Chromosome numbers in some mosses from western Canada

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Received December 21, 1982

RAMSAY, H. P. 1983. Chromosome numbers in some mosses from western Canada. Can. J. Bot. **61**: 2384–2387.

Chromosome numbers are reported for six moss species from western Canada, four from British Columbia, two from Alberta. These give data on chromosome numbers from new localities in Canada for populations of five species and the first record for *Kiaeria starkei* from Canada. Chromosome numbers reported are $n = 13$, *Grimmia affinis*; $n = 14$, *Kiaeria starkei*; $n = 14$ ($13 + m$), *Dicranum scoparium*; $n = 20$, *Bryum pseudotriquetrum*; $n = 11$, *Ptilium crista-castrensis*; and $n = 6$, *Hypnum circinale*.

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L'auteur présente des nombres chromosomiques pour six espèces de mousses de l'ouest du Canada, quatre de Colombie-Britannique et deux de l'Alberta. Ces données représentent des dénombrements pour de nouvelles localités canadiennes chez cinq espèces et le premier dénombrement chromosomique chez *Kiaeria starkei* au Canada. Les nombres chromosomiques signalés sont les suivants: $n = 13$, pour *Grimmia affinis*, $n = 14$ pour *Kiaeria starkei*, $n = 14$ ($13 + m$) pour *Dicranum scoparium*, $n = 20$ pour *Bryum pseudotriquetrum*, $n = 11$ pour *Ptilium crista-castrensis* et $n = 6$ pour *Hypnum circinale*.
[Traduit par le journal]

Introduction

Details of chromosome number records from western Canada have been reviewed by Ramsay and Schofield (1981*a*, 1981*b*). For Canadian mosses data are now available for 62 species from the Rocky Mountains (Alta.) (Anderson and Crum 1958), 3 species from Nova Scotia (Anderson and Bryan 1958), 7 species from Quebec (Al-Aish and Anderson 1960; Anderson and Bryan 1958), 5 species from Ontario, and 3 species from Vancouver (Inoue 1979), while Ramsay and Schofield (1981*a*, 1981*b*) studied 14 species endemic to western Canada and an additional 17 nonendemic species. A total of 31 of the 90 species endemic to western Canada have been examined but many from single populations only. In view of the richness of the moss flora (ca. 700 species) in British Columbia alone (Ireland *et al.* 1980) analysis of the cytology of mosses in the area has barely scratched the surface.

Methods

The work reported here was carried out during a short visit in July 1980. Chromosome counts were obtained from meiotic studies. Sporocytes were squeezed directly into acetocarmine allowing about a minute for penetration; then either (*i*) a drop of acetocarmine containing Hoyers solution was added before covering and spreading cells or (*ii*) cells were covered with a cover slip and spread as usual, then the slide was ringed with Hoyers, allowing it to run in and penetrate.

Slides made this way can be kept for at least a month, enabling rapid examination of material. Penetration of stain is good, although cytoplasm may also take up some stain. Slides can be made permanent using the dry-ice method (Conger and Fairchild 1953) at a suitable time, even 1–2 weeks later.

The method was modified from Beeks (1955) and from suggestions given to me by B. Mischler (personal communication), to whom I am most grateful, who used acetoorcein. Heat was not applied by me but has been found successful by others. The technique is of great value when travelling enabling rapid assessment of material and quick preparation of permanent or semipermanent slides in one operation. Experimentation with relative quantities of stain and Hoyers will improve the final product.

Results and discussion

The results are summarized in Table 1 together with locality details.

Grimmia affinis Hornsch., 23/80, $n = 13$ Fig. 1

The chromosome number $n = 13$ (Fig. 1) recorded here for a population from the Rocky Mountains agrees with that previously reported from the same area (Anderson and Crum 1958) and U.S.A. (Khanna 1967). Vysotskaya (1975) reported $n = 14$ in the same species from U.S.S.R. The chromosomes studied consisted of nine large and four small ones as bivalents at metaphase of meiosis.

Kiaeria starkei (Web. & Mohr) I. Hag., 26/80; 21/80; 27/80, $n = 14$ Figs. 2–4

All three separate populations of *Kiaeria starkei* examined had the chromosome number $n = 14$ (Fig. 2). Previous records for this species include $n = 7$, 14 from U.S.S.R. (Lazarenko *et al.* 1971; Vysotskaya 1972) and $n = 14$ ($13 + m$) from Washington, U.S.A. (Ireland 1965). These are the first records from Canada. The bivalents are small and early disjunction of some bivalents as well as bivalents off the metaphase I plate was noted (Fig. 3). Diakinesis stages were clear (Fig. 4). The *m* bivalent reported by Ireland was not observed in the Canadian populations studied.

