Thaiszia, Košice, 2:11-39, 1992

Karyological differentiation of *Luzula* sect. *Luzula* in Europe

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KIRSCHNER J. (1992): Karyological differentiation of *Luzula* sect. *Luzula* in Europe. - Thaiszia, Košice, 2: 11-39. ISSN 1210-0420.

ABSTRACT: *Luzula* sect. *Luzula* (*L. campestris* agg.) samples from about 15 European countries have been examined karyologically. Chromosome numbers and karyotypes are given for the samples referable to more than 12 taxa. Probable ways of karyotype differentiation within the section *Luzula* are summarized.

KEYWORDS: *Luzula* sect. *Luzula*, *Juncaceae*, karyotypes, chromosome counts, taxonomy, evolution

Introduction

The section *Luzula* is understood here in the conception adopted in Flora Europaea (CHRTEK et KŘÍSA 1980). Thus, it excludes such groups like the arctic-alpine *L. spicata* agg. (sect. *Alpinae*) or sect. *Nodulosae*. Briefly, it corresponds to the '*L. campestris-multiflora* group' of NORDENSKIÖLD (1951 etc). The section *Luzula* has been paid great attention in a number of recent studies of the author (KIRSCHNER 1990, 1991, 1992, KIRSCHNER et al. 1988 etc.). The taxonomy of the group will be summarized elsewhere; the present paper is devoted to the karylogy of the group.

Notes on karyology of the group

Notes introducing the reader to the peculiarities of the *Luzula* karyology can be found in many works of H. NORDENSKIÖLD (1951, 1956 etc.). I should only like to emphasize that her studies have shown

the most efficient approach to *Luzula* sect. *Luzula*. The apparently close general habits of many taxa of the section, quantitative character of many diacritical features, a common coexistence of several taxa at a locality, not rare presence of hybrids, wide variation ranges of some members of the section, all these general features call for a more universal criterion allowing a more profound insight into the processes found in the group. Such a criterion is represented by a karyotype pattern examined on a rich material within a (relatively) limited territory.

Karyotype analysis, when combined with a detailed investigation of quantitative features correlated with the karyological pattern, proved to be the most efficient and productive biosystematical approach to the section.

Thus, the following survey not only provides a karyological guide to the taxonomic structure of the section *Luzula* in Europe but also represents the most important set of data for inferences concerning the evolution within the section.

Methods and Material

Plants have been examined karyologically using root tips of mature plants, and young seedlings in the case of their progeny. The rapid squash method was employed (Farmer's fixative after two hours of p-dichlorobenzene pretreatment, and lactic-propionic orcein stain after five minutes of ethanol + hydrochloric acid maceration). The karyotype formulae are given according to NORDENSKIÖLD (1951); important information concerning hybridisation can be found in NORDENSKIÖLD (1956). The AL symbol denotes unfragmented chromosomes of 'normal' diploids and polyploids. BL chromosomes are those fragmented once (chromosomes of half the size of the AL ones); CL chromosomes underwent two fragmentation steps and are of quarter size.

Three sources of live material were used. First, my own collections made during expeditions or excursions in Europe and the adjacent regions. The most important travels were:

1, Bulgaria (1988, 1991)
2, Ukraine and Crimea (1989)
3, Siberia and the Altai (1988)
4, N. Germany and Poland (1990, 1991)
5, C. Sweden (1990)
6, Czechoslovakia (1976-79, 1989-91)
7, Yugoslavia (1991)
8, the Caucasus (1977)

Secondly, many colleagues collected, or organised gathering of the section *Luzula* material for my studies. I am totally indebted for the invaluable help to all the collectors mentioned below:

- W. LIPPERT (Munich): Bavaria
- D. SÁNCHEZ-MATA (Madrid): Spain
- S. SNOGERUP (Lund): Greece
- P. MONTSERRAT-RECODER (Jaca): Spain, French Pyrenees
- M. CARMEN FERNANDEZ-CARVAJAL (Oviedo): Spain
- R. ŘEPKA (Brno): Czechoslovakia

- J. ŠTĚPÁNKOVÁ and J. ŠTĚPÁNEK (Průhonice): Bulgaria etc.
- B. KUZMANOV (Sofia): Bulgaria
- B. SLAVÍK (Průhonice): Austria, Bulgaria
- T. C. G. RICH (Lancaster): Ireland
- S. ROBERTSON: Britain
- D. KOVÁTS (Budapest): Hungary
- F. KRAHULEC and D. BLAŽKOVÁ (Průhonice): The East Carpathians, Ukraine
- D. BLAŽKOVÁ: Austria
- M. ŠOURKOVÁ (Praha): N. Russia, White Sea region
- L. KLIMEŠ (Třeboň): N. E. Russia
- M. CHYTRÝ (Brno): Bulgaria, Siberia

Many other botanists contributed by one or a few samples.

Thirdly, herbarium collections meant a very important contribution. Due to the fact that *Luzula* sect. *Luzula* seeds remain viable for a relatively long time (up to nine years), it has been possible to cultivate plants or obtain chromosome numbers from seeds found in herbarium specimens in many herbaria. In the following list, the most important herbaria are given whose samples were used in the above way. In brackets, regions are mentioned where the samples came from.

GLM (Germany)	M (Italy, Germany)
LD (Greece)	W (Austria)
GZU (Austria)	ROZ (ČSFR)
WRSL (Poland)	MMI (ČSFR)

Altogether, live material from 15 European countries has been cultivated, studied and examined karyologically. I should repeat that I am greatly indebted to all the above collectors or Institutions for the material they put at my disposal. Without their help this work would have never appeared.

KARYOTYPES FOUND IN *LUZULA* SECT. *LUZULA* IN EUROPE

An annotated survey of the taxa, chromosome counts and karyotypes in *Luzula* sect. *Luzula* in Europe

Note: Most European taxa were examined in the course of this study. The rest, studied on herbarium collections, has been subjected to the stomatal test (stomata measured in the isolated cuticle slides). Comparison of many measurements carried out on various taxa with known karyotypes has shown that, in most cases, the ploidy level can be assessed on the basis of the stomatal test with sufficient certainty. In some instances, crossability between strains with unclear karyotypes and close diploids and polyploids was used to determine the ploidy level. The notes are confined to the problems of chromosome numbers and karyotypes.

Luzula alpina HOPPE 2n=36=12AL+24BL

Luzula campestris (L.) DC.

subsp. *campestris* 2n=12=12AL

subsp. *nevadensis* MONTS. 2n=? [polyploid]

Note: In the type material length of cauline leaf stomata were measured. Results clearly show that this subspecies is polyploid.

Luzula calabra TENORE 2n=24=24BL

Note: VIRZO et MIGGLIACCIO (1965) counted the chromosomes of *L. calabra.* It proved to have 2n=24 and the authors suggested (on the basis of chromosome size) that it is a true tetraploid. Length of cauline leaf stomata, however, indicates with great certainty that *L. calabra* is a diploid. Thus, VIRZO et MIGGLIACCIO either did not count *L. calabra,* which is not probable because the discussion and figures in MIGGLIACCIO (1964) and VIRZO et MIGGLIACCIO (1965) evidently point to the true *L. calabra,* or they misinterpreted the karyotype. The latter alternative is much more likely.

Luzula congesta (THUILL.) LEJ. 2n=48=48AL

Luzula divulgata KIRSCHNER 2n=24=24AL

Luzula fallax KIRSCHNER 2n=24=24BL

Luzula multiflora (EHRH.) LEJ.

subsp. *multiflora* 2n=24=24AL

2n=36=36AL

subsp. *frigida* (BUCHEN.) SAMUELSS. 2n=36=36AL

subsp. *sibirica* V. KRECZ. 2n=36=36AL

Note: *L. m.* subsp. *sibirica* has not been confirmed to be a member of the European flora. However, it has been reported to grow in the northeasternmost European Russia (NOVIKOV 1976, LAŠČENKOVA 1976), and its occurrence there is well possible. I have counted a few Siberian samples representing the typical subsp. *sibirica.*

subsp. *snogerupii* KIRSCHNER 2n=36=12AL+24BL

2n=35=13AL+22BL

Note: A taxon published in KIRSCHNER 1992.

