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CHROMOSOME STUDIES AND DISTRIBUTION OF NINE SPECIES OF *COUSINIA* SECTION *STENOCEPHALAE* (ASTERACEAE) IN IRAN

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Résumé

Quelque 9 espèces iraniennes de *Cousinia* sect. *Stenocephalae* (Asteraceae) font l'objet d'une étude caryologique. Les nombres chromosomiques de base, x=13, et la valence diploïde paraissent homogènes. Les régions du nord-est de l'Iran constituent le centre de diversité et d'origine de la section Stenocephalae.

Summary

Some nine Iranian species of *Cousinia* sect. *Stenocephalae* (Asteraceae) are the subject of a caryological study. The base chromosome number is x=13, and the diploid valence appears homogenous. Northeastern Iran appears to be the center of diversity and origin of *Cousinia* section *Stenocephalae*.

INTRODUCTION

Cousinia section *Stenocephalae* Bunge, with thirty-four species, is the third largest of the genus after sections *Cynaroideae* and *Alpinae* respectively (RECHINGER, 1972). Of these, twenty-three are endemic to Iran. To date, chromosome studies on the section have been limited to six species: CHYKASANOVA (see FEDOROV, 1974), AFZAL-RAFII (1980), GHAFFARI & CHARIAT-PANAHI (1985), and TSCHERNEVA (1985). In this paper, we report on nine species that are endemic (except one) to Iran. We also present chromosome counts and notes on their meiotic behavior for the first time.

OBSERVATIONS

The results of this study are summarized in Table 2. However, each species is dealt with in detail here.

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Cousinia aggregata DC.

This species is endemic to Iran, and is found in the central and eastern parts of the country. Meiosis was observed in three collections (Table 1), with 13 bivalents, three of which were associated with the nucleolus in diakinesis (fig. 1, 2). Occasionally, in some cells, one quadrivalent was observed. Chiasma frequency was 1.86, 1.80 and 1.68 per bivalent. This is the first chromosome count for this species.

Cousinia assyriaca Jaub. & Spach.

This species is endemic to Iran. Meiosis in this species is regular with 13 bivalents, each of which usually had two terminal chiasmata per arm (fig. 3, 4).

The mean number of chiasmata was estimated at 1.56 for each bivalent at Metaphase I. Occasionally, in some cells, one quadrivalent was observed. This is the first chromosome count for this species.

Cousinia calolepis Boiss.

This species is endemic to Iran, and is found in a restricted area of the country. Meiosis in this species was regular and showed thirteen bivalents at Metaphase I, most of which appeared in a ring conformation (fig. 5, 6). The mean number of chiasmata was estimated 1.82 for each bivalent at Metaphase I. This is the first chromosome count for this species.

Cousinia commutata Bunge

The previous report of this species is 2n=26 (AFZAL-RAFII, 1980). In our study, meiosis was seen at diakinesis, Metaphase I, and Anaphase one. Thirteen bivalents were observed at Metaphase I, but also in some cells, one, two or three quadrivalents were observed. Chiasma frequency was 1.84 per bivalent. In diakinesis, three bivalents of chromosomes were associated with nucleolus (fig. 7, 8).

Cousinia cylindracea Boiss.

This species is endemic to Iran, and is found in many parts of the country. Meiosis in this species showed 13 bivalents at Metaphase I, but in some cells, one or two quadrivalents were observed (fig. 9, 10). The chiasma frequency determined from six cells, were 1.78 per bivalent. This is the first chromosome count for this species.

Cousinia gaubae Bornm.

This species is endemic to Iran, and is found in a restricted area of the country (Tehran, Karaj, and Qazvin). The previous chromosome count of this species is n=13 (GHAFFARI & CHARIAT - PANAHI, 1985). We found 13 bivalents of 11 bivalents and one quadrivalent at Metaphase I. Three bivalents were associated with nucleolus at diakinesis stage. The mean number of chiasmata per each bivalent was 1.86 at Metaphase I. Chromosome segregation at Anaphase I was also (13-13) (fig. 11,12).

Cousinia glaucopsis Bornm. & Rech.f.

This species is endemic to Iran, and is distributed in the areas of Damghan, Semnan, Firouz-kuh, and Gorgan. Meiosis in this species was regular and showed 13 bivalents at Metaphase I which most of them were in a ring conformation.

There are usually two terminal chiasma per arm. The mean number of chiasmata per each bivalent was 1.81 at Metaphase I. In diakinesis stage 3 bivalents of chromosomes were associated with nucleolus (fig. 13, 14). This is the first chromosome count for this species.

Cousinia nekarmanica Rech.f.

