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Morphological Investigation of Some North Cyprus Endemics

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Abstract

The aim of this study is to investigate the morphology of nine endemic plant species belonging to 5 families distributed in North Cyprus and also to assess the systematic positions of the species according to the data obtained. Drawings depicting the general view and detailed flower and fruit morphology of each species were made, micrographs of the seeds were taken by means of trinocular stereo dissection microscopy, and detailed morphological features were determined.

It was observed that the species that were studied displayed certain differences from one another in that the seeds of *Delphinium caseyi* B.L. Burtt had a a scaled surface, the seeds of *Rosularia cypria* (Holmboe) Meikle, *Rosularia pallidiflora* (Holmboe) Meikle and *Sedum lampusae* (Kotschy) Boiss. had a furrowed surface and the seeds surfaces of *Hedysarum cyprium* Boiss. did not have any ornamentation at all. Our investigation led us to believe that *Rosularia cypria* and *Rosularia pallidiflora* were not separate species, but hybrids or varieties of the same species. Furthermore, endangered endemic species of North Cyprus were determined.

Key Words: Endemic, North Cyprus, morphology, seed.

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 [1-5]. Apart from some floristic studies on the plants of North Cyprus, there are very few biological studies [6-8], 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 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; and conduct studies for the purpose of protecting these species.

MATERIALS AND METHODS

Nine endemic species belonging to five 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.

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).

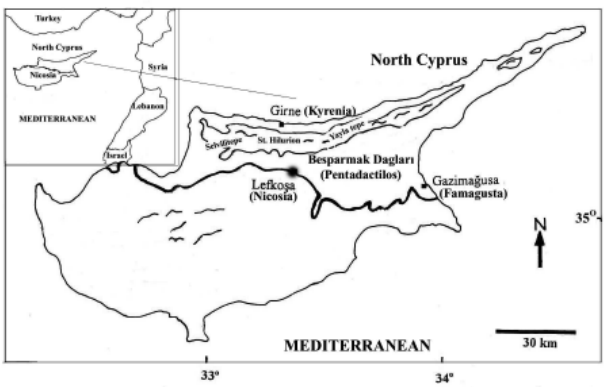


Figure. 1. General appearance of North Cyprus.

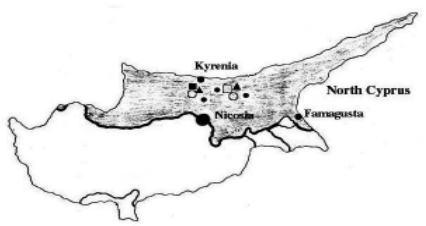


Figure. 2. Distribution area of ■ : *Delphinium caseyi*, ▲: *Brassica hilarionis*, O: *Arabis cypria*, □ : *Dianthus cyprius*. and ● : *Sedum lampusae*.

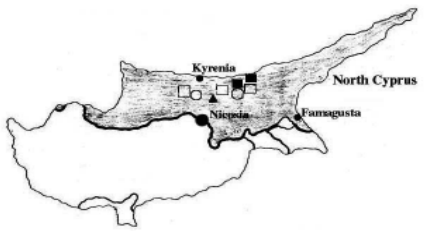


Figure. 3. Distribution area of ■: *Silene fraudatrix*, ▲: *Hedysarum cyprium*, O: *Rosularia cypria* and □: *Rosularia pallidiflora.*

