONYMS: *Cynara cardunculus* L. var. *inermis* [auct de Candolle?], *Le bon jardinier, almanach: 39* (1813), *fide* de Candolle, *Prodromus systematis naturalis regni vegetabilis, 6*: 620 (1838); *Cynara cardunculus* L. var. *scolymus* (L.) Fiori "b" [= f.?] *inermis* (DC. [?]) Fiori in Fiori & Béguinot, *Flora analitica d'Italia, 3*: 380 (1904). TYPE: not seen.

SYNONYMS: *Cynara cardunculus* L. var. *altilis* [auct. de Candolle?], *Le bon jardinier, almanach: 39* (1813) *fide* de Candolle, *Prodromus systematis naturalis regni vegetabilis, 6*: 620 (1838); *Cynara cardunculus* var. *scolymus* (L.) Fiori "c" [= f.?] *altilis* (DC[?]) Fiori in Fiori & Béguinot, *Flora analitica d'Italia, 3*: 380 (1904). TYPE: not seen.

SYNONYMS: *Cynara scolymus* L. var. *hortensis* [auct. de Candolle?] *Le bon jardinier, almanach: 38 (1813), fide* de Candolle, *Prodromus systematis naturalis regni vegetabilis, 6*: 620 (1838); *Cynara scolymus* L. var. *hortensis* Cutanda in Cutanda & del Amo y Mora, *Manual de botánica descriptiva*. Madrid: 483 (1848); *nom. superfl.* TYPE: not seen.

SYNONYM: *Cynara corsica* Viviani, *Flora Libycae specimen*: 68 (1824). TYPE: not seen.

SYNONYM: *Cynara spinosissima* J. & C. Presl, *Deliciae pragenses, 1*: 109 (1832). TYPE: not seen.

SYNONYM: *Cynara ferox* Tenore fide Steudel, *Nomenclator botanicus*, 1. Ed. 2: 462 (1840). TYPE: not seen.

SYNONYM: *Cynara cardunculus* L. var. *sativa* Moris, *Flora sardoa*: 460 (1840–1843). TYPE: not seen.

SYNONYM: *Cynara scolymus* L. var. *pungens* de Visiani, *Flora dalmatica, 2*: 46 (1847). TYPE: not seen.

SYNONYM: *Cynara scolymus* L. var. *mutica* de Visiani, *Flora dalmatica, 2*: 46 (1847). TYPE: not seen.

SYNONYM: *Cynara cardunculus* L. var. *scolymus* (L.) Fiori "e" [= f.?] *spinescens* Fiori in Fiori & Béguinot, *Flora analitica d'Italia, 3*: 381 (1904). TYPE: not seen.

For further synonyms see under the subspecies.

NOMENCLATURAL NOTE: No specimens of *C. cardunculus* were found at BM or LINN, where the main collections of Linnaeus are kept (Stafleu & Cowan, 1981), nor in the Linnean herbarium at S. However, Linnaeus (1753) added to his description of *C. cardunculus* a reference to a woodcut by Tabernaemontanus (1590, sub. '*Scolymus aculeatus*'). This illustration is here chosen as lectotype.

For several of the names of cultivated varieties of *C. cardunculus* no types were

encountered. Of these, Brotero's varieties *major*, *minor* and *hortensis* were studied by Brotero in a botanic garden (Brotero, 1804). No type material was found at LISU or MO where Brotero's types are kept (Stafleu & Cowan, 1976) and it seems possible that no herbarium material ever existed.

Aiton (1811) reported that his new species *C. horrida* had been collected by Masson on Porto Santo in the Madeiran archipelago. At S one specimen collected by Masson on this island was found and this specimen is here selected as lectotype. No material from Porto Santo was found at BM where Masson's specimens are mainly kept (Stafleu & Cowan, 1981).

Mariz (1892) admitted two infraspecific categories, without indicating their ranks, when describing his new taxa *silvestris*, *major*, *minor* and *hortensis*. According to I.C.B.N. Art. 35.2 these names are validly published.

No type of *C. corsica* Viviani was found. According to Stafleu & Cowan (1986), Viviani's herbarium and types kept at GE have been destroyed. No duplicates were found in the other herbaria reported to have collections of Viviani (Stafleu & Cowan, 1986).

According to Index Kewensis (suppl. 4), Grecescu has described a *Cynara* hybrid, *C. erysithaloides*, in his *Suplement la conspectul florei romaniei*: 94 (1909). I did not succeed in finding this work, nor did I find any type. However, if this is indeed a *Cynara*, it seems possible that the name belongs under *C. cardunculus*.

ILLUSTRATIONS: Fig. 14.