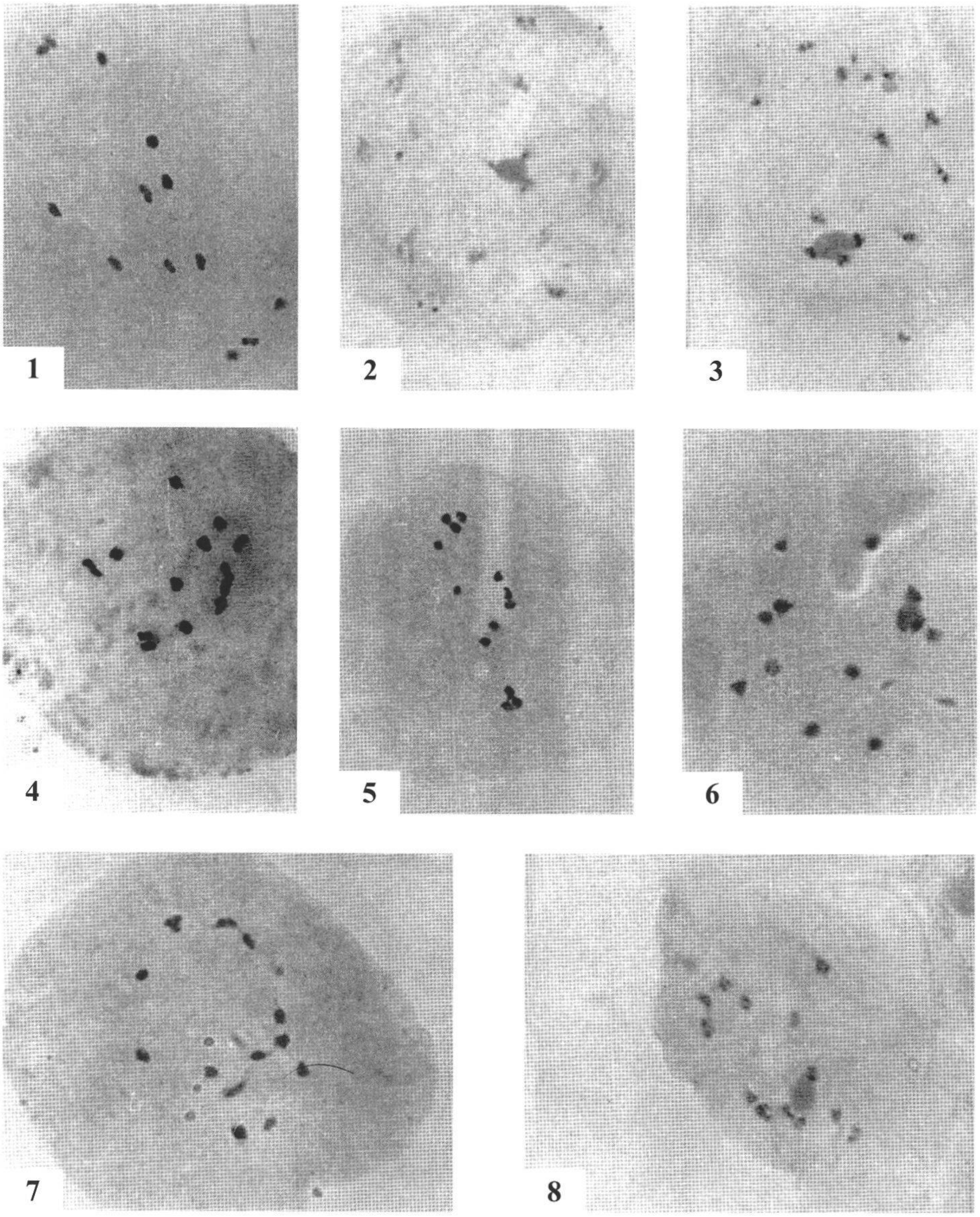
This species is endemic to Iran, and is found in a restricted area of the country (Semnan, Damghan, and Firouz-kuh). Meiosis was regular and shows 13 bivalents at Metaphase I (fig. 15, 16). Occasio-

Taxon	Altitude (m)	Locality
C. aggregata Dc.	2320	Tehran: Damavand, between Deh-e-chenar & Daryacheh-e-Tar
C. aggregata DC.	1630	Tehran: kuh-Dasht
C. aggregata DC.	2200	Tehran: Ab-Ali
C. assyriaca Jaub. & Spach	1200	Karaj: Dehak
C. calolepis Boiss.	2220	Karaj: Shahrestanak
C. commutata Bunge	2300	Karaj: Chalus road, Baladeh
C. cylindracea Boiss.	1750	Tehran: Kuh-Dashteh
C. gaubae Bornm.	1770	Karaj: 20 km towards Chalus
C. glaucopsis Bornm. & Rech. f.	2050	Firuz-kuh: 17 km towards Semnan
C. nekarmanica Rech. f.	2050	Firuz-kuh: 17 km towards Semnan
C. stahliana Bornm. & Gauba	1750	Qazvin: between Abhar & Khorramdareh

