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MORPHOLOGICAL INVESTIGATIONS AND TRANSPLANTATION ATTEMPTS ON SOME ENDEMIC SPECIES OF NORTHERN CYPRUS

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Abstract

The aim of this study was to investigate the morphology of 10 endemic taxa *Pimpinella cypria, Ferulago cypria, Limonium albidum* subsp. *cyprium, Onosma caespitosum, Origanum syriacum* var. *bevanii, Salvia veneris, Sideritis cypria, Phlomis cypria* var. *cypria, Scutellaria sibthorpii and Teucrium cyprium* subsp. *kyreniae* distributed in Northern Cyprus. These belong to the families Apiaceae, Plumbaginaceae, Boraginaceae, and Lamiaceae. All these species are distributed only on the Beshparmak mountains in the northern part of Cyprus and are under a threat of extinction due to severe habitat degradation arising from human activities, forests fires and stone queries. The micrographs of the seeds were taken by means of trinocular stereo dissection microscope, and detailed morphological features recorded from the fresh and dried samples collected during 2001-2004. An attempt has been made for transplantation of these species to some protected sites.

Introduction

The studies conducted by a number of researchers revealed the presence of 1257 species in the Flora of North Cyprus. A total of 121 endemic species have been determined for entire Cyprus. 19 of these species are endemic to North Cyprus (Meikle, 1977, 1985; Viney, 1994, 1996). Apart from some floristic studies on the plants of North Cyprus, there are very few biological studies (Snogerop *et al*., 1990; Stephenson, 1993), and these are far from being sufficient; however, there are biosystematic studies on many species belonging to the genera that include these endemics. These studies helped us determine the general characteristics of the genera that include the species we examined. The location and the general view (Fig. 1) of the investigation area have been presented and distribution of the species shown in separate maps (Figs. 2-3).

The objectives of the present study include examining the morphological characteristics of endemics of North Cyprus on which a limited number of biosystematic studies have been carried out so far; laying the basis for biosystematic studies to be conducted in the future; determining other endangered species in addition to those stated in the Bern Agreement (www.ecnc.nl); and conduct studies for the purpose of protecting these species.

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Materials and Methods

10 endemic plant species belonging to 4 families distributed in North Cyprus, were selected as study materials. The specimens that were collected were then dried according to standard procedures and transformed into herbarium specimens. A portion of the specimens were placed into 70% alcohol to be used in morphological studies. Seeds extracted from the plant specimens containing mature fruits were deposited into envelopes in the field to be used in seed examinations. In the taxonomical examination carried out, flowering time, growth environment and distribution of the species in the investigation area were determined after each species was described. Distribution of the species in the investigation area is based on the specimens we have collected. The specimens collected were assigned numbers starting with K (The first letter of "Kıbrıs", the Turkish word for Cyprus) (Table 1).

Table 1: Data for the collection of North Cyprus Endemics (Figs. 1-3).

