原著論文（**Original article**）

Distribution and Habitat of an Endangered *Pilotrichopsis dentata* (Mitt.) Besch., Rediscovered in Ibaraki Prefecture after 90 Years*

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（Accepted July 5, 2025）

Abstract

Pilotrichopsis dentata (Mitt.) Besch. (Musci, Cryphaeaceae) was found on Mt. Tsukuba, for the first time in 90 years after the collection by Mr. Sasaoka in 1930. This species is listed in the Regional Red Data Books and is considered to be rare. In this survey, *P. dentata* was found growing on a trunk of *Fagus crenata* Blume in only one location. To obtain basic information on the distribution and ecological characteristics of this species, we conducted a specimen information survey of *P. dentata* using the specimen database and collected specimens publicly available at the National Museum of Nature and Science. The results revealed that the species grows on rocks, mainly limestone, as well as on the trunks of beech and hemlock trees and on fallen trees in the hilly and mountainous zones (alt. 200–1,400 m) of the Pacific coast of Honshu, Shikoku, and Kyushu.

Key words: conservation, distribution, endangered species, *Fagus crenata*, habitat, limestone, Mt. Tsukuba, *Pilotrichopsis dentata,* substrate.

Introduction

The Ibaraki Nature Museum has been conducting comprehensive surveys of the natural environment in Ibaraki Prefecture since 1994, focusing on regional flora and fauna. These surveys are ongoing (Ibaraki Nature Museum, 1998, 2001, 2004, 2007). Sugimura, one of the authors of this paper, surveyed bryophyte specimens from Ibaraki Prefecture housed at the Makino Herbarium of Tokyo Metropolitan University. This survey concentrated on specimens collected by Dr. Makino in Ibaraki Prefecture, mainly on Mt. Tsukuba, during the 1890s to early 1900s, resulting in a compilation of these specimens (Sugimura, 2009). The specimens comprise several valuable species, such as *Sphagnum subsecundum* Nees ex Sturm var. *junsaiense* (Warnst.) H. A. Crum and *Neckera fauriei* Cardot, which are no longer found growing in the wild. One noteworthy bryophyte, whose current status is unknown, is *Pilotrichopsis dentata*. *P. dentata* is a relatively large bryophyte and typically grows in clusters on tree trunks or cliffs, occasionally hanging downward, making it relatively noticeable and easily identifiable in its natural habitat (Iwatsuki, 2001). Despite ongoing bryophyte surveys over numerous years in various parts of Ibaraki Prefecture by the Ibaraki Nature Museum, the growth of *P. dentata* has not been confirmed since its collection by Mr. Sasaoka on Mt. Tsukuba in 1930 (National Museum of

* This research was conducted as part of comprehensive surveys of plants, animals and geology in Ibaraki Prefecture by the Ibaraki Nature Museum.

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Nature and Science, 2025a).

Sugimura surveyed the distribution of bryophytes on Mt. Tsukuba in October 2020 and rediscovered growth of *Pilotrichopsis dentata* in Ibaraki Prefecture for the first time in 90 years. In this study, we report the vegetation of the habitat of this species at the sampling site on Mt. Tsukuba. To gather essential information for future conservation of this species, we surveyed specimen label data on *P. dentata* specimens from the sample databases.

Materials and Methods

1. Overview of the survey area

The survey was conducted on Mt. Tsukuba (altitude of 877 m) in Ibaraki Prefecture (36°13′N, 140°6′E). At the Mt. Tsukuba Meteorological Observatory (altitude of 866 m), located on the summit of Mount Nantai, one of the peaks of Mount Tsukuba, the average annual temperature is 9.3°C and the average annual precipitation is 1,270 mm (Mito Meteorological Office, 1996).

2. Materials

On October 21, 2020, a bryophyte survey was conducted on Mt. Tsukuba as part of a comprehensive survey by the Ibaraki Nature Museum, and it resulted in the collection of *Pilotrichopsis dentata* on the trunks of *Fagus crenata* at one location. (Fig. 1, F110107 INM) This species is distributed from Honshu to the Ryukyus, China, Southeast Asia, and Assam (Iwatsuki and Mizutani, 1972; Iwatsuki, 2001). The primary stem is thin and creeping, and the secondary stem reaches a length of about 20 cm. The branches and leaves are 1.5–2 mm long, growing lanceolate from an ovate base, with a thin, sharp tip. There are many teeth on the middle and upper parts of the leaf margins (Iwatsuki and Mizutani, 1972; Iwatsuki, 2001). The thin midrib reaches almost to the tip of the leaf, and there are papillae on the upper dorsal surface (Iwatsuki and Mizutani, 1972; Iwatsuki, 2001). The last record from Ibaraki Prefecture was a specimen collected by Mr. Sasaoka on Mount Tsukuba in 1930, and this is the first rediscovery in 90 years.

