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REVISION OF THE GENUS *LILIUM* L. (LILIACEAE) IN TURKEY

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REVISION OF THE GENUS *LILIUM* L. (LILIACEAE) IN TURKEY

by
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Approval of the Graduate School of Natural and Applied Sciences

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I certify that this thesis satisfies all the requirements as a thesis for the degree of Doctor of Philosophy.

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This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Doctor of Philosophy.

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ABSTRACT

REVISION OF THE GENUS *LILIUM* L. (LILIACEAE) IN TURKEY

İkinci, Nursel
Ph.D. Thesis, Department of Biology
Supervisor: Prof. Dr. Adil Güner

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The genus *Lilium* is revised for Turkey with the help of morphological characters, nuclear ribosomal DNA ITS sequence data and RAPD data. Approximately 700 herbarium specimens from 13 major herbaria and from private collections have been examined. Phylogenetic analysis of the section *Liriotypus* was performed by using ITS sequences of 27 *Lilium* taxa and as outgroup 3 species from Liliaceae; *Cardiocrinum giganteum, Notholirion thomsonianum,* and *Nomocharis saluenensis*. Phylogenetic analysis was accomplished by using RAPD data of 170 individuals and 93 bands. Seven species are recognized, one of them have two varieties. *L. artvinense* Miscz. is reduced to synonymy of *L. ponticum* K.Koch. *L. ponticum* K.Koch is increased to species status which was formerly assigned as subspecies of *L. carniolicum* Bernh. ex W.D.J.Koch in Flora of Turkey. A determination key to the species is given. On the basis of detailed morphological studies all taxa are fully described with notes on distribution, habitat and their red list categories. All names are given with complete synonymy and typification as far as possible.

Keywords: Liliaceae, *Lilium*, Turkey, molecular phylogenetics, nrDNA ITS, RAPD analysis.

ÖZET

LILIUM L. (LILIACEAE) CİNSİNİN TÜRKİYE REVİZYONU

İkinci, Nursel
Doktora Tezi, Biyoloji Bölümü
Tez Danışmanı: Prof. Dr. Adil Güner

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Bu çalışmada, ülkemizin *Lilium* cinsine ait türleri morfolojik karakterler, çekirdek ribozomal DNA ITS bölgesinin dizi analizi ve RAPD analizi kullanılarak revize edilmiştir. Yaklaşık 700 herbaryum örneği, 13 herbaryumdan ve kişisel koleksiyonlardan ödünç alınarak incelenmiştir. *Liriotypus* seksiyonunun filogenetik analizi 27 *Lilium* taksonunun ve dış gurup olarak Liliaceae familyasından 3 türün (*Cardiocrinum giganteum, Notholirion thomsonianum* ve *Nomocharis saluenensis*) ITS dizini kullanılarak yapılmıştır. RAPD analizi sonucunda 170 bireye ait 93 bant kullanılarak filogenetik analiz gerçekleştirilmiştir. 7 tür ayırt edilmiştir, bunlardan birinin iki varyetesi belirlenmiştir. *L. artvinense* Miscz., *L. ponticum* K.Koch'un sinonimi durumuna indirgenmiştir. Daha önce Türkiye Florası'nda *L. carniolicum* Bernh. ex W.D.J.Koch'un alttürü olarak kabul edilen *L. ponticum* K.Koch tekrar tür düzeyine çıkarılmıştır. Tür tanıma anahtarı verilmiştir. Detaylı morfolojik çalışmalar sonucu herbir taksonun ayrıntılı betimi, o türün yayılışı, habitatı ve tehlike kategorisi ile beraber verilmiştir. İsimler tipifikasyonları ve tam sinonimleri ile verilmiştir.

Anahtar Kelimeler: Liliaceae, *Lilium*, Türkiye, moleküler filogenetik, nr DNA ITS, RAPD Analizi.

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ABBREVIATIONS

ACCTRAN	Accelerated Transformation
AFLP	Amplified Fragment Length Polymorphism
bp	Basepair
DNA	Deoxyribonucleicacid
dNTPs	Deoxynucleotides
FISH	Flourescent in situ Hybridization
Nİ	Nursel İkinci
OTU	Operational Taxonomic Unit
PAUP	Phylogenetic Analysis Using Parsimony
PCR	Polymerase Chain Reaction
RAPD	Random Amplified Polymorphic DNA
TAE	Tris-Acetate-EDTA
Taq	Thermus aquaticus
TBR	Tree bisection-reconnection
U	Units
UPGMA	Unweighted Pair-Group Method using Arithmetic Average

1.INTRODUCTION

The genus *Lilium* L. belongs to the family Liliaceae. Until recently, Liliaceae family traditionally classified to contain more than 200 genera (McRae, 1998), this polyphyletic taxon reclassified into several families (Vinnersten and Bremer, 2001), and now the Liliaceae family is delimited with only 10 genera and around 350 species (Mabberley, 1997). According to Takhtajan (1997), 10 genera included in the Liliaceae *sensu stricto*: *Tulipa* L. (80) and *Erythronium* L. (c. 20) belong to the tribe ***Tulipeae***; *Cardiocrinum* (Endl.) Lindl. (3), *Notholirion* Wall. ex Boiss. (4), *Nomocharis* Franch. (7), *Lilium* L. (100), *Fritillaria* L. (100) and *Rhinopetalum* Fisch. ex D.Don belong to the tribe ***Lilieae***, and the third tribe is ***Lloydieae*** with genera *Gagae* Salisb. (90) and *Lloydia* Salisb. ex Rchb. (12). However, there are still discussions about the members of the family Liliaceae, and of the families within the Liliales (Hayashi and Kawano, 2000).

Members of the Liliaceae family are distributed in temperate regions of the Northern Hemisphere. They are mainly spring-blooming plants, occupying prairies, mountain meadows, and other open communities. They are insect-pollinated as can easily be inferred from the showy flowers. The seeds are dispersed by water and wind (Judd et al., 1999).

As to the intergeneric relationships within the tribe ***Lilieae*** *Cardiocrinum*, *Fritillaria*, and *Nomocharis* are the closest genera to *Lilium*. According to Lighty (1968) the genera *Lilium*, *Fritillaria*, and *Nomocharis* evolved out of a proto-lilium genus. Recent cladistic analysis of chloroplast DNA studies also confirms that *Fritillaria* and *Nomocharis* are the two closest genera to *Lilium* (Vinnersten and Bremer, 2001).

The genus *Fritillaria* has about 100 species occurring in the temperate regions of the Northern Hemisphere. Its distribution ranges from North America, Europe, the Meditterranean region, Central Asia, China, and Japan (Ronsted et al., 2005). Generally, Fritillaria bulbs have a thin, translucent tunic, but some Fritillaria species have naked bulbs composed of many scales. Such bulbs are very similar to *Lilium* bulbs. A recent phylogenetic analysis of the *matK gene*, *trnK intron*, and nuclear ribosomal ITS region defined *Lilium* and *Fritillaria* as sister groups (Ronsted et al., 2005).

Nomocharis and *Lilium* are very similar causing taxonomic confusions (Hayashi and Kawano, 2000). Pollen morphology analysis of some *Lilium* and *Nomocharis* species also confirms their close relationship (Sung-Yun and Wu-Xiu, 1985). *Nomocharis* is similar to both *Lilium* and *Fritillaria* but differs from both in having dissimilar inner and outer tepals. *Nomocharis* has scaly bulbs like in *Lilium* (Evans, 1925). *Nomocharis* has a restricted distribution in western China and adjacent parts of south-eastern Tibet and north-east Upper Burma (Sealy, 1983). *Nomocharis* is represented by seven species in the world.

The genus *Notholirion* has only four species which are distributed in China and Himalayas (Stoker, 1935, Cotton, 1934). It differs from the other members of the subfamily Lilieae by having tunic covered monocarpic bulbs and trifid stigmas (Stapf, 1934). Notholirion has wingless seeds and radical leaves (Dasgupta, 1984).

Members of the genus *Cardiocrinum* inhabit the Himalaya, China, and Japan. This genus has only three representative species. Its members are easily distinguished from other genera by their broad, heart-shaped and long-petiolated leaves, their much branched leaf venation, their monocarpic bulbs, and their capsules with fibrous teeth along the valve-edges. They have funnel-shaped flowers with very short pedicels and their stigma is slightly lobed. Main distinguishing characters among the genera *Notholirion, Lilium, Fritillaria, Nomocharis,* and *Cardiocrinum* are listed in Table 1.

1.1. The Genus *Lilium*

Lilium L. consists of about 100 species distributed in the cold and temperate regions of the Northern Hemisphere (Fig. 1). Several other genera have the similar distribution as *Lilium*, for example *Gentiana* and *Primula* (Stern, 1938). The two closely allied genera, *Nomocharis* and *Notholirion* are found only in Eastern Asia. Lighty (1970) proposed that the possible center of origin of the genus *Lilium* is probably in Korea and the adjacent area of Manchuria.

Lilies are known from the ancient times, especially *L. candidum* L. which furnished the palace walls of Crete in the Middle Minoan Third Period and also Creten Vases. Ancient people were interested in lilies not only because of their beauties, but also because of their medicinal and food values. In the *Materia Medica* of the Anatolian herbalist Dioscorides (the first century A.D) there are illustrations of *L. candidum* for educational purposes. Parkinson (1689) in his book Paradisus, or Garden of Pleasant Flowers mentions five varieties of "Martagon Imperial" (*L. martagon* L.). These are actually *L. canadense* L., *L. pomponium* L., *L. chalcedonicum* L., *L. carniolicum* Bernh. ex W.D.J.Koch, and *L. pyrenaicum* Gouan. He also described six varieties of umbellate lilies and two varieties of white lily. Kaemper in the 'Amoenitates Academicae' published in 1712 also described several species of *Lilium* (Elwes, 1880). Linnaeus in his *Species Plantarum* (1753) defines *L. bulbiferum* L., *L. candidum, L. martagon, L. pomponium,* and *L. canadense*.

Table 1. Comparison of the Genera within the tribe *Lilieae*, (Turrill, 1948 and Stapf, 1934, Wilson, 1925, Woodcock & Stearn, 1950)

	Mature Bulbs	Stigma	Anthers	Perianth	Tepals
Lilium L.	Perennial. Many fleshy imbricate, ovate to lanceolate store-scales without scarious or membraneus outer coats	Trilobed	dorsifixed, versatile	Funnel-shaped to subcampanulate	More or less diverging with recurved tips to revolute
Nomocharis Franch.	Several imbricate scales without outer coats	Trilobed	Dorsifixed, versatile	Spreading, cup-shaped, subcampanulate	Dissimilar outer and inner petals. Tepals papillose at apex
Notholirion Wall. ex Boiss.	Monocarpic, varying number of fleshy ovate to lanceolate store-scales surrounded by scarious or membraneus outer coats	Trifid or tricuspitate	Versatile	Campanulate	Obliquely erect with more or less recurved tips
Cardiocrinum (Endl.) Lindl.	Monocarpic, with few imbricate scales, tunicated	Capitate, lobed	Dorsifixed	Trumpet-shaped (or funnel-shaped)	Slightly drooping
Fritillaria L.	Small 1 or 2, or more free or more or less fused depressed store-scales without outer coats or with thin translucent tunic	Entire or trifid	Basifixed, erect	Campanulate	Subparallel or diverging, but tips not recurved

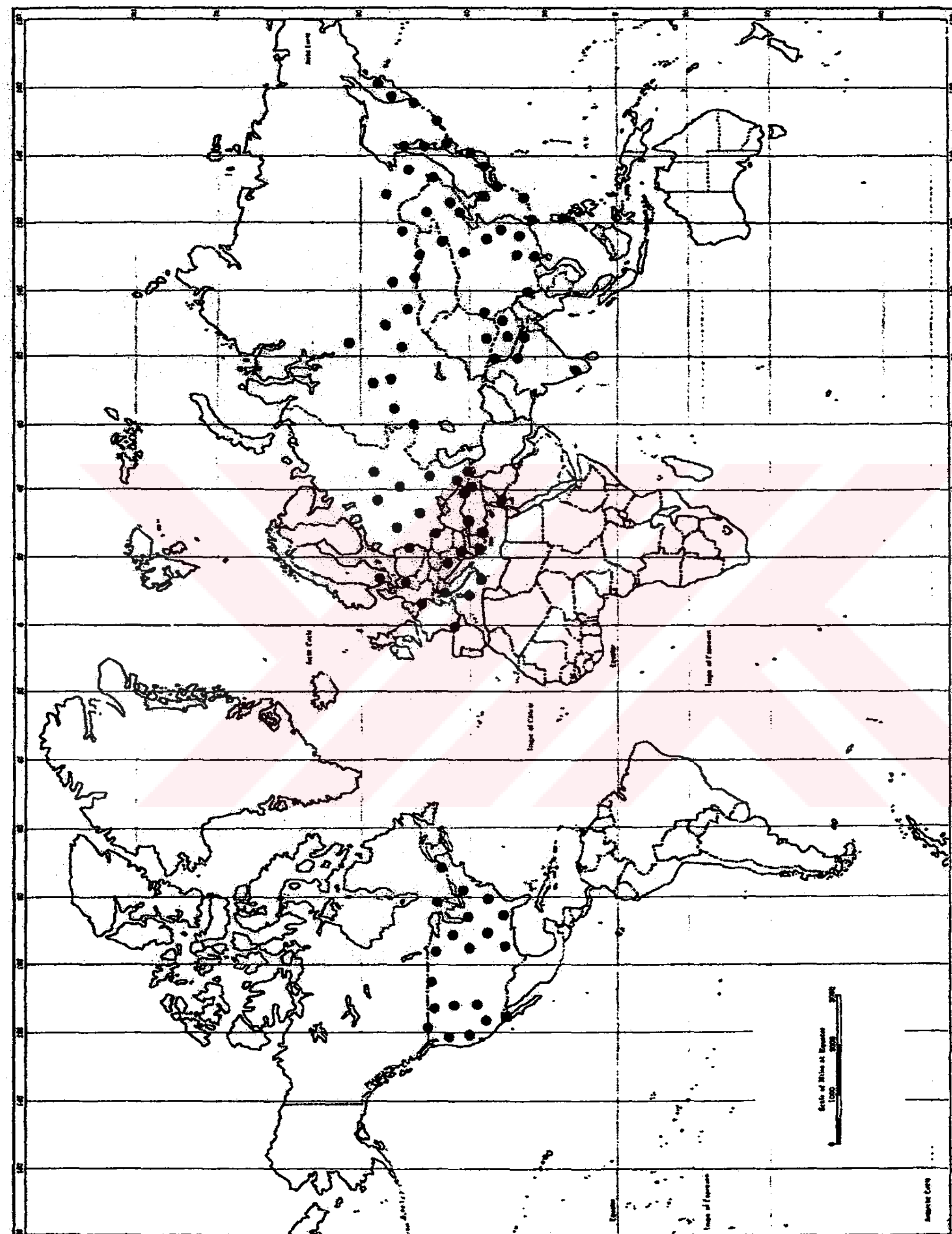

Figure 1. World Distribution of the genus *Lilium* (Sligthly modified from Anderson, 1986).

Table 2. Subgeneric Classification in *Lilium* and changes in classification systems.

Reichenbach (1828)	**Endlicher**(1836)	**Baker** (1871)	**Wilson** (1925)	**Woodcock & Stern** (1950)	**Comber** (1949)
Sect. Martagon (with pendulous revolute flowers	***Sect. Amblirion (Fritillaria)***	**Subgen.*Notholirion*** **Subgen.*Lilium proper****	***Sect. Leucolirion*** Trumpet lilies	***Sect. Leucolirion*** white lily Trumpet or funnel shaped, mostly white ***L. candidum***	Sect. ***Leucolirion*** Trumpet ***L. longiflorum*** Eastern Asia
Sect. Lilium proper (with ascending flowers)	***Sect. Eulirion***	***Group Archelirion***	***Sect. Archelirion***	***Sect. Archelirion*** chief white lily, Bowl or open funnel-shape, slightly recurved at tips ***L. auratum***	Sect. ***Archelirion*** ***L. auratum*** Japan & China
	Sect. Pseudolirium	***Group Isolirion***	***Sect. Pseudolirium***	***Sect. Pseudolirium*** false,white lily, Orange or red, erect and open widely giving a bowl-like form ***L. philadelphicum***	Sect. ***Pseudolirium*** ***L.philadelphicum*** N. America
	Sect. Martagon	***Group Martagon***	***Sect. Martagon***	***Sect. Martagon*** pendulous,segments strongly recurved	Sect. ***Martagon*** Europe, Northern and Eastern Asia
	Sect. Cardiocrinum	***Group Eulirion***	Subgen. *Eulirion** Subgen. *Cardiocrinum* Subgen. *Lophophorum (= Nomocharis)* Subgen. *Notholirion*		Sect. ***Liriotypus*** *monadelphum,carniolicum, kesselringianum,pyrenaicum,pomponium,bulbiferum, chalcedonicum,polyphyllum* Europe & Western Asia ***L. candidum***
					Sect. ***Sinomartagon*** Asiatic ***L. davidi*** Eastern Asia
					Sect. ***Daurolirion*** North-East Asia ***L. dauricum***, *L. maculatum*

Among all the *Lilium* species *L. martagon* has the widest distribution and is assumed to be the oldest extant *Lilium* species (Dubouzet and Shinoda, 1999). The genus *Lilium* belongs to the northern temperate zone. There is a gap for the distribution of lilies from eastwards Asia Minor till eastern Afghanistan (Stern, 1938). All the American lilies have rhizomatous or stoloniferous bulbs as distinguishing character from the old world lilies. There is no common species to Asia and America. It seems that geographical separation was occurred a long time ago. Geographical distribution of lilies is largely affected by the Quaternary Ice Age. Woodcock and Stearn (1950) classify lilies as being European and West Asiatic, East Asiatic, and American.

Subgeneric classification of *Lilium* is based on mainly flower poise and form. The most widely accepted classification of *Lilium* is provided by Comber (1949) based on 13 morphological characters and two germination types. His classification together with other authors' classification systems are given in **Table 2.** According to Hayashi and Kawano (2000), seed germination does not provide useful information for phylogeny construction. *Lilium* flowers have differentiated convergent in relation to pollinator specificity as a consequence of adaptive radiation (Wilson, 1925; Comber, 1949).

According to Comber's classification (1949) all Turkish lilies belong to the Section *Liriotypus*, except *L. martagon* which belongs to the Section *Martagon*. However, Davis and Henderson (1969) accepts Wilson's classification system, in which Pontic-Caucasian group of lilies belong to the Sect. *Martagon* (Rchb.) Wilson Subsect. *Sparsifoliae* Manden. *L. ponticum, L. ciliatum* P.H.Davis, *L. georgicum* Manden. and all the European Lilies of the *L. carniolicum* group (*L. pyrenaicum, L. pomponium, L. heldreichii* Freyn, *L. chalcedonicum* and *L. carniolicum*) are grouped in Series ***Ponticae***. The other group, Series ***Monadelphae*** includes *L. monadelphum* M.Bieb., *L. szovitsianum* Fisch. & Avé-Lall., *L. kesselringianum* Miscz. and the Bulgarian *L. rhodopeum* Delip.

1.1.2. Carniolicum Group of lilies

This group is composed of European aggregate of lilies having scattered leaves and Martagon-type flowers. These are *L. carniolicum, L. chalcedonicum, L. heldreichii, L. pomponium* and *L. pyrenaicum*. This group of lilies occupies alpine or subalpine habitats. A precarniolicum group gave rise to Asiatic scattered-leaved Martagons and also to the European Carniolicums (Stoker, 1938). According to Stoker (1938), *Lilium* has no fossil evidence. He argues that, following the Eocene (53-37 mya) cooling helped *Lilium* species to move southward. During Pleistocene (1.6-0.01), *Lilium* species moved through Carpathians to Caucasus, from there to Balkans. They inhabited the Balkan and Adriatic Countries and Hungary, then to France and Spain and to the western Alps. Dispersal of lilies was affected by geographical and climatic changes.

Until 1949, *Lilium* was classified by flower shape and position. Then, other characters, such as seed germination, nectary position, etc. were added to this classification. Some morphological characters such as flower shape are common in distantly related species. Previous studies with other plant species and also with *Lilium* species provide that phylogeny obtained from ITS sequence is consistent with the classifications derived from morphological, chemical, serological, and cytological data (Dubouzet & Shinoda, 1999).

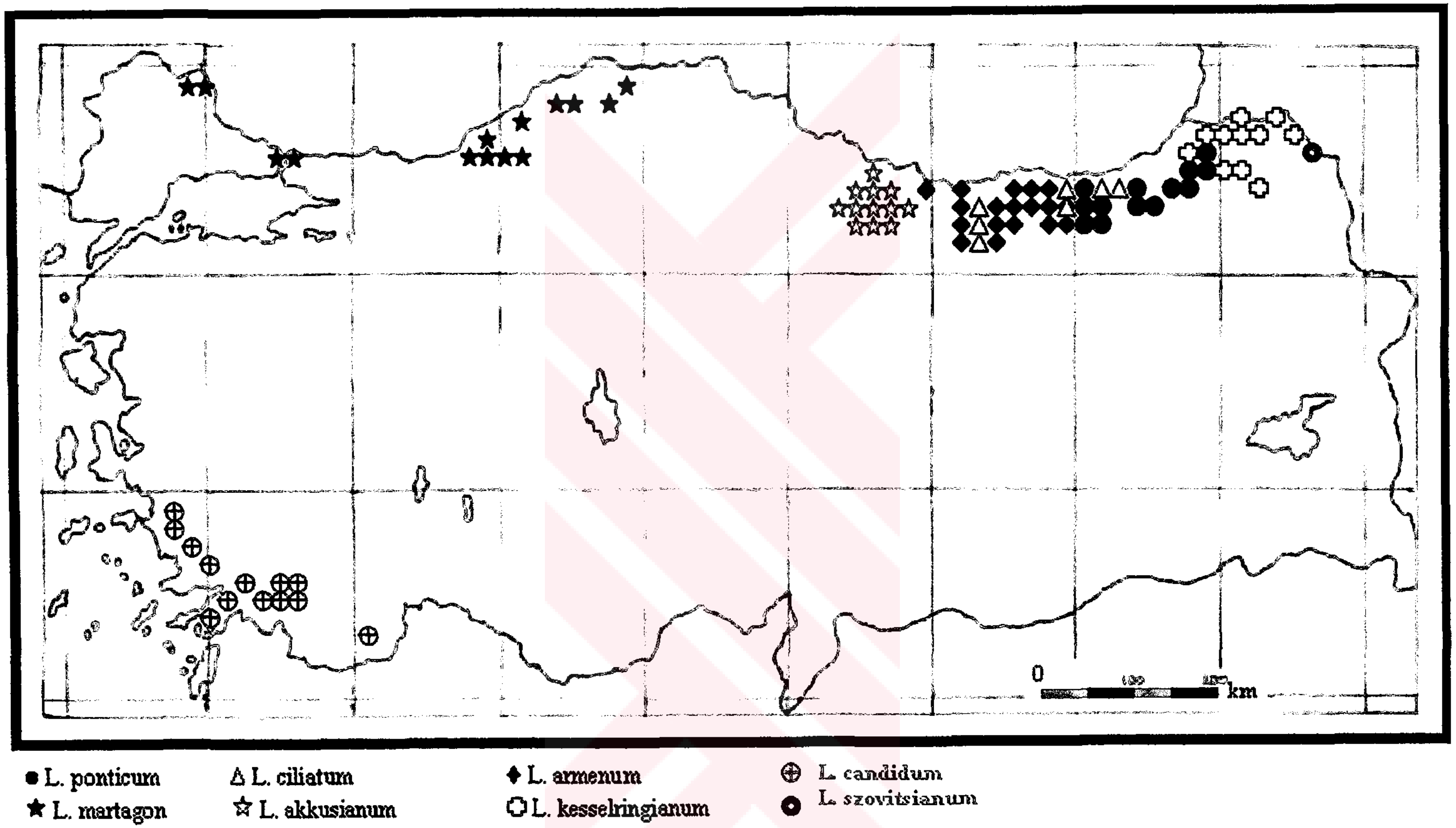

Figure 1. Distribution of *Lilium* Species in Turkey

1.1.3. Turkish Lilies

According to Davis (1984), the genus *Lilium* has 8 taxa in Turkey and recently a new species described from Turkey (Gämperle, 1998). Turkish lilies are mainly restricted to the Northern part of Turkey, except for *L. candidum*, which has a distribution in southern Turkey and is an East Mediterranean element. Fig. 2 shows the distribution of *Lilium* species in Turkey.

According to Mandenova (1940), all Caucasian lilies belong to the Subgen. *Eulirion*, section *Martagon*. She further divided this section into two subsection; subsec. *Verticillatae* and subsec. *Sparsifoliae*. *Lilium caucasicum* is the only member of the subsec. *Verticillatae*, the rest of the Caucasian species belong to the subsect. *Sparsifoliae*. She also states that members of this latest subsection have only small differences, and it is possible only in nature to see these differences. Important distinguishing characters can be as flower form, tepal color, size, and form, and also the color of scales, stigma, anthers, and filaments. Mandenova divided subsec. *Sparsifoliae* into three series. Series *Ponticae* includes *L. ponticum*, *L. georgicum*, and *L. ciliatum*. Series *Monadelphae* includes *L. kesselringianum, L. armenum, L. monadelphum* and *L. szovitsianum*. Series *Ledebourianae* has only *L. ledeborii*.

1.1.4. Series Monadelphae

Some authors treat *L. szovitsianum* as distinct species, but according to Davis (1984), it is only a variety of *L. monadelphum*, together with var. *armenum*. *L. kesselringianum* is similar to *L. monadelphum*, but it is smaller, its flowers paler, straw yellow flowers with cinnamon-brown dots, and it has shorter stamens. According to Kesselring (1932), *L. monadelphum* is present in Northern Caucasus, but *L. szovitsianum* in west and south Transcaucasia, especially in the subalpine zone of Gurien and Adzhariya. *L. szovitsianum* was collected from Suchum district of Blacksea, which has smaller bulbs than the two above mentioned species and was different from both species above. Which is later on defined as *L. kesselringianum* by Misczenko (1914). The differences between *L. szovitsianum* and *L. monadelphum* are shape of ovary and the stigma. *L. monadelphum* has cylindric-prismatical ovary. *L. szovitsianum* has inverted conical and slightly lobed. The stigma of *L. szovitsianum* is dark purple and that of *L. monadelphum* is green. *L. szovitsianum* has thick, round triangled fleshy filaments, on the other hand, *L. monadelphum* has flat, thin and comparatively membraneus like a petal filaments. The difference between leaves is that, in *L. monadelphum* nerves of the leaves are more raised and in *L. szovitsianum* weaker. Bulbs of two species are very similar, but the scales of *L. szovitsianum* are little bit broader, more intensely colored and the outer ones are nearly as long as the inner ones. Kesselring (1932), differentiates *L. kesselringianum* from *L. monadelphum* and *L. szovitsianum* as being smaller, having lighter petal color, with petals segments only slightly reflexed, with shorter chestnut-purple anthers, and with the type of stigma. The anthers are twice shorter than in *L. szovitsianum*.

As to the phylogeny of Caucasian lilies, according to Mischenko, *L. szovitsianum* is phylogenetically the older form, belonging to the relict flora of Caucasus, and three species (*L. kesselringianum*, *L. monadelphum*, and *L. szovitsianum*) are independent of each other (Kesselring, 1932).

L. ledebourii (Baker) Boiss. is close to *L. monadelphum* but has whitish flowers and linear leaves. This species is native to Azerbaijan and Iran (Wendelbo, 1977.

L. kosa Orekh. & Erem. (1963) is a variant of monadelphum (pink monadelphum?), not followed by a Latin diagnosis. It was first collected from the mountains near the town Nalchik, (may be it is *L. monadelphum*, because Eremin (1966) says that it has the largest flowers [pale yellow and anthers also yellow] and the most pleasant odour).

1.1.5. Series *Ponticae*

Davis treated *L. ponticum* and *L. artvinense* as the varieties of *L. carniolicum* Bernh. subsp. *ponticum*. It was treated as a different subspecies because of its geographical distribution. According to McRae (1998), *L. ponticum* is a subspecies of *L. pyrenaicum* and subsp. *ponticum* has two varieties, var. *artvinense* P.H.Davis & Hend. and var. *ponticum* K.Koch.

Turkish lilies fall in two sections under Comber's classification (Comber, 1949): **Section *Martagon*** only *L. martagon*. **Section *Liriotypus*** contains *L. candidum, L. ponticum, L. ciliatum, L. akkusianum, L. monadelphum,* and *L. kesselringianum.* Baranova (1988) proposed a different subgeneric classification in *Lilium*, in which Turkish lilies were grouped under three different sections. **Sect. *Lilium*** is monotypic and includes *L. candidum*. **Sect. *Eurolirium*** Subsect. *Alternifolia*, Ser1. *Carniolica* includes *L. ciliatum, L. artvinense*. Subsect.*Sparsifolia*: Ser1. *Monadelpha* includes *L. kesselringianum, L. monadelphum, L. szovitsianum, L. ponticum.* **Sect. *Martagon*:** Ser1. *Martagon* includes *L. martagon.*

1.2. Molecular Tools for Phylogeny Construction

Classification involves delimitation and naming of taxa, and also ranking the groups and placing them in a hierarchical order. Phylogenetic classification additionally reflects the evolutionary history of the groups. On the other hand, the other major school in systematics known as Phenetics, takes into account of only overall similarity for classification purposes. Phenetic systems do not distinguish between synapomorphy and convergent or parallel evolution. Our main question is how the morphological diversity arises. Therefore, we should correlate all the gathered information to solve the above question.

Genome rearrangements and sequences of DNA can be used as phylogenetic characters. Molecular phylogenetic methods use mutations (point mutations, insertions, deletions) to infer relationships between genes (Salemi et al, 2003). Compared genes or sequences are assumed to be homologous.

Maximum parsimony, pairwise distance, and likelihood methods are the major methods used for phylogeny inference from sequence data. All of these methods rely on the use of optimality criteria. Phylogenetic inference under criterion-based methods couples the selection of a suitable optimality criterion with a search for an optimal tree topology under that criterion. On the other hand, UPGMA or neighbour-joining (NJ) are algorithmic approaches. They simply cluster taxa according to a prescribed set of rules and operations (Salemi and Vandamme, 2003).

Bootstrap analysis is a method used for testing the reliability of obtained trees. It is the creation of pseudoreplicate datasets by resampling. Bootstrapping allows you to assess whether the distribution of characters has been influenced by stochastic effects. In phylogenetic analyses nonparametric bootstrapping is the most commonly used method. The pseudoreplicate datasets are generated by randomly sampling the original character matrix to create new matrices of the same size as the original. The frequency with which a given branch is found is recorded as the bootstrap proportion. These proportions can be used as a measure of the reliability of individual branches in the optimal tree. Clades with bootstrap values near to 100 % support value are very robust. In a bootstrap consensus tree, a clade with a bootstrap value of 90% was present in 90% of the cladograms generated in the bootstrap analysis (Judd et al., 1999).

The most common measure of homoplasy is the consistency index (CI), which is the minimum amount of possible evolutionary change divided by the actual tree length. The shortest tree will have the highest consistency index value. Lower consistency indices shows many characters that contradict the evolutionary tree. Consistency indices tend to be lower when the analysis was performed with many taxa. Retention index (RI) is another measure to define how the characters vary over the tree. Retention index is equals to the maximum lenth minus the actual length.

Measure of divergence in DNA sequences of taxa which are derived from a common ancestor is called as genetic distance (or evolutionary distance). This is also a measure of the dissimilarity between sequences. Additionally, according to molecular clock hypothesis, the genetic distance is linearly proportional to the time elapsed. In the evolutionary trees constructed from sequences the branch lengths represent the distances between the nodes in the tree.

1.2.1 Sequence Analyses of ITS Region

The internal transcribed spacers (ITSs) are non-coding nuclear ribosomal DNA occurring in eukaryotes. Ribosomal DNA genes have a high copy numbers. The copy numbers may change from several hundreds to several thousands. The small subunit (18S) and the large subunit (26S) genes are separated by a smaller (5.8S) gene. There are short transcribed spacers (ITS) between the three genes. Fig. 3 shows the organization of ITS region used in this study. This whole system, External Transcribed Spacer region (ETS) is transcribed as a single unit (Judd, et al., 1999). Nuclear ribosomal DNA ITS region was chosen because it accumulates mutations rapidly compared to coding regions and it was proved to be phylogeneticaly useful in many angiosperm families (Baldwin et al., 1995). Sometimes not all copies of the nuclear ribosomal DNA ITS region have the same sequences. Then, concerted evolution can be seen in such highly repetitive sequences to homogenize the all copies. However, heterogeneity of the ITS within individuals is possible when concerted evolution is not fast enough, or it fails to homogenize rDNA repeat units. This is an indication of recent hybridization event (Judd et al., 1999). Heterogeneity of ITS1 was also shown in *Tulipa gesneriana* L., *T. kaufmanniana* Regel, and in their interspecific hybrids (Booy et al., 2000).

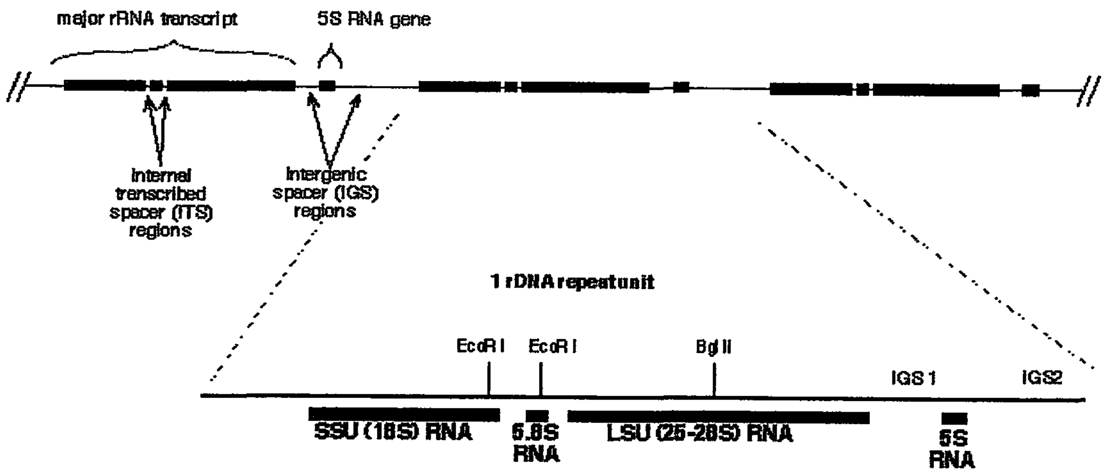

Figure 3. Structure of Ribosomal Genes. Coding regions of the 18S small subunit (SSU), 5.8S, and 26S large subunit(LSU).

1.2.2. Sequence Analysis of Chloroplast DNA

The sequences of the chloroplast *rbcL* gene, encoding the large subunit of the photosynthetic enzyme ribulose-1,5-biphosphate carboxylase/oxygenase (RuBisCO) is widely used in all photosynthetic eukaryotes and in cyanobacteria. However, this gene is highly conserved to be used at subgeneric level for *Lilium*, as also indicated by the study of Hayashi and Kawano (2000).