Luzula pallidula KIRSCHNER 2n=12=12AL

Luzula sudetica (WILLD.) SCHULT. 2n=48=48CL

Luzula taurica (V. KRECZ.) V. NOVIK. 2n=12=12AL
(including *L. campestris* var. *atrofusca* MALY)

Note: *Luzula taurica* has recently been recognised as a Balkan species. The Balkan populations correspond to the Crimean ones in their ecology, general habit, seed and floral part measures, and all the populations studied have the same karyotype. Taxonomic treatment of *L. taurica* will be given elsewhere.

Summary of the karyotypes ascertained in the sect. *Luzula* material studied by the author

TAXA

Luzula alpina HOPPE 2n=36=12AL+24BL
Luzula campestris (L.) DC. subsp. *campestris* 2n=12AL
Luzula congesta THUILL. 2n=48AL, 2n=49AL
Luzula divulgata KIRSCHNER 2n=24AL, 2n=25AL
Luzula fallax KIRSCHNER 2n=24BL
Luzula pallidula KIRSCHNER 2n=12AL
Luzula sudetica (WILLD.) SCHULT. 2n=48CL
Luzula taurica (V. KRECZ.) V. NOVIK. 2n=12AL
(incl. Balcanic material of *L. campestris* var. *atrofusca*)
Luzula multiflora (EHRH.) LEJ.
subsp. *multiflora* 2n=36AL, 2n=24AL
subsp. *sibirica* V. KRECZ. 2n=36AL
susbp. *frigida* (BUCH.) V. KRECZ. 2n=36AL
subsp. *snogerupii* KIRSCHNER 2n=12AL+24BL
A Pyrenean agmatoploid (KIRSCHNER, unpubl.) 2n=24BL

NATURAL HYBRIDS AND FORMS DIRECTLY DERIVED FROM HYBRIDS (KIRSCHNER 1991, 1992)

Luzula sp. (*fallax*-derived) 2n=29BL, 2n=29BL+1AL
Luzula divulgata x **snogerupii* 2n=18AL+14BL,
2n=17AL+14BL

Luzula x *bogdanii* KIRSCHNER	2n=3AL+18BL=21
(various nothomorphs)	2n=6AL+12BL=18
	2n=6AL+14BL=20
	2n=4AL+18BL=22
	2n=24BL
	2n=1AL+22BL=23
	2n=7AL+10BL=17
	2n=5AL+14BL=19
	2n=11AL+2BL=13
Luzula x *heddae* KIRSCHNER	2n=6AL+24CL=30
(*campestris* x *sudetica*)	
Luzula x *media* KIRSCHNER	2n=26AL, 2n=27AL,
(*divulgata* x *multiflora* s.str.)	2n=27AL+2f

ARTIFICIAL CROSSES

Luzula x *bogdanii* x *campestris*	2n=6AL+12BL
Luzula campestris x *pallidula*	2n=12AL
Luzula multiflora	
subsp.*frigida* x subsp.*sibirica*	2n=36AL
Luzula congesta x *multiflora* s.str.	2n=42AL

EUROPEAN TAXA NOT EXAMINED BY THE AUTHOR

Luzula calabra TENORE	2n=24 (VIRZO et MIGGLIACCIO 1965)
Luzula x *danica*	2n=42AL etc. (cf. KIRSCHNER 1991)
NORDENSKIÖLD et KIRSCHNER	(vouchers at UPS studied)

Chromosome counts, karyotypes, localities and sample references

Note: Chromosome counts of hybrids are not included in the list. The majority of them have already been published (KIRSCHNER 1991, 1992). Counts made on the Spanish material are not included, either; they form a part of another article. At the same time, some critical cases were excluded because they require further studies.

Luzula ***alpina*** HOPPE 2n=36=12AL+24BL [K 80/86]

Loc.: Austria, Tirolia, montes Oetztaler Alpen: opp. Vent, Niedertal - Martin-Busch-Hütte, ca 2200 m.

1981, POLATSCHEK [orig.: W]

Cult. sub no. L126, a.1989-1990 lecta.

Publ.: Preslia 60: 101, 1988

Luzula ***alpina*** HOPPE 2n=36=12AL+24BL [K 67/86]
Loc.: Austria, Osttirol/Kärnten, pars occid. mont. Kreuzeck situ orient. a Dölsach, ca 2000 m.
1983, SCHEUER, GZU
Publ.: Preslia 60: 100-101, 1988 (fig.)

Luzula ***alpina*** HOPPE 2n=36=12AL+24BL [K 78/86]
Loc.: Austria, Osttirol, Karnische Alpen, situ austro-occid. a Kartisch, ca 1400 m.
1979, POLATSCHEK, W
Publ.: Preslia 60: 101, 1988

Luzula ***alpina*** HOPPE 2n=36=12AL+24BL [K 79/86]
Loc.: Austria, Tirol, Zillertaler Alpen, Zemmgrund, 1635-1720 m.
1982, POLATSCHEK, W
Publ.: Preslia 60: 101, 1988

Luzula ***alpina*** HOPPE 2n=36=12AL+24BL [K 175/89]
Loc.: Austria, Tirolia, Stubaital, Fulmpes, Kalkkögel, ca 2300 m.
1988, D. BLAŽKOVÁ
Cult. sub no. L163, a. 1990 lectae.

Luzula campestris (L.) DC. 2n=12AL [K 181/89]
subsp. ***campestris***
Loc.: Bohemia centralis, opp. Sedlčany, distr. phytogeogr. 41, pagus Brzina.
1986, R. HLAVÁČEK, Mus. Příbram no. 3310

Luzula campestris (L.) DC. 2n=12AL [K 3/86]
subsp. ***campestris***
Loc.: Bohemia orientalis, oppidum Hlinsko, pagus Lhoty, 0.3 km situ austro-orient. a vico, 680 m.
1985, R. ŘEPKA, herb.: 4967

Luzula campestris (L.) DC. 2n=12AL [LK+JK 19/1]
subsp. ***campestris***
Loc.: Bohemia australis, oppidum Vimperk: in graminosis in adjac. bor. oppidi, loco "Rokle" dicto.
1987, L. KIRSCHNEROVÁ., Cult. sub no. L151

Luzula campestris (L.) DC. 2n=12AL [K 185/89]
subsp. ***campestris***

Loc.: Slovakia australis, in collibus Kováčovské kopce (Burda), non procul a pago Chlaba.

1987, L. HROUDA [orig. XX-1]

Cult. sub no. L160, a. 1990 lectae

Luzula campestris (L.) DC. 2n=12AL [K 179/89]
subsp. ***campestris***

Loc.: Slovakia orientalis, distr. Trebišov: in decl. stepposis ad vineam, ca 1.5 km a stat. ferroviae Somotor.

1985, J. RYDLO [orig. ROZ]

Cult. sub no. L155, a. 1990 lectae.

Luzula campestris (L.) DC. 2n=12AL [K 231]
subsp. ***campestris***

Loc.: Slovakia orientalis, distr. Rožňava, regio Slovenský kras: locis siccis calcareis supra pagum Jovice

1989, J. KIRSCHNER, PR

Luzula campestris (L.) DC. 2n=12AL [K 232]
subsp. ***campestris***

Loc.: Slovakia orientalis, distr. Rožňava, regio Slovenský kras: in graminosis inter pagos Silická Brezová et Gombasek.

1989, J. KIRSCHNER, PR

Luzula campestris (L.) DC. 2n=12AL [K 261-L318]
subsp. ***campestris***

Loc.: Polonia borealis, insula Wolin, reserv. Wolinski Park Narodowy, opp. Miedzyzdroje: in sylvaticis et caeduis situ australi ab oppido.

