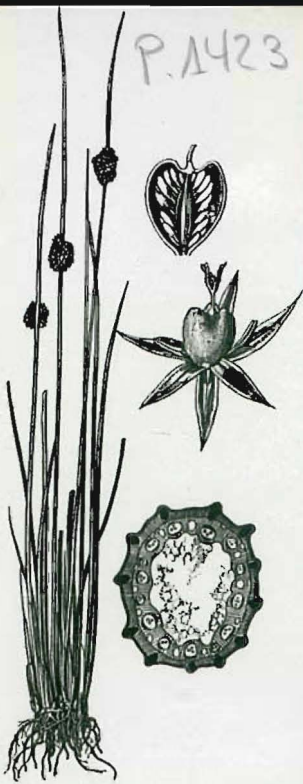


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International Organization of Plant Biosystematists

Newsletter No. 32

Edited by

J. Kirschner & L. Drábková

C. A. Stace & B. Oxelman

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Luzula campestris L.

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IOPB NEWSLETTER NO. 32

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Editors' Column

Dear IOPB Members,

The present issue of IOPB Newsletter, number 32 in the series, should represent a further step towards a better communication within IOPB. The IOPB Directory provides updated addresses of our members (please note that we would like to get E-mail addresses of all members, and include them in the internet version of the directory soon). After a period of certain difficulties, IOPB is present on a new web site where the Newsletter will be available (beginning with No. 31).

There is a very interesting lab profile with a valuable account of karyology of bryophytes, and another contribution with IOPB Chromosome Numbers, so successfully edited by Clive Stace. This time we have no molecular news.

First information about the forthcoming IOPB Symposium 2001 in Albuquerque, New Mexico. It will be an exciting event, also because of the possibility to meet other botanists at the meetings of several American botanical societies taking place in Albuquerque.

The Editors are grateful for the contributions published in the present issue of the Newsletter, and would like to encourage the members to send their materials. In particular, Molecular News will be greatly appreciated (please, send them to Bengt Oxelman). Individual Research News, New Publications, Profiles of Laboratories will also fill a gap in the Newsletter. The periodicity of the Newsletter also depends on the quantity of the contributions submitted, and we are looking forward to receiving them.

The next Newsletter deadline is March, 2001.

With best wishes

The Editors



Phyllodoce caerulea

Profiles

Cytotaxonomy of bryophytes in the Department of Plant Cytology and Embryology, Institute of Botany, Jagiellonian University, Cracow, Poland

E. Kuta & L. Przywara

GENERAL OUTLINE OF RESEARCH

Our interest in karyology of bryophytes has started in 1980 in collaboration with taxonomist prof. Ryszard Ochyra (Poland) and later with Dr. Frank D. Bowers (USA) and Prof. Jerzy Szweykowski (Poland). During twenty years we have counted chromosomes of approximately 300 species from different geographic areas (Antarctica, Europe, North America, New Zealand) (Kuta et al. 1982, 1984, 1990, 1995, 1997, 1999; Kuta, Ochyra 1987, 1988; Ochyra et al. 1982, 1985; Ochyra, Kuta 1990; Przywara et al. 1983, 1984, 1991, 1992; Przywara, Bowers 1992). Recently, we have broadened our karyological study on karyotype analysis using classical and differential (C-banding) staining methods of selected moss species (*Plagiomnium*, *Pleurozium*) (Kuta et al. 1998, 2000; Klos et al. 2000). In our laboratory, experiments with cytological techniques have also been carried out (Przywara & Kuta 1983) and in vitro culture of hepatics and mosses to produce the material (regenerated gametophytes and callus) for cytological study (Kowalusk et al. 1997; Sokal et al. 1997).

CHROMOSOME DATA

In 1995 we published a monograph on the karyology of bryophytes (Przywara & Kuta 1995). Using our data, chromosome data compiled by Fritsch (1991), and other published counts we discussed basic chromosome numbers, intraspecific karyological variability and the frequency of diploids, polyploids, and aneuploids in particular taxa. In more than a hundred years of studies on bryophytes, chro-

