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Research Article

Chromosome Numbers of 16 Endemic Plant Taxa from Northern Cyprus

Kemal YILDIZ[1], Salih GÜCEL[2]

[1]Celal Bayar University, Faculty of Science and Letters, Department of Biology, Muradiye, Manisa - TURKEY

[2]Near East University, Science Education Department, Lefkoşa (Nicosia) - NORTHERN CYPRUS

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Abstract: The chromosome numbers of 16 of the 19 endemic taxa of Northern Cyprus were investigated, 15 of which are new records. Diploid chromosome numbers of the taxa investigated varied between 2n = 12 and 2n = 30. One species, *Scutellaria sibthorpii* (Benth.) Hal., was both diploid (2n = 14) and tetraploid (2n = 28), and *Sideritis cypria* Post, 2n = 30, was either diploid or triploid.

Key Words: Northern Cyprus, endemics, chromosome numbers

Kuzey Kıbrıs'ın 16 Endemik Bitki Taksonunun Kromozom Sayısı

Özet: Kuzey Kıbrıs'ın 19 endemik bitki taksonundan 16'sının kromozom sayısı incelenerek, birisi dışında 15 taksonun tamamı ilk defa tespit edildi. Bir türün (*Scutellaria sibthorpii* (Benth.) Hal.) kromozom sayısı hem diploit (2n = 14), hem de tetraploit (2n = 28), bir diğer türün ise diploit veya triploit (*Sideritis cypria* Post, 2n = 30) olmak üzere, diploit taksonların kromozom sayısının 2n = 12 ve 2n = 30 arasında değiştiği görüldü.

Anahtar Sözcükler: Kuzey Kıbrıs, Endemikler, Kromozom sayıları

Introduction

The floristic study by Meikle (1977, 1985) covered the whole of Cyprus, whereas those by Viney (1994, 1996) covered only Northern Cyprus, where about 1300 species occur. A total of 121 endemic species have been determined for the whole of Cyprus, 19 of which are endemic to Northern Cyprus. Almost all the Northern Cyprus endemics are distributed in and around the Kyrenia mountain range (Figures 1-5).

Chromosome numbers of many representatives of genera that we have studied have already been published by many authors and have a worldwide distribution. They include some species belonging to the genera that we examined. A chromosome number comparison of the taxa we investigated with those studied before revealed that 15 of the 16 taxa whose chromosome numbers we studied were new counts.

Apart from some floristic studies on the plants of Northern Cyprus, there are very few biological studies (Snogerop et al., 1990; Stephenson, 1993; Anderson & Warwick, 1999). The present study is important as it investigates the chromosome numbers of almost all the endemic taxa of Northern Cyprus, a subject that had not been studied previously.

The main objective of this study was to determine the chromosome numbers of the endemics of Northern Cyprus, laying the basis for future biosystematic studies as well as introducing these endemic taxa.

Materials and Methods

Mature seeds were collected from the plants in the field (Table 1, Figures 1-5) and placed into envelopes. Herbarium specimens of all taxa were deposited in the Biology Department of Celal Bayar University.

Table 1. Localities of material studied and chromosome numbers obtained.

Taxa	Locality, date, specimen no.	2n
Ferulago cypria H.Wolf (*Apiaceae/Umbelliferae*)	1. Girne (Kyrenia), from Girne to Lefkoşa (Nicosia), by St. Hilarion castle, 310 m, 15.05.2001, K008. 2. Gazimağosa (Fagamusta), between Geçitkale-Geçitköy, near road, 200 m, 16.06.2003, K045.	No results
Pimpinella cypria Boiss. (Apiaceae/Umbelliferae) Figure 6 (locality 3)	1. Girne (Kyrenia), from Alevkayası (Halevga) to Girnekaya, north slopes, 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.	20 (locality 1, 2, 3)
Onosma caespitosum Kotschy (Boraginaceae) Figure 7 (locality 2)	1. Lefkoşa (Nicosia), Alevkayası-Kalavaç road, 700 m, 26.02.2001, K001. 2. Lefkoşa (Nicosia), Buffavento castle, south slopes, 700 m, 04.03.2002, K031.	14 (locality 1, 2)
Arabis cypria Holmboe (*Brassicaceae/Cruciferae*) Figure 8 (locality 1)	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.	14 (locality 1, 2)
Brassica hilarionis Post (*Brassicaceae/Cruciferae*) Figure 9 (locality 1)	1. Girne (Kyrenia), St. Hilarion castle, 800 m, 25.04.2001, K019. 2. Girne, (Kyrenia) Girnekaya, scrub on limestone cliffs, 800 m, 25.04.2001, K020.	18 (locality 1, 2)
Dianthus cyprius A.K. Jackson et Turrill (*Caryophyllaceae*) Figure 10.	Lefkoşa (Nicosia), Alevkayası (Halevga), rocks near road, south-east slopes, 750-800 m, 15.08.2001, K022.	30
Silene fraudatrix Meikle (*Caryophyllaceae*) Figure 11 (locality 1)	1. Lefkoşa (Nicosia), Alevkayası (Halevga), in the forest, 800 m, 24.04.2001, 03.05.2002, K002, K032. 2. Lefkoşa, (Nicosia), Yayla hill, in the forest, 900 m, 16.06.2003, K050.	24 (locality 1, 2)
Rosularia cypria (Holmboe) Meikle (*Crassulaceae*)	1. Girne (Kyrenia), 1 km from St. Hilarion castle, south -west limestone hill, north and south slopes, 750-800 m, 25.06.2002, 24.06.2002, 16.06.2003, K027, K039, K043. 2. Lefkoşa (Nicosia), Geçitkale-Yayla hill road, under forest, north slopes, 800 m, 16.06.2003, K044.	No results
Rosularia pallidiflora (Holmboe) Meikle (*Crassulaceae*) Figure 12 (locality 4)	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 south-west of St. Hilarion castle, rocky places, 750-800 m, 24.06.2002, K028, K040. 4. Lefkoşa (Nicosia), south and north of Yayla hill, rocky places, 900 m, 16.06.2002, K042.	12 (locality 1, 2, 3, 4)
Sedum lampusae Boiss. (*Crassulaceae*) Figure 13 (locality 3)	1. Girne (Kyrenia), Lapta centre, rocky places, 350 m, 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 slopes, 750 m, 23.06.2001, 16.06.2003, K026, K041.	12 (locality 1, 2, 3)

Table 1. Continued.