Annual to perennial (*fide* coll.) herb to 11(–18) dm high, often richly branched, with taproot. STEM to 17 mm wide, densely to slightly ±floccose-woolly to subglabrous, densely glandular, 14–44-ribbed, with secretory canals. LEAVES basally rosulate, ±densely set along stem, broadly lanceolate to lanceolate in outline, somewhat folded along midrib and along nerves of segments, pinnatifid with ±pinnate base, with *c.* 11–25 segments, 21–88 × 10–33 cm, ±decurrent; base to 30 mm wide, with long and clustered marginal spines; rachis 3–21 mm wide; leaf segments narrowly ovate to ovate in outline, narrowly triangular-lobed to serrate, apically caudate, 29–170 × 7–78 mm, with 3–21 mm wide rachis, with basal lobes sometimes slightly serrate-dentate, with lobes and teeth terminating in a 7–30 mm long spine; with revolute margins, abaxial surface pale greyish to whitish green, moderately to densely woolly, densely glandular; adaxial surface green, moderately pilose to glabrescent, densely glandular; major secondary veins of leaf segments ±densely reticulate, somewhat thickened below spines. CAPITULA usually in corymb-like groups, ±sessile. INVOLUCRES (broadly) cyathiform to (broadly) ovate, 33–75 × 32–95 mm, with middle bracts protruding 14–31 mm. Involucral bracts *c.* 65–110, in 5–8 series, containing secretory canals; outer narrowly triangular, entire, 9–24 × 2–6 mm, initially pale green, sometimes with narrow scarious margins, moderately pilose in central part or glabrous; middle basally oblong to ovate, apically abruptly acute to acuminate or ovate and apically acute to acuminate (or broadly transverse-elliptic and apically abruptly acuminate), 30–55 × 9–20 mm, with a 2–9 mm long spine, basally usually dark brown, with narrow scarious incolour lateral rims, initially pale green, becoming beige, apically often tinged with dark lilac, with margins apically yellow-rimmed or not distinctly coloured, glabrescent, eglandular; inner narrowly oblong, sometimes with an ovate appendage, apically obtuse to acute and aristate, apically irregularly serrate,

31–55 × 2–8 mm, usually brownish centrally, glabrous or with minute hairs dorsally and marginally, dorsally sometimes with minute glands. RECEPTACLES 4–16 mm thick, apically convex to flat. Receptacular bristles 16–49 mm long. FLORETS 80–240, corolla 32.0–53.4 × 1.6–2.3 mm; limb 10.5–18.6 mm long, dark lilac, pale lilac or white, with cells with straight lateral walls. ANTHERS apically rounded (to subacute), 8.0–11.1 mm long, ± white. STYLES 35–66 mm long, lilac or whitish; style-branches 12.1–16.1 mm long. CYPSELAS somewhat laterally compressed, indistinctly 3-edged, ± obovate in outline, with rounded basal scar, sometimes faintly 2–4-ribbed, apically somewhat convex, 3.7–7.0 × 2.2–4.5 mm, greyish brown to straw-coloured, usually with dark brown and sometimes also whitish dots and short longitudinal lines. PAPPUS consisting of 54–104 flattened to dorsally faintly keeled bristles in 3–6 series, 16–41 mm long; outer 0.11–0.22 mm wide; inner 0.22–0.32 mm wide; innermost with basal ventral part densely covered by hairs.

CHROMOSOME NUMBER: $2n = 34$ (Covas & Schnack, 1947; Fernandes & Queiros, 1971; Janaki-Ammal, 1945 *fide* Darlington & Wylie, 1955 (incl. *C. scolymus*); Larsen, 1960).

FLOWERING PERIOD: Mainly June and July, although flowering specimens were seen between May and August. In the southern hemisphere flowering specimens were seen between November and January.

NOTES: *C. cardunculus* as here circumscribed includes the 'artichoke' which has usually been treated as the separate species *C. scolymus* (for a discussion see also Cladistics and notes on phytogeography) and the 'cardoon'. However, only data from what were here determined to be wild representatives of *C. cardunculus* were included in the description. A short characterization of the cultivars of *C. cardunculus* follows below.

Wild representatives of *C. cardunculus* may generally be distinguished from the other *Cynara*-species by their many long and pungent spines. This species reaches, like *C. auranitica*, heights of 1 m or more. Equally long spines are also occasionally found in *C. auranitica*. However, *C. cardunculus* may be separated from *C. auranitica* by its smaller cypselas and the absence of scabrid leaf hairs. It also lacks the pinkish colour of the involucral bracts and the orange-brown filaments usually found in *C. auranitica*.

