鹿児島県屋久島産高等植物の細胞分類学的研究II. 特筆すべき分類群

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Cytotaxonomical studies of flowering plants in Yakushima Island, Kagoshima Prefecture, Japan Part II : noteworthy taxa

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Abstract

Chromosome numbers of 23 taxa of noteworthy plants collected from Yakushima Island are reported, including seven taxa in six families published for the first time: *Acer morifolium* (2n = 26), *Tripterospermum distylum* (2n = 46), *Ophiorrhiza japonica* (2n = 22), *Ainsliaea apiculata* vars. *acerifolia* (2n = 26) and *rotundifolia* (2n = 26), *Smilax china* var. *yakusimensis* (2n = ca. 90), and *Juncus wallichianus* (2n = 80). The chromosome number for *Smilax china* var. *yakusimensis* was found to be different from that of the typical variety, var. *china* in Honshu (2n = 60, 64), and we consider that *Smilax china* may exhibit a polyploid series within the species. The chromosome number for *Aruncus dioicus* var. *kamtschaticus* (2n = 14) is different from that of materials in Hokkaido (2n = 18). Although chromosome number of *Euphorbia jolkinii* (2n = 26) is different from a previous report based on Korean material (2n = 28), the number of the previous report is considered doubtful. Chromosome counts for the remaining 14 taxa agree with those already published: *Illicium anisatum* (2n = 28), *Trochodendron aralioides* (2n = 40), *Heterotropa kumageana* (2n = 24), *Sorbus commixta* (2n = 34), *Viola iwagawae* (2n = 22), *Viola sieboldii* (2n = 24), *Rhododendron yakushimanum* (2n = 26), *Utricularia yakusimensis* (2n = 16), *Ainsliaea apiculata* var. *apiculata* (2n = 26), *Ainsliaea faurieana* (2n = 26), *Ixeris yakuinsularis* (2n = 21), *Chionographis koidzumiana* (2n = 24), *Metanarthecium luteo-viride* f. *luteo-viride* (2n = 52), and *Arisaema sazensoo* (2n = 28). When comparing these chromosome numbers with those of closely related taxa, no differences were found except for *Aruncus dioicus* and *Smilax china*.

Key words : chromosome number, cytotaxonomy, endemism, noteworthy taxa, Yakushima Island.

The flora of Yakushima Island, Kagoshima Prefecture in southern Japan, is characterized by a high rate of endemism and occurrence of many dwarf taxa (Sugimoto 1957; Yahara et al. 1987). In a previous paper we reported chromosome numbers for 33 dwarf taxa collected from Yakushima Island (Yamamoto et al. 2008). This second report is concerned with the chromosome numbers for noteworthy taxa, such as those that are endemic to Yakushima Island, those which represent the southernmost or northernmost limit of distributions, and those for which chromosome numbers have not previously been reported.

Materials and methods

Root tips for 23 taxa in 19 genera in 15 families from Yakushima Island (Table 1) were collected and fixed in the field. Field preparation and cytological observation procedure followed Yamamoto et al. (2008). Voucher specimens are deposited in the Herbarium of Okayama University of Science (OKAY).

Results and discussion

Chromosome numbers of 23 examined taxa are presented in Table 1. The chromosomes observed in a somatic cells of nine taxa which show the first or new records of chromosome numbers are shown in Fig. 1. Taxonomic notes and cytological characteristics are described be-

Table 1. Localities (all in Yakushima Island), voucher specimens (all vouchers at OKAY), and chromosome counts of examined taxa.