Taxa	Locality, date, specimen no.	2n
Hedysarum cyprium Boiss. (Fabaceae/Leguminosae) Figure 14.	Lefkoşa, (Nicosia), above Değirmenlik lake, sand stone slopes, 200 m, 25.04.2001, 04.05.2001, K003, K034. 14	14
Origanum syriacum L. var. *bevanii* (Holmes) Ietsw. (*Lamiaceae/Labiatae*) Figure 15.	Girne (Kyrenia), 1 km from St. Hilarion by Selvili hill, north slope, 850 m, 24.6.2001, K038.	30
Phlomis cypria Post var. *cypria* (*Lamiaceae/Labiatae*) Figure 16 (locality 2).	1. Lefkoşa (Nicosia), above Boğazköy, 600 m, 15.05.2001, K007. 2. Girne (Kyrenia), St. Hilarion castle, rocky places, 800 m, 08.05.2002, K036.	20 (locality 1, 2)
Salvia veneris Hedge (*Lamiaceae/Labiatae*) Figure 17.	Lefkoşa (Nicosia), above Değirmenlik lake, sandstone hills, 200 m, 25.04.2001, 04.05.2002, K006, K033.	18
Scutellaria sibthorpii (Benth.) Hal. (Lamiaceae/Labiatae) Figure 18 (locality 1, 2, 3)	1. Girne (Kyrenia), above Arapköy lake, 50-100 m, 25.04.2001, 05.05.2002, K004, K035 (tetraploid). 2. Girne (Kyrenia), St. Hilarion castle, 800 m, 25.04.2001, K005. 3. Gazimağosa (Fagamusta), between Geçitkale and Yayla hill, in the forest, 800 m, 16.06.2003, K046.	14 (diploid) (loc. 1,2,3 28 (tetraploid) (locality 1)
Sideritis cypria Post (Lamiaceae/Labiatae) Figure 19 (locality 1)	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.	30 (locality 1, 2, 3)
Teucrium cyprium Boiss. subsp. *kyreniae* P.H.Davis (*Lamiaceae/Labiatae*) Figure 20 (locality 2)	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. Gazimağosa (Fagamusta), between Geçitkale and Yayla hill, in the forest, rocky places, south slope, 800 m, 16.06.2003, K049.	14 (locality 1, 2, 3)
Limonium (Guss.) Pignatti subsp. *cyprium* Meikle (*Plumbaginaceae*) Figure 21 (locality 1)	1. Girne (Kyrenia), Tatlısu village, sea level, 28.06.2001, K017. 2. Girne (Kyrenia), near Hz. Ömer tomb, sea level, 28.06.2001, K018.	18 (locality 1, 2)
Delphinium caseyi B.L.Burtt (*Ranunculaceae*)	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.	No results

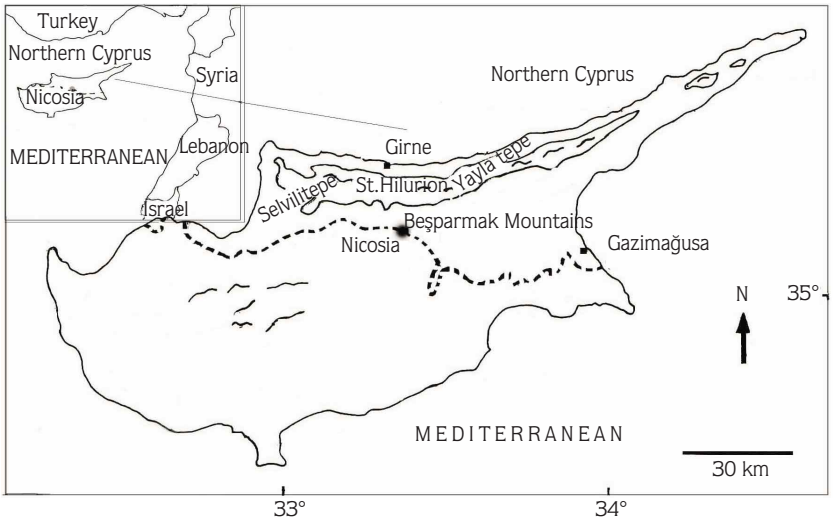

Figure 1. Location of Northern Cyprus.

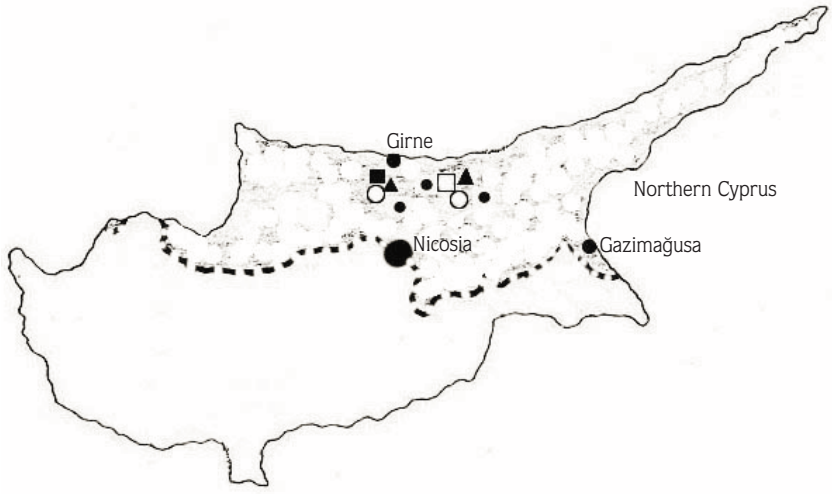

Figure 2. Locality of ■: *Delphinium caseyi*, ▲: *Brassica hilarionis*, ❍: *Arabis cypria*, ❑: *Dianthus cyprius* and ●: *Teucrium cyprium* subsp. *kyreniae*.

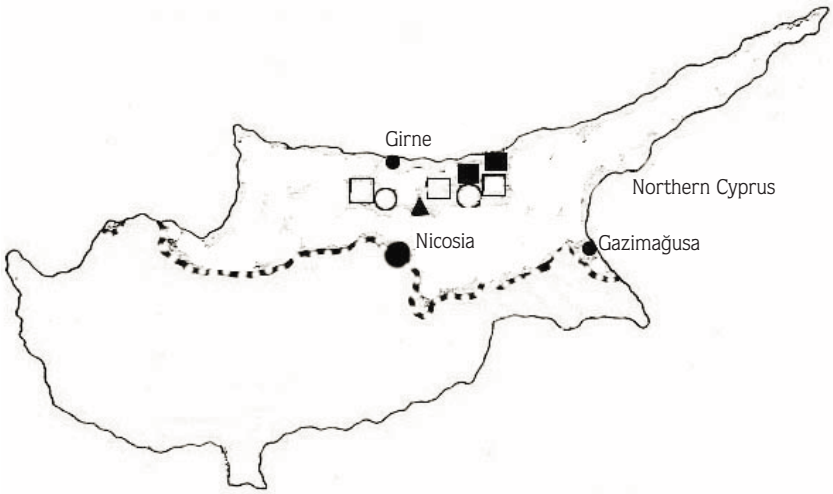

Figure 3. Locality of ■: *Silene fraudatrix*, ▲: *Hedysarum cyprium*, ❍: *Rosularia cypria* and ❑: *Rosularia pallidiflora*.