1990, L. KIRSCHNEROVÁ et J. KIRSCHNER

Cult. sub no. L318, a. 1991 lectae.

Luzula campestris (L.) DC. 2n=12AL [K 184/89]
subsp. ***campestris***

Loc.: Polonia, pagus Stare Kolnie.

1983, SWIDER, WRSL 68227

Luzula campestris (L.) DC. 2n=12AL [K 413/91]
subsp. ***campestris***

Loc.: Germania australis, Lausitz, distr. Zittau, 5054/24 Oberseifersdorf, cota 383.3 situ bor. a pago.

1986, JEHMLICH, GLM.

Luzula campestris (L.) DC. 2n=12AL [K 433/91]
subsp. ***campestris***

Loc.: Austria occident., Vorarlberg, Knitz apud Fraxern, alt. ca 1200 m

1990, KETTNEROVÁ, PR

Luzula campestris (L.) DC. 2n=12AL [K 410/91]
subsp. ***campestris***

Loc.: Bulgaria occidentalis, ca 35 km situ bor.-occid. ab urbe Sofia, ad limitem bulg.-serb., ca 2 km bor.-occid. a pago Komščica. Alt. ca 900 m.

1990, J. ŠTĚPÁNKOVÁ, PR.

Luzula campestris (L.) DC. 2n=12AL [L 501, L 504]
subsp. ***campestris***

Loc.: Bulgaria, urbs Sofia, pagus Gorni Lozen: in pratis summit. montibus Lozenska Planina, ca 1000 m s.m.

1991, J. KIRSCHNER, PR

Cult. sub no. L501, L504, a. 1992 lectae.

Publ.: Ann. Bot. Fenn., sub prelo.

Luzula campestris (L.) DC. 2n=12AL [K 201/89]
subsp. ***campestris***

Loc.: USSR, Ucraina, urbs Kyjev, oppidum Vasilkov: locis arenosis in valle fl. Stugna haud procul ab oppido.

1988, J. ŠTĚPÁNEK

Cult. sub no. JS 3461, a. 1990 lectae.

Luzula ***congesta*** (THUILL.) LEJ. 2n=48AL [K 214/89]

Loc.: W. Ireland, Galway, Loch Bola, [02/7.3]

1989, T. C. G. RICH, no 3

Cult. sub no. L257.

Luzula ***congesta*** (THUILL.) LEJ. 2n=48AL [K 215/89]
Loc.: SE. Ireland, Co. Carlow, Bagnelstown, [21/7.5]
1989, T. C. G. RICH, no 4
Cult. sub no. L256.

Luzula ***congesta*** (THUILL.) LEJ. 2n=48AL [K 217/89]
Loc.: W. Ireland, Co. Mayo, Cluddnar, [13/0.2].
1989, T.C.G. RICH, no 2
Cult. sub no. L255.

Luzula ***congesta*** (THUILL.) LEJ. 2n=48AL [K 219/89]
Loc.: Great Britain, Wester Ross, 6.5 km situ occid.
a Garve (25 mil. bor.-occid. a Inderness).
1989, Sheena ROBERTSON.
Cult. sub no. L261.

Luzula ***divulgata*** KIRSCHNER 2n=24AL [K 222/89,K 227/89]
Loc.: Bohemia centralis, distr. Rakovník: in silva mixta
Brabečka dicta, ca 1.0-1.5 km situ austro-occid. a pago Nový Mlýn.
1987, J. HAŠKOVÁ, J. KIRSCHNER & F. KRAHULEC, PR

Luzula ***divulgata*** KIRSCHNER 2n=24AL [K 1/86]
Loc.: Bohemia centralis-orientalis, oppidum Ledeč nad Sázavou,
pagus Borovsko: in pineto (solo serpent.) inter viam
("highway") et pagum.
1986, J. KIRSCHNER, PR.

Luzula ***divulgata*** KIRSCHNER 2n=24AL [K 2/86]
Loc.: Bohemia australis, oppidum Český Krumlov, pagus Holubov:
in pinetis (solo serpent.) in valle rivi ad pagum.
1986, J. KIRSCHNER, PR.

Luzula ***divulgata*** KIRSCHNER 2n=24AL [LK+JK 19/2]
Loc.: Bohemia bor.-occid., oppidum Louny, regio Džbán,
distr. phytogeogr. 6, in silvis occid. a pago Smilovice.
1982, J. KIRSCHNER, PR.

Luzula ***divulgata*** KIRSCHNER 2n=c.24AL [LK+JK 27/1]
Loc.: Moravia centralis, oppidum Vyškov, Drahanská
vrchovina (71), in silvis deciduis in adjacentibus pagi Ferdinandsko.
1982, L. HROUDA, PR.

Luzula ***divulgata*** KIRSCHNER 2n=24AL [K 188/89]
Loc.: Moravia centralis, montes Chřiby (77), pagus Osvětimany: ca 1.6 km situ bor.-orient. a pago. Alt. 400 m s.m.
1987, R. ŘEPKA, orig. herb. ŘEPKA no. 10007.
Cult. sub no. L179, a. 1990 lecta.

Luzula ***divulgata*** KIRSCHNER 2n=24AL [K 182/89]
Loc.: Moravia centralis, distr. phytog. 68, pagus Oleksovice: in calluneto et robinieto, ca 0.5 km situ austro.-austro- occid. a pago. Alt. ca 235 m s.m.
1987, R. ŘEPKA, orig. herb. ŘEPKA no. 10013.
Cult. sub no L161, a. 1990 lecta.

Luzula ***divulgata*** KIRSCHNER 2n=24AL [K 177/89]
Loc.: Moravia centralis, distr. phytog. 68, pagus Padochov: in querceto sicco ca 1.5 km situ orient.-austro-orient. a pago. Alt. 370 m.
1987, R. ŘEPKA, orig. herb. ŘEPKA no 10011.
Cult. sub no. L157, a. 1990 lecta.

Luzula ***divulgata*** KIRSCHNER 2n=24AL [K 176/89]
Loc.: Moravia centralis, montes Chřiby (77), pagus Roštín: in silvis situ austro.-orient. a pago. Alt. ca 560 m s.m.
1987, R. ŘEPKA, org. herb. ŘEPKA no. 10010.
Cult. sub no L156, a. 1990 lecta.

Luzula ***divulgata*** KIRSCHNER 2n=24AL [K 237]
Loc.: Moravia australis, distr. phytogeogr. 18b. Dolnomoravský úval, opp. Hodonín: in silvis lucidis Dúbrava dictis, haud procul a casa venatoria Červené Domky.
1989, R. ŘEPKA et J. KIRSCHNER, PR

Luzula ***divulgata*** KIRSCHNER 2n=24AL [K 243, K 244]
Loc.: Moravia australis, distr. phytogeogr. 16. Znojemsko-brněnská pahorkatina, opp. Moravský Krumlov: in silvis frondosis inter stat. ferroviae Budkovice et pagum Rakšice.
1989, R. ŘEPKA et J. KIRSCHNER, PR.

Luzula ***divulgata*** KIRSCHNER 2n=24AL [K 68/86]

Loc.: Moravia australis, opp. Znojmo, in valle fl. Dyje, pagus Čížov: in silva decidua oppos. loci Hardegg, ca 2.6 km situ austro-austro-occid. usque australi a pago.

1985, V. GRULICH, MMI (no B 792/15).

Luzula ***divulgata*** KIRSCHNER 2n=25AL [K 178/89]

(? > *L.* x *media*)

Loc.: Moravia australis, distr. phytogeogr. 68, opp. Ivančice, pagus Hlína: in caeduo in silva decidua ca 1.5 km situ occid.-bor.-occid. a pago, ca 5 km situ bor.-orient. ab oppido. Alt. ca 400 m s.m.

1987, R. ŘEPKA, orig. herb. ŘEPKA no 10018.

Cult. sub no. L169, a. 1990 lecta.