Florets of *C. cardunculus* have been noted for their strong fragrance (Lowe, 1868). They have been observed to have abundant nectar and easily seen inflorescences that are pollinated by a wide variety of insects (Foury, 1967 (*C. scolymus*); Valletta, 1979). Dried florets have been used to coagulate milk (Brotero, 1804; Mathews, 1830).

Cynara cardunculus is cultivated as a vegetable and a large number of garden cultivars of the 'cardoon' and the 'artichoke' exist. These are generally larger than wild *C. cardunculus*. Annual forms of the 'artichoke' have been reported (Foury, 1967).

The 'cardoon' of which young stems and the main rib of the leaves are eaten, may reach heights of up to 2 m. It may have very short or no leaf spines. The leaf segments are frequently broader and more rounded at the apex than in wild *C. cardunculus*.

The 'artichoke', of which the receptacles of unripe capitula are consumed,

TABLE 3. Character of middle involucral bracts in *Cynara cardunculus* used for the preparation of a pictorialized dot map (Fig. 16). The symbol (◐) was used for a single Sicilian specimen found to be intermediary in character 1

Character	Subsp. *cardunculus*		Subsp. *flavescens*	
1. Width of yellowish margin	Absent or < 0.5 mm	(○)	> 0.5 mm	(●)
2. Length of narrow apical part	22–38 mm ("abruptly acuminate")	(○)	4–21 mm ("absent to acute to short acuminate")	(♁)
3. Length of spine	6–9 mm	(○)	2–5 mm	(♀)

may be very similar to the 'cardoon'. However, it is usually shorter and has larger capitula. Involucral bracts are often apically truncate to emarginate, ±spineless and sometimes involute, although cultivars with acute and spiny involucral bracts also exist. The leaves may be entire to pinnatifid. The 'artichoke' has also been used for medicinal purposes. It has been reported to have diuretic, laxative and appetite-stimulating effects (Adly, 1985). For further information and references on cultivars of the 'artichoke' see Foury (1967, 1969).

In wild *C. cardunculus* a certain variability in characters pertaining to the involucral bracts was noted, Thus, they could have distinct, up to *c.* 1 mm broad, or almost imperceptible to completely absent yellowish margins, acute, short-acuminate or acuminate apex and short or long spine-tips (Table 3). A pictorialized dot map (Davis & Heywood, 1973) showing the distribution of these characters in all mature specimens available is seen in Fig. 16. This map revealed that distinctly yellow-margined specimens generally occur in the Iberian peninsula and in the Macaronesian region, although a few specimens with inconspicuous margins were also found in Madeira and in southern Portugal. Specimens with inconspicuous or no margin on the involucral bracts were mainly found in the central and north-eastern Mediterranean region. It was, furthermore, found that the western, usually broad-margined specimens had bracts with acute to short-acuminate apex and short apical spines, whereas the more eastern specimens with narrow or no rim often had longer, acuminate points and longer spine-tips on the involucral bracts. In the meeting-zone between these two morphs, on Sicily and in the adjacent North African territory, a more variable situation was found.

The observed pattern of morphological variation was thus found to be geographically correlated. It is also considered to merit taxonomic recognition. Because the geographical separation was found to be incomplete (and since the differences between the two morphs was found to be small), the two morphs are here recognized taxonomically at subspecific level. The western morph receives the name subsp. *flavescens* and the eastern morph subsp. *cardunculus*. Whether the isloated occurrences of narrow-margined specimens on Madeira and in Portugal represent a westerly outpost of subsp. *cardunculus* or are due to local morphological aberrations of subsp. *flavescens* could not be determined. Because of their morphology they were included under subsp. *cardunculus*.

In Madeira three collections are reported to be annual (*fide* coll.) (*Hampshire*

460, *521* and *564* (BM)). It was not possible in this study to investigate the occurrence of this character within the species, nor was any distinct morph from Madeira detected.

Morphological variability has also been reported to be added by escape and naturalization of garden cultivars of the 'cardoon' and the 'artichoke'. Both are, according to Thomsen *et al.* (1986), normally vegetatively propagated. They found that, when grown from seeds, a wide variety of morphs is yielded from the cultivars, ranging from typical 'cardoon'-like morphs to morphs almost identical to wild *C. cardunculus* (see also Foury, 1967). This agrees with the wide array of ± 'artichoke'- or 'cardoon'-like morphs seen in this study. These were found to occur in scattered localities in Portugal, Spain, France, Italy, Morocco and Algeria, countries in which wild *C. cardunculus* was also found. In addition, these morphs were found in Australia and California. Because of their morphology and their scattered geographical distribution, they were here interpreted as belonging to the above mentioned escaped and naturalized garden cultivars. In these specimens a great variability was found in the degree of incision of the leaves, the length of the leaf spines and the shape of the middle involucral bracts. The latter are blunt to ± acute with often irregular margins or rarely acuminate. They usually have distinct yellowish margins. They were also found often to have at least some measurements that exceed those of specimens of wild *C. cardunculus*. Because of the observed more or less continuous range of morphological variation between 'typical' wild *C. cardunculus* and cultivars of the 'cardoon' and the 'artichoke' and because of the shared apomorphies found in these morphs (see Cladistics of *Cynara*) I consider them to be best placed in a single species, *C. cardunculus*.

