

Bryophytes of the Imperial Palace, Tokyo, Japan

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Abstract. The bryophyte flora of the Imperial Palace, Tokyo, was investigated in 2009–2013. The bryophytes recognized comprise 46 families, 77 genera, 107 species and 2 varieties. A total of 25 species and 2 varieties are newly added to the bryophyte flora of the area. In total 131 species and 2 varieties of bryophytes are recognized in this area. The Imperial Palace presents the richest bryophyte flora in the urban areas of Tokyo Metropolis, that is, in the 23 wards. For each species, locality, substrate and specimen number were given.

Keywords: Bryophytes, flora, Imperial Palace, Japan.

This study deal with the bryophyte flora of the Imperial Palace, Tokyo, Japan based on the collection by the authors in 2009–2013, following the previous report based on the collection in 1995–1999 (Higuchi and Furuki, 2000). The Imperial Palace is the broadest wooded area in the urban areas of Tokyo Metropolis, that is, in the 23 wards. Although the potential natural vegetation of the area is the evergreen broad-leaved forest (laurel forest) comprising of *Castanopsis sieboldii*, *Machilus thunbergii* and *Quercus acuta*, the present vegetation is mainly artificial and partly the secondary forests.

Higuchi and Furuki (2000) reported in the previous report that the bryophyte flora of this area consisted of 38 families, 72 genera and 107 species. The purpose of this study is to investigate the bryophyte flora of the Imperial Palace, Tokyo, and to know the change of the flora and habitat with special reference to rare and endangered species.

Materials and Methods

Field studies were carried out in 2009–2013, and a total of ca. 320 specimens were collected. The main sites investigated are divided as fol-

lows. The order is almost from north to south.

I: Fukiage Imperial Garden, along trail in deciduous broad-leaved forest, stream, pond and fruit garden.

II: Inui-bori, garden besides moat.

III: Hasuike-bori, garden besides moat.

IV: Shimo-dokan-bori, garden besides moat.

V: Omichi Garden, along trail in garden.

VI: Kyuden-nishi-mikurumayose, roadside planting in west of Palace.

VII: Biological Laboratory, along trail in the rice field and plantations of mulberry, persimmon, etc.

VIII: Kami-dokan-bori, garden besides moat.

Results and Discussion

The bryophytes recognized in this study comprise 46 families, 77 genera, 107 species and 2 varieties. We added 25 species and 2 varieties to the bryophyte flora of the Imperial Palace this time. In total 131 species and 2 varieties of bryophytes are recognized in this area. Recently Higuchi and Kawai (2013) investigated the bryophyte flora of Meiji Jingu where is the second broadest wooded area in the urban areas of Tokyo Metropolis. They recorded 118 species and 1 vari-

ety of bryophytes and in total 124 species and 2 varieties are recognized in the area adding the results of the previous reports (Inoue, 1980; Mizushima, 1980). Consequently the Imperial Palace presents the richest bryophyte flora in the urban areas of Tokyo Metropolis.

Six species were recognized as rare or endangered species in the Imperial Palace (Higuchi and Furuki, 2000). We checked their original localities and investigated the habitats in other areas. As the result, *Tortula obtusifolia* and *T. pagorum* were not found in this study, while *Monosolenium tenerum*, *Riccia fluitans* and *Taxiphyllum alternans* were found at new localities. *Radula tokiensis* was observed at the same locality.

Enumeration of species

The families, genera and species are arranged alphabetically in Bryophyta, Marchantiophyta and Anthocerotophyta. The scientific names follow Iwatsuki (2004) and Goffinet *et al.* (2009) for Bryophyta, and Katagiri and Furuki (2012, 2013) for Marchantiophyta and Anthocerotophyta. Taxa new for the area are marked with asterisk. Each species is referred by collecting sites (I–VIII), the substrates and specimen numbers, and notes for some species. The name of the collectors is abbreviated as follows: Masanobu Higuchi (mh) and Tatsuwo Furuki (tf). The complete set of the specimens are preserved in the herbarium of the Department of Botany, National Museum of Nature and Science (TNS) and duplicates in the herbarium of Natural History Museum and Institute, Chiba (CBM).

Bryophyta (by M. Higuchi)

Amblystegiaceae

Cratoneuron filicinum (Hedw.) Spruce, Cat. Musc. 21 (1867).

I: on humus, mh-50164, 51497.

Leptodictyum riparium (Hedw.) Warnst., Krypt.-Fl. Brandenburg, Laubm. 2(5): 878 (1906).

IV: on decaying log, mh-51504, 51505, 51558, 51570. V: on soil, mh-51369. VIII: on concrete wall, mh-51431.

Anomodontaceae

Herpetineuron toccocae (Sull. & Lesq.) Cardot, Beih. Bot. Centralbl., Abt. 2, 19(2[1]): 127 (1905).

III: on stone wall, mh-51470. IV: on rock-cliff, mh-51567. VII: on tree-trunk, mh-51384.

Bartramiaceae

Philonotis turneriana (Schwaegr.) Mitt., J. Proc. Linn. Soc., Bot., Suppl. 1: 62 (1859).

VI: on soil of rock-cliff, mh-51410.

Brachytheciaceae

Brachythecium buchananii (Hook.) A. Jaeger, Ber. S. Gall. Naturw. Ges. 1876–77: 341 (1878).

VI: on stone wall, mh-51401.

Brachythecium plumosum (Hedw.) Schimp., Bryol. Eur. 6: 8 (1853).