SPECIES	LOCALITY, DATE, SPECIMEN NUMBER
Pimpinella cypria	1. Girne (Kyrenia), from Alevkayası (Halevga) to Girnekaya, north slope, 820 m, 25.04.2001, K009. 2. Girne (Kyrenia), St.Hilarion castle, rocky places, 800 m, 25.04.2001, K010. 3. Girne (Kyrenia), near Girnekaya, north slope, rocky places, 750-800 m, 09.05.2002, K037.
Ferulago cypria	1. Girne (Kyrenia), from Girne to Lefkoşa (Nicosia), under St.Hilarion castle, 310 m, 15.05.2001, K008. 2. Gazimağusa (Fagamusta), between Geçitkale-Geçitköy, near road, 200 m, 16.06.2003, K045.
Limonium albidum* subsp. *cyprium	1. Girne (Kyrenia),, Tatlısu village, sea level, 28.06.2001, K017. 2. Girne (Kyrenia), near Hz.Ömer tomb, sea level, 28.06.2001, K018.
Onosma caespitosum	1. Lefkoşa (Nicosia), Alevkayası-Kalavaç road, 700m,26.02.2001, K001. 2.Lefkoşa (Nicosia), Buffavento castle, south slopes, 700 m, 04.03.2002, K031.
Origanum syriacum* var.*bevanii	Girne (Kyrenia), 1 km of St.Hilarion to Selvilitepe, north slope, 850 m, 24.6.2001, K038.
Salvia veneris	Lefkoşa (Nicosia), above Değirmenlik lake, sandstone hills, 200 m, 25.04.2001, 04.05.2002, K006, K033.
Sideritis cypria	1. Girne (Kyrenia), lower Alevkayası (Halevga) rocky places, south-west slopes, 700-750 m, 15.05.2001, 17.06.2003, K011, K047. 2. Lefkoşa (Nicosia), Buffavento castle, rocky places, 800-850 m, 16.05.2002, K012. 3. Girne (Kyrenia), St.Hilarion castle, rocky places, 800 m, 16.05.2002, K013.
Phlomis cypria* var.*cypria	1. Lefkoşa (Nicosia), above Boğazköy, 600m, 15.05.2001, K007. 2. Girne (Kyrenia),, St. Hilarion castle, rocky places, 800 m, 08.05.2002, K036.
Scutellaria sibthorpii	1. Girne (Kyrenia), above Arapköy lake, 50-100 m, 25.04.2001, 05.05.2002, K004, K035. 2. Girne (Kyrenia), St.Hilarion castle, 800 m, 25.04.2001, K005. 3. Gazimağusa (Fagamusta), from Geçitkale to Yaylatepe, under forest, 800 m, 16.06.2003, K046.
Teucrium cyprium* subsp.*kyreniae	1. Lefkoşa (Nicosia), Buffavento castle road, rocky places, south slope, 550 m, 18.5.2001, K015. 2. Lefkoşa (Nicosia), above Boğazköy, rocky places, 500-600 m, 19.06.2001, K016. 3. Gazimağusa (Fagamusta), from Geçitkale to Yaylatepe, under forest, south slope, rocky places, 800 m, 16.06.2003, K049.

Table 2: Seed morphology of North Cyprus Endemics (Figs. 14-33)

SEED → SPECIES ↓	Length x width (mm)	Type	Surface type	Back type	Granulation	Hylar zone type	Colour
Pimpinella cypria **(Figs. 14, 15)**	2.0-2.5 x 1.3-1.35	Ovate, with 5 distinct	Convex dorsally Filiform ridges	Convex-Flat	A little striate, hairy	Densely hairy	Dark brown or pallid
Ferulago cypria **(Figs. 16, 17)**	6.1-6.2 x 2.6-2.7	Oblong	Prominent 3 ridges	3 dorsal ridges very prominent, winged	Absent	Flat	Brown
Limonium albidum **subsp. *cyprium*** **(Figs. 18, 19)**	7.0-8.0x1.8-2.0	Long tubular	Flat	Flat	Little lineolate	Flat, little recessed, narrow	Rich brown
Onosma caespitosum *(Figs. 20, 21)*	3.2-3.8x2.1-2.8	Triangular, broadly ovoid, strongly keeled ventral	Flat	Rounded, convex	Punticulate	Scar flat	Darkish and very pale brown
Origanum syriacum **var.*bevanii* (Figs. 22, 23)**	0.8-0.95x 0.7-0.8	Broadly oblong or suborbicular	Flat	Rounded-convex	Minutely granulose, from tuberculate to faveolate	Littke prominent, granulate, obtuse	Rich brown
Salvia veneris **(Figs. 24, 25)**	2.9-3.0x 1.0-1.5	Ovoid, rounded-trigonous	Convex	Convex	Darker venation, punticulate	Flat, very little recessed	Pale Brown
Sideritis cypria **(Figs. 26, 27)**	2.6-2.8x 1.5	Obovoid, with 3 faces	Convex	Dorsal convex, ventral recessed	Fine granulate, verruculose	Little prominent	Brown
Phlomis cypria **var.*cypria*** **(Figs. 28, 29)**	4.0-4.1x 1.5-1.6	Narrowly oblong	Wide, sharply triquetrous	Conveks	Rugged, from lineolate to striate	Little prominent	Dark brown or greyish brown
Scutellaria sibthorpii **(Figs. 30, 31)**	1.4-1.5x 0.9-1.0	Oblately ovoid	Convex	Convex, obtuse tuberculate	Rugulose-verruculose, hairy	From Flat to recessed	Dark brown
Teucrium cyprium **subsp.*kyreniae* (Figs. 32, 33)**	1.6-1.7x 0.9-1.1	Broadly obovoid	Falsifoveate	Convex-Flat, sinuous obtuse	From punticulate to granulate	Distinctly, foveolate, suborbicular, width: 0.6-1.0 mm	Dark brown