In California, Mexico and Argentina specimens that were virtually identical to *C. cardunculus* subsp. *flavescens* have been collected. These were noted to differ only in their broader leaf rachis and occasionally slightly larger measurements of floral or involucral parts. Specimens like these have been reported by Thomsen *et al.* (1986) to be aggressive rangeland weeds that have originated from garden escapes of cultivated varieties. Because of the tendency in these specimens towards a larger size, which is typical for the artichoke and the cardoon, it appears possible that they have originated as outlined by Thomsen *et al.* (1986). However, the possibility cannot be ruled out that wild *C. cardunculus* subsp. *flavescens*, like the related *Silybum marianum*, has become naturalized on other continents.

GEOGRAPHICAL DISTRIBUTION AND HABITAT: Fig. 13. *Cynara cardunculus* is a mainly Mediterranean and Macaronesian species, which generally occurs in regions with coastal influence. The subsp *flavescens* is found in Macaronesia, Portugal and the N.W. Mediterranean region, whereas subsp. *cardunculus* has a mainly central and N.E. Mediterranean distribution. Naturalized cultivars, very similar to subsp. *flavescens*, are also found as aggressive rangeland weeds in Calfornia, Mexico, Argentina and (*fide* Thomsen *et al.*, 1986) in Australia (not shown on map).

Cynara cardunculus has been reported (Franco, 1976) to occur on Crete. Since no material of *C. cardunculus* was seen from this island, and because of the existence of Cretan material of *C. cyrenaica*, erroneously labelled *C. cardunculus*, this locality was not included on the map of distribution of *C. cardunculus*.

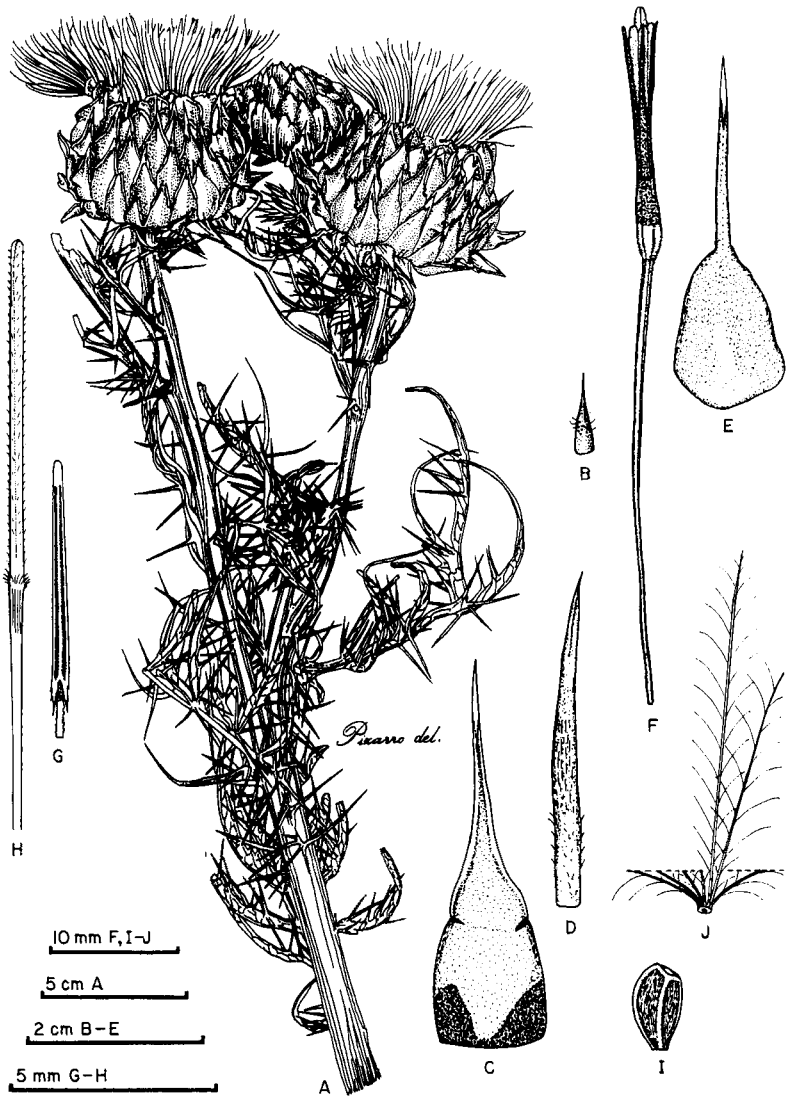

Figure 15. *Cynara cardunculus*. A–D, F–J. Subsp. *flavescens*. E. Subsp. *cardunculus*. A. Habit. B–E. Involucral bracts. F. Corolla with style. G. Stamen. H. Style. I. Cypsela. J. Part of pappus. A. *Talavera & Valdés 2216bis/73* (SEV). B.–D, F–J. *Wiklund 103* (S). E. *De Mercey 152* (BM).