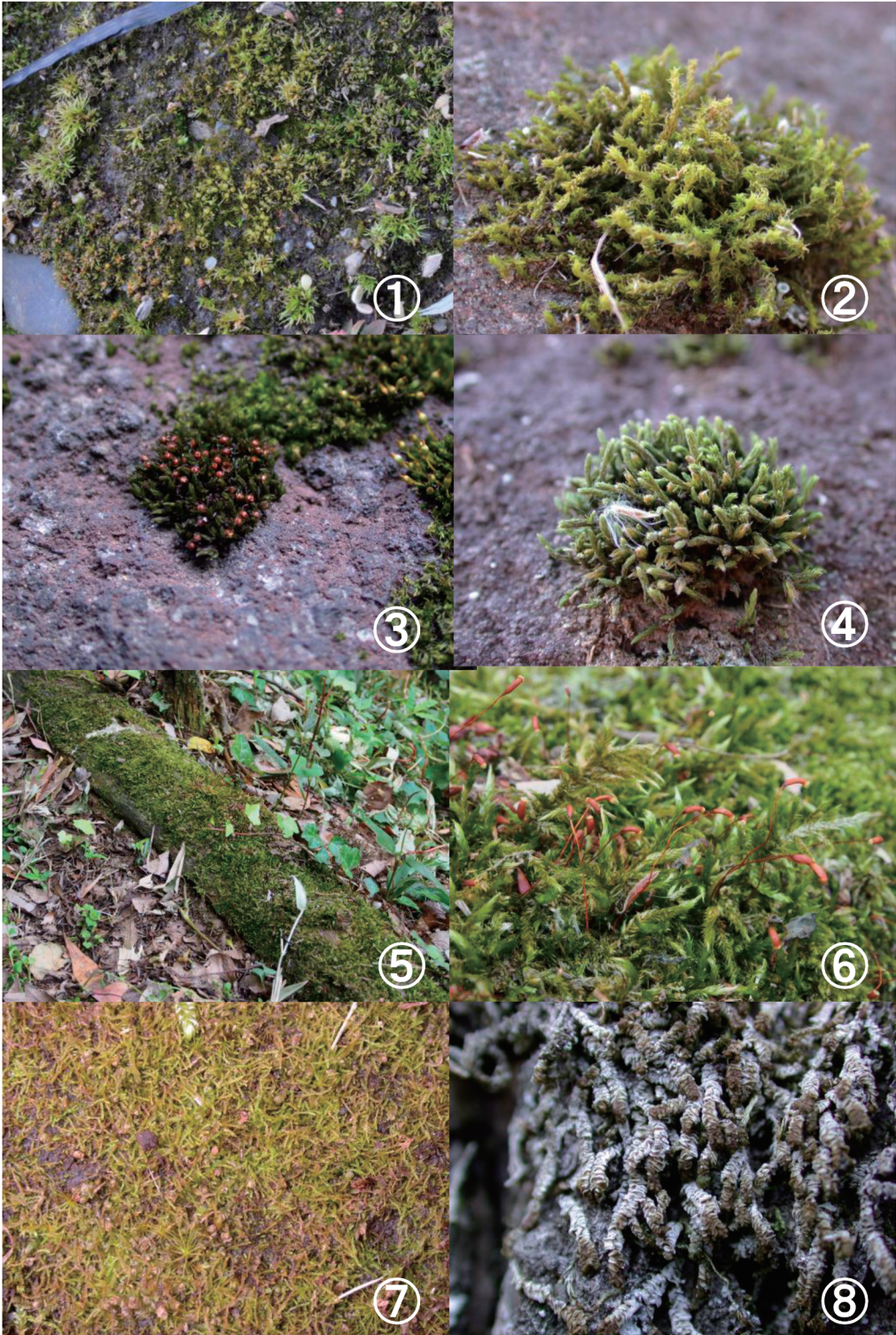
I: on boulder, mh-51550. III: on stone wall, mh-51452, 51458. IV: on rock-cliff, mh-51568, 51576. VI: on soil, mh-51406.

Bryhnia novae-angliae (Sull. & Lesq.) Grout, Bull. Torrey Bot. Club 25(5): 229 (1898).

I: on humus, mh-51541, on soil, mh-51542, 51545.

Eurhynchium hians (Hedw.) Sande Lac., Ann.

Fig. 1. Bryophytes newly recorded. 1. *Ephemerum spinulosum* growing on bare soil. 2. *Racomitrium barbuloides* growing on sunny stone wall. 3. *Schistidium strictum* growing on sunny stone wall. 4. *Hedwigia ciliata* growing on sunny stone wall. 5, 6. *Callicladium haldanianum* growing decaying log. 7. *Nardia assamica* growing on bare soil. 8. *Trocholejeunea sandvicensis* growing on trunk of *Triadica sebifera*.



Mus. Bot. Lugduno-Batavi **2**: 299 (1866).

I: on boulder, mh-50143, 50177. III: on stone wall, mh-51454. VI: on soil, mh-51407. V: on soil, mh-51366.

Eurhynchium savatieri Schimp. ex Besch., Ann. Sci. Nat., Bot., sér. 7, **17**: 378 (1893).

I: on soil, mh-50154; on root, mh- 50155; on humus, mh-51485; on boulder, mh-51553. VI: on soil, mh-51403.

Myuroclada maximoviczii (Borz.) Steere & W. B.Schofield, Bryologist **59**: 1 (1956).

II: on stone wall, mh-51390. IV: on soil, mh-51584.

Rhynchostegium contractum Cardot, Bull. Soc. Bot. Genève, Sér. 2, **4**: 381 (1912).

I: on fallen log, mh-50167.