Family	Taxon	Locality and voucher specimen	Present counts (2n)	Previous counts (n**, 2n)	References
Illiciaceae	*Illicium anisatum* シキミ	Near Yodogawa-hut, 1,380 m alt. (Ikeda et al. 04102399)	28	14**	Morinaga et al. (1929)
Trochodendraceae	*Trochodendron aralioides* ヤマグルマ	Near Yodogawa-hut, 1,370 m alt. (Ikeda & Yamamoto 05060813)	40	20**	Ratter and Milne (1976)
				38	Whitaker (1933)
				40	Okada (1975)
Aristolochiaceae	*Heterotropa kumageana* クワイバカンアオイ	Along Hanaage River, 120 m alt. (Yamamoto 06012014)	24	24	Yuasa and Maekawa (1976)
Rosaceae	*Aruncus dioicus* var. *kamtschaticus* ヤマブキショウマ	Near the summit of Mt. Miyanoura, 1,935 m alt. (Ikeda et al. 05092007)	14	14, 18	Zhukova (1980)
				18	Kawano (1963), Kiehn et al. (1991)
	Sorbus commixta ナナカマド	Yodogawa Tozan-guchi -- Yodogawa-hut, 1,360 m alt. (Ikeda et al. 04042302)	34	34	Nishikawa (2004)
Euphorbiaceae	*Euphorbia jolkinii* イワタイゲキ	Nagakubo, 3 m alt. (Ikeda et al. 04042109)	26	28	Chung et al. (2003)
Aceraceae	*Acer morifolium* ヤクシマオナガカエデ	Kurio, Hanayama pass, 100--200 m alt. (Ikeda & Yamamoto 05061104)	26*		
Violaceae	*Viola iwagawae* ヤクシマスミレ	Hanano-ego Moor -- Yodogawa-hut, 1,620 m alt. (Ikeda & Yamamoto 05060816)	22	22	Yoshioka and Tanaka (1981)
	Viola sieboldii フモトスミレ	Mt. Miyanoura -- Nageshi-daira, 1,710 m alt. (Yamamoto 06012006)	24	24	Yoshioka and Tanaka (1981)
Ericaceae	*Rhododendron yakushimanum* ヤクシマシャクナゲ	Near Yodogawa-hut, 1,370 m alt. (Ikeda & Yamamoto 05060814)	26	26	Janaki Ammal et al. (1950)
Gentianaceae	*Tripterospermum distylum* ハナヤマツルリンドウ	Nageshi-daira -- summit of Mt. Miyanoura, 1,720 m alt. (Ikeda et al. 04102307)	46*		
Rubiaceae	*Ophiorrhiza japonica* サツマイナモリ	Mugio, Senpiro-no-taki Waterfall, 460 m alt. (Yamamoto 06011400)	22*		
Lentibulariaceae	*Utricularia yakusimensis* ムラサキミミカキグサ	Near Shikano-sawa-hut, 1,560 m alt. (Ikeda et al. 05092103)	16	16	Tanaka and Uchiyama (1988)
Compositae	*Ainsliaea apiculata* var. *apiculata* キッコウハグマ	Mugio, Senpiro-no-taki Waterfall, 540 m alt. (Yamamoto 06012013)	26	26	Watanabe et al. (1992)
	var. *acerifolia* モミジバキッコウハグマ	Yodogawa-tozan-guchi -- Yodogawa-hut, 1,360 m alt. (Yamamoto 06012008)	26*		
	var. *rotundifolia* マルバキッコウハグマ	Mugio, Senpiro-no-taki Waterfall, 540 m alt. (Ikeda et al. 04042413)	26*		
	Ainsliaea faurieana ホソバハグマ	Mugio, Senpiro-no-taki Waterfall, 540 m alt. (Yamamoto 06012007)	26	26	Watanabe et al. (1992)
	Ixeris yakuinsularis コスギニガナ	Hanano-ego Moor -- Nageshi-daira, 1,670 m alt. (Ikeda et al. 04042898)	21	21	Watanabe (1997)
Liliaceae	*Chionographis koidzumiana* チャボシライトソウ	Hanano-ego Moor -- Yodogawa-hut, 1,590 m alt. (Ikeda & Yamamoto 05060820)	24	24	Hara and Kurosawa (1962)
	Metanarthecium luteoviride f. *luteo-viride* ノギラン	Near the summit of Mt. Nagata-dake, 1,900 m alt. (Ikeda et al. 05092116)	52	52	Satô (1942)
	Smilax china var. *yakusimensis* ヤクシマカカラ	Near Hanano-ego Moor, 1,680 m alt. (Ikeda et al. 05092216)	ca. 90*		
Juncaceae	*Juncus wallichianus* ハリコウガイゼキショウ	Yodogawa, near Kigen-sugi, 1,220 m alt. (Ikeda et al. 05091999)	80*		
Araceae	*Arisaema sazensoo* ヒメテンナンショウ	Kosugi-dani, 790 m alt. (Ikeda et al. 04042523)	28	28	Kurakubo (1940), Hotta (1971), Murata and Iijima (1983)

* : First record of chromosome numbers.