Dicranum scoparium Hedw. 30/80, $n = 14$ ($13 + m$) Figs. 5 and 6

Dicranum scoparium has been investigated cytologi-

TABLE 1. Chromosome numbers in some mosses from western Canada

Species	Voucher details	Chromosome no., n	Figure
Grimmiaceae			
Grimmia affinis Hornsch.	23/80 Valley of Ten Peaks, Banff National Park, Alta., 8 July 1980. H. P. Ramsay	13	1
Dicranaceae			
Kiaeria starkei (Web. & Mohr) I. Hag.	21/80 Cypress Bowl, Vancouver, B.C., 14 July 1980. H. P. Ramsay	14	2–4
	26/80 Mt. Seymour, Vancouver, B.C., 13 July 1980. H. P. Ramsay	14	
	27/80 Cypress Bowl, Vancouver, B.C., 14 July 1980. H. P. Ramsay	14	
Dicranum scoparium Hedw.	30/80 Rocky Mountain House, Alta., 7 July 1980. H. P. Ramsay	14 (13 + m)	5–6
Bryaceae			
Bryum pseudotriquetrum (Hedw.) Schwaegr.	24/80 Marble Canyon, Kootenay National Park, Alta., 8 July 1980. H. P. Ramsay	20	7
Hypnaceae			
Ptilium crista-castrensis (Hedw.) De Not.	25/80 Sutherland Falls, B.C., 11 July 1980. H. P. Ramsay	11	8–9
Hypnum circinale Hedw.	22/80 Cypress Bowl, Vancouver, B.C., 14 July 1980. H. P. Ramsay	6	10–11

NOTE: All voucher specimens have been deposited in the herbarium, Botany Department, University of British Columbia, Vancouver, B.C., Canada (UBC).

cally in Europe, Japan, Great Britain, United States, and Canada (see Fritsch 1982) and chromosome numbers vary: n = 11, 12, 12 + m, 13, 14, 14 + 3m. North American records include n = 12 from North Carolina, Monterey, Michigan, and Wyoming, while the only previous count for Canada is for a population from Quebec with n = 12 (Al-Aish and Anderson 1960).

The population examined in these studies was kept in a plastic bag for some days as sporocytes were too young, then sent airmail as a semidried specimen with *Sphagnum* to Australia, where a chromosome count was obtained 3 weeks later. Meiosis was normal and the 14 bivalents (Fig. 5) included one m bivalent which disjoined early (Fig. 6). Although the number differs from the Quebec population and other North American records, n = 14 has been reported previously from U.S.S.R.

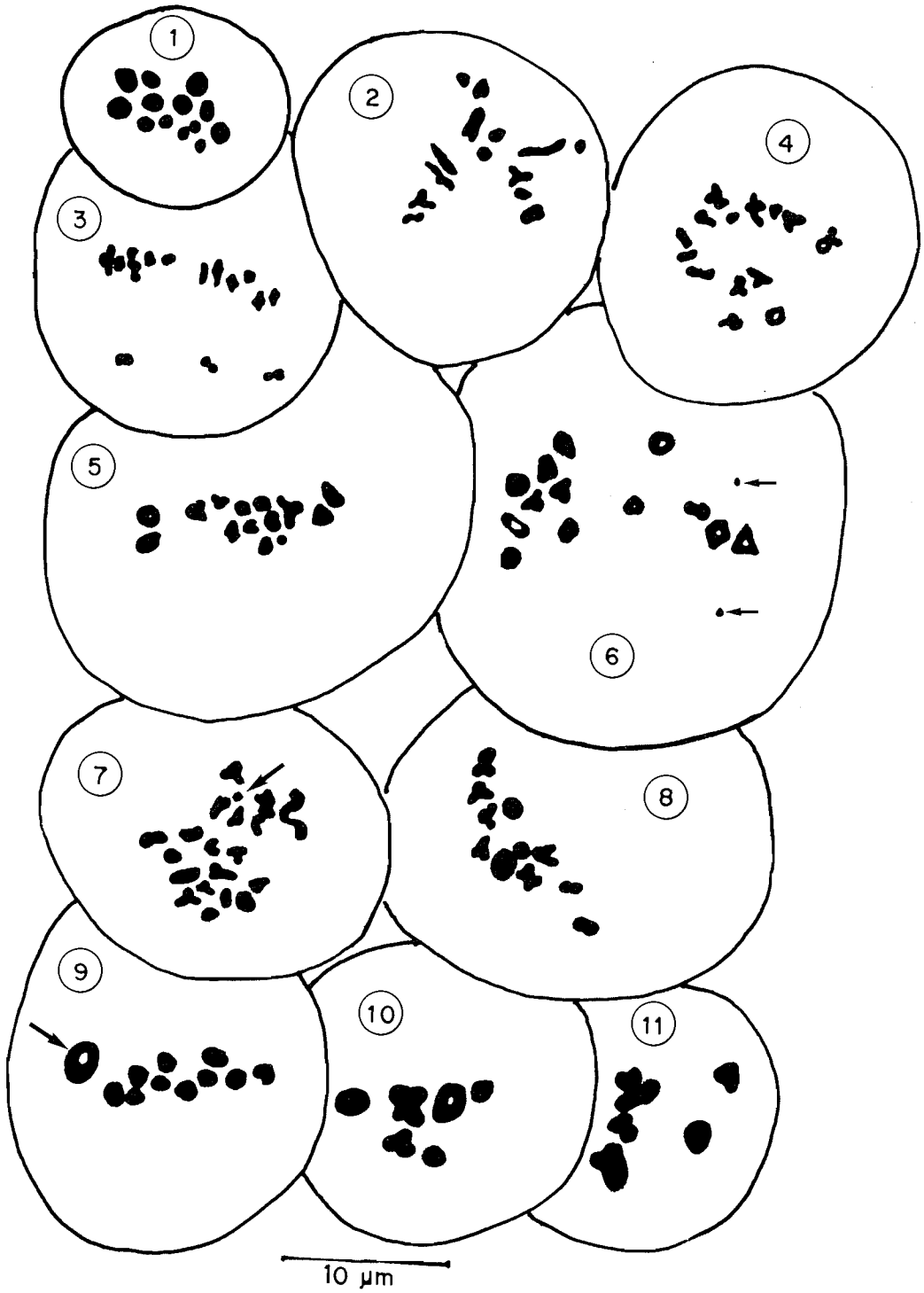
Bryum pseudotriquetrum (Hedw.) Schwaegr. 24/80, n = 20 Fig. 7