Noncoding regions of the chloroplast DNA can be employed for closely related taxa, even at the intraspecific level (Gielly and Taberlet, 1996). Noncoding sequences of chloroplast DNA, the *trnL* (UAA) intron and the intergenic spacer (IGS) region between the *trnL* (UAA) 3' exon and the *trnF* (GAA) gene evolves more than three times faster than rbcL, so that they can be used at lower taxonomic levels to increase phylogenetic resolution. The spacer evolves even faster than the intron in some groups of flowering plants (Gielly and Taberlet, 1994). These noncoding regions are relatively short and have more informative sites. Additionally universal primers are applicable and there is no need for internal primers due to the small size of the region.

1.2. 3. RAPD Analysis

In this method unknown (random) segments of DNA are amplified, i.e. target sequences to be amplified is unknown. Short primers (10 bp) with random sequences and low annealing temperatures are used to amplify a fragment of DNA. These fragments are compared for individuals or for species. This method requires previous testing of many primers (Lee et al., 1996). This technique allows us to detect sequence changes within PCR priming sites.

- Base substitutions within priming sites

- Large insertions or deletions between priming sites
- Template DNA quality
- Other factors affecting PCR reactions

will change the efficiency of amplification and also the profile of fragments produced by a given primer (Hillis, et. al., 1996). RAPDs show polymorphism and thus can be used as genetic markers. It can be used at the population level. This method allows us to see how many genotypes present in a population. RAPDs are dominant markers. This means the presence of a RAPD band does not allow distinction between heterozygous and homozygous states. However, in some cases, RAPD bands of different lenghts can be assigned to the same locus. In such a case, these RAPD bands are codominant. Application of RAPD markers for Korean lilies showed that the method is very helpful for systematics purposes (Bin et al., 1993). Furthermore, RAPD method was used to estimate genetic variation within populations and relatedness among populations of *L. martagon* (Persson, 1998).

1.3. Problems and Aims

The present study aims to solve the following problems;

- Infrageneric relationships within *Lilium* and closely related genera, such as *Nomocharis, Cardiocrinum, Notholirion*, and *Fritillaria.*
- The evolutionary relationships among *Lilium ponticum, L. pyrenaicum* and *L. carniolicum* species complexes by means of nrDNA ITS sequencing.
- The relationship between *L. artvinense* and *L. ponticum.*
- Taxonomic position of newly described *L. akkusianum* with the other Turkish lilies.
- Evolution of Pontic-Caucasian *Lilium* species.
- Retreat species according to Threat Categories (IUCN, 2001).
- To contribute to the knowledge of the distribution of *Lilium* in Turkey with extensive field studies.
- Finally, to prepare a taxonomic identification key.

1.4. Hypothesis

- *L. artvinense* is only a synonym of *L. ponticum.* There are no differences between these two taxa.
- *L. akkusianum* is a distinct species which is closely allied to *L. ciliatum.*
- *L. ponticum, L. carniolicum*, and *L. pyrenaicum* are distinct species.
- Pontic-caucasian complex of lilies and European lilies have a separate evolutionary history.

2. MATERIALS AND METHODS

2.1. Morphological Analysis

This revision is based mainly on plant material collected from Turkey. Field trips started in June 2001 and continued until July 2004. The voucher specimens of all individuals are stored in the herbarium of the Abant Izzet Baysal University (AIBU). Additionally, the study is based on herbarium material from the following public herbaria, abbreviated as in Holmgren et al. (1990) and private collections:

B	Botanischer Garten und Botanisches Museum Berlin-Dahlem
C	Botanical Museum and Library, University of Copenhagen
E	Royal Botanic Garden, Edinburgh
FI	Museo di Storia Naturale, Museo Botanico, Firenze
G	Conservatoire et Jardin botaniques de ville de Genève
GAZI	Gazi Üniversitesi, Ankara
HUB	Hacettepe Üniversitesi, Ankara
JE	Friedrich-Schiller-Universität Jena
K	Royal Botanic Gardens, Kew (London)
M	Botanische Staatssammlung München
SOM	Bulgarian Academy of Sciences, Sofia
W	Naturhistorisches Museum Wien
WU	Universität Wien
Herb. Oberprieler	Private collection of Ch. Oberprieler (Regensburg)
Herb. Parolly	Private collection of G. Parolly (Berlin)

Approximately 700 herbarium specimens examined from the above listed herbaria. All specimens cited in the text have been seen unless otherwise stated. Author citations follow Brummitt and Powell (1992). Genus name is followed by the author and the reference, as well as other related publications to the genus. Generic type and the distribution of the genus follow the generic description. Variations, discussions and results are given about the morphology, nr ITS sequence analysis and RAPD analysis. A dichotomous identification key to the Turkish species is provided. Name of section, its authority and relevant reference are followed by the treatment of relevant Turkish species. Taxonomy of the species are given in the following order:

Sequential number, legitimate species name, author(s) and the publication.

Some relevant references.

Synonyms, author(s) and the publication.

Illustrations.

Type citation.

Description and flowering time. The description of taxa is based on measurments made on dried plants. The variation ranges cited cover the total observed variation exhibited by a specific taxon. Extreme values have been placed in paranthesis.

Distribution in Turkey.

World distribution.

Vernacular names if available.

Treat category is discussed according to the IUCN (2001).

Notes: Taxonomic and variational discussions take place.

Selected examined specimens from Turkey and adjacent countries as separate paragraph. Citation of a specimen is constituted of locality, habitat, altitude, latitude and longitude, collecter(s) and their collection number, herbarium, date of collection, if any of those is available. Examined specimens belong to the relevant species from other countries are given with the same citational sequence. Selected examined specimens first are given for Turkey from west to east, as the order in the Flora of Turkey, followed by specimens from outside Turkey which are in alphabetical order.

2.2. Sequence Analysis

2.2.1. Collection of Plant Material

Silica gel-dried leaf tissue used for Turkish material and herbarium material used for the European and for the Caucasian species. Source of plant material and voucher information is given in Table V. According to Chase and Hills (1991), silica gel dried leaves are equivalent to fresh leaves in terms of efficiency of DNA studies (RFLP and sequencing). This method is more practical when compared to alcohol (70 %) and liquid nitrogen preservation of samples.

2.2.2. DNA Extraction

- Total DNA extraction was performed using Qiagen DNeasy Plant Mini Kit. Approximately 25 mg of silicagel-dried leaf material were used for this purpose. The same protocol was followed as provided by the company.
- DNA extraction followed by a 2% agarose gel electrophoresis to determine the quality and concentration of DNA.

- Proper dilutions were made in order to get a homogenous DNA concentration throughout all samples.

2.2.3. Polymerase Chain Reaction (PCR) for ITS

PCR was carried out in an Eppendorf thermal cycler. ITS region is amplified in two pieces as ITS1 and ITS2. Fig. 4 shows agarose gel picture of the purification products of ITS2 region. PCR conditions are given in Table III. Each reaction mixture was 25 µl, containing;

16.92 µl dH_2O

0.5 µl primer 1 (0.2 µM)

0.5 µl primer 2 (0.2 µM)

2.5 µl reaction buffer (10X concentrated, contains 10 mM $MgCl_2$)

2.5 µl dNTPs (2 mM of each dNTP)

0.08 µl Taq polymerase (5U/µl)

Table 3. PCR Profile for rDNA ITS Sequencing

	Temperature °C	Time	Number of cycles
Initial Denaturation	94	2 min	1
Denaturation	94	20 s	40
Annealing	55	45 s	
Elongation	72	1 min	
Final Elongation	72	10 min	1

- In order to amplify ITS1 region of the nuclear DNA, the primers ITS1P1, ITS2P2, and ITSL (Hsiao et al., 1994) were used. The sequences for ITS1P1 and ITS2P2 were obatained from T. Brun's homepage (plantbio.berkeley.edu/~bruns/primers.html). The primer list is given in Table 4.
- For nrDNA ITS2 sequencing ITS2P3 and ITS2P4 primers were used which were obatained from T. Brun's homepage (plantbio.berkeley.edu/~bruns/primers.html).
- Chloroplast trnL-F interspacer region and the intron were amplified using the universal primers of trnl-c, trnl-d, trn-e and trnl-f of Taberlet (1991).
- PCR products purified by Montage PCR Centrifugal Filter Device, provided by Millipore Company.

Table 4. Primers used in ITS Sequencing

Primer	**Sequence 5'-3'**	**Length**
ITS1P1 (plantbio.berkeley.edu/~bruns/primers.html)	GGAAGTAAAAGTCGTAACAAGG	22 bp
ITS1P2 (plantbio.berkeley.edu/~bruns/primers.html)	CTCGATGGAACACGGGATTCTGC	23 bp
ITSL (Hsiao et al., 1994)	TCGTAACAAGGTTTCCGTAGGTG	23 bp
ITS2P3 (plantbio.berkeley.edu/~bruns/primers.html)	GCATCGATGAAGAACGCAGC	20 bp
ITS2P4 (plantbio.berkeley.edu/~bruns/primers.html)	TCCTCCGCTTATTGATATGC	20 bp

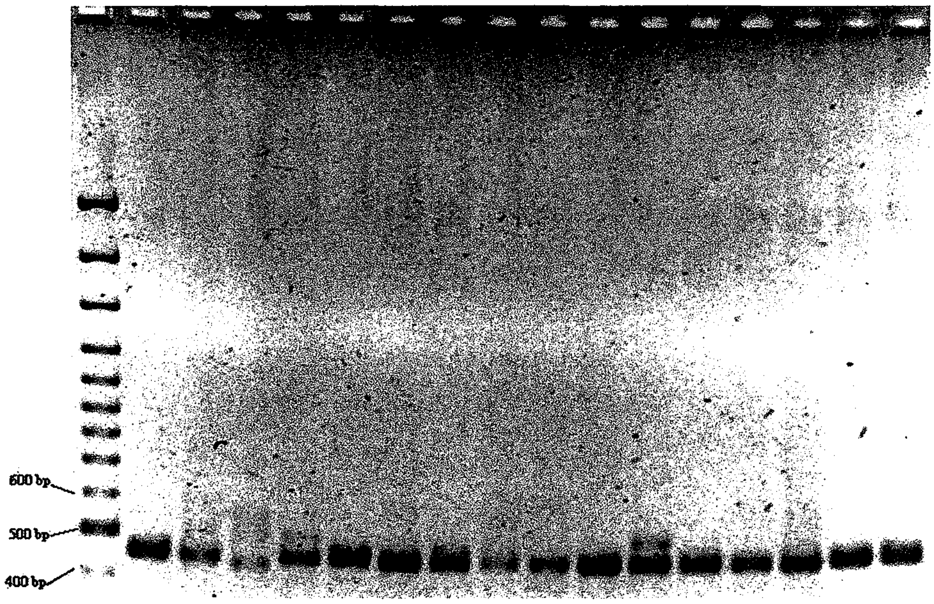

Figure 4. 2% Agarose Gel Picture of Purified ITS2 PCR Products

2.2.4. DNA Sequencing:

DNA sequencing was performed in our laboratory by using a dye terminated cycle sequencer (from Beckman Coulter Company).

2.2.5. Sequence Alignment and Cladistic Analyses

The limits of the ITS-1, 5.8S, and ITS-2 were determined by comparison with published sequences. DNA sequences were aligned by using ClustalX program (Thompson et al., 1997) and alignments were corrected manually (Appendix 1). ClustalX program aligns sequences in pairs to generate a distance matrix. The program generates a tree using the Neighbour Joining method and then uses this tree to guide the multiple alingment (Salemi and Vandamme, 2003). The character-state matrix is the alinged DNA sequences. The states are the nucleotides A, C, G, and T.

Genetic distances of aligned sequences obtained by using PAUP* version 3.1 (Swofford, 1993) are given in Table IX. In PAUP* program tree with minimum evolutionary change is searched.

Maximum parsimony analyses of the data set were performed using the heuristic search algorithm of PAUP* version 3.1 (Swofford, 1993) with ACCTRAN; MULPARS; tree–bisection-reconnection (TBR) branch swapping for 1000 random addition sequence replicates. Character states were specified unordered and unweighted. Gaps in aligned sequences were treated as missing data. Bootstrap analysis was performed for measurment of support for clades with the following settings: 100 bootstrap replicates, simple addition sequence, ACCTRAN, TBR branch swapping, MULPARS, MAXTREES = 1000 per replicate.

Table 5. List of Taxa and sources of plant material analysed in ITS sequencing. Accession numbers starting with AB are from Nishikawa et al., 1999 and starting with AY are from Ronsted et al., 2005.

Taxon	Accession	Genbank Accession
Lilium candidum L.	Turkey, Muğla, Köyceğiz, 02 June 2002, Nİ 1912	
L. ponticum K.Koch	Turkey, Trabzon, Çaykara, 28 June 2002, Nİ 1944	
L. ponticum K.Koch *var.artvinense* (Miscz.) P.H.Davis & D.M.Hend.	Turkey, Artvin, 2 July 2002, Nİ 1960	
L. ciliatum P.H.Davis & D.M.Hend.	Turkey, Giresun, Tamdere, 25 June 2002, Nİ 1932	
L. monadelphum M.Bieb. var.*szovitsianum* (Fisch. & Avé-Lall.)Elwes	Turkey, Ardahan, Çıldır, 5 July 2002,Nİ 1973	
L. monadelphum M.Bieb. var.*armenum* (Miscz. ex Grossh.) P.H.Davis & D.M.Hend.	Turkey, Trabzon, Tonya, 25 June 2002, Nİ 1933	
L. kesselringianum Miscz.	Turkey, Artvin, Ardanuç, 3 July 2002, Nİ 1966	
L. akkusianum R.Gämperle	Turkey, Ordu, Akkuş, 23 June 2002, Nİ 1928	
L. rhodopaeum Delip.	Greece, Dramas, Rhodopi Mt., 23 July 1981, Strid & al. 19503	
L. carniolicum Bernh. ex W.D.J.Koch	Austria, Königsberg, Raibl im Kacrnthen	
L. bosniacum G.Beck	Croatia, Velebit, Karlobag, B. Zollitsch.	
L. carniolicum Bernh. ex W.D.J.Koch *L. jankae* (A. Kern.) Hayek	Romania, Transsilvania, Cstaó	
L. carniolicum Bernh. ex W.D.J.Koch *L. albanicum* (Griseb.) Hayek	Albanien-Montenegron Border, Krajina, 29 June 1914, I. Dörfler 432.	
L. monadelphum M.Bieb.	Russia, Stawropol, Kislowodsk, 29 May 1970	
L. pyrenaicum Gouan		AB020428
L. bulbiferum L.		AB020468
L. martagon L.		AB020455
L. davidii Duch. apud Elwes		AB020461
L. longiflorum Thunb.		AY684927
L. philippinense Baker		AB020437
L. dauricum Ker Gawl.		AB020473
L. canadense L.		AB020457
L. philadelphicum L.		AB020432
L. auratum Lindl.		AB020472
L. pumilum DC		AB020430
L. japonicum Thunb.		AB020451
Cardiocrinum giganteum (Wall.) Makino		AB020466
Nomocharis saluenensis Balf.		AB020449
Notholirion thomsonianum		AY616752

2.3. RAPD Analysis

2.3.1. Plant Material

Silica-gel dried leaf material used in RAPD analysis. Material was collected from Turkey, Armenia, and from Greece. The list of the plants used in the RAPD is given in Table 7.

2.3.2. DNA Extraction: Modified CTAB Protocol

Total nucleic acids were isolated from about 4 mg of silica-gel dried leaf tissue using a modified CTAB Protocol and a Qiagen DNeasy Plant Mini Kit following manufacturer's protocol. Contents of some solutions and buffers are given in Appendix 4.

The modified CTAB protocol is as follows;

- Leaf material is grinded by the help of a grinding machine in 2 ml eppendorf tubes.
- For each sample 700 µl CTAB-Buffer, and for 1 ml CTAB-Buffer 2.5 µl β-Mercaptoethanol is required.
- CTAB buffer and β-Mercaptoethanol (0.2% v/v) were mixed and put in waterbath (74°C) for 10-15 min.
- 700 µl preheated CTAB-Buffer was added to each grinded leaf material and vortexed.

- The mixture was incubated in waterbath at 74°C for 30 min.
- The tubes were shaken every 10 min.
- The tubes were left for cooling at room temperature.
- The centrifuge was allowed to cool to 5°C.
- The tubes were centrifuged at 10000 rpm for 2 min.
- Only the upper phase was transferred to new tubes.
- 700 µl Phenol/Chloroform/Isoamylalcohol mixture (25:24:1) was added.
- The tubes were mixed gently for 2 min.
- The tubes were centrifuged at 12 upm for 5 min
- 500 µl from the upper phase was taken into new tubes without touching the white phase (protein).
- Approximately 600 µl chloroform was added.
- The tubes were shaken gently for 1 min in shaker.
- Then, the tubes were centrifuged at 12 000 rpm for 5 min.
- Approximately 500 µl from the upper phase was taken into new tubes without the white phase. ca. 1/10 volume (for 500 µl 50 µl) 3M sodium acetate solution (pH=5) was added and mixed by hand.
- At least 0,6 volume (for 450 µl 270 µl) isopropanol was added, mixed and incubated for 30 min. at room temparature (RT) or 20 min. at 4°C.
- The tubes were centrifuged (cold) at 13000 rpm for 20 min.
- The liquid part was taken without touching the pellet
- 800 µl icecold (-20°C) 70% ethanol was added.
- The tubes were centrifuged at 13000 rpm for 15 min.

- The liquid part was taken and the pellet was dried in a hood.
- 50 µl TE Buffer was added, mixed and vortexed shortly.
- The tubes left for 15 min to dissolve the DNA in TE buffer and kept at 4°C (do not freeze the dissolved DNA, otherwise it will denature).
- 1:20 dilution of the RNAse solution was prepared (stock 100 ng/ml) with dH_2O. 1 µl from this solution was added to each tube.
- The tubes were incubated for 45 min at 37°C in waterbath.
- The volume was completed to 100 µl with water and 10 µl 3M sodium acetate was added and mixed.
- 70 µl isopropanol was added and left for min at 5°C.
- The mixture centrifuged at 13000 upm for 20 min.
- The liquid part was removed, DNA is in the pellet.
- 800 µl icecold ethanol (70%) was added and then centrifuged at 13000 rpm for 15 min.
- The liquid part was removed and the pellet was dried for 20 min.
- 50 µl TE Buffer were added and the extracted DNAs were kept at 4°C.
- DNA concentrations were measured with a spectrophotometer.
- The quality of the DNA was checked on a 1% agarose gel electrophoresis (Fig. 5).
- The concentrations of the extracted DNAs were arranged to 10 ng/µl prior to PCR reaction.

2.3.3. Primer Screening

Hundred and eight 10-mer primers were used for initial screening (C, AB, B, A, J, and I Kits from Roth Company) on four individuals from different species to identify primers that exhibit polymorphism and give reproducible results. After the initial screening, 11 primers with 94 bands were selected for further analysis. The list of selected primers together with their sequences is given in Table 6.

Table 6. Primers used in the RAPD Analysis

Primer	Sequence (from Roth Company)
I-15	5'-TCATCCGAGG-3`
AB-02	5'-GGAAACCCCT-3`
AB-11	5'-GTGCGCAATG-3'
AB-14	5'-AAGTGCGACC-3'
AB-16	5'-CCCGGATGGT-3'
C-04	5'-CCGCATCTAC-3'
C-10	5'-TGTCTGGGTG-3`
C-11	5'-AAAGCTGCGG-3`
C-14	5`-TGCGTGCTTG-3`
C-16	5`-CACACTCCAG-3`
C20	5`-ACTTCGCCAC-3`

Table 7. List of the populations used in RAPD Analysis

	Locality	Altitude (m)	Coordinates	Voucher Number
L. akkusianum	Ordu, Akkuş	1270-1380	40°44/37°01	1928, 1929, 1982
	Ordu, Başçiftlik	1360	40°31/37°07	1930
	Tokat, Erbaa	1200-1220	40°44/36°45	2220
	Tokat, Erbaa	1160-1410	40°48/36°35	2221, 2222
L. ciliatum	Giresun, Dereli	1230-1620	40°33/38°21, 40°30/38°21	1931, 1932, 1983
	Trabzon, Maçka	1400-1700	40°41/39°27, 40°40/39°25	1935, 1938, 1939
	Yağmurdere/Araklı	900-1670	40°34/39°51	1941
	Rize, İkizdere	1410	40°42/40°39	1952
	Rize, Çayeli	1600-1700	40°52/40°43	2275
L. armenum	Trabzon, Tonya	650-1150	40°55/39°16	1933, 1934, 1987
	Trabzon, Maçka	1400-1700	40°41/39°27, 40°39/39°25, 40°38/39°21	1936, 1937, 1940, 1984
	Gümüşhane, Yağmurdere	900-1670	40°35/39°53	1942, 1943
	Ordu, Ulubey	1000	40°49/37°38	2223
	Giresun, Bulancak	200-1470	40°43/38°77	2224, 2225, 2226
	Giresun, Tirebolu	600	40°54/38°51	2234
	Armenia,Kotayk, Hrazdan	2100	40°32/44°41	10077
	Armenia, Gegharunik, Sevan	2180	40°26/44°57	10064
L. szovitsianum	Ardahan, Çıldır	1880-1930	41°10/43°11	1973
L. kesselringianum	Artvin, Ardanuç	1450-1800	40°59/42°04, 41°00/42°03, 41°05/42°09	1965, 1966, 1967, 1968
	Artvin, Şavşat	1550		1970
	Ardahan, Posof	1660-1750	41°28/42°46	1974
	Artvin, Borçka	1620-1950	41°22/41°51, 41°20/41°56	1975, 1976
L. ponticum	Trabzon, Çaykara	800-2050	40°34/40°17, 40°44/40°17 40°51/40°06, 40°51/40°06	1944, 1945,1946, 1947 1948, 1949,1950
	Rize, İkizdere	880-1770	40°40/40°41, 40°43/40°36	1953, 1954, 1955
	Rize, Çamlıhemşin	1400-1500	40°51/40°56	1958, 1959
L. artvinense	Artvin, Kafkasör	1350-1440	41°09/41°46, 41°09/41°47	1960, 1961
	Artvin, Hatilla Vadisi	1450-1900	41°06/41°39, 41°07/41°36	1963, 1964
L. albanicum	Greece, Trikalon, Mt. Peristeri	1650	39°37/21°10	
	Greece,Florinis, Mt.Vernon	1900-2000	40°39/21°22	2269
	Greece,Florinis, Mt. Varnous	1950-2000	40°50/21°15	2272

2.3.4. PCR Amplification for RAPD Analysis

PCR conditions are given in Table 8. Total volume of the reaction mixture was 12,5 µl, containing;

- 6,2 µl dH2O (Roth water for microbiology)
- 0,5 µl dNTPs (5 mM)
- 1,25 µl 10X Polymerase Buffer (100 mM Tris-HCl, pH=8,7, 100 mM KCl, 15 mM $MgCl_2$)
- 0,75 µl Roth Primer (10 µM)
- 0,0625µl Q-BioTaq Polymerase (5 U/µl).

Table 8. PCR Profile for RAPD Reactions

	Temperature °C	Time	Number of cycles
Initial Denaturation	94	2 min	1
Denaturation	94	12 s	40
Annealing	45	48 s	
Elongation	72	1:30 min	
Final Elongation	72	10 min	1
The reaction mixture were kept at 4°C			

Agarose Gel Electrophoresis

1. 1,5 µl Gel Loading Buffer added to PCR amplification product prior to electrophoresis.
2. 10 µl from this mixture were loaded to each well.
3. Amplification products were then electrophoresed in 3% agarose gels (6 gr agarose, 20 ml 10X TBE Buffer, 180 ml dH_2O) for 2 h at 180 V.
4. The gels were photographed under ultraviolet light.

2.3.4. Analysis of the RAPD Data

RAPD data are coded as absent/present, 0 or 1 respectively. RAPD data were evaluated by using clustering method which is a kind of distance-based tree-building method. Although these methods were originally developed to analyze taxonomic phenograms (i.e. trees based on overall similarity) (Sneath and Sokal, 1973), later they were used for phylogenetic analyses, too.

In unweighted-pair group method with arithmetic averages (UPGMA) we have operational taxonomic units (OTUs). The most similar OTUs are grouped in a stepwise manner. First two OTUs are grouped, after that they are treated as a new single OTU. Then this OTU is grouped with the most similar OTU. This process continues until only two OTUs are left.

3. RESULTS AND DISCUSSION

3.1. Taxonomic Treatment of Turkish Lilium Species

***Lilium* L. Species Plantarum 302, 1753.**

- Parkinson, 1689. Paradisus.
- Tournefort, J.P. 1700. Institutiones Rei Herbariae 1: 367-372; 2: t.195-201. Paris.
- Kaempfer. 1712. Amoenitates Academicae.
- Reichenbach, H.T. 1828. Consp. Veget.: 65.
- Baker, J.G. 1871. Gard. Chron., Jan. 28: 104.
- Baker, J.G. 1874. Revision of the Genera and Species of Tulipeae. J. Linn. Soc. 14:211-310.
- Elwes, H.J. 1880. A Monograph of the Genus *Lilium*. London.
- Balls, E.K. 1934. Lilies in the Pontus. Royal Horticultural Society Lily Year Book 3: 50-52.
- Stoker, F. 1938. The carniolicum group of Lilies. Lily Year Book 7: 86-107.
- Mandenova, I. 1940. Caucasian Lilies. Trudy Tbilissk. Bot. Inst. 8:149-208.
- Comber, H.F. 1949. A New Classification of the Genus Lilum. RHS Lily Year Book 13: 86-105.
- Woodcock, H.B.D. and Stearn, W.T. 1950. Lilies of the World: their cultivation and classification. London.
- Furse, P. 1963. Lilies of North-East Turkey. Lily Year Book 27: 63-67.

- Davis, P.H. and Henderson, D.M. 1969. A revision of Turkish Lilies. Lily Year Book 33: 212-223.
- Synge, P.M. 1980. Lilies: a revision of Elwes' Monograph of the Genus *Lilium* and its supplements. London.
- Matthews, V. 1984. *Lilium pyrenaicum*: a complex species. Kew Mag., 1(1):36-43.
- Baranova, M.V. 1988. A Synopsis of the System of the Genus *Lilium* (Liliaceae). Botaniceskij Zurnal, vol. 73: 1319-1329.
- McRae, E.A. 1998. Lilies: A Guide for Growers and Collectors. Timber Press. Oregon.

Bulbous, sometimes stoloniferous or rhizomatous perennial herbs, bulbs with tightly or loosely overlapping fleshy scales without a tunic; scales numerous, rarely few; several true roots emerge from base of bulb; annual stem-roots present just above bulb. Aerial stems erect and unbranched, rarely with a horizontal underground part, glabrous, hispid or scabrid. Leaves gray or lustrous green, sessile, rarely petiolate, cauline, scattered or verticillate or both; sometimes bulbils present in leaf-axils; margins recurved or plane, entire or minutely toothed, or with a colourless line. Inflorescence racemose, rarely umbellate. Flowers pendulous, inclined, horizontal, or erect, solitary or clustered. Perianth segments 6, free, red, orange, yellow, white, pink, purple, scarcely differentiated as petal and sepal, each bearing a nectar-groove or furrow at base naked or margined by a raised ringe, by pubescence or by raised fleshy papillae. Style long, straight or curved; stigma swollen, simple, capitate, or three-lobed. Stamens six, slender; anthers dorsifixed, versatile. Fruit a dry, loculicidal, many-seeded capsule, winged, furrowed or smooth, usually summit flattened, depressed, base stipitate, opening at top and splitting down middle of each of the three carpels; each carpel with two upright rows of seeds. Seeds flat, papery, with a membranous wing.

Type: *L. candidum* L.

Distribution : All over the temparate regions of the Old and New Worlds, between the latitudes of 68° N (central Siberia) to 10° N (southern India).

3.1.1. Bulb

Lilium bulbs are made up of fleshy scales which provide food for the following growth season. The scales are modified leaves. In some East Asiatic and North American species scales are jointed. The bulb has a basal plate which produces the roots, scales and buds for new growth. Bulbs of the lilies are two types, concentric and rhizomatous, yet few species bear stoloniferous bulbs. Many of the European and Asiatic lilies have concentric bulbs. The rhizomatous type of stem is seen in American species. There are basal roots, extending from the base of the bulb and as well annual stem-roots just above the bulb. Bulb colour and shape is species characteristic. Lily bulbs also differ in their mode of development and renewal. Bulblets develop in the axils of the bulb scales and on the underground part of the stem. In some species bulbs split up into several bulbs (McRae, 1998).

Turkish lilies have concentric bulbs, still, in some very large bulbs of the *L. ciliatum* we see nonsymmetrical growth. Bulb color changes slightly from species to species. *L. martagon* has small and yellow bulbs. The rest of the species have bulbs with white or pinkish-white color. Bulb scales are many and oblong or lanceolate in shape. Presence of radical leaves from the bulb scales is seen only in *L. candidum*.

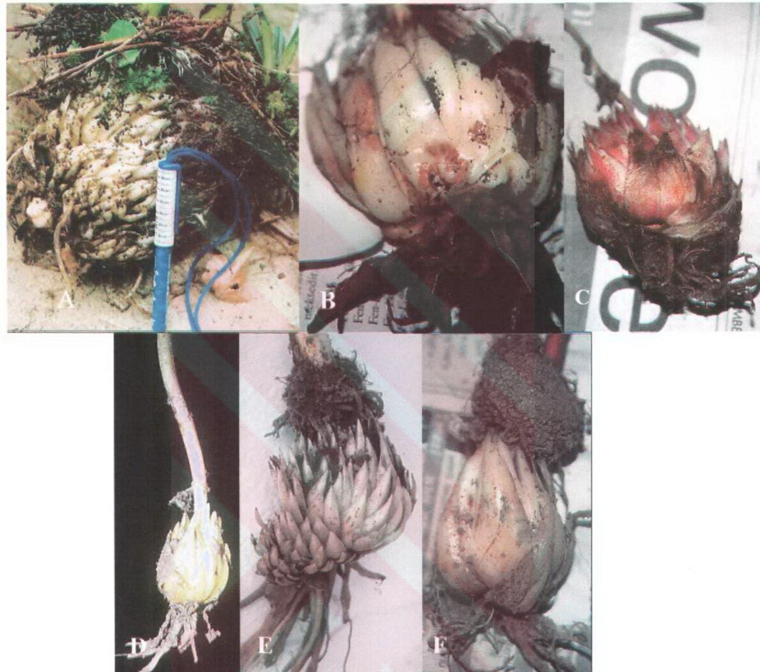

Figure 6. Bulbs of Turkish lilies, A: *L. ciliatum*, B,E: *L. szovitsianum*, C,F: *L. ponticum*, D: *L. martagon*

3.1.2. Stem and Leaves

Stems can rise directly from the bulb or may have horizontal underground parts with bulb bearing stolons. Such a stoloniferous stem is seen in some east Asiatic species and is different from the American species. None of the old world species are truly stoloniferous. Stem heigth may vary from few to 250 centimeters. Stem-roots are present between the bulb and the soil surface. On the stem between the bulb and the soil surface there are small bulbs in some species, like *L. regale* and *L. tigrinum*. Stem color as being green, blotched, or totally black can also be a distinguishing character. The stem can be smooth or ribbed, glabrous or hairy (Woodcock and Stearn, 1950).

Basal leaves are usually absent. Usually the leaves are of one form, but in a few species, like in *L. henryi* Baker, they are dimorphic. The shape of the leaves changes from linear to broad lanceolate. Leaf venation is more or less parallel. Arrangement of the leaves on the stem is either whorled or alternate. In some species small bulbils are present in the leaf axils and this character is specifically constant (Wilson, 1925). The number of leaves is usually a response to ecological conditions and have no taxonomic importance.

Turkish lilies have mainly two types of leaf arrangement; whorled and alternate. Only *L. martagon* has whorled leaves and it is placed in Section *Martagon*. The rest of the Turkish lilies with alternate leaves are placed in Section *Liriotypus*. In this latter group leaves are more or less similar; elliptic, lanceolate or linear-lanceolate in shape. Type of leaf indumentum is extremely significant for the classification of Turkish lilies. *L. ciliatum* and *L. akkusianum* with long hairs in their leaf margins can be without difficulty separated from the rest of the species. *L. candidum* has a unique character in the genus with over-wintering basal leaves.

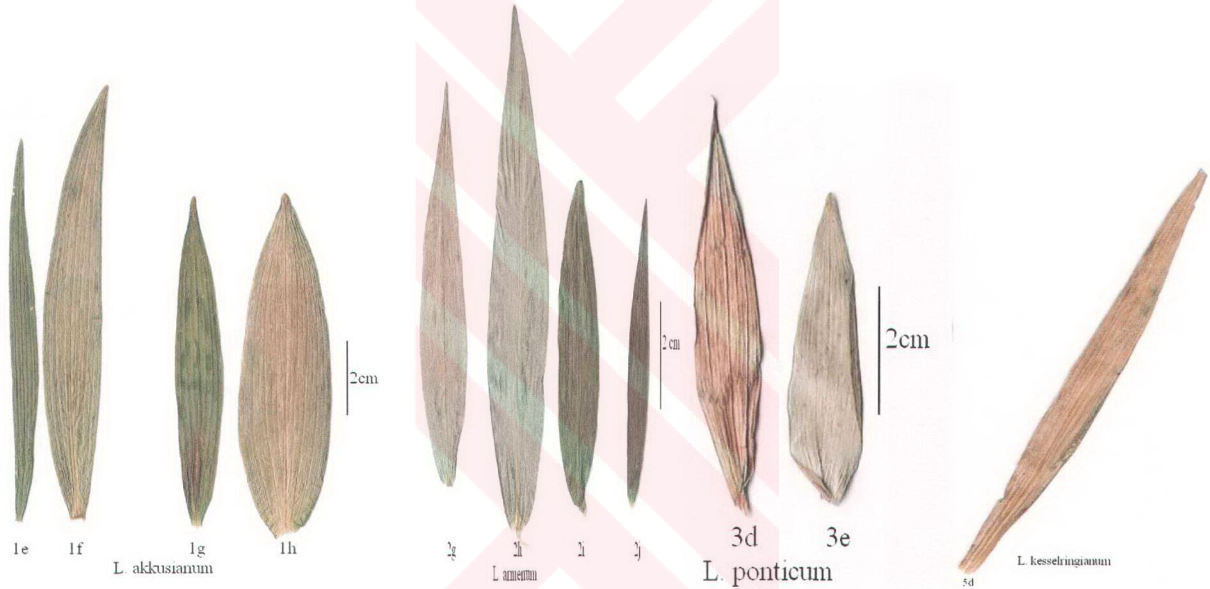

Figure 7. Leaves of lilies. 1.*L. akkusianum* (e-g: median leaf; f-h: basal leaf), 2. *L. armenum* (g-i: basal leaf; h-j: median leaf), 3. *L.ponticum* (d: median leaf; e: basal leaf), 5.d. *L.kesselringianum* median leaf.