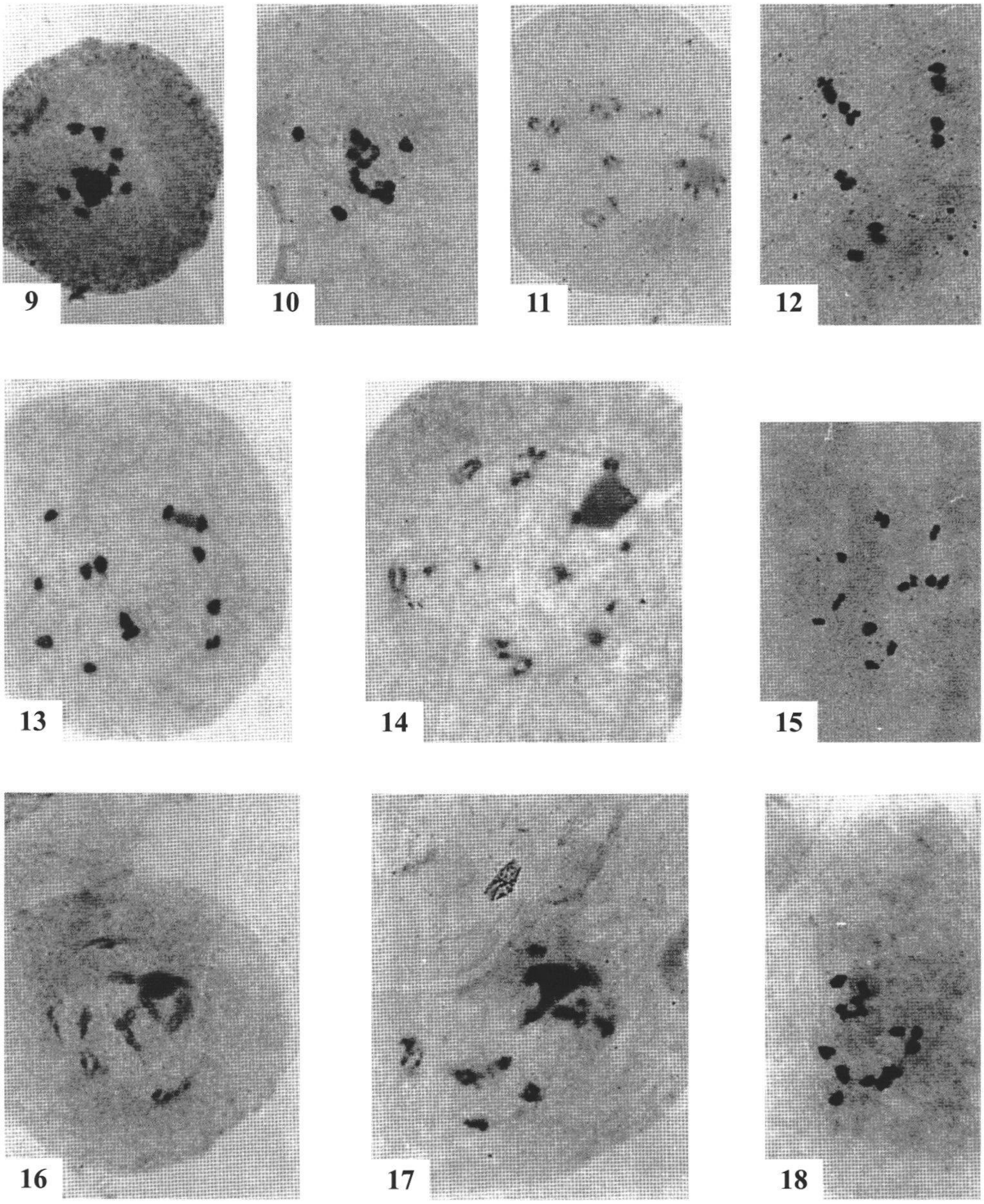
Table 1: The origin of material used in chromosome studies.