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

SPECIES	LOCALITY, DATE, SPECIMEN NUMBER
Delphinium caseyi	Girne (Kyrenia), 1 km from St.Hilarion castle, south west limestone hill, north slope, 850-900 m, 25.06.2001, 16.06.2003, K021, K048.
Brassica hilarionis	1. Girne (Kyrenia), St.Hilarion castle, 800 m., 25.04.2001, K019. 2. Girne, (Kyrenia) Girnekaya, scrubs and limestone cliffs, 800 m, 25.04.2001, K020.
Arabis cypria	1. Girne (Kyrenia), St.Hilarion castle, limestone cliffs and rocks, 800 m, 27.02.2001, K014. 2. Lefkoşa (Nicosia), Alevkayası (Halevga), rocks, 750-800 m, 08.05.2002. K030.
Dianthus cyprius	Lefkoşa (Nicosia), Alevkayası (Halevga), rocks and near road, south east slopes, 750-800 m, 15.08.2001, K022.
Silene fraudatrix	1. Lefkoşa (Nicosia), Alevkayası (Halevga), under forest, 800 m, 24.04.2001, 03.05.2002, K002, K032. 2. Lefkoşa, (Nicosia), Yayla tepe, under forest, 900 m, 16.06.2003, K050.
Hedysarum cyprium	Lefkoşa, (Nicosia), above Değirmenlik Lake, sand stone slopes, 200 m, 25.04.2001, 04.05.2001, K003, K034.
Rosularia cypria	1. Girne (Kyrenia), 1 km from St.Hilarion castle southwest limestone hill, north and south slopes, 750-80m, 25.06.2002, 24.06.2002, 16.06.2003, K027, K039, K043. 2. Lefkoşa (Nicosia), Geçitkale-Yayla tepe road, under forest, north slopes, 800 m, 16.06.2003, K044.
Rosularia pallidiflora	1. Lefkoşa (Nicosia), above Boğazköy, south east slopes, 600 m, 15.08.2001, K023. 2. Lefkoşa (Nicosia), Buffavento castle, walls of castle and rocky places, south-east slopes, 850-900 m, 850-900 m, 23.06.2002, K024. 3. Girne (Kyrenia), 1 km of south-west, , St.Hilarion castle, rocky places, 750-800 m, 24.06.2002, K028, K040. 4. Lefkoşa (Nicosia), Yayla tepe, south and north, rocky places, 900 m, 16.06.2002, K042.
Sedum lampusae	1.Girne (Kyrenia), Lapta centre, rocky places, 350m, 13.08.2001, K025. 2.Girne(Kyrenia), above Karaman, rocky places, 400 m, 25.06.2002, K029. 3. Girne (Kyrenia), between Alevkayası (Halevga)-Girnekaya, rocky places, north slope, 750m, 23.06.2001, 16.06.2003, K026, K041.

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).

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. 13-30). Seed morphology of each species was assessed according to Prentice [9] and Stearn [10] with the help of microphotographs obtained from the microscope images.

RESULTS AND DISCUSSION

In our study on nine species belonging to eight 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. 4-30).

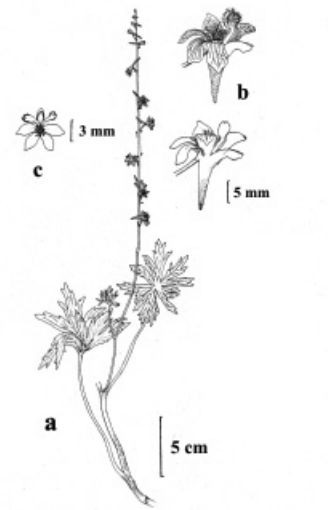


Figure. 4. *Delphinium caseyi* a. General appearance, b. Flower side view, c. Flower, top view

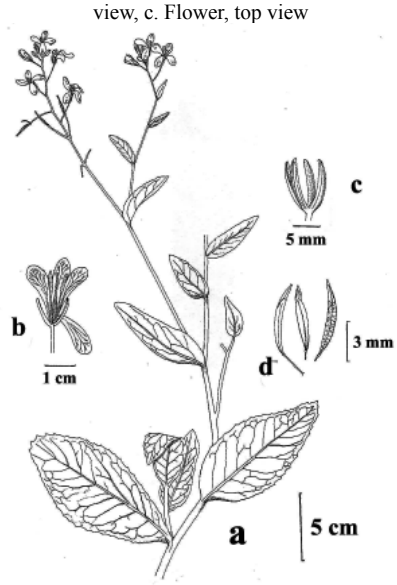


Figure. 5. *Brassica hilarionis* a. General appearance, b. Flower longitudinal section, c. sepal, d. Fruit.