Rhynchostegium inclinatum* (Mitt.) A.Jaeger, Ber. Thätigk. St. Gallischen Naturwiss. Ges. 1876–77: 366 (Gen. Sp. Musc. **2: 432) (1878).

II: on soil, mh-51510. IV: on decaying log, mh-51503; on stone wall, mh-51580.

Rhynchostegium pallidifolium (Mitt.) A.Jaeger, Ber. Thätigk. St. Gallischen Naturwiss. Ges. 1876–77: 369 (Gen. Sp. Musc. **2**: 435) (1878).

I: on decaying log, mh-50157, 51481; on decaying stump, mh-50148, 51483; on rock-cliff, mh-50172; on soil, mh-51543. III: on stone wall, mh-51447. VIII: on concrete wall, mh-51426,

Bryaceae

Brachymenium exire (Dozy & Molk.) Bosch & Sande Lac., Bryol. Jav. **1**: 139 (1860).

V: on soil, mh-51370. VI: on soil, mh-51398. VIII: on soil, mh-51429, 51440.

Bryum argenteum Hedw., Sp. Musc. Frond. 181–182 (1801).

I: on tree-trunk, mh-50183. VII: on tree-trunk, mh-51383.

Pohlia prolifera (Kindb.) Arnold, Bot. Not. 1894: 54 (1894).

I: on soil, mh-51547. III: on soil of stone wall, mh-51469. VI: on soil, mh-51397. VIII: on rock-cliff, mh-51433.

Rosulabryum capillare (Hedw.) J.R.Spence, Bryologist **99**(2): 223 (1996).

III: on stone wall, mh-51456. VI: on stone wall, mh-51415. VIII: on rock-cliff, mh-51434.

Climaciaceae

Climacium dendroides (Hedw.) Web. & Mohr, Naturh. Reise Schweden 96 (1804).

I: on humus, mh-50165, 51593.

Dicranaceae

Campylopus japonicus Broth., Hedwigia **38**: 207 (1899).

III: on soil covering stone wall, mh-51457, 51518.

Dicranella heteromalla (Hedw.) Schimp., Coroll. Bryol. Eur. 13 (1856).

VI: on soil, mh-51408.

Ditrichaceae

Ceratodon purpureus (Hedw.) Brid., Bryol. Univ. **1**: 480 (1826).

II: on soil, mh-51394. VII: on soil, mh-51535.

Ditrichum pallidum* (Hedw.) Hampe, Flora **50: 182 (1867).

VIII: on rock-cliff, mh-51438.

Entodontaceae

Entodon challengeri (Paris) Cardot, Beih. Bot. Centralbl. **17**(1): 32 (1904).

I: on tree-trunk, mh-50180; on decaying log, mh-51480. III: on stone wall, mh-51461, 51473. VII: on tree-trunk, mh-51376, 51526. VIII: on asphalt of road, mh-51442.

Entodon sullivanii (Müll.Hall.) Lindb., Contr. Fl. Crypt. As. 233 (1873).

I: on boulder mh-50162, 51490. III: on stone wall, mh-51476, 51521. IV: on stone wall, mh-51557.

Notes. This species was reported as *Entodon sullivanii* (Müll.Hall.) Lindb. var. *versicolor* (Besch.) Mizushima in the previous report (Higuchi & Furuki, 2000).

Ephemeraceae

**Ephemerum spinulosum* Bruch & Schimp., Syn. Musc. Eur. 6 (1860).

VII: on soil, mh-51534, 51536, tf-23224.

Erpodiaceae

Venturiella sinensis (Venturi) Müll.Hal., Nuovo Giorn. Bot. Ital., n.s., 4: 262 (1897).

I: on tree-trunk, mh-51487. II: on tree-trunk, mh-51507, 51388; on concrete wall, mh-51512. VI: on tree-trunk, mh-51400. VII: on tree-trunk, mh-51382.

Fabroniaceae

Fabronia matsumurae Besch., J. Bot. (Morot) 13: 40 (1899).

I: on tree-trunk, mh-50178. II: on tree-trunk, mh-51387. IV: on concrete wall, mh-51582. VI: on tree-trunk, mh-51399. VII: on tree-trunk, mh-51381, 51527.

Fissidentaceae

**Fissidens bryoides* Hedw. var. *bryoides*, Sp. Musc. Frond. 153 (1801).

I: on rock-cliff, mh-51494; on soil of rock-cliff, mh-51498; on boulder, mh-51500. III: on stone wall, mh-51465. V: on soil, mh-51600. VIII: on soil, mh-51427; on boulder, mh-51439.

**Fissidens bryoides* Hedw. var. *esquirolii* (Thér.) Z.Iwats. & Tad.Suzuki, J. Hattori Bot. Lab. 51:

361 (1982).

I: on boulder, mh-51552.

Fissidens gardneri Mitt., J. Linn. Soc., Bot. 12: 593 (1869).

II: on stone wall, mh-51515, 51517.

Notes. This species was listed as *Fissidens microcladus* Thwaites & Mitt. in the previous report (Higuchi and Furuki, 2000).

**Fissidens geminiflorus* Dozy & Molk., Pl. Jungh. 316 (1854).

I: on humus, mh-51496.

**Fissidens hyalinus* Hook. & Wilson, Hooker's J. Bot. Kew Gard. Misc. 3: 89. 2 (1840).

I: on boulder, tf-23268.

Fissidens linearis Brid. var. *obscurirete* (Broth. & Paris) I.G.Stone, J. Bryol. 16: 404 (1991).

I: on soil mh-50145.