Table 3: Results of the germination trials

	EX-SITU OBSERVATIONS		PHENOLOGIC OBSERVATIONS	
	In petri dishes	In peat	Vegetative development	Generative development
Pimpinella cypria	+	+	+	-
Ferulago cypria	-	-	-	-
Limonium albidum* subsp.*cyprium	+	-	-	-
Onosma caespitosum	+	+	+	-
Origanum syriacum* var.*bevanii	+	-	-	-
Salvia veneris	+	+	+	+
Sideritis cypria	+	-	-	-
Phlomis cypria* var.*cypria	+	+	+	-
Scutellaria sibthorpii	+	+	+	+
Teucrium cyprium* subsp.*kyreniae	+	-	-	-

The general view as well as the shapes of the flowers and the fruit were drawn by hand due to their significance in the identification of the species (Figs. 4-12). Micrographs showing the general view of the seeds belonging to each species were taken using an Olympus camera at enlargements ranging between 10x0.6 and 10x4 at an Olympus VM binocular stereo microscope and then added to the study. Seed characteristics were also included in the report in tabloid form (Figs. 14-33). Seed morphology of each species was assessed according to Prentice (1979) and Stearn (1996) with the help of microphotographs obtained from the microscope images.

Once the fruiting period had finished, seeds were collected from 10 endemic species and germination and seedling survival were examined. Germination experiments were carried out approximately a week after collection of seeds. In the meantime the seeds were stored at environment temperature in glass vials. Experiments were performed to investigate the effects on germination (a) of light (b) of cold treatment and (c) of hormones in petri dishes on filter paper and in pots filled with peat. In addition, we assessed seedling survival over a 1-year period in both botanic garden and sub alpine greenhouse conditions.

Results and Discussion

Various floristic studies that were conducted (Meikle, 1977, 1985; Viney, 1994, 1996) have revealed that approximately 1300 species, of which 19 are endemic, grow in the North Cyprus Flora. In our study on 10 species belonging to 10 genera that are endemic to Cyprus, all morphological characteristics of the species (general plant structure, leaf, flower parts, seed testa surface and others) were dealt with (Figs. 4-33, Table 2). It is our belief that further examination of the morphological characteristics of the species in the present study will lay the foundations for future study on this subject.

Of these species, *Origanum syriacum* var.*bevanii* is known to be distributed in the Syrian, Palestine and Sinai Flora (Post, 1932-33) as well as in the Turkish Flora (Davis, 1982). Furthermore, *Origanum syriacum* var. *bevanii* was also reported in various floristic studies conducted by Çatan and Düzenli (1992), Göktürk & Sümbül (1996, 1997). Meikle (1985), on the other hand, clearly stated this taxon as an endemic from North Cyprus in "Flora of North Cyprus". The reason for that is the fact that var.*bevanii* another North Cyprus endemic, resembles var.*syriacum,* which is distributed in the same area, in that the leaves and flowers are thin-short, grayish white and densely downy (hairy) and the lower surface of the leaves is distinctively net-veined and has a spot-like gland pouch. According to Meikle (1985), the species found in Turkey, Syria and Palestine is var.*syriacum*. For this reason *Origanum syriacum* var.*bevanii* taxon has been considered a North Cyprus endemic in our study. A definite result can be obtained if a comparative study is to be conducted on species from both Turkey and North Cyprus in future.