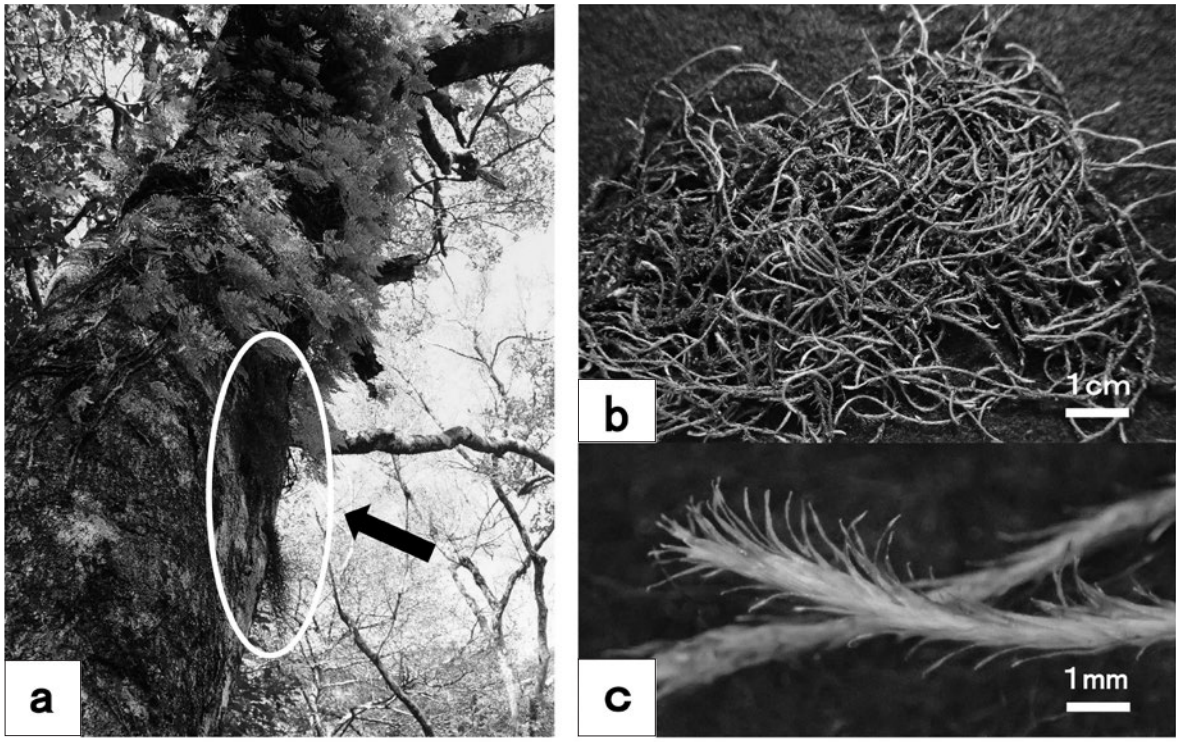

Fig. 1. *Pilotrichopsis dentata* (Mitt.) Besch. in Mt. Tsukuba, Japan.
a: Growth status of large *Fagus crenata* on Mt. Tsukuba (Arrow: populations of *Pilotrichopsis dentata*).
b: Specimen of *P. dentata* collected by *Sugimura, K. F110107* (INM).
c: Close-up of *P. dentata* by *Sugimura, K. F110107* (INM).
All photos taken in 2020.

3. Survey of the habitat

We recorded the height, vegetation coverage, and the main species of each layer of the *F. crenata* forest (15 m × 15 m quadrate) at the sampling site. We also recorded the species composition around the colony of *P. dentata* on the trunk of *F. crenata*.

4. Survey of specimen information

Specimen information cited on specimen label data on 188 specimens of *Pilotrichopsis dentata* from Japan were obtained from the Collection Database of Specimens and Materials operated by the National Museum of Nature and Science (National Museum of Nature and Science, 2025a) and Science Museum Net (S-net) (National Museum of Nature and Science, 2025b) (Table 1). The specimen storage institutions, collectors, collection dates, collection locations, habitats (e.g., geological feature, vegetation zone, topography, soil moisture), substrates, and altitudes (with calculated when only altitude ranges was cited) were recorded.