Publ.: Preslia, 1991

Luzula ***divulgata*** KIRSCHNER 2n=24AL [K 260-L324]

2n=24AL [K 456/91-L321]

Loc.: Polonia borealis, insula Wolin, reserv. Wolinski Park Narodowy, opp. Miedzyzdroje: in decl. silvaticis situ austr. ab oppido.

1990, L. KIRSCHNEROVÁ et J. KIRSCHNER.

Cult. sub no. L324, a.1991 lecta.

Luzula ***divulgata*** KIRSCHNER 2n=24AL [K 220/89,K 221/89]

Loc.: Hungaria, urbs Budapest, Nagy Hars Hegy.

1989, D. KOVÁTS, PR.

Luzula ***divulgata*** KIRSCHNER 2n=24AL [L507, L508]

Loc.: Bulgaria, urbs Sofia, pag. Gorni Lozen, in silvis summit. montibus Lozenska Planina, alt. ca 1000 m.

1991, J. KIRSCHNER, PR.

Cult. sub no. L507, L508, a. 1992 lectae.

Publ.: Ann. Bot. Fenn., sub prelo.

Luzula ***fallax*** KIRSCHNER 2n=24BL [K 251]

Loc.: Graecia bor.-orient., Mt. Pangeon: ca. 0.5 km situ orient. a summo, 1800-1850 m

1987, S. SNOGERUP & A. STRID, orig. LD

Cult. sub no L134, a.1989-1990 lectae.

HOLOTYPUS !

Publ.: Preslia 1991

Luzula ***fallax*** KIRSCHNER 2n=24BL [K198]

Loc.: Bulgaria australis, oppid. Melnik, montes Pirin: supra pagum Rožen, Vlaškija Put. Alt. ca 1450 m s.m.

1988, KIRSCHNER, no.L116

Cult. sub no L116, a. 1990 lectae.

Publ.: Preslia 1991

Luzula multiflora (EHRH.) LEJ. 2n=24AL [K 209/89]
subsp. ***multiflora*** s.l.

Loc.: Austria, Osttirol, Praegraten, Venediger Gruppe, Eisseehütte, ca 2500 m s.m.

1987, ALBERTSHOFER, M.

Luzula multiflora (EHRH.) LEJ. 2n=24AL [K 210/89]
subsp. ***multiflora*** s.l.

Loc.: Slovakia borealis, montes Belanské Tatry, ad viam in jugo magno, in decl. montis Zadné Jatky, ca 2000 m

1989, J. KIRSCHNER, seeds PR.

Cult. sub no. L258, a.1991 lectae.

Luzula multiflora (EHRH.) LEJ. 2n=ca 24AL [K 211/89]
subsp. ***multiflora*** s.l.

Loc.: Slovakia borealis, montes Belanské Tatry, ad viam in jugo inter montium Zadné Jatky et Hlúpy, ca 2000 m.

1989, J. KIRSCHNER, seeds PR.

Cult. sub no. L259, a.1991 lectae.

Luzula multiflora (EHRH.) LEJ. 2n=24AL [K 212/89]
subsp. ***multiflora*** s.l.

Loc.: Slovakia borealis, montes Belanské Tatry, ad viam prope Kežmarská chata, non procul a Kopské sedlo, ca 1800 m.

1989, J. KIRSCHNER, seeds PR.

Cult. sub no. L260, a.1991 lectae.

Luzula multiflora (EHRH.) LEJ. 2n=24AL [K 66/86]
subsp. ***multiflora*** s.l.

Loc.: Austria, Oberoesterreich: Lackenmoosalm, bor.a Schladming, 2000 m

1985, BASTL, GZU.

Luzula multiflora (EHRH.) LEJ. 2n=36AL [K 186/89]
subsp. ***multiflora***

Loc.: Bohemia bor.-orient., montes Orlické hory: in prato Trčkovská louka ad pagum Trčkov.

1985, D. TUROŇOVÁ, orig. ROZ 31470
Cult. sub no. L168, a. 1990 lectae.

Luzula multiflora (EHRH.) LEJ. 2n=36AL [K 69/86]
subsp. ***multiflora***

Loc.: Bohemia centralis, oppidum Dobříš, in silva ca 2 km situ occidentali ab oppido.

1985, V. GRULICH, MMI

Luzula multiflora (EHRH.) LEJ. 2n=36AL [K 180/89]
subsp. ***multiflora***

Loc.: Bohemia centralis, distr. Příbram: in silvis Vranovické polesí (87) non procul a pago Vranovice (adjac. oppidi Rožmitál p. Třemš.).

1985, P. PYŠEK, orig. Mus.Příbram C3949
Cult. sub no. L166, a. 1990 lectae.

Luzula multiflora (EHRH.) LEJ. 2n=36AL
subsp. ***multiflora***

orig. pl.:	no. count.:
D3	K 142/88
D11	K 143/88
D12	K 144/88
D17	K 146/88
D13	K 147/88
D5	K 148/88
D1	K 149/88
D15	K 150/88, K 155/88
D16	K 151/88
D6	K 152/88
D23	K 156/88
D9	K 157/88
D4	K 160/89
D14	K 161/89

D10 K 165/89
D21 K 190/89

Loc.: Moravia australis, districtus Hodonín (18b): in caeduis in silva Dúbrava dicta, haud procul a casa venatoria Červené Domky, in adjacentibus bor. oppidi Hodonín.
1987, R. ŘEPKA & J. KIRSCHNER, all PR

Luzula multiflora (EHRH.) LEJ. 2n=36AL [K 170/89]
subsp. ***multiflora***

Loc.: Moravia centralis, montes Chřiby (77): in silvis situ austro-orient. a pago Roštín, alt. ca 560 m.
1987, R. ŘEPKA, orig. herb. ŘEPKA no. 10009
Cult. sub no. L162, a.1990 lectae.

Luzula multiflora (EHRH.) LEJ. 2n=36AL [K 242]
subsp. ***multiflora***

Loc.: Moravia australis, distr. phytogeogr. 18b. Dolnomoravský úval, oppidum Hodonín: in silvis ad marg. bor. oppidi.
1989, R. ŘEPKA et J. KIRSCHNER, PR

Luzula multiflora (EHRH.) LEJ. 2n=36AL [K 233]
subsp. ***multiflora***

Loc.: Slovakia orientalis, distr. Košice: ad viam publicam in parte summitati montis Bralo (cota 836 m).
1989, P. MÁRTONFI & J. KIRSCHNER, PR

Luzula multiflora (EHRH.) LEJ. 2n=36AL [K 401/91]
subsp. ***multiflora***

Loc.: Polonia bor.-occid., oppidum Miedzyzdroje, reserv. Wolinski Park Narodowy: in declivibus silvaticis ca 1 km austr. ab oppido.
1990, L. KIRSCHNEROVÁ et J. KIRSCHNER
Cult. sub no. L319, a. 1991 lecta.

Luzula multiflora (EHRH.) LEJ. 2n=36AL [K404/91]
subsp. ***multiflora***

Loc.: Germania borealis, distr. Roztock, paeninsula Darss, pagus Prerow, in arenaceis silvaticis situ bor.-orient. a pago.
1990, L. KIRSCHNEROVÁ et J. KIRSCHNER, PR

Luzula multiflora (EHRH.) LEJ. 2n=36AL [K 426/91]
subsp. ***multiflora***

Loc.: Germania australis, Bavaria, Unterfranken, Rhoen-Grabfeld: 5625/3 Rothenrain.

1988, W. LIPPERT, M 23738.

Cult. sub no. L223, a. 1990 lectae.

Luzula multiflora (EHRH.)LEJ. 2n=36AL [K 432/91]
subsp. ***multiflora***

Loc.: Germania australis, Bavaria, Allgäuer Alpen: in collibus situ occid. a Obermaiselstein (8527/1) prope Schwabenhaus, austro-orient. a Gr. Ochsenkopf, alt. 1440 m.

1990, SAITNER (herb.)