Eunll *et al*. (1997) determined the most typical seed character of 8 species from the family *Umbelliferae*. The seed sizes determined in the present study were between 2-7x2-5 mm; the seed shape rectangular or oval and ovate; the seed colour yellow, light yellow or brown, dark brown or black; *Pimpinella cypria*, a member of *Umbelliferae*, which is an endemic of North Cyprus whose seed characteristics have been specified in this study, 2.0-2.5x1.3-1.35 mm; ovate, dark brown (Figs. 43, 44, Table 2); and *Ferulago cypria,* 6.1-6.2x2.6-2.7 mm, ovate, brown, groove-like structures yellowish (Figs. 45, 46, Table 2). These displayed resemblances with the characteristics determined by Eunll *et al*. (1997) as far as size, shape and colour are concerned. It is clear that especially the seed shape and colour are quite similar among the species in the family.

Observations we made within the course of our studies showed that the researchers had not visited the points that were difficult to reach during the creation of the Flora of Cyprus (Meikle, 1977; 1985) and the Flora of North Cyprus (Viney, 1994; 1996). Therefore, it was concluded that it would be necessary that the flora and vegetation of North Cyprus be examined in a more detailed study in future. The germination results of the species studied are presented in Table 3. Germination and transplantation experiments were carried out in order to test the germination possibility and survival capacity of these endemics in ex-situ conditions. According to our results only *Ferulago cypria* didn't germinate in any condition. Only five species (*Pimpinella cypria, Onosma caespitosum, Salvia veneris, Phlomis cypria* var. *cypria* and *Scutellaria sibthorpii*) developed vegetatively and out of these five species two of them (*Salvia veneris* and *Scutellaria sibthorpii*) developed fruits.

Furthermore, we are of the opinion that ex-situ studies should be carried out on not only the endemics of North Cyprus but also those of the whole Island of Cyprus. To do this, seeds belonging to all endemic species can be collected from the area of the study and their reproduction and reintroduction can be made. Moreover, the seeds collected could be transferred to the North Cyprus seed bank to be established for this purpose. Such studies will help protect the biological diversity of North Cyprus as well as endemic plant species in particular. In addition, areas where endemic plants have a dense distribution can be converted into special parks, natural parks and environmental protection areas. To start with the area located between St. Hilarion and Yayla mount can be declared as a special protection area by the authorities concerned and only the area where such endangered species grow can be fenced.

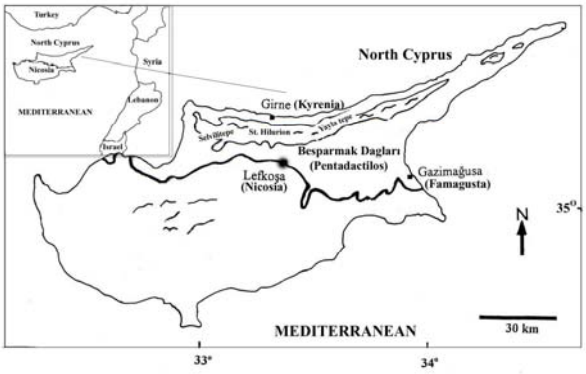


Fig. 1. General appearance of North Cyprus.

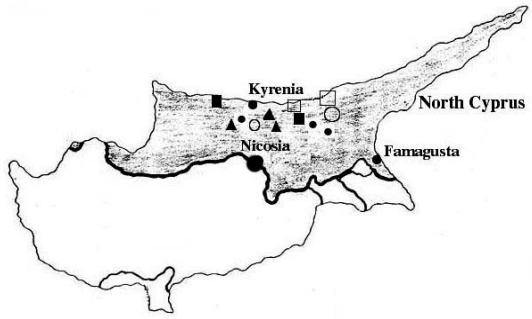


Fig. 2. Distribution area of ■: *Teucrium cyprium* subsp.*kyreniae*, ▲: *Pimpinella cypria*, O: *Ferulago cypria*, □: *Limonium albidum* subsp.*cyprium* and ●: *Scutellaria sibthorpii*.

Fig. 3. Distribution area of ▲: *Onosma caespitosum*, ■ : *Origanum syriacum* var.*bevanii*, O: *Salvia veneris*, □: *Sideritis cypria* and ●: *Phlomis cypria* var.*cypria*.