Taxon	No of cells	Mean chiasma frequency per bivalent	Present count (n)	Previous	count	
				n	2n	
C. aggregata	16	1.86	13	.	.	
C. aggregata	14	1.80	13	.	.	
C. aggregata	7	1.68	13	.	.	
C. albiflora	.	.	.	.	26	TSCHERNEVA 1985
C. assyriaca	14	1.56	13	.	.	
C. calolepis	10	1.82	13	.	.	
C. commutata	12	1.84	13	.	26	AFZAL-RAFII 1980
C. cylindracea	6	1.78	13	.	.	
C. gaubae	22	1.86	13	13	.	GHAFFARI & CHARIAT-PANAHI 1985
C. glaucopsis	8	1.81	13	.	.	
C. hypopolia	.	.	.	.	18	CHYKASANOVA
C. lucida	.	.	.	.	26	AFZAL-RAFII 1980
C. nekarmanica	28	1.63	13	.	.	
C. recurvata	.	.	.	12	.	AFZAL-RAFII 1980
C. stahliana	20	1.58	13	.	.	

Table 2: Chromosome number and chiasma average in *Cousinia* section *Stenocephalae*.



Figures 1-8: Meiosis. **1-2** *C. aggregata*, metaphase I and diakinesis. **3-4** *C. assyriaca*, diakinesis and metaphase I. **5-6** *C. calolepis*, metaphase I and diakinesis. **7-8** *C. commutata*, metaphase I and diakinesis. All diakinesis show 3 bivalents that they are associated with nucleolus (magnification: 1320 x).



Figures 9-18: Meiosis. **9-10** *C. cylindracea*, diakinesis, and metaphase I. **11-12** *C. gaubae*, diakinesis and metaphase I. **13-14** *C. glaucopsis*, both are diakinesis. **15-16** *C. stahliana*, diakinesis and metaphase I. **17-18** *C. Stahliana*, diakinesis and metaphase I. All diakinesis (except one) showing e bivalents that they are associated with nucleolus. In Fig. 13 two bivalents are associated with nucleolus. (magnification: 1320 x).

nally, in some cells, one quadrivalent was observed. Chiasma frequency in 14 cells gave a mean of 1.69 per bivalent. This is the first chromosome count for this species.

Cousinia stahliana Bornm. & Gauba

This species is endemic to Iran and Turkmenistan. Eleven bivalents and one quadrivalent were observed at Metaphase I. Three pairs of chromosomes were associated with the nucleolus at diakinesis (fig. 17, 18). Chiasma frequency was 1.58 per bivalent. This is the first chromosome count for this species.

DISCUSSION

RECHINGER (1986) reported that *Cousinia* with 662 species is the third largest genus in the Asteraceae, and is also the largest in the tribe *Cynareae*. The distribution of *Cousinia* overlaps the Irano-Turkmenistanian region, but most of the species are concentrated in the mountains of Iran and Turkmenistan (KNAPP, 1987).

Cousinia section *Stenocephalae* is one of the largest sections of the genus, and is distributed in southwestern Asia (fig. 19). It appears that northeastern Iran is the center of diversity and origin of this section because of the 34 species in the section, 22 of the 25 species that occur in Iran are endemic. Iran shares 2 species with Turkmenistan (*Cousinia stahliana* and *C. hypopolia* Bornm. & Sint.) and one each with Iraq, Syria, and Turkey (*C. stenocephala*). Turkmenistan (Kopetdagh region) has 8 species, of which 6 are endemic (*C. oreoxerophila*, *C. mucida*, *C. leptocephala*, *C. albiflora*, *C. chejraba-*