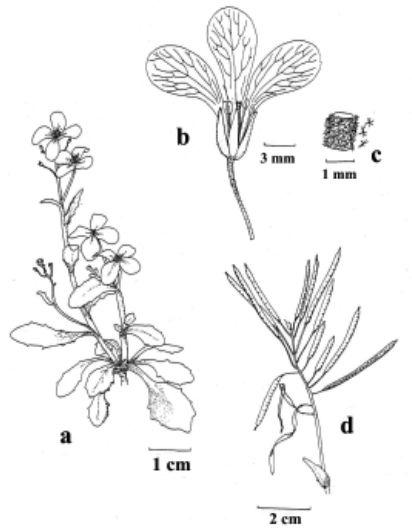


Figure. 6. *Arabis cypria* a. General appearance, b. Flower longitudinal section, c. Flower Stalk, d. Fruit.

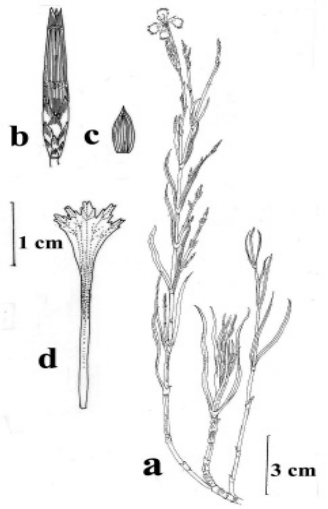


Figure. 7. *Dianthus cyprius* a. General appearance, b. Flower. c. Brakteol, d. Petal

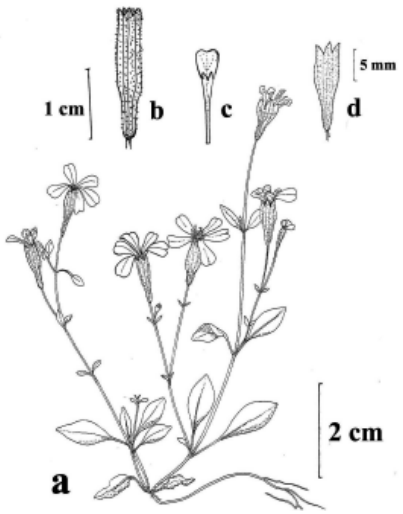


Figure. 8. *Silene fraudatrix* a. General appearance, b. Flower, c. Petal d. Calyx in fruit.

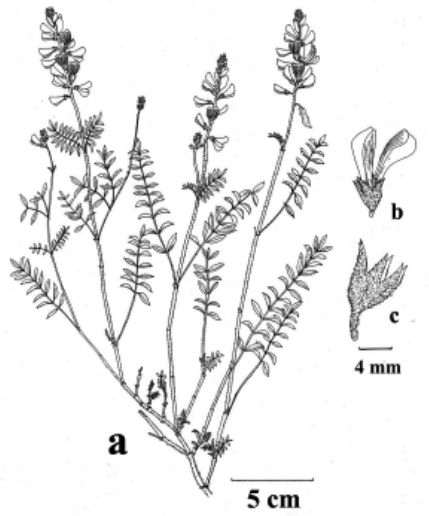


Figure. 9. *Hedysarum cyprium* a. General appearance, b. Flower, c. Calyx.

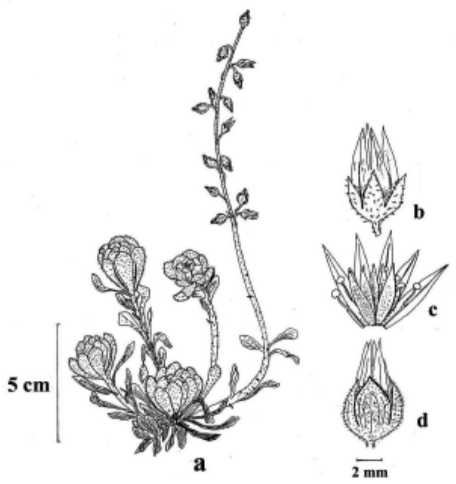


Figure. 10. *Rosularia cypria* a. General appearance, b. Flower, c. Detailed view of flower, d. Flower at unripen fruit.