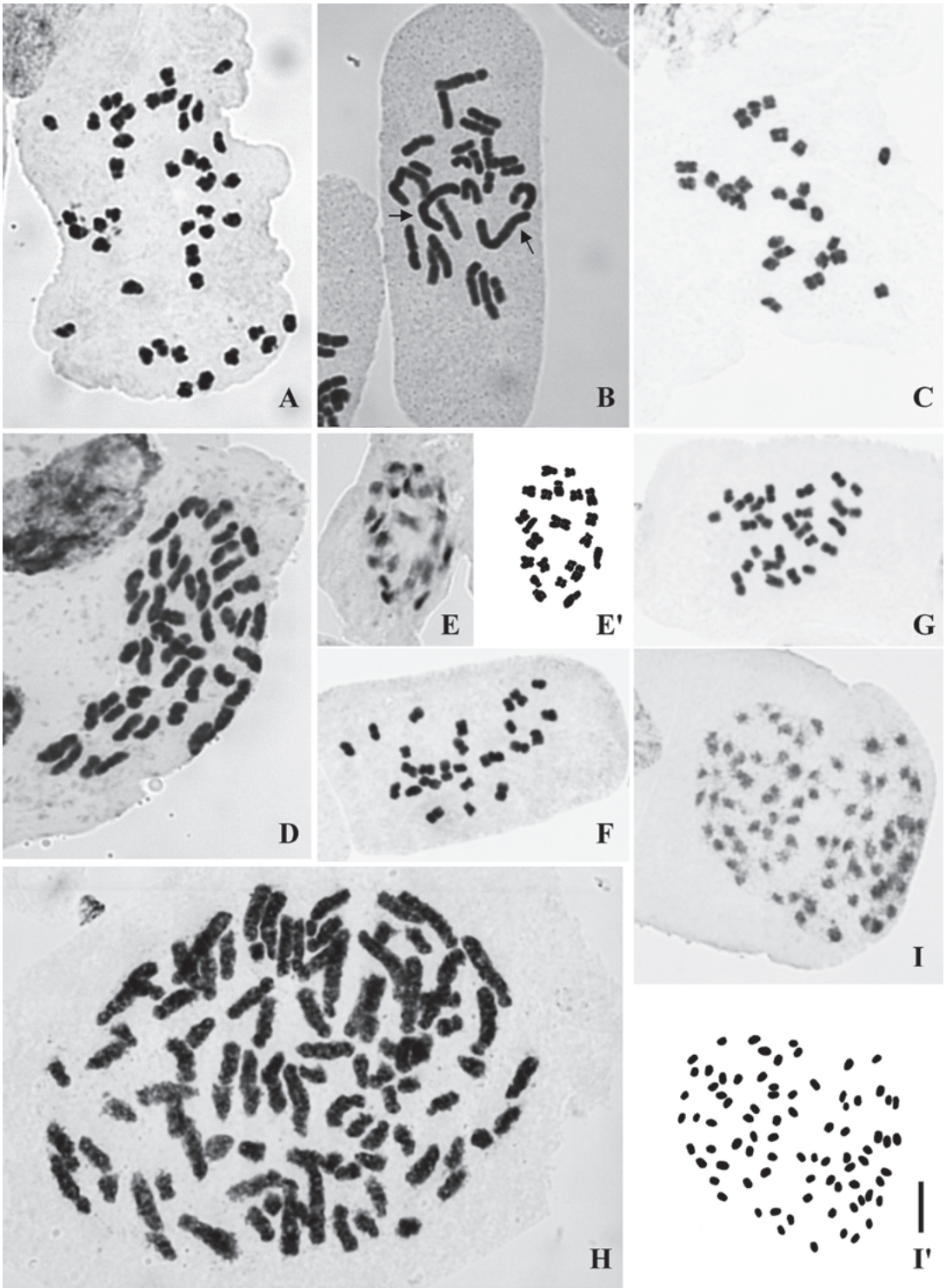

Fig. 1. Mitotic chromosomes of noteworthy taxa in Yakushima Island. A : *Trochodendron aralioides* (2n = 40). B: *Euphorbia jolkinii* (2n = 26). C : *Acer morifolium* (2n = 26). D : *Tripterospermum distylum* (2n = 46). E : *Ophiorrhiza japonica* (2n = 22). E' : Drawing of chromosomes in E. F : *Ainsliaea apiculata* var. *acerifolia* (2n = 26). G : *Ainsliaea apiculata* var. *rotundifolia* (2n = 26). H: *Smilax china* var. *yakusimensis* (2n = ca. 90). I : *Juncus wallichianus* (2n = 80). I' : Drawing of chromosomes in I. Arrows in B indicate larger chromosomes. Bar = 5 µm.

low under each family (ordered following Melchior 1964).

Illiciaceae

1. *Illicium anisatum* L.

Illicium anisatum is distributed from central to western Honshu, Shikoku, Kyushu and Ryukyu in Japan, and southernmost Korea (Ueda 2006). On Yakushima Island, it grows under forests in the montane zone. The chromosome number for this taxon was counted as 2n = 28. Morinaga et al. (1929) reported gametophytic number for this taxon as n = 14 from a cultivated plant, coincided to the sporophytic number in wild plants recorded in the present study.

Trochodendraceae

2. *Trochodendron aralioides* Siebold et Zucc. (Fig. 1A).

Trochodendron aralioides is distributed in Honshu (southward from Yamagata Prefecture), Shikoku and Kyushu in Japan, and also in Taiwan, S. Korea, and S. China (Akiyama 2006). On Yakushima Island, it grows from montane zone to near the mountain summits, and occasionally is epiphytic on trunks of *Cryptomeria japonica* (L. f.) D. Don. We counted the chromosome number of this species as 2n = 40. Although a chromosome number for this species was firstly reported as 2n = 38 (Whitaker 1933), later Ratter and Milne (1973) reported a gametophytic number for this species as n = 20, and Okada (1975) as 2n = 40. In addition to the present study, chromosome number for this species was also studied in material collected from Hiroshima Prefecture, again revealing counts of 2n = 40 (Yamamoto et al., unpubl.). We therefore, conclude that Whitaker's count is in error, and that the chromosome number of *T. aralioides* should be 2n = 40.