In addition, specimen information were recorded from three specimens of this species housed in the Makino Herbarium of Tokyo Metropolitan University. A total of 277 specimens were used in this study, excluding 180 duplicate data entries from the Collection Database of Specimens and Materials of the National Museum of Nature and Science and Science Museum Net (S-net). Voucher information for the 277 specimens of *P. dentata* is presented in Appendix 1. For information not published in the Collection Database of Specimens and Materials, a set of specimens was borrowed from the National Museum of Nature and Science, and the above items were recorded using the specimen label information.

Results

1. Rediscovery of *Pilotrichopsis dentata* on Mt. Tsukuba

The first confirmed specimen of *P. dentata* in Ibaraki Prefecture was collected by Mr. Suzuki on Mt. Tsukuba in May 1897. Subsequently, Dr. Makino collected a specimen on Mt. Tsukuba on January 2, 1901, and in Hitachi City on October 13, 1905. In addition, Mr. Sasaoka collected a specimen on Mt. Tsukuba on April 6, 1929, and May 10, 1930. After 1930, this species had not been reported in Ibaraki prefecture. In this study, we confirmed growth of *P. dentata* on Mt. Tsukuba on October 21, 2020 for the first time in 90 years. A small and pure population of *P. dentata* was found on the trunk (approximately 3.5 m high) of a large *Fagus crenata* (approximately 16 m high and 90 cm in diameter at breast height) within an *F. crenata* forest in the upper mountain range on the southern slope at an altitude of around 700 m on Mt. Tsukuba. The confirmation site was situated in a relatively bright area near the edge of the *F. crenata* forest, located on a gentle slope, and distant from any water source.

2. Survey of the habitat

The colony of *P. dentata* found in this study was very small and hanging down slightly from the trunks of *F. crenata*. The trunk around the colony was populated by various ferns (e.g., *Davallia mariesii* T. Moore ex Baker), mosses (e.g., *Pterobryon arbuscula* Mitt., *Neckera humilis* Mitt., *Fissidens gymnogynus* Besch. and *Leucodon atrovirens* Nog.), and liverworts (e.g., *Frullania muscicola* Steph.).

Table 1. Name of specimen storage institution and number of specimens of *Pilotrichopsis dentata*.

Name of organization (Herbarium Code)	Number of specimens
National Museum of Nature and Science,Tokyo (TNS)	185
Hiroshima University (HIRO)	31
Museum of Nature and Human Activities, Hyogo (HYO)	30
Kanagawa Prefectural Museum of Natural History (KPN)	8
Osaka Museum of Natural History (OSA)	8
Saitama Museum of Natural History (SMNH)	6
Akita Prefectural Museum (AKPM)	4
Makino Herbarium, Tokyo Metropolitan University (MAK)	3
Hokkaido University of Education Asahikawa Campus (AEC)	1
Ibaraki Nature Museum (INM)	1
Total	277

These plants are commonly found in the deciduous broadleaf forests of *F. crenata* Blume and *Quercus crispula* Blume at slightly higher altitudes in Ibaraki Prefecture.

Table 2 shows the hierarchical structure of the *Fagus crenata* forest in which the specimen was collected. This forest community consists of four distinct layers: tree layer, sub-tree layer, shrub layer, and herb layer. The vegetation coverages of the tree and herb layers were relatively high, at 80%, respectively, and those of the sub-tree and shrub layers were relatively low, at 30–40%, respectively. The species in the tree layer included *F. crenata* and *Q. crispula*. The sub-tree species consisted of *Fraxinus lanuginosa* Koidz. f. *serrata* (Nakai) Murata and *Acer rufinerve* Siebold et Zucc. The shrub layer comprised *Lindera praecox* (Siebold et Zucc.) Blume and *Lindera umbellata* Thunb. All of these species were typical components of summer-green broad-leaved trees. The herb layer was mainly composed of *Sasa borealis* (Hack.) Makino et Shibata. These forest structures are commonly observed in the upper mountain ranges of Mt. Tsukuba.

3. Survey of specimen information

Table 1 shows the names of the specimen storage institutions and the corresponding number of specimens out of the 277 *Pilotrichopsis dentata* used in this study. The National Museum of Nature and Science, Tokyo (TNS) holds the largest collection, comprising 185 specimens. This is followed by Hiroshima University (HIRO) with 31 specimens and the Museum of Nature and Human Activities, Hyogo (HYO) with 30 specimens.