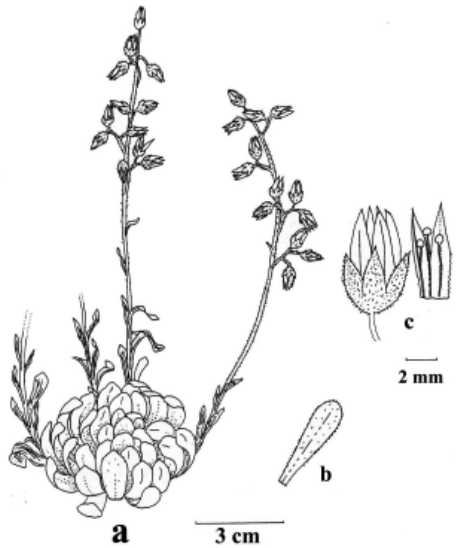


Figure. 11. *Rosularia pallidiflora* (K 028) a. General appearance, b. Basal leaves, c. Flower and flower parts.

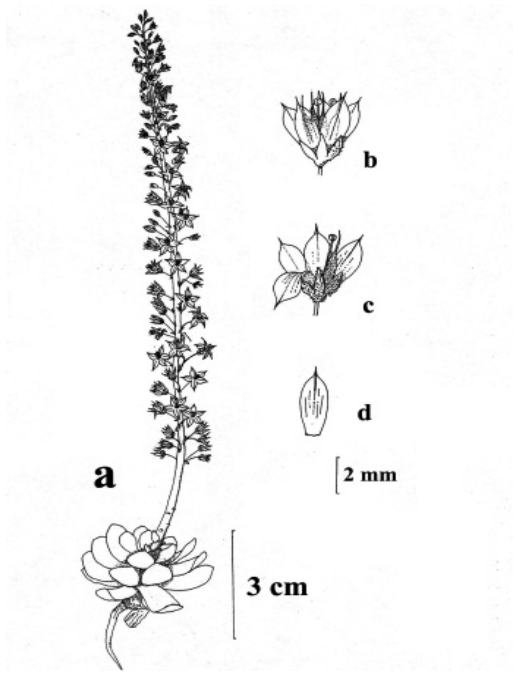


Figure. 12. *Sedum lampusae* a. General appearance, b. Flower, c. Detailed view of Flower, d. Petal.

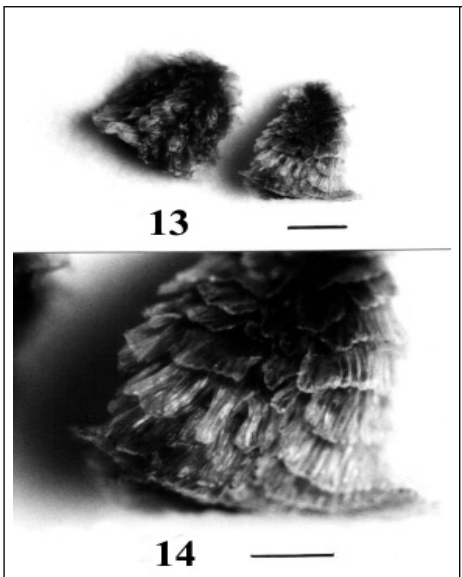
In a study he conducted, Ilarslan [11] stated that *Delphinium cilicicum* P.H.Davis & Kit Tan species is distinguished from *Delphinium caseyi*, an endemic from North Cyprus, in that its blue-coloured flowers have a darker shade, its spurs are horizontal and have a pouch-like tip, its sepals are twice as long and leaf parts are extremely thin.

In a study he conducted on the *Silene* species all over the world, Chowdhuri [12] examined 443 species under 44 sections. The study was used as the main reference by Coode and Cullen [13] while studying *Silene* species in the "Flora of Turkey" as it provided valuable information on these sections and some problematic species. The species *Silene fraudatrix* was first described and named by Meikle in 1969, but it is not included in this study. However, species belonging to Atoicon Otth. Section, which also includes *Silene fraudatrix* were mentioned in Chowdhuri's study.