Luzula multiflora (EHRH.) LEJ. 2n=36AL [K L298-K257]
subsp. ***multiflora***

Loc.: Suecia centralis, urbs Stockholm, pagus Lidingö: in declive silvatico haud procul a Södergarn.

1990, J. KIRSCHNER

Cult. sub no. L298, a.1991 lecta.

Luzula multiflora (EHRH.) LEJ. 2n=36AL [K 276/90A]
subsp. ***multiflora*** [a morphotype answering to the type of *L. m.* subsp. *pyrenaica* (SENNEN) MONTS.]

Loc.: France, East Pyrenees, Mérens-les-Vals, Refuge de Besines, ca 1750 m s.m.

1990, Z. SKÁLA & H. SKÁLOVÁ.

Cult. sub no. L338.

Luzula multiflora (EHRH.) LEJ. 2n=36AL [K 425/91]
subsp. ***multiflora***

Loc.: Italia borealis, Tirolia australis, montes Mendelgebirge, inter St. Pauls et Perdonig', 46°29'N, 11°15'E.

1987, I. et H. HERTEL, M 33725.

Cult. sub no. L224, a. 1990 lectae.

Luzula multiflora (EHRH.) LEJ. 2n=36AL [K 203/89]
subsp. ***multiflora***

Loc.: USSR, Rossia europaea extremi-bor.-orient., montes Ural (polaris): Mikuňs.

1986, L. KLIMEŠ , no. rel. 393

Cult. sub no. L129, a.1989-1990 lectae.

Luzula multiflora (EHRH.) LEJ. 2n=36AL [K 71,72,74,76/86]
subsp. ***multiflora***

Loc.: USSR, Ucrainia, Carpati orient., Zakarpatskaya oblast: ad pedem bor. montis Pikuj.

1986, F. KRAHULEC et D. BLAŽKOVÁ 18.7.1986, PR

Luzula multiflora (EHRH.) LEJ. 2n=36AL [K 169/89]
subsp. ***frigida*** (BUCHENAU) V. KRECZ.

Loc.: USSR. Rossia europaea borealis, regio maris albi, Murmanskaja oblast, pagus Pojakonda, statio biologica.

1987, M. ŠOURKOVÁ no.6871, PR

Cult. sub no. L 159, a. 1990 lecta.

Publ.: Preslia 1991

Luzula multiflora (EHRH.) LEJ. 2n=36AL [K 153/88]
subsp. ***sibirica*** V. KRECZ.

Loc.: USSR. Sibiria australis, regio montana Altai, distr. Jabogan: in prato subalpino supra ang. Jaboganskij pereval.
Alt. ca 1850 m s.m.

1988, J. KIRSCHNER

Cult. sub no. ALT 22, a. 1989-90 lecta.

Luzula multiflora (EHRH.) LEJ. 2n=36AL [K 189/89]
subsp. ***sibirica*** V. KRECZ.

Loc.: USSR, Sibiria australis, montes Altai, distr. Ust-Koksu, in valle fluminis Multa, in silva mixta, 1900 m. 50°05'N, 85°55'E.

1983, I. M. KRASNOBOROV, no.245, herb. NOVOSIBIRSK ut *L. pallescens*

Luzula multiflora 2n=36=12AL+24BL [K 205/89]
subsp. ***snogerupii*** KIRSCHNER

Loc.: Graecia boreo-orient., nom. Serrai: Mt. Vrondous, 2 km austro-occid a summo montis, 1250-1300 m.

1987, S. SNOGERUP, no 5052.

Cult sub no. L132, a. 1989 lectae.

Publ.: Ann. Bot. Fenn., sub prelo

Luzula multiflora 2n=35=13AL+22BL [K 192/89]
subsp. ***snogerupii*** KIRSCHNER

Loc.: Bulgaria occidentalis, urbs Sofia, Lozenska planina: in graminosis planitiei summit. montibus, supra pagum Gorni Lozen. Alt. ca 950-1050 m.

1988, J. KIRSCHNER.

Cult. sub no. L110, a. 1989-1990 lecta.

Publ.: Ann. Bot. Fenn., sub prelo

Luzula multiflora 2n=36=12AL+24BL [L512,L513,L524]
subsp. ***snogerupii*** KIRSCHNER

Loc.: Bulgaria occidentalis, urbs Sofia, Lozenska planina: in graminosis planitiei summit. montibus, supra pagum Gorni Lozen. Alt. ca 950-1050 m.

1991, J. KIRSCHNER.

Cult. sub no. L512,L513,L524, a. 1992 lecta.

Publ.: Ann. Bot. Fenn., sub prelo

Luzula ***pallidula*** KIRSCHNER 2n=12AL [K 70/86]

Loc.: Bohemia boreo-orient., distr. Trutnov, pagus Bohuslavice: ca 0.5 km situ austro-occid. a vico Adamov.

1983, V. GRULICH, MMI

Luzula ***pallidula*** KIRSCHNER 2n=12AL [K 158/88]

Loc.: Moravia australis, distr. Hodonín: in caeduis in silva Dúbrava dicta, haud procul a casa venatoria Červené Domky in adjacentibus septentr. oppidi Hodonín.

1987, R. ŘEPKA & J. KIRSCHNER, no D8

HOLOTYPUS !

Publ.: Taxon 39: 110, 1990.

Luzula ***pallidula*** KIRSCHNER 2n=12AL [K 145/88]

Loc.: Moravia australis, distr. Hodonín: in caeduis in silva Dúbrava dicta, haud procul a casa venatoria Červené Domky in adjacentibus septentr. oppidi Hodonín.

1987, R. ŘEPKA & J. KIRSCHNER, no D7

ISOTYPUS !

Luzula ***pallidula*** KIRSCHNER 2n=12AL [K 234]

Loc.: Slovakia orient., distr. Košice, in graminosis ca 1-1.5 km situ orient. a pago Vyšná Myšľa.

1989, P.MÁRTONFI & J. KIRSCHNER, PR.

Luzula ***pallidula*** KIRSCHNER 2n=12AL [K 414/91]
Loc.: Germania australis, Lausitz, distr. Niesky, 4654/42 Petershain, non procul a loco 'Moenchsgraben' dicto.
1985, STARK, GLM.

Luzula ***pallidula*** KIRSCHNER 2n=12AL [K 434/91]
Loc.: Suecia centralis, Sala, Heby, pagus Huddunge.
1990, J. KIRSCHNER, PR
Cult. sub no. L300, a. 1991 lecta.

Luzula ***pallidula*** KIRSCHNER 2n=12AL [K 171/89]
Loc.: USSR, Rossia, Sibiria centralis, distr. Novosibirsk: in betuleto non procul a pago Klju i (54°50'N, 83°10'E)
1983, D. ŠAULO
Cult. sub no. L154, a.1990 lecta.

Luzula ***sudetica*** (WILLD.) SCHULT. 2n=48CL [K 187/89]
Loc.: Bohemia bor.-orient., montes Orlické hory: in reservatione "Velka louka" prope pagum Trčkov.
1985, D. TUROŇOVÁ, orig. ROZ 26665
Cult. sub no. L167, a. 1990 lecta.

Luzula ***sudetica*** (WILLD.) SCHULT. 2n=48CL [K 267]
Loc.: Bohemia orientalis, montes dárské vrchy (91), ca 10 km situ orient.-austro-orient. ab oppido Hlinsko, pagus Svratka: ad marg. silvae Borovina occid. a pago, 635 m.
1989, P. BUREŠ , BRNU

Luzula ***sudetica*** (WILLD.) SCHULT. 2n=48CL [K 168/89]
Loc.: Slovakia borealis, montes Vysoké Tatry, pagus Vyšné Hágy. Alt. ca 1630 m s.m.
1985, R. ŘEPKA, orig. herb. ŘEPKA 10035
Cult. sub no. L153, a. 1990.

Luzula ***sudetica*** (WILLD.) SCHULT. 2n=48CL [K 435/91]
Loc.: Slovakia orientalis, montes Belanské Tatry, ad viam turisticam supra loc. 'Kežmarská chata' dictum.
1989, J. KIRSCHNER, PR.
Cult. sub no. L301, a. 1991 lecta.