Cynara cardunculus has been collected at altitudes from about sea-level to 900 m (one specimen from Mexico (*Arséne 1990* (MPU) is reported to have been collected at 2160 m height). It grows in fields, pastures, waste-ground and on road-sides. It has been reported to occur on clay, rocks and sand. It has often been found on calcareous substrates.

8a. *Cynara cardunculus* L. subsp. *cardunculus*

For type and synonyms, see under the species.

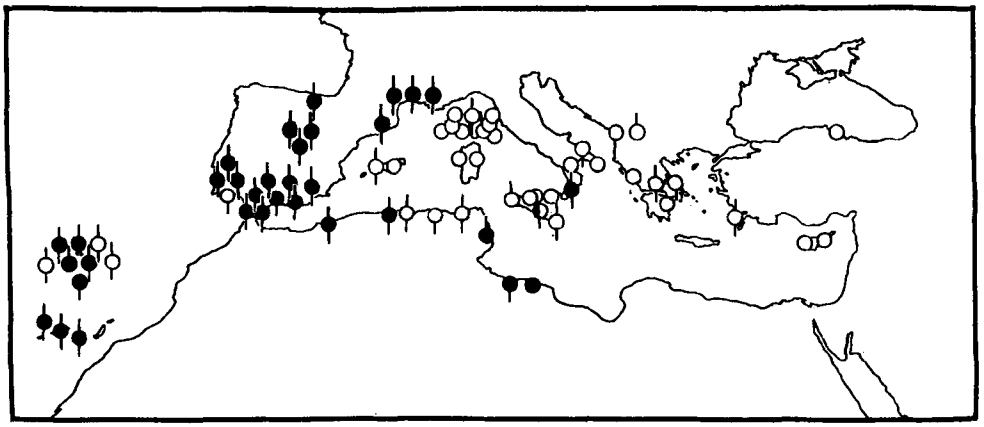

Figure 16. Approximate distributions of all available mature specimens of *Cynara cardunculus* from the Mediterranean and Macaronesian region. For explanations of symbols see Table 3.

ILLUSTRATIONS: Fig. 15E.

Middle involucral bracts apically acuminate, with point (15–) 22–38 mm long, with spine (4.5–) 6–9 mm long, in upper part with an indistinct, $\leqslant 0.5$ mm broad yellowish margin or concolourous.

REPRESENTATIVE COLLECTIONS (48 collections examined): SPAIN: *Balearic Islands*: Mallorca, Inca, 1917, *Bianor-Marie* (K). FRANCE. *Corsica*: Bonifacio, waste-ground, 1849, *Kralik 671* (G, K. P). ITALY. *Sicily*: Province of Palermo, 8 km S of Monreale, 2.5 km S.E. of Damiani by turnoff to Altofonte, 38°0′N.3°15′E, 33SUC2180, 1983, *Akeroyd et al.* (BM). *Sardinia*: Gulf of Argolis, −30, *Atchley 250* (K). TURKEY: Province of Sinop, S of Sinop, 1962, *Davis et al* D.38064 (K).

8b. *Cynara cardunculus* L. subsp. *flavescens* Wikl., subsp. nov.

HOLOTYPE: Toledo; Villasequilla de Yepes, 510 m, talud de borde de camino, 6-VII-80, Laorga (MAF).

ILLUSTRATIONS: Fig. 15A–D, F–J.

Bracteae involucrales mediae apice interdum acutae interdum breviter acuminatae, acumine usque ad 21 (–28) mm longo, spina 2–5 (–6) mm longa, margine in parte supera perspicue flavescenti.

Middle involucral bracts apically acute to short-acuminate, with point to 21 (–28) mm long, with spine 2–5 (–6) mm long, in upper part with a distinct, *c.* 0.5–1.0 mm broad yellowish margin.