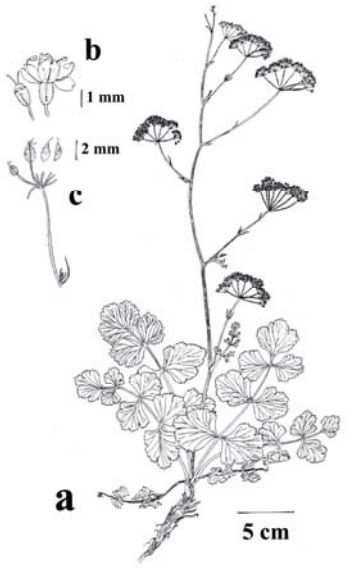


Fig. 4. *Pimpinella cypria* a. General appearance, b. Flower, c. Fruit.

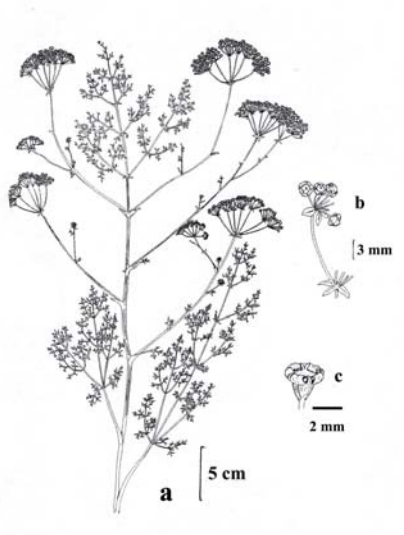


Fig. 5. *Ferulago cypria* a. General appearance, b. Fruits, c. Unripe fruit.

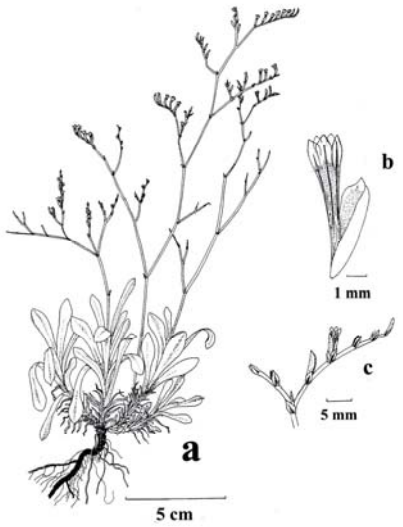


Fig. 6. *Limonium albidum* subsp.c*yprium* a. General appearance, b. Inflorescence, c. Flower and brakteol.

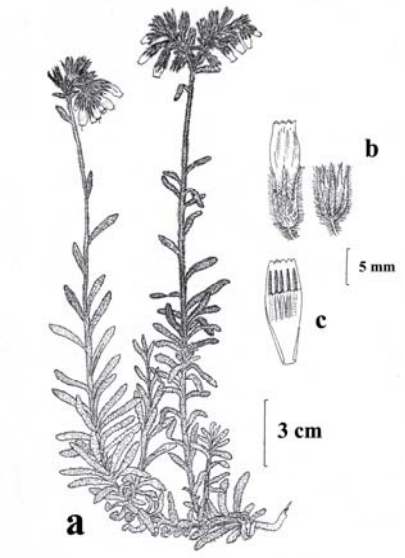


Fig 7. *Onosma caespitosum* a. General appearance, b. Flower and calyx, c. Corolla**.** and stamen.

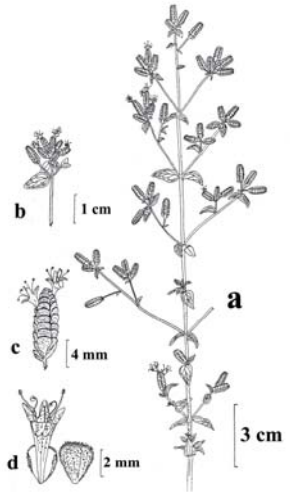


Fig. 8. *Origanum syriacum* var.*bevanii* a. General appearance, b. Inflorescence, c. Detailed view of inflorescence, d. Detailed view of flower and calyx.