As regards the collection date, the largest numbers of specimens were collected in the 1950s (79 specimens) and 1970s (40 specimens), followed by the 1980s (27 specimens) and 1960s (26 specimens). Most specimens were collected over 40 years ago, and only a limited number of specimens were collected after the 2000s (Appendix 2, Fig. 2).

The largest number of specimens (74) was collected by Dr. Nagano. Professor Nagano is a famous researcher of limestone-dwelling bryophytes and has authored numerous publications, primarily focusing on the limestone areas of Saitama Prefecture (Nagano, 1953, 1962, 1964, 1969).

Figure 2 shows the distribution map of *Pilotrichopsis dentata* based on specimen data. The main distribution of *P. dentata* in Japan is thought to be on the Pacific side of Honshu and west of the Kanto, Kii Peninsula, and Shikoku regions, but it has also been reported in Akita. (Fig. 2, Appendix 3). The distribution of the collection sites of this species before 1999 is wider than that after 2000.

The place names of the collection sites and environmental records revealed that numerous specimens had been collected from limestone areas and (25 from Mt. Buko in Saitama, 13 from Mt. Futago in Saitama, five from Mt. Ishitate in Tokushima and five from Mt. Mitake in Saitama; Appendix 4) and in the forest of *Fagus crenata* (nine from Tanzawa Mountains in Kanagawa, seven from Mount Koya in Wakayama and six from Odakihara in Nara; Appendix 5).

Table 3 presents the number of specimens categorized by substrate type. Rocks are the most common substrate (93 specimens), followed by tree trunks (65 specimens). Table 4 shows the number of specimens categorized by the geological features of the substrate. Limestone (55 specimens) is the most common, followed by serpentine

Table 2. Representative species of *Fagus crenata* forests where *Pilotrichopsis dentata* grew according to their hierarchical structure.

Layer	Height	Coverage	Main species
Tree layer	~16 m	80%	*Fagus crenata* Blume *Quercus crispula* Blume *Carpinus japonica* Blume *Acer amoenum* Carrière
Sub-tree layer	~10 m	30%	*Fraxinus lanuginosa* Koidz. f. *serrata* (Nakai) Murata *Acer rufinerve* Siebold et Zucc.
Shrub layer	~5 m	40%	*Lindera praecox* (Siebold et Zucc.) Blume *Lindera umbellata* Thunb. *Hydrangea hirta* (Thunb.) Siebold et Zucc.
Herb layer	~1 m	80%	*Sasa borealis* (Hack.) Makino et Shibata *Euonymus fortunei* (Turcz.) Hand.-Mazz. *Ainsliaea acerifolia* Sch.Bip. var. *subapoda* Nakai