Aristolochiaceae

3. *Heterotropa kumageana* (Masam.) F. Maekawa ex Yahara

Heterotropa kumageana is endemic to Yakushima Island, and grows on floor of evergreen forests below 1000 m alt. The chromosome number for this taxon, 2n = 24, was the same as that reported by Yuasa and Maekawa (1976).

Rosaceae

4. *Aruncus dioicus* (Walter) Fernald var. *kamtschaticus* (Maxim.) H. Hara

Aruncus dioicus var. *kamtschaticus* is distributed in S. Kuriles, Hokkaido, Honshu, Shikoku and Kyushu in Japan, and widely distributed in temperate regions of the Northern Hemisphere (Ikeda 2001). Yakushima Island is the southernmost limit of distribution for the species, where it grows near the mountain summits. The chromosome number for this taxon was counted as 2n = 14. Chromosome numbers for *A. dioicus* have been reported as 2n = 18 (Kawano 1963; Kiehn et al. 1991), and 2n = 14 and 18 (Zhukova 1980). For the Japanese plants, Kawano (1963) reported 2n = 18 for materials from Hokkaido. It is possible that infraspecific variation in chromosome number exists in *A. dioicus*, and this merits further study.

5. *Sorbus commixta* Hedl.

Sorbus commixta is distributed in S. Kuriles, Hokkaido, Honshu, Shikoku and Kyushu in Japan, and also in Sakhalin, the Kuriles, and Korea (Iketani and Ohashi 2001). Yakushima Island is the southernmost limit of distribution for the species. On Yakushima Island, this species is often epiphytic on trunks of *Cryptomeria japonica*. Chromosome number for this species was observed as 2n = 34, agreeing with past reports from Hokkaido (Nishikawa 2004).

Euphorbiaceae

6. *Euphorbia jolkinii* Boiss. (Fig. 1B).

Euphorbia jolkinii grows along the sea coasts of Honshu (westward from Chiba Prefecture), Izu Islands, Shikoku, Kyushu and Ryukyu in Japan, and also in S. Korea and Taiwan (Kurosawa 1999). The chromosome number of *E. jolkinii* had been reported as 2n = 28 from Korea (Chung et al. 2003), whereas we recorded a chromosome number for this species as 2n = 26. In addition we also counted chromosomes from materials collected in Okayama Prefecture, which also proved to be 2n = 26 (Yamamoto

et al., unpubl.). There are two possibilities for this incongruity; one is an error in counting, and another is infraspecific variation within the species. The chromosome complement of *E. jolkinii* showed a bimodal karyotype, composed of two larger chromosomes and 24 smaller ones. The larger chromosomes were metacentric and nearly two times as long as the smallest ones (Fig. 1B : arrows). Chung et al. (2003) showed a figure of chromosomes of *E. jolkinii*, but we could not see such larger chromosomes, and we suggest that Chung et al. (2003) miscounted these two larger chromosomes as four smaller chromosomes. This bimodal karyotype in chromosome length for *Euphorbia* species were also reported for two Himalayan species, *E. sikkimensis* Boiss. and *E. griffithii* Hook. f. (Ikeda et al. 2008), and such bimodality might be a cytological characteristic for some species of *Euphorbia*.

Aceraceae

7. *Acer morifolium* Koidz. (Fig. 1C).

Acer morifolium is endemic to Yakushima Island, and grows warm temperate forests (Ogata 1999). The chromosome number for this species, 2n = 26, is here reported for the first time. The chromosome number of the closely related species, *A. capillipes* Maxim., was also reported as 2n = 26 (Santamour 1971).

Violaceae

8. *Viola iwagawae* Makino

Viola iwagawae is distributed on Yakushima Island and the Ryukyu (Amami-oshima, Tokunoshima and Okinawa-jima) (Akiyama et al. 1999). Yakushima Island is the northernmost limit of distribution for this species. On Yakushima Island, it grows in shady places or along the sides of streams. The chromosome number for this species was seen to be 2n = 22, same as that reported by Yoshioka and Tanaka (1981).

9. *Viola sieboldii* Maxim.

Viola sieboldii is distributed in Honshu (westward from Kanto District), Shikoku and Kyushu in Japan, and also in S. Korea (Cheju Island) (Akiyama et al. 1999). Yakushima Island is the southernmost limit of distribution for the species. We observed that the chromosome number for this species was 2n = 24, same as that reported by Yoshioka and Tanaka (1981).

Ericaceae

10. *Rhododendron yakushimanum* Nakai

Rhododendron yakushimanum is endemic to Yakushima Island, and grows from mountain sides to near the summits. The chromosome number for this species was counted as 2n = 26, the same as that reported by Janaki Ammal et al. (1950). The chromosome number of the most closely related species, *R. japonoheptamerum* Kitam., was also reported as 2n = 26 (Nakamura 1931, as *R. metternichii* Siebold et Zucc.).