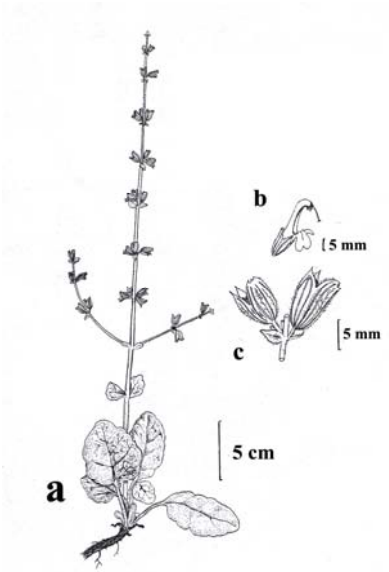


Fig. 9. *Salvia veneris* a. General appearance, b. Flower, c. Calyx

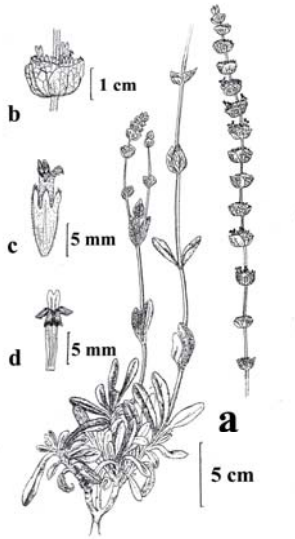


Fig. 10. *Sideritis cypria* a. General appearance, b. Inflorescence, c. Flower, d. Corolla.

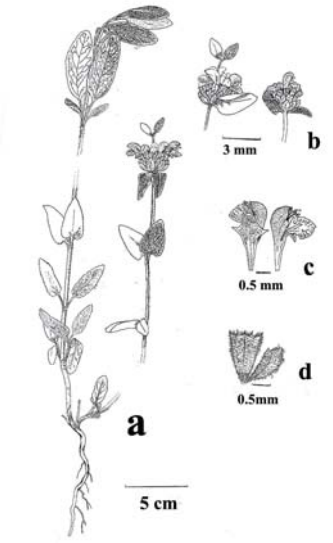


Fig. 11. *Phlomis cypria* var.*cypria* a. General appearance, b. Inflorescence, c. Flower, d. Calyx and brakteol (Fruit).

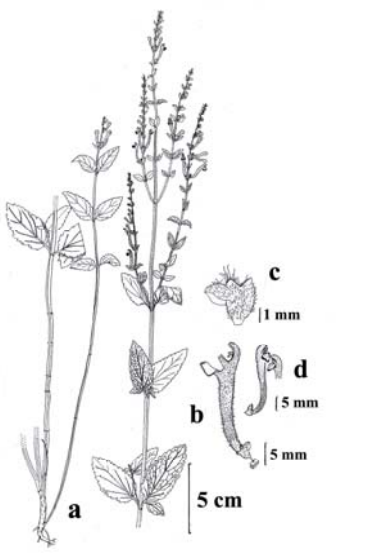


Fig. 12. *Scutellaria sibthorpii* a. General appearance, b. Flower, c. Calyx, d. Corolla.