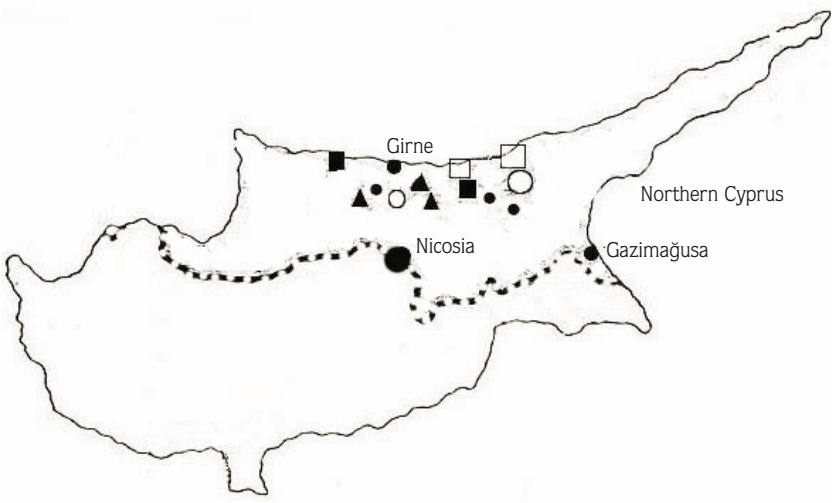

Figure 4. Locality of ■: *Sedum lampusae*, ▲: *Pimpinella cypria*, ❍: *Ferulago cypria*, ❑: *Limonium albidum* subsp. *cyprium* and ●: *Scutellaria sibthorpii*.

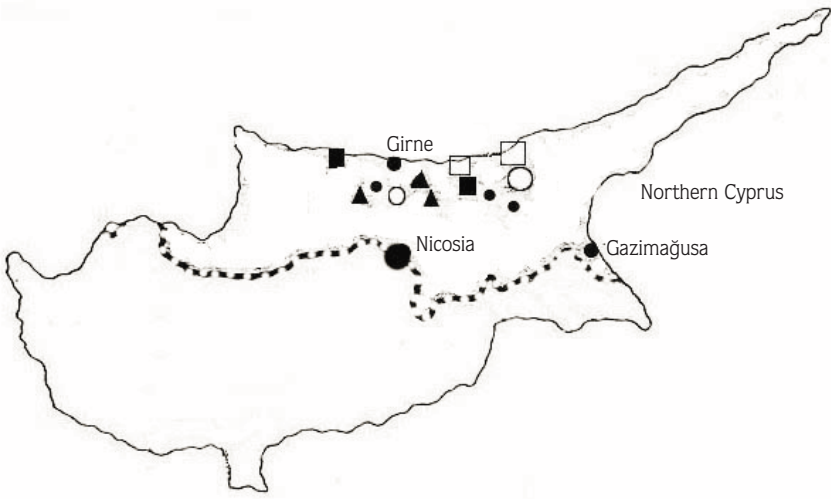

Figure 5. Locality of ▲: *Onosma caespitosum*, ■: *Origanum syriacum* var. *bevanii*, ❍: *Salvia veneris*, ❑: *Sideritis cypria* and ●: *Phlomis cypria* var. *cypria*.

The seeds were germinated on filter paper placed inside petri dishes. As seeds belonging to only 10 taxa germinated initially, several different methods were tried. First, the seeds were left in gibberellic acid (400 ppm GAA3), a germination hormone, in a dark environment for 24 h at +4 °C (in a refrigerator). Seeds were then left to germinate in petri dishes, containing a mixture of sea sand and soil under normal conditions. Following hormone application, the seeds were left in a cool (+4 ºC) environment (shock treatment). Of the 9 taxa that were sown, 7 germinated.

When root tips belonging to 17 taxa grew to a length of 0.5 mm-1 cm, each root tip was removed and pretreated with 0.5% colchicine for 1-5 hand the aceto-orcein squash method (Elçi, 1994) was applied to the root tips. The preparations obtained were examined and photomicrographs taken using an Olympus triocular microscope with a D-plan 100-1.25 160/0.17 oil immersion objective and NFK X 3.3 LD 125 lens. Somatic chromosome images obtained were redrawn by hand using tracing paper. A great number of seeds were taken from at least 5 plant specimens belonging to each taxon and were germinated in the study, with no fewer than 20 cell divisions observed in each preparation. Owing to the fact that chromosome numbers could not be calculated accurately in some species (*Scutellaria sibthorpii* (Benth.) Hal. and *Teucrium cyprium* Boiss. subsp. *kyreniae* P.H.Davis), further studies were carried out. Photographs were taken of the best cells where the chromosome numbers could be accurately counted (Figures 6-21).

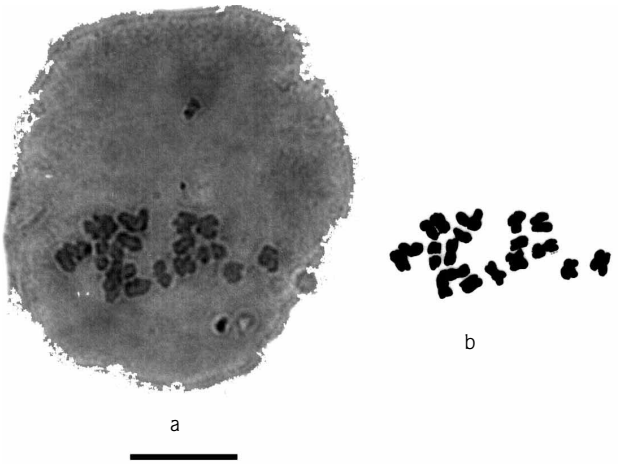

Figure 6. Mitotic chromosomes of *Pimpinella cypria*; 2n = 20. Scale bar = 10 µm. a. Somatic cell, b. Chromosome drawing.