Notes. This species was reported as *Fissidens obscurirete* Broth. & Paris in the previous report (Higuchi and Furuki, 2000).

Fissidens taxifolius Hedw., Sp. Musc. Frond. 155 (1801).

I: on boulder, mh-50151; on soil, mh-51493. VI: on soil, mh-51414. VIII: on soil, mh-51422.

Fissidens tosaensis Broth., Öfvers. Förh. Finska Vetensk.-Soc. 62A(9): 5 (1921).

I: on rock-cliff, mh-50170. II: on soil covering boulder, mh-51508, 51511.

Funariaceae

Physcomitrium japonicum (Hedw.) Mitt., Trans. Linn. Soc. London 3: 164 (1891)

IV: on soil, mh-51574.

Physcomitrium sphaericum (Ludw.) Fühnr., Flora 20: 285 (1837).

VII: on soil, mh-51375.

Grimmiaceae

Grimmia pilifera P.Beauv., Prodr. Aethéogam. 58 (1805).

III: on stone wall, mh-51460.

**Racomitrium barbuloides* Cardot, Bull. Herb. Boissier, sér. 2, 8: 336 (1908).

III: on stone wall, mh-51475.

**Schistidium strictum* (Turner) Loeske ex Mårtensson, Kung. Svenska Vetenskapsakad. Avh. Naturskyddsärenden 14: 110 (1956).

III: on stone wall, mh-51464.

Hedwigiaceae

**Hedwigia ciliata* (Hedw.) P.Beauv., Prodr. Aethéogam. 15 (1805).

III: on stone wall, mh-51474.

Hypnaceae

**Callicladium haldanianum* (Grev.) H. A. Crum, Bryologist 74(2): 167 (1971).

I: on decaying log, mh-50158, 51486, 51592.

Eurohypnum leptothallum (Müll.Hall.) Ando, Bot. Mag. (Tokyo) 79: 761 (1966).

IV: concrete wall, mh-51577; on stone wall, mh-51586.

Hypnum plumaeforme Wilson, London J. Bot. 7: 277 (1848).

II: on soil, mh-51392. III: on stone wall, mh-51463, 51472; on soil, mh-51520. VI: on soil, mh-51411.

Pseudotaxiphyllum pohliaecarpum (Sull. & Lesq.) Z.Iwats., J. Hattori Bot. Lab. 63: 449 (1987).

III: on soil of stone wall, mh-51519.

Taxiphyllum taxirameum (Mitt.) M.Fleisch., Musci Buitenzorg 4: 1435 (1923).

VIII: on soil, mh-51421.

Taxiphyllum alternans (Cardot) Z.Iwats., J.Hattori Bot. Lab. 26: 67 (1963).

I: on soil, mh-51501, 51594. II: on boulder, mh-51391. IV: on soil, mh-51572; on humus, mh-51573; Naka-dokan-bori, on decaying log, April 6, 2012, coll. T. Kitayama (mh-51506).

Leskeaceae

Haplocladium angustifolium (Hampe & Müll. Hal.) Broth., Nat. Pflanzenfam. 229 (I,3): 1008 (1907).

I: on decaying stump, mh-50147; on log, mh-50163. III: on stone wall, mh-51477. IV: on decaying log, mh-51569.

Haplocladium microphyllum (Hedw.) Broth., Nat. Pflanzenfam. 229 (I,3): 1007 (1907).

I: on mushroom, mh-51482. III: on stone wall, mh-51449. VIII: on soil, mh-51430.

Mniaceae

Epipterygium tozeri (Grev.) Lindb., Öfvers. Förh. Kongl. Svenska Vetensk.-Akad. 21(10): 576 (1865).

I: on boulder, tf-23269.

Plagiomnium acutum (Lindb.) T.J.Kop., Ann. Bot. Fenn. 12: 57 (1975).

I: on humus, mh-51540; on soil, mh-51549. IV: on soil covering stone wall, mh-51562, 51565,

Plagiomnium maximoviczii (Lindb.) T.J.Kop., Ann. Bot. Fenn. 5: 147 (1968).

I: on soil, mh-51484.

Trachycystis microphylla (Dozy & Molck.) Lindb., Not. Sällsk. Fauna Fl. Fenn. Förh. 9: 80 (1868).

IV: on rock-cliff, mh-51563.

Plagiotheciaceae

Plagiothecium nemorale (Mitt.) A.Jaeger, Ber.

Thätigk. St. Gallischen Naturwiss. Ges. 1876–77: 451 (Gen. Sp. Musc. 2: 1269) (1878).

IV: on tile, mh-51561; on stone wall, mh-51564.

Polytrichaceae

Atrichum undulatum (Hedw.) P.Beauv., Prodr. Aethéogam. 42 (1805).

III: on soil covering stone wall, mh-51478.

IV: on soil, mh-51402.

Pottiaceae

**Barbula unguiculata* Hedw., Sp. Musc. Frond. 118 (1801).

VIII: on soil, mh-51428.

Chenia leptophylla (Müll.Hal.) Zand., Bull. Buffalo Soc. Nat. Sci. 32: 258 (1993).

V: on soil, mh-51599.

Didymodon constrictus (Mitt.) K.Saito, J. Hattori Bot. Lab. 39: 514 (1975).

III: on stone wall, mh-51446, 51453.

Hyophila propagulifera Broth., Hedwigia 38: 212 (1899).

III: on stone wall, mh-51455. VIII: on concrete wall, mh-51420, 51443.

**Micromitrium megalosporum* Austin, Musci Appalach. 11 (1870).

VII: on soil, mh-51534.