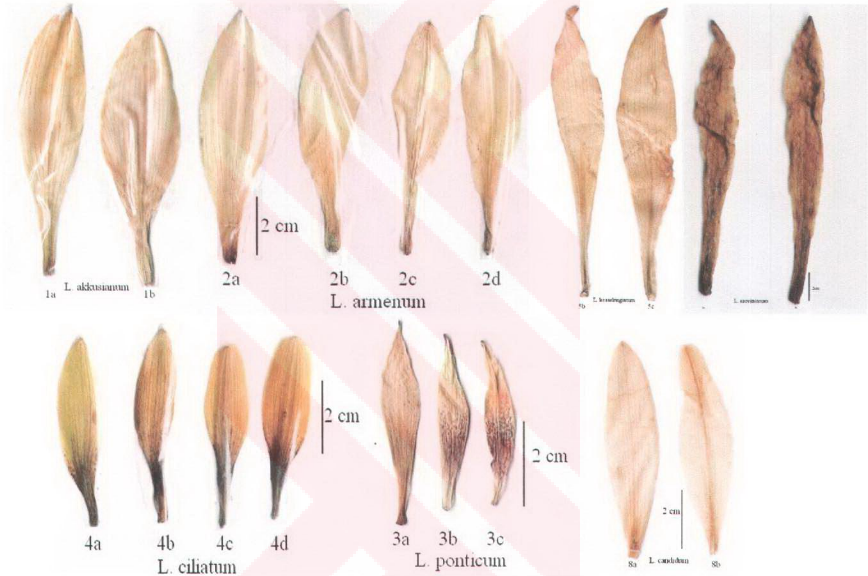

Figure 8. Tepals of Turkish lilies. *L. akkusianum* 1a: outer, 1b: inner; *L. armenum* 2a-2b:outer, 2c-2d: inner; *L. ponticum* 3a, 3b: outer, 3c: inner; *L. ciliatum* 4a-4b: outer, 4c-4d: inner; *L. szovitsianum* 6a-6b; *L. kesselringianum* 5b: outer, 5c: inner; *L. candidum* 8a: outer, 8b: inner.

3.1.3. Inflorescence

In lilies there are chiefly three types of inflorescences, these are racemose, umbellate, or a single terminal flower. We see umbellate inflorescences in *Pseudolirium* group. Flower stalks, or pedicels can be either branched or unbranched (Woodcock and Stearn, 1950).

The inflorescence type of Turkish lilies is either a raceme or a solitary terminal flower. It is not a differentiating character among Turkish lilies.

3.1.4. Flower

Flower color varies significantly within the genus *Lilium,* yellow and red pigments are very common but we do not see the blue color. There are mainly three basic flower forms, namely turk's-cap, trumpet, and bowl-shaped. Flowers can be also pendulous, horizontal or erect. Turk's-cap flowers are pendent and have reflexed petals that curve backward toward the stalk. Trumpet flowers have narrow conical throats and the petal tips are slightly reflexed. In bowl-shaped flowers petals are not reflexed, they are rather open and sometimes flat. Perianths are composed of three petals and three sepals, collectively called as tepals. Tepals usually have the same color pattern. There are nectary furrows at the base of each petal. *Lilium* flowers have six stamens composed of slender filaments and large versatile anthers. The color of the filaments and anthers are sometimes helpful in species identification. The color of the pollen changes significantly from species to species. The female reproductive organ is composed of the ovary at the base, a long style, and a three-lobed stigma at the tip (McRae, 1998).

The presence or absence of pubescence on filaments and nectariferous furrow important in most of the species. Whether the nectary furrow is naked or papillose is taxonomically important.

The shape of the flower is the main criteria for subgeneric or sectional classification. Wilson's sectional classification is based on completely flower shape and poise. This classification based on flower shape and poise is first introduced by Endlicher (1836) (Woodcock and Stearn, 1950).

In Turkish lilies flower shape is Turk's-cap, except in *L. candidum* which has funnel-shaped flowers. In Turk's-cap flowers amount of recurvation of petals is important in classification. Flower color is as well one of the most important character distinguishing species. Figure 8 shows tepals of Turkish lilies.

3.1.5. Fruit

Capsules are divided into three two-part sections with papery dividing walls. There are numerous flat, papery seeds inside these walls. The seeds are very light and have wings to help them in wind dispersal. Fruit shape and size varies greatly and are not taxonomically very important. On the otherhand, the size and shape of the seeds and seed-wings are important characters (Woodcock and Stearn, 1950).

In Turkish lilies capsule can be globular, obovate, or cylindric. Seeds are brown to dark brown, all with a narrow membraneous margin. It is hard to distinguish Turkish lilies only basing on their capsules or seeds features.

3.1.6. The Chromosomes

Basic chromosome number is X=12 in the genus *Lilium* (Hall, 1934) and there are no great variations in chromosome morphology in the genus (Stewart, 1947). In only *L. japonicum* and *L. tigrinum* there are triploids (3n) which are sterile (Sen, 1978). There are no wild tetraploids of *Lilium*. However, there are many tetraploid lily cultivars obtained artificially. All *Lilium* species have a very large genome (Yakovlev et al., 2003). Genome size of all lilies have not been studied completely, but among the studied ones genome size ranges from 2C=69,5 pg to 2C=96 pg (Van Tuyl and Boon, 1997). Conventional karyological methods do not provide important differences. On the other hand, recent studies with flourochrome banding and FISH experiments supply differentiating results between species. Furthermore, genome size and chromosome organization are beneficial at the level of species differentiation (Muratović et al., 2005). C-band patterns have also limited taxonomical usage since they change rapidly in *Lilium* (Smyth et al., 1989). Karyotype analysis showed that all Turkish *Lilium* species chromosome number is 2n=24 (Inceer et al., 1999).

3.1.7. Nuclear Ribosomal DNA ITS Sequencing

Nuclear ribosomal DNA ITS sequences were determined for 30 taxa. *Cardiocrinum giganteum, Notholirion thomsonianum,* and *Nomocharis saluenensis* were used as outgroup. At least two taxa representing the all sections in *Lilium* were added to analysis. A total of 112 variable nucleotide positions were detected. The number of base substitutions ranged from 1 (between *L. artvinense* and *L. ponticum*) to 94. A strict consensus tree (50% majority rule consensus tree) of the ITS region with its bootstrap values is shown in Figure 9. A majority-rule consensus tree shows all groups that are present in 50% or more of the trees. The distance matrix obtained from the ITS sequences of 30 taxa is given in Table 9.

The resulting tree supports Comber's classification system for the section *Liriotypus*, except for *L. bulbiferum* which was placed within the section *Sinomartagon*. *L. bulbiferum* is the only European species with non-martagon type flowers, i.e. with upward facing flowers. This species is found in south-west and central Europe (Matthews, 1989). When *L. bulbiferum* is excluded sect. *Liriotypus* forms a monophyletic group. This monophyletic group consisting of all the Caucasian and European lilies was well separated from the rest of the taxa with a bootstrap value of 91. Within this clade there is two subclades; first one with a bootstrap value of 98, includes all the pontic-caucasian lilies except two Turkish endemics *L. ciliatum* and *L. akkusianum*. *L. armenum* and *L. szovitsianum* formed a clade with a bootstrap value of 64. The other clade with a bootstrap value of 58, includes *L. ponticum, L. artvinense,* and *L. kesselringianum*. *L. monadelphum* was seen as an isolated species.

The second clade constitutes a large single clade with a bootstrap value of 83, with two distinct subclades. The first subclade consists of *L. ciliatum* and *L. akkusianum* with a bootstrap value of 93. The appearance of long-ciliate hairs on leaf margins and on flower buds in *L. ciliatum* and *L. akkusianum* is a synapomorphy since it is unique to these two species in the whole sect. *Liriotypus*. These two species have different geographical distribution than the rest of the clade. They are distributed in the North Eastern Turkey, like the other Turkish lilies. The second subclade includes all the other European lilies with a bootstrap value of 52. *L. rhodopaeum, L. jankae,* and *L. candidum* forms a monophyletic group with a bootstrap value of 67. Within this clade *L. rhodopaeum* and *L. jankae* were separated with a bootstrap value of 78. The other monophyletic group was formed by *L. pomponium* and *L. pyrenaicum* with a bootstrap value of 88. *L. pyrenaicum* occurs only in eastern Pyrenees on both side of the range in northern Spain and in southern France and *L. pomponium* in Maritime Alps in the south of France and in north-west Italy (Synge, 1980). They occupy the western limit of European lilies and there is distance of more than a thousand miles between the carniolicum group of lilies. *L. bosniacum* and *L. carniolicum* also forms a clade with a bootstrap value of 61. *L. bosniacum* has only distribution in Bosnia and Hercegovina. *L. albanicum* occurs as an isolated species, which has the southern-most distribution among Carniolicum group of lilies, in the mountains of Albania and in northern Greece.

L. martagon is assumed to be the first species to migrate into the Europe from the center of diversity of northwest Asia. According to Lighty (1968), *L. dauricum* migrated across central Asia in the north and finally gave rise to *L. bulbiferum* in Europe. A more southern line over southern Russia penetrated into Caucasus and into the Balkans. *L. candidum* constitutes the southern end of this radiation in Europe.
Our results are also in accordance with Mandenova (1940), who stated that Caucasia not only bears old relict types, but also is a place where the evolution and development of lilies took place.

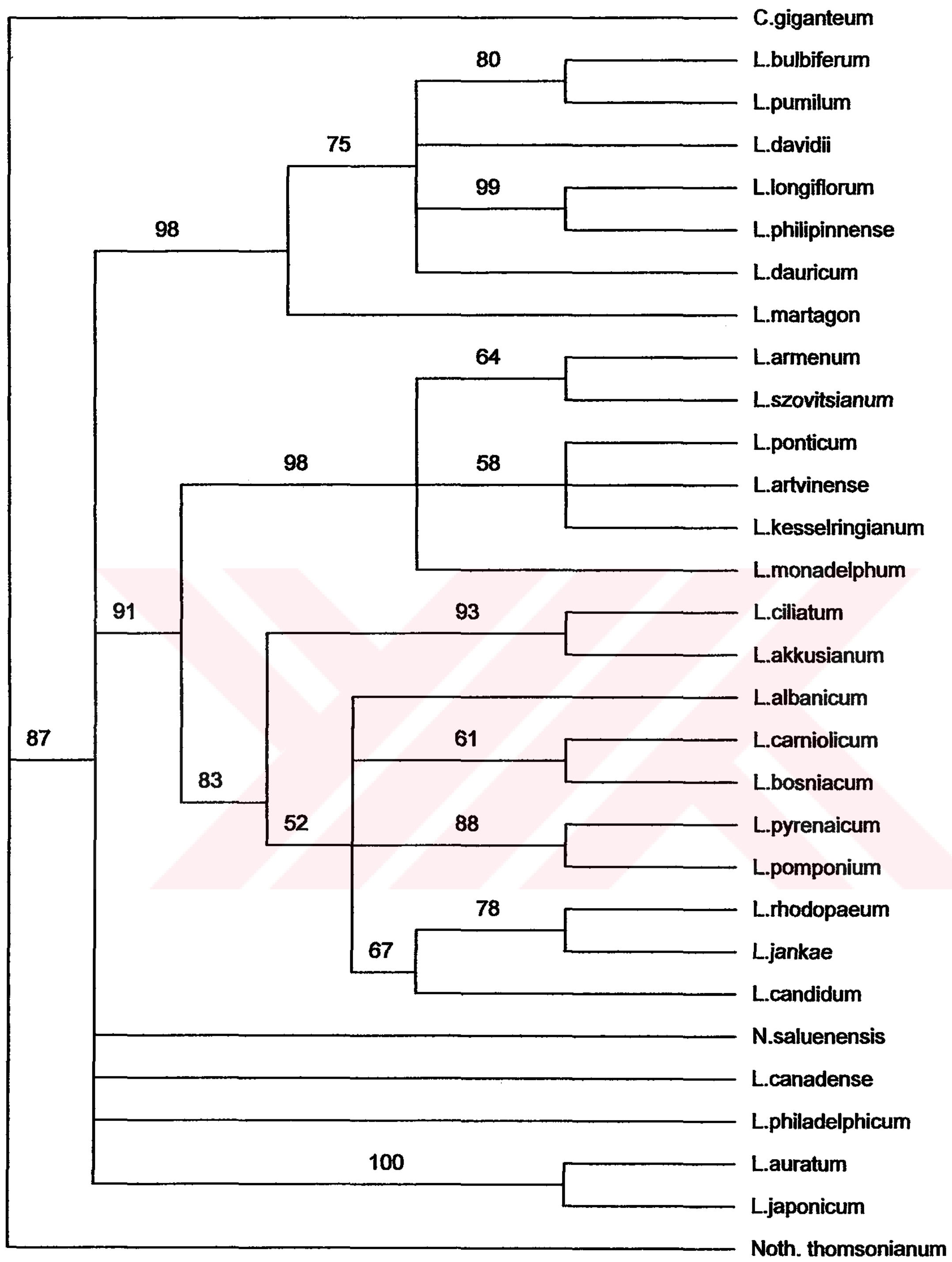

Figure 9. The 50% majority-rule consensus tree obtained from the phylogenetic analysis of ITS region of 30 taxa. Percentages above branches are bootstrap values (x1000 replications). The length of the shortest tree was 315 steps, consistency index (CI) = 0.602, homoplasy index (HI) = 0.398, retention index (RI) = 657.

Table 9. Distance Matrix of nrITS sequences from 30 taxa of *Lilium* species and allied taxa. Base pair differences (below diagonal) and number of base substitutions per site (above diagonal).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 C.giganteum	-	0.094	0.090	0.101	0.111	0.099	0.096	0.102	0.96	0.096	0.096	0.094	0.096	0.106	0.098	0.104
2 L.bulbiferum	59	_	0.021	0.035	0.047	0.037	0.029	0.048	0.073	0.072	0.072	0.073	0.078	0.075	0.075	0.083
3 L.pumilum	56	13	-	0.030	0.048	0.038	0.030	0.048	0.070	0.069	0.069	0.070	0.075	0.072	0.072	0.078
4 L.davidii	63	22	19	-	0.044	0.035	0.035	0.050	0.074	0.072	0.072	0.074	0.079	0.076	0.074	0.079
5 L.longiflorum	69	29	30	27	-	0.026	0.043	0.061	0.082	0.080	0.077	0.079	0.087	0.080	0.082	0.090
6 L.philipinnense	62	23	24	22	16	-	0.037	0.050	0.077	0.075	0.070	0.072	0.081	0.075	0.078	0.086
7 L.dauricum	60	18	19	22	27	23	-	0.048	0.064	0.062	0.065	0.067	0.070	0.067	0.067	0.073
8 L.martagon	64	30	30	31	38	31	30	-	0.075	0.075	0.077	0.075	0.077	0.077	0.072	0.077
9 L.armenum	60	46	44	46	51	48	40	47	-	0.003	0.006	0.005	0.008	0.021	0.035	0.042
10 L.szovitsianum	60	45	43	45	50	47	39	47	2	-	0.005	0.005	0.010	0.018	0.037	0.043
11 L.ponticum	60	45	43	45	48	44	41	48	4	3	-	0.002	0.010	0.014	0.038	0.046
12 L.artvinense	59	46	44	46	49	45	42	47	3	3	1	-	0.008	0.016	0.037	0.045
13 L.monadelphum	60	49	47	49	54	51	44	48	5	6	6	5	-	0.026	0.035	0.042
14 L.kesselringianum	66	47	45	47	50	47	42	48	13	11	9	10	16	-	0.046	0.054
15 L.ciliatum	61	47	45	46	51	49	42	45	22	23	24	23	22	29	-	0.008
16 L.akkusianum	65	52	49	49	56	54	46	48	26	27	29	28	26	34	5	-
17 L.albanicum	69	55	51	52	58	59	49	56	27	28	29	28	29	35	27	23
18 L.carniolicum	72	55	51	51	54	53	45	54	31	32	30	30	33	34	29	25
19 L.bosniacum	71	56	52	52	57	56	48	55	29	30	32	31	32	36	26	22
20 L.pyrenaicum	77	66	64	64	69	70	60	63	43	44	45	44	45	47	41	37
21 L.pomponium	66	56	52	50	59	56	48	55	32	33	33	32	34	34	28	24
22 L.rhodopaeum	75	72	68	69	72	74	66	70	45	46	48	47	45	54	40	38
23 L.jankae	80	70	66	67	70	72	64	69	42	43	45	44	43	43	41	39
24 L.candidum	68	64	60	64	70	70	61	65	40	41	43	42	42	49	33	31
25 N.saluenensis	65	52	49	49	60	55	48	55	46	44	45	46	50	48	46	50
26 L.canadense	69	53	49	47	59	52	48	56	44	45	45	44	45	48	44	50
27 L.philadelphicum	70	63	60	60	67	61	57	58	57	57	57	56	59	61	61	63
28 L.auratum	54	44	39	46	56	51	46	47	40	40	40	39	42	44	44	48
29 L.japonicum	63	51	48	53	59	56	49	55	47	47	47	46	49	51	50	55
30 Nt.thomsonianum	79	81	76	77	83	78	74	78	79	78	78	79	81	82	79	83

Table 9. (cont.) Distance Matrix of nrITS sequences from 30 taxa of *Lilium* species and allied taxa. Base pair differences (below diagonal) and number of base substitutions per site (above diagonal).

	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1 C.giganteum	0.111	0.115	0.114	0.123	0.106	0.120	0.130	0.109	0.104	0.111	0.113	0.086	0.101	0.126
2 L.bulbiferum	0.088	0.088	0.090	0.105	0.089	0.115	0.114	0.102	0.083	0.085	0.101	0.070	0.081	0.129
3 L.pumilum	0.082	0.081	0.083	0.102	0.083	0.109	0.107	0.096	0.078	0.079	0.096	0.062	0.077	0.121
4 L.davidii	0.084	0.082	0.084	0.103	0.080	0.111	0.109	0.103	0.079	0.076	0.097	0.074	0.085	0.124
5 L.longiflorum	0.093	0.087	0.092	0.111	0.095	0.116	0.114	0.113	0.096	0.095	0.108	0.090	0.095	0.133
6 L.philipinnense	0.095	0.085	0.090	0.112	0.089	0.119	0.117	0.112	0.088	0.084	0.098	0.081	0.089	0.125
7 L.dauricum	0.079	0.072	0.077	0.096	0.077	0.106	0.104	0.098	0.077	0.077	0.091	0.073	0.078	0.118
8 L.martagon	0.090	0.086	0.088	0.101	0.088	0.112	0.112	0.104	0.088	0.090	0.093	0.075	0.088	0.125
9 L.armenum	0.043	0.050	0.046	0.069	0.051	0.072	0.068	0.064	0.074	0.071	0.091	0.064	0.075	0.126
10 L.szovitsianum	0.045	0.051	0.048	0.070	0.053	0.074	0.070	0.066	0.070	0.072	0.091	0.064	0.075	0.125
11 L.ponticum	0.046	0.048	0.051	0.072	0.053	0.077	0.073	0.069	0.072	0.072	0.091	0.064	0.075	0.125
12 L.artvinense	0.045	0.048	0.050	0.070	0.051	0.075	0.072	0.067	0.074	0.071	0.090	0.062	0.073	0.126
13 L.monadelphum	0.046	0.053	0.051	0.072	0.054	0.072	0.070	0.067	0.080	0.072	0.095	0.067	0.078	0.129
14 L.kesselringianum	0.056	0.054	0.058	0.075	0.054	0.087	0.070	0.079	0.077	0.077	0.098	0.070	0.082	0.131
15 L.ciliatum	0.043	0.046	0.042	0.065	0.045	0.064	0.067	0.053	0.074	0.071	0.098	0.070	0.080	0.126
16 L.akkusianum	0.037	0.040	0.035	0.059	0.038	0.061	0.063	0.050	0.080	0.080	0.101	0.077	0.088	0.133
17 L.albanicum	-	0.019	0.022	0.048	0.030	0.043	0.046	0.051	0.083	0.084	0.097	0.074	0.083	0.135
18 L.carniolicum	12	-	0.019	0.051	0.034	0.054	0.057	0.061	0.088	0.087	0.099	0.080	0.089	0.126
19 L.bosniacum	14	12	-	0.050	0.032	0.050	0.057	0.054	0.083	0.085	0.103	0.078	0.088	0.131
20 L.pyrenaicum	30	32	31	-	0.042	0.071	0.078	0.085	0.101	0.103	0.115	0.094	0.104	0.144
21 L.pomponium	19	21	20	26	-	0.059	0.059	0.062	0.082	0.079	0.100	0.078	0.088	1.129
22 L.rhodopaeum	27	34	31	44	37	-	0.039	0.050	0.108	0.110	0.129	0.101	0.111	0.149
23 L.jankae	28	35	35	48	36	24	-	0.068	0.106	0.105	0.119	0.099	0.109	0.153
24 L.candidum	32	38	34	53	39	31	42	-	0.095	0.092	0.117	0.089	0.101	0.141
25 N.saluenensis	52	55	52	63	51	67	65	59	-	0.092	0.098	0.083	0.099	0.138
26 L.canadense	52	54	53	64	49	68	64	57	57	-	0.083	0.075	0.082	0.130
27 L.philadelphicum	60	62	64	72	62	80	73	73	61	52	-	0.078	0.085	0.130
28 L.auratum	46	50	49	59	49	63	61	56	52	47	49	-	0.021	0.120
29 L.japonicum	52	56	55	65	55	69	67	63	62	51	53	13	-	0.133
30 Nt.thomsonianum	84	79	82	90	81	93	94	88	86	81	81	75	83	-

3.1.8. RAPD Analysis

In our RAPD analysis a total of 93 DNA bands, amplified by 11 different 10-mer oligonucleotide primers were scored. The approximate size of the fragments ranged from 221 to 760 bp. The short fragment lengths are due to the Taq polymerase used, which gave clearer, but shorter bands. Figure 10 and Figure 11 shows the resulting RAPD profiles of 16 individuals for the primers AB16 and AB02.

In the final analysis of RAPD data 170 individuals (samples) and 93 bands (variables) were used. On the PCA analysis of RAPD data we see a clear separation of the species confirming their status as separate taxonomic units. The most prominent result is that two Turkish endemics *L. ciliatum* and *L. akkusianum* form a clearly distinct cluster in every type of analysis. They are very well isolated from the rest of the Turkish *Lilium* species. *L. albanicum* is clearly separated from the rest of the species. *L. ponticum* and *L. monadelphum var. armenum* are grouped together. These two species have allopatric distribution in Turkey without any overlap. On the other hand, *L. monadelphum var. szovitsianum* and *L. kesselringianum* are clustered together. A geographical structuring is seen in the principal coordinate analysis of RAPD data.

The phenogram generated by UPGMA clustering analysis revealed that all the examined taxa show a clear separation confirming their status as separate taxa. However, there is one exception, *L. artvinense* which is clustered within *L. ponticum* group. This is supporting our morphological findings that these two taxa are not different and taxonomic status of *L. artvinense* is questionable.

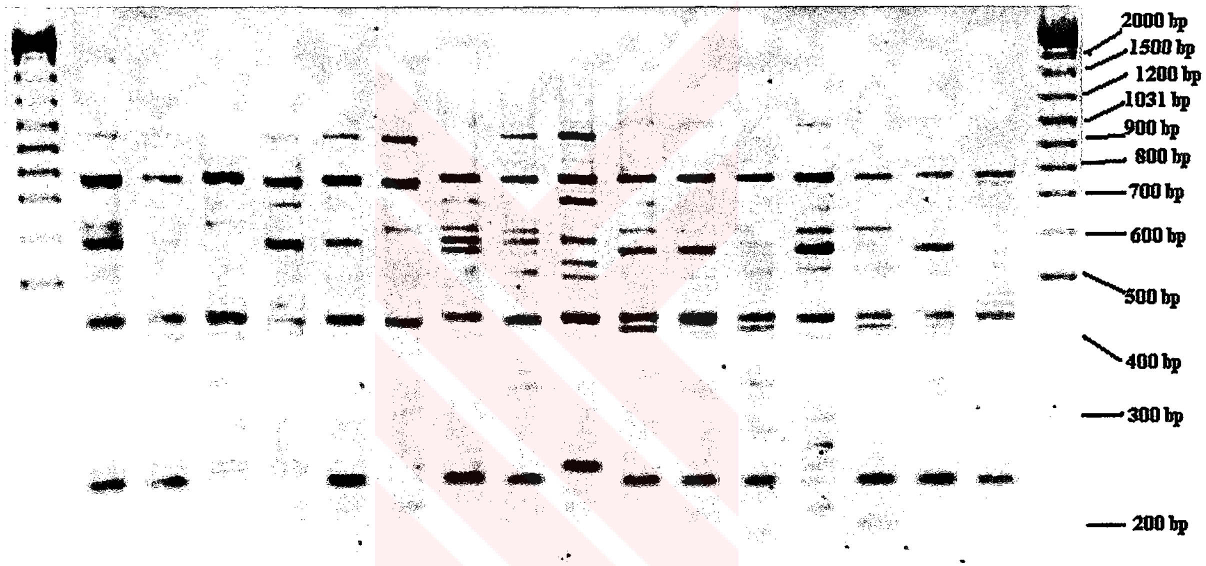

Figure 10. 3 % Agarose Gel Electrophoresis Picture of the RAPD profile of 16 individuals for the primer AB16-7. Lanes from 1-16 (between the markers) belongs to indiviuals with numbers 97-112, details of them are given in Appendix 3.

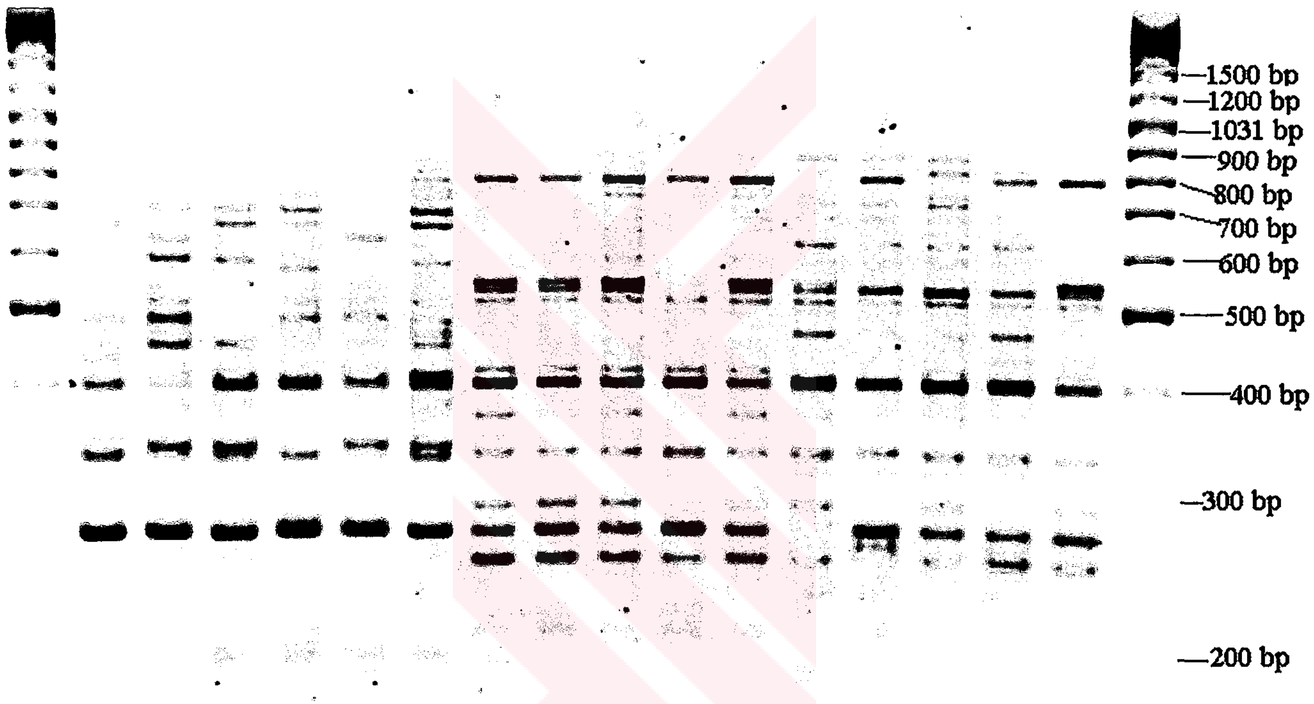

Figure 11. 3 % Agarose Gel Electrophoresis Picture of the RAPD profile of 16 indivuals for the primer AB02-12. Lanes from 1-16 (between the markers) belong to indiviuals with numbers 116-192, details of them are given in Appendix 3.

Generally, the genetic relationships between species revealed by cluster analysis of RAPDs are consistent with those described in traditional taxonomy. RAPD cluster analysis results powerfully supports the results of phylogenetic analysis obtained from nuclear ribosomal DNA ITS sequence data. We observe similar patterns of relationships between *Lilium* species in both type of analysis.

3.1.9.Sequence Analysis of Chloroplast DNA

Sequence analysis of the trnL (UAA) intron and the intergenic spacer region between the trnL (UAA) 3' exon and the trnF (GAA) gene of chloroplast DNA were obtained for Turkish Lilium species. However, it was seen that there is not enough variation for phylogeny construction. The obtained sequences were nearly identical in all specimens examined. Therefore, we preferred not to include these chloroplast sequence data to our analysis.

3.1.10. AFLP Analysis

Amplified fragment length polymorphism (AFLP) method was also applied to some Turkish *Lilium* L. species. However, we were unable to get reproducible amplification products with this method. Possible explanation for this problem is the large genome size of *Lilium* L. (pers. com. Mark Chase).

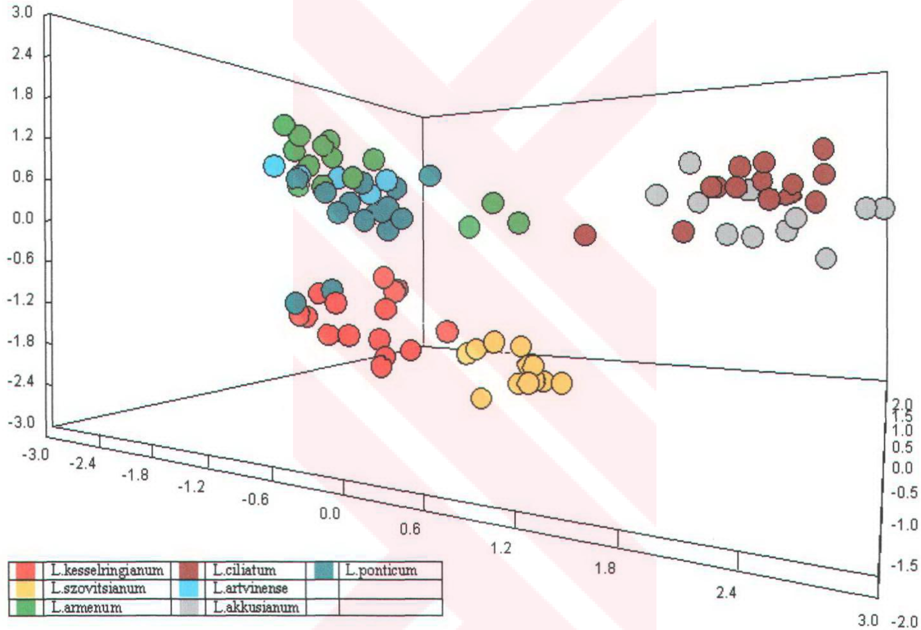

Figure 12. Ordination of OTUs in three dimensional space formed by principal components PC 1 (14.1 %), PC 2 (23.0 %), and PC 3 (30. 5 %) of RAPD Data of Appendix 2.

Figure 13. UPGMA Results of RAPD Data for Lilium Species
(The Figure is enclosed at the end of the thesis)

3.2.1. Identification Key to Turkish Lilium Lilies

1. Flowers white or pink, or purple
   2. Flowers white; leaves scattered — 1. ***L. candidum***
   2. Flowers purple or pink; leaves whorled — 2. ***L. martagon***
1. Flowers pale cream to yellow, or orange
   3. Leaf margins and flower buds with long hairs; leaf veins beneath glabrous
      4. Flowers small; tepals 35-50 mm long; perianth segments strongly recurved, touching and hiding the tube — 3. ***L. ciliatum***
      4. Flowers large; tepals 65-90 mm long; perianth segments only slightly recurved, never touching the tube — 4. ***L. akkusianum***
   3. Leaf margins and flower buds glabrous; leaf veins beneath with short hairs
      5. Perianth segments 15-45 mm long, yellow to deep orange, strongly recurved — 5. ***L. ponticum***
      5. Perianth segments 65-120 mm long, only slightly revurved
         6. Flowers pale cream or whitish-yellow; anthers chestnut-purple — 6. ***L. kesselringianum***
         6. Flowers yellow; anthers orange — 7. ***L. monadelphum***

Section *Martagon* Rchb. Cons. Reg. Veg. (1828).

3.2.2. *Lilium martagon* L., Sp. Pl. 302. (1753).

Reichenbach, H.T. Fl. Germ. 10. t. 451 (1828).

Baker, J.G. in J. Linn. Soc. 14. 244 (1874).

Komaraov, Fl. URSS 4. 288 (1935).

Tutin et al., Flora Europaea, vol. 5, Cambridge Uni. Press. (1980).

Synonyms:

L. martagon L. subsp. *caucasicum* Miscz. in P.I. Mischenko, 1911, On the systematics and geography of the family Liliaceae.

L. caucasicum (Miscz.) Grossheim in Flora Caucasica ed.2, ii. 142 (1940).

Iconibus: Grey-Wilson & Matthew, Bulbs t. 3 (1981).

Type: Described from Hungary, Switzerland, Siberia and Leipzig (Hb. Burser III: 117)

Plant up to 180 cm. Bulbs small, ovoid, diameter 3.5-4(-6) cm, scales numerous, 6-10 mm wide, (1.5-)2.5-3.3 cm long, yellow, oblong or lanceolate, acuminate. Stem purplish or green, stem roots in 1-2 rows, stem glabrous in lower part, with strigose hairs in upper part. Leaves glabrous, medians in 3 distant whorls with 5-11 unequal leaflets, 2.2-5.5 cm wide, 10-15(-16) cm long, uppermost whorl smaller, lanceolate to oblanceolate, tapered below, acuminate; upper leaves few, scattered, 4-5(18) mm wide, 4-9 cm long, linear-lanceolate. Inflorescence racemose, with 1-7(-16) flowers. Bracts lanceolate to linear lanceolate, 2-3(-8) mm wide, 2.2-2.5(-4.5) cm long. Pedicels purplish, with short hairs, 7-11 cm long. Flower buds purplish-green, tips hairy. Flowers pendulous or nodding, in turk's cap shape or flat, strongly recurved, 2.8-3 cm in diameter; perianth segments pink or purplish pink with dark maroon spots, throat sometimes whitish with dark-purple spots, at apex hairy, linear-oblong, obtuse, 5-9 mm wide, 3-4.5 cm long. Stamens free, shorter than style; filaments pinkish-green, 23-28 mm long; anthers purple to salmon color, 1-1.5 mm wide, 7-8(-11) mm long, pollens orange to orange-yellow. Ovary yellowish-green, 7-10 mm long; style curved, 2.3-2.5 cm long, whitish-pink, darker towards stigma; stigma purple to pink. Fruit capsule globular to obovatus, at base brownish-cream, green in upper part, 2-3.5 cm long, 1.2-2.5 cm in diameter; seeds flat, papery, brown with a narrow membranous margin, 9 mm in diameter. Scent not strong. *Fl. 6-7.*

Distribution. Turkey-in-Europe, North-West Anatolia.