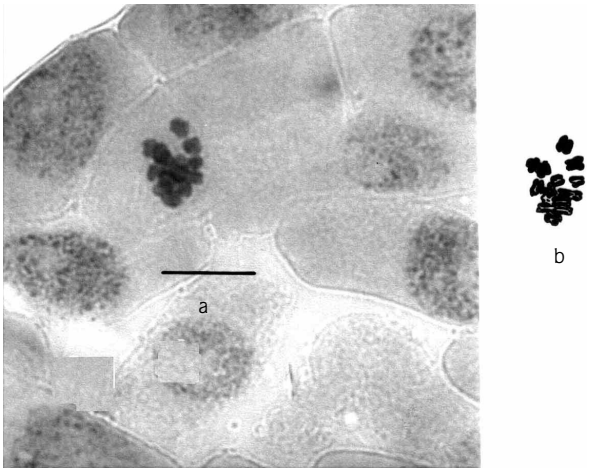

Figure 7. Mitotic chromosomes of *Onosma caespitosum*; 2n = 14. Scale bar = 10 µm. a. Somatic cell, b. Chromosome drawing.

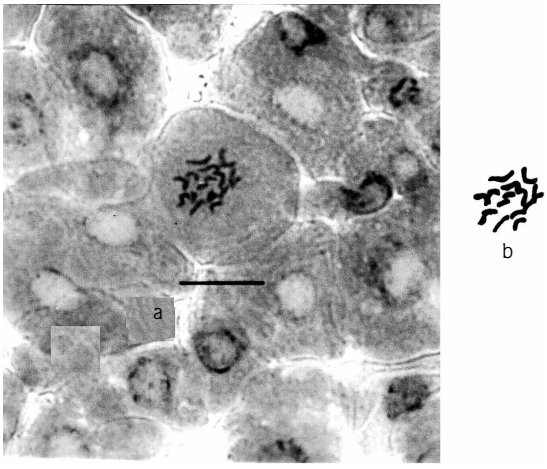

Figure 8. Mitotic chromosomes of *Arabis cypria*; 2n = 14. Scale bar = 10 µm. a. Somatic cell, b. Chromosome drawing.

Figure 9. Mitotic chromosomes of *Brassica hilarionis*; 2n = 18. Scale bar = 10 µm. a. Somatic cell, b. Chromosome drawing.

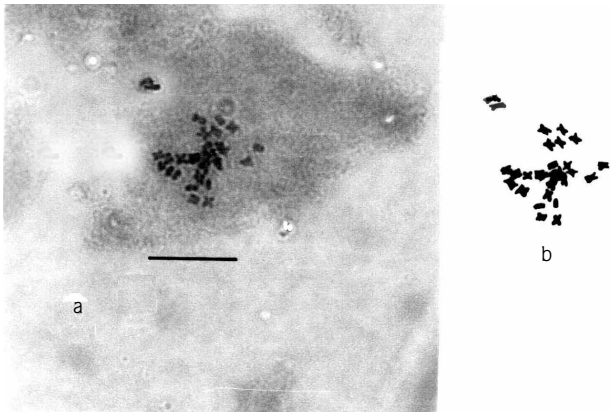

Figure 10. Mitotic chromosomes of *Dianthus cyprius*; 2n = 30. Scale bar = 10 µm. a. Somatic cell, b. Chromosome drawing.

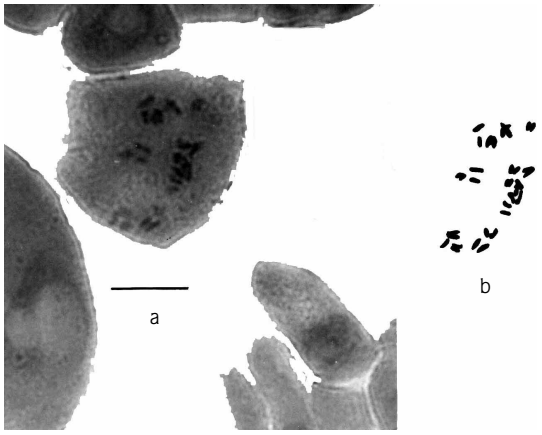

Figure 11. Mitotic chromosomes of *Silene fraudatrix*; 2n = 24. Scale bar = 10 µm. a. Somatic cell, b. Chromosome drawing.

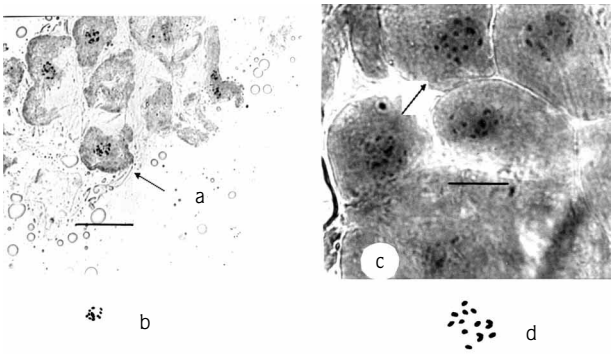

Figure 12. Mitotic chromosomes of *Rosularia pallidiflora*; 2n = 12. (a, b; K 023, K 024: scale bar = 25 µm; c, d; K028: scale bar = 10 µm).
a, c. Somatic cell, b, d. Chromosome drawing.

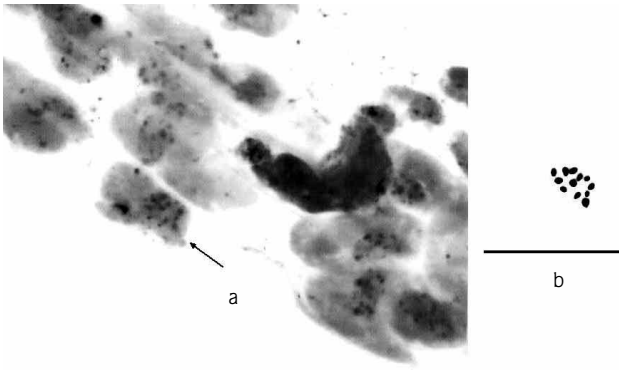

Figure 13. Mitotic chromosomes of *Sedum lampusae*; 2n = 12. Scale bar = 25 µm.
a. Somatic cell, b. Chromosome drawing.
Scale bar = 10 µm. a. Somatic cell, b. Chromosome drawing.