Gentianaceae

11. *Tripterospermum distylum* J. Murata et Yahara (Fig. 1D).

Tripterospermum distylum is endemic to Yakushima Island, and grows on rocky slope or at edge of bamboo thicket at higher elevation. Chromosome number for this species, 2n = 46, was counted for the first time. To our knowledge, the chromosome number of this genus has been reported on only one species, *T. japonicum* (Siebold et Zucc.) Maxim. among 25 species (Mabberley 2008). The chromosome number of *T. japonicum* has been reported as 2n = 46 (Wada 1966; Nishikawa 1981; Shigenobu 1984; Yamamoto et al. 2008, for var. *tenue* (Masam.) Honda).

Rubiaceae

12. *Ophiorrhiza japonica* Blume (Figs. 1E and E').

Ophiorrhiza japonica is distributed in Honshu (southward from Chiba Prefecture), Shikoku and Kyushu, and also in Taiwan, central to southern China and north Vietnam (Yamazaki 1993). On Yakushima Island, it grows on moist ground under evergreen forest at lower elevations. The chromosome number for this species, 2n = 22, was counted for the first time.

Lentibulariaceae

13. *Utricularia yakusimensis* Masam.

Utricularia yakusimensis is distributed in Hokkaido, Honshu, Shikoku and Kyushu in Japan (Ohwi 1984). Yakushima Island is the type locality and the southernmost limit of distribution for this species. It grows in wet places or on wet mossy rocks in the temperate zone. We counted chromosome number for this species as 2n = 16, the same as that reported by Tanaka and Uchiyama (1988).

Compositae

14. *Ainsliaea apiculata* Sch. Bip.

14a. var. *apiculata*

14b. var. *acerifolia* Masam. (Fig. 1F).

14c. var. *rotundifolia* Masam. (Fig. 1G).

Ainsliaea apiculata is distributed in Hokkaido (Okushiri-jima), Honshu, Shikoku and Kyushu in Japan, and also in S. Korea (Koyama 1995). On Yakushima Island, it grows under forests, and shows great variation in leaf shape. Within this species three varieties are distinguished by leaf shape: var. *apiculata* with normal 5-angled leaves; var. *acerifolia* with palmately-lobed leaves; and var. *rotundifolia* with rounded leaves (Masamune 1934). Chromosome numbers for these infraspecific taxa were all counted as 2n = 26. Chromosome number for var. *apiculata* was same as that reported by Watanabe et al. (1992), while those for vars. *acerifolia* and *rotundifolia* are reported for the first time.

15. *Ainsliaea faurieana* Beauverd

Ainsliaea faurieana is endemic to Yakushima Island, and grows on wet rocks along stream sides. The chromosome number for this species was 2n = 26, the same as that reported by Watanabe et al. (1992).

16. *Ixeris yakuinsularis* Yahara

Ixeris yakuinsularis is endemic to Yakushima Island, and grows in open grassland at higher elevations. Chromosome number for this species was 2n = 21, the same as that tentatively reported by Watanabe (1997). *Ixeris yakuinsularis* is considered to be of hybrid origin between *I. dentata* (Thunb.) Nakai and *I. laevigata* (Blume) Sch. Bip. ex Maxim. (Yahara et al. 1987; Yahara 1995). Cytologically, the species of *Ixeris* are divided into two groups on the basis of chromosome numbers: one is with basic chromosome number x = 8, and another is with x = 7 (Pak and Kawano 1990). The chromosome numbers of *I. dentata* are 2n = 14, 21, 28, and that of *I. laevigata* is 2n = 14, both with basic chromosome number x = 7. Therefore, *I. yakuinsularis* is thought to be a triploid taxon with basic chromosome number x = 7.

Liliaceae

17. *Chionographis koidzumiana* Ohwi

Chionographis koidzumiana is distributed in Honshu (Mikawa and Kii Prov.), Shikoku and Kyushu (Yakushima) (Ohwi 1984). Yakushima Island is the southernmost limit of distribution for this taxon. Chromosome number for this species was 2n = 24, the same as that reported by Hara and Kurosawa (1962).

18. *Metanarthecium luteo-viride* Maxim. f. *luteo-viride*

Metanarthecium luteo-viride is distributed in Hokkaido, Honshu, Shikoku and Kyushu (Ohwi 1984). On Yakushima Island, a dwarf form (f. *yakusimense* Masam.) occurs as well as normal form (f. *luteo-viride*). Chromosome number for the dwarf form, f. *yakusimense*, in the preceding paper (Yamamoto et al. 2008), as 2n = 52 + 1B. Chromosome number for f. *luteo-viride* was 2n = 52, the same as that reported by Satô (1942). The cytological difference between f. *luteo-viride* and f. *yakusimense* is the presence/absence of a B-chromosome.

19. *Smilax china* L. var. *yakusimensis* Masam. (Fig. 1H).