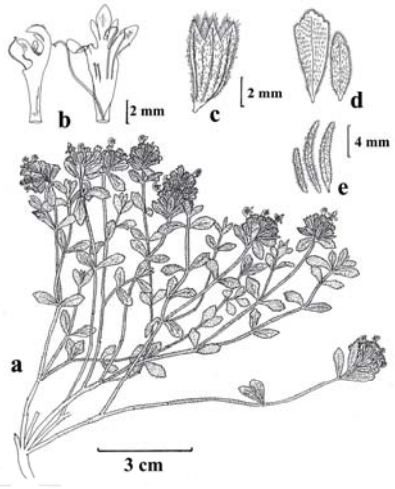
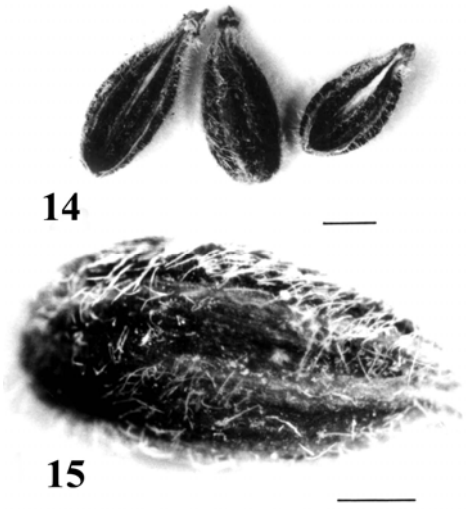
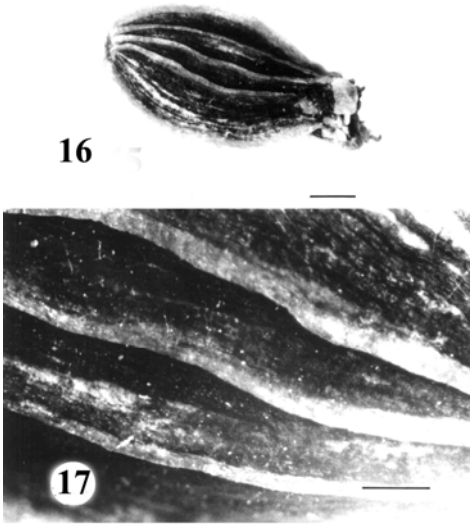


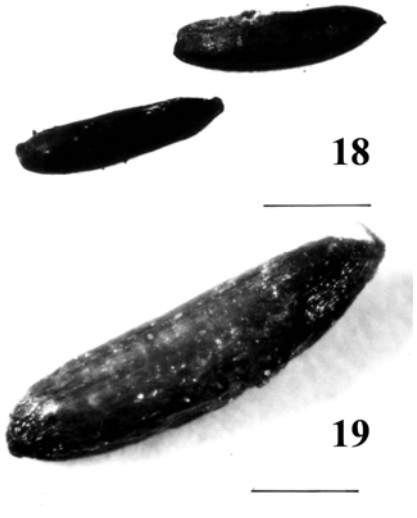
Fig. 13. *Teucrium cyprium* subsp.k*yreniae* a. General appearance, b. Corolla, c. Calyx, stamens and style, d. Cauline leaves, e. Brakteol.



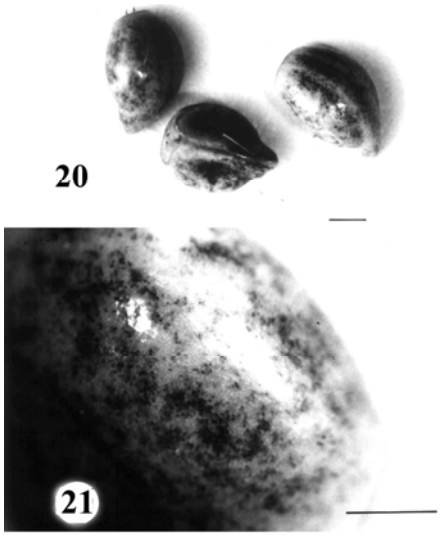
Figs. 14: Detailed general appearance (scale bar: 1 mm) and **Figs. 15:** View of surface (scale bar: 0.5 mm) of *Pimpinella cypria*



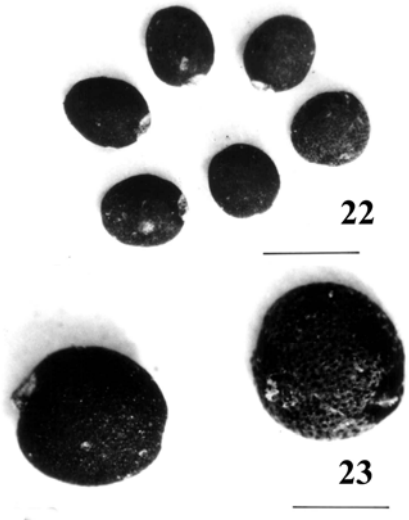
Figs. 16: Detailed general appearance (scale bar: 1 mm) and **Figs. 17:** View of surface (scale bar: 0.5 mm) of *Ferulago cypria*