mosome counts have been determined in approximately 2,250 species from all over the world which represent about 15% of the total number of species. Representatives of all orders have been made subject of karyological studies, but the coverage of various orders differs significantly. There are still no chromosomal data for 14 families and 194 genera of hepatics and for 20 families and 442 genera of mosses. The bryophyte flora of the northern hemisphere is much better covered than that of the southern hemisphere. The range of chromosome counts is from $n = 4$ to $n = 10$ in *Anthocerotae* ($n = 5$ is most common among the species); in *Hepaticae* $n = (34$ to $n = 48$ (most species have $n = 8$ and $n = 9$); and in *Musci* $n = 4$ to $n = 72(96)$ (most common are species with chromosome numbers $n = 11$ and $n = 10$). As primary basic numbers: $x = 5$ in *Anthocerotae*, $x = 9$ in *Hepaticae* and $x = 7$ in *Musci* have been suggested. The often occurring gametophytic chromosome number $n = 8$ in hepatics is probably of secondary origin, as are the low gametophytic chromosome numbers $n = 4, 5$ and 6 found in mosses, which are secondary numbers originating by descending aneuploidy.

INTRASPECIFIC KARYOLOGICAL VARIABILITY

Intraspecific karyological variability occurring in bryophytes is caused by aneuploidy (aneusomy, dysploidy, the presence of m -chromosomes, accessory chromosomes, sex chromosomes) and polyploidy. Aneuploidy is of frequent occurrence in mosses and relatively rare in hornworts and hepatics; aneuploid cytotypes appear at different levels of ploidy. In hornworts and hepatics most species are not karyologically variable and possess only one cytotype (70% of species in *Anthocerotae* and 76% in *Hepaticae*).

Discussing intraspecific karyological variability some points need critical comments. All numbers quoted by different authors should not be accepted uncritically. Misinterpretation of numbers is very easy

and the more workers there are the more likely this is to happen. So it could not be excluded that this is the reason that mosses from regions intensively investigated by a number of workers are so variable cytologically. A further point is taxonomic confusion and differences of interpretation of taxa, so that different counts may not necessarily come from the same species. Additional causes of high karyological variability in mosses could be so-called "false aneuploidy" resulting from mistakes in determining chromosome number. Such situation cannot be excluded, especially when chromosome numbers were established from meiosis and from individuals with high ploidy levels or aneuploids in which meiosis is often disturbed. The same applies to specimens with *m*-chromosomes and sex chromosomes (heteromorphic bivalents as well as structural sex chromosomes disjoin precociously). In such individuals it is sometimes very difficult to distinguish between bivalents and univalents, and in the case of *m*-chromosomes between chromosomes and chromatids (in meiosis, both chromosomes and chromatids of the *m*-bivalents separate prematurely). So-called mixoploidy, often observed in different tissues, may be an additional cause of karyological variability.

Generally, in bryophytes chromosome races (even different ploidy levels) of a species are indistinguishable morphologically – they are part of cryptic variability. Many naturally occurring intraspecific polyploids are morphologically indistinguishable from diploids. Such situation has been observed by Smith and Newton (1968) in English populations of *Funaria hygrometrica* ($n = 28, 56$), *Physcomitrium pyriforme* ($n = 26, 56$), and *Atrichum undulatum* ($n = 7, 14, 21$). What is a taxonomical status of chromosome races? All depends on species concept. On the basis of genetic criteria it is suggested to consider each ploidy level as separate species but it is being increasingly rejected by practising plant taxonomists.

POLYPLOIDY

The issue of polyploidy in bryophytes we discussed on the basis of the primary basic numbers. In contrast to most previous studies we related the level of ploidy to the sporophyte. The following chromosome numbers are considered as polyploid numbers: $n > 10$ in *Anthocerotae* and *Hepaticae*, and $n > 9$ in *Musci*. The calculated percentage of polyploid species is 0% in hornworts, 8% in liverworts (in which an additional 6% of the species have both diploid and polyploid cytotypes), 76% in mosses (in which an additional 9% of species have both diploid and polyploid cytotypes) (Przywara & Kuta 1995).

A special paper was devoted the evolutionary role of polyploidy in mosses (Kuta & Przywara 1997). In this article to determine the correlation between polyploidy and geographical distribution we introduced the category of high polyploids (species with $n > 15$) among polyploids (all species with $n > 9$). Introducing additional category of polyploids was necessary because in mosses species that are tetraploids in relation to the sporophyte are, in fact, diploids as gametophytes. High polyploids represent 28% of polyploid mosses.

A clear correlation was found between the frequency of high polyploids and latitude. The frequency of high polyploids increases from the equator towards the North and South poles. The percentage of high polyploids jumps dramatically from tropical and subtropical zones (approximately 13%) to temperate and cold climatic zones (over 30%) (Kuta & Przywara 1997).