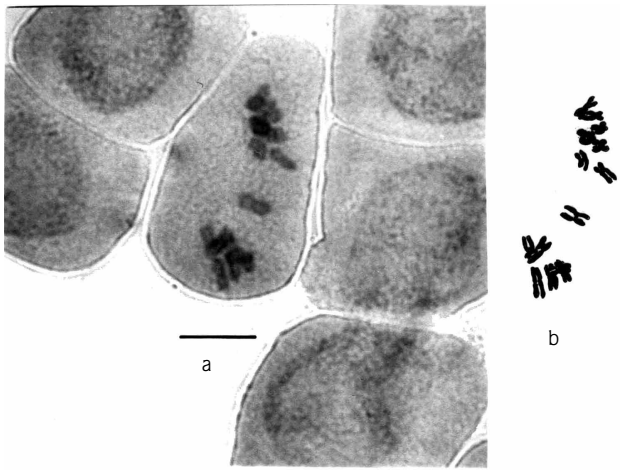

Figure 14. Mitotic chromosomes of *Hedysarum cyprium*; 2n = 14. Scale bar = 10 µm. a. Somatic cell, b. Chromosome drawing.

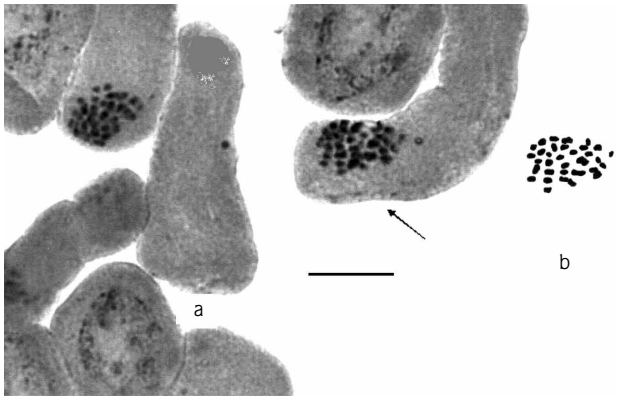

Figure 15. Mitotic chromosomes of *Origanum syriacum* var. *bevanii*; 2n = 30. Scale bar = 10 µm. a. Somatic cell, b. Chromosome drawing.

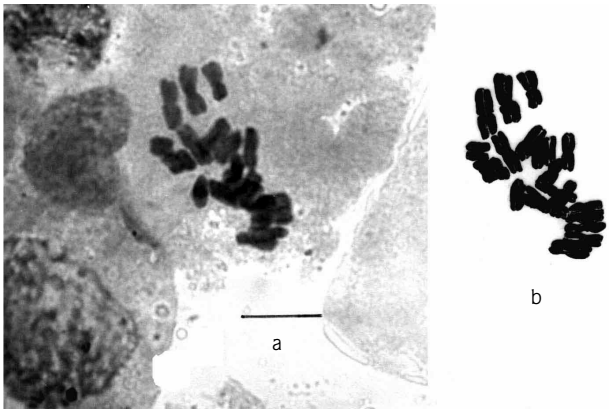

Figure 16. Mitotic chromosomes of *Phlomis cypria* var. *cypria*; 2n = 20. Scale bar = 10 µm. a. Somatic cell, b. Chromosome drawing.

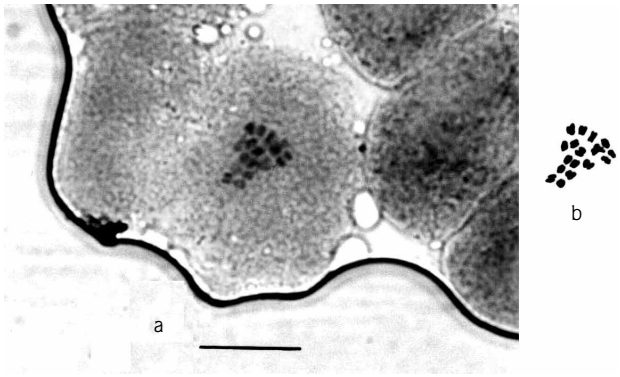

Figure 17. Mitotic chromosomes of *Salvia veneris*; 2n = 18. Scale bar = 10 µm. a. Somatic cell, b. Chromosome drawing.

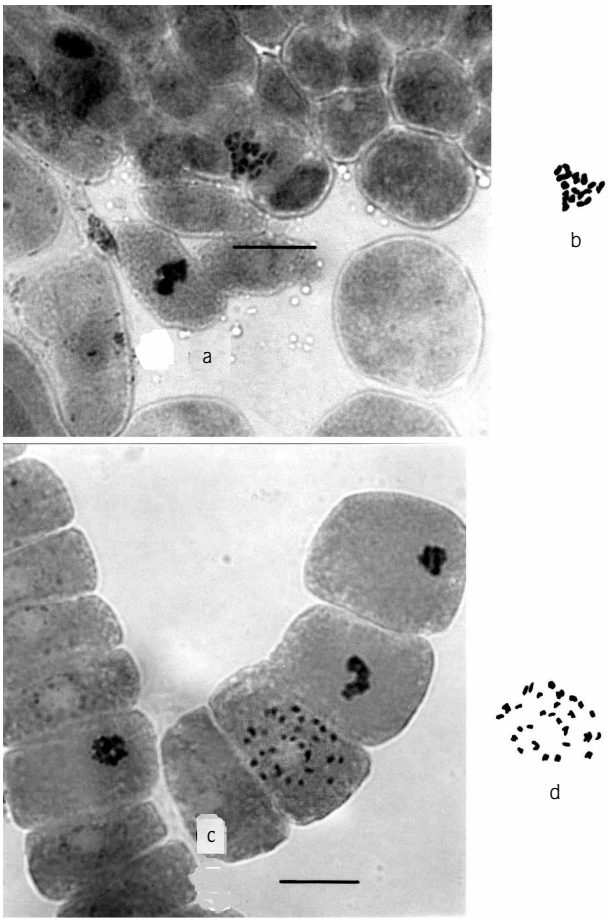

Figure 18. Mitotic chromosomes of *Scutellaria sibthorpii*; 2n = 14 and 2n = 28. Scale bar = 10 µm. (a, b; K 004, K 005: 2n=14)
a. Somatic cell,
b. Chromosome drawing; (c, d; K 035: 2n = 28)
c. Somatic cell, d. Chromosome drawing.