Scopelophila cataractae (Mitt.) Broth., Nat. Pflanzenfam. I(3): 436 (1902).

I: on soil, mh-50168, 51548, 51595; on stone wall, mh-51544. III: on stone wall, mh-51462. VI: on soil, mh-51396. VIII: on soil, mh-51441.

Weissia controversa Hedw., Sp. Musc. Frond. 67 (1801).

II: on soil, mh-51393, 51395, 51509, 51516.

III: on stone wall, mh-51450. V: on soil,

mh-51367, 51368. VIII: on rock-cliff, mh-51432.

Ptychomitriaceae

Ptychomitrium sinense (Mitt.) A.Jaeger, Ber. Thätigk. St. Gallischen Naturwiss. Ges. 1872–73: 104 (Gen. Sp. Musc. 1: 382) (1874).

III: on stone wall, mh-51448, 51459, tf-22817; IV: on rock-cliff, mh-51566,

Pylaisiadelphaceae

Isopterygium minutirameum (Müll.Hal.) A.Jaeger, Ber. Thätigk. St. Gallischen Naturwiss. Ges. 1876–77: 434 (Gen. Sp. Musc. 2: 1252) (1878).

I: on boulder, mh-50146; on decaying stump, mh-50149.

Pylaisiadelpha tenuirostris (Bruch & Schimp. ex Sull.) W.R.Buck, Yushania 1(2): 13 (1984).

I: on tree-trunk, mh-50156, 50182, 51539

II: on tree-trunk, mh-51389, 51513. III: on stone wall, mh-51467 VII: on tree-trunk, mh-51379, 51529.

Rhabdoweisiaceae

Glyphomitrium humillimum (Mitt.) Cardot, Rev. Bryol. 40: 42 (1913).

I: on tree-trunk, mh-50179, 51538. III: on tree-trunk, mh-51444; on stone wall, mh-51451. IV: on concrete wall, mh-51578. VI: on rock-cliff, mh-51417. VII: on tree-trunk, mh-51530, 51374, 51377.

Sematophyllaceae

Sematophyllum subhumile (Müll.Hal.) M. Fleisch., Musci Buitenzorg 4: 1264 (1923).

I: on fallen log, mh-50159.

Notes. This species was listed as *Sematophyllum subhumile* subsp. *japonicum* (Broth.) Seki in the previous report (Higuchi and Furuki, 2000). *Sematophyllum pulchellum*

(Cardot) Broth. reported in the report was treated here as one of synonyms of *S. subhumile* (cf. Tan and But, 1997).

Thuidiaceae

Thuidium kanedae Sakurai, Bot. Mag. (Tokyo) **57**: 345 (1943).

I: on log, mh-50161.

Marchantiophyta (by T. Furuki)

Aytoniaceae

Reboulia hemisphaerica (L.) Raddi subsp. *orientalis* R.M.Schust., Phytologia **56**: 461 (1985).

II: on soil, tf-23210. III: on stone wall of moat, mh-51445, tf-22812. IV: on soil covering stone wall, mh-51579, tf-23260. VI: on soil, tf-22758. VII: on soil, mh-51373, 51537, tf-22623. VIII: on soil, mh-51425; on stone wall, mh-51437, tf-22769.

Cephaloziaceae

Cephalozia otaruensis* Steph., Spec. Hep. **6: 434 (1924).

VIII: on soil covering stone wall, tf-22770.

Notes. This species is newly found on the north facing stone wall along the road.

Cephaloziellaceae

Cephaloziella spinicaulis* Douin, Rev. Bryol. **40: 81 (1918).

I: on rock, tf-22182.

Notes. This species is newly found on rock around the bottom of the Falls.

Conocephalaceae

Conocephalum sp. (= *Conocephalum conicum* auct. non (L.) Underw., quoad. Pl. japon).

I: on soil, mh-51546, mh-51596, tf-23249; on rock, mh-50175, tf-22179, 22828. II: on soil, tf-22633. III: on stone wall of moat, tf-22813. VIII: on soil, mh-51423, tf-22763.

Notes. *Conocephalum conicum* and its related species in Japan can be separated into three types in basis of the allozyme variability and molecular analysis, among them *C. salebrosum* Szweyk., Buczkowska & Odrzykoski was the only species described as independent species, and other two species were not described yet (Akiyama, 2009). *Conocephalum conicum* (L.) Underw. is not distributed in Japan (Szweykovsky *et al.*, 2005; Akiyama, 2009; Borovichev *et al.*, 2009).

Conocephalum japonicum (Thunb.) Grolle, J. Hattori Bot. Lab. **55**: 501 (1984).

V: on soil, mh-51363, tf-22620. VI: on soil, mh-51404, tf-22762. VII: on soil, tf-23218. VIII: on stone wall, mh-51435, tf-22768.

Deravaellaceae

Liochlaena subulata* (A.Evans) Schljakov, Pecen. Mhi Severa SSSR **4: 71 (1981).

VIII: on soil covering stone wall, tf-22765.

Notes. This species is newly found on north facing stone wall along road.

Dumortieraceae

Dumortiera hirsuta (Sw.) Nees, Fl. Bras. Enum. Pl. **1**: 307 (1833).

I: on boulder, mh-51492, tf-22822; on rock, tf-22832; on soil, mh-50152, tf-22172, 22175, 22818. II: on soil, mh-51514, tf-22632, 23207. IV: on soil covering stone wall, tf-23257.

Frullaniaceae

Frullania hamatiloba* Steph., Spec. Hep. **4: 400 (1910).