In conclusion, polyploidy plays a very important evolutionary role in mosses being the basis of speciation and intraspecific karyological variability. It is assumed that in bryophytes most polyploids are predominantly autopolyploids. This results both from the generative mode of reproduction (short distance of gamete dispersion) and from various means of vegetative

propagation. However, allopolyploid origin of some species: *Plagiomnium medium* (Wyatt et al. 1988, 1992), *P. curvatulum* (Wyatt et al. 1993a), *Rhizomnium punctatum* (Wyatt et al. 1993b), *Plagiomnium cuspidatum* (Wyatt & Odrzykoski 1998), *Sphagnum jensenii* (Sastad et al. 1999), and *Polytrichastrum pallidisetum*, *P. ohioense*, and *P. sexangulare* (Derda & Wyatt 2000) has recently been confirmed by molecular methods such as isozyme, and DNA analysis. It indicates that allopolyploidy is probably not such an infrequent phenomenon in mosses as previously suggested but it is a question of the methods used to recognize it.

KARYOTYPE ANALYSIS

Karyotypes have been presented for approximately 30% of karyologically investigated taxa (see Przywara & Kuta 1995 for details). However, lack of microphotographs, chromosome measurements and idiograms in many publications makes the comparison and interpretation of results difficult or even impossible. Some authors have provided only the total and relative length of chromosomes without information about the centromere position (arm ratio). Moreover, very often the karyotype formula was based on a single metaphase plate.

Variation in karyotype formulae within species with only one chromosome number has been found in some mosses and hepatics (for details and references see Kuta et al. 1998). In each example, however, the material originated from different populations, and the chromosome data were provided by several investigators using different techniques and ways of presenting the results. It is therefore an open question whether this variation is due to structural chromosome rearrangements or due to interpretation of the results.

We found significant variability in karyotype of *Pleurozium schreberi* from populations in Poland that contrasted with high uniformity in chromosome number of this species ($n = 5$). Variation in ka-

ryotype was discovered within the population and among populations. Eight types of karyotypes were distinguished. Such great intra- and interpopulation variability was unexpected in populations of the dioecious haploid moss reproducing in Poland exclusively vegetatively. The structure of Polish populations of *Pleurozium schreberi* might be the remnants of the populations reproducing sexually in the past. Loss of sexual reproduction is probably caused by the occurrence of one sex only. Introduced genetic variability has been stabilized by vegetative propagation. Another possibility is that haploid gametophytes are affected by structural mutations. Different cytotypes could be stabilized by the asexual mode of reproduction. It is a well known phenomenon in asexually reproducing plant species. Moreover, some other factors might also cause karyotype variation: the type of tissue and the differential condensation of the chromosome arms.

In another moss, *Plagiomnium affine* – a dioecious species reproducing in Poland sexually – we found variability in chromosome numbers ($n = 6, 7, 12$, and 18) and also in karyotype formula. Variation in karyotype was discovered within the population and among populations; four types of karyotype were distinguished.

Differential staining methods, including Giemsa C-banding and fluorochromes, have been introduced only to a very few bryophyte species (for references see Przywara & Kuta, 1995). For example, until now only six moss species (*Atrichum undulatum*, *A. crispum*, *Dicranum tauricum*, *Gymnostomum aeruginosum*, *Plagiomnium ellipticum*, and *Rhizomnium pseudopunctatum*) have been investigated using this technique (Newton 1977, 1979, 1983, 1984, 1986), however, C-band pattern was rather poorly visible.

In our laboratory, we used C-banding according to Schwarzsacher et al. (1980) to investigate the karyotype of *Pleurozium schreberi*, the object of Vaarama's (1954) classical work and to *Plagiomni-*

um affine to identify heterochromatin and compare the heterochromatin pattern with Ono's (1970) hypothesis concerning the origin of sex chromosomes.

The C-banding demonstrated that in *Pleurozium schreberi* (Kuta et al. 2000) haploid karyotype is heterochromatin rich. The total amount of heterochromatin is 44.1% of the karyotype length. Telomeric as well as intercalary bands were observed in particular chromosomes. Centromeric bands were recognized in one chromosome only. The banding pattern of chromosome A, the longest, resembles, to a great extent, Vaarama's description. Heterochromatic bodies were also observed in interphase nuclei.