The chromosome numbers previously recorded for *B. pseudotriquetrum* show the species to be cytologically variable: n = 12, 11 (10 + m), 11, 12, 20, 22, 33. Populations have been studied in Europe, India, Great Britain, United States, Canada (Ontario (Inoue 1979) and Rocky Mountains (Anderson and Crum 1958)) (see Fritsch 1982). The Canadian populations were aneuploids (n = 10, 11, 12 (Inoue 1979)) or polyploid on a base n = 10 (n = 20 (Anderson and Crum 1958)).

The chromosome number n = 20 reported here, also from the Rocky Mountains, is in agreement with that determined by Anderson and Crum (1958). In the population examined one large rod-shaped bivalent which tended to be found peripherally on the metaphase I plate was noted (Fig. 7). Anderson and Crum do not mention or illustrate such a bivalent. A small bivalent, possibly an m bivalent (Fig. 7), was also present.

Ptilium crista-castrensis (Hedw.) De Not. 25/80, n = 11 Figs. 8 and 9

Previously chromosome records for *P. crista-castrensis* are from Japan (n = 10), Finland (n = 11), and Canada (Rocky Mountains) (n = 10, 10 + m) (see Fritsch 1982). The complement of 11 bivalents reported for this



FIGS. 1–11. Meiosis in sporocytes. Fig. 1. *Grimmia affinis*, $n = 13$. Figs. 2–4. *Kiaeria starkei*, $n = 14$. Figs. 2 and 3. Metaphase I (MI). Note three bivalents lying off the MI plate. Fig. 4. Diakinesis. Figs. 5–6. *Dicranum scoparium*, $n = 14 (13 + m)$. Fig. 5. MI. Fig. 6. MI. Note m bivalent disjointed early (arrows). Fig. 7. *Bryum pseudotriquetum*, $n = 20$. Fig. 7. MI. Note large rod-shaped bivalent located peripherally on the MI plate and small, possibly m bivalent (arrow). Figs. 8–9. *Ptilium crista-castrensis*, $n = 11$. Fig. 8. MI. Fig. 9. MI. Note large ring-shaped peripheral bivalent (arrow). Figs. 10–11. *Hypnum circinale*, $n = 6$, MI. Note three large, three smaller bivalents. Largest bivalent fully contracted not rod shaped as in populations previously examined.

population from British Columbia included one large bivalent which was often located at the edge of the metaphase I plate (Fig. 8). No *m* bivalent was noted (Figs. 8, 9).

Vaarama (1968) described a frequent multivalent formation in what he considered partially polyploid spore mother cells in some capsules of the species. A "special bivalent" was shown as a distinct group of four with chromatids in loose connection with each other. This precocious disjunction into chromatids in first metaphase has been reported also in other mosses. Neither of these phenomena was detected in the populations examined here.

Hypnum circinale Hedw. 22/80, $n = 6$ Figs. 10 and 11

Hypnum circinale, a species endemic to western North America, has been used extensively by Dill (1964*a*, 1964*b*) for a study of meiosis and the experimental effects of heat stress on meiotic division. Chromosome numbers $n = 6, 12$ have been recorded by Dill (1964*b*) and Ramsay and Schofield (1981*a*). The six bivalents (Fig. 11) in the population examined here included three large and three small ones. Possible dimorphy of a rod-shaped large bivalent reported by Ireland (1965), Dill (1964*b*), and Ramsay and Schofield (1981*a*) did not seem to be present in this population in which the largest bivalent was usually ring shaped (Fig. 12). Erratic behaviour and early disjunction characteristic of this species was noted also in the population examined.

Acknowledgments

Heartfelt thanks are extended to Professor W. B. Schofield, who made microscopes and laboratory facilities available for preparation of slides. Fieldwork was entirely dependent on transport and guidance provided by Professor Dale Vitt and Dr. Diana Horton, University of Alberta, to whom I am deeply grateful. Professor Vitt also assisted with identification of some species.

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