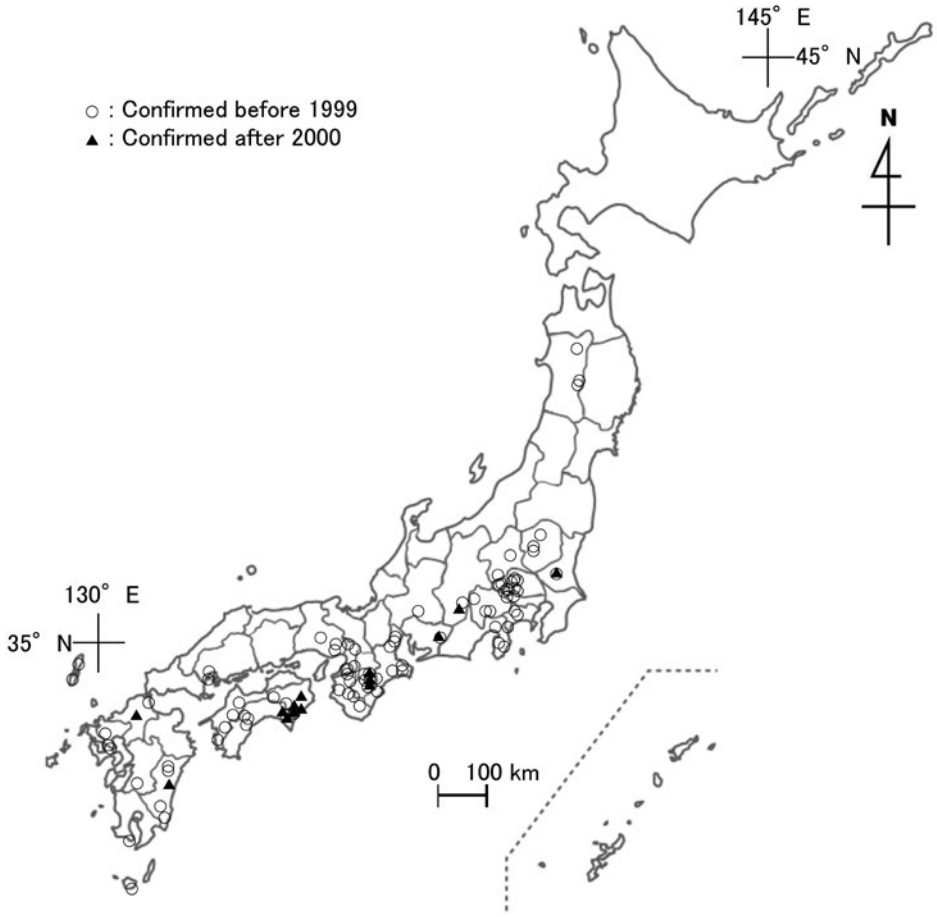

Fig. 2. Distribution map of *Pilotrichopsis dentata* based on collected specimens.

Table 3. Number of *Pilotrichopsis dentata* specimens by substrate.

Substrate	Number of specimens
Rock	93
Tree trunk	64
Fallen tree	7
Unknown	113
Total	277

Table 4. Number of *Pilotrichopsis dentata* specimens by geological feature.

Geological feature	Number of specimens
Limestone	55
Serpentinite	6
Conglomerate	3
Chert	1
Sericite schist	1
Unknown	27
Total	93

(six specimens). Table 5 shows the number of specimens categorized by substrate tree species in the vegetation zones, which are *Fagus crenata* (ten specimens), a summer green broadleaf tree, and *Tsuga sieboldii* Carrière (nine specimens), an evergreen coniferous.

Figure 3 shows the distribution of occurrences of *Pilotrichopsis dentata* by altitude. Looking at the overall distribution of this species, it occurs over a wide area from hilly to mountainous regions at altitudes of 200 to 1,400 m. Moreover, looking at these distributions in relation to the epiphytic substrate and the forest zone, species on rocks other than limestone occur in hilly zones at altitudes of 200 to 600 m, species on limestone occur throughout hilly and mountain zones at altitudes of 400 to 1,400 m, species on evergreen broadleaf tree trunks occur in hilly to lower mountain zones at altitudes of 500 to 800 m, species on deciduous broadleaf tree trunks occur in mountain zones at altitudes of 600 to 1,400 m, and species on evergreen

Table 5. Number of *Pilotrichopsis dentata* specimens by tree species.

Tree species	Vegetation zone	Number of specimens
Fagus crenata	Summer green broadleaf	10
Acer sp.		3
Quercus crispula		2
Tilia japonica		1
Quercus sp.		1
Deutzia sp.		1
Tsuga sieboldii	Evergreen coniferous	9
Abies firma		2
Tsuga diversifolia		1
Cryptomeria japonica		1
Buxus microphylla var. *japonica*	Evergreen broadleaf	2
Quercus glauca		1
Unknown	Unknown	30
	Total	64

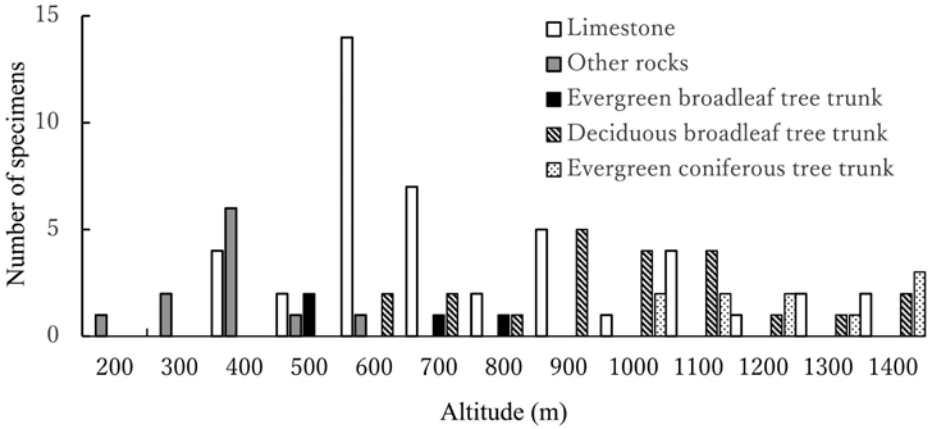

Fig. 3. Number of specimens of *Pilotrichopsis dentata* by substrate type and altitude.

coniferous tree trunks occur in upper mountain zones at altitudes of 1,000 to 1,400 m.