REPRESENTATIVE COLLECTIONS (92 collections examined): PORTUGAL: *Algarve*: Portimão, towards Monchique near bridge over Rib[a] de Odelouca, 1978, *Malato-Beliz & Guerra 14717* (MA). SPAIN: *Logroño*: Castilla, Fuenmayor, 1917, *Elías 3273* (BM, K, LISE, MA, W). *Canary Islands*: Tenerife, near Guimar, 1846, *Borgeau 461* (BM, G, K, P, W). FRANCE: *Hérault*: Road from Agde, herb. *Chevallier* (G).

EXCLUDED TAXA

Cynara acaulis L. = *Leuzea acaulis* (L.) Holub (1973). *Cynara integrifolia* Vahl, c.f. *Serratula pauana* Iljin. *Cynara pygmaea* Willd., c.f. *Carduncellus* Adans. *Cynara tournefortii* Boiss. & Reut., under revision by me.

ACKNOWLEDGEMENTS

The revison was carried out at the Departamento de Biologia Vegetal II of the Universidad Complutense in Madrid. It was made possible by a Postdoctoral Fellowship granted by the CAICYT of the Spanish Ministerio de Educación y Ciencia. The field trip to S. Spain and Morocco was financed by a grant from the Royal Swedish Academy of Sciences. I wish especially to thank Dr A. Anderberg for valuable comments on the manuscript; Dr A. Anderberg and Mr T. Eriksson for help with the computer analysis of the data matrices, and Professor K. Bremer for giving me access to an unpublished treatment of the Carduoideae. I am also indebted to Mr A. Moth M.A. (Oxon.) for revising the English and to Mr J. Updegraff for the Latin text, as well as to J. Pizarro Dominguez for preparing drawings of the habit of all *Cynara* species. Thanks are also due to my former colleagues at the Universidad Complutense, and especially to Dr M. Gutierrez, for bearing with me and for always managing to understand my Spanish. Finally, I wish to thank the curators of all the herbaria that have lent me material.

REFERENCES

ACKERY, P. R. & VANE-WRIGHT, R. I., 1984. *Milkweed Butterflies, their Cladistics and Biology*. London: British Museum (Natural History).

ADLY, A., 1985. *Cynara* Mediterranean Medicinal Plant. *Actas Congreso Internacional de Historia de la Farmacia. Granada.*

AITON, W., 1811. *Hortus Kewensis, 3.* London.

ANDERSON, L. E., 1954. Hoyer's solution as a rapid permanent mounting medium for bryophytes. *Bryologist, 57:* 242–247.

BALL, J., 1873. Descriptions of some new species, subspecies, and varieties of plants collected in Morocco by J. D. Hooker, G. Maw, and J. Ball. *The Journal of Botany, 11:* 364–374.

BÉGUINOT, A. & VACCARI, A., 1913. Terzo contributo alla Flora della Libia. *Annali di Botanica (Roma), 12:* 87–150.

BELMONTE, A., 1989. *Estudios palynológicos en las subtribus Carduinae Dumort y Centaureinae Dumort (Asteraceae-Cardueae).* Unpublished thesis of the Universidad Complutense de Madrid.

BOISSIER, E., 1849. *Diagnoses Plantarum Orientalium Novarum, Ser. 1(10).* Lipsiae.

BREMER, K., 1987. Tribal interrelationships of the Asteraceae. *Cladistics, 3(3):* 210–253.

BROTERO, F. A., 1804. *Flora Lusitanica, 1.* Olissipone.

BURDET, H. M., CHARPIN, A. & JACQUEMOND, F., 1983. Types nomenclaturaux des taxa ibériques décrits par Boissier ou Reuter. IV. Cistacées à Composées. *Candollea, 38:* 751–802.

CAVARA, F., 1923. Di alcune piante nuove o rare della Cirenaica. *Bollettino della Società Botanica Italiana, N. 1–2:* 8–13.

COVAS, G. & SCHNACK, B., 1947. Estudios cariológicos en Antófitas, II. *Revista Argentina de Agronomía, 14:* 224–231.

DARLINGTON, C. D. & WYLIE, A. P., 1955. *Chromosome Atlas of Flowering Plants.* London: J. Wiley.

DAVIS, P. H. & HEDGE, I. C., 1971. Floristic Links between N.W. Africa and S.W. Asia. *Annalen des Naturhistorischen Museums in Wien, 75:* 43–57.

DAVIS, P. H. & HEYWOOD, V. H., 1973. *Principles of Angiosperm Taxonomy.* Huntington, New York: Robert E. Krieger Publishing Company.

DE CANDOLLE, A. P., 1838. *Prodromus Systematis Naturalis, 6.* Paris

DE CANDOLLE, A. P., 1886. *Origin of Cultivated Plants,* 2nd ed. New York: Hafner Publishing Company.

DITTRICH, M., 1970. Morphologische und anatomische Untersuchungen an Früchten der Carduinae (Compositae). I. Morphologischer Teil. *Candollea, 25(1):* 45–67.