By contrast, in *Plagiomnium affine* (Klos et al. 2000) the amount of heterochromatin is low. The differential staining demonstrated one chromosome with large telomeric heterochromatin block and one intercalary band. This chromosome was the fifth in the haploid complement according to chromosome length and was the only chromosome marker that is easy to identify in the C-banded karyotype. Centromeric bands were not recognized. There is, however, evidence to suggest that none of those C-banded chromosomes were structural sex chromosomes of *Mnium* type according to Ono (1970).

Further investigations on karyotype variability in bryophytes are needed on species with different modes of reproduction, and on polyploids.

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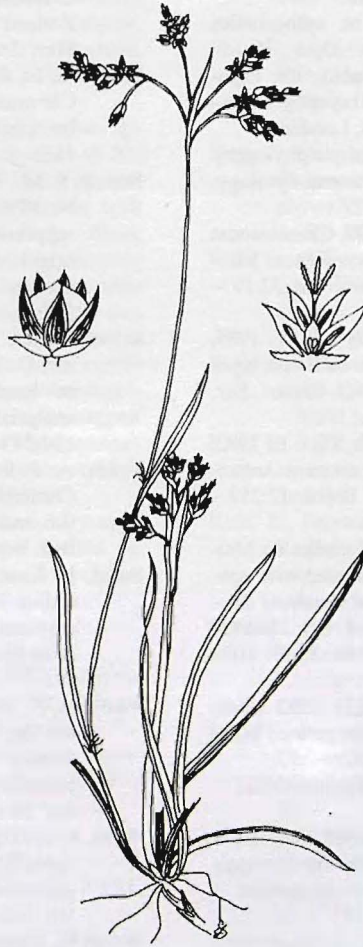
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Luzula campestris

IOPB Chromosome Data 16

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Please send contributions to Professor Stace at the above address (preferably by email with the contribution in the main text, not as an attachment, but failing that on a 3.5 inch microdisc with text in ASCII-file and a printed copy) using the exact layout of the present list. Neither proofs nor reprints will be made available, but the editor will acknowledge receipt of contributions and raise queries with authors if necessary.

Reports by:

- **Lenka Drábková**, Institute of Botany, Academy of Sciences of the Czech Republic, CZ-252 43 Pruhoňovice, Czech Republic (E-mail: drabkova@ibot.cas.cz). All localities in Czech Republic. Vouchers in PRC.

SAXIFRAGACEAE

Saxifraga rosacea Moench subsp.

spohemica (Gmelin) D.A. Webb

2n=cca 40, 42. Czech Republic:

Phytogeographical region Lounské středohoří, Bořeň hill, near town Bilina, 50°31'N, 13°45'E, 7.06.1997

2n=46, 48. Czech Republic:

Phytogeographical region Labské středohoří, Solanská hora hill, near Děkovka village, 50°29'N, 13°54'E, 15.05.1998

2n=48. Czech Republic:

Phytogeographical region Labské středohoří, Děkovka-Hrádek ruin, S of Děkovka village, 50°29'N, 13°55'E, 17.05.1996

2n=46. Czech Republic:

Phytogeographical region Labské středohoří, Blešenský vrch hill, NW of Dřemčice hamlet, 50°28'N, 13°54'E, 3.05.1997

2n=46. Czech Republic:

Phytogeographical region Labské středohoří, Martinská stěna rock, between Kundratice hamlet and Čeřeniště hamlet, 50°35'N, 14°06'E, 17.05.1996

2n=52. Czech Republic:

Phytogeographical region Labské středohoří, Holý vrch hill, near Hlinná hamlet, 50°34'N, 14°06'E, 3.05.1997

2n=46. Czech Republic:

Phytogeographical region Labské středohoří, Ostrý hill, S of Milešov village, 50°31'N, 13°56'E, 14.05.1998

2n=46. Czech Republic:

Phytogeographical region Labské středohoří, Boreč hill, S of Režný Újezd village, 50°30'N, 13°59'E, 3.05.1997

2n=46. Czech Republic:

Phytogeographical region Český kras, Voškov rock, near Zadní Třebáň village, 49°55'N, 14°11'E, 19.05.1996

2n=50. Czech Republic:

Phytogeographical region Český kras, Tetínské skály rocks, between Beroun town and Srbsko village, 49°56'N, 14°06'E, 1.05.1996