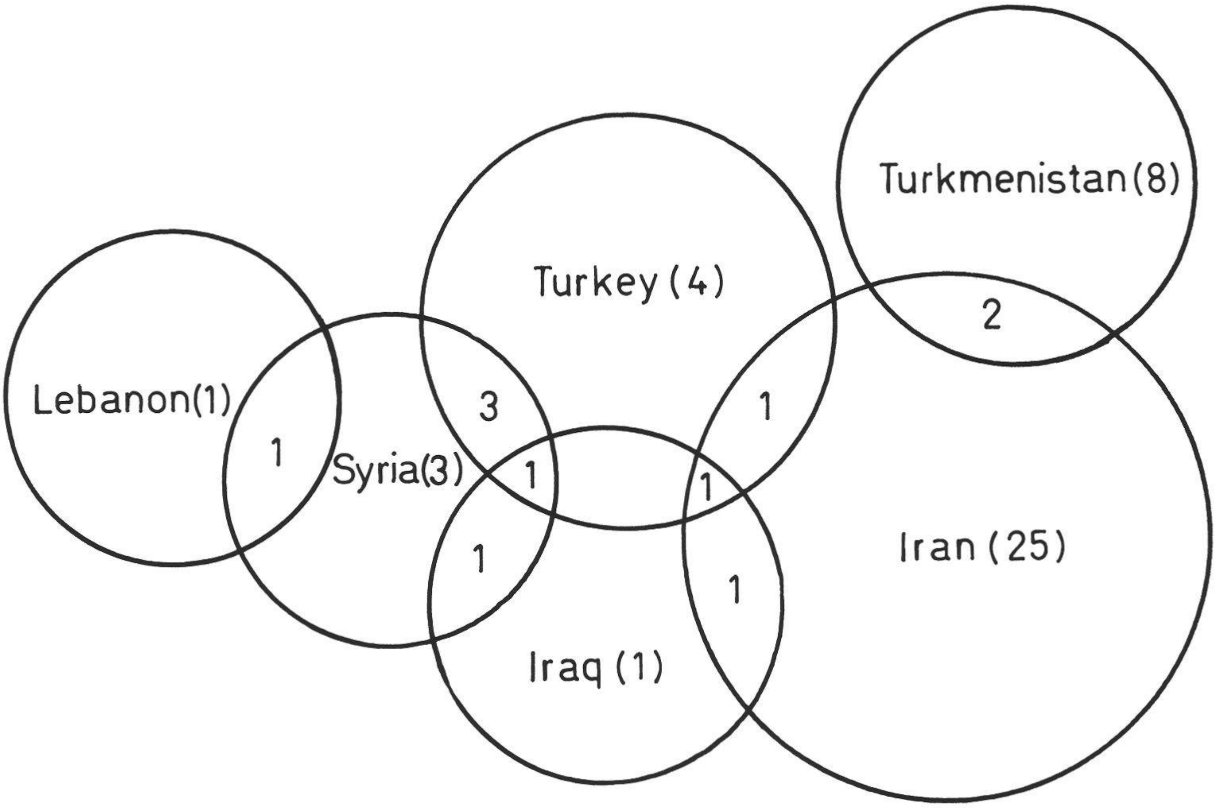


Figure 19: Distribution of different species of the section Stenocephalae. Overlapping areas show the common species.

densis and *C. chaetocephala*). *Cousinia stenocephala* Boiss. is the only species native to Iraq that ranges to Turkey and Syria. Turkey has 4 species, of which one (*C. davisiana* Hub.-Mor.) is endemic (HUBER-MORATH, 1975). Syria has 3 species, namely, *C. foliosa* Boiss. & Bal., *C. stenocephala*, and *C. ramosissima* Boiss., the former of which ranges to Lebanon (POST, 1933). As is shown in fig. 19, the density and variation of the section decreases from east to west where only a single species occurs in Lebanon.

The conclusions obtained from the chromosome studies on pollen mother cells, show the same base chromosome number (x=13) in all species. From a cytological point of view, the presence of three chromosomes associated with the nucleolus in diakinesis stage, quadrivalent combinations, and eventually the similarity of chiasma frequency average for each bivalent, verify the affinity of these species to another (table 2). Therefore, it appears that the placement of these species in section *Stenocephalae* based on Rechinger classification (RECHINGER, 1972) is in accordance with their cytological affinities. There is only one base chromosome number in section *Stenocephalae*, i.e. x=13. The presence of x=9 and x=12 seems to be contradictory (table 2).

In a cytological investigation of *C. recurvata* DC., AFZAL-RAFFII (1980) reported its chromosome number as n=12. Since quadrivalent combination in meiosis of the species under this section were observed in plenty, the error in the chromosome counts is related to one tetravalent instead of one bivalent (l.c.). CHYKASANOVA (see FEDOROV, 1974) gave the chromosome count of *C. hypopolia* as 2n=18. In this species, it seems that the error in the chromosome count is either due to the misidentification of the species or simply a wrong chromosome count. Besides, in the other cases on chromosome reports, the writer (l.c.) disagrees with other investigator's opinions. For example, the chromosome complement in *C. karatavia* Regel & Schmalh. was reported by him as 2n=26, was also counted as 2n=36 (TSCHERNEVA, 1985). Also, 2n=18 for *C. bekeri* Trautv. which belongs to the section *Cynaroideae*, seems to be erroneous, because according to the other workers (GHAFFARI, 1984, 1986 and 1987; ARYAVAND, 1975; AFZAL-RAFFII, 1980 and TSCHERNEVA, 1985), the base chromosome number in this section was reported as x=12. Consequently, the base chromosome number in section *Stenocephalae*, follows a general trend of stability. It also appears that an important role was played by the heterozygotic translocation in the evolution of this section.

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