DITTRICH, M., 1977. Cynareae–systematic review. In V. H. Heywood, J. B. Harborne & B. L. Turner (Eds), *The Biology and Chemistry of the Compositae, 2:* 999–1015. London: Academic Press.
FARRIS, J. S., 1988. *Hennig 86, version 1.5, Users Reference.* Stony Brook.
FEINBRUN-DOTHAN, N., 1978. *Flora Palaestina, 3.* Jerusalem.
FERNANDES, A. & QUEIROS, M., 1971. Contribution a la connaissance cytotaxinomique des Spermatophyta du Portugal. 2 Compositae. *Boletim da Sociedade Broteriana, 45:* 5–122.
FOURY, C., 1967. Étude de la biologie floral de l'artichaut (*Cynara scolymus* L.). Application a la sélection. 1. *Annales de l'Amélioration des Plantes. Hors Sér., 17:* 357–373.
FOURY, C., 1969. Étude de la biologie floral de l'artichaut (*Cynara scolymus* L.). Application a la sélection. 2. *Annales de l'Amélioration des Plantes. Hors Sér., 19:* 23–52.
FRANCO, A., 1976. *Cynara* L. In T. G. Tutin *et al.* (Eds), *Flora Europaea, 4.* Cambridge: Cambridge University Press.
GREUTER, W., 1971. Betrachtungen zur Pflanzengeographie der Sudägäis. *Opera Botanica, 30:* 49–64.
HENNIG, W., 1966. *Phylogenetic Systematics.* Urbana, Chicago & London: University of Illinois Press.
HOLMGREN, K., KEUKEN, W. & SCHOFIELD, E., 1981. *Index Herbariorum, 1: The Herbaria of the World.* Ed. 7. Utrecht/Antwerpen: Bohn, Scheltema & Holkema. [*Regnum Vegetabile, 106.*]
HOLUB, J., 1973. Contribution to the taxonomy and nomenclature of *Leuzea* DC. and *Rhaponticum* auct. *Folia Geobotanica et phytotaxonomica Bohemoslovaca.* (*Praha*), *8:* 377–395.
HUMPHRIES, C. J. & FUNK, V. A., 1984. Cladistic Methodology. In V. H. Heywood & D. M. Moore (Eds), *Current Concepts in Plant Taxonomy.* [*Systematics Association Special Volume 25.*] London & Orlando: Academic Press.
HUMPHRIES, C. J. & PARENTI, L., 1986. Cladistic biogeography. In W. George, A. Hallam & T. C. Whitmore (Eds), *Oxford Monographs on Biogeography.* Oxford: Clarendon Press.
JEFFREY, C., 1968. Notes on Compositae: 3. The Cynareae in east tropical Africa. *Kew Bulletin, 22(1):* 107–140.
KUPICHA, F. K., 1975. *Cynara* L. In P. H. Davis (Ed.), *Flora of Turkey, 5:* 327–329. Edinburgh: Edinburgh University Press.
LAGASCA, M., 1805. Caracteres diferenciales de once especies nuevas de plantas y de otras poco conocidas. *Variedades de ciencias, literatura y artes, 2(4):* 212–217.
LARSEN, K., 1960. Cytological and experimental studies on the flowering plants of the Canary islands. *Biologiske Skrifter udgivet af Det Kongelige Danske Videnskabernes Selskab, 11(3):* 1–60.
LINNAEUS, C., 1753. *Species Planatarum, 2.*
LOWE, R. T., 1868. *A manual Flora of Madeira 1. Dichlamydeae.* London: John van Voorst.
MAIRE, R. & WEILLER, M., 1939. Contributions à létude de la Flore de la Libye. In R. Maire, Contributions à l'étude de la Flore de l'Afrique du Nord. *Bulletin de la Société d'Histoire Naturelle d'Afrique du Nord, 30:* 255–314.
MARIZ, J. DE, 1892. Subsidios para o estudo da flora portugueza. *Boletim da Sociedade Broteriana, 10:* 196–253.
MATHEWS, A., 1830. 2. On the varieties of cardoon, and the methods of cultivating them. *Transactions of the Horticultural Society of London, 7:* 9–15.
MEINHEIT, K., 1907. *Der anatomische Bau des Stengels bei den Compositae-Cynareae.* Unpublished Thesis of the Systematische Geobotanisches Institut der Universität Göttingen.
MOUTERDE, P., 1983. *Nouvelle Flore du Liban et de Syrie, 3.* Beyrouth: Dar el-Machreq Sarl.
PAIVA, D. DE, 1961. Subsidios para o conhecimento da flora portuguesa –1. *Anuário da Sociedade Broteriana, 27:* 5–19.
PAMPANINI, R., 1921. *Cynara sibthorpiana* Boiss. & Heldr. var. *mauginiana* Pampanini. In A. Maugini, Appunti sulla vegetazione della Cirenaica e sulla sua utilizzazione agraria. *Agricoltura coloniale A, 15:* 378–381.
PAMPANINI, R., 1930. *Prodromo della Flora Cirenaica.* Forlì: Tipografia Valbonesi.
POST, G.-E., 1893. *Cynara auranitica* Post. In G.-E. Post & E. Autran, Plantae Postianae. 6. *Bulletin de l'herbier Boissier, 1(8):* 393–411.
QUEZEL, P., 1978. Analysis of the Flora of Mediterranean and Saharan Africa. *Annals of the Missouri Botanical Garden, 65:* 479–534.
RECHINGER, K. H., 1950. Grundzüge der Pflanzenverbreitung in der Ägäis I. *Vegetatio, :* 55–119.
RECHINGER, K. H., 1979. *Cynara* L. In K. H. Rechinger, *Flora Iranica, Compositae 3—Cynareae.* Graz: Akademische Druck u. Verlagsanstalt.
SANDWITH, N. Y. & SIMPSON, N. D., 1941. Additions to the Flora of Cyrenaica. *The Journal of Botany, London, 79:* 33–44.
SENNEN, E. M. G., 1936. *Campagnes botaniques du Maroc oriental de 1930 à 1935 des frères Sennen & Mauricio.* Madrid.
SOLEREDER, H., 1908. *Systematic Anatomy of the Dicotyledons, 1 & 2.* Oxford: Clarendon Press.
STAFLEU, F. & COWAN, R., 1976. *Taxonomic Literature, 1.* Bohn, Scheltema & Holkema. [*Regnum Vegetabile, 94.*]
STAFLEU, F. & COWAN, R., 1979. *Taxonomic Literature, 2.* Bohn, Scheltema & Holkema. [*Regnum Vegetabile, 98.*]