Discussion

In this study, we showed the habitat vegetation and other information from specimen databases, on *Pilotrichopsis dentata*, which was rediscovered in Ibaraki Prefecture. Only one colony of this species was found on the trunk of *Fagus crenata* during our survey on Mt. Tsukuba.

In Ibaraki Prefecture, *Pilotrichopsis dentata* is cited as having "Insufficient Information" in the Red Data Books (RDBs) of Ibaraki (Ibaraki Prefecture, 2020), Oita (Oita Prefecture, 2022), and Tochigi Prefectures (Tochigi Prefecture, 2023). Moreover, it is cited as being "Unknown/ Extinct" in Chiba Pref. (Chiba Prefecture, 2023), "Rank B (highly rare species)" in Hyogo Pref. (Hyogo Prefecture, 2020), and "Near Threatened" in Kanagawa Pref. (Kanagawa Prefecture, 2022, Table 6). This species is not cited in the IUCN International or Ministry of the Environment RDB (IUCN, 2025; Ministry of the Environment Government of Japan, 2020), but is considered endangered.

The frequency of occurrence in substrate types (Fig. 3) indicates that *Pilotrichopsis dentata* is closely related to calcareous and deciduous broadleaved trees, such as *Fagus crenata*. *P. dentata* is excluded from calcareous bryophytes because it does not occur restrictively in limestone environments (Tanaka, 2014). However, because it appears more frequently in limestone areas compared with other common species, it can be considered a semi-calcareous bryophyte. On the other hand, *F. crenata* is widely distributed in Japan, from the southern part of Hokkaido, along

Table 6. Red Data Book (RDB) and Red List (RL) selection status for *Pilotrichopsis dentata*.

Sources of RDB and RL	Valuable Categories	Reasons for selection	Remarks
IUCN Red List (2024)	—	—	—
Ministry of the Environment National RL (2020)	—	—	—
Ibaraki Prefecture RDB (2020)	Data Deficient (DD)	Insufficient information to evaluate, few growing sites	Since it was collected by Dr. Sasaoka on Mt. Tsukuba in 1930, there have been no records of it, and it has not been possible to confirm whether it is still alive or not.
Tochigi Prefecture RL (2023)	Data Deficient (DD)	Not enough information to assess	Changed from "Featured Species" in 2011 to "Data Deficient (DD)" in 2023.
Chiba Prefecture RDB (2023)	Extinct in the wild (EW)	No reported cases of survival in the last 50 years	It was reported from the Kiyosumi mountain range in 1947, but there are no further records.
Kanagawa Prefecture RDB (2022)	Near Threatened (NT)	The survival basis is fragile	Grown in seven locations in the Nishi-Tanzawa region.
Hyogo Prefecture RDB (2020)	Vulnerable (VU)	A rare species with few confirmed locations	It has become extinct in Kamikawa Town and Sayo Town, and its distribution area in the Prefecture has been reduced to three locations: Kobe City, Nishinomiya City, and Himeji City.
Oita Prefecture RDB (2022)	Data Deficient (DD)	Not enough information to evaluate	It grows on cliffs at the edge of forests and is believed to have been washed away by typhoons or heavy rains, so its growth cannot be confirmed.

— : Not applicable.

Honshu, to Shikoku and Kyushu, but mainly along the coast of Sea of Japan, from Aomori to Fukui Prefecture, with numerous stands where it dominates the community (Tanaka and Matsui, 2007). However, the distribution of *P. dentata* in Japan has been limited to the Pacific coast from the Kanto region to Kyushu, except for Akita Pref. (Fig. 2). It is suggested that the species may not be adapted to heavily snowy environments, like *Hypnum cupressiforme* Hedw., which is a well-known snow avoidance species (Shirasaki, 2020). This should be a reason for the discrete distribution of *P. dentata* found in *F. crenata* forest along the Pacific coast.

The noticeable decline and mortality of *Fagus crenata* and other trees in Japan is thought to be associated with air pollution and acid rain that commenced in the 1980s (Matsui *et al.*, 2004; Sasakawa *et al.*, 2006). The *F. crenata* forests on Mt. Tsukuba are close to the Tokyo metropolitan area and are thought to experience decline and mortality (Obata and Tanaka, 2014). This situation has led to the implementation of conservation measures (Ibaraki Prefecture, 2012). It is important to monitor and conserve a broad area of the entire *F. crenata* forest to protect the natural habitat of *Pilotrichopsis dentata* on Mt. Tsukuba, including the confirmed locations of this species.