Luzula ***sudetica*** (WILLD.) SCHULT. 2n=48CL [K 429/91]
Loc.: Germania australis, Bavaria, Grenzhammer /Oberwarmensteinach (5936/4).
1990, WURZEL, herb. WURZEL.

Luzula ***sudetica*** (WILLD.) SCHULT. 2n=48CL [K 430/91]
Loc.: Germania australis, Bavaria, Berchtesgadener Alpen: Reiteralm, Traunsteiner Hütte.
1990 SPRINGER, herb. SPRINGER.

Luzula ***sudetica*** (WILLD.) SCHULT. 2n=48CL [K 266/90A]
Loc.: Bulgaria, montes Rila: "in fundus convexi ad lacus Ribni ezera, 2250 m s.m."
1989, M. CHYTRÝ (orig. herb. CHYTRÝ & PR).

Luzula ***sudetica*** (WILLD.) SCHULT. 2n=48CL [K 409/91]
Loc.: Bulgaria centralis, montes Rila, oppidum Samokov: secundum rivum Maljovica in valle inter 'Komplex Maljovica' et casam alpinam Maljovica. Alt. ca 1900 m.
1990, J. ŠTĚPÁNEK, PR

Luzula ***sudetica*** (WILLD.) SCHULT. 2n=48CL [K 204/89]
Loc.: Flora Graeca: Nom. Serrai, Mt. Vrondous, in clivo occid., ca 2 km occid. a summo montis, 1400-1450 m.
1987, S. SNOGERUP & A. STRID, orig. LD5015
Cult. sub no. L133, a. 1989-1990 lectae.

Luzula ***sudetica*** (WILLD.) SCHULT. 2n=48CL [K 75/86]
Loc.: USSR, Ucrainia, Carpati orient., Zakarpatskaya oblast: in summo montis Pikuj, ca 1450 m s.m.
1986, F. KRAHULEC et D. BLAŽKOVÁ, PR.

Luzula ***taurica*** (V. KRECZ.) V. NOVIK. 2n=12AL [K 189/2]
Loc.: URSS, Ucrainia australis, paeninsula Krym (Tauria), oppidum Alušta, pagus Lučistoe: in pratis subalpinis Demerdži Jaila dictis, situ occid a cacum. montis Demerdži. Alt. ca 1100-1200 m s.m.
1989, J. KIRSCHNER
Cult. sub no. L189, a.1990 lectae.

Luzula ***taurica*** (V. KRECZ.) V. NOVIK. 2n=12AL [K 190/1]

Loc.: URSS, Ucrainia australis, paeninsula Krym (Tauria), oppidum Alušta, pagus Lučistoe: in pratis subalpinis Demerdži Jaila dictis, situ austro-occid. a cacum. montis Demerdži.

Alt. ca 1100-1200 m s.m.

1989, J. ŠTĚPÁNEK

Cult. sub no. L190, a.1990 lectae.

Luzula ***taurica*** (V. KRECZ.) V. NOVIK. 2n=12AL

(= *L. campestris* var. *atrofusca* MALY)

K 262/90A	Cult.L141	fig.!	orig.5004B	Publ.:Preslia 1991
K 258	Cult.L145		orig.5004F	
K 202/89	Cult.L143		orig.5004D	
K 253	Cult.L139		orig.5004N	
K 249	Cult.L137		orig.5004K	Publ.:Preslia 1991
K 265	Cult.L135		orig.5004M	Publ.:Preslia 1991

Loc.: Graecia septentrionalis, nom. Serrai: mons Vrondous, in regio summitati montis, alt. ca 1750-1849 m.

1987, S. SNOGERUP & A. STRID, orig. no. 5004, LD,PR

Luzula ***taurica*** (V. KRECZ.) V. NOVIK. 2n=12AL [K 411/91]

(= *L. campestris* var. *atrofusca* MALY)

Loc.: Bulgaria centralis, montes Rila, situ orient. ab oppidulo Rila, in decl. siccis (austr.), supra vicum Dolgija Rid, supra Rilski Monastyr.

1990, leg. J. ŠTĚPÁNKOVÁ, PR.

Luzula ***taurica*** (V. KRECZ.) V. NOVIK. 2n=12AL [K 477/91]

(= *L. campestris* var. *atrofusca* MALY)

Loc.: Bulgaria, montes Vito a, in planitiei subalpini, alt. ca 2000 m s.m.

1991, B. KUZMANOV, PR

PREVIOUS CHROMOSOME COUNTS OF THE SECT. *LUZULA* TAXA BY THE AUTHOR (a critical review)

Luzula campestris (L.) DC. 2n=12

subsp. *campestris*

Loc.: ČSFR, Nymburk, Velenka

KIRSCHNER 1979 MS

Loc.: ČSFR, Praha, Barrandov
KIRSCHNER 1979 MS
Loc.: ČSFR, Trutnov, Malé Svatoňovice
KIRSCHNER 1979 MS

Luzula divulgata KIRSCHNER 2n=24
Loc.: ČSFR, Hodonín, inter pagos Sobůlky et Věteřov
KIRSCHNER 1980:434
Loc.: ČSFR, Kladno, in valle rivi Kačák situ merid. a pago Dol. Bezděkov. KIRSCHNER 1980: 434
Loc.: ČSFR, Praha, in silvis inter pagos Všenory et Černolice.
KIRSCHNER 1980: 434
Loc.: ČSFR, Levice, inter pagos Rybník et Tlmač
KIRSCHNER 1980: 434

Luzula multiflora (EHRH.) LEJ. 2n=36
subsp. *multiflora*
Loc.: ČSFR, Žatec, Veletice
KIRSCHNER 1979 MS
Loc.: ČSFR, Mladá Boleslav, Kosmonosy
KIRSCHNER 1979 MS
Loc.: ČSFR, Rýchory Mts.
KIRSCHNER 1979 MS
Loc.: ČSFR, Krkonoše Mts., Pec p. S.
KIRSCHNER 1979 MS
Loc.: ČSFR, Krkonoše Mts., Richtrovy boudy
KIRSCHNER 1979 MS
Loc.: ČSFR, Krušné hory Mts., Boží Dar
KIRSCHNER 1979 MS
Loc.: ČSFR, Šumava Mts., Kvilda
KIRSCHNER 1979 MS
Loc.: ČSFR, Domažlice, Mt. Hora near Kdyně
KIRSCHNER 1979 MS
Loc.: ČSFR, Blatná, Vrbno
KIRSCHNER 1979 MS
Loc.: ČSFR, Hlinsko, Dědová
KIRSCHNER 1979 MS
Loc.: ČSFR, Olomouc, Hlubočky
KIRSCHNER 1979 MS
Loc.: ČSFR, south of Bzenec
KIRSCHNER 1979 MS

Loc.: ČSFR, Fiľakovo, Hajnáčka
KIRSCHNER 1979 MS
Loc.: Caucasus, Teberda, Ulu-Chatipara
KIRSCHNER et KŘÍSA 1979: 335

Luzula pallidula KIRSCHNER 2n=12
Loc.: ČSFR, Mladá Boleslav, Kosmonosy
KIRSCHNER 1979 MS
Loc.: ČSFR, south of Bzenec
KIRSCHNER 1979 MS
Loc.: ČSFR, Olomouc, Krakovec
KIRSCHNER 1979 MS
Loc.: Caucasus, Dombaj, Russkaja Poljana
KIRSCHNER et KŘÍSA 1979: 335
Loc.: Caucasus, Dombaj, Kluchorskoe ozero
KIRSCHNER et KŘÍSA 1979: 335

Luzula stenophylla STEUDEL 2n=24
Loc.: Caucasus, Dombaj, Alibek
KIRSCHNER et KŘÍSA 1979: 334
Loc.: Caucasus, Teberda, Ulu-Chatipara
KIRSCHNER et KŘÍSA 1979: 334
Loc.: Caucasus, Dombaj, Kluchorskoe ozero
KIRSCHNER et KŘÍSA 1979: 334