World Distribution: Most of the Europe, Balkans, Caucasus, Russia, and Siberia.

Vernacular Name. Sultan Zambağı.

Threat Category: Although this lily has a very wide distributional area in the Northern Hemisphere, its subpopulations in Turkey are not exceeding 10 and these subpopulations are not very species rich. Therefore, *L. martagon* should be placed in vulnerable (VU) category.

Selected Examined Specimens

- Kırklareli, Demirköy, Büyükada, Rezve River, Bulgarian Border, Riversides, Fagus, Alnus, Ulmus, Carpinus forests, 200 m, 41°59.380 N, 27°47.507 E, Nİ 1978, 18.07.2002; Demirköy, Thrakien, Iğneada, 2-4 km SSWK. Bauer & F. Spitzenberger 502, W, 05-06.06.1967.
- Istanbul, Belgrad Forest, Carpinus, Fagus, Castanea, Corylus, Quercus mixed forests, 30-50 m, Nİ 1918-1927, 21.6.2002; Istanbul, Belgrad Forest, B. Post, E, 8.07, 1928; Belgrad Forest, B. V. D. Post, E, 05.07.1920; Belgrad Forest, shady banks, B. V. D. Post, E, 12.11.1939; Istanbul, Therapia, B. V. D. Post, E, 07.1895; Büyükdere, E; Vigue Feuerli, Terapia 2152, E, 06.07.1890;

Balaban Deresi, E, 06.07.1902; Umgebung von Constantinopel, J. Nemetz, WU, 18.07.1896; Istanbul, W, 27.06.1887.

- Bolu, Kale, on the way to Yığılca, Abies, Fagus forest, with Prunus laurocerasus, roadsides, 1240-1360 m, 40°53.419 N, 31°36.888 E, N 1979, 23, 07, 2002; Kale, on the 35th km of the road from Bolu to Yığılca. Monumental Corylus Area, Mixed forests, Fagus, Acer, Corylus, Prunus laurocerasus, 1200-1250 m, Nİ 1908, 12.7.2001; Kale Mevkii, 1250-1350 m, 41°59 N, 27°45 E, Nİ 1988, 23.09.2002; Bolu, Karadere to Yedigöller, Fagus-Carpinus Forest, 650 m, Davis, Coode & Yaltirik, D 37690, E, 18.07.1962; 47 km N of Bolu at Yedigöller. Dense mixed forest of Fagus Abies, Alnus sp., 750 m, Margaret Johson JOHM4, K, 07.1982.
- Bartın, Arıt, Karapinar Yaylasi, Küre National Park, Abies-Fagus forest openings, wet-swampy area, 880-890 m, 41°42.00 N, 32°40.00 E, Nİ 1980, 25.07. 2002.
- Karabük-Bartın, 15 km of Safranbolu, 1030 m, Max Nydegger 11391, G, 22.07.1976.
- Kastamonu, Küre, Akdivan Köyü, Kösreli Bölgesi, Abies-Fagus forests, 1250-1400 m, 41°49.323 N, 33°33.261 E, Nİ 1981, 26.07.2002; Küre-Nahas, Paphlagonia, in silvis, P. Sintenis 4052, JE, 03, 09, 1892; Küre-Nahas, prope Prozisler Kayasi, in silvis, P. Sintenis 4052, K, 25, 08, 1892.
- Albania: in pratis silvaticis, Greca (Trijepsi) Klementi, A. Baldacci 381, M, 30.07.1900.
- Albania: Kuci, In silvis, A. Baldacci 98, K, 24.06.1900.
- Albania: Scardus ad rupes montis Serdarica Duran, J. Dörfler, WU, 01.08.1890.

Figure 14. *L. martagon*, Bartın, Arıt

- Austria: Osttirol, St. Jakob/Defereggen, zwischen Erlach und Sprung, 1650 m, R. Vocke, I. Haesler 2854, M, 03.08.1970.
- Bosnia: An der Straße Gorazde-Visegrad, Straßenränder, Weide, Buschwald, 700 m, A. Rennschmid, M, 17.07.1970.
- Bosnia: Praca Schlucht, an der Straße Sarajevo-Gorazde, Laubwälder und Wiesenstreifen über Kalk, 680 m, P. Orendi, M, 17.07.1970.
- Bulgaria, Varna, B. Gilliat-Smith 215, K, 9.06.1923; Varna, B. Gilliat-Smith 1925, K, 19.07.1935; Varna, B. Gilliat-Smith, B.Baker K382, K, 26.06.1933.
- Bulgaria: in pratis mt. Vitosa, Kaparlivetz, SOM, 27.07.1902.
- Bulgaria: in silvaticis ad radicem mt. Pirin non procul vicum Bansko, Lv. K. Urumov, SOM, 1915.
- Bulgaria: in silvaticis et clumosis ad Loreclv. K. Urumov, SOM, 1889.
- Bulgaria: in silvatieis mt. Balkan-central, Lipka-balkan-Kuru Dere, Jr. Nejceff, SOM, 26.07.1902.
- Bulgaria: Sofia, Mt. Viloska, in shady woods on mountain slope, R. De Sausmarey 25, K, 07.07.1950.
- France: Luis des Alpes, monto Sonchaud pres Montreuy, 3000', H. Paparf, FI.
- Germany: Bayern, Kreis Berchtesgaden, Inzell, Weg Kohleralm, Weissbach, lichter Wald, 900 m, R. Grützmann, M, 30.06.1952.
- Germany: München, M, 15.07.1903.
- Greece, Pellas, Almopias, Mt. Voras, Mt. Piperitza, Seyrek kayin acikligi, Juniperus, 1640 m, 40°50 N, 21°44 E, Nİ 2236, 29.06.2004.
- Greece: Macedonia orientalis: Montes Laila prope Serrai, in saxosis ad limitem silvarum, 1600-1700 m, Bertil Nordenstam, W, 09.07.1973.

- Greece: Mt. Bourinon, 1450 m, Dr. C. Goulimy, K, 05.07.1956; Mt. Bourinon, 1200-1600 m, C. Goulimy, K, 05.07.1956.
- Greece: Parnassidou, Fokidosin monte Parnasso prope dipotamo parissimes, 5000', Theodorus G. Orphanides 833, JE, 3-15.07.1854.
- Greece: S. C. Cuchley 2246, K, 07.1934.
- Greece: Thessalicum, Malakasi: in monte Thrasopeba, J. Freyn 832, M, 13.07.1896; Attika, Malakasi, monte Thracopetra, P. Sintenis 832, JE.
- Greece: Thessalien, Pilion-Gebirge: E von Chania, Buchenwald, 800 m, H. Malicky, W, 15.06.1979.
- Hungary: Budapset, in silvaticus versus pag. Budakeszi, F. Filarszky & G. Timko, E, 17.06.1913.
- Macedonia: SE von Prilep, am Ljvada, Lockerer Laubmischwald, Blockheiden, Silikat, 1200-1500 m, F. Krendl, W, 18.06.1977.
- Makedonia: In silvis subalpinus montis Capari, 1300-1400 m, J. Bornmüller 2032, JE, 23.07.1917.
- Makedonia: Skopska Crna Gora nördlich von Skopje: Buchenwald und Wiesen nördlich des Klosters Sveti Ilija, 700-800 m, Roessler 5998, M, 20.06.1968.
- Poland: Moravia Orient, Valasske Mezirici, Policna, in dumetis vallis fluvii Becva, 300 m, R. Rican, FI, 05.1934.
- Romania: M, 11.07.1963.
- Romania: Transsilvania. Distr. Cluj. In silva penes vicum Cojocna-Boj, 4202643, W, 20.08.1924.
- Russia, Sedletzin pinetis pr. Urb. Lukow 2378, WU, 10.07.1902.

- Russia: Briansk, Novozybkov, 12 km S-SE a Novozybkov, A.K. Skvortsov, A. Shvetsov, M, 26.07.1980.
- Russia: Sibiria (Tomsk) in pratis vere inundatis ad urb. Tomsk 2379, WU, 25.06.1902.
- Slowenia: Bled, Alpine meadows & woody places, 1400', G. Martiudoll 75, K, 06.1938.
- Spain: Montenegro de cameros (Soria), In nemoralibus ad solo siliceo, cum Fagus sylvatica, Pinus sylvestris, Fragaria vesca, Festuca rubra, Arenaria montana ssp. montana, Prunella grandiflora ssp. pyrenaica, Senecio sylvaticus., 1600 m, A. Segura Zubizarreta 10920, M, 07.07.1962.
- Ukraine: Transcarpatica, Vliki Berezny, ad pag. Ljnka, silva mixta frondosa (Fagus-Acer), 1100 m, A. K. Skvortssov, M, 14.07.1968.

Section *Liriotypus* Asch. et Graebn., Synop., 3, 172 (1905).

3.1.3. *Lilium candidum* L., Sp. Pl. 302 (1753).

Elwes, Mon. of *Lilium* t. 9 (1880).

Tutin et al., Flora Europaea, vol. 5, Cambridge Uni. Press. (1980).

Synonyms:

L. candidum L. *var. salonikae* Stoker in Lily Year Book 4: 10 (1935).

Iconibus:

Grey-Wilson & Matthew, Bulbs t. 3 (1981).

Synge, P. M., Lilies. t.1. (1980) (as black and white).

Figure 15. *L. candidum*, Muğla, Köyceğiz

Type: Described from Palestine and Syria (Hb. Linn 420/1).

Plant up to 140 cm. Bulb broadly ovoid, scales numerous, linear-lanceolate, pinkish-white, sometimes apex membranous. Stem ligth green. Basal leaves formed in autumn, over-wintering, oblanceolate, glabrous; stem leaves numerous, glabrous and shiny, rarely purplish; lower leaves linear-lanceolate or oblanceolate, 5-7 cm wide, 4-14.5 cm long; upper leaves much shorter than lower ones, ovate to lanceolate, 0.6-1.1 cm wide, 2.5-2.7(-4.5) cm long. Inflorescence racemose with 1-7(-12) flowers, lax or dense. Bracts ovate or elliptic, ligth green, at base and apex purplish, 0.5-0.8 cm wide, 2.1-3 cm long. Pedicels whitish-green, purplish at base, 2.2-4 cm long. Flower buds white or rarely dirty-white, apex greenish. Flowers infundibular-recurved; perianth segments white, oblanceolate, 1-1.5 cm wide, 6-6.5(-7.6) cm long, only tips sligthly reflexed. Stamens free, much shorter than style; filaments white, 4.1-5.6 cm long; anthers yellow, 1.5-2 mm wide, 7-8 mm long; pollen yellow. Ovary whitish-green, 8-11 mm long; style curved, white, very thin, 5-5.8(-6) cm long; stigma yellowish-green. Fruit capsule pyriform, ligth brown; seeds reddish-brown, papery with a narrow membranous margin. Scent strong, pleasent. *Fl.* 5-6.

Habitat. Under olive plantations and macchie, s.l.- 700(-1300) m.

Distribution. South-West Anatolia.

World Distribution: Balkans and eastern Mediterranean Area.

Vernacular Name. Mis zambak, ak zambak, dağ bambılı, deli bambıl.

Threat Category: *L. candidum* should be placed in vulnerable (VU) category in the light of the situation of its subpopulations which are composed of only few individuals.

Selected Examined Specimens

- Istanbul, Cultive, achete, Herbier G.V.Aznavour, Robert College 2151, E, 11.06.1891.
- Aydın, Söke-Milas, 35 km from Bafa Gölü, new road, Juniperus, Quercus, Dry roadside banks, 10-20, Dudley D34984, E, 25.05.1962.
- Muğla, Milas, Selimiye, Hacıahmet Köyü, Eset Deresi, Olive groves, 170 m, 37°24 N, 27°40 E, Nİ 1917, 3.6.2002; Milas, Around Bafa Lake, Canlıbalık, 37°24 N, 27°40 E, Nİ 1916, 3.6.2002.
- Muğla, Köyceğiz, Çandir, Above Horozlar Mahallesi, 50 m, 36°50 N, 28°37 E, Nİ 1915, 2.6.2002; Köyceğiz, Kersele Deresi, Maquis, 36°54 N, 28°35 E, Nİ 1912, 2.6.2002; Köyceğiz, Sultaniye Köyü, Kersele Deresi, Makilik, serpentin arazi, 150 m, A. Güner 10661, 08.06.1992; Köyceğiz, Horozlar-Ülemez Arasi, makilik, 10-700 m, A. Güner 10541, 17.05.1992.
- Muğla, Ula, Çiçekli Köyü mezarlığı, 570 m, 23.06.2001.
- Muğla, Marmaris, 1913, 2.6.2002; Marmaris, Adakoy, 50 m, 36°48 N, 28°17 E, Nİ 1914, 2.6.2002; Marmaris, Turgut to Bayır, ocky limestone slopes, in maquis, 50 m, Davis 41106, E, 15.04.1965; Marmaris, Marmaris-Datca, 35 km from Hisarönü, conglomerate and sandstone 300 m, D 35427, E, 6.06.1962.

3.2.4. *Lilium ciliatum* P.H.Davis in Notes from the Royal Botanic Garden Edinburgh 28(1): 235-236 (1968).

Iconibus:

Woodcock & Stearn, Lilies of the World f. 94, p. 256 (1950), as *L. ponticum*; J. Roy. Hort. Soc. 86: f. 70 (1961).

Davis, P.H., Henderson, D.M. A Revision of Turkish Lilies. Lily Year Book 33: t. 29 (a, c) (1969).

Synge, P. M., Lilies. t.2. (1980). (as black and white).

Ferns, F. E. B., 1878. Consider the Lilies. Quart. Bull. Alp. Gard. Soc., 46(1): 42.

Type: Turkey A8 Trabzon: 45 miles (72.4 km) S. of Of on road to Bayburt, N. Side of pass, 2040 m, Apold, Cox & Hutchinson 189A (holo. E!).

Plant 40-180 cm. Bulbs very large; large bulbs rarely not concentric (or rarely subrhizomatous), circumference up to 36 cm, scales numerous, lanceolate to linear lanceolate, creamy-white, acute, 6-12 mm wide, 33-52 mm long. Stem greenish-yellow, up to 8 cm diameter. Leaves numerous, alternate, sessile, lower leaves ovate to lanceolate, 1,3-2,9 cm wide, 7,4-9 cm long; median leaves lanceolate to linear lanceolate, very acute, 10-14(-16) mm wide, 8.6-14(-18) cm long, glabrous on both surface, leaf margins and base with long white ciliate hairs. Inflorescence racemose, with 1-5(-15) flowers. Bracts sessile, lanceolate, acuminate, purplish at apex, (2-)4-12 mm wide, 32-70 mm long, glabrous on both surfaces, margins and base with long white ciliate crisped hairs. Pedicels drooping, green, purplish at base, 4-8 cm long. Flower buds shiny green to greenish-yellow, usually at base and apex puplish, rarely greenish, narrow at base, enlarged towards apex, apex with long hairs. Flowers pendulous, ivory, cream, pale sulphur or pale lemon, usually with a purplish brown center, rarely absent, and with fine or dense purplish spots in lower half, perianth segments strongly recurved, hiding purplish-green tube; outer tepals lanceolate, tapered below, obtuse at apex, 6-12 mm wide, 35-57 mm long; inner tepals oblong, obtuse, 7-10 mm wide, 45-50 mm long. Stamens free, equal to or sligthly longer than style; filaments yellowish-green, 22-27 mm long; anthers orange, 1-2 mm wide, 6-11 mm long; pollen yellow to orange. Ovary 9-12(-15) cm long, style yellowish-green, 15-20 mm long; stigma trilobed, whitish-green or purple. Fruit capsule broadly cylindric. Seeds flat, papery, dark brown, with a membranous margin. Scent strong. *Fl.* 6-7.

Habitat. Wet, steep meadows, *Picea orientalis* and *Fagus* forest clearings, 1200-1700 m.

Distribution. North-East Anatolia.

World Distribution: Endemic to Turkey.

Threat Category: This species has an extent of occurence c. 5000 km^2. Therefore, it is convinient to assign it as endangered (EN).

Notes. The population in Çayeli differs from the other populations by having flower buds with greenish-yellow base and apex, not purplish. Flowers pale sulhur, throat and tips are also greenish yellow, not purplish, and flowers lack a purplish brown center (or much smaller than the other populations) and they are only sligthly spotted with purplish spots on the lower half. Although, the individuals of this population have different flower color characters, the differences are not enough to give this population a different taxonomical status.

Figure 16. *L. ciliatum*, Rize, Çayeli

Figure 17. *L. ciliatum*, Giresun

Selected Examined Specimens

- Giresun, Dereli, Tamdere, Karinca, Astrantia field, wet, steep hills, 1230 m, 40°33.942 N, 38°21.266 E, Nİ 1931, 24.06.2002; Dereli, Tamdere'ye 1-2 km kala, Corylus, Veratrum, Anemone, Astrantia, wet, steep hills, 1620 m, 40°30.934 N, 38°21.023 E; Nİ 1932, 25.06.2002; Dereli, 1-2 km to Tamdere, 1600 m, Nİ 1983, 18.08.2002.
- Giresun, 23 miles north of Şebinkarahisar on road to Giresun, 5000', J. Apold, P. A. Cox & P. C. Hutchison, 50A, 50B, E, 18.06.1962; Giresun-Şebinkarahisar, 64 km from Giresun, In grassy meadows in hazel scrub & sandstone, 1800, Stainton & Henderson, 5844, E, 25.06.1960; Şebinkarahisar-Giresun, Şehitlerden 9 km, 1800 m, N. Özhatay, 01.07.1984.
- Giresun, Belove Tamdere, In Fagus scrub, 1600 m, Davis 20621, E, 09.08.1952; Tamdere, Yedigözü Yaylalari, Laubwald 2 km N unter Tamdere, 1610 m, A. Huber-Morath, 14402, G, 01.07.1955.
- Giresun, Pontus australis: ad Karahisar.1600 m, E. Rodiger, B, 1899; Giresun, Armenia turc., ad Karahisar.1600 m, E. Rodiger, B, 7.06.1890. (as L. ponticum).
- Giresun,Yavuzkemal, Bicik, Schlag in Fichtenhochwald. Feucht, häufig Nebel, 1570, Kerck 45/1, W, 28.06.1961.
- Trabzon, Maçka, Hamsiköy'den 3-4 km ileride, Corylus, Aquilegia, Picea forest openings, 1400-1550 m, 40°41.041 N, 39°27.173 E, 1935, 27.06.2002; Maçka, 7-8 km far from Hamsiköy, Picea forest openings, Veratrum, 1600-1700 m, 40°39.937N, 39°25.966 E, Nİ 1938, 27.06.2002; Maçka, Zigana Pass, above Hamsiköy, 5500', E.K. Balls 1661, K, 12.07. 1934; Maçka, Pontic Range, Zigana Pass, Humus and rocks, at the edge of beech and fir

forest, 5000’, P. Furse and P.M.Synge 905, K, 05.07.1960; Maçka, Pontic Alps, Zigana Dagh, south slopes, growing on steep acid wooded slopes among scrub of Rhododendron, Pinus sylvestris etc., 5500’, E. K. Balls 1661a, K, 12.07.1934; Maçka, Zigana above Hamsiköy sheltered fern-filled gully near road, 5000', K. J. Guichard, K, 13.07.1960.

- Trabzon, N. side of pass from Bayburt to Rize, rich humus and stones open slope, facing North, covered thickly with Veratrum, Geranium, Anemone, Polygonatum, etc., 700 m, Furse & Synge 831, B, 04.07.1960; Bayburt-Of, 3 km. N. of pass top, Species-rich alpine pasture, 2400 m, Stainton & Henderson 6190, K, 11.07.1960.
- Trabzon, 45 miles south of Of on Of-Bayburt road, 6700’, J. Apold, P. A. Cox, & P. C. Hutchison 189B, 189A, E, 7.07.1962.
- Gümüşhane, Yağmurdere Girisi, between Yağmurdere and Araklı, Alpine meadows, together with L. armenum, 900-1670 m, 40°34.301 N, 39°51 E, Nİ 1941, 27.06.2002ç
- Gümüşhane-Trabzon, Gümüşhane’den 46 km, 1730 m, N. Özhatay, 10.06.1982.
- Rize, Ikizdere, Çamlik Köyü Riversides, wet meadows, 1410 m, 40°42.471 N, 40°39.717 E, Nİ 1952, 29.06.2002.
- Rize, Çayeli, Çataldere Köyü, Düzmezra, Karos'un alti, seyrek ladin ormani, 1600-1700 m, 40°52 N, 40°43 E, Nİ 2275, 09.07.2004.

3.2.5. *Lilium akkusianum* R.Gämperle in Quart. Bull. Alp. Gard. Soc. 66: 380, photos (1998).

Type: 25.6.1996. in Anatolia, secundum viam ab ünye ad Niksar, 6-7 km ab coemeterio Akkus vici, Niksar versus, in clivo viae, inter frutices fagorum, altitudo 1150 m, Leg. René Gämperle, (holo. Z; iso. ISTE).

Plant up to 150 cm. Bulb ovate, circumference up to 20 cm, bulb scales numerous, scales creamy white, lanceolate, acute, 5-7 mm wide, 32-40 mm long. Stem smooth, yellowish-green. Leaves numerous, alternate, sessile, getting narrower up to stem, lower leaves ovate to lanceolate, obtuse, 1.5-2.8(-35) mm wide, 8.6-14 cm long, median leaves lanceolate to very linear-lanceolate, acute 7-20 mm wide, 6.5-15.5 cm long, veins glabrous, leaf margins and leaf bases are with long lanate hairs; lower leaves almost glabrous; indumentum increases towards upper leaves. Inflorescence racemose, with 1-6(-12) flowers. Bracts lanceolate to linear lanceolate, very acute, 3-11 mm wide, 35-75 mm long, margins and base with long lanate hairs. Pedicels ligth green, sligthly drooping, 1.8-10 cm long. Flower buds shiny cream or greenish-yellow, strongly lanate, specially at apex, base greenish, rarely purplish. Flowers noding to pendulous, tepals sligthly to strongly recurved, outer tepals lanceolate, sometimes spathulate, tapered below, obtuse 69-90 mm long, 10-22 mm wide, inner tepals lanceolate, tapered below, obtuse, 65-82 mm long, 14-26 mm wide, ivory-white, with a darker central line, with or without chocolate dots, throat greenish-yellow, tips with long lanate hairs. Nectaries smooth, olive to ligth green. Stamens free, sligthly shorter than style; filaments whitish-green, 45-60 mm long; anthers orange or orange-red, 1-2 mm wide, 7-13 mm long; pollen orange. Ovary cylindric, 10-22 mm long, whitish-green. Style 42-52 mm long, whitish-green. Stigma trilobed, ligth yellowish-green or sometimes with a purple tinge. Fruit capsule cylindric. Seeds dark brown with a narrow membranous margin, flat. *Fl.* 6-7.

Habitat. Mainly *Fagus* forest clearings, but sometimes also found under *Oak, Pinus,* and *Fagus* mixed forests, 1160-1420 m.

Distribution : Central Black Sea Region.

World Distribution: Endemic to Turkey.

Threat Category: This endemic species is in endangered (EN) category because its extent of occurrence is approximately 2400 km^2 and it is known from only four localities.

Selected Examined Specimens

- Ordu, Akkuş, Gökcebayır Köyüne varmadan 1-2 km geride, Oak shrubs, Pinus, Daphnea, Fagus forest, 1270 m, 40°44.616 N, 37°01.681 E, Nİ 1929, Nİ 1928, 23.06.2002; Akkuş, 1380 m, 40°45.698 N, 37°02.052 E, Nİ 1982, 18.08.2002.
- Ordu, Başçiftlik, Başçiftlige 1-2 km kala, Fagus forest, Taxus, Lonicera, Prunus laurocerasus, Sanicula, 1360 m, 40°31.447 N, 37°07.459 E, Nİ 1930, 23.06.2002.
- Tokat, Erbaa, Madenli Köyü, Kayin ormani acikligi, Rubus, Sambucus nigra, S. ebulus, Phleum. Cok dik yamaclar, 1200-1220 m, 40°44 N, E 36°45 E, Nİ 2221, 21.06.2004; Erbaa, Gökal, Kızılotu orman deposu, Seyrek kayin ormani alti, 1410 m, 40° 48 N, 36° 35 E, Nİ 2222, 21.06.2004.

Figure 18. *L. akkusianum*

Figure 19. *L. akkusianum*

Figure 20. *L. akkusianum*, Tokat, Erbaa

3.4.6. *Lilium ponticum* K.Koch in Linnaea 22:234 (1849).

Boissier, Fl. Orient 5. 174 (1881).

Grossheim, Fl. Kavk. I. 218 (1928).

Komaraov, Fl. URSS 4. 293 (1935).

Synonyms:

L. artvinense Miscz. in Trudy Bot. Mus. Imp. Akad. Nauk 8: 191 (1911).

L. carniolicum Bernh. ex W.D.J.Koch subsp. *ponticum* (K.Koch) P.H.Davis & D.M.Hend. var. *ponticum* in Notes from the Royal Botanic Garden Edinburgh, vol. 41: 53 (1983).

L. carniolicum Bernh. ex W.D.J.Koch subsp. *ponticum* (K.Koch) P.H.Davis & D.M.Hend. var. *artvinense* (Miscz.) P.H.Davis & D.M.Hend. ibid.

L. georgicum I.Manden. in Trudy Tbilisskogo Botaniceskogo Instituta, vol. 8:180 (1941).

L. pyrenaicum Gouan subsp. *ponticum* (K.Koch) V.A.Matthews var. *ponticum* in Matthews, V. *Lilium pyrenaicum*: a complex species. Kew Mag., 1(1):36-43 (1984).

L. pyrenaicum Gouan subsp. *ponticum* (K.Koch) V.A.Matthews var. *artvinense* (Miscz.) V.A.Matthews ibid.

L. szovitsianum sensu Tchih., Flore De L'Asie Mineure. Paris (1860).

L. szovitsianum subsp. *ponticum* (K.Koch) Kudrjasch. in Genus *Lilium* L. In Caucaso. Novitates Systematicae Plantarum Vascularium. Vol 8: 95-109. Leningrad (1971).

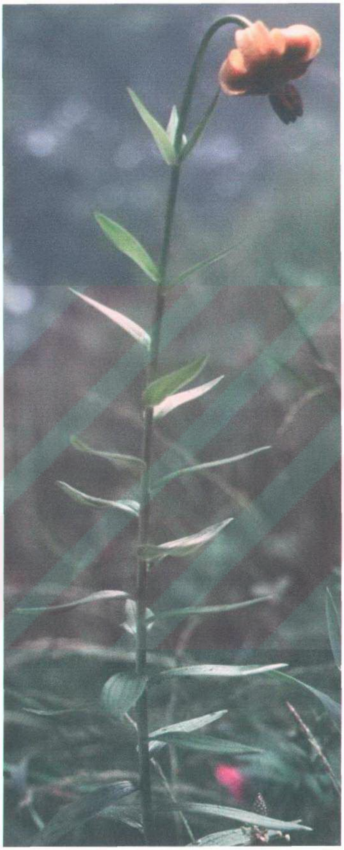

Figure 21. *L. ponticum*

Figure 22. *L. ponticum*

Iconibus: Lily Year Book 3: f. 30 & 31 (1934), as *L. szovitsianum* Fisch. & Avé-Lall. and *L. monadelphum* M.Bieb.

op. cit. 27: f. 26 & 27 (1963).

op. cit. 33: t. 29(e) (1970), as *L. ponticum* var.*ponticum.*

Type: (Turkey A8 Rize) im Hochgebirge des Trebisonder Paschalik, namentlich in den Gauen Risa (Rize) and Hemschin (Hemşin) auf Porphyr und Urgestein, 1830-2135 m, K.Koch. (holo. B, Possibly destroyed during 2. World War).

Plant 20-100 cm. Bulbs small, ovoid, scales numerous, lanceolate, acute, bulb circumference 7-12 cm, 2-3 stem roots present. Stem smooth, glabrous, purplish near base, green in upper part. Leaves numerous, alternate, sessile, elliptic to lanceolate or linear lanceolate, 6-15 mm wide, 40-100(-180) mm long, lower leaves wider and shorter than upper leaves, leaves getting shorter up to stem, leaf margins glabrous, short hispid hairs present on the veins of lower surface of leaves. Inflorescence racemose, with up to 15 flowers, usually 1-6. Bracts sessile, equitant, obovate to lanceolate, tips purplish, 4-13 mm wide, 20-48 mm long. Pedicels slightly drooping, 15-65 mm long. Flower buds shiny yellow to greenish-yellow, glabrous, at base purplish-green, apex purplish. Flowers nodding to pendulous, in turk's cap shape, strongly recurved, when fully open closing tube, flower color very variable, changing from bright light yellow to deep orange, sometimes lower 2/3 part deep purple or with purple spots, sometimes apex purplish. Perianth segments 5-11 mm wide, 15-45 mm long, apex papillose, at base and tips and throat purplish; outer tepals oblanceolate, inner elliptic, acute, reflexed. Stamens free, filaments whitish-green, 10-25 mm long, 0.5-1 mm wide; anthers 6-10 mm long, 1.5-2 mm wide, when young dark purple then turning to brick-red; pollen orange or orange red. Ovary cylindrical, 9-17 mm long, style green, 11-15 mm long, stigma purple, getting curved in fully open flowers. Fruit capsule conical-globose, greenish brown, 3.2-4.2 cm long, 2.2 cm in diameter. Seeds brown with a narrow membranous margin, flat, 6-7 mm in diameter. Scent not too strong. *Fl. 6-7.*

Habitat. Wet meadows on slopes, among *Corylus* shrubs, *Picea* forest clearings, *Alnus* forests, among *Rhododendron* and *Corylus* bushes or in rocky areas, 400-2050 m.

Distribution. North-East Anatolia.

World Distribution: Georgia.

Threat Category: *L. ponticum* with an extent of occurrence of c. 4500 km^2 in Turkey. Therefore, it should be assessed in the endangered (EN) category.

Notes. This species was treated by Davis (1984) as subspecies of *L. carniolicum* and by Matthew (1984) as subspecies of *L. pyrenaicum* together with other European Carniolicum group of lilies. We prefer to treat it as a separate species in the light of the results of our molecular studies. Phylogentic analysis of the ITS sequence data and the evaluation of the RAPD data showed that *L. ponticum* has a separate evolutionary history than both *L. carniolicum* and *L. pyrenaicum. L. ponticum* was clustered together with the other pontic-caucasian lilies which are actually morphologically less similar to *L. ponticum* than *L. carniolicum* group of lilies. However, parallel evolution of flower structure is seen in distinct group of lilies. Here again such a parallel evolution may have occurred at the same time in the Balkans and in Caucasia separately, resulting in similar morphological patterns.

We reduced *L. artvinense* to synonymy of *L. ponticum* after a through population level field study. There are no morphological differences between these two taxa. Flower color is very variable within *L. ponticum*. Therefore, any taxonomical assestment depending on flower color will not make any sense. Additionally, distinguishing characters mentioned in Flora of Turkey (Davis, 1984) can be seen in both *L. artvinense* and *L. ponticum* populations.

Selected Examined Specimens

- Trabzon, Above Trabzon, 700 m, E. K. Balls.B 388a, K, 23.07.1933.
- Trabzon, Bayburt-Of, 3 km N of pass, species rich alpine pasture. Corolla orange-yellow, often with brown markings. 2400 m, Stainton & Henderson 6191, E, 11.7.1960; Of, 35 miles south of Of on Of-Bayburt road. On open slopes, often in lush meadow, although sometimes in poor stony soil, occasionally among azalea scrub, 3000-6000', J. Apold, P. A. Cox, & P. C. Hutchison.156A-156B, 4.07.1962 (as var. artvinense). Trabzon, N. side of Pass from Bayburt to Rize, Humus pockets among igneous rocks, 6000', Furse & Synge 832, K, 04.07.1960.
- Trabzon, Çaykara, N. slope of Soganli dag above Çaykara, bushy slopes (granite), 1600 m, Davis & Hedge D32097, K, 05.08.1957; Çaykara, Soganli Gecidi, north side (Of-Bayburt track), edge of conifer forest by track, 5500', K. M: Guichard, K, 19.07.1960; Çaykara, Soganli Pass, hay slopes, P. Furse 4004, K, 17.08.1962; Çaykara, Uzungöl, steep, wet meadows, Picea forest openings, Corylus, 950 m, 40°37.519 N, 40°16.929 E, Nİ 1947, 28.06.2002; Çaykara, above Kabataş village, Alnus forest, 800 m, 40°45.270 N, 40°16.068 E, Nİ 1948, 28.06.2002; Trabzon, Çaykara, Kabatas Koyu

Yukarisi. Paziha Yaylasi, Wet meadows, 1200 m, 40°44.794 N, 40.17.493 E, Nİ 1945, 28.06.2002; Çaykara, Kabataş Köyü, S. Ayaz 1018, 23.08.1983; Çaykara, Paziha Yaylasi, Steep meadows, upper limit, 1650 m, 40°44.979 N, 40°.18.312 E, Nİ 1950, 28.06.2002; Çaykara, above Uzungöl, Stony meadows, Rhododendron luteum, 1700-1860 m, 40°34.739 N, 40°17.461 E, Nİ 1949, 28.06.2002; Çaykara, above Uzungöl, Stony alpine meadows, 1700-1900 m, Nİ 1985, 11.09.2002; Çaykara, Above Uzungöl, Soganli Mountains, Alpine meadows, stony. Upper limit, 2050 m, 40°34.077 N, 40.17.631 E, Nİ 1944, 28.06.2002.