Smilax china var. *yakusimensis* is endemic to Yakushima Island. The chromosome number for this taxon, 2n = ca. 90, was counted for the first time. The chromosome number for the typical variety, var. *china*, has been reported as 2n = 60 based on material from Japan (Nakajima 1937; Satô 1942). Kong et al. (2007) reported a polyploid series in *S. china*, diploid (2n = 32), tetraploid (2n = 64), and hexaploid (2n = 96) with the basic chromosome number x = 16.

Smilax china var. *yakusimensis* is thought to be a hexaploid taxon of the species, but further work is needed to clarify an accurate chromosome number for this taxon.

Juncaceae

20. *Juncus wallichianus* Laharpe (Figs. 1I and I').

Juncus wallichianus is distributed from Hokkaido to Ryukyu in Japan, and also in Sachalin, Ussuri, Taiwan, China, and India (Ohwi 1984). It grows on wet ground from low elevation to near the summits of mountains in Yakushima Island. The chromosome number for this taxon, 2n = 80, was counted for the first time.

Araceae

21. *Arisaema sazensoo* (Blume) Makino

Arisaema sazensoo is distributed in central and southern Kyushu (Ohashi and Murata 1980). Yakushima Island is the southernmost limit of distribution for this species. The chromosome number for this species was 2n = 28, the same as reported by Kurakubo (1940), Hotta (1971), and Murata and Iijima (1983).

Among the 23 taxa examined, chromosome numbers of seven taxa (*Acer morifolium*, *Tripterospermum distylum*, *Ophiorrhiza japonica*, *Ainsliaea apiculata* vars. *acerifolia* and *rotundifolia*, *Smilax china* var. *yakusimensis*, and *Juncus wallichianus*) are reported for the first time. The chromosome number of *Smilax china* var. *yakusimensis* is different from that of the typical variety, var. *china*, in Honshu. Furthermore, the chromosome number of *Aruncus dioicus* from Yakushima Island is different from that from Hokkaido with aneuploidal deviation. No difference was found when comparing the chromosome numbers of the plants examined with those of closely related taxa except *Aruncus dioicus* and *Smilax china*. This strengthens support for our hypothesis (Yamamoto et al. 2008), that there has not been sufficient time since the last glaciation (about 14,000 years) to influence chromosomal differentiation after isolation from the mainland of Kyushu Island (see Kimura 1996; Kuroda and Ozawa 1996).

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References

Akiyama, S. 2006. Trochodendraceae. In: Iwatsuki, K., Boufford, D. E. and Ohba, H. (eds.). Flora of Japan IIa, Angiospermae, Dicotyledoneae, Archichlamydeae (a), p. 255. Kodansha, Tokyo.

Akiyama, S., Ohba, H. and Tabuchi, S. 1999. Violaceae. In: Iwatsuki, K., Boufford, D. E. and Ohba, H. (eds.). Flora of Japan IIc, Angiospermae, Dicotyledoneae, Archichlamydeae (c), pp. 161–190. Kodansha, Tokyo.

Chung, G.-Y., Oh, B.-U., Park, K.-R., Kim, J.-H., Kim, M.-S., Nam, G.-H. and Jang, C.-G. 2003. Cytotaxonomic study of Korean *Euphorbia* L. (Euphorbiaceae). Kor. J. Plant Tax. **33**: 279–293.

Hara, H. and Kurosawa, S. 1962. Morphological and chromosomal variations in *Chionographis japonica* Maxim. Acta Phytotax. Geobot. **20**: 34–38.

Hotta, M. 1971. Study of the family Araceae. General remarks. Jpn. J. Bot. **20**: 269–310.

Ikeda, H. 2001. *Aruncus* Koster. In: Iwatsuki, K., Boufford, D. E. and Ohba, H. (eds.). Flora of Japan IIb, Angiospermae, Dicotyledoneae, Archichlamydeae (b), pp. 101–102. Kodansha, Tokyo.

Ikeda, H., Kurosawa, T. and Ohba, H. 2008. Chromosome numbers and karyomorphology of three species of the genus *Euphorbia* L.

(Euphorbiaceae) in the Sikkim Himalaya. J. Jpn. Bot. **83**: 295–300.

Iketani, H. and Ohashi, H. 2001. *Sorbus* L. In: Iwatsuki, K., Boufford, D. E. and Ohba, H. (eds.). Flora of Japan IIb, Angiospermae, Dicotyledoneae, Archichlamydeae (b), pp. 113–114. Kodansha, Tokyo.

Janaki Ammal, E. K., Enoch, I. C. and Bridgwater, M. 1950. Chromosome numbers in species of *Rhododendron*. Rhododendron Yearb. **5**: 78–91.

Kawano, S. 1963. Brief notes on the chromosomes of some Japanese plants (2). J. Jpn. Bot. **38**: 47–50.