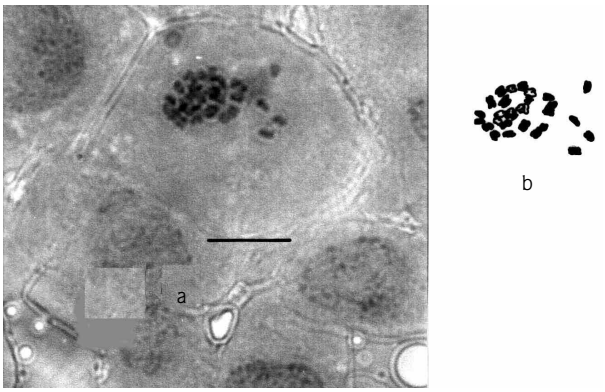

Figure 19. Mitotic chromosomes of *Sideritis cypria*; 2n = 30. Scale bar = 10 µm. a. Somatic cell, b. Chromosome drawing.

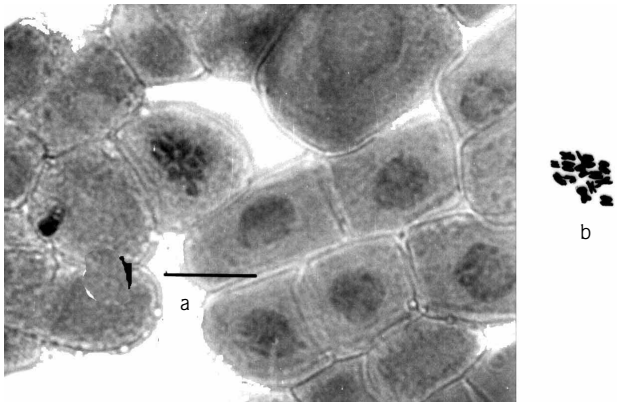

Figure 20. Mitotic chromosomes of *Teucrium cyprium* subsp. *kyreniae*; 2n = 14.
Scale bar = 10 µm. a. Somatic cell, b. Chromosome drawing.

Results

In the present study, which involved 18 genera of the 19 taxa endemic to Northern Cyprus, chromosome numbers of 16 taxa were determined (Table 1). All but one of these are new records. The count for *Brassica hilarionis* Post of 2n = 18 agrees with that published previously by Snogerop et al. (1990) and Anderson & Warwick (1999). The 15 new counts are *Pimpinella cypria* Boiss. 2n = 20, Figure 6; *Onosma caespitosum* Kotschy 2n = 14, Figure 7; *Arabis cypria* Holmboe 2n = 14, Figure 8; *Dianthus cyprius* A.K. Jackson & Turrill 2n = 30, Figure 10; *Silene fraudatrix* Meikle 2n = 24, Figure 11; *Rosularia pallidiflora* (Holmboe) Meikle 2n = 12, Figure 12; *Sedum lampusae* (Kotschy) Boiss. 2n = 12, Figure 13; *Hedysarum cyprium* Boiss. (*Fabaceae*) 2n = 14, Figure 14; *Origanum syriacum* L. var. *bevanii* (Holmes) Ietsw. 2n = 30, Figure 15; *Phlomis cypria* Post var. *cypria* 2n = 20, Figure 16; *Salvia veneris* Hedge 2n = 18, Figure 17; *Scutellaria sibthorpii* 2n = 14, 2n = 28, Figure 18; *Sideritis cypria* 2n = 30, Figure 19; *Teucrium cyprium* subsp. *kyreniae* 2n = 14, Figure 20, and *Limonium albidum* (Guss.) Pignatti subsp. *cyprium* Meikle 2n = 18, Figure 21.

The chromosome numbers of the investigated taxa vary between 2n = 12 for *Rosularia pallidiflora* and *Sedum lampusae*, and 2n = 30 for *Dianthus cyprius, Origanum syriacum* var. *bevanii* and *Sideritis cypria*. Despite many studies conducted on germinated *Rosularia*

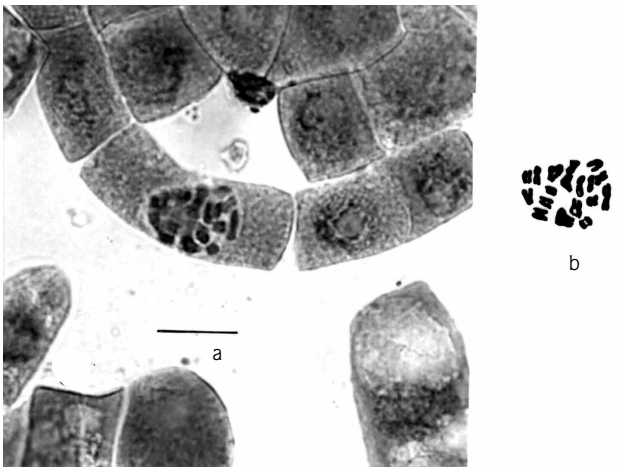

Figure 21. Mitotic chromosomes of *Limonium albidum* subsp. *cyprium*; 2n = 18.
Scale bar = 10 µm. a. Somatic cell, b. Chromosome drawing.

cypria (Holmboe) Meikle seeds, the chromosome number could not be determined accurately. No counts were obtained for *Delphinium caseyi* B.L.Burtt*, Rosularia cypria* or *Ferulago cypria* H.Wolff*.*

Although the chromosome lengths could not be measured, our observations as well as the photomicrographs obtained showed that *Hedysarum cyprium* and *Phlomis cypria* var. *cypria* (Figures 14, 16) had the largest chromosomes, and *Rosularia pallidiflora* and *Sedum lampusae* (Figures 12, 13) the smallest ones. In the first cytological examination on *Scutellaria sibthorpii* specimens, the chromosome number was found to be 2n = 14 for the specimens taken from plants numbered K004 and K005 (Figures 18a, b), whereas the chromosome number of the plant specimen numbered K035 was 2n = 28 (tetraploid) (Figures 18c, d). In this species, the chromosomes of the tetraploid (2n = 28) plant were found to be bigger that those of the diploids (2n = 14). No differences in the chromosome numbers or any abnormalities in the chromosomes were observed in chromosome investigations carried out on different plant specimens of the same taxon. In the chromosome investigation of *Teucrium cyprium* subsp. *kyreniae*, the best results were obtained from plant specimens numbered K016 and K049 (Table 1), where the chromosome number was determined as 2n = 14 for this taxon (Figure 20).