- Trabzon, Haldizan, S.E. of Trabzon.7500', B 1661F, B, 11.08.1934.
- Trabzon, Sürmene, Köprübaşı, Erica, ferns, Pine plantation field, 420 m, 40°51.530 N, 40°06.204 E, Nİ 1946, 28.06.2002; Sürmene, 300 m, E. K. Balls B388B, K, 25.07.1933.
- Rize, Gül Yayla to Chokje. Growing in steep meadows above scrub and tree levels. Much broken rock in acid soil, 8000', E. K. Balls 1661B, K, 31.07.1934.
- Rize, Ikizdere, Çamlik Köyü Cikisi, Steep wet meadows, among Corylus shrubs., 1480-1560 m, 40°41.849 N, 40°41.228 E, Nİ 1953, 29.06.2002; Ikizdere, Ispire dogru, Alpine meadows, Lonicera, Rubus, upper limit, 1770 m, 40°40.715 N, 40°42.479 E, Nİ 1954, 29.06.2002; Ikizdere, Ispire doğru, 880 m, 40°43.689 N, 40°36.090 E, Nİ 1955, 29.06.2002; Ikizdere, road valley from Rize to Ispir, near Ikizdere. Steep N. E. bank of lush moist pasture with occasional rock outcrops and briars, among lower areas of Rhododendron scrub, also on E banks, 5000', J. M. Watson 262, K, 25.06.1964; Ikizdere, between Ikizdere and Cimil, Ö. Cavas 7157, K, 12.08.1962; Ikizdere,

Yetimhoca (Cimil).Grassy slopes, 2100 m, Davis 20988, Dodds 20988, K, 27.08.1952; Ikizdere, Kalohar Köyü üstü, 1700 m, 40°39' N, 40°37' E, A. Güner 11587, 15.09.1993.

- Rize, Güneysu, Region Montagnense du Lazistan, B. Balansa 1531, JE, 06.09.1866.
- Rize, Çamlıhemşin, Çatköy, Steep meadows, R. luteum, Picea, Corylus, 1400, 40°51.977 N, 40°56.237 E, Nİ 1958, 30.06.2002; Çamlıhemşin, Steep meadows, R. luteum, Picea, Corylus, 1500 m, Nİ 1959, 30.06.2002; Çamlıhemşin, Nordhang des Kackar-Massivs oberhalb der Kavrun Yayla, 1800-2100 m, H. Ern, B, 10.09.1980; Çamlıhemşin, Kale-i Köyü, 1900 m, 40°48' N, 40°56' E, A. Güner 11617, 19.09.1993.
- Artvin, 5 miles from Mersivan, dense scrub and woodland on a steep bank by the roadside, 5200', J. Apold, P. A. Cox, & P. C. Hutchinson, 145D - 145C, E, 30.06.1962; 5 miles from Mersivan, Dense scrub and woodland on a steep bank by the roadside, 5200', J. Apold, P. A. Cox, & P. C. Hutchison.145A & 145B, E, 30.06.1962; Artvin, Hill above town, in wet banks in Rhododendron ponticum-flavum thicket, Stainton & Henderson 5941, K, 01.07.1960.
- Artvin, Above Kafkasör, Picea forest clearings with Populus, Rhododendron, 1440 m, 41°09.327 N, 41.46.824 E, Nİ 1960, 01.07.2002; Artvin, above Kafkasör, Corylus and Rhododendron shrubs, 1350 m, 41°09.188 N, 41.47.182 E, Nİ 1961, 01.07.2002.
- Artvin, Hatilla Valley (National Park), Picea forests, Rhododendron, 1450 m, 41°06.577 N, 41°39.100 E, Nİ 1963, 02.07.2002; Artvin, Hatilla Valley, Nakenav Village, Above Aripinar, Cayirlik Mevkii., Picea forest openings,

Rhododendron luteum and R. ponticum shrubs, along roadsides., 1700-1900 m, 41°07.913 N, 41°36.771 E, Nİ 1964, 02.07.2002.

- Artvin, in habidis sylvaticis foucius Laschachew deresi, G. Woronow, FI, 1907.
- Artvin, Prope Salalet ad margines sylvae et in pratis sylvaticis, 5000-6000', G. Woronow, JE, 14.06.1911; Lazistani Russica, ad margines slvae prope Salalet, G. Woronow, M, 01.07.1910.

3.2.7. *Lilium kesselringianum* Miscz. in Trudy Bjuro. Prikl. Bot. 7:251, t.117 f. 1 and p.243, f. 712c, (1914).

Grossheim, Fl. Kavkaza I. 218 (1928).

Kesselring, W. in RHS Lily Year Book I. 68. figs. 14, 15 (1932).

Komarov, Fl. U.S.S.R, vol. 4. 293 (1935).

Iconibus:

Woodcock, H.B.D., Stearn, W.T. Lilies of the World f. 68 (1950).

Lily Year Book 33: t. 29 (d) (1969).

Ferns, F. E. B., 1878. Consider the Lilies. Quart. Bull. Alp. Gard. Soc., 46(1): 41.

Type: Based on cultivated material collected in the Caucasus by Mme. Woronow, probably from Sukhumi district. Lectotype (designated by Davis & Henderson in Lily Year Book 33: 222, 1969): the coloured plate cited with the original description.

Figure 23. *L. kesselringianum*

Figure 24. *L. kesselringianum*

Figure 25. *L. kesselringianum*

Plant up to 170 cm. Bulbs broadly ovoid, scales numerous, ovate to lanceolate, yellowish-cream with yellow stripes. Stem smooth, ligth green. Leaves numerous, lower leaves oblong to lanceolate, veins beneath and margins with setulose hairs, 1.5-2(-2.7) cm wide, 6-9(-12) cm long; median leaves lanceolate to linear lanceolate, tapered at both ends, very acute, leaf margins papillose, veins with dense setose hairs, 0.9-1.5 cm wide, 10-12.5(-18) cm long. Inflorescence racemose with 1-6(-8) flowers. Bracts lanceolate, margins and underneath surface with setose hairs, at apex purplish, (2-)4-10 mm wide, 35-52(-7) mm long. Pedicels nodding to pendulous, 4.8-5.5(-8) cm long. Flower buds cream or greenish-yellow, at base and apex purplish. Flowers infundibular-recurved, not closing tube, ligth cream to pale straw-yellow, at base and apex purplish, with or without fine chocolate spots, with a central darker yellow line. Outer tepals linear lanceolate, apex tuberculate, 7-1.2(-1.6) cm wide, 6.5-8.5(-10) cm long. Inner tepals narrow oblanceolate, tapered below, 1.3-1.5(-2) cm wide, 7-8(-10) cm long. Stamens free, shorter than style; filaments ligth green, 32-42 mm long; anthers purple, 1.5-2(-2.5) mm wide, 8-10(-12.5) mm long; pollens yellowish brown or dirty yellow. Ovary 12-17.5(-2.5) mm long. Style whitish-green, curved, 30-37 mm long; stigma purple, rarely yellowish-green with only a small touch of purple. Fruit capsule round to cylindric, dark purple-brown, 1.2-2.4 cm in diameter, 3-4 cm long. Seeds flat, brown to dark brown, with a narrow membranous margin, 4-7 mm in diameter. *Fl.* 6-7.

Habitat. Under *Pinus, Picea,* and *Abies* forests, sparse *Picea* forests with *Rhododendrons*, 1450-2100 m.

Distribution. North-East Anatolia.

World Distribution: Abhasia, Georgia.

Threat Category: *L. kesselringianum* has an extent of occurrence of c. 4000 km^2 in Turkey, so it is asigned as endangered (EN).

Notes. In some flowers, position of bracts (or there are bracteoles?) different from other turkish lilies. It is present just below the middle of pedicel. This character was seen in few *L. armenum* specimens too.

Seleceted Examined Specimens

- Artvin, Borçka, Above Gorgit Yaylasi, Steep meadows, Veratrum, 1700-1730 m, Nİ 1899-1900, 27.6.2001; Borçka, Between Camili and Borçka, Steep meadows, among sparse Corylus shrubs, 1530 m, Nİ 1901, 28.6.2001; Borçka, Karagöl, Picea forests, Rhododendron, Fagus, Alnus, Vaccinium, 1620 m, 41°22.400 N, 41°51.752 E, Nİ 1975, 06.07.2002; Borçka, Otingol (Balci), around Balci Deresi, up to Kaynarca Yaylasi, Sparse Picea forests with Rhododendron, 1700-1950 m, 41°19.650 N, 41°56.126 E, Nİ 1976, 06.07.2002; Borçka, Balcı, Nİ 1986, 12. 09.2002; Borcka, Otingol, on shady slopes. 1800 m, Stainton & Henderson 6001, E, 04.07.1960; Borçka, Gorgit Beyazsu yaylasi, Orman içi açıklık ve çayırlıklar, 2000 m, AG 12496, 12.07.1997.
- Artvin, Ardanuç, Peynirli Köyü, at higher elavations under very old Pinus forets and at lower elavations under Picea forests, 1800-2100 m, 40°59.328 N, 42°04.729 E, Nİ 1965, 03.07.2002; Peynirli Köyü, Quercus, Picea, Carpinus forest openings, lower limit, 1450 m, 41°00.112 N, 42°02.500 E, Nİ 1966, 03.07.2002; Peynirli Köyü, Yukari Evhari, Picea forest openings, meadows, Nİ 1967, 03.07.2002; between Ardanuç and Bilbilan, Picea forest, 1700 m, 41°05.859 N, 42°09.001 E, Nİ 1968, 04.07.2002; Ardanuç, Peynirli

Köyü, Çukur Çayırlar Mevkii, 1700-2300 m, 02.08.1984; Ardanuç, Ardanuç-Kordevan Dag (Artvin-Ardahan), lush meadow at edge of Picea forest. 1450 m, Davis & Hedge D. 30111, E, 27.06.1957; Ardanuç, Coruh Ardanuç-Kordevan Dag (Artvin-Ardahan). Lush meadow at edge of Picea forest, & in forest verge. 1700 m, Davis & Hedge D.30099, E, 27.06.1957; Ardanuç, direction Ardanuç-Yalnizcam, approx. 53 km east of Ardanuç. Mixed forest 1850 m, Pasche & Taubenheim P + T 75/157, E, 1.07.1975; Ardanuç, Pasanuri, oberhalb Berg Bilbiliani 1200-2000 m, F. K. & J. Meyer 13898, JE, 09.06.1982.

- Artvin, 6 km to Şavşat (from Ardahan), around Kocabey Village, Fagus forest, 1550 m, Nİ 1970, 04.07.2002; Şavşat, 20 km E of Şavşat (3 km E Karaköy) Felsblockhalde mit Hochstauden 2200-2300 m, Dr. Friederike Sorger 81-76-10, W, 08.08.1981; Şavşat, 5 km E of Şavşat above above Yavuzkoy, foothills and valleys, igneous, bare sports, cornlands, few, local, 1300 m, M.J. Cheese, A, C & W 3197, E, 11.07.1967.
- Artvin, Yalnizcam Silsilesi 10 km E.S.E. of Şavşat 2400 m, Albury, Cheese and Watson 3197, K, 10.07.1967.
- Artvin, Alaca (Tiryal) Dag, E. Side, Düzler Mevkii Moist places 1540 m, A. Duzenli 835, E, 13.07.1977.
- Artvin, Karanlik Meşe östl. von Artvin gegen Ardahan Feuchtwiese von Bach, Fichtenhochwald, Haselbusch umgrenzt, 1250 m, Kerck 37, W, 17.06.1961.
- Ardahan, Posof, Above Alköy, between Elekler Deresi and Değirmenler, Picea forest with Corylus, Pinus, Salix, 1660-1750 m, 41°28.519 N, 42°46.677 E, Nİ 1974, 05.07.2002; Posof, Damal, Arap mezarlarindan

Derindere Köyüne orman yolu boyunca orman içi, 2400 m, Demirkus 3258, 03.08.1986; Posof, Camyazi-Asmakonak Köyünden Posof'a orman yolu boyunca, 1600-2000 m, Demirkus 2917. 25.08.1985; Posof, Ulgar Dağından Çamyazı Köyü, Huran Mevkiinden Alköyüneö 1586-2730 m, Demirkus 3543, 16-20.06.1986.

- Georgia: Abchasia, Rezervatum Ritza-Avadcharense, brachia occidentalia montis Adzhara in limite regionum silvatici et subalpini, in altiherbosis subalpinis. E, 12.07.1964.
- Georgia: Svanetia superior (=Zemo Svanethi): Caucasus Major. In valle suprema flum. Inguri (circa pedem meridion. Montis Schara): In montibus a pago Usguli (=Cazasi) c. 1-3 km meridionali-orientem versis: (a) in rupestribus graminosis (b) in pascuis herbosis (C) in altherbosis betuletis (subalpinis). Substr. Ton schiefer. 43°04/42°55 Manfred A. Fischer, Elvira Hörandl, Franz Hadecek 8911, W, 23.07.1988.
- Georgia: Caucasus occidentalis: distr. Gulripsh: vicinitas pagi Sakeni latior, in declivibus septentrionale-orientalibus montis Lachult. 1600-2000 m, V. Vasak, W, 14.07.1979.

3.2.8. *Lilium monadelphum* M.Bieb., Flora Taurico-Caucasica I: 267 (1808).

Plant 60 to 120(-180) cm tall. Bulb ovoid, 4.5-6.5 cm in diameter, scales numerous, lanceolate, 8-11 mm wide, 3-3.6(-5) cm long. Leaf veins beneath and margins with short setulose hairs; lower leaves elliptic, 1.5-2.3(-4) cm wide, (4.5)7-9(14.5) cm long; median leaves linear-lanceolate or lanceolate, acuminate, (8-)11-14(-21) mm wide, 5.5-11(-14.5) cm long. Inflorescence racemose with 1-5(-13) flowers. Bracts lanceolate, veins beneath shortly setulose, base purplish, 0.6-1.6 cm wide, 3.5-5(5.6) cm long. Pedicels whitish-green, slightly nodding, 2.8-3.5 cm long. Flower buds greenish-yellow, base and apex purplish. Flowers nodding to pendulous, yellow or lemon yellow with dense or few or rarely without fine purplish dots, base purplish, throat greenish-yellow, apex papillose, sometimes purplish, loosely recoiled, not hiding tube; outer perianth segments oblong, rarely spatulate 9-18 mm wide, (6-)7.5-12 cm long, inner perianth segments lanceolate, acute, 18-22 mm wide, 8.5-10.2 cm long. Stamens free, rarely monadelphous; filaments whitish-green, 4.2-5.8(-6) cm long; anthers orange or purple, 2 mm wide, 7-11(-17) mm long; pollen dull orange to orange or yellow. Ovary cylindric, (13-)16-22(-25) cm long; Style greenish-yellow 2.8-4.4 cm long; stigma purple or rarely yellowish-green. Fruit capsule dark purple or greenish-brown, broadly cylindrical, 2.5 cm diameter, 56 cm long. Seeds shiny brown, papery, with a membranous narrow margin, 6-8 mm in diameter. Scent strong and pleasant. *Fl.6- 7.*

1. Perianth segments 9.6-12 cm long; anthers 10-17 mm long; style 3.5-4.4 cm long **var. *szovitsianum***

1. Perianth segments 6-7.8 cm long; anthers 7-11 mm long; style 2.8-3.6 cm long **var. *armenum***

Var. *szovitsianum* (Fisch. & Avé-Lall.) Elwes, Monogr. *Lilium* t. 37 (1880).

Synonyms:

L. szovitsianum Fisch. & Avé-Lall. in Index Hortus Petrop vi, 16 (1839).

L. loddigesianum Spae in Ann. S. Agr. B. Gand. 2. 363, t. 85 (1849).

L. colchicum Stev. Ledebour, Fl. Ross. 4. 150 (1852).

Iconibus:

Elwes, Monograph of the Genus *Lilium*, 1. c. tab. 36.(1880).

Woodcock and Stearn, fig. 107. pg. 298 (1950).

Synge, P. M. Lilies t. v as *L. szovitsianum* (1980).

J.E.P., Flore des Serres 5., t. 507-509, as *L. szovitsianum* (1849).

Type: (Caucasia) in Colchide, Szovits (probably from Adjaro-Imeretia in Georgia, fide Manden., op. cit. 192 (1941), (holo. in Leningrad).

Habitat. Wet, steep, and stony meadows with Rosa sp. bushes, 1880-1950 m.

Distribution. North-East Anatolia.

World Distribution: Southern Georgia and Armenia.

Threat Category: This variety has a single and very small population in Turkey, and is the most showy Turkish lily. Therefore, care should be taken to prevent its overcollection or habitat destraction. Regarding its Red List Category (IUCN, 2001), we can say that it is critically endangered (CR) if we consider only turkish population (criteria; number of mature ind less than 250, extent of occurrence less than 100 km^2, area of occupancy less than 10 km^2).

Figure 26. *L. monadelphum* var. *szovitsianum*

Figure 27. *L. monadelphum* var. *szovitsianum*

Selected Examined Specimens

- Ardahan, Çıldır, Above Aktaş Lake (Hozapin Gölü). Wet, stony meadows, 1880-1930 m, 41°16.776 N, 43°11.869 E, Nİ 1973, 05.07.2002; Çıldır, Kenarbel Köyü, Ercan Mevkii, 1900-2000 m, G. Akgül 1580, HUB, 29.06.1996; Ardahan: Hanout, 7000', E. K. Balls 462, E, 6.07.1933.
- Georgia: Caucasus occidentalis: distr. Chokhatauri, ad orientem versus pagi Bakhmaro, montes Meskhetski khrebet, in declivibus montis Mzis amosvlis gori, 2000-2300 m, V. Vasak, G. Esvandzhia, M, 23.07.1979.
- Georgia: Khartli, SW Tbilissi, Nordöstliche Ausläufer des Trialetzki-gebirgs-zuges des Kl. Kaukasus, zwischen Mannglisi und Zalka: b. Gochnuri subalpine Hochstandenfeur, Peter Schmidt, JE, 12.06.1969.
- Georgia: Tiflis, Borzhom, Prope pagum Bakuriani. Transcaucassia occidentalis, centralis et australis.ad marginem silvae, 1500 m, V. Kozlovsky 329, K, 05.07.1925.
- Georgia: Pasanauri, Hochstadenflora im Bergwald des Nebenflusses der Weißen Aragwi nahe Wasserfall, Ch. Beck B, 11.07.1971.

Var. *armenum* (Miscz. ex Grossh.) P.H.Davis & D.M.Hend., Flora of Turkey, vol. 8: 283 (1984).

Synonyms:

L. szovitsianum Fisch. & Avé-Lall. var. *armenum* Miscz. ex Grossh., Fl. Kavk. 1:219 (1928).

L. armenum (Miscz.) Manden. In Trudy Tbilisskogo Botaniceskogo Instituta 1941, vol. 8: 195.

Iconibus:

Balls in R.H.S. Lily Year Book 3: f. 28 & 29 (1934), as *L. monadelphum.*

Lily Year Book 33: t. 29 (b) (1969), as *L. szovitsianum* var. *armenum.*

Type: Described from Darachichagh in Soviet Armenia (holo. in Tbilisi).

Habitat. *Alnus* forests, wet meadows, field borders, *Abies* forests, 200-1700 m.

Distribution. North-East Anatolia.

World Distribution: Georgia and Armenia.

Threat Category: This variety has an extent of occurrence of approximately 4800 km^2 in Turkey. Therefore, it is considered in the endengared (EN) category.

Selected Examined Specimens

- Ordu, Ulubey, Ohtamis Köyü, Tepekisla Mah., Nemli, dik cayirlar, 1000 m, 40° 49 N, 37°38 E, Nİ 2223, 22.06.2004.
- Giresun, Bulancak, Demircik Köyü, Kayaliklarin üzeri,yol boyunca seyrek, Nİ 2224, 23.06.2004; Bulancak, Bayindir Köyü, Nemli cayirlar, new Corylus plantation area, Aquilegia, Peducularis, 1040 m, 40°43 N, 38°77 E, Nİ 2225, 23.06.2004; Bulancak, Seyrek ladin ormani, taslik alanlar, Rhododendron luteum ve R. ponticum, 1470 m, Nİ 2226, 23.06.2004.
- Giresun, Tirebolu, Ketençukur Köyü, meadows with Erica bushes, 600 m, 40°54 N, 38°51 E, Nİ 2234, 24.06.2004.

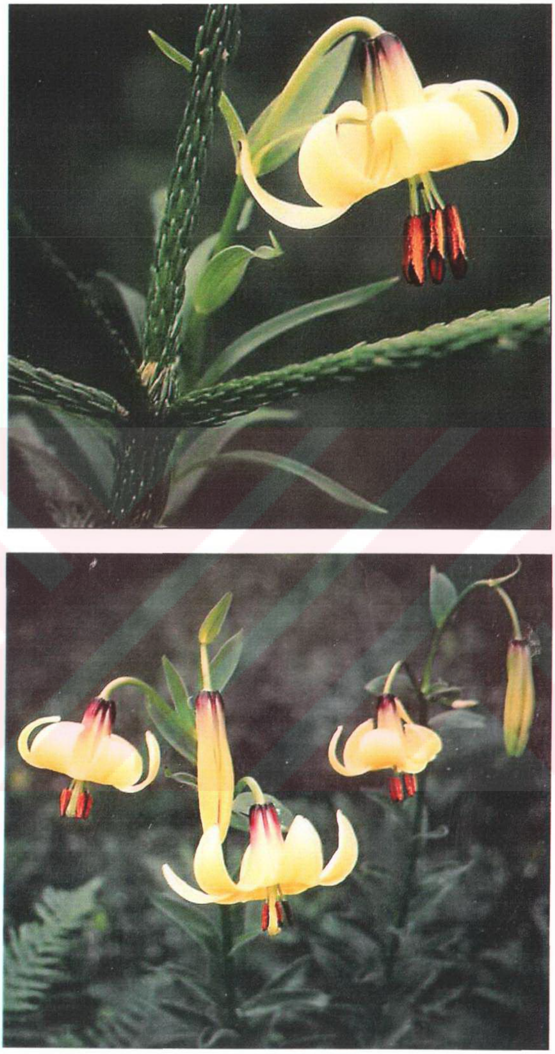

Figure 28. *L. monadelphum* var. *armenum*, Trabzon, Tonya

- Trabzon, Tonya, Kadiralak Yaylasi, wet, steep meadows, sparse Alnus and Picea forest clearings, 1300-1400 m, Nİ 1903, 2001; Tonya, Lazu, Alnus forests, Rubus shrubs, wet, steep meadows, 1030 m, 40°55.754 N, 39°16.724 E, Nİ 1933, 25.06.2002; Tonya, Lazu, Ruş, Alnus forests, potato field borders, 1140 m, 40°55.754 N, 39°.15.857 E, Nİ 1934, 26.06. 2002.
- Trabzon, Maçka, 3-4 km from Hamsiköy. Corylus, Aquilegia, Picea forest openings, 1400-1550 m, 40°41.041 N, 39°27.173 E, Nİ 1936. 27.06.2002; Maçka, Above Hamsiköy, Picea forest clearings with Veratrum, Rumex, Urtica, 1600-1700 m, 40°39.937 N, 39°25.966 E, Nİ 1937, 27.06.2002; Maçka, above Hamsiköy, Picea forest openings, 1600-1700, 1984, 11.09.2002.
- Gümüşhane, just after the Zigana Pass, Abies forests, steep hills, among Quercus shrubs, 1580 m, 40°38.836N, 39°21.684 E, Nİ 1940, 27.06.2002.
- Gümüşhane, Yağmurdere entrance, between Yağmurdere and Araklı, meadows, 900-1670 m, Nİ 1942, 27.06.2002; Gümüşhane, 4 km from Yağmurdere, Picea forest openings, with *L. ciliatum*, 1580 m; 40°35.820 N, 39°53.567 E, Nİ 1943, 27.06.2002.
- Trabzon, Vakfikebir, Mesonrack 7400', E. K. Balls, K, 04.07.1933; Fol, Vakfikebir, In ditione vici Fol Köy (ad austro-occid. Trapezunti) in glareis Minae Efkiar ad marginem silvarum. Substrato eruptivo 1600 m, Handel-Mazzetti 482, WU, 12.07.1907.
- Trabzon, Above Trebizond Growing among dense Rhododendron and Vaccinium, acid soil. 7000 ft, E. K. Balls B1565a, E, 5.7.1934; Trabzon, Boztepe above Trabzon Shady woods by paths 200', D. W. Winfield TUR/141/62, E, 06.1962.

- Trabzon, Maçka, Zigana Pass, south slopes Growing on steep acid slopes among turf and rank herbage, also with Rhododendron and Liliums of the B1661 group. Quite sunny warm exposure, 5600', E. K. Balls 1565c, K, 12.07.1934; Maçka, above Maçka, (left side of valley) Growing in rocky soil among azalea, Rhododendron etc. 3000', E. K. Balls B388D K 18.07.1933; Maçka, Meryem Ana, SSÖ von Maçka Ueberwachsenes Geröllfeld schatts. 1300 m, Kerck 36, W, 11.06.1961; Maçka, Right side of valley, E. K. Balls B388E, E, 19.07.1933; Maçka, Zigana Pass, south slopes Growing on rich acid slopes among ? Linf and sand herbage, Also with Rhododendron and Lilium of the B1661, 5600', E. K. Balls B1565e, E, 12.7.1934; Maçka, Between Zigana Pass and Hamsiköy, Bekciler semti. 1600 m, K. Karamanoglu, M. Guley, H. & N. Tanker, M. Koyuncu 3324, E, 17.7.1970; Maçka, Picea orientalis wald 4 km ob Hamsiköy 1420 m, A. Huber-Morath 14403, G, 04.07.1955.
- Trabzon, Maçka, N. side of Zigana Pass; Edge of beech & spruce forest; Furse & Synge, B; Maçka, Hamsiköy, 4450', E. K. Balls B1565b, K, 11.07.1934; Maçka, Zigana Pass, E. Yayla, Clearing in spruce forest. 5000', P. Furse 4114, K, 22.08.1962; Maçka, Edge of beech & spruce forest, Furse & Synge 833, K, 05.07.1960.
- Trabzon, Sürmene, Bulbs collected on moist slopes at 1600 ft. on other side of mountain chain. 300 m, E. K. Balls B388B, E, 25.06.1933.
- Gümüşhane, 44 km NW of Gümüşhane on Torul road, steep roks above road in Zigana Pass. Edge of Pinus forest, 1730 m, Margeret Johnson JOHM74, K, 07.1982.

- Erzurum, Olur, Salacur Village, Sumat Mahallesinin Goller Yoresi 2300 m, M. & N. Tanker, M. Koyuncu, R. Apaydin 3173, E, 02.07.1970.
- Armenia: Lake Sevan to Dilizhan, north side of pass. Steep roadside slopes. 1980 m, Francis Ferns 5248, E, 13.06.1979.
- Armenia: Kotayk Hrazdan, 2 km W of Tsaghkadzor, mountain Teghensis (= Ali Bek), area between upper and lower lif station Quercus macranthera forest, 2100 m, 40°32 N, 44°41 E, Ch. Oberprieler 10077, B, 16.06.2002
- Armenia: Gegharunik, Sevan, ca. 10 km SSW of Sevan, Gegham Range 8 km SSE of village Lchashen, Polposht Subalpine meadows and high grasses, 2180 m, 40 26 N, 44 57 E, Ch. Oberprieler 10064, B, 14.06.2002.
- Armenia: N.W. shore of Lake Sevan, Grassy hillside, near bushes, V.A.Matthews 1054, E, 13.06.1979.

Selected Specimens Examined (for non-Turkish Lilies)

L. chalcedonicum L., Sp. Pl. I: 302 (1753).

- Greece: Upper part of Metamorphosis Village, 1160 m, 40°40 N, 21°58 E, Nİ 2255, 30.06.2004.

L. ledebourii (Baker) Boiss., Fl. Or. 5:175 (1881).

- Iran: Gilan, Near Damesh-East of Rudbar, Meadows between scrub forest, 0.5-1.5 m high, 2-15-flowered, flowers white-yellowish, green towards base, with small purple dots, 1700 m, P. Wandelbo & Ann Ala 18234, E, 21-22.6.1975.

L. rhodopaeum Delip. In Naučni Trud. Agron. Fak. Plovdiv 1: 219-224 (1952).

- Greece: Dramas, Rhodopi mountains, N of Zagradenia forest station, area called Trigono near the Bulgarian border; Meadows in opening of Picea abies forest. Crystalline schist; 1800-1850 m, L. Farsakoglou, R. Franzen, & A. Strid 19503, B, 25.07.1981.

L. pomponium L., Sp. Pl. I. 302 (1753).

- France: Alpes Maritimes, mont Aution, Les rochers, E. Reverchon 29, B, 17.06.1885; Alpes-Maritimes, E. Reverchon, B, 16.06.1885
- France : Rana-Alpes: Aurent Reverchon, B, 17.08.1886.
- Italy: Riviera di Ponente, Testa d'Alpe Dinter, B, 08.1893.
- France: Pentes herbeure, ro cailleures calcaus, 1040, Caussols, Col du Ferrier, B, 18.08.66.
- France : Basses Alpes, E. Reverchon & A. Derbez 29, B, 15.06.1886; Basses-Alpes. Flurent, E. Reverchon, B, 29/6-17/8.1886.

L. pyrenaicum Gouan, I11. Obs. Bot. 25 (1773).

- France: Gedre (Hautes-Pyrénées), Bordere, B, 06.1867; Gedre, Hautes-Pyrénées, Bordere, WU, 06.1871; Gedre, Hautes-Pyrénées, Bordere, WU, 06.1872; Gedre, Hautes-Pyrénées, Bordere, 95, WU; Gedre, Hautes-Pyrénées, Juillet, WU; Gedre, Madril Ferei, 1500 m, Bremmer, WU, 24.06.69; Gedrel, Tülün, E, 1868; Gedre, Hautes Pyrenees, Salpiniere de Madril (Luz).1500 m, Bordere, WU, 07.1887; Gedre (Hautes-Pyrénées), Sapiniere de Madril.1500 m, B, 07.1881.

- France: Sur les schistes dans les ravins de la foret de Barrancoueii pres d'Arreau (Hautes-Pyrénées), Rec. Par D. Boutigny, B, 25-28.06.1851-1852.
- France: Languedoc-Roussillon. In Pyr. Or. Supr Mont Louis locus la Tet, P. Bubani, WU, 1836.
- France: Rhone-Alpes, Haute-Savoie.Val D'Eyne (Val d'Este), 1650 m, W Spanaosly, JE, 09.07.1961.
- France: Champagne-Ardenne, Mont-Laurent, Pyr. Centr, B, 07.1830.

L. carniolicum Bernh. ex W.D.J.Koch **subsp.** ***albanicum*** (Griseb.) Hayek, Prod. Fl. Balcan 3 : 62 (1932).

- Albania: Kalis, Korab, Nordwestseite alpine Hänge gegen Rodomir, 2000 m, I. Dörfler, WU, 06.07.1918.
- Albania: Lura, Kunora e Lures, 2000 m, F. K. Meyer 4674, JE, 02.08.1959; Lura, südlich zwischen Lura und Lan Lura, 1700 m, F. K. Meyer 4720, JE, 03.08.1959.
- Albania: Mt. Alaminia-Mojan ad firey Turcorum, In herbidis alpinis, A. Baldacci 388, WU, 17.07.1898.
- Albania: mt. Dibala, Kostica, Kuci, In herbidis alpinis, A. Baldacci 388, WU, 11.07.1898.
- Albania: Sala, An felsigen Hängen östl. den Cafa Normajns bei abala, 1800 m, I. Dörfler 121, WU, 19.06.1916.
- Albania: Theti, am Maja e Radohimes, 1600-1900 m, F. K. Meyer, 4243, JE, 25.07.1959; Theti, am maja e Radohimes, 1800 m, F. K. Meyer 4293, JE, 24-26.07.1959.

- Albania: Tropoje, Kolgecaj (Bajram Curri), an der Straße zwischen Kam und Kolgecaj, Serpentin, 400 m, F. K. Meyer 5639, JE, 13.05.1960.
- Albania-Montenegro, Prokledija Gebiet auf felsige Boden oben Buni Jeseree, Auf felsigen Boden in den hochalpinen Region oben Dumijezerce, 1900 m, I. Dörfler 486, WU, 13.07.1914; Krajina., Alpine Wiesen der Vila südl. von Rikavac, 1900, I. Dörfler 432, C, 29.06.1914; Korab i Madh, nördlicher Teil, Serpentin, 2500-2600 m, F. K. Meyer 5047, JE, 07.08.1959.
- Bulgaria: Rila, In fascuis saxasii mt. Monastisska-Rila: ad coenebium Rila, 1300 m, B. Davidoff, SOM, 21.05.1912.
- Bulgaria: Sofia, Korab, Gräben oberhalb Radomir, 1300 m, F. K. Meyer, 4293, JE, 05.08.1959; Korab, Radomir, am Luftina, 1900 m, F. K. Meyer 4293, JE, 07.08.1959.
- Greece : Mt. Smolika, in summo monte Smolika, in saxosis serpentinicis, 2200-2400 m, K. H. Rechinger, W, 09.07.1958; Mt. Smolikas, great SE. Ravine, 3.5 km SW of Samarina by the forest road along the river, W-facing moist slope in mixed forest, Serpentine, 1250-1275 m, P. Hartvig & O. Seberg 4930, C, 28.08.1975.
- Greece: Between Florinis and Kastorias, Mt. Vernon (Vitsi). The northern parts of the highest summit below the military campus, Open meadows with much Vaccinium.Granit, 1900-2000 m, 40°39 N, 21°22 E, Nİ 2269, 03.07.2004; Mt. Vitsi, N part of the summit area, Meadows and rocky outcrops. Schist, 1850-2050, L. Farsakoglou, R. Franzen, K. Papanicolaou, A. Strid, 18949, B, 10.07.1981.
- Greece: Florina, Mt. Bella Voda, Stony ground, Juniperus and Vaccinium myrtillus and prominent rocks. Gregarious, 1950-2100 m, E. Stamatiadou

16029, C, 25.06.1972; Mt. Varnous, in astro-orientali verticum "Bela Voda" vocatorum. In megaphorbietis clivorum saxosorum et rubestrium, solo granitico, 2000-2050 m, W. Greuter 14132, C, 01.08.1976; Nördlicher Pindus. Aufstieg zur Kiwaniza vom Kataphygion des Alpine Club Florina bei Pisoderion, Silikat, 1800-2130 m, C, 08.07.1982; Florinis, Mt. Varnous, c.13-14 km from Agios Germanos. The summit Kalo Nero (or Bela Voda). N.slopes, Stony meadows, Juniperus, Vaccinium & Chamaecytus. Granit, 1950-2000 m, 40°50 N, 21°15 E, Nİ 2272, 04.07.2004.

- Greece: Imatia, Naousa. Vermion-Massiv, Südöstlich von Rodochorion: Felsdurch ragte Bergweiden am nordöstl. Abfall des Mavri Petra, Kalkgestein, 1750-1900 m, I. hagemann, H. Ketelhut, H.-J. Wolf 1366A, C, 25.08.1983.
- Greece: Ioanninon, Dodonis: Mt. Aftia, 14 km of NW of Metsovon, SW. Steep, rocky slopes in Pinus nigra forest, 1300-1400 m, P. Hartvig, C. Baden & S. G. Christiansen 6284, C, 25.07.1976; 8 km N of Metsovon, 2 km SW of the village Milea by the road to Katara, Grassy and rocky slopes, 1450 m, P. Hartvig, C. Baden & S. G. Christiansen 6252, C, 24.07.1976; Mt. Milea, 12 km of Metsovon. SW slope to summit, Serpentine, 2100 m, P. Hartvig, C. Baden & S. G. Christiansen 6155, C, 23.07.1976.
- Greece: Ioanninon, Trikalon, Katara Pass, just S of the top, Serpentine, 1700 m, R. Franzen & A. Strid, 18045, C, 19.06.1981.
- Greece: N Pindhos, Mt. Pirostia, 9 km W of Krania., S slope with woodland of Pinus heldreichii Serpentine, 1800 m, S. G. Christiansen, P. Hartvig, K. Papanicolaou & A. Strid, P. Hartvig 7604, C, 11.07.1979.