The specimen information in the Collection Database of Specimens and Materials of the National Museum of Nature and Science and the Science Museum Net (S-net) has some issues, such as unentered and unpublished data (Hosoya *et al.*, 2018; Ohno *et al.*, 2020). However, it is extremely useful as an important source of information for obtaining basic information to understand the distribution characteristics of endangered species (Sugita *et al.*, 2021).

Acknowledgements

In conducting this research, we had the opportunity to examine specimens of *Pilotrichopsis dentata* from Dr. Yuya Inoue of the Department of Plant Research at the National Museum of Nature and Science. We would like to extend our gratitude to Dr. Inoue for this opportunity.

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（要　旨）

杉村康司・鵜沢美穂子．茨城県で 90 年ぶりに生育が再確認された稀少蘚類ツルゴケの分布・生態．茨城県自然博物館研究報告　第 28 号（2025）pp. 1–11.

ツルゴケは，イトヒバゴケ科に属する蘚類である．本種の茨城県での採集記録を見ると笹岡博士が 1930 年に筑波山で採集した以降，生育が確認されることがなかった．その後，著者の一人杉村が 2020 年 10 月に筑波山で蘚苔類相調査を行った時に，ツルゴケの生育を 90 年ぶりに再確認したので報告する．本種は，茨城県など県レベルの地方版レッドデータブックに選定されて貴重種である．そのため，本種の今後の保全を進めるための基礎情報を得ることを目的として，国立科学博物館の標本データベースと収蔵標本の中からツルゴケの確認調査を行った．その結果，本州，四国，九州の主に太平洋側の丘陵帯から山地帯（標高 200 ～ 1400 m）の石灰岩を中心とした岩上，またブナ，ツガなどの樹幹，さらに倒木に生育することが明らかになった．

（キーワード）：保全，分布，絶滅危惧種，ブナ，生育環境，石灰岩，筑波山，ツルゴケ，着生基物．

Appendix 1. Voucher information.

Information on voucher specimens of *Pilotrichopsis dentata* (Mitt.) Besch collected in Japan is shown below. The information is the name of the prefecture where the specimen was collected, the name of the collector, the specimen number, and the specimen library abbreviation. The order of prefectures follows the Ministry of Internal Affairs and Communications' National Local Government Code (Ministry of Internal Affairs and Communications of Japan, 2025). Collectors are listed in alphabetical order, and specimen numbers are listed in ascending order from lowest to highest. –indicates unknown collector.