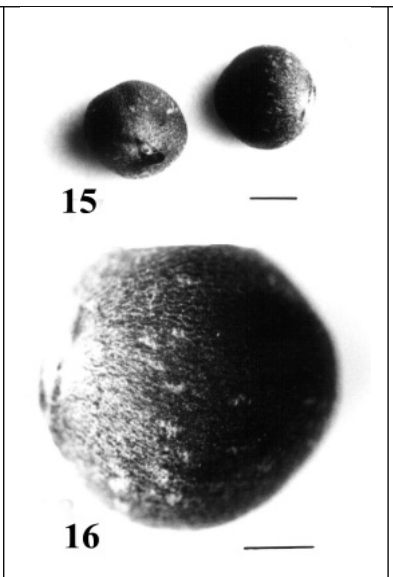
In the systematic revision he made on the *Silene* taxa distributed in the Balkans, Melzheimer [14] conducted a comparative study on the seed, flower, calyx and corolla characteristics of the genus *Silene*. The general morphological characteristics of a great number of species obtained in the examinations carried out displayed a great resemblance to the flower, fruit and especially seed characteristics of *Silene fraudatrix*. Moreover, the fact that *Silene* pollens are polyporate, puntitegillate-spinulose and reticulate is in fully compatible with the data obtained in our study.

Table 2. Seed morphology of North Cyprus Endemics (Figs. 13-30).

SEED / SPECIES	Length x width (mm)	Type	Surface type	Back type	Granulation	Hylar zone type	Colour
Delphinium caseyi (Figs. 13, 14)	2.3-2.7 x 1.9-2.1	Oblong to triangular	Membranous scale	Membranous scale	Absent	Flat	Dark brown
Brassica hilarionis (Figs. 15, 16)	2.1-2.3 x 2.0-2.1	Subglobose	Flat	Ovoid-Flat, punctuate	Punctate, minuately reticulate	Flat, little prominent	Light and dull brown
Arabis cypria (Figs. 17, 18)	0.7-1.0 x 0.7-0.9	Subreniform, broadly ovate	Flat	Rounded tuberculate	tuberculate, minutely faveolate verrucate	Little recessed	Light and dark brown
Dianthus cyprius (Figs. 19, 20)	1.7-3.0x 1.4-2.0	Oblong, scale-like	Flat	Convex, sinuous	Dorsal scalariform, Ventral rugged	Prominent	Light and dark brown
Silene fraudatrix (Figs. 21, 22)	1.2-1.4 x 0.8-1.0	Reniform	Concave, Flat	Convex, obtuse tuberculate	Obtuse tuberculate	Flat, litlle recessed	Dull Grey-brown
Hedysarum cyprium (Figs. 23, 24)	3.9-4.0 x 2.9-3.1	Reniform	Flat	Convex-rounded	Absent	Recessed	Shining Brown
Rosularia cypria (Figs. 25, 26)	0.4-0.6 x 0.2-0.3	Narrowly elipsoid	Regular, longitudinal ribs	Flat	Absent	Prominent	Light yellowish and dark brown
Rosularia pallidiflora (Figs. 27, 28)	0.5-0.6 x 0.2-0.3	Narrowly elipsoid	Regular, longitudinal ribs	Flat	Absent	Prominent	Light yellowish and dark brown
Sedum lampusae (Figs. 29, 30)	0.6 x 0.2-0.3	Bluntly oblong-elipsoid – Falcate	Little longitudinal ribs	Flat	Absent	Prominent	Light and dark Brown