- Greece: Serron, Sintikis, Mt. Belles, Neon Triethnes, between the filakion and the summit, Alpine meadows and rocky outcrops. Gneiss and schist, 1700-1850, R. Franzen, K. Papanicolaou, A. Strid & E. Zacharof 18555, B, 04.07.1981.
- Jugoslavia: Kosmet, Sar Pl., S of the Prevalac, Damp subalpine grassland and along streams, 2000-2020 m, P. Frost-Olsen, 491, C, 12.07.1976.
- Macedonia: Baba Planina: Nordseite des Pelister bei Bitola, Grasige und zum Teil felsige Hänge mit Pinus, 1700-2100 m, H. Roessler 6342, M, 30.06.1968.
- Macedonia: Bistra planina oberhalb Mavrovo Hanovi, Kalk, steinig-rasiger Hang oberhalb der Buchenwald-grenze, A. Polatschek, W, 10-24.06.1978.
- Macedonia: Macedon. Austr, In pascuis alpinis montis Kaimakçalan, J. Dörfler, 359 WU, 04.07.1893.
- Macedonia: Peristeri, obere Waldgrenze, hang ober Prespasee, F. Kasy, W, 25.07.1959.
- Montenegro: CG: Bijelasica: 2 km SSE Biogradsko Jezero: M. Platno, Zwerggesträuch m. Juniperus nana, 1700-1800 m, G. Parolly, 04.07.1990.
- Montenegro: Mt. Dibala supra Kat. Kostic distr. Kuci, Antonio Baldacci 388, M, 02.07.1898.
- Serbia: Auf dem Patara Gebirge bl. Tirot, L. Hamari, M, 06.1892.

L. carniolicum Bernh. ex W.D.J.Koch **subsp. *jankae*** (A.Kern.)Hayek, Prod. Fl. Balcan 3: 61 (1932).

- Bulgaria: Mt. Vitosha in graminosis ad cacum. Cernata skala, N. Efremov, C, 09.07.1951.

- Hungary: Verespatak, In pratis montibus "Gaur" prope Verespatak Transsilvaia. Locus classicus, Janka, WU, 19.06.1869; Auf Bergwiesen bei Verespatak, Csato, JE, 13.06.1874; In declivibus graminosis fruticosis prope Verespatak, Aladar Richter, JE, 25.06.1875; Transsilvania-Cornitatus Alba-inferior. In pratis montanis prope pagum Verespatak, Jul. A. Tauschey, WU, 10.06.1878; In pratis montanis supra oppidum Verespatak. Locus classicus! Solo argill, 600, Jul. Wolff, C, 06.1888; In pratis montibus prope Verespatak, Csato, M, 08.07.1886; In declivibus graminosis fruticosis prope Verespatak, A. Richter, B, 17.07.1909.
- Romania: Oltenia, distr. Rimnicul vilcea, Montibus Capatina, In pratis montanis ad Piciorul Marului, 1300 m, leg. et det. M. Ciurchea 2998, C, 01.06.1957.

L. carniolicum Bernh. ex W.D.J.Koch, Synop. Fl. Germ.: 708 (1837) subsp. ***carniolicum.***

- Croatien: Mittlerer Velebit, Südhang der Bacic Kosa, nordöstlich von Karlobag, Wiesen und Buchenwald, 900 m, W. Lippert & B. Zollitsch, M, 31.05.1966.
- Italy : Trieste, Illyrie, autriche.Prairies sur les montagnes calcaires, p. e. sur le monts Kokusch, Nanas, Staernick, etc. pres de Trieste (Illyrie, Autriche), 1000 m, Rec. M. Tommasini 565, C, 04.06.1860.
- Jugoslawia: Wochein (Bohinj), Felswände an der Crna gora, 1500 m, H. Merxmüller & W. Wiedmann 5927, M, 24.07.1953.
- Jugoslawien: Slowenien, Slavnik, Wiesen und Buchenwald, 900-1028 m, W. Lippert & B. Zollitsch, M, 30.05.1966.

- Slovenia: Julijske Alpe: In herbidis prope refugium alpinum Dom na Komni dicum, supra lacum Bohinjsko Jezero..Solo calcareo, 1500, T. Wraber 9748/2, C, 07.07.1977.
- Slowenia: Nördliches Istrien, Slavnik, unterhalb des Gipfels.Gebüsch und Wiese, 950 m, G. Wagenitz, T. Wraber 97, B, 07.06.1961.

4. CONCLUSIONS

In this research, the genus *Lilium* is revised for Turkey. After detailed morphological studies, phylogenetical analysis of sequences of nrDNA ITS region and RAPD data, the genus *Lilium* is represented in Turkey by seven species, one with two varieties. In this study, we placed Turkish lilies into two sections according to their type of leaf arrangement on the stem. *L. martagon* with whorled leaf arrangement placed in section *Martagon*, the rest of the Turkish lilies with alternate leaeves placed in section *Liriotypus*. We adopted here Comber's classification system which is also strongly supported by our results of sequence analysis of nrDNA Internal Transcribed Spacer (ITS) Region. Phylogentic analysis results using ITS sequences showed that *L. martagon* clustered together with East Asiatic lilies and the rest of the European species (excluding *L. bulbiferum*) clustered together forming a monophyletic group. Therefore, phylogenetic analysis of the nrDNA ITS region proved the monophyly of section *Liriotypus*. However, Davis in the Flora of Turkey grouped Turkish lilies into two sections, according to their floral structure but leaf arrangement. He placed *L. candidum* in section *Leucolirion* and the rest of the species in section *Martagon*. Differentiating lilies as having trumpet and turk's-cap flowers. However, as also supported by molecular findings, type of leaf arrangement is far more important in classification on Turkish lilies than floral morphology.

L. ponticum K.Koch was reduced by Davis in the Flora of Turkey to a subspecies of *L. carniolicum* Bernh. ex W.D.J.Koch. Matthews (1984) assigned *L. ponticum* K.Koch and *L. carniolicum* Bernh. ex W.D.J.Koch as subspecies of *L. pyrenaicum* Gouan. Analysis of the results of nrDNA ITS sequences suggests that *L. ponticum* K.Koch has a separate evolutionary history than the European *L.*

pyrenaicum Gouan and *L. carniolicum* Bernh. ex W.D.J.Koch. Moreover, taking into account of large geographical separation between them supports the increasing of *L. ponticum* K.Koch to species level. My conclusion is that these three taxa are different species.

In the Flora of Turkey *L. artvinense* Miscz. was assigned as a variety of *L. carniolicum* Bernh. ex W.D.J.Koch subsp. *ponticum* (K.Koch) P.H.Davis & D.M.Hend. In this study *L. artvinense* is reduced to synonymy of *L. ponticum* K.Koch, because the differentiating characters between the two taxa mentioned in the Flora of Turkey can be seen in the populations of both taxa without any correlation. These characters are flower color which is very variable even in a single population changing from yellow to deep orange and number of flowers per inflorescence which can also change from 1 to 15.

This study confirms that newly described species *L. akkusianum* R.Gämperle is a distinct species with close alliance to *L. ciliatum* P.H.Davis.

Among Turkish *Lilium* species *L. martagon* L. along with widest distributional area is phylogenetically the oldest one. The two Turkish endemics *L. ciliatum* P.H.Davis and *L. akkusianum* R.Gämperle with very narrow distributional area are phylogenetically youngest ones.

In a previous study of Ekim et al., (2000), all Turkish lilies were placed in vulnerable (VU) category. However, after detailed field observations of each taxa, it was seen that there is a need of revision for red list categories of Turkish lilies and this previous assessment is too optimistic. All Turkish lilies should be placed in endangered (EN) category, except *L. martagon* and *L. candidum* which were assessed in vulnerable (VU) category. The *Lilium* species occupying the North Eastern Turkey are only found in adjacent regions of Georgia and Armenia.

REFERENCES

Anderson, O.N. 1986. The Distribution of the Genus *Lilium* with Reference to its Evolution. Herbertia: 31-50.

Ascherson, P.F.A., Graebner, K.O.R.P.P. 1905. Synop., 3, 172.

Baker, J.G. 1871. A new Synopsis of All the Known Lilies. The Gardeners' Chronicle and Agricultural Gazette.

Baker, J.G. 1874. Revision of the Genera and Species of Tulipeae. J. Linn. Soc. 14: 211-310.

Baldwin, B.G., Sanderson, M.J., Porter, J.M., Wojcieshowski, M.F., Campbell, C.S., Donoghue, M.J. 1995. The ITS region of nuclear ribosomal DNA: a valuable source of evidence on angiosperm phylogeny. Ann. Missouri Bot. Garden 82: 247-277.

Balls, E.K. 1934. Lilies in the Pontus. Royal Horticultural Society Lily Year Book 3: 50-52.

Baranova, M.V. 1966. The Geographical Distribution of *Lilium* Species in the Flora of the U.S.S.R. Botanical Journal, No. 12, Vol. 51.

Baranova, M.V. 1988. A Synopsis of the System of the Genus *Lilium (Liliaceae)*. Botanical Journal, vol. 73: 1319-1329.

Bieberstein, M von. 1808. *Lilium monadelphum*. Flora Taurico-Caucasica. Pg. 267.

Bin, L.W., Choi, S.Y., Kim, Y.S. 1993. An Application of Random Amplified Polymorphic DNA (RAPD) to Systematics of Some Species of *Lilium* in Korea. Kor. J. Bot. Vol. 23, No.2: 35-42.

Boissier, E. 1881. Flora Orientalis, v. Monocotyledoneae.

Booy, G., Van der Schoot, J., Vosman, B. 2000. Heterogeneity of the Internal

Transcribed Spacer 1 (ITS1) in Tulipa (Liliaceae). Plant Syst. Evol. 225: 29-41.

Brummitt, R.K., Powell, C.E. 1992. Authors of Plant Names. Royal Botanic Gardens, Kew.

Chase, M.W., Hills, H. H. 1991. Silica gel: An ideal material for field preservation of leaf samples for DNA studies. Taxon 40: 215-220.

Comber, H.F. 1949. A New Classification of the Genus Lilum. RHS Lily Year Book 13: 86-105.

Cotton, A.D. 1934. The Genus *Notholirion*. Royal Horticultural Society Lily Year-Book.

Davis, P.H. 1968. A New Turkish Lily. Notes from the Royal Botanical garden Edinburgh, vol. 28 No.1: 235-236.

Davis, P.H. 1984. Flora of Turkey. Edinburgh. Vol.8: 279-284.

Davis, P.H., Henderson, D.M. 1969. A Revision of Turkish Lilies. The Lily Year Book, 33: 212-223.

Davis, P.H., Henderson, D.M. 1983. Notes from the Royal Botanic Garden Edinburgh vol.41 No.1:53.

Delipavlov, D. 1952. Lilium rhodopaeum Delip. Sp. N. Naučni Trud. Agron. Fak. Plovdiv. 1:219-224.

Dubouzet, J.G. Shinoda, K. 1999. Phylogenetic Analysis of the Internal Transcribed Spacer Region of Japanese *Lilium* Species. Theoretical and Applied Genetics 98: 954-960.

Ekim T., Koyuncu, M., Vural M., Duman H., Aytaç Z., Adıgüzel, N. 2000. Turkish Plants Red Data Book (Pteridophyta and Spermatophyta). Turkish Association for the Conservation of Nature and Van Centennial University, Ankara.

Elwes, H.J. 1880. A Monograph of the Genus *Lilium*. London.
Endlicher, S. 1836. Genera Plantarum, 141. Vienna.

Eremin, V. 1966. Species Lilies of the Caucasus. Royal Horticultural Society Lily Yearbook 29: 57-65.

Evans, W.E. 1925-1927. A Revision of the Genus Nomocharis. Notes from the Royal Botanic Garden Ediburgh, vol. XV: 1-45.

Ferns, F.E.B., 1878. Consider the Lilies. Quart. Bull. Alp. Gard. Soc., 46(1): 22-45.

Fischer, F.E.L. von, 1839. *Lilium szovitsianum*. Index Hortus Petrop. vi (1839) 16.

Furse, P. 1963. Lilies of North-East Turkey. R.H.S. Lily Year Book 27:63-67.

Gämperle, R. 1998. A new Species of Lily from Turkey. Quarterly Bulletin of the Alpine Garden Society. Vol.66 No. 3.

Gielly, L., Taberlet, P. 1994. The Use of Chloroplast DNA to Resolve Plant Phylogenies: Noncoding Versus *rbcl* Sequences. *Molecular Biology and Evolution* 11: 769–777.

Gielly, L., Taberlet, P. 1996. A Phylogeny Of The European Gentians Inferred From Chloroplast *Trnl* (UAA) Intron Sequences. *Botanical Journal of the Linnean Society* 120: 57–75.

Grey-Wilson, Ch., Matthew, B. 1981. Bulbs. Collins.

Grisebach, A. 1843. Spicilegium Florae rumelicae et bithynicae Brunsvigae.

Grossheim, A.A. 1940. Flora des Kaukasus 2. verv. aufl. 2. Baku.

Grossheim, A.A. 1928. Flora Kaukasus. Tiflis and Erivan.

Hall, D. 1934. The Chromosomes of Lilium. R.H.S. Lily Year Book.

Harold F.C. 1949. A New Classification of the Genus *Lilium*. The Lily Year Book, the Royal Horticultural Society, London.

Hayashi, K., Kawano, S. 2000. Molecular Systematics of *Lilium* and allied genera (Liliaceae): phylogenetic relationships among *Lilium* and related genera based on the rbcL and matK gene sequence data. Plant Species Biology 15, 73-93.

Hayek, A. 1927-1933. Prodromus Florae Peninsulae Balcanicae, Dahlem, Berlin.

Hillis, D.M., Moritz, C., Mable, B.K. 1996. Molecular Systematics. Second Edition. Sinauer Associates, Inc.

Holmgren, P.K., Holmgren, N.H., & Barnett, L.C. 1990: Index herbariorum 1. The herbaria of the world, ed. 8. Regnum Veg. 120.

Hsiao, C., Chatterton, N.J., Asay, K.H., Jensen, K.B. 1994. Phylogenetic Relationships of ten Grass Species: an Assassment of the Phylogenetic Utility of the Internal Transcribed Spacer Region in Nuclear Ribosomal DNA in monocots. Genome 37: 112-120.

Inceer, H., Beyazoglu, O., Hayirlioglu-Ayaz, S. 1999. Karyotype Analysis of Some *Lilium* L. (Liliaceae) Species from Turkey. Pak. J. Bot., 31(2): 315-321.

IUCN. 2001. *IUCN Red List Categories and Criteria: Version 3.2.* IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK. Ii + 30 pp.
J.E.P. 1849. Flore des Serres 5. 507-509.

Jekyll, G. 1983. Lilies. The Ayer Company. New Hampshire.

Judd, W.S., Campbell, C.S., Kellog, E.A., Stevens, P.F. 1999. Plant Systematics, A Phylogenetic Approach. Sinauer Associates, Inc.

Kaempfer. 1712. Amoenitates Academicae.

Kesselring, W. 1932. Lilium monadelphum and its allies. Royal Horticultural Society Lily Yearbook 1: 66-71.

Koch, C. 1849. *Lilium ponticum* in Linnaea 22:234.

Koch, W.D.J. 1835/37. Synopsis Florae Germanicae et Helveticae. Francofurti ad Moenum.

Komarov, V.L. 1935. Flora of the U.S.S.R vol.4. Botanicheskii Institut Akademii Nauk SSSR. Leningrad.

Lee, J.S., Lee, P.O., Lim, Y.P., Shin, E.M., Park, S.Y. 1996. Classification of Lilies Using Random Amplified Polymorphic DNA (RAPD) Analysis. Proc. Int. Sym. On *Lilium*, Acta Hort. 414: 137-144.

Lighty, R.W. 1968. Evolutionary Trends in Lilies. Royal Horticultural Society Lily Yearbook: 40-44.

Ligthy, R.W. 1970. The Lilies of Korea. The Lily Year Book: 103-105.

Linnaeus, C. 1753. Species Plantarum. 1st Edition.

Mabberley, D.J. 1997. The Plant Book. Cambridge.

Mandenova, I. 1940. Caucasian Lilies. Trudy Tbilisskogo Botaniceskogo Instituta. Vol. 8: 149-208. Tbilissi.

Matthews, V. 1984. *Lilium pyrenaicum*: a complex species. Kew Mag., 1(1):36-43.

Matthews, V. 1989. Kew Gardening Guides: Lilies. The Royal Botanical Gardens, Kew.

McRae, E.A. 1998. Lilies. A Guide for Growers and Collectors. Timber Press. Portland, Oregon.

Misczenko, P.I. 1911. *Lilium artvinense* in Trudy Bot. Mus. Imp. Akad. Nauk 8:191.

Misczenko, P.I. 1914. Lilium monadelphum M.B., L. szovitsianum Fisch. & Avé-Lall., L. kesselringianum sp. nova vom Kaukasus. Trudy Bjuro po Prikladnoj Botanike-Petrograd. Vol. 7: 241-257.

Muratović, E., Bogunić, F., Šoljan, D., Yakovlev, S.S. 2005. Does Lilium bosnaicum merit species rank? A classical and molecular-cytogenetic analysis. Plant Systematic Evolution 252: 97-109.

Nishikawa, T., Okazaki, K., Uchino, T., Arakawa, K., Nagamine, T. 1999. A Molecular Phylogeny of Lilium in the Internal Transcribed Spacer Region of Nuclear Ribosomal DNA. Journal of Molecular Evolution 49: 238-249.

Parkinson, 1689. Paradisus, or Garden of Pleasant Flowers.

Persson, H.A., Lundquist, K., Nybom, H. 1998. RAPD Analysis of Genetic Variation within and among Populations of Turk's-cap lily (*Lilium martagon* L.). Hereditas 128: 213-220.

Reichenbach, H.TH. L. 1828. Conspectucs Regni Vegetabilis.

Ronsted, N., Law, S., Thornton, H., Fay, M.F. and Chase, M.W. 2005. Molecular phylogenetic evidence for the monophyly of Fritillaria and Lilium (Liliaceae; Liliales) and the infrageneric classification of *Fritillaria*. Journal of Molecular Phylogenetics and Evolution.

Salemi, M., Vandamme, A.M. 2003. The Phylogenetic Handbook: a practical approach to DNA and protein phylogeny. Cambridge University Press.

Sealy, R.J. 1983. A revision of the genus *Nomocharis* Franch.. Botanical Journal of the Linnean Society 87: 285-323.

Sen, S. 1978. Intraspecific Differentiation in Karyotype of *Lilium*. Cytologia 43: 305-315.

Smyth, D.R., Kongsuwan, K., Wisudharomn, S. 1989. A survey of C-band Patterns in Chromosomes of Lilium (Liliaceae). Pl. Syst. Evol. 163: 53-69.

Sneath, P.H.A., Sokal, R.R. 1973. Numerical Taxonomy. San Francisco: W. H. Freeman.

Stapf, O. 1934. *Lilium, Notholirion,* and *Fritillaria*. Royal Botanical Gardens, Kew, Bulletin of Miscellaneous Information. London. Pg.: 94-96.

Stern, F.C. 1938. A Geographical Survey of the Genus *Lilium*. Proceedings of the Linnean Society of London.

Stewart, R.N. 1947. The Morphology of Somatic Chromosomes in Lilium. American Journal of Botany 34: 9-26.

Stoker, F. 1933. The Environment of Lilies in Nature. RHS Lily Year Book: 11-57.

Stoker, F. 1935. A list of Lily Names and Synonyms. RHS Lily Year-Book: 4-34.

Stoker, F. 1938. The Carniolicum group of lilies. Royal Horticultural Society Lily Yearbook 7:86-107.

Sung-Yun, L., Wu-Xiu, Z. 1985. Pollen Morphology of the Genus *Nomocharis* and its Delimitation with *Lilium*. Acta Phytotaxonomica Sinica vol. 23, No.5: 405-417.

Swofford, D.L. 1993. PAUP*. Phylogentic Analysis Using Parsimony (* and other methods) version 3.1. Sunderland, Massachusetts (USA): Sinauer Associates, Inc.

Synge, P.M. 1980. A Revision of Elwes' Monograph of the Genus *Lilium* and its Supplements. B.T.Batsford Ltd. London.

Taberlet, P. 1991. Universal primers for amplification of three non-coding regions of chloroplast DNA. Plant Molecular Biology 17:1105-1109.

Takhtajan, A. 1997. Diversity and Classification of Flowering Plants. Columbia University Press.

Thompson, J.D., Gibson, T.J., Plewniak, F., Jeanmougin, F. and Higgins, D.G. 1997. The ClustalX windows interface: flexible strategies for multiple sequence alignment aided by quality analysis tools. Nucleic Acids Research, 24:4876-4882.

Tournefort, J.P. 1700. Institutiones Rei Herbariae 1: 367-372; 2: t.195-201. Paris.

Turrill, W.B. 1948. The Generic Concept with Reference to *Fritillaria*. RHS Lily Year Book.

Tutin, T.G., Heywood, V.H., Burges, N.A., Moore, D.M., Valentine, D.H., Walters, S.M., Webb, D.A. 1980. Flora Europae 5: 34-35. Cambridge University Press.

Van Tuyl, J.M., Boon, E. 1997. Variation in DNA Content in the Genus Lilium. Acta Hort. 430: 829-835.

Vinnersten, A. Bremer, K. 2001. Age and Biogeography of Major Clades in Liliales. American Journal of Botany 88(9): 1695-1703.

Wendelbo, P. 1977. Tulips and Irises of Iran and their relatives. Botanical Institute of Iran. Tehran.

Wilson, E.H. 1925. The Lilies of Eastern Asia. Dulau and Company Ltd. London.

Woodcock, H.B.D., Stearn, W.T. 1950. Lilies of the World: Their Cultivation and Classification. London: Country Life.

Yakovlev, S.S., Peccenini, S., Muratovic, E., Zoldos, V., Robin, O., Vallés, J. 2003. Chromosomal Differentiation and Genome Size in the three European Mountain *Lilium* Species. Plant Syst. Evol. Vol.236:151-163.

APPENDICES

APPENDIX 1. Aligned Nuclear rDNA ITS Sequence Data of 27 Representatives of *Lilium* and Its Closely Related Genera *Cardiocrinum*, *Nomocharis*, and *Notholirion* as Outgroup Taxa.

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C. giganteum        TCGAGAACCG-ACCGAAAGACCGCGAACCTGTAAACGGA-TGACACCGTGTCGGGCGGGCA--TTA---TGCCCGCCCTGTTGGGGACCTCGCACGGTGT
L.bulbiferum        CCGAGAATCG-ATTGAGAGACCGCGAACCTGTAAACGGA-TGATACCGTGTCAGGCAGGCG--TTA---TGCCCGCCCAACTCGGGACCTCGCATCGTGT
L.pumilum           TCGAGAATCG-ATTGAGAGACCGCGAACCTGTAAACGGA-TGACACCGTGTCGGGCAGGCT--TTA---TGCCCGCCCAACTCGGGACCTCGCATCGTGT
L.davidii           TCGAGAATCG-ATTGAGAGACCGCGAACCTGTAAACGGA-TGACACCGCGTCGGGCGGGTG--TTA---TGCCCGCCCAACTCGGGACCTCGCATCGTGT
L.longiflorum       TCGAGAATCG-ATTGAGAGACCGCGAACCTGTAAACGGA-TGATACCGTGTCGGGCAGGCG--TTA---AGCCCGCCCAACTCGGGACCTCGCATCGTGC
L.philipinnense     TCGAGAATCG-ATTGAGAGACCGCGAACCTGTAAACGGA-TGATACCGTGTCGGGCAGGCG--TTA---AGCCCGCCCAACTCGGGACCTCGCATCGTGC
L.dauricum          TCGAGAATCG-ATTGAGAGACTGCGAACCTGTAAACGGA-TGATACCGTGTCGGGTAGGCG--TTA---TGCCCGTCCAACTCGGGACCTCGCATCGTGT
L.martagon          TCGAGAATCG-ATTGAGAGACCGTGAACCTGTAAACGGA-TGATACCGTGTCGGGCGGGCG--TTA---TGCCCGCCCAACTCGGGACCTCACATCGTGT
L.armenum           TCGAGAATCG-ACCGAGAGACYGCGAACCTGTTAACGGA-CGATACCGTGTCGGGCGGGCA--TTA---TGCCCGTCCTRCTCGGGACCTCGCATCGTGT
L.szovitsianum      TCGAGAATCG-ACCGAGAGACTGCGAACCTGTTAACGGA-CGATACCGTGTCGGGCGGGCA--TTA---TGCCCGGCCTRCTCGGGACCTCGCATCGTGT
L.ponticum          TCGAGAATCG-ACCGAGAGACYGCGAACCTGTTAACGGA-CGATACCGTGTCGGGCGGGCA--TTA---TGCCCGCCCTGCTCGGGACCTCGCATCGTGT
L.artvinense        TCGAGAATCG-ACCGAGAGACYGCGAACCTGTTAACGGA-CGATACCGTGTCGGGCGGGCA--TTA---TGCCCGCCCTGCTCGGGACCTCGCATCGTGT
L.monadelphum       TCGAGAATCG-ACCGAGAGACCGCGAACCWGTTAACGGA-CGATACCGTGTCGGGCGGGCA--TTA---TGCCCGTCCTGCTCGGGACCTCGCATCGTGT
L.kesselringianum   TCGAGAATCG-ATCGAGAGACTGCGAACCTGTTAACGGA-CGATACCGTGTCGGTCGGGCA--TTA---TGCCCGCCCTACTCGGGACCTCGCATCGTGT
L.ciliatum          TCGAGAACCG-ATCGAGAGACCGCGAACCTGTAAACGGA-TGATACCGTGTCGGACGGGCA--TTA---TGCCCGYCCTACTCGGGACCTCGCATCGTGT
L.akkusianum        TCGAGAACCG-ATCGAGAGACCGCGAACCTGTAAACGGA-TGAYACCGTGTCGGACGGGCA--TTA---TGCCCGTCCTACGCGGGACCTCGCATCGTGT
L.albanicum         TCGAGAACCG-ACCGAGAGACCGCGAACCTGTAAACGGA-CGAC-CCGTGTCGGTCGGGCA--TTA---TGCCTGTCCTACGCGGGACCTCGCATCGTGT
L.carniolicum       TCGAGAACCG-ATCGAGAGACCGCGAACCTGTAAACGGA-CGACACCGTGTCGGTCGGGCA--TTA---TGCCTGTCCTACGCGGGACCTCGCATCGTGT
L.bosniacum         TCGAGAACCG-ATCGAGAGACCGCGAACCTGTAAACGGA-CGACACCGTGTCGGTCGGGCA--TTA---TGCCTGTCCTACGCGGGACCTCGCATCGTGT
L.pyrenaicum        TCGAGAACTG-ACCGAGAGACCACGAACCTGTAAACGGA-AGACACCGTGTAGGTCGGGCA--TTA---TGCCTGTCTTATGCAGGACCTCACATCTTGT
L.pomponium         TCGAGAACCG-ATCGAGAGACCGCGAACCTGTAAACGGA-TGACACCGCGTCGGTCGGGCA--TTA---TGCTTGTCTTACGCGGGACCTCGCATCGTGT
L.rhodopaeum        TCGAGAACCG-ACCGAGAGACCGCGAACCTGTAAACGGATCGACACCGTGTCGGTCGGGCA--TTA---TGCTTGTCCTATGCGGGACCTCACATCGTGT
L.jankae            TCGAGAACCG-ACCGAGAGACCGCGAACCTGTTAACGGA-CAACACCGTGTCGGTCGGGCA--TTA---TGCCTGTCCTACGCGGGACCTCGCATCGTGT
L.candidum          TCGAGAACCG-ATCGAGAGACCGCGAACCTGTAAACGGA-CGACACCGTGTCGGGCGGGCA--TTA---TGCCTGTCCTACGCGGGACCTCGCATTGTGT
N.saluenensis       TCGAGAACCG-ACCGAGAGACTGCGAACCTGTAAACGGA-TGACACCGTGTCGGGCGGGCG--TTA---TGCCTGCCCTACTCGGGACCTCGCATCGTGT
L.canadense         TCGAAAACCGGATCGAGAGACCGCGAACCTATAAACGGA-C--CACCGTGTCGGGCGGGCA--TTA---TGCCCGTCCTACTCCGGACCTCGCATCGTGT
L.philadelphicum    TCGAGAACTG-ACCGAGAGACCGCGAACTTGTAATCGAA-CTACACCGTGTCGGGCGGGCG--TTA---TGTCCGCCCTACTCGGGACCTCGCATCGTGT
L.auratum           TCGAGAACCCGACCGAGAGACCGCGAACCTGTAAACGGA-CGACACCGTGTCGGGCGGGCA--TTA---TTCCCGCCCTACTCGGGACCTCGCATCGTGT
L.japonicum         TCGAGAACCCGACCGAGAGACCGCGAACCTGTAAACGGA-CGATACCGTGTCGGGCGGGCA--TTA---TGTCCGCCCTACTCGGGACCTCGCATCGTGT
Noth.thomsonianum   TTGAGAACTG-ACCGAAAGACCGTGAACTTGTAAATGGA-TGACACCGTGTTGGGTGGGAA--TTA---TTCTTGCCCTACTCGGGACCTCGCATCGTGT
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C._giganteum          CCGCGGCCGCCCT-GAGCGTTACGGACACGATTTGCGGGGGACGGA-CGAAACCCCGGCGCGGCCTGCGCCAAGGAACATA-TGACAGGACGGACGCG-C
L.bulbiferum          CCGCGGCTGCCTTAGAGCGTTTCGGGCACGATTTGCGGGGGACGAA-CGAAACCCCGGCACGGCCTGTGCCAAGGAACATA-TGTCAGGACGGACGCT-C
L.pumilum             CCGCGCCTGCCTTCGAGCGTTTCGGGCACGATTTGCGGGGGACGAA-CGAAACCCCGGCACGGCCTGTGCCAAGGAACATA-TGTCAGGACGGACGCT-C
L.davidii             CCGCGGTTGGCTTCGAGCGTTTCGGGCACGATTTGCGGGGGACGAA-CGAAACCCCGGCACGGCCTGTGCCAAGGAACATA-TGTCAGGACGGATGCT-C
L.longiflorum         CTGTGGTT-CCTTCGAGCGTTTCAGGCATGATTTGTGGGGGACGAAACGAAACCCCGGCACGGCCTGTGCCAAGGAACATA-TGTCAGGACGGACGCT-C
L.philipinnense       CTGCGGTTGCCTTCAAGCGTTTCGGGCACGATTTGTGGGGGACGAA-CGAAACCCCGGCACGACCTGTGCCAAGGAACATA-TGTCAGGACGGACGCT-C
L.dauricum            CCGCGGCTGCCTTAGAGCATTTCGGGCACGATTTGCGGGGGACGAA-CGAAACCCCGGCACGGCCTGTGCCAAGGAACATA-TGTCAGGACGGACGCT-C
L.martagon            CCGTGGCCGCCTCGGAGCGTTTCGGGCACGATTTGCGGGGGACGAA-CGAAACCCCGGCACGTCCTGTGCCAAGGAACATA-TGTCAGGACGGACGCG-C
L.armenum             CCGCGGCTGCCTCCTGGCGTTTTGGACACGATTTGCGGGGGACGAA-CGAAACCCCGGCGCGGCCTGCGCCAAGGAACATA-TGTCAGGACGGACGCG-C
L.szovitsianum        CCGCGGCTGCCTCCTGGCGTTTTGGACACGATTTGCGGGGGACGAA-CGAAACCCCGGCGCGGCCTGCGCCAAGGAACATA-TGTCAGGACGGACGCG-C
L.ponticum            CTGCGGCTGCCTCCTGGCGTTTTGGACACGATTTGCGGGGGACGAA-CGAAACCCCGGCGCGGCCTGCGCCAAGGAACATA-TGTCAGGACGGACGCG-C
L.artvinense          CTGCGGCTGCCTCCTGGCGTTTTGGACACGATTTGCGGGGGACGAA-CGAAACCCCGGCGCGGCCTGCGCCAAGGAACATA-TGTCAGGACGGACGCG-C
L.monadelphum         CCGCGGCTGCCTCCTGGCGTTTTGGACACGATTTGCGGGGGACGAA-CGAAACCCCGGCGCGGCCTGCGCCAAGGAACATA-TGTCAGGACGGACGCG-C
L.kesselringianum     CTGCGGCTGCCTCCTGGCGTTTTGGACACGATTTGCGGGGGACGAA-CGAAACCCCGGCGCGGCCTGCGCCAAGGAACATA-TGTCAGGACGGACGCG-C
L.ciliatum            CCGYGGCTGCCTCCTGGCATTTCGGACATGATTTGCGGGGGACGAA-CGAAACCCCGGCGCGGCCTGCGCCAAGGAACATA-TGTCAGGACGGAYGYG-C
L.akkusianum          CCGYAGCTGCCTCCTGGCATTTCGGACATGATTTGCGGGGGACGAA-CGAAACCCCGGCGCGGCCTGCGCCAAGGAACATA-TGTCAGGACGGATGCG-C
L.albanicum           CCGCAGCTGCCTCCTGGCATTTCGGACATGATTTGCGGGGGACGAA-CGAAACCCCGGCGCGGCCTGCGCCAAGGAACATA-TGTCAGGACGGATGCG-C
L.carniolicum         CTGCAGCTGCCTCCTGGCATTTCGGACATGATTTGTGGGGGACGAA-CGAAACCCCGGCGCGGCCTGTGCCAAGGAACATA-TGTCAGGACGGATGCA-C
L.bosniacum           CCGCAGCTGCCTCCTGGCATTTCGGACATGATTTGTGGGGGACGAA-CGAAACCCCGGCGCGGCCTGTGCCAAGGAACATA-TGTCAGGACGGATGCG-C
L.pyrenaicum          CCGTAGCTGCCTCCTGGCATTTCGGACATGATTTACGGGGGACGAA-CAAAACCCCGGCGCGGCCTGTGCCAAGGAACATA-TGTCAGGACGGATGCG-C
L.pomponium           CCGCAGCTGCCTCCTGGCATTTCGGACATGATTTGCGGGGGACGAA-CGAAACCCCGGCGCGGCCTGCGCCAAGGAACATA-TGTCAGGACGGATGCG-C
L.rhodopaeum          CCGCAGCTGCCTCCTGGCATTTCGGACATGATTTGTGGGGGACGAA-CGAAACCCCGGCGCGGCCTGTGCCAAGGAACATA-TGTCAGGACGGATGCG-C
L.jankae              CCGCAGCTGCCTCCTGGCATTTCGGACATGATTTGTGGGGGACGAA-CGAAACCCCGGCGCGGCATGCGCCAAGGAACATA-TGTCAGGACGGATGCG-C
L.candidum            ACGCGGCTGCCTCYTGGCATTTCGGACATGATTTGCGGGGGACGAA-CGAAACCCCGGCGCGGCCTGCGCCAAGGAACATA-TGTCAGGACGGATGCG-C
N._saluenensis        CCGCGACTTCCTCTTGGCGTTTCGGACACGATTTGCGGGGGACAGA-CGAATCCCCGGCGCGGCCTGCGCCAAGGAACATA-TGTCAGGACGGATGTG-C
L.canadense           CCGCGGTTACCTTCGAGCATTTTGGGCACGATTTGCGAGGGATGAA-CGAAACCCCGGCGCGGCCTGCGCCAAGGAACATA-TGTCAGGACGGACATG-C
L.philadelphicum      CCGCTGTCGCCTTTGAGTGTTTCGGGCACGATTTGCG-GGGACGAA-CGAAACCCCGGCGCGGCCTGCGCCAAGGAACATA-TGTCAGGACGGACGTGAC
L.auratum             CCGCGGCCGCCTCCGAGCGTTCCCGGCACGATTTGCGGGGGACGAA-CGAAACCCCGGCGCAGCCTGTGCCAAGGAACATA-TGTCAGGACGGACGCG-T
L.japonicum           CCGCGGTCGCCTCCGAGCATTCCCGGCACGATTTGCGGGGGATGAA-CGAAACCCCGGCGCAGCCTGTGCCAAGGAACATA-TGTCAGGACGGACGCG-T
Noth._thomsonianum    TCGCGGCTGTCTTTGAGACCGTCGGGCACGATTTGTGGGGGACGGA-CGAAACCCCGGCACAGCCTGTGCCAAGGAACATA-TGACAGGACGGACGCA-C