- 2n=cca 38. Czech Republic:
Phytogeographical region Český kras, Kobyla quarry, near Srbsko village, 49°56'N, 14°08'E, 21.10.1995
- 2n=46. Czech Republic:
Phytogeographical region Doupovské vrchy, Skalky skřítků rocks, near Dubina village, 50°14'N, 13°00'E, 6.07.1996
- 2n=46, 52. Czech Republic:
Phytogeographical region Střední Povltaví, Štěchovice rocks, N of Štěchovice town, 49°51'N, 14°23'E, 22.10.1995
- 2n=46, 52. Czech Republic:
Phytogeographical region Střední Povltaví, Příběnice rock, S of Tábor town, 49°23'N, 14°33'E, 19.07.1997

- 2n=46. Czech Republic:
Phytogeographical region Moravské podhůří Vysočiny, Oslavany rock, near Oslavany town, 49°06'N, 16°20'E, 22.06.1997
- Saxifraga rosacea* Moench subsp. *steinmannii* (Tausch) Holub.
- 2n=52. Czech Republic:
Phytogeographical region, Železnobrodské Podkrkonoší, Riegrova stezka rocks, near Bitouchov town, 50°36'N, 15°18'E, 25.05.1996



Saxifraga rosacea

Tatyana V. Alexeeva, Michael G. Pimenov and Eugene V.

Kljuykov, Botanical Garden of Moscow State University, Moscow 119899, Russia (E-mail: pimenov@2.botgard.bio.msu.ru) and **Hu ZhiHao**, Yunnan University, Kunming, Yunnan, R. P. China. Vouchers in MW. All localities in China. Collectors: M. G. Pimenov, E. V. Kljuykov and Hu ZhiHao. The investigations were supported by grants of the Russian Foundation of Fundamental Investigations and the National Geographic Society.

APIACEAE

- Acronema paniculatum* (Franch.) H. Wolff. 2n=20. Yunnan: Lijiang Co., Mts. Yulongxue Shan, eastern slope near village of Jushi, alpine pasture Machuonba, 27°06'N, 100°11'E, alt. 3500 m, 02.10.1998. N 531.
- Acronema muscicolum* (Hand.-Mazz.) Hand.-Mazz. 2n=10. Yunnan: NW part, Deqen Co., road Zhongdian - Deqen, Mts. Baimashan, Pamala pass, 28°20'N, 99°05'E, alt. 4410 m, 28.09.1998. N 465.
- Angelica songpanensis* Shan RenHwa et Pu FaTing. 2n=44. Sichuan: Songpan Co., route to Hunglong, Limbo village, near Limbo Temple, spruce forests and their margins, shrubs (*Salix*, *Sibiraea*, *Berberis*), 32°46'N, 103°38'E, alt. 3300 m, 14.09.1998. N 141.
- Bupleurum longicaule* DC. 2n=12. Yunnan: NW part, Deqen Co., road Zhongdian-Deqen, Mts. Baimashan, western slope, 28°28'N, 99°04'E, alt. 3800 m, 29.09.1998. N 480.
- Bupleurum microcephalum* Diels. 2n=12. Sichuan: Danba Co., basin of Daduhe river, upper part of Jiangxigua river valley, 30°35'N, 101°39'E, alt. 3200 m, 18.09.1998. N 235.
- Bupleurum petiolulatum* Franch. 2n=12. Yunnan: NW part, Zhongdian Co., 2 km from Luzo village, valley of river, 27°49'N, 99°54'E, alt. 3450 m, 27.09.1998. N 456.
- Bupleurum smithii* H. Wolff. 2n=12. Sichuan: Songpan Co., route to Hunglong, Limbo village, near Limbo Temple, spruce forests and their margins, shrubs (*Salix*, *Sibiraea*, *Berberis*), 32°46'N, 103°38'E, alt. 3300 m, 14.09.1998. N 134.
- Heracleum hemsleyanum* Diels. 2n=22. Sichuan: between Yajiang and Litang, 90 km road station, 29°59'N, 100°52'E, alt. 3900 m, 23.09.1998. N 327.
- Heracleum souliei* H. Boissieu. 2n=22. Sichuan: route Hongyuan-Barkam, valley of Suome river, near Maerkang, 31°55'N, 102°39'E, alt. 2800 m, 16.09.1998. N 192.
- Hymenidium chloroleucum* (Diels) Pimenov et Kljuykov (*Trachydium chloroleucum* Diels). 2n=44. Yunnan: Lijiang Co., Mts. Yulongxue Shan, eastern slope, alpine belt, 27°06'N, 100°12'E, alt. 4500 m, 01.10.1998. N 501.
- Hymenidium heterosciadium* (H. Wolff) Pimenov et Kljuykov (*Pleurospermum heterosciadium* H. Wolff). 2n=44. Sichuan: between Xinduqiao and Yajiang, pass near Gaul Temple, 30°03'N, 101°23'E, alt. 4450-4700 m, 22.09.1998. N 317.
- Ligusticopsis rechingiana* Leute. 2n=22. Sichuan: between Yajiang and Litang, 90 km road station, 29°59'N, 100°52'E, alt. 4100 m, 23.09.1998. N 329.
- Ligusticum acuminatum* Franch. 2n=22. Yunnan: NW part, Zhongdian Co., 15 km from Zhongdian on road to Bifa lake, 27°48'N, 99°48'E, alt. 3240 m, 27.09.1998. N 445.