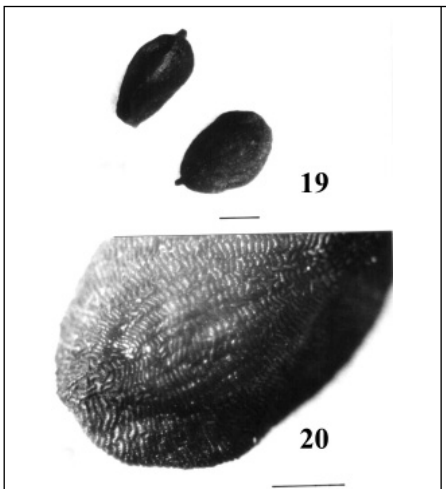


Figures. 13, 14. *Delphinium caseyi*

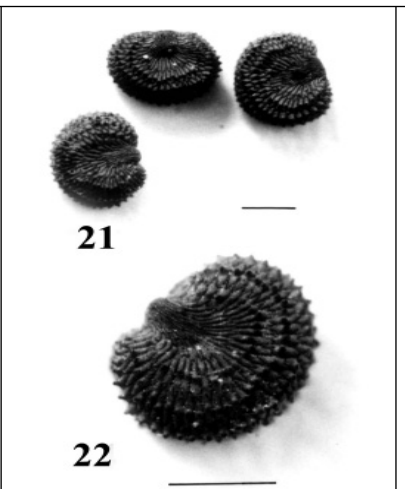


Figures. 15, 16. *Brassica hilarionis*

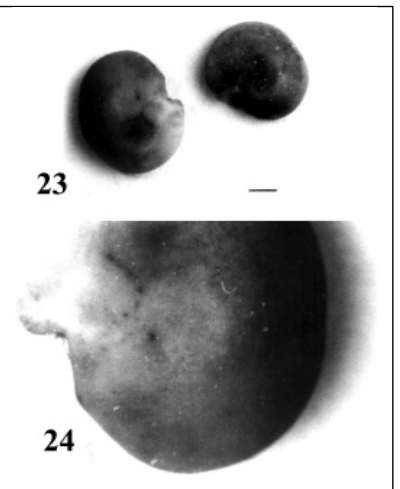
Figures. 17, 18. *Arabis cypria*



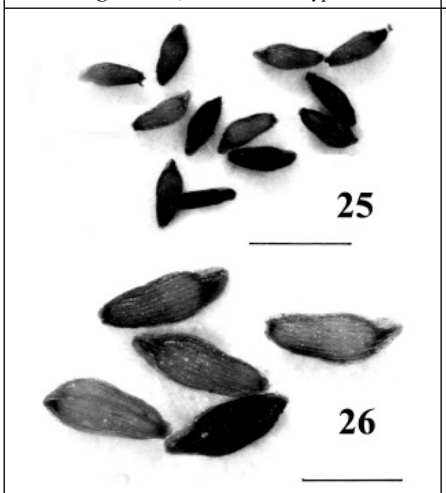
Figures. 19, 20. *Dianthus cyprius*



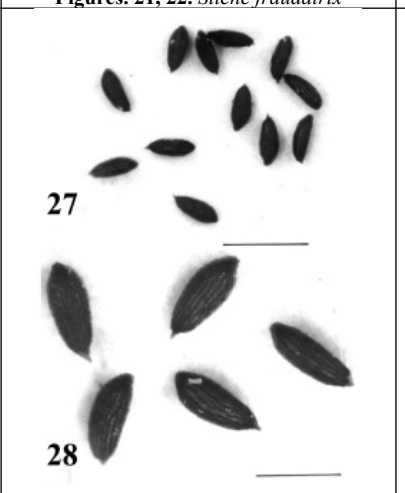
Figures. 21, 22. *Silene fraudatrix*



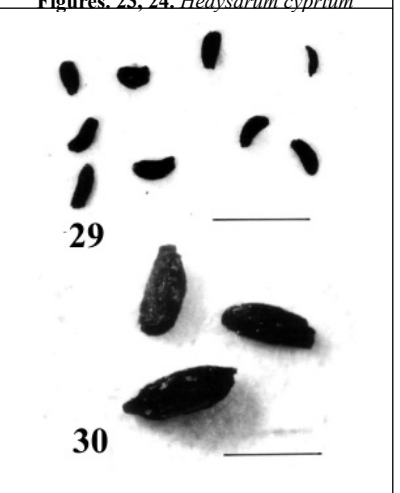
Figures. 23, 24. *Hedysarum cyprium*



Figures. 25, 26. *Rosularia cypria*



Figures. 27, 28. *Rosularia pallidiflora*



Figures. 29, 30 *Sedum lampusae*

Figures. 13, 15, 17, 19, 21, 23, 25, 27, 29. General appearance of seed (scale bar: 1 mm).

Figures. 14, 16, 18, 20, 22, 24, 26, 28, 30. Detailed view of seed surface (scale bar: 0.5 mm).