C._giganteum          GTCAACGCCTCCGTGGTGGGGCGACGTC----CGCTCTTTATCT-GTA-CGACTCTCGGCAACGG-ATATCTCGGCTCTCGCATCG-ATGAAGAACGTAG
L.bulbiferum          GTCAATGCCTCAGTGGTGGGGCGACGTT----CGCTCTCTATCT-ATA-CGACTCTCGGCAACGG-ATATCTCGGCTCTCGCATCG-ATGAAGAACGTAG
L.pumilum             GTCAATGCCTCAGTGGTGGGGCGACGTT----CGCTCTCTATCT-ATA-CGACTCTCGGCAACGG-ATATCTCGGCTCTCGCATCG-ATGAAGAACGTAG
L.davidii             GTCAATGCCTCAGTGGTAGGGCGACGTT----CGCTCTCTATCT-ATA-CGACTCTCGGCAACGG-ATATCTCGGCTCTCGCATCG-ATGAAGAACGTAG
L.longiflorum         GTCAATGCCTCAGTGGTTGGGCGACGTT----CGCTCTCTATCT-ATA-CGACTCTCGGCAACGG-ATATCTCGGCTCTCGCATCG-ATGAAGAACGTAG
L.philipinnense       GTCAATGCCTCAGTGGTTGGGTGACGTT----CGCTCTCTATCT-ATA-CGACTCTCGGCAACGG-ATATCTCGGCTCTCGCATCG-ATGAAGAACGTAG
L.dauricum            GTCATTGCCTCAGTGGTGGGGCGACGTT----CGCTCTCTATCT-ATA-CGACTCTCGGCAACGG-ATATCTCGGCTCTCGCATCG-ATGAAGAACGTAG
L.martagon            GTCAATGCCTCAGTGGTGGGGCGACGTC----CGCTCTCTATTT-ATA-CGACTCTCGGCAACGG-ATATCTCGGCTCTTGCATCG-ATGAAGAACGTAG
L.armenum             GTCAACGCCTCTGTGGTGGGGCGACGTC----CGCTCTATATCC-ATA-CGACTCTCGGCAACGG-ATATCTCGGCTCTCGCATCG-ATGAAGAACGTAG
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L.szovitsianum       GTCAACGCCTCTGTGGTGGGGCGACGTY----CGCTCTATATCT-ATA-CGACTCTCGGCAACGG-ATATCTCGGCTCTCGCATCG-ATGAAGAACGTAG
L.ponticum           GTCAACGCCTCTGTGGTGGGGYGACGTT----CGCTCTATATCY-ATA-CGACTCTCGGCAACGG-ATATCTCGGCTCTCGCATCG-ATGAAGAACGTAG
L.artvinense         GTCAACGCCTCTGTGGTGGGGYGACGTC----CGCTCTATATCY-ATA-CGACTCTCGGCAACGG-ATATCTCGGCTCTCGCATCG-ATGAAGAACGTAG
L.monadelphum        GTCAACGCCTCTGTGGTGGGGCGACGTC----CGCTCTATATCT-ATA-CGACTCTCGGCAACGG-ATATCTCGGCTCTCGCATCG-ATGAAGAACGTAG
L.kesselringianum    GTCAACGCCTCTGTGGTGGGGCGACGTT----CGCTCTATATCT-ATA-CGACTCTCGGCAACGG-ATATCTCGGCTCTTGCATCGCATGAAGAACGTAG
L.ciliatum           GTCAACGCCTCTGTGGTGGGGCGACGTC----CGCTCTATATCT-ATA-CGACTCTCGGCAACGG-ATATCTCGGCTCTCGCATCG-ATGAAGAACGTAG
L.akkusianum         GTCAACGCCTCTGTGGTGGGGCGACGTC----CGCTCTATATCT-ATA-CGACTCTCGGCAACGG-ATATCTCGGCTCTCGCATCG-ATGAAGAACGTAG
L.albanicum          GTCAATGCCTCTGTGGTGTGGCGACGTC----CGCTCTATATCT-ATA-CGACTCTCGGCAACGG-ATATCTCGGCTCTCGCATCG-ATGAAGAACGTAG
L.carniolicum        GTCAATGCCTCTGTGGTGGGGCGACGTY----CGCTCTATATCT-ATA-CGACTCTCGGCAACGG-ATATCTCGGCTCTCGCATCG-ATGAAGAACGTAG
L.bosniacum          GTCAACGCCTCTGTGGTGGGGCGACGTCCGTACGCTCTATATCT-ATAACGACTCTCGGCAACGG-ATATCTCGGCTCTCGCATCG-ATGAAGAACGTAG
L.pyrenaicum         GTCAACGCCTCTGTGGTGGGGCGACGTC----CGCTCTATATCT-ATA-CGACTCTCGGCAACGG-ATATCTCGGCTCTCGCATCG-ATGAAGAACGTAG
L.pomponium          GTCAACGCCTCTGTGGTGGGGTGACGTC----CGCTCTATATCT-ATA-CGACTCTCGGCAACGG-ATATCTCGGCTCTCGCATCG-ATGAAGAACGTAG
L.rhodopaeum         GTCAACGCCTCTGTGGTGGGGCGACGTC----CGCTCTATATCT-ATA-CGACTCTCGGCAACGG-ATATCTCGGCTCTCGCATCG-ATGAAGAACGTAG
L.jankae             GTCAACGCCTCTGTGGTGGGGCGACGTC----CGCTCTATATCTCATA-CGACTCTCGGCAACGGCATATCTCGGCTCTCGCATCG-ATGAAGAACG---
L.candidum           GTCAACGCCTCTGTGGTGGGGCGACGTC----CGCTCTATATCT-ATA-CGACTCTCGGCAACGG-ATATCTCGGCTCTCGCATCG-ATGAAGAACGTAG
N._saluenensis       GCCAACGCCTTTGTGGTGGGGCGACGTT----TGCTCAATATCT-ATA-CGACTCTCGGCAACGG-ATATCTCGGCTCTCGCATCG-ATGAAGAACGTAG
L.canadense          GTCAACGCCTTTGTGGTGGGGTGACATC----TGCTCTCTATCT-ATA-TGACTCTCGGCAACGG-ATATCTCGGCTCTCGCATCG-ATGAAGAACGTAG
L.philadelphicum     GCCAACGCCTTTACGGTGAGGCGATGTC----CACTCTCTATCT-ATA-CGACTCTCGGCAACGG-ATATCTCGGCTCTCGCATCG-ATGAAGAACGTAG
L.auratum            GCCAACGCCTCTGTGGTGGGGCGACGTC----CGCTCTTTATCT-GTA-CGACTCTCGGCAACGG-ATATCTCGGCTCTCGCATCG-ATGAAGAACGTAG
L.japonicum          GCCAACGCCTCTGTGGTGGGGCAACGTC----CGCTCTTTATCT-GTA-CGACTCTCGGCAACGG-ATATCTCGGCTCTCGCATCG-ATGAAGAACGTAG
Noth._thomsonianum   GTCTACACCTCTGTGGTGGGGCGACGTT----TGCTCTTTATCT-CTA-CGACTCTCGGCAACGG-ATATCTCGGCTCTCGCATCG-ATGAAGAACGTAG

C._giganteum         CGAAATGCGATACTTGGTGTGAATTGCAGAATCCCGTGAACCATCGAGTCTTTGAACGCAAGTTGCGCCCGAGGCCTTTCGGTCGAGGGCACGCCTGCCT
L.bulbiferum         CGAAATGCGATACTTGGTGTGAATTGCAGAATCCCGTGAACCATCGAGTCTTTGAACGCAAGTTGCGCCCGAGGCCTTTCGGCTGAGGGCACGCCTGCCT
L.pumilum            CGAAATGCGATACTTGGTGTGAATTGCAGAATCCCGTGAACCATCGAGTCTTTGAACGCAAGTTGCGCCCGAGGCCTTTCGGTTGAGGGCACGCCTGCCT
L.davidii            CGAAATGCGATACTTGGTGTGAATTGCAGAATCCCGTGAACCATCGAGTCTTTGAACGCAAGTTGCGCCCGAGGCTTTT-GGTTGAGGGCACGC-TGCCT
L.longiflorum        CGAAATGCGATACTTGGTGTGAATTGCAGAATCCCGTGAACCATCGAGTCTTTGAACGCAAGTTGCGCCCGAGGCCTTTCGGTTGAGGGCACGCCTGATT
L.philipinnense      CGAAATGCGATACTTGGTGTGAATTGCAGAATCCCGTGAACCATCGAGTCTTTGAACGCAAGTTGCGCCCGAGGCCTTTCGGTTGAGGGCACGCCTGCCT
L.dauricum           CGAAATGCGATACTTGGTGTGAATTGCAGAATCCCGTGAACCATCGAGTCTTTGAACGCAAGTTGCGCCCGAGGCCTTTCGGTTGAGGGCACGCCTGCCT
L.martagon           CGAAATGTGATACTTGGTGTGAATTGCAGAATCCCGTGAACCATCGAGTCTTTGAACGCAAGTTGCGCCCGAGGCCTTTCGGTTGAGGGCACGCCTGCCT
L.armenum            CGAAATGCGATACTTGGTGTGAATTGCAGAATCCCGTGTTCCATCGAGTCTTTGAACGCAAGTTGCGCCCGAGGCCTTTCGGTTGAGGGCACGCCTGCCT
L.szovitsianum       CGAAATGCGATACTTGGTGTGAATTGCAGAATCCCGTGTTCCATCGAGTCTTTGAACGCAAGTTGCGCCCGAGGCCTTTCGGTTGAGGGCACGCCTGCCT
L.ponticum           CGAAATGCGATACTTGGTGTGAATTGCAGAATCCCGTGTTCCATCGAGTCTTTGAACGCAAGTTGCGCCCGAGGCCTTTCGGTTGAGGGCACGCCTGCCT
L.artvinense         CGAAATGCGATACTTGGTGTGAATTGCAGAATCCCGTGTTCCATCGAGTCTTTGAACGCAAGTTGCGCCCGAGGCCTTTCGGTTGAGGGCACGCCTGCCT
L.monadelphum        CGAAATGCGATACTTGGTGTGAATTGCAGAATCCCGTGTTCCATCGAGTCTTTGAACGCAAGTTGCGCCCGAGGCCTTTCGGTTGAGGGCACGCCTGCCT
L.kesselringianum    CGAAA-GCGATACTGGTAGTGAATTGCAGAATCCCGTGAACCATCGAGTCTTTGAACGCAAGTTGCGCCCGAGGCCTTTCGGTTGAGGGCACGCCTGCCT
L.ciliatum           CGAAATGCGATACTTGGTGTGAATTGCAGAATCCCGTGTTCCATCGAGTCTTTGAACGCAAGTTGCGCCCGAGGCCTTTCGGTTGAGGGCACGCCTGCCT
L.akkusianum         CGAAATGCGATACTTGGTGTGAATTGCAGAATCCCGTGTTCCATCGAGTCTTTGAACGCAAGTTGCGCCCGAGGCCTTTCGGTTGAGGGCACGCCTGCCT
L.albanicum          CGAAATGCGATACTTGGTGTGAATCGCAGAATCCCGTGTTCCATCAAGTCTTTGAACGCAAGTTGCGCCCGAGGCCTTTCGGTTGAGGGCACGCCTGCCT
L.carniolicum        CGAAATGCGATACTTGGTGTGAATCGCAGAATCCCGTGTTCCATCAAGTCTTTGAACGCAAGTTGCGCCCGAGGCCTTTCGGTTGAGGGCACGCCTGCCT
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L.bosniacum          CGAAATGCGATACTTGGTGTGAAT-GCAGAATCCCGTGTTCCTACAGATCTTTGAACGCAAGTTGCGCCCGAGGCCTTTCGGTTGAGGGCACGCCTGCCT
L.pyrenaicum         CGAAATGCGATACTTGGTGTGAATTGCAGAATCCCGTGAACCATCGAGTCTTTGAACGCAAGTTGCGCCTAAGGCCTTTCGGTTGAGGGCACGCCTGCCT
L.pomponium          CGAAATGCGATACTTGGTGTGAATTGCAGAATCCCGTGAACCATCGAGTCTTTGAACGCAAGTTGCGCCCGAGGCCTTTCGGTTGAGGGCACGCCTGCCT
L.rhodopaeum         CGAAATGCGATACTTGGTGTGAATTGCAGAATCCCGTGTTCCATCGAGTCTTTGAACGCAAGTTGCGCCCGAGGCCTTTCGGTTGAGGGCACGCCTGCCT
L.jankae             ----ATACG----TGGAWGTGAATTGCAGAATCCCGTGAACCATCGAGTCTTTGAACGCAAGTTGCGCCCGAGGCCTTTCGGTTGAGGGCACGCCTGCCT
L.candidum           CGAAATGCGATACTTGGTGTGAATTGCAGAATCCCGTGTTCCATCGAGTCTTTGAACGCAAGTTGCGCCCGAGGCCTTTCGGTTGAGGGCACGCCTGCCT
N._saluenensis       CGAAATGCGATACTTGGTGTGAATTGCAGAATCCCGTGAACCATCGAGTCTTTGAACGCAAGTTGCGCCCGAGGCCTTTCGGTTGAGGGCACGCCTGCGT
L.canadense          CGAAATGCGATACTTGGTGTGAATTGCAGAATCCCGTGAACCATCGAGTCTTTGAACGCAAGTTGCGCCCGAGGCCTTTCGGTTGAGGGCACGCCTGCCT
L.philadelphicum     CGAAATGCGATACTTGGTGTGAATTGCAGAATCCCGTGAACCATCGAGTCTTTGAACGCAAGTTGCGCCCGAGGCCTTTCGGTTGAGGGCACGCCTGCCT
L.auratum            CGAAATGCGATACTTGGTGTGAATTGCAGAATCCCGTGAACCATCGAGTCTTTGAACGCAAGTTGCGCCCGAGGCCTTTCGGTTGAGGGCACGCCTGCCT
L.japonicum          CGAAATGCGATACTTGGTGTGAATTGCAGAATCCCGTGAACCATCGAGTGTTTGAACGCAAGTTGCGCCCGAGGCCTTTCGGTTGAGGGCACGCCTGCCT
Noth._thomsonianum   CGAAATGCGATACTTGGTGTGAATTGCAGAATCCCGTGAACCATCGAGTCTTTGAACGCAAGTTGCGCCCGAGGCCTTTCGGTCGAGGGCACGCCTGCCT

C._giganteum         GGGCGTCACGCCTTGTTTC-GCTCTACGG--CCATGCCCCTTTGGGAG-CGGTCATGGATGCGGAAATTGGCCCTCCGTGCC-TCGT-GT-GCGGCGGGC
L.bulbiferum         GGGCGTCACGCCTTGTTTC-GCTCTGTGC--CCATGCCCTTTCGGGGG-CGGTCATGGATGCGGAGATTGGCCCTCCGTGCC-TCGT-GC-GTGGCGGGC
L.pumilum            GGGCGTCACGCCTTGTTTC-GCTCTGTGG--CCATGCTCTTTCGGGGG-CGGTCATGGATGCGGAGATTGGCCCTCCGTGCC-TCGT-GT-GCGGAGGGC
L.davidii            GGGCGTCACGC-TTGTTTC-GCTCTGTGC--CCATGCTCTTTCGGGGG-CGGTCATGGATGCGGAGATTGGCCCTCCGTGCC-TAGT-GT-GCGGCGGGC
L.longiflorum        GGGCGTCACGCCTTGTTTC-GCTCTGTGC--CCATGCCCTTTTGGGGG-CGGTCATGGATGCGGAGATTGGCCCTCCGTGCC-TTGT-GT-GCGGCGGGC
L.philipinnense      GGGCGTCACGCCTTGTTTC-GCTCTGTGC--CCATGCCCTTTTGGGGG-CGGTCATGGATGCGGAGATTGGCCCTCCGTGCC-TCGT-GT-GCGGCGGAC
L.dauricum           GGGCGTCACGCCTTGTTTC-GCTCTGTGC--CCATGCTCTTTCGGGGG-CGGTCATGGATGCGGAGATTGGCCCTCCGTGCC-TCGT-GT-GCGGCGGGC
L.martagon           GGGCGTCACGCCTTGTTTC-GCTCTGTGC--CCATGCTCTTTCGGGGG-CGGTCATGGATGCGGAGATTGGCCCTCCGTGCC-TCGT-GT-GCGGCGGGC
L.armenum            GGGCGTCACGCCTTGTTTG-GCTCTGTGC--CCATGCTCCTTCGGGGG-CGGTCATGGATGCGGAGATTGGCCCTCCGTGCC-TCGT-GT-GCGGCGGGC
L.szovitsianum       GGGCGTCACGCCTTGTTTG-GCTCTGTGC--CCATGCTCCTTCGGGGG-CGGTCATGGATGCGGAGATTGGCCCTCCGTGCC-TCGT-GT-GCGGCGGGC
L.ponticum           GGGCGTCACGCCTTGTTTT-GCTCTGTGC--CCATGCTCCTTCGGGGG-CGGTCATGGATGCGGAGATTGGCCCTCCGTGCC-TCGT-GT-GCGGCGGGC
L.artvinense         GGGCGTCACGCCTTGTTTT-GCTCTGTGC--CCATGCTCCTTCGGGGG-CGGTCATGGATGCGGAGATTGGCCCTCCGTGCC-TCGT-GT-GCGGCGGGC
L.monadelphum        GGGCGTCACGCCTTGTTTT-GCTCTGTGC--CCATGCTCCTTCGGGGG-CGGTCATGGATGCGGAAATTGGCCCTCCGTGCC-TCGT-GT-GCGGCGGGC
L.kesselringianum    GGGCGTCACGCCTTGTTTT-GCTCTGTGC--CCATGCTCCTTCGGGGG-CGGTCATGGATGCGGAGATTGGCCCTCCGTGCC-TCGT-GT-GCGGCGGGC
L.ciliatum           GGGCGTCACGCCTTGTTTC-GCTCTGTGC--CCATGCTCCTTCGGGGG-CGGTCATGGATGCGGATATTGGCCCTCCGTACC-ACGT-GT-GCGGCGGGC
L.akkusianum         GGGCGTCACGCCTTGTTTC-GCTCTGTGC--CCATGCTCCTTCGGGGG-CAGTCATGGATGCGGATATTGGCCCTCCGTACC-ACGT-GT-GCGGCGGGC
L.albanicum          GGGCGTCACGCCTTGTTTT-GCTCTGTGC--CCATGCTCCTTCGGGGG-CGGTCATGGATGCAAAGATTGGCCCTCCGTGCC-T-GTTGT-GCGGCGGGC
L.carniolicum        GGGCGTCACGCCTTGTTTTCGCTCTGTGC--CCATGCTCCTTCGGGGG-CGGTCATGGATGCAGAGATTGGCCCTCCGTGCC-TCGTTGT-GCGGCGGGC
L.bosniacum          GGGCGTCACGCCTTGTTTC-GCTCTGTGC--CCATGCTCCTTCGGGGG-CGGTCATGGATGCAGAGATTGGCCCTCCGTGCC-TCGT-GT-GCGGCGGGC
L.pyrenaicum         GGGTGTCATGCCTTGTTTT-GCTATGTGC-CCCATGCTCCTTCGGGGG-CGGTCATGGATGCAGAGATTGGCCCTCCGTGCC-TCGT-GT-GTGGCGGGC
L.pomponium          GGGCGTCACGCCTTGTTTT-GCTCTGTGC--CCATGCTCCTTCGGGGG-CGGTCATCGATGCAGAGATTGGCCCTCCGTGCC-TCGT-GT-GCGGCGGGC
L.rhodopaeum         GGGCGTCACGCCTTGTTTC-GCTCTGTGC--CCATGCTCCTTCGGGGG-CGGTCTTGGATGC-AAAATGGGCCCTCCGTGCC-TGGTTGT-GCGGCGGGC
L.jankae             GGGCGTCACGCCTTGTTTC-GCTCTGTGC--CCATGCTCCTTCGGGGG-CGGTCATGGATGCGAAAATKGGCCCTCCGTGCCCTTGTTGTTGCGGCGGGC
L.candidum           GGGCGTCACGCCTTGTTTC-GCTCTGTGC--CCATGCTCCTTCGGGGG-CAGTCATGGATGCGGATATCGGCCCTCCGTGCC-TCGT-GT-GCGGCGGGC
N._saluenensis       GGGCGTCACACCCTGTTTC-GCTCTGTGC--CCATGCTCTTTCGGGG--CGGTCATGGATGCGGAGATTGGCCCTCCTCGCC-TCGT-GT-GCGGCGGGC
L.canadense          GGGCGTCACGCCTT-GTTTTGCTCTGTGC--CCATGCTCCTTCGGGGG-CGGCCATGGATGCGGAGATTGGCCCTCCGTGCC-TCGT-GT-GCGGCGGGC
L.philadelphicum     GGGCGTCACGCCTT-GTTTTGCTCTGTGT--CCATGCTCCTTTGGGGG-CGGTCATGGATGCGGAGACTGGCCCTCCGTGCC-TCGT-GT-GCGGCGGGC
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L.auratum             GGGCGTCACGCCTTTGTTTCGCTCTGTGTGCCCATGCTCCTTCGGGGG-CGGTCATGGATGCGGAGATTGGCCCTCCGTGCC-TCGT-GT-GCGGCGGGC
L.japonicum           GGGCGTCACGCCTTTGTTTCGCTCTGTGTGCCCATGCTCCTTCGGGGG-CGGTCATGGATGCGGAGATTGGCCCTCCGTGCC-TCGT-GT-GCGGCGGGC
Noth._thomsonianum    GGGCGTCACGCCTTGTTTC-GCTCTGTGC--CCATGCTCCTTTGGGGGGTGGCCATGGATGCAGATAGTGGCCCTCCGTGCC-TCGT-GT-GCGGCGGGC

C._giganteum          TTAA-GTGT-GGGCTGTCGGCGCCGGGAT-GGGCACGACGAAT-GGTGGACGGAGCGCCAGCA--GGATGTCTTGGCCCCCCCTTGCCTTGA-GGGG--C
L.bulbiferum          TTAA-GCGC-GGGCTGTCGGCGTCGGGAT-GGGCACGACGAGT-GGTGGACGGAGCACCAGCA--GGATGTTGTGGTCCCCCGTCGCCTTAA-GGGG--C
L.pumilum             TTAA-GCGC-GGGCTGTCGGCGTCGGGAT-GGGCACGACGAGT-GGTGGACGGAGCACCAGCA--GGATGTTGTGGTCCCCCGTCGCCTTAA-GGGG--C
L.davidii             TTAA-GCGC-GGGCTGTCGGTGTCGGGAT-GGGCACGACGAGT-GGTGGACGGAGCACCAGCA--GGATGTTGTGGTCCCCCGTCGCCTTAA-GGGG--C
L.longiflorum         TTAA-GCGC-GGGCTGTCGGTGTCGGGAT-GGGCACGACGAGT-GGTGGACGGAGCACCAGTA--GGATGCTGTGGTCCCCCGTCGCCCTAA-GGGG--C
L.philipinnense       TTAA-GTGC-GGGCTGTCGGTGTCGGGAT-GGGCACGACGAGT-GGTGGACGGAGCACCAGCA--GGATGTTGTGGTCCCCCGTCGCCTTAA-GGGG--C
L.dauricum            ATAA-GCGT-GGGCTGTCGGCGTCGGGAT-GGGCACGACGAGT-GGTGGACGGAGCACCAGTA--GGATGTTGTGGTCCCCCGTCGCCTTAA-GGGG--C
L.martagon            TTAA-GTGC-GGGCTGTCGGTGTCGGGAT-GGGCACGACGAGT-GGTGGACGGAGCACCAACA--GGATGTTGTGGTCCCCTGTCGCCTTAA-GGGG--C
L.armenum             TTAA-GCGC-GAGCTGTCGGCGTCGGGAT-GGACACGACGAGT-GGTGGACGGAGCACCAGAA--GGATGTCGTGGTCCCCCGTCGCCTAAA-GGGG--C
L.szovitsianum        TTAA-GCGC-GAGCTGTCGGCGTCGGGAT-GGACACGACGAGT-GGTGGACGGAGCACCAGAA--GGATGTCGTGGTCCCCCGTCGCCTAAA-GGGG--C
L.ponticum            TTAA-GCGC-GAGCTGTCGGCGTCGGGAT-GGACACGACGAGT-GGTGGACGGAGCACCAGAA--GGATGTCGTGGTCCCCCGTCGCCTAAA-GGGG--C
L.artvinense          TTAA-GCGC-GAGCTGTCGGCGTCGGGAT-GGACACGACGAGT-GGTGGACGGAGCACCAGAA--GGATGTCGTGGTCCCCCGTCGCCTAAA-GGGG--C
L.monadelphum         TTAA-GCCS-GAGCTGTCGGCGTCGGGAT-GGACACGACGAGT-GGTGGACGGAGCACCAAAA--GGATGTCGTGGTCCCCCGTCGCCTAAA-GGGG--C
L.kesselringianum     TTAA-GCGC-GAGCTGTCGGCGTCGGGAT-GGACACGACGAGT-GGTGGACGGAGCACCAGAA--GGATGTCGTGGTCCCCCGTCGCCTAAA-GGGG--C
L.ciliatum            TTAA-GCGC-GGGCTGTCGGCGTCGGGAT-GGACACAACGAGA-GGTGGACGGAGCACCGACA--GGATGTCGTGGTCCCCCGTCGCCTAAA-GGGG--C
L.akkusianum          TTAA-GCGC-GGGCTGTCGGCGTCGGGAT-GGACACGACGAGA-GGTGGACGGAGCACCGACA--GGATGTCGTGGTCCCCTGTCGCCTAAA-GGGG--C
L.albanicum           TTAA-GCGC-GGGCTGTCGGCGTCGGGAT-GGACACGACGAGT-GGTGGACGGAGCACCAGTA--GGATGTCGTGGTCCCCTGTCGCCTAAA-GGGG--C
L.carniolicum         TTAA-GCGT-GGGCTGTCGGCGTCGGGAT-GGACACGACGAGT-GGTGGACGGAGCACCAGTA--GGATGTCGTGGTCCCCTGTCGCCTAAA-GGGG--C
L.bosniacum           TTAA-GCGCTGGGCTGTCGGCGTCGGGAT-GGACACGACGAGT-GGTGGACGGAGCACCAGTA--GGATGTCGTGGTCCCCTGTCGCCTAAA-GGGG--C
L.pyrenaicum          TTAA-GCGC-GGGCTGTCGGCGTCGGGAT-GGACACGACGAGT-GGTGGACGGAGCACCAGTA--GGATGTCGTGGCCCCCTGTCGCCTAAAAGGGG--C
L.pomponium           TTAA-GCGC-GGGCTGTCGGCGTCGGGAT-GGACACGACGAGT-GGTGGACGGAGCACCAGTA--GGATGTCGTGGCCCGCTGTCGCCTAAA-GGGG--C
L.rhodopaeum          TTAA-TCGC-GGGCTGTCGGCYTCGGGATTGGACMCAACAAKT-GGTGAACGGACCCCCATTA--GRATKTCTKGGTCCCCKGTCCCCTAA--GGGG--C
L.jankae              TTAAGYCGCGAGCCKGTCGGCTTCGGGATTGGACCCAACRAGTTGGTGGACGGACCACCAGTATAGGATGTCGTGGTCCCCTGTCCCCTAAAGGGGG--C
L.candidum            TTAA-GCGC-GGGCTGTCGGCGTCGGGAT-GGACACAAYGAAT-GGTGAACGGACCACCAGYA--GGATGTCTTGGTCCCCTGTCGCCTAAAGGGGC--T
N._saluenensis        TAAA-GCGC-GGGCTGTCGGCGTCGGGAT-GGGCACGACGAGT-GGTGGACGGAGCACCAGCA--GGATGTTGTGTTCCCCCCTCGCTTTAA-GGGG--C
L.canadense           TTAA-GCGG-GGGCTGTCGGTGTCGGGAT-GGACACAATGATT-GGTGGACGGAGCACCAGCA--GGATGTCGTGGTCCCCCGTCGCCTTAAGGGG---C
L.philadelphicum      TTAA-GTGT-GGGTTGTCGGCGTCGGGAT-GGGCACGATGAGT-GGTGGACGGAGCACCAGTA--GGATGTCGTGTTCCCCTGTCGCCTCAAGTGG---C
L.auratum             TTAA-GCGC-GGGCTGTCGGCGTCGGGTT-GGGCACGACGAGT-GGTGGACGGAGCACCAGCA--GGATGTCGTGGTCCCTCGTCGCCTTAAGGGGGGGC
L.japonicum           TTAA-GCGC-GGGCTGTCGGCGTCGGGCT-AGGCACGACGAGT-GGTGGACGGAGCACCAGTA--GGATGTCGTGGTCCCTCGTCGCCTTAAGGGGGGGC
Noth._thomsonianum    TTAA-GTGT-GGGCTGTCGGTGTCGGGAA-GGACACGATGAGT-GGTGGACGGAGCACCAGAT--GGATGTCGCGGTCCCCCGTTGCCTTGA-GGGG--C
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C._giganteum	TCAAAAAACCCGGACTA-GGCGAGCCGTGCTCCGTAAG-AGGAGGGG--TTTCCGTCTCCCAAT
L.bulbiferum	TCAAGAGACCCGGACTA-GGCGAGCCGTGCTCCGTAAG-AGGAGGAA--AGGCCGTCTCGCAAT
L.pumilum	TCAAGAGACCCGGACTA-GGCGAGCCGTGCTCTGTAAG-AGGAGGAA--AGGCCGTCTCGCAAT
L.davidii	TCAAGAGACCCGGACTA-GGCGTGCCGTGCTCCGTAAG-AGGAGGAC--GAGCCGTCTCGCAAT
L.longiflorum	TCAAGA--CCCGGACTA-GGCCAGCCGTGCTCCGTAAG-AGGAGGGC--GAGCTGTCTCGCAAT
L.philipinnense	TCAAGAGACCCGGACTA-GGCGAGCCGTGCTCCGTAAG-AGGAGGGC--GAGCCGTCTCGCAAT
L.dauricum	TCAAGAGACCCGGACTA-GGCGAGCCGTGCTCCGTAAG-AGGAGGGC--GAGCCGTCTCGCAAT
L.martagon	TCAAGAGACCCGGACTA-GGCGAGTCGCCCTCCGTACG-AGGAGGGA--GAGCCGTCTCGCAAT
L.armenum	TCAAGAGTTCCGGACTA-GGCGAGCCGTGCTCCGTACG-AGGAGGGC--GAGCTGTCTCGTAAT
L.szovitsianum	TCAAGAGTTCCGGACTA-GGCGAGCCGTGCTCCGTACG-AGGAGGGC--GAGCTGTCTCGTAAT
L.ponticum	TCAAGAGTTCCGGACTA-GGCGAGCCGTGCTCCGTACG-AGGAGGGC--GAGCTGTCTCGTAAT
L.artvinense	TCAAGAGTTCCGGACTA-GGCGAGCCGTGCTCCGTACG-AGGAGGGC--GAGCTGTCTCGTAAT
L.monadelphum	TCAAGAGTTCCGGACTA-GGCGAGCCGTGCTCCGTACG-AGGAGGGC--GAGCTGTCTCGTAAT
L.kesselringianum	TCAAGAGTTCCGGACTA-GGCGAGCCGTGCTCCGTACG-AGGAGGGC--GAGCTGTCTCGTAAT
L.ciliatum	TCAAGAGATTCGGACTA-GGCGAGCCGTGCTCCGTACG-AGGAGGGC--GAGCTGTCTCGCAAT
L.akkusianum	TCAAGAGATTCGGACTA-GGCGAGCCGTGCTCCGTACG-AGGAGGGC--GAGCTGTCTCGCAAT
L.albanicum	TCAAGAGATCCGGACTA-GTCAAGCCGTGCTCCGTACG-AGGAGGGC--AAGCTGTCTCGCAAT
L.carniolicum	TCAAGAGATCCGAACTA-GTCGAGTCGTGCTCCGTACG-AGGAGGGC--GAGCTGTCTCGCAAT
L.bosniacum	TCAAGAGATCCGGACTA-GTCGAGCCGTGCTCCGTACGTAGGAGGGC--GAGCTGTCTCGCAAG
L.pyrenaicum	TCAAGAGATCCAGACTA-GTCGAGCCGTGCTCCGTACG-AGGAGGGC--GAGCTGTCTCGCAAT
L.pomponium	TCAAGAGATCCGGACTA-GTCGAGCCGTGCTCCGTACG-AGGAGGGC--GAGCTGTCTCACAAT
L.rhodopaeum	TCARAAAATCCGGACTA-TTCAAGCCGTGCTCCGTACA-AGGAGGGC--AASCTGTYTCGCAWT
L.jankae	TCAAGAGATCCGGACTAGTTCAAGTCTTGCTCCGTACA-AGGAGGGC--AAGCTGTCTCGYAAT
L.candidum	CAAAAAAATCCGGACTA-GGCAASCCGTCCTCCGTACA-AGGAGGGCYAAGCCTGTCTCGCAT-
N._saluenensis	TCAAAAGACCCGGACTA-GGCGAGCCGTGCTCCGTACG-AGGAGGGC--GAGCCGTCTCGCAAC
L.canadense	TTAAGAGACCCGGACTA-GGCGAGCCGTGCTCCGTACG-AGGAGGAC--GAGCCGTCTCGCAAT
L.philadelphicum	TCAAGAGACCCGGATTA-GGCGAGTTGTGCTCCGTACG-TGGAGGGC--GAGCCGTCTCGCAAT
L.auratum	TCAAGAGACCCGGACTA-GGCGAGCCGTGCTCCGTACG-GGGAGGGC--AGGCCGTCTCGCAGT
L.japonicum	TCAAGAGACCCGGACTA-GGCGAGCCGTGCTCCGTATG-GGGAGGGC--AGGCCGTCTTGCAGT
Noth._thomsonianum	TCAAGAGACCCGGATTA-GGCGAGCCGCCCTATGTGCAATGTAGTGC--GTGCTGTCTTGCAAT