Kiehn, M., Vitek, E., Hellmayr, E., Walter, J., Tschenett, J., Justin, C. and Mann, M. 1991. Beiträge zur Flora von Österreich: Chromosomenzählungen. Verh. Zool.-Bot. Ges. Österreich **128**: 19–39.

Kimura, M. 1996. Quaternary paleogeography of the Ryukyu Arc. J. Geogr. **105**: 259–285. (in Japanese with English abstract)

Kong, H.-H., Wang, A.-L., Lee, J. and Fu, C.-X. 2007. Studies of systematic evolution and karyotypic variation in *Smilax* and *Heterosmilax* (Smilacaceae). Acta Phytotax. Sin. **45**: 257–273. (in Chinese with English abstract)

Koyama, H. 1995. *Ainsliaea* DC. In: Iwatsuki, K., Yamazaki, T., Boufford, D. E. and Ohba, H. (eds.). Flora of Japan IIIb, Angiospermae, Dicotyledoneae, Sympetalae (b), pp. 168–170. Kodansha, Tokyo.

Kurakubo, Y. 1940. Über die Chromosomenzahlen von Araceae-Arten. Bot. and Zool. **8**: 1492. (in Japanese)

Kuroda, T. and Ozawa, T. 1996. Paleoclimatic and vegetational changes during the Pleistocene and Holocene in the Ryukyu Islands inferred from pollen assemblages. J. Geogr. **105**: 328–342. (in Japanese with English abstract)

Kurosawa, T. 1999. *Euphorbia* L. In: Iwatsuki, K., Boufford, D. E. and Ohba, H. (eds.). Flora of Japan IIc, Angiospermae, Dicotyledoneae, Archichlamydeae (c), pp. 22–30. Kodansha, Tokyo.

Mabberley, D. J. 2008. Mabberley's Plant Book -A portable dictionary of plants, their classification and uses. 3rd ed. Cambridge University Press, New York.

Masamune, G. 1934. Floristic and geobotanical studies on the Island of Yakushima, Province Osumi. Mem. Fac. Sci. Agric. Taihoku Imp. Univ. 11, Bot. (4): 1–637.

Melcior, H. 1964. A. Engler's Syllabus der Pflanzenfamilien Bd. 2. 12, Aufl. 666 pp., 1 map. Gebrüder Borntraeger, Berlin.

Morinaga, T., Fukushima, E., Kanô, T., Maruyama, Y. and Yamasaki, Y. 1929. Chromosome numbers of cultivated plants II. Bot. Mag. Tokyo **43**: 589–594.

Murata, J. and Iijima, M. 1983. New or noteworthy chromosome records in *Arisaema*. J. Jpn. Bot. **58**: 270–280.

Nakajima, G. 1937. Cytological studies in some dioecious plants. Cytologia, Fujii Jub. Vol.: 282–292.

Nakamura, M. 1931. Caryological studies on the genus *Rhododendron*. Soc. Trop. Agric. Taihoku Imp. Univ. **3**: 103–108.

Nishikawa, T. 1981. Chromosome counts of flowering plants of Hokkaido (5). Rep. Taisetsuzan Inst. Sci. (16): 45–53. (in Japanese with English abstract)

Nishikawa, T. 2004. Chromosome counts of flowering plants of Hokkaido (24). J. Hokkaido Univ. Edu. (Sect. II B) **55**: 43–51. (in Japanese with English abstract)

Ogata, K. 1999. Aceraceae. In: Iwatsuki, K., Boufford, D. E. and Ohba, H. (eds.). Flora of Japan IIc, Angiospermae, Dicotyledoneae, Archichlamydeae (c), pp. 60–73. Kodansha, Tokyo.

Ohashi, H. and Murata, J. 1980. Taxonomy of the Japanese *Arisaema* (Araceae). J. Fac. Sci. Univ. Tokyo, III **12**: 281–336.

Ohwi, J. 1984. Flora of Japan (in English). 1066 pp. Smithsonian Institution, Washington D.C.

Okada, H. 1975. Karyomorphological studies of woody Polycarpicae. J. Sci. Hiroshima Univ., ser. B, div. 2, **15**: 115–200.

Pak, J.-H. and Kawano, S. 1990. Biosystematic studies on the genus *Ixeris* (Compositae-Lactuceae) II. Karyological analyses. Cytologia **55**: 553–570.