Peucedanum praeruptorum Dunn. $2n=22$.

Sichuan: upper part of Minjiang basin, near Songpan, stony slope, $32^{\circ}39'N$, $103^{\circ}36'E$, alt. 3000 m, 13.09.1998. N 123.

Pimpinella diversifolia DC. $2n=18$.

Yunnan: near Kunming, Heilongtan, park of Kunming Institute of Botany, CAS, $25^{\circ}08'N$, $102^{\circ}42'E$, alt. 1950 m, 03.09.1998. s.n.

Sinocarum filicinum H. Wolff. $2n=20$.

Yunnan: Tali Co., Diancang Shan Mts., eastern slope, above Yangbi, rich mixed forests, rocks, $25^{\circ}42'N$, $100^{\circ}06'E$, alt. 3600 m. N 558.

Sinodielsia bipinnata (Shan RenHwa et Pu FaTing) Pimenov et Kljuykov (*Vicatia bipinnata* Shan RenHwa et Pu FaTing). $2n=22$. Sichuan: route Hongyuan – Barkam, valley of Suome river, near Maerkang, $31^{\circ}55'N$, $102^{\circ}39'E$, alt. 2800 m, 16.09.1998. N 190.

Tonglooa elata H. Wolff. $2n=12$.

Sichuan: route Songpan – Hongyuan, Moiqi river, road post 90 km, high mountain plateau, moist place, $32^{\circ}56'N$, $103^{\circ}09'E$, alt. 3950 m, 15.09.1998. N 171.



Bupleurum stellatum

Announcements

2001 Meetings of the IOPB

The 2001 meeting of the IOPB will be August 12–16, 2001 in the Albuquerque Convention Center in Albuquerque, New Mexico, USA. IOPB members will be able to register electronically or via paper forms that will be mailed in the spring of next year. For the first time IOPB will be meeting with the major botanical societies in the U.S. including: American Bryological & Lichenological Society (ABLS), American Fern Society (AFS), American Society of Plant Taxonomists (ASPT), and Botanical Society of America (BSA). There will be an All Society mixer in the evening of the 12th of August and the IOPB opening ceremony/plenary session on the night of Monday 13th. There will be a joint ASPT/IOPB banquet on Wednesday 15th. The meetings will feature contributed papers, symposia, workshops, and field trips. Information about submitting abstracts for contributed papers will be made available later this year. The meeting organizers are presently soliciting proposals for symposia, workshops, and field trips. The initial announcement for the meeting including the call for proposals is posted at the following Internet address: <http://www.botany2001.org/>. Links to information about Albuquerque and New Mexico are included in the website. We hope to see a large attendance of IOPB members for this exciting group of meetings to be held in the American Southwest.

IOPB on the web

In May 2000, Prof. Scott Russell of University of Oklahoma who runs the BSA computer servers offered to serve as system administrator for an IOPB web site at <http://www.iopb.org/>, to set up the initial site and to provide maintenance for the server-side of the website. The IOPB Council agreed and there is now a worldwide website at <http://www.iopb.org/>. IOPB is still looking for a web master to maintain this site. Professor Russell does not have a support staff, so it will be essential for IOPB to develop the site with their own personnel. The web site is provided as a service for IOPB in conjunction with the Botany 2001 meeting this summer in Albuquerque.

E-mail addresses of the IOPB members

The editors ask all the IOPB members to send their E-mail addresses to the E-mail address of the editors: kirschner@ibot.cas.cz or drabkova@ibot.cas.cz

The addresses will be included in the directory and available on the IOPB web site.

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