Discussion

Darlington & Wylie (1955), Löve & Löve (1961), Federov (1974), Löve (1978a, 1978b) and Moore (1982) gave the basic chromosome numbers of a great variety of flowering plants distributed worldwide including the 17 genera we studied as follows: *Pimpinella* L. x = 9, 10, 11; *Ferulago* W.D.J.Koch x = 11; *Onosma* L. x = 6, 7; *Arabis* L. x = 6, 7, 8 (7?); *Brassica* L. x = 8, 9, 10, 11, 12, 17, 19, 23; *Dianthus* L. x = 15; *Silene* L. x = 10, 12, 15, 17, 19, 25; *Sedum* L. x = 4, 5, 6, 7, 8, 10, 11, 17; *Hedysarum* L. x = 7, 8, 12; *Origanum* L. x = 8, 15 (8?); *Phlomis* L. x = 6, 8, 10, 11 (6?, 10?); *Salvia* L. x = 6, 7, 8, 9, 11, 15, 17, 19; *Scutellaria* L. x = 8, 9, 11, 15, 17; *Sideritis* L. x = 7, 8, 9, 10, 11, 12, 13, 15, 17; *Teucrium* L. x = 5, 8, 13, 15, (17?); *Limonium* Mill. x = 6, 7, 8, 9, 17, 25, 27; *Delphinium* L. x = 8.

In Volumes 10 (Davis et al., 1988) and 11 (Güner et al., 2000) of the Flora of Turkey, the chromosome numbers of several species belonging to the genera we studied were given as follows: *Pimpinella* 2n = 18, *Ferulago* 2n = 22, 20; *Onosma* 2n = 12, 14, 14 + 2B, 30, 44; *Arabis* 2n = 16; *Brassica* 2n = 28, 30, 60; *Dianthus* 2n = 30, 60; *Silene* 2n = 24, 48; *Rosularia* (DC.) Stapf 2n = 14, 26, 28, 36, 56, 70, 84, 112; *Sedum* 2n = 12, 14, 16, 18, 20, 22, 24, 26, 30, 34, 40, 42, 48, 50, 52, 60, 64, 68, 72, 76, 80, 94, 96, 100; *Hedysarum* 2n = 16; *Origanum* 2n = 30; *Salvia* 2n = 14, 14 + 1b, 14 + 2b, 15, 16, 16 + 1b, 16 + 2b, 20, 22, 32, 42, 44, 46, 48; *Scutellaria* 2n = 34; *Sideritis* 2n = 28, 30, 32, 34; *Teucrium* 2n = 30, 64, 56, 90. *Limonium* 2n = 16, 27, 44; *Delphinium* 2n = 16.

A comparison between these results and ours revealed that the chromosome numbers and basic chromosome numbers in 13 taxa were the same as previously reported for other species in the genus. Our results for *Scuttellaria sibthorpii* [2n = 14, 2n = 28 (tetraploid) x = 7] and *Teucrium cyprium* subsp. *kyreniae* (2n = 14, x = 7), however, were different although with the same basic numbers as published. We are of the opinion that 2n = 56, reported for a *Teucrium* taxon in a previous study (Güner et al., 2000), is an octoploid (8x), based on x = 7. Basic chromosome numbers mentioned in several previously published karyological studies of *Sideritis* include x = 10 and x = 15. In the karyological investigation we conducted on several individuals of *Sideritis cypria*, the somatic chromosome number was found to be 2n = 30. We conclude that if the basic

chromosome number of this species is based on x = 10, the species will be triploid (and therefore sterile), or more likely it is a diploid, based on x = 15.

Brassica hilarionis Post (*Brassicaceae*)

The taxonomic study on the genus *Brassica* from the section *Brassica* by Snogerop et al. (1990) also included chromosome information and that the basic number of this section is x = 9. A study of specimens from the Aegean area, Sicily and Corsica, including *Brassica hilarionis*, also gave the basic number of x = 9 for this section. Anderson & Warwick (1999) discussed taxon changes in the tribe *Brassiceae* DC. with reference to chromosome numbers, based on isozyme studies. Their study was carried out on 108 taxa belonging to 35 genera, including *Brassica hilarionis*, as investigated by us. The haploid chromosome number of the tribe *Brassicaceae* was reported as n = 6-75. The basic chromosome numbers of 40 species of the genus *Brassica* were determined as x = 7, 8, 9, 10, 11 in the same study. That being the case, the basic chromosome number of the genus *Brassica* and the tribe to which it belongs was left open to discussion. However, the chromosome number of *Brassica hilarionis* was calculated as 2n = 18 (x = 9) in both the studies mentioned above (Snogerop et al., 1990; Anderson & Warwick, 1999), confirming the karyological studies which we carried out (Table 1, Figure 9).

Silene fraudatrix Meikle (*Caryophyllaceae*)

In the biosystematic revision by Melzheimer (1977) on *Silene* taxa distributed in the Balkans, he also determined the chromosome number of all the species he studied. They all had 2n = 24, which agrees with the data obtained in our study. In a karyological investigation carried out on 19 *Silene* species distributed in Turkey (Yıldız & Çırpıcı, 1996) all were based on x = 12. The chromosome numbers of the 14 species were 2n = 24 (2x) and 4 species 2n = 48 (4x). In the karyological investigation we carried out, the chromosome number and the basic chromosome number of *Silene fraudatrix* was also determined as 2n = 24 (Figure 11).

Rosularia cypria (Holmboe) Meikle, **R. pallidiflora** (Holmboe) Meikle and **Sedum lampusae** Boiss. (*Crassulaceae*)

't Hart (1991) conducted a biosystematic study on *Sedum*, a species from Europe. In this study, which covered 54 *Sedum* species distributed in Europe in addition to 8 species from North Africa and Anatolia, the hybridisation, cytology and morphology of 53 of these species were investigated. It was established that inter-specific hybrids of these species were completely sterile.

't Hart et al. (1993) conducted a biosystematic study on species belonging to the subsection *Spathulata* (Boriss.) H.Ohba. of the genus *Sedum* collected from Anatolia, Greece and the Caucasus, and determined a series of basic chromosome numbers as x = 5, x = 6, x = 7. In this study, morphological differences of *Sedum obtusifolium* C.A.Meyer, which includes diploid and polyploid individuals, were reviewed. They observed that the diploid plants of both *Sedum obtusifolium* (section *Sedum*) (2n = 12) and *Sedum lampusae* (section *Cepaea* Caesalp.) (x = 6) were smaller. Despite being from different sections these 2 species have the same basic chromosome number and the photomicrographs obtained during our examinations revealed that the chromosome lengths of *Sedum lampusae* (Figure 13) were very similar to those of *Sedum obtusifolium.* We think that it would be appropriate to conduct a phylogenetic investigation on these species having the same diploid and basic chromosome numbers and similar chromosome lengths.