Notes. This species was reported as *Frullania ericoides* (Nees) Mont. based on the specimen (tf-13456) occurring on the trunk of *Prunus mume* in the previous report (Higuchi and Furuki, 2000), but its voucher

specimen was reexamined and identified as this species.

Frullania inflata Gottsche in Gottsche, Linden-berg & Nees, Syn. Hep.: 424 (1845).

I: on rock, tf-22831.

Frullania muscicola Steph., Hedwigia **33**: 146 (1894).

I: on trunk of *Salix subfragilis*, tf-22176. II: on trunk of *Cerasus* sp., tf-23205. IV: on tree-trunk, tf-23261. IV: on trunk of *Cerasus* sp., mh-51583, tf-23263. VII: on trunk, tf-22628; on trunk of *Sapinus sabiferum*, mh-51385.

Frullania parvistipula Steph., Spec. Hep. **4**: 397 (1910).

I: on trunk of *Catalpa ovata*, tf-22183; on trunk of *Diospyros kaki*, tf-22184; on trunk of *Catalpa ovata*, tf-23244; on tree-trunk, mh-50181, 51555, tf-23246. II: on trunk of *Arcer*, tf-22631. III: on stone wall of moat, mh-51466, tf-22811. IV: on stone wall, mh-51581; on trunk of *Ginkgo biloba*, mh-51585. VII: on trunk of *Cerasus* sp., tf-22626, 23220; on trunk of *Diospyros kaki*, tf-22627; on trunk of *Sapinus sabiferum*, mh-51380, on tree-trunk, mh-51528.

****Frullania usamiensis*** Steph., Bull. Herb. Boiss. **5**: 91 (1897).

III: on stone wall of moat, mh-51471, tf-22816.

Lejeuneaceae

Acrolejeunea pusilla (Steph.) Grolle & Gradst., J. Hattori Bot. Lab. **38**: 332 (1974).

I: on rock, tf-22829; on trunk of *Zelkova serrata*, mh-50144, tf-22169, 22177; on trunk of *Castanea crenata*, mh-50150, tf-23245; on trunk of *Quercus acutissima*, tf-23247; on trunk of *Cerasus* sp., tf-23251; on tree-trunk, mh-51554. II: on trunk of *Cerasus* sp., tf-23204; on trunk of *Pinus* sp., tf-23206. III: on trunk of *Myrica rubra*, tf-22809. IV: on

trunk of *Zelkova serrata*, mh-51571. VIII: on trunk of *Cinnamomum camphora*, tf-22767.

Cololejeunea japonica (Schiffn.) S.Hatt. ex Mizut., J. Hattori Bot. Lab. **24**: 241 (1961).

I: on rock, tf-22173. I: on trunk of *Zelkova serrata*, mh-50144; on trunk of *Diospyros kaki*, tf-22185; on tree-trunk, mh-51554. III: on stone wall of moat, tf-22815. IV: on trunk of *Cerasus* sp., tf-23259.

****Cololejeunea raduliloba*** Steph., Hedwigia **34**: 251 (1895).

I: on rock, mh-50171, 51488, tf-22180, 22823, 22824, 22825, 22872, 23252, 23253, 23272. Notes. This species is newly found on wet rock around the bottom of the Falls.

****Lejeunea discreta*** Lindenb. in Gottsche, Linden-berg & Nees, Syn. Hep.: 361 (1845).

IV: on stone wall, tf-23255.

Lejeunea japonica Mitt., Trans. Linn. Soc., Lon-don, Bot. **3**: 203 (1891).

I: on rock, mh-50171, tf-22181, 22826. III: on stone wall of moat, tf-22814. IV: on stone wall, mh-51556.

Lejeunea ulicina (Tayl.) Gottsche, Lindenb. & Nees, Syn. Hep.: 387 (1845).

I: on trunk of *Quercus acutissima*, tf-23248. II: on trunk of *Cerasus* sp., tf-23203. IV: on tree-trunk, tf-23262.

****Trocholejeunea sandvicensis*** (Gottsche) Mizut., Misc. Bryol. Lichenol. **2**(12): 169 (1961).

VII: on trunk of *Triadica sebifera*, mh-51378.

Lophocoleaceae

Heteroscyphus argutus (Reinw., Blume & Nees) Schiffn., Österr. Bot. Zeit. **60**: 172 (1910).

I: on boulder, mh-51499, tf-22820; on rock, mh-50176, tf-22174, 22830. II: on rock, tf-23209. IV: on rock, mh-51560, tf-23254.

Chiloscyphus minor (Nees) J.J.Enger & R. M. Schust., *Nova Hedwigia* **39**: 419 (1984).

I: on rock, tf-22170; on trunk of *Metasequoia glyptostroboides*, mh-51551, tf-23250. III: on stone wall of moat, mh-51468, tf-22810. IV: on stone wall, mh-51575, tf-23256. VI: on stone wall, mh-51418. VIII: on soil covering stone wall, tf-22766.

Notes. This species was listed as *Lophocolea minor* Nees in the previous report (Higuchi and Furuki, 2000).

Lunulariaceae

Lunularia cruciata (L.) Dumort. ex Lindb., *Not. Sällsk. Fauna Fl. Fenn. Förh.* **9**: 298 (1868).

II: on soil, tf-23213. II: on soil, tf-22634. III: on soil, mh-51524. V: on soil, mh-51362, tf-22618. VI: on soil, mh-51409, tf-22759. VIII: on soil, tf-22764.

Marchantiaceae

Marchantia emarginata Reinw., Blume & Nees subsp. *tosasna* (Steph.) Bischl., *Cryptog. Bryol. Lichénol.* **10**: 77 (1989).