Appendix 2. 0/1 Matrix for RAPD Analysis of 170 individuals. Numbers from 1 to 192 indicate individuals details of which are given in Appendix 3

Ind	AB16	AB14	AB11	C14	C16	C20	C04	I15	AB02	C11	C10
1	11100110	1111011	01010011010101	110110	10000100001	0110	1010	1010110111	00100101000	110101	000101000101
2	11100110	1111011	01010011010001	111110	11000100011	0110	1010	1000010101	01100101001	101101	000101000101
3	11100110	1111011	00010011000101	111111	10000100001	0110	1010	1000010101	01000101011	101001	000001000101
4	11101110	1111011	00010011000001	110010	11000100011	0110	1010	0010010111	00100101011	101001	010101000101
5	11101111	1111011	01010010010101	011011	11000100011	0110	1010	1010010101	00100101001	101001	010001000101
6	11101110	1111011	01010010001101	111110	11000100011	0100	0010	1010010101	01100101011	101101	010001000101
8	11101010	1011010	00110010010101	011010	10000100011	1010	1010	1010010111	01100101011	101101	010101000101
10	11101111	0111010	00100010101101	011011	01000100011	0100	0010	0010010001	01000101011	101110	000000100101
11	11101111	0111010	00010011000101	111011	00000100001	1000	0010	1000010001	00000101011	101110	000001000101
12	11101111	0111010	00010011000101	111011	01000100011	1010	0010	1000010011	00000101011	101110	000000100101
13	11100010	0011000	00010000101101	111001	00000100001	1000	0010	1010000111	00000101011	101110	000001000101
14	11101010	0011000	00010010000101	111010	10000100011	1000	0010	0000000101	00000101011	101101	100001000101
15	11101111	1111000	01010010000101	110011	10000100011	0110	0010	1000000101	00000101011	101101	100001000101
16	11101110	0111001	00000011010101	011011	00000100011	0110	0010	0000010100	00000001011	101001	010001000101
17	11100011	0111011	00010001000011	110011	10010100011	0110	0110	1000100000	01000101011	101101	010000010101
18	11101110	1111001	00010000110101	111011	10010110011	0100	0010	1000100000	01000101001	101101	010001010101
19	11100110	1111001	00010001001101	011011	10010110011	0110	0110	1000000000	01100101001	101101	000001010101
20	11101111	1111001	00010000001101	010011	00000110011	0110	0110	1000100000	01100101001	101101	010001010101
21	11101111	1111001	00010000101101	111011	10010100011	0100	0110	1000100000	01100101011	101101	010001010101
22	11101111	0111010	00010001101101	011011	10000110001	0100	0000	1000100000	01000101001	101101	000001000101
24	11101110	0111001	00010000001101	011010	10010100011	0100	0010	0000100000	01000100111	101101	010001000101
25	11100111	1111001	00010000000001	010000	10010110001	0100	0010	0000100000	01000100110	101101	100001000101
26	11101111	0011001	00010000001101	011001	10010110011	0100	0010	1000000000	01000100111	101001	000001000101
27	11101110	0011000	00010000001101	100010	10000110011	0101	0010	0000100000	01000100100	101001	010001000101
28	11101110	0111001	00010011001101	011011	10010110011	0110	0110	1000000000	01100100111	101001	010000110101
29	11101111	1111000	00010011010101	111011	10010110011	0100	0010	1000100000	00000101011	101001	100000110101
30	*10100101*	*0111001*	*00100011100100*	*111011*	*10010100001*	*0110*	*0010*	*0000100000*	*00000101011*	*101101*	*000000110101*
31	10101101	1111011	00100010100100	011010	10010101000	1110	0010	0000100000	00000101010	010101	000000110101
32	10100101	0101011	00000000100100	011011	10000101000	0100	0010	0000100000	00000101010	101101	010000110101
34	10111001	0011001	00100011010100	000011	01010101001	1101	0011	0100111001	00001101010	111010	010101010110
35	10100101	0011011	01000011011000	010011	01000011001	1101	0001	0000111000	00000001010	111010	010101010100
36	11111001	0011001	00010110101100	010011	01010101000	1101	0011	0000111000	00000101010	110110	000101010110
37	11000101	0011011	00000110100100	010011	01010100101	1101	0011	0000111000	00001001010	111010	010100110110
38	10110101	0001001	00001110100100	010010	00010101000	0101	0010	0000001000	00001101010	110010	000000010110
39	10100101	0101000	01001010010000	010011	00010110101	0100	0010	0100111000	00001101010	111010	001101000110
40	11011100	0001001	00000011010100	010011	00010100101	0101	0001	0100111000	00001101010	111010	010001010110
41	10110101	0001001	00001010010100	000011	00010010101	0101	0011	0000111000	00001101010	111010	010101010110
42	10100101	0001001	00000010000100	010011	00010110001	1101	0001	0100010000	00001101010	111010	010101010110
43	11110101	0001001	00000110001000	010011	01010101100	1101	0011	0000111000	00001101010	111010	010101010110
44	11100101	0101001	00001011010100	010011	01010101100	1101	0011	0000111000	00001101010	111010	010100110110
47	10100101	0001001	00001011010100	111011	01010100001	0110	0011	0100111000	00001101010	111010	000101010110
48	10110101	0001001	01000011010000	111011	00010100101	0110	0011	0100101010	00001101010	111010	001001010110
49	11111101	1011001	10001001000100	010011	01110100000	1101	0001	0100110000	00001101010	111010	000001010110
50	11111101	1011001	10001011000100	111011	01010100000	0111	0001	0000110110	00001101010	111010	000001010110
51	10111101	1011001	10001011000100	000010	01010100000	0101	0101	0100110000	00001101010	111010	000101010110
52	11100101	1111001	10001010001000	011011	01010100001	1101	0101	0100110100	00001001010	111010	000101010110
53	10101101	0011001	10001011001000	011011	00110100000	0110	0101	0000110100	00000101010	011010	000101010110
54	11101100	1101001	01001011000100	001001	00000100000	0101	0101	0010110100	00000101010	111010	000101010110
55	11100100	1111001	10001010000100	011011	00110100000	0101	0100	0010111000	00001101010	011010	001000000110
56	11101101	1111001	00000000000100	101011	00100000001	0111	0100	0000010100	00001101010	101010	000100010110
57	11101101	0011001	10001010000100	011011	01000100001	0110	0001	0010110100	00000101010	110110	000101000110
58	10110101	1001011	01000010000100	011011	00000100001	0101	0000	0000110100	00001101010	110010	000101000110
59	11110100	1101011	01001011000100	011011	00000100001	0110	0010	0000110100	00000001010	110110	000101010110
60	11111101	1101011	01001011000100	111011	00000100001	1101	0010	0000110000	00000101010	110110	000101010110

61	11101101	1110011	01001011000100	111011	00010000001	1100	0101	0000110000	00001101010	111010	000101010110
62	1C110100	1101011	10001010000100	111011	00010100001	0110	0101	0000110100	00001101010	111010	000101010110
63	1C110101	1111011	10001011000100	111011	00010100001	1010	0101	0010110100	00001101010	110001	000101010110
64	11100101	C111011	10001010000100	011011	00010100001	0110	0011	0000110000	00001001010	110010	000101010110
65	11000100	1011011	00001001000100	001011	01100100001	0110	0001	0010110100	00001101010	100001	010101000110
68	11100100	1001001	10001001000100	001011	01110100001	0110	0011	0010110000	00000101010	101001	000111001110
69	11100100	1011001	10000001000100	001011	01000100001	0110	0011	0000111000	00001101110	101101	000001001110
70	11101100	1011001	10001001100010	100010	00010100001	0110	0011	0000111000	00001001110	101101	000101001110
71	11101100	1111001	10000101100010	001010	00100110001	0110	0001	0000110100	00000101110	101101	000111001110
72	11011100	1111001	01000101010010	001010	01100100001	0110	0011	0000111000	00001101110	101101	000001001110
73	11000100	1111001	10001001100100	001011	01100110001	0110	0001	0000110100	00001101110	111101	000101001110
74	11101100	1111001	10001001100100	001011	01100110001	0110	0001	0000111000	00000101010	101101	000101000110
75	11100100	1111001	10001001000100	000010	01100100001	0110	0011	0000110100	00001100010	101101	000011001110
76	11111101	1111001	01001001000100	001011	01010100111	0110	0011	0000110100	00001101010	101101	000011000110
77	11101100	C011001	01001001000100	011010	01010100011	0110	0011	0000010100	00001101010	110101	000110000110
78	1C100101	1111001	01001001000100	001011	01110110001	1010	0011	0000110100	00001101010	110101	000111001110
79	1C101100	1111001	10001001100100	001011	01110100011	1110	0011	0000110000	00001101010	110101	000111001110
80	1C101100	1111001	10001000000010	001011	01110100011	0110	0011	0000110100	00001101010	111001	000111001110
81	1C100101	1111011	10000111100000	011011	00000100011	0110	0011	0000110110	00000101010	101001	001101000110
82	11100100	C011001	01000011000010	011011	01000110011	0110	0001	0010110100	00001101010	101101	001001000110
83	11100100	1111001	00100001110000	010010	00000100011	0110	1011	0000110100	00001101010	101101	000101000110
84	11100100	1111001	01000010010010	011011	01000100011	1110	1011	0011110110	00001101110	101101	000000100010
85	11100101	1101001	01000110010010	011011	01000100011	1010	1011	0000110110	00001101110	101101	000000110011
86	11100100	0101001	01000110010010	011011	01000110011	0010	0011	0000110110	00001101110	101101	000000100011
87	11100100	1111001	01000010110010	011011	01000100011	1010	1011	0001111110	00000101110	101101	000000100011
88	11100101	0101011	01000110110010	011011	00000100011	1010	0011	0000110100	00000101110	101101	000100110011
89	11100101	0101001	01000110110010	011010	01000100011	1010	1011	0011111110	00001101110	101101	000000100111
90	11100101	0001001	01000100011010	001011	01000100011	1010	0010	0011110110	00001001110	111101	000100100011
91	11100100	0011001	01000110000010	001011	00000100011	1010	1011	0011110110	00001101000	111101	000000100011
92	11100100	0011001	01000010110010	001010	01000100011	0100	1010	0011100010	00001100110	010101	000100100011
93	11100100	0011001	01000100100010	011011	00000100011	1100	1011	0011110110	00001101110	101001	000000100011
94	11100100	1101011	01000110010010	011011	00000000011	1100	1001	0001110110	00000000000	101101	000100100011
95	11100100	1101011	01000011100010	011011	00000110011	0110	1011	0011110100	00001101010	101101	000100101011
96	11100100	1111001	01000110010011	001011	01000010011	0010	0011	0000110010	00001101010	101101	010001000110
97	11100100	1011011	01000110010011	001011	01001110011	0110	1011	0000010010	00011110010	101001	010100000110
98	1C100100	1010010	01000010010011	001010	01000110011	1010	1011	0000110010	00011110010	101010	011101010110
99	11100100	1011001	01000110010001	001011	01001110001	1010	1011	0000110010	00011100010	101001	011001000110
100	1C100100	1111011	00100110010011	001011	01001110011	1010	1011	0000100010	00011110010	101010	011101010110
101	11100101	1011011	00101110011111	001000	01001110001	1010	1011	0000110010	00011110010	101010	010001000110
102	11000101	1111011	01001110001111	001001	00001010011	1010	1011	0000010010	00011100010	101010	011101010110
103	11100101	1111011	01000010011011	101000	01001110101	0110	0011	0000110010	00011110010	101010	011101010110
104	11100100	1111011	01000100010101	101011	01001110001	1010	1011	0000010010	00011110010	101010	011101010110
105	1C000101	1011011	01001110011111	101011	01001110001	0100	1011	0000110010	00011110010	101001	011101000110
106	11100101	1011011	01001010001111	110011	01001110001	1100	1011	0000100000	00011110010	101010	000101010110
107	11100100	1111011	01000110001101	100000	01001110001	0100	1011	0000100010	00011110010	110010	000100010110
108	11100101	1111011	01001110001101	110011	00001110001	1100	1011	0000100010	00011110010	110010	010100000110
109	11100101	1111011	01000010001101	110011	01001110001	1100	1011	0000100010	00011110010	101001	011100010110
110	11100100	1111011	01001010001111	110011	01001110101	1100	1011	0000100010	00011110010	110010	011101010110
111	11100101	1010011	01000110001101	010011	00001110101	1100	1011	0000100010	00011110010	110010	010100000110
112	11100100	1111011	01000110001101	010010	01001110001	1100	1011	0000000010	00011110010	110001	010100010110
113	11010101	1110001	01000010001101	010011	01001110001	1010	1011	0000110110	00011111010	101001	010000000110
114	11100101	1111001	01000010001101	010010	01001110001	1010	1011	0000110110	00011111010	101001	010000000110
115	1C100101	1110001	10000110000101	010000	01001110101	1000	1011	0000110110	00011111010	110001	010000000110
116	11110101	1111000	10001010000101	011000	11000010001	1100	1011	0001010000	10001101010	010101	000000010110
117	1C110101	1101001	01001010000101	011000	11001110001	1100	0001	0001010000	10000101010	010101	000000010110
118	1C100C01	1111000	01001010000100	101010	11000110101	1100	0000	0001100110	10001101010	101101	010010010110
119	1C110101	1101001	01001010000100	111010	11001110101	1100	0001	0001000010	10000101010	101110	000100010110
120	11110101	1001011	10001000010100	111010	11001110101	1100	0001	0001110000	10000001010	001110	010011010110
121	11110101	1111011	01001010000100	111010	11001110001	1100	0001	0001100110	10001001010	001110	000010010110
122	11110100	1111011	01001010000101	111010	11001110001	1100	0001	0001110010	11001101010	001110	010010010110

123	11110101	1101011	01001010000101	111000	11000000101	1100	0001	0001110010	11001101010	101110	010011010110
124	11110101	1001011	01001010000101	011010	10001110101	1100	0001	0001110010	11001101010	101110	100001010110
125	11110100	1111001	01001010000101	111010	11001110101	1100	0001	0001110010	11001101010	010110	000001000110
126	10110101	1111011	01001010000101	111000	11001100101	1100	1001	0001110000	11001101010	010110	100010010110
127	11110101	1111011	10001010001111	011010	00000110111	1100	0001	0000110000	11001101010	010110	000010010110
128	11010101	1101011	10001010000101	111010	11000100001	1100	0001	0000110010	11001101010	110110	100000010110
129	11110100	0011001	01001010000001	111010	01001111101	1011	0101	1110010100	11001101010	001110	000000010110
130	10100100	0111001	01001010000010	011010	00001000001	1011	0111	1011100101	11001101010	001101	000000110110
131	11110100	1111000	01001010000011	111010	00001110001	1011	0111	0011110110	11000101010	001101	000000010110
132	11100101	1111000	01001000000010	111010	01001110101	1010	0111	0000110110	10001001010	001010	000000010110
134	11101101	1101011	00001010000100	001000	01001110101	1011	0111	0000110110	11001001010	001101	000000010110
135	00100100	0111000	00001010000011	111000	00001110101	1011	0011	0000110111	10001001010	010001	000001010110
136	11100101	0101011	01001000000100	011001	00001110111	1011	1011	0000110110	11001101010	001110	000001110110
137	11001101	1111001	10001000010100	111011	00001110101	1011	0111	0000110110	11001001010	001111	000001110110
138	11100100	1111001	10001010010010	111011	01001110101	1011	1101	0000110110	11001101010	001001	000000010110
139	11001101	1111000	10001000000001	000100	01001110101	0010	0111	0001110101	11001101010	001001	000000110110
140	00100000	0011001	00010000010101	000100	00001110011	1011	0111	0100010111	11001000010	001101	000000010110
141	11101100	1111001	00001010010101	011110	00000110001	1011	0111	0100100110	11001001010	001101	000000110110
142	11100110	1001000	01001010010001	011111	00000100011	1001	0011	0100111001	01000100010	001101	000001110110
146	11100111	1111001	01011010010101	001110	10010100011	0100	1011	0010101110	01100101011	101101	010001000110
147	11100110	1011001	01011011010101	011101	00000100011	0100	1011	0010101110	01100101010	101101	000001010110
148	11100110	1011000	00011010010101	011111	10010100011	0100	1010	0010111101	01100101011	101101	010001010110
149	11100111	1011001	00111010010101	011111	10010100011	0100	1011	0010101110	01100101011	101101	010001000110
150	11101110	1111010	00111010110101	111111	10010100011	0100	1010	0010101110	01100101011	101101	000001100110
151	11100111	1011010	00111010110101	111111	10010100011	0100	1011	0010101101	01100101010	101101	010001100110
152	11100111	1111010	00010010010101	111110	10010100011	0100	1011	0010101110	01100101011	101101	010001010110
153	11000110	1011010	00110110110101	011101	10010100011	0101	0010	0010101100	01100101011	101101	010001010110
154	11000110	1111010	00110011010101	111110	10010100011	0101	0010	0010101110	01100101011	001101	010001010110
155	11101110	1111011	00110010010101	011111	00010100011	0100	1010	0010101100	01100101001	001101	010001000110
156	11100111	1011010	00101011010101	111111	00000100011	0100	0010	0010101100	01100101011	101101	010001100110
158	11100010	1111011	00010010010101	110100	01010100011	0101	0010	0010101010	01100101011	001101	010001110110
159	11100110	1111011	00010011010100	111011	10010100011	0100	0000	0010101111	01100101011	101101	100000110110
161	10111011	0011011	00001010010000	010010	01000101111	0110	0000	0000101100	00010000010	110110	100001000110
162	10111001	1011011	01001010010100	010011	01010101111	0110	0000	0010110100	00000001010	110110	000100010110
163	10100001	1011011	00001010010000	000011	01010101011	0110	0000	0000110100	00010001010	010110	000100010110
164	10111001	0011010	00001010010100	011010	01010101111	0110	0000	0000110100	00010001010	111010	010100010110
165	10111001	0011001	01001010010000	000001	01010101111	0110	0001	0000110100	00010001010	111010	000100010110
166	10111001	0011011	01001010010000	001001	01010101111	0110	0001	0000110100	00010001010	111010	000100010110
167	10111001	0011011	01001010000100	001010	00000101101	0110	0000	0000100100	00010001010	011010	010100010100
168	10111011	1011010	00000010010100	011011	00010100011	0010	0000	0000110110	00000001010	110110	000100000110
169	10110001	0011000	00100010000100	101001	00000101101	0110	0000	0000101000	00010001010	010110	000100010110
170	10110001	0001001	00001010000100	110011	00000000101	0110	0000	0000101000	00010001010	011010	010100010110
171	11111001	1011000	00001010010100	110010	00000101111	0110	0000	0000101000	00010001010	110110	010100010110
172	00010001	0011000	00101010010000	010010	01000001101	0110	0000	0000101000	00010000010	010110	000100010110
173	10111001	1011011	01001010000100	110010	00000001110	0110	0000	0000101000	00010001010	110110	010100010110
174	10101101	0001010	00001010000100	010011	00010001111	0110	0000	0000111000	00010001010	011010	000100010110
183	11101111	1011001	01010010000101	111011	10110110011	1000	0010	1101010111	01100101011	110110	000001010110
184	11101111	1011001	01010010000101	111011	10110110011	1000	0010	1101010111	01100101011	110110	000001010110
185	11101111	1011001	01010010001001	111011	10110110011	1000	0010	1101010111	01100101011	110110	000001010110
186	11100010	1011001	00010010011001	111010	10110110011	1010	0010	0101110101	01100101011	110110	000001000110
187	11100000	1011001	01010010001001	111011	10110110011	1000	0010	1101010111	01100101011	110110	000001010110
188	11101110	1011000	01010010000001	111011	10110110011	1000	0010	1101110111	01100101001	110010	010001010110
189	11101100	0011000	01010010010101	111011	10110110011	1000	0010	1101110111	01100101011	110110	010001010110
190	11101111	1011001	01010010010101	111011	10110110011	1010	0010	0101100111	01100101011	110010	010001010110
191	11101100	1011001	01010010010101	111010	10110110011	1010	0010	1101110111	01100101011	110010	010001010110
192	11101111	1011001	01010010001001	111011	10110110011	1000	0010	1101100010	01100101011	111010	000001010110

APPENDIX 3.List of All *Lilium* Species Used in RAPD Analysis

Key	Species	Collection #	Locality
001	*akkusianum*	NI 1982	Ordu, Akkuş
002	*akkusianum*	NI 1928a	Ordu, Akkuş
003	*akkusianum*	NI 1928b	Ordu, Akkuş
004	*akkusianum*	NI1928c	Ordu, Akkuş
005	*akkusianum*	NI1928d	Ordu, Akkuş
006	*akkusianum*	NI1928e	Ordu, Akkuş
008	*akkusianum*	NI1928g	Ordu, Akkuş
010	*akkusianum*	NI1929b	Ordu, Akkuş
011	*akkusianum*	NI1929c	Ordu, Akkuş
012	*akkusianum*	NI1930a	Ordu, Aybasti
013	*akkusianum*	NI1930b	Ordu, Aybasti
014	*ciliatum*	NI1931	Giresun, Dereli
015	*ciliatum*	NI1932a	Giresun, Dereli
016	*ciliatum*	NI1932b	Giresun, Dereli
017	*ciliatum*	NI1932c	Giresun, Dereli
018	*ciliatum*	NI1932e	Giresun, Dereli
019	*ciliatum*	NI1932f	Giresun, Dereli
020	*ciliatum*	NI1932g	Giresun, Dereli
021	*ciliatum*	NI1932h	Giresun, Dereli
022	*ciliatum*	NI1932i	Giresun, Dereli
024	*ciliatum*	NI1935	Trabzon, Maçka
025	*ciliatum*	NI1939	Trabzon, Maçka
026	*ciliatum*	NI1938	Trabzon, Maçka
027	*ciliatum*	NI1941	Trabzon, Maçka
028	*ciliatum*	NI1983	Giresun, Dereli
029	*ciliatum*	NI1952	Rize, Rize, İkizdere
030	*armenum*	NI1933a	Trabzon, Tonya
031	*armenum*	NI1933	Trabzon, Tonya
032	*armenum*	NI1934a	Trabzon, Tonya
034	*armenum*	NI1934	Trabzon, Tonya
035	*armenum*	NI1936a	Trabzon, Maçka
036	*armenum*	NI1936b	Trabzon, Maçka
037	*armenum*	NI1937	Trabzon, Maçka
038	*armenum*	NI1940	Trabzon, Maçka
039	*armenum*	NI1942a	Trabzon, Araklı
040	*armenum*	NI1942b	Trabzon, Araklı
041	*armenum*	NI1942c	Trabzon, Araklı
042	*armenum*	NI1943	Trabzon, Araklı
043	*armenum*	NI1984a	Trabzon, Tonya
044	*armenum*	NI1984b	Trabzon, Tonya
047	*artvinense*	NI1960x	Artvin
048	*artvinense*	NI1961x	Artvin
049	*artvinense*	NI1963x	Artvin
050	*artvinense*	NI1964a	Artvin
051	*artvinense*	NI1964b	Artvin
052	*ponticum*	NI1944	Trabzon, Çaykara
053	*ponticum*	NI1945a	Trabzon, Çaykara
054	*ponticum*	NI1945b	Trabzon, Çaykara
055	*ponticum*	NI1946	Trabzon, Çaykara
056	*ponticum*	NI1947	Trabzon, Çaykara
057	*ponticum*	NI1948	Trabzon, Çaykara
058	*ponticum*	NI1949a	Trabzon, Çaykara
059	*ponticum*	NI1949b	Trabzon, Çaykara
060	*ponticum*	NI1950	Trabzon, Çaykara
061	*ponticum*	NI1953	Rize, İkizdere
062	*ponticum*	NI1954	Rize, İkizdere

063	*ponticum*	NI1955	Rize, İkizdere
064	*ponticum*	NI1958	Rize, Çamlıhemşin
065	*ponticum*	NI1959	Rize, Çamlıhemşin
068	*ponticum*	NI1985c	Trabzon, Çaykara
069	*kesselringianum*	NI1965a	Artvin, Ardanuç
070	*kesselringianum*	1NI965b	Artvin, Ardanuç
071	*kesselringianum*	NI1966	Artvin, Ardanuç
072	*kesselringianum*	NI1967	Artvin, Ardanuç
073	*kesselringianum*	NI1967b	Artvin, Ardanuç
074	*kesselringianum*	NI1967c	Artvin, Ardanuç
075	*kesselringianum*	NI1968	Artvin, Ardanuç
076	*kesselringianum*	NI1970a	Artvin, Şavşat
077	*kesselringianum*	NI1970b	Artvin, Şavşat
078	*kesselringianum*	NI1974a	Artvin, Borçka
079	*kesselringianum*	NI1975	Artvin, Borçka
080	*kesselringianum*	NI1976a	Artvin, Borçka
081	*kesselringianum*	NI1976b	Artvin, Borçka
082	*kesselringianum*	NI1976c	Artvin, Borçka
083	*kesselringianum*	NI1974b	Artvin, Borçka
084	*szovitsianum*	NI1973	Ordu, Aktaş
085	*szovitsianum*	NI1973b	Ordu, Aktaş
086	*szovitsianum*	NI1973c	Ordu, Aktaş
087	*szovitsianum*	NI1973d	Ordu, Aktaş
088	*szovitsianum*	NI1973e	Ordu, Aktaş
089	*szovitsianum*	NI1973f	Ordu, Aktaş
090	*szovitsianum*	NI1973g	Ordu, Aktaş
091	*szovitsianum*	NI1973h	Ordu, Aktaş
092	*szovitsianum*	NI1973j	Ordu, Aktaş
093	*szovitsianum*	NI1973i	Ordu, Aktaş
094	*szovitsianum*	NI1973k	Ordu, Aktaş
095	*szovitsianum*	NI1973l	Ordu, Aktaş
096	*armenum?*	ChO10077/1	Armenia, Kotayk
097	*armenum?*	ChO10077/2	Armenia, Kotayk
098	*armenum?*	ChO10077/3	Armenia, Kotayk
099	*armenum?*	ChO10077/4	Armenia, Kotayk
100	*armenum?*	ChO10077/5	Armenia, Kotayk
101	*armenum?*	ChO10077/6	Armenia, Kotayk
102	*armenum?*	ChO10077/7	Armenia, Kotayk
103	*armenum?*	ChO10077/8	Armenia, Kotayk
104	*armenum?*	ChO10077/9	Armenia, Kotayk
105	*armenum?*	ChO10077/10	Armenia, Kotayk
106	*armenum?*	ChO10064/1	Armenia, Gegharunik
107	*armenum?*	ChO10064/2	Armenia, Gegharunik
108	*armenum?*	ChO10064/3	Armenia, Gegharunik
109	*armenum?*	ChO10064/4	Armenia, Gegharunik
110	*armenum?*	ChO10064/5	Armenia, Gegharunik
111	*armenum?*	ChO10064/6	Armenia, Gegharunik
112	*armenum?*	ChO10064/7	Armenia, Gegharunik
113	*armenum?*	ChO10064/8	Armenia, Gegharunik
114	*armenum?*	ChO10064/9	Armenia, Gegharunik
115	*armenum?*	ChO10064/10	Armenia, Gegharunik
116	*albanicum*	AV2329/1	Greece, Mt. Pindos
117	*albanicum*	AV2329/2	Greece, Mt. Pindos
118	*albanicum*	AV2329/3	Greece, Mt. Pindos
119	*albanicum*	AV2329/4	Greece, Mt. Pindos
120	*albanicum*	AV2329/5	Greece, Mt. Pindos
121	*albanicum*	AV2329/6	Greece, Mt. Pindos
122	*albanicum*	NI2269/1	Greece, Mt. Vernon
123	*albanicum*	NI2269/2	Greece, Mt. Vernon
124	*albanicum*	NI2269/3	Greece, Mt. Vernon

125	*albanicum*	NI2269/4	Greece, Mt. Vernon
126	*albanicum*	NI2269/5	Greece, Mt. Vernon
127	*albanicum*	NI2269/6	Greece, Mt. Vernon
128	*albanicum*	NI2269/7	Greece, Mt. Vernon
129	*albanicum*	NI2269/8	Greece, Mt. Vernon
130	*albanicum*	NI2269/9	Greece, Mt. Vernon
131	*albanicum*	NI2269/10	Greece, Mt. Vernon
132	*albanicum*	NI2272/1	Greece, Mt. Varnous
134	*albanicum*	NI2272/3	Greece, Mt. Varnous
135	*albanicum*	NI2272/4	Greece, Mt. Varnous
136	*albanicum*	NI2272/5	Greece, Mt. Varnous
137	*albanicum*	NI2272/6	Greece, Mt. Varnous
138	*albanicum*	NI2272/7	Greece, Mt. Varnous
139	*albanicum*	NI2272/8	Greece, Mt. Varnous
140	*albanicum*	NI2272/9	Greece, Mt. Varnous
141	*albanicum*	NI2272/10	Greece, Mt. Varnous
142	*akkusianum*	NI2220/1	Tokat, Erbaa-Madenli
146	*akkusianum*	NI2220/5	Tokat, Erbaa-Madenli
147	*akkusianum*	NI2220/6	Tokat, Erbaa-Madenli
148	*akkusianum*	NI2220/7	Tokat, Erbaa-Madenli
149	*akkusianum*	NI2220/8	Tokat, Erbaa-Madenli
150	*akkusianum*	NI2220/9	Tokat, Erbaa-Madenli
151	*akkusianum*	NI2220/10	Tokat, Erbaa-Madenli
152	*akkusianum*	NI2221/1	Tokat, Erbaa-Çatalan
153	*akkusianum*	NI2221/2	Tokat, Erbaa-Çatalan
154	*akkusianum*	NI2221/3	Tokat, Erbaa-Çatalan
155	*akkusianum*	NI2221/4	Tokat, Erbaa-Çatalan
156	*akkusianum*	NI2221/5	Tokat, Erbaa-Çatalan
158	*akkusianum*	NI2221/7	Tokat, Erbaa-Çatalan
159	*akkusianum*	NI2221/8	Tokat, Erbaa-Çatalan
161	*akkusianum*	NI2221/10	Tokat, Erbaa-Çatalan
162	*armenum*	NI2223	Ordu, Ulubey
163	*armenum*	NI2224	Giresun, Bulancak
164	*armenum*	NI2225/1	Giresun, Bulancak
165	*armenum*	NI2225/2	Giresun, Bulancak
166	*armenum*	NI2225/3	Giresun, Bulancak
167	*armenum*	NI2226/1	Giresun, Bulancak
168	*armenum*	NI2226/2	Giresun, Bulancak
169	*armenum*	NI2226/3	Giresun, Bulancak
170	*armenum*	NI2226/4	Giresun, Bulancak
171	*armenum*	NI2226/5	Giresun, Bulancak
172	*armenum*	NI2226/6	Giresun, Bulancak
173	*armenum*	NI2226/7	Giresun, Bulancak
174	*armenum*	NI2234	Giresun, Tirebolu
183	*ciliatum*	NI2275/1	Trabzon, Çayeli
184	*ciliatum*	NI2275/2	Trabzon, Çayeli
185	*ciliatum*	NI2275/3	Trabzon, Çayeli
186	*ciliatum*	NI2275/4	Trabzon, Çayeli
187	*ciliatum*	NI2275/5	Trabzon, Çayeli
188	*ciliatum*	NI2275/6	Trabzon, Çayeli
189	*ciliatum*	NI2275/7	Trabzon, Çayeli
190	*ciliatum*	NI2275/8	Trabzon, Çayeli
191	*ciliatum*	NI2275/9	Trabzon, Çayeli
192	*ciliatum*	NI2275/10	Trabzon, Çayeli

APPENDIX 4.Solutions and Buffers

10x TBE Buffer				
Tris p.a.	108 g	54 g	27 g	32,4
Boric acid p.a.	55 g	27,5 g	13,75 g	16,5
0,5 M EDTA pH 8,0	40 ml	20 ml	10 ml	12 ml
Completed with Millipore-Water to	1 l	500 ml	250 ml	300 ml

EDTA 0,5 M pH 8,0 (M= 372,24 g/mol)				
EDTA p.a.	46,54 g	37,23 g	18,62 g	9,31 g
ROTH-Water	250 ml	200 ml	100 ml	50 ml
Arrange the pH with 2M NaOH to 8,0				

DNA-Stopmix (10 ml)	
0,25% Bromphenolblue	0,025 gr
0,25% Xylencyanol	0,025 gr
50% Glycerin	5 ml
50 mM EDTA	1 ml 0,5 M (186,13 mg)
	Complete to 10 ml

CTAB Isolation Buffer:	1.4 M NaCl
	100 mM Tris-HCL, pH= 8.0
	20 mM EDTA
	2% (w/v) Ethyltrimethylammonium Bromide (CTAB)
	0.2% (v/v) 2-Mercaptoethanol

TAE Agarose Gel (250 ml)
3 % Agarose (7.5 gr)
10 ml 25X TAE
Complete to 250 with dH_2O

TE Buffer:	ph= 8.0
	1 mM EDTA
	10 mM Tris-HCl

APPENDIX 5. Curriculum Vitae

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Place and Date of Birth	: Tonya, 1974
Secondary Education	: Kurtuluş Lisesi, Ankara, 1991.

Collegiate institutions attended	Dates	Degree	Date of degree
Middle East Technical University	1991-1996	B.S.	07.07.1996
Abant İzzet Baysal University	1996-2000	M.S.	27.03.2000
Abant İzzet Baysal University	2000-2005	Ph.D.	03.06.2005

Abstracts:

- Ikinci, N. & Güner, A. 2002. Endemic Species of the Gölcük Area and Their Threat Categories. 6th Plant Life of Southwest Asia Symposium, 10-14 June 2002, Van-Turkey. Program and Abstract: 78.
- Ikinci, N., Güner, A., Oberprieler, Ch. 2005. Systematic position of *Lilium akkusianum* R.Gämperle (Liliaceae) based on morphological and nrDNA ITS sequence data. 17th International Botanical Congress. Vienna.
- Ikinci, N. & Güner, A. 2005. Ethnobotanical Uses of Turkish *Lilium* L. (Liliaceae) Species. 4th International Congress of Ethnobotany. Istanbul-Turkey.
- Ikinci, N. & Güner, A. 2005. Plant Diversity of the Marshy Habitats around the Lake Gölcük (Bolu, Turkey). 10th European Ecological Congress. Aydin-Turkey.

Positions held: 1996- as Research Assistant at Abant İzzet Baysal University, Bolu