Moreover, the data presented in the same study (Eggli, 1988; t'Hart & Eggli, 1988) also confirmed this resemblance regarding chromosome lengths in that the basic chromosome number of the section *Chrysanthae* Eggli and the section *Ornithogalopsis* of *Rosularia* was determined as x = 7, with larger chromosomes; and those of the sections *Rosularia* and *Sempervivella* as x = 9, with very small chromosomes. Also in a different study, it was seen that *Silene* chromosomes, which are polyploid, were smaller than diploid chromosomes (Yıldız & Çırpıcı, 1996). Diploid (2n = 14) and polyploid (2n = 28) chromosomes of the species *Scutellaria sibthorpii* were observed and diploid chromosomes were found to be larger than polyploids (Figure 18). However, no morphological difference was observed between diploid and polyploid plants. As can be clearly understood from a number of studies carried out, diploid chromosomes of the same species are bigger than polyploid ones.

In a study carried out on the relationships and the evolution of 112 *Crassulaceae* species, Mort et al. (2001) dealt with 33 out of a total of 35 genera. It was stated in this study that the gene centre of the family *Crassulaceae* was originally in South Africa, which later moved towards North Africa and the Mediterranean. Its general flower characteristics had a haplostemon structure with

compound petals and multi-pieced flowers. The study gave the basic chromosome number of the family as generally x = 8, sometimes x = 6 or x = 7, and also reported a wide variety of polyploidy ranging from x = 6 to x = 270 in *Acre* and *Leucosedum* Fourr. as well as *Sedum* in the family *Crassulaceae.* The study carried out showed that the species *Rosularia pallidiflora* (x = 6) and *Sedum lampusae* (x = 6), which we examined in our study and whose chromosome number we established, both belong to the *Leucosedum* Fourr. clade (x = 6, 7) of the subfamily *Seoideae* Endl.

Origanum syriacum L. var. bevanii (Holmes) Ietsw. (*Lamiaceae*)

Our chromosome count of 2n = 30 for *Origanum syriacum* var. *bevanii* agrees with that reported for *Origanum syriacum* by Kıtıkı et al. (1997), who studied 52 individuals from 10 species from the Aegean and Mediterranean regions. The chromosome number of all taxa studied by Kıtıkı et al. (1997) was 2n = 30.

Salvia veneris Hedge (*Lamiaceae*)

Mercado et al. (1989) gave the karyotypes of 5 *Salvia* species belonging to the subgenus *Calosphace* Rafin from Mexico. The species investigated in their study were *Salvia amarissima* Ortega (2n = 20), *S. fluvatialis* Fern. (2n = 22), *S. hispanica* L. (2n = 12), *S. longispicata* M.Martens & Galeotti (2n = 22) and *S. tillifolia* Vahl (2n = 22).

Nakipoğlu (1993) investigated the karyology of 4 *Salvia* L. species collected from Turkey. The chromosome number of *Salvia tomentosa* Mill. was 2n = 16, while those of *S. fruticosa* Mill., *S. smyrnea* Boiss. and *S. officinalis* L. were 2n = 14.

Al-Turki et al. (2000) in a karyological study on a total of 31 taxa belonging to 14 families distributed in Saudi Arabia also included counts of 2n = 28 for *Salvia aegyptica* L. and 2n = 20 for *S. spinosa* L., with basic numbers of x = 7 and x = 10. The basic number for *Salvia* is variable, with reports based on x = 6, 7, 8, 9, 11, 15, 17 and 19 published. Our study of *S. veneris*, which has 2n = 18, is based on x = 9 (Figure 17).

Sideritis cypria Post (*Lamiaceae*)

In another biosystematic study by Kıtıkı et al. (1998) on 20 of the 68 *Sideritis* species distributed in south-west Turkey, the chromosome numbers were also determined for the species. The chromosome number of species in the section *Hesioide* Moench. was determined as 2n = 28, while the species in the section *Empedoclia* Rafn. were found to have a chromosome number of 2n = 32. The diploid chromosome numbers of *Sideritis* species were 2n = 28, 30, 32, 34, and the basic chromosome numbers were x = 7, 8, 9, 10, 11, 12, 13, 15, 17. The chromosome examination we carried out revealed that *Sideritis cypria* has 2n = 30 (Figure 19) (x = 10 or x = 15).

Limonium albidum (Guss.) Pignatti subsp. cyprium Meikle (*Plumbaginaceae*)

Saez et al. (1998) examined the morphology of *Limonium vigoi* L. Sáez, Curcó & Rosselló (*Plumbaginaceae*), a new tetraploid species distributed in the north-west of the Iberian Peninsula. Karyological, morphological and palynological differences between *Limonium girardionum* (Guss.) Fourr. and *L. grosii* L.Llorens were established in this study.

The interaction of hybridisation among *Limonium peregrinum* Bergius. *Limonium purpuratum* L. (Morgan et al., 1995), and *Limonium perezii* (Staph) Hubb. and *Limonium sinuatum* (L.) Mill. (Morgan et al., 1998) was observed. The chromosome number of species such as *Limonium peregrinum* and *L. purpuratum* and their hybrids was determined as 2n = 24.

The chromosome numbers of *Limonium aphroditae* Artelari & Georgiou and *L. cythereum* Artelari & Georgiou, described by Artelari & Georgiou (1999) as 2 new species distributed in Kithira (Greece), were determined as 2n = 27 (triploid) and 2n = 54 (hexaploid), respectively. The basic chromosome number established in the study was x = 9, which displayed similarities with the diploid (2n = 18) and basic chromosome numbers of the taxon *Limonium albidum* subsp. *cyprium* (Figure 21).

The chromosome number in this study was 2n = 14 for *Limonium perezii*, 2n = 16 for *L. sinuatum* and n = 15 (in meiosis) for the hybrid obtained.

Conclusion

In this study we obtained chromosome counts for 16 endemic taxa from Northern Cyprus. All but one species are new records.

With the exception of *Delphinium caseyi* and *Ferulago cypria*, whose seeds did not germinate, the taxa whose chromosome numbers were the most difficult to count were *Rosularia pallidiflora* and *Sedum lampusae*.

Determining the chromosome numbers the 16 endemics of Northern Cyprus in this study lays the foundation for future biosystematic studies. We conclude that a comparative biosystematic study needs to be conducted on Turkish as well as Cypriot specimens of *Delphinium caseyi* and *D. cilicicum*, and also *Origanum syriacum* var. *bevanii* and *O. syriacum* var. *syriacum*, which only occur in Northern Cyprus.

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