Luzula sudetica (WILLD.) SCHULT. 2n=48
Loc.: ČSFR, Krušné hory Mts., Boží Dar
KIRSCHNER 1979 MS
Loc.: ČSFR, Šumava Mts., Kvilda
KIRSCHNER 1979 MS
Loc.: ČSFR, Šumava Mts., Horská Kvilda
KIRSCHNER 1979 MS
Loc.: ČSFR, Krkonoše Mts., Pančavské rašeliniště
KIRSCHNER 1979 MS
Loc.: ČSFR, Krkonoše Mts., Richtrovy boudy
KIRSCHNER 1979 MS
Loc.: ČSFR, Krkonoše Mts., Výrovka
KIRSCHNER 1979 MS
Loc.: ČSFR, Krkonoše Mts., Luční bouda
KIRSCHNER 1979 MS

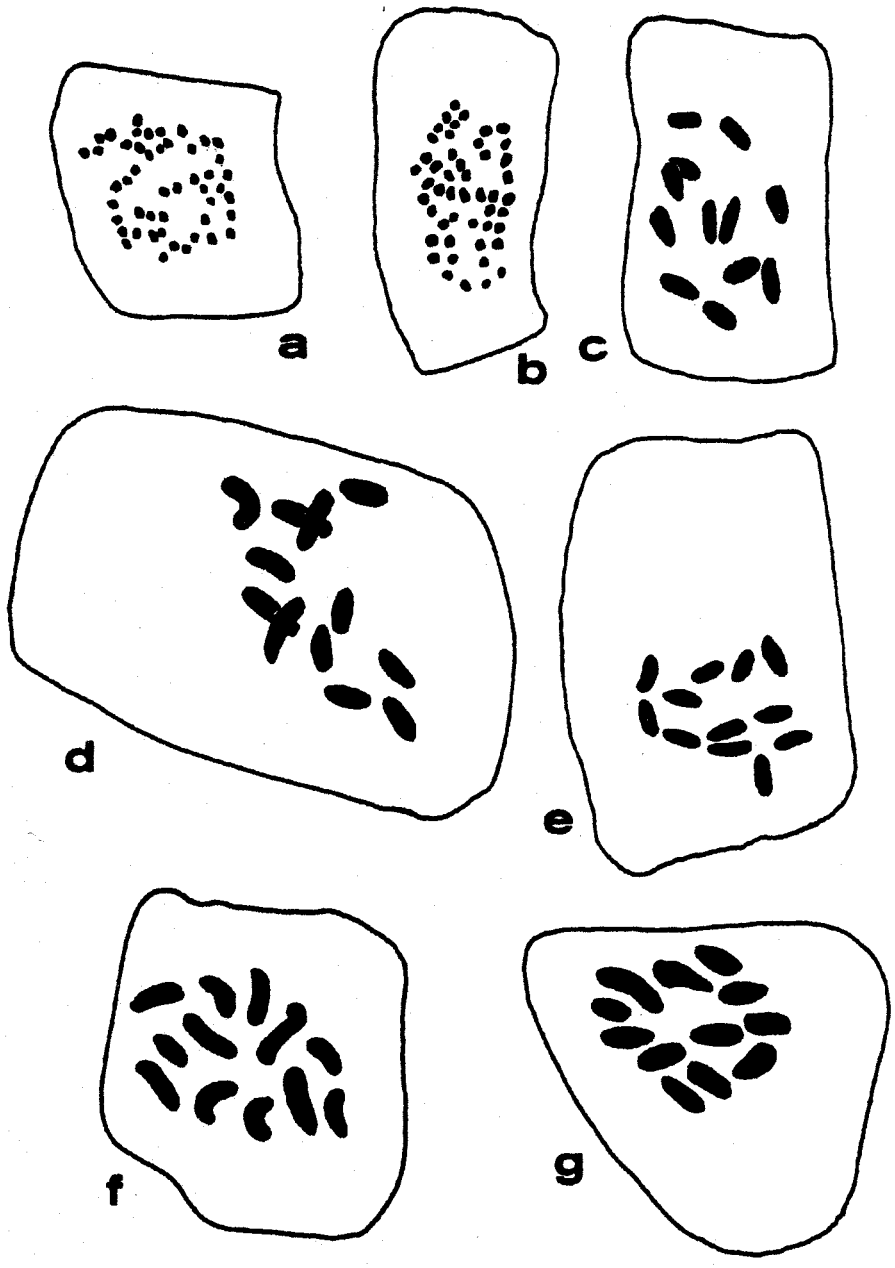

Fig. 1. - a: *L. sudetica*, 2n=48CL, Tatry, Vyšné Hágy (K168/89). **b:** *L. sudetica*, 2n=48CL, Bulgaria, Rila (K409/91). **c:** *L. campestris*, 2n=12AL, Slovakia, Jovice (K231). **d:** *L. taurica*, 2n=12AL, Crimea, Demerdži Jaila (L190/1). **e:** *L. taurica*, 2n=12AL, Rila (K411/91). **f, g:** *L. nipponica* SATAKE, a diploid with 2n=12AL for comparison, N. Korea (K259). Note one longer and one shorter chromosome (a translocation).

Considerations on the karyotype evolution in the European sect. *Luzula*

Theoretically speaking, there are five ways of karyotype differentiation in the section: (1) agmatoploidy (=endonuclear polyploidy), (2) alloploid partial agmatoploidy, (3) autoploid partial agmatoploidy, (4) true alloploidy, and (5) autoploidy.

A closer examination of the karyotype list shows that most of the possible karyotype configurations expectable (with respect to the above differentiation modes, and to the fact that almost exclusively simultaneous fragmentation is found in the section) can be ascertained in the material, either in 'clean' populations or in hybrids (the latter, however, are not considered in this paper).

Luzula campestris subsp. *campestris*, *L. taurica* (including the Balcanic *L. campestris* var. *atrofusca*) and *L. pallidula* represent true diploids available for differentiation mechanisms to operate upon. *L. calabra*, *L. fallax*, a multifloroid diploid from Spain (not treated here; submitted for publication under the name of *L. multiflora* subsp. *monticola*), and, very likely, *L. stenophylla* are agmatoploids with 2n=24BL, while *L. sudetica* is the only octo-agmatoploid (2n=48CL). Partial agmatoploids at the tetraploid level are rare: *L. alpina*, *L. multiflora* subsp. *snogerupii*. True tetraploids are found in the *L. multiflora* subsp. *multiflora* assemblage; *L. divulgata* and an Irish form (not annotated in the present study) are the other cases. Geographically very common hexaploids are confined to *L. multiflora* s.l. (*L. multiflora* subsp. *multiflora*, *L. m.* subsp. *frigida* and *L. m.* subsp. *sibirica*, not speaking about the various forms found in the Iberian Peninsula). The octoploid level is only reached by *L. congesta.*

Thus, primarily, there are three true diploids as a possible material for karyotype evolution. *Luzula campestris* subsp. *campestris* is a western, south and southwestern taxon showing the most conspicuous variation in the Iberian Peninsula. None of the agmatoploids, according to their morphology, should be considered as a direct descendant of the *L. campestris*-like plants. Artificial tetraploids synthesized from *L. campestris* subsp. *campestris* have a remarkable morphology almost perfectly matching that of *L. campestris* subsp. *nevadensis*. Thus, the subspecies pair of susbp. *campestris* and subsp. *nevadensis* may represent a very rare mode of karyotype differentiation, the true autoploidy (5). On the other hand, *L. divulgata*, the closest morphological neighbour of *L. campestris* s.str. in C. Europe, probably is of another ancestry. One can hypothesize that, in the latter case, progenitors should be searched for in the group of the second diploid, *L. taurica* (including *L. campestris* var. *atrofusca*

MALY of the Balkans) although, except for the general habit, there are few features supporting this hypothesis. *Luzula taurica* is an eastern diploid without any clear relative in Europe (with the possible exception of *L. divulgata*, see above).