Ratter, J. A. and Milne, C. 1973. Chromosome counts in primitive angiosperms: II. Notes

Roy. Bot. Gard. Edinburgh **32**: 423–428.
Santamour, F. S. 1971. In IOPB chromosome reports. XXXII. Taxon **20**: 355.
Satô, D. 1942. Karyotype alteration and phylogeny in Liliaceae and allied families. Jpn. J. Bot. **12**: 57–161.
Shigenobu, Y. 1984. Karyomorphological studies in some genera of Gentianaceae II. *Gentiana* and its allied four genera. Bull. Coll. Child. Develop., Kochi Women's Univ. **8**: 55–104.
Sugimoto, J. 1957. On the pygmy plants of Yakusima Island. Shokubutsu-Shumi **18**: 2–10. (in Japanese)
Tanaka, R. and Uchiyama, H. 1988. Chromosomes of four species of *Utricularia* in Japan. J. Jpn. Bot. **63**: 219–223.
Ueda, K. 2006. Illiciaceae. In: Iwatsuki, K., Boufford, D. E. and Ohba, H. (eds.). Flora of Japan IIa, Angiospermae, Dicotyledoneae, Archichlamydeae (a), p. 238. Kodansha, Tokyo.
Wada, Z. 1966. Chromosome numbers in Gentianaceae. Chromosome Inf. Serv. **7**: 28–30.
Watanabe, K. 1997. Index to chromosome numbers of Japanese Asteraceae (1911–1996). Proc. Jpn. Soc. Pl. Taxon. **12** (2): 1–64.
Watanabe, K., Yahara, T. and Kadota, H. 1992. Natural hybrid population between chasmogamous and cleistogamous species, *Ainsliaea faurieana* and *A. apiculata* (Asteraceae; Mutisiae): morphology, cytology, reproductive mode and allozyme variation. Plant Sp. Biol. **7**: 49–59.
Whitaker, T. W. 1933. Chromosome number and relationship in the Magnoliales. J. Arnold Arb. **14**: 376–385.
Yahara, T. 1995. *Ixeris*. In: Iwatsuki, K., Yamazaki, T., Boufford, D. E. and Ohba, H. (eds.). Flora of Japan IIIb, Angiospermae, Dicotyledoneae, Sympetalae (b), pp. 15–19. Kodansha, Tokyo.
Yahara, T., Ohba, H., Murata, J. and Iwatsuki, K. 1987. Taxonomic review of vascular plants endemic to Yakushima Island, Japan. J. Fac. Sci. Univ. Tokyo, III **14**: 69–119.
Yamamoto, N., Ikeda, H. and Hoshino, T. 2008. Cytotaxonomical studies of flowering plants in Yakushima Island, Kagoshima Prefecture, Japan Part I: dwarf taxa. J. Phytogeogr. Taxon. **56**: 79–93.
Yamazaki, T. 1993. Rubiaceae. In: Iwatsuki, K., Yamazaki, T., Boufford, D. E. and Ohba, H. (eds.). Flora of Japan IIIa, Angiospermae, Dicotyledoneae, Sympetalae (a), pp. 206–240. Kodansha, Tokyo.
Yoshioka, H. and Tanaka, R. 1981. Chromosomes of *Viola*. Shin Kaki (New Fl.) **112**: 64–72. (in Japanese)
Yuasa, H. and Maekawa, F. 1976. Chromosomes of *Asarum* and *Heterotropa* (Aristolochiaceae) in the Ryukyu Islands. La Kromosomo II-**1**: 8–18. (in Japanese with English summary)
Zhukova, P. G. 1980. Chromosome numbers of some South Chukotka plant species. Bot. Zhurn. **65**: 51–59.

山本伸子[1]・池田 博[2]・星野卓二[3]：鹿児島県屋久島産高等植物の細胞分類学的研究　Ⅱ．特筆すべき分類群

鹿児島県屋久島に生育する高等植物に関する細胞分類学的研究の第二報である。この報告では，屋久島に固有な分類群，屋久島を分布の南限・北限とする分類群，あるいはこれまで染色体数の報告のない分類群など，特筆すべき分類群に関する染色体数の報告をおこなう。

15科19属23分類群について染色体数を算定したところ，7分類群（ヤクシマオナガカエデ（2n = 26），ハナヤマツルリンドウ（2n = 46），サツマイナモリ（2n = 22），モミジバキッコウハグマ（2n = 26），マルバキッコウハグマ（2n = 26），ヤクシマカカラ（2n = ca. 90），ハリコウガイゼキショウ（2n = 80））については，今回はじめて染色体数を算定した。ヤマブキショウマについては，2n = 14が算定されたが，北海道産のもの（2n = 18）と異数性の違いがみられた。また，イワタイゲキについては，これまで，2n = 28の報告があったが，今回2n=26を算定した。14分類群（シキミ（2n = 28），ヤマグルマ（2n = 40），クワイバカンアオイ（2n = 24），ナナカマド（2n = 34），ヤクシマスミレ（2n = 22），フモトスミレ（2n = 24），ヤクシマシャクナゲ（2n = 26），ムラサキミミカキグサ（2n = 16），キッコウハグマ（2n = 26），ホソバハグマ（2n = 26），コスギニガナ（2n = 21），チャボシライトソウ（2n = 24），ノギラン（2n = 52），およびヒメテンナンショウ（2n = 28））については，これまでの報告と同じ染色体数が算定された。

第一報と同様，同種内あるいは近縁種との間に細胞学的変異は少なく，屋久島産高等植物においては形態的多様性と細胞学的多様性の関連性は低いと考

えられる。

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