VI: on soil, tf-22754. VII: on soil, tf-23217.

****Marchantia polymorpha*** L. subsp. *ruderalis* Bischl. & Boisselier-Dubayle, *J. Bryol.* **16**: 364 (1991).

V: on soil, tf-22621.

Metzgeriaceae

Metzgeria lindbergii Schiffn., *Denkschr. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl.* **67**: 182 (1898).

I: on rock, mh-50169, 51491, tf-22178, 22821. IV: on stone wall, tf-23258.

Monosoleniaceae

Monosolenium tenerum Griff., *Icon. Pl. Asia. II, Notulae ad plantas Asiaticas, II.* 341 (1849).

I: on soil, mh-50153, 51479, 51591, tf-22171,

22819, 23270. V: on soil, mh-51365, 51371, tf-22619. VIII: on soil, mh-51424, 51587, tf-23264.

Notes. In Japan this species is distributed from Ryukyu to the central Honshu (Tokyo) and it grows on wet nitrogen rich soil around the house, fields or on margins of agricultural canal in the past days. Its populations strongly declined by the recent changes and improvement of living conditions and the modernization of agriculture. It is the vulnerable species designated in the Red List of Japan (Ministry of the Environment Government of Japan, 2012). Two new localities were found in this study. In the Imperial Palace it grows rarely on wet soil rich in nitrogen by watering the plant and fertilization at the Bonsai gardening area, around house and on trail at garden.

Pelliaceae

Pellia endiviifolia (Dicks.) Dumort., *Recuril d'Obs. Jungerm.*: 27 (1835).

VI: on soil, mh-50405, tf-22761. VIII: on soil covering stone wall, mh-51436, tf-22771.

Porellaceae

Macvicaria ulophylla (Steph.) S.Hatt., *J. Hattori Bot. Lab.* **5**: 81 (1951).

I: on trunk, mh-50160. VII: on trunk of *Diospyros kaki*, tf-23221.

Radulaceae

****Radula japonica*** Gottsche ex Steph., *Hedwigia* **23**: 152 (1884).

I: on rock, tf-22825.

Notes. This species is newly found on boulder at the bottom of the Falls.

Radula tokiensis Steph., *Spec. Hep. Hedwigia* **23**: 150 (1884).

I: on rock, mh-50171, 50174, 51502, tf-22833.

Notes. The Imperial Palace is the type locality of this species, that is, “Tokio; in nemore Fukiage” described in the original description.

Ricciaceae

**Riccia bifurca* Hoffm., Deitschl. Fl.: 95 (1795).

(= *Riccia glauca* auct. non L., quoad. Pl. japon)

V: on soil, tf-23265. VI: on soil, mh-51413, tf-22751, 22756. VII: on soil, tf-22625, 23215.

Notes. This species has been misidentified in more than a hundred year in Japan, and the most specimens labelled *R. glauca* are referable to *R. bifurca* (Tominaga and Furuki, 2012).

Riccia fluitans L., Spec. Plant. 1: 1139 (1753).

V: on soil, mh-51588, tf-23267. VII: on soil, mh-51533, tf-23223.

Riccia glauca L., Spec. Plant. 1: 1139 (1753).

VI: on soil, tf-22752. VI: on soil, tf-22757.

Notes. For the identification of this species, see the notes of *R. bifurca*. The voucher specimens named *Riccia glauca* in the previous report (Higuchi and Fruki, 2000) are *R. bifurca*, and the occurrence of *R. glauca* was newly confirmed in the Palace in this study.

**Riccia lamellosa* Raddi, Opusc. Sci. 2: 351 (1818).

II: on soil, tf-22635, 23211. III: on soil, mh-51522. V: on soil, mh-51372, 51589, 51590, 51597, tf-22622, 23274. VI: on soil, mh-51413, tf-22750. VII: on soil, tf-23216.

Notes. This species was newly found in 2000 in Japan (Furuki, 2000), and it was found in several places in this area.

Riccia miyakeana Schiffn., Österr. Bot. Zeit. 49: 386 (1899).

VII: on soil, mh-51532, tf-22624, 23222.

**Riccia nigrella* DC., Fl. Franç (ed. 3) 6: 193

(1815).

II: on soil, tf-23212. III: on soil, mh-51523. V: on soil, tf-22617, 23275. V: on soil, mh-51364, 51589, 51598. VI: on soil, tf-22760. VII: on soil, tf-22630, 23219.

Notes. All voucher specimens (tf-13439, 13440, 13868, 15170, mh-31368, 32405) named as *Riccia sorocarpa* in the previous report (Higuchi and Furuki, 2000) were examined and identified as *R. nigrella*. The occurrence of this species in Japan was confirmed in 2005, and it may be considered an alien species (Kasai and Furuki 2005). This species is one of the most common species of the genus in the Palace as well as in central Tokyo.

Riccia nipponica S.Hatt. ex Shimizu & S.Hatt., J. Hattori Bot. Lab. 9: 38 (1953)

VII: on soil, mh-51525, tf-22624, 23214.

Riccia sorocarpa Bisch., Nova Actorum Acad. Caes. Leop.-Carol. German. Nat. Cur. 17: 1053 (1835)

V: on soil, tf-23266. VI: on soil, tf-22753.

Notes. See *Riccia nigrella*.

Solenostomataceae

**Nardia assamica* (Mitt.) Amakawa, J. Hattori Bot. Lab. 25: 23 (1963)

VI: on soil, mh-51412.

Solenostoma truncatum (Nees) R.M.Schust. ex Vána & D.G.Long, Nova Hedwigia 89: 510 (2010).