The most ancient and most widely distributed diploid, *L. pallidula*, has a crucial position in the karyotype evolution of the section. Almost all the agmatoploids (particularly, *L. calabra* and *L. sudetica*) exhibit close relationships to *L. pallidula*. Both *L. calabra* and *L. sudetica* approach *L. pallidula* morphologically to such a great extent that their relatedness is obvious. They most probably represent close agmatoploid (1) derivatives of *L. pallidula*.

Note: There are two BL diploids, agmatoploids, *L. fallax* and a Pyrenean type (*L. multiflora* subsp. *monticola*, ined.), whose ancestors cannot be assessed owing to lack of evidence.

Only two karyotypic units that presumably came into being through partial agmatoploidy are recognised formally. *Luzula multiflora* subsp. *snogerupii* (12AL+24BL), a small-flowered, *L. pallidula*-like taxon confined to the Balkans, is comparatively similar to pale-flowered forms of *L. multiflora* subsp. *multiflora*. However, a closer examination of its morphology shows that it is morphologically intermediate between *L. pallidula* and *L. fallax*, and may be related to them. It is hypothesized that *L. multiflora* subsp. *snogerupii* is an allopolyploid (2) descendant of *L. pallidula* (12AL) and *L. fallax* (24BL).

Relationships of the other partial agmatoploid, *L. alpina* (12AL+24BL) are even less clear. In the Alps, related diploids are not found, and there are two morphologically close partners in the Pyrenees (KIRSCHNER, unpubl.). In spite of the fact that there is no indication which of the two differentiation modes is more likely, I consider it more probable that *L. alpina* is an alloploid (relatively high variability and close similarity to the former of the two presumable relatives). Thus, there is no evidence documenting autoploid partial agmatoploidy.

The origin of the tetraploid-hexaploid group of *L. multiflora* has partly been elucidated by the experimental induction of the *L. pallidula* tetraploids carried out by H. NORDENSKIÖLD (1956). The artificial tetraploids (studied at UPS in 1990) are morphologically close to *L. multiflora* in many features. It is plausible that some of the members of the *L. multiflora* group are of this origin. Nevertheless, the hexaploid *L. multiflora* exhibits a regular bivalent formation during meiosis, which indicates the alloploid origin. Thus, both alloploidy and autoploidy (4, 5) have probably played an important role in the evolution of *L. multiflora* s.l. (However, as the genetical basis of bivalent formation has not been

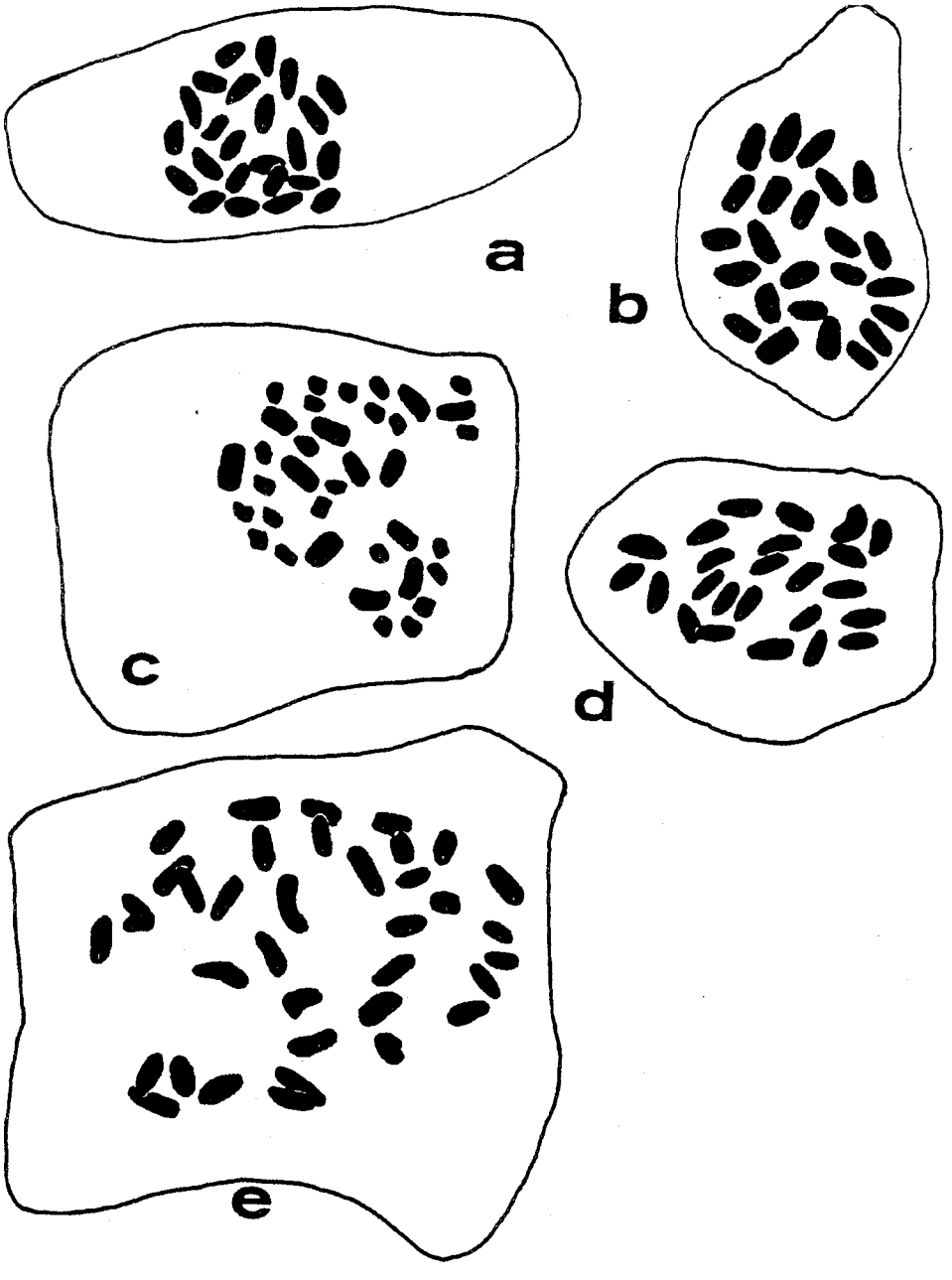

Fig. 2. - **a:** *L. divulgata*, 2n=24AL, Hungary (K221/89). **b:** *L. divulgata*, 2n=24AL, Moravia, Roštín (K176/89). **c:** *L. alpina*, 2n=12AL+24BL, Austria, Stubaital (K175/89). **d:** *L. multiflora*, 2n=24AL, Belanské Tatry (K210/89). **e:** *L. multiflora* subsp. *frigida*, 2n=36AL, the White Sea region, Pojakonda (K169/89).

studied in *Luzula* multiflora [cf. the case of *Triticum aestivum* L.], a possibility of true autoploidy in the hexaploid *L. multiflora* cannot be excluded.)

It can be summarized that true agmatoploidy, alloploid partial agmatoploidy at the tetraploid level and true alloploidy seem to be documented satisfactorily in the European material of the section, the autoploidy being a very likely mode. On the other hand, there is no convincing evidence concerning autoploid partial agmatoploidy.

Two general facts seem to have emerged during the studies. First, it is very likely that agmatoploidy exclusively operates at the diploid level and agmatoploid chromosome sets only are 'carried' to higher ploidy levels through alloploidy. (There is no evidence in favour of the hypothesis that any partial agmatoploid came into being within the polyploid level.) Secondly, the differentiation modes and processes in most cases are connected with *L. pallidula*, an ancient diploid. Not only agmatoploid and alloploid descendants of it are known but it also has taken part in autoploid processes. The other diploids, including *L. campestris*, are involved in much lower number of modes and cases of karyotypic differentiation.

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