Yıldız and Çırpıcı [15] determined the seed morphology of a total of 19 *Silene* species distributed in Turkey, 3 of which were endemic, making use of stereo and scanning electron microscopy. Yıldız [16] studied the seed morphology of 17 *Caryophyllaceae* species also distributed in Northern Turkey including *Dianthus* and *Silene* species. The seed type of the *Silene* species in these two studies was described as reniform, sometimes ovate; the seed size, between 2.2-2.8x1.6-2.1 mm and 0.5-0.7x0.4-0.6 mm; tubercules, obtuse conical and long cylindrical; the hilum area, usually clearly recessed; and the seed surface, usually slightly or excessively granulated. The seeds of the *Dianthus* species, on the other hand were described as scaly winged; tubercules, usually obtuse; the hilum area clearly recessed; and the seed surface, slightly granulated. As in the case of the seed type, there are often certain resemblances between the seed characteristics specified in these studies and those of *Dianthus cyprius* and *Silene fraudatrix* (Figs. 19-22; Table 2).

Kostak and Tan [17] studied the morphology of a total of 55 *Dianthus* species distributed in the Aegean and Western Mediterranean regions and determined the phenological, morphological and cytological characters. They emphasized that the most significant characters in the classification of the *Dianthus* species were the flower, bracteole structure and petal shape. In the morphological examination we carried out, the bracteole structure and petal shape were also found to be important characters in the distinction of *Dianthus* species. Therefore, these plant parts need to be used in the future biosystematic studies on *Dianthus*.

T'hart [18] added 8 more species from North Africa and Anatolia to 54 *Sedum* (*Crassulaceae*) species distributed in Europe and conducted a evolution-based biosystematic study. Morphological, cytological and hybridization studies on 53 of the species revealed that all the hybrids were sterile. In consideration of these findings, it was concluded that the *Sedum* section, which is described to be of single origin, could possibly have a second origin. Moreover, 3 more series have been added to the affinity relations, which are usually seen as 27 series in the *Sedum* section of genus *Sedum*. A similar study to be conducted on the species of the same genus distributed in Anatolia and Cyprus that have a phylogenetic relationship between one another will reveal the affinity not only between North Cyprus endemics and those all over the Island of Cyprus, but also between these taxa and those in Anatolia. We believe that such a study could be carried out on all endemics from North Cyprus and that it is necessary to conduct studies between *Delphinium caseyi* and *D.cilicicum* (from Turkey); between *Rosularia cypria*, *R.pallidiflora* and the *Rosularia* species in Turkey and on the Aegean Islands; and between North Cyprus varieties of *Origanum syriacum* (var.*syriacum*, var.*bevanii*) and Turkish, Syrian and Egyptian varieties.

Stephenson [7] made observations on the morphology and distribution of seven endemic succulent species from family *Crassulaceae* distributed on the island of Cyprus. In his observation on *Rosularia cypria, R.pallidiflora* and *Sedum lampusae* that grow in the same locality (St. Hilarion Castle), Stephenson stated that the *Rosularia* species were probably hybrids of one another. In addition Stephenson's observation, Meikle [1] draws little attention to findings although he identifies the species in his work entitled "The Flora of Cyprus". Contradictory findings have been obtained as the result of studies we have conducted on *Rosularia cypria* and *Rosularia pallidiflora*. We could acquire more information on the taxonomy of the species in a more detailed study that might be conducted in the future.

Weng *et al*. [19] made a biosystematical study in which they investigated the seed micromorphology, anatomy and histochemical structure of *Sedum formasanum* N.E. Br. and *S.morrisonense* Hayata species. The seeds in both species were reported to have a rectangular shape while the surfaces were tightly cuticular and with tubercules. Except for the morphological differences stemming from the fact that they are different species in that the seeds of *Sedum lampusae* are slightly sickle-shaped and rectangular; and the surface is without granules and clearly tuberculated (Figs. 29, 30, Table 2), the species have resemblances with respect to seed structure.

We believe that our study will lay the foundation for future biosystematic studies within the light of general morphology and seed characteristics of the endemics of North Cyprus determined in our study in a detailed manner. We also believe that comparative biosystematic studies should be conducted on North Cyprus and Turkish specimens of *Delphinium caseyi* as well as *D.cilicicum*, which is distributed in Turkey. It is also necessary to investigate *Rosularia cypria* and *Rosularia pallidiflora* in a more extensive manner and to review the places of genera.

Acknowledgements

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