II: on soil, tf-23208. VI: on soil, mh-51419, tf-22755. VIII: on soil covering stone wall, tf-22772.

Notes. This species was listed as *Jungermannia truncata* Nees in the previous report (Higuchi and Furuki, 2000).

Anthocerotophyta (by T. Furuki)**Anthocerotaceae**

- **Anthoceros agrestis* Paton, J. Bryol. **10**: 257 (1979).
V: on soil, tf-23273.

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皇居のコケ類

樋口正信・古木達郎

皇居のコケ類フロラを2009年から2013年にかけて調査した。今回の調査で本地域から46科77属107種2変種のコケ類を確認した。それらのうち、25種2変種が皇居のコケ類フロラに新たに加わるものであった。皇居には131種2変種のコケ類が認められ、都区内で最もコケ類フロラの豊富な地域であることが明らかになった。各種について、基物、産地、標本番号を示した。

Appendix

The species recorded from the Imperial Palace, Tokyo, Japan are listed based on the previous report (Higuchi and Furuki, 2000) and this report. Taxa new for the area are marked with asterisk.

Bryophyta

Atrichum undulatum

**Barbula unguiculata*

Brachymerium exile

Brachythecium buchananii

Brachythecium helminthocladum

Brachythecium plumosum

Brothera leana

Bryhnia novae-angliae

Bryhnia tokubuchii

Bryum argenteum

**Callicladium haldanianum*

Campylopus japonicus

Campylopus umbellatus

Ceratodon purpureus

Chenia leptophylla

Climacium dendroides

Cratoneuron filicinum

Dicranella heteromalla

Didymodon constrictus

**Ditrichum pallidum*

Entodon challengerii

Entodon scabridens

Entodon sullivantii

**Ephemerum spinulosum*

Epipterygium tozeri

Eurhynchium hians

Eurhynchium savatieri

Eurohypnum leptothallum

Fabronia matsumurae

**Fissidens bryoides* var. *bryoides*

**Fissidens bryoides* var. *esquirolii*

Fissidens bryoides var. *lateralis*

**Fissidens geminiflorus*

Fissidens gymnogynus

Fissidens gardneri (Syn. *F. microcladus*)

**Fissidens hyalinus*

Fissidens linearis var. *obscurirete*

Fissidens taxifolius

Fissidens teysmannianus (Syn. *F. adelphinus*)

Fissidens tosaensis

Glyphomitrium humillimum

Grimmia pilifera

Haplocladium angustifolium

Haplocladium microphyllum

Haplohymenium triste

**Hedwigia ciliata*

Herpetineuron toccoeae

Hyophila involuta

Hyophila propagulifera

Hypnum plumaeforme

Isopterygium minutirameum

Leskeella pusilla

**Micromitrium megalosporum*

Mnium lycopodioides

Myuroclada maximoviczii

Oncophorus crispifolius

Philonotis turneriana

Physcomitrium japonicum

Physcomitrium sphaericum

Plagiomnium acutum

Plagiomnium maximoviczii

Plagiomnium vesicatum

Plagiothecium nemorale

Pogonatum neesii

Pohlia flexuosa

Pohlia prolifera

Pseudoleskeopsis zippelii

Pseudotaxiphyllum pohliaecarpum

Ptychomitrium sinense

Pylaisiadelphina tenuirostris

**Racomitrium barbuloides*

Raiiella fujisana

Rhynchostegium contractum

**Rhynchostegium inclinatum*

Rhynchostegium pallidifolium

Rosulabryum capillare

**Schistidium strictum*

Scopelophila cataractae

Sematophyllum pulchellum

Sematophyllum subhumile (Syn. *S. pulchellum*,
S. subhumile subsp. *japonicum*)

Taxiphyllum alternans

Taxiphyllum taxirameum

Thuidium cymbifolium

- Thuidium kanedae*
Tortula obtusifolia
Tortula pagorum
Trachycystis microphylla
Trematodon longicollis
Venturiella sinensis
Vesicularia flaccida
Weissia controversa
- Marchantiophyta
Acrolejeunea pusilla
 **Cephalozia otaruensis*
 **Cephaloziella spinicaulis*
Chiloscyphus minor (Syn. *Lophocolea minor*)
Cololejeunea japonica
 **Cololejeunea raduliloba*
Conocephalum japonicum
Conocephalum sp.
Dumortiera hirsuta
 **Frullania hamatiloba*
Frullania inflata
Frullania muscicola
Frullania parvistipula
 **Frullania usamiensis*
Heteroscyphus argutus
 **Lejeunea discreta*
Lejeunea japonica
Lejeunea ulicina
 **Liochlaena subulatus*
- Lunularia cruciata*
Macvicaria ulophylla
Marchantia emarginata subsp. *tosana*
Marchantia paleacea subsp. *diptera*
 **Marchantia polymorpha* subsp. *ruderalis*
Metzgeria lindbergii
Monosolenium tenerum
 **Nardia assamica*
Pellia endiviifolia
 **Radula japonica*
Radula tokiensis
Reboulia hemisphaerica subsp. *orientalis*
 **Riccia bifurca*
Riccia fluitans
Riccia glauca
Riccia huebeneriana
 **Riccia lamellosa*
Riccia miyakeana
 **Riccia nigrella*
Riccia nipponica
Riccia sorocarpa
Solenostoma truncatum (Syn. *Jungermannia truncata*)
 **Trocholejeunea sandvicensis*
- Anthocetotophyta
 **Anthoceros agrestis*
Notothylas orbicularis