Figs. 18: Detailed general appearance (scale bar: 1 mm) and **Figs. 19:** View of surface (scale bar: 0.5 mm) of *Limonium albidum* subsp.*cyprium*



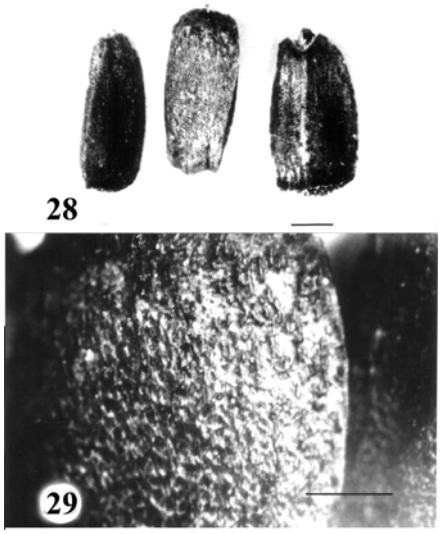
Figs. 20: Detailed general appearance (scale bar: 1 mm) and **Figs. 21:** View of surface (scale bar: 0.5 mm) of *Onosma caespitosum*



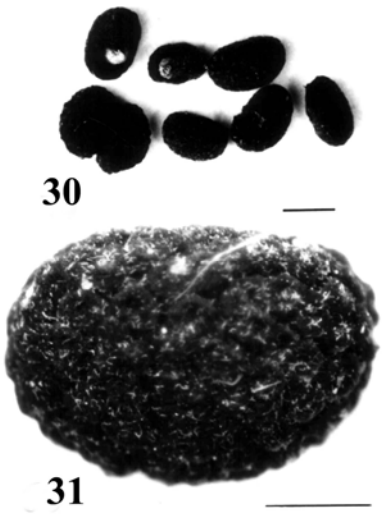
Figs. 22: Detailed general appearance (scale bar: 1 mm) and **Figs. 23:** View of surface (scale bar: 0.5 mm) of *Origanum syriacum* var.*bevanii*

Figs. 24: Detailed general appearance (scale bar: 1 mm) and **Figs. 25:** View of surface (scale bar: 0.5 mm) of *Salvia veneris*

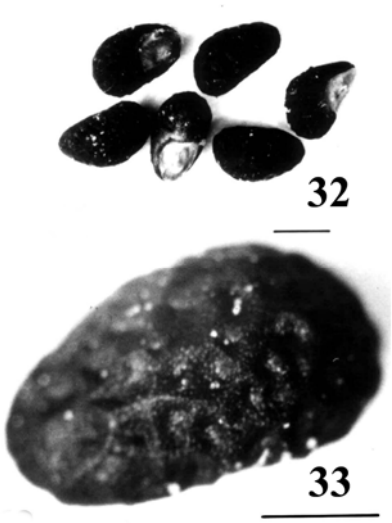
Figs. 26: Detailed general appearance (scale bar: 1 mm) and **Figs. 27:** View of surface (scale bar: 0.5 mm) of *Sideritis cypria*



Figs. 28: Detailed general appearance (scale bar: 1 mm) and **Figs. 29:** View of surface (scale bar: 0.5 mm) of *Phlomis cypria* var.*cypria*



Figs. 30: Detailed general appearance (scale bar: 1 mm) and **Figs. 31:** View of surface (scale bar: 0.5 mm) of *Scutellaria sibthorpii*



Figs. 32: Detailed general appearance (scale bar: 1 mm) and **Figs. 33:** View of surface (scale bar: 0.5 mm) of *Teucrium cyprium* subsp.*kyreniae*.

Moreover, we believe that the construction work on the Kyrenia Range (building new roads, residential projects and stone quarries), which holds almost the whole flora of North Cyprus including *Delphinium caseyi, Brassica hilarionis, Dianthus cyprius, Silene fraudatrix, Hedysarum cyprium, Salvia veneris, Sideritis cypria* and *Phlomis cypria* var.*cypria* will eventually affect not only the endangered endemics but also other endemic species and therefore necessiate protection of the flora as a whole. Otherwise, the number of species in the Flora of North Cyprus will decrease in a relatively short period of time.

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