STAFLEU, F. & COWAN, R., 1981. *Taxonomic Literature, 3.* Bohn, Scheltema & Holkema. [*Regnum Vegetabile, 105.*]
STAFLEU, F. & COWAN, R., 1986. *Taxonomic Literature, 5.* Bohn, Scheltema & Holkema. [*Regnum Vegetabile, 112.*]
STEARN, W. T., 1973. *Botanical Latin*, 2nd edition. Newton Abbot: David & Charles.
SUNDING, P., 1970. Elementer i Kanariøyernes flora, og teorier til forklaring av floraens oprinnelse. *Blyttia, 28:* 229–259.
TABERNAEMONTANUS, J., 1590. *Eicones Plantarum, 2(10).* Francofurti ad Moenum.
TALAVERA, S., 1980. Notas taxonómicas y corológicas sobra la flora de Andalucía occidental 1–24. *Lagascalia, 9(2):* 219–248.
TALAVERA, S., 1981. Números cromosómicos para la flora Española. Números 201–208. *Lagascalia, 10(2):* 225–256.
TALAVERA, S., 1987. 82. *Cynara* L. In B. Valdés, S. Talavera & E. Fernandes-Galiano (Eds), *Flora Vascular de Andalucía occidental, 3.* Barcelona: Ketres Editora, S. A.
THOMSEN, C., BARBE, D., WILLIAM, W. & GEORGE, M., 1986. Escaped artichokes are troublesome pests. *California Agriculture, March–April:* 7–9.
WAGENITZ, G., 1958. Die Gattung *Myopordon* Boiss. (Compositae-Cynareae). Berichte der deutschen botanischen Gesellschaft, *71(7):* 271–277.
VALLETTA, A., 1979. Insect pollinators on *Cynara cardunculus* L. *The Central Mediterranean Naturalist, 1(1):* 22.
WATROUS, L. & WHEELER, Q., 1981. The outgroup comparison method of character analysis. *Systematic Zoology, 30(1):* 1–11.
WIKLUND, A., 1985. The genus *Asteriscus* (Asteraceae-Inuleae). *Nordic Journal of Botany, 5:* 299–314.
WIKLUND, A., 1987. The genus *Nauplius* (Asteraceae-Inuleae). *Nordic Journal of Botany, 7:* 1–23.
WIKLUND, A., 1989. A study of the morphological variability in *Cynara humilis* L. and *C. hystrix* Ball (Asteraceae-Cardueae). *Lazaroa, 11:* 19–27.
ZOHARY, D. & BASNIZKY, J., 1975. The cultivated artichoke–*Cynara scolymus*. Its probable wild ancestors. *Economic Botany, 29:* 233–235.