JAPAN. Prf. Akita: *–5360, 5361, 5362, 5363* (AKPM), **Prf. Ibaraki:** *Makino, T. B100411, B101619* (MAK), *Sasaoka, H. 7663, 229730* (TNS), *Sugimura, K. F110107* (INM); Duplicate specimen *Uzawa, M. MU 5724*, *Suzuki, Y. B102753* (MAK), **Prf. Tochigi:** *Kawaguchi, K. 36615* (TNS), *Matsumura, J. 36075* (TNS), *Numajiri, Y. 191081* (TNS), **Prf. Gunma:** *Nagano, I. 160606, 160636, 160643* (TNS), *Tsunoda K.36470, 7662* (TNS), **Prf. Saitama:** *Iwata, T. 24870* (TNS), *Nagano, I. 160581, 160582, 160586, 160587, 160588, 160589, 160594, 160595, 160596, 160597, 160598, 160601, 160602, 160607, 160608, 160609, 160611, 160613, 160614, 160615, 160616, 160617, 160618, 160619, 160620, 160621, 160622, 160623, 160624, 160625, 160626, 160627, 160628, 160629, 160630, 160631, 160632, 160633, 160637, 160638, 160639, 160640, 160641, 160642, 160644, 160645, 160646, 160647, 160648, 160649, 160650* (TNS), *Watanabe, R. 85952, 93512, 132448, 132656, 136290, 136319, 136408* (TNS), *–001184, 001185, 002295, 002296* (SMNH), *–223312, 223315* (TNS), **Tokyo:** *Nagano, I. 160603, 160604, 160605, 160612* (TNS), *Saito, K. 233222, 234023* (TNS), *Sekine, Y. 223311* (TNS), *–000442, 000443* (SMNH), *–C6029799a* (HYO), **Prf. Kanagawa:** *Kariya, S. 7667* (TNS), *Katsumata, Y. 191071* (TNS), *Saito, K. 230566, 230660* (TNS), *Sasaoka, H. 7666* (TNS), *–NB0007466, NB1002028, NB1002029, NB1002030, NB1002031, NB1002032, NB1002033, NB1002034* (KPN), **Prf. Yamanashi;** *Sasaoka, H. 7665* (TNS), *Takahasi, G. 7664* (TNS), *Watanabe, R. 89896, 92693, 95192, 126058, 134388* (TNS), *–2810* (AEC), **Prf. Nagano:** *Sakuma, E. 51493* (TNS), *–1118912, 1138461* (HIRO), **Prf. Gifu:** *–7650* (TNS), **Prf. Shizuoka:** *Fujii, K. 36424, 36601* (TNS), *Saito, K. 230359* (TNS), *–C6004350* (HYO), **Prf. Aichi:** *Watanabe, R. 127584, 127585, 127814, 129336, 135386* (TNS), *–1122434* (HIRO), **Prf. Mie:** *Kodama, T. 191079* (TNS), *Magohuku, T. 7657, 7658* (TNS), *Murata, K. 36077* (TNS), *Sasaoka, H. 7661, 24720* (TNS), *Tutiga, Y. 7659, 7660, 36469* (TNS), *Yasuda, A. 36468, 36471* (TNS), **Prf. Osaka:** *Sekine, Y. 223314* (TNS), *–103529, 103530, 103531, 103532, 103533, 103534, 103535, 103536* (OSA), **Prf. Hyogo:** *Kodama, T. 191067* (TNS), *Koidzumi, H. 191070, 191080* (TNS), *Magohuku, T. 7674* (TNS), *Matsushima, K. 191074* (TNS), *–C6004357, C6028073, C6029797b, C6029798b* (HYO), **Prf. Nara:** *Kusuyama, M. 7676* (TNS), *Tutiga, Y. 7648, 7649, 7653, 7675* (TNS), *–1110625, 1110648, 1110667, 1130559, 1130973, 1131179, 1132901, 1135976* (HIRO), *–C6004349, C6004352, C6004353, C6004358, C6004360, C6009119, C6009120, C6009121, C6009122, C6009123, C6009133, C6009134* (HYO), **Prf. Wakayama:** *Minakata, K. 7668, 7647, 7672, 7679, 7680, 7681, 22863* (TNS), *Uemura, T. 7669, 7670, 7671, 7673* (TNS), **Prf. Okayama:** *–C6011754* (HYO), **Prf. Hiroshima:** *Kasimura, I. 7654, 7655* (TNS), *–C6004356, C6004363, C6004365* (HYO), **Prf. Tokushima:** *Saito, K. 237529, 237630, 237676, 237707, 237710, 237718* (TNS), *–1125599, 1133480, 1139119, 1139189, 1139520, 1139870, 1140723* (HIRO), *–C6004359* (HYO), **Prf. Ehime:** *Ogata, M. 36271* (TNS), *Watanabe, T. 7677* (TNS), *–C6004354, C6004361* (HYO), **Prf. Kochi:** *Nagano, I. 160585, 160610, 160634, 160635* (TNS), *Saito, K. 234885, 237825, 237848, 237896, 238049, 238060, 238062* (TNS), *Yamamoto, K. 191083* (TNS), *–1122534, 1136958, 1138709, 1138774, 1138988, 1139987, 1141329* (HIRO), *–C6004355, C6004364* (HYO), **Prf. Fukuoka:** *Iwasaki, N. 7651* (TNS), *–1131400, 1132092, 1132795, 1132819* (HIRO), **Prf. Saga:** *Hirotsu 24752* (TNS), *Kuwabara, Y. 56422* (TNS), *Shiraga, J. 191075* (TNS), T*akenouti, M. 7652* (TNS), **Prf. Nagasaki:** *Amakawa, T. 54660* (TNS), *Osada, T. 54658, 54659, 54661* (TNS), **Prf. Kumamoto:** *Inoue, S. 245278, 245279* (TNS), *Tanaka, T. 223310* (TNS), *–C6028273* (HYO), **Prf. Miyazaki:** *Hattori, S. 191068, 191069, 191077, 191078, 191082* (TNS), N*agano, I. 160577, 160578, 160579, 160580, 160583, 160584, 160590, 160591, 160592, 160593, 160599, 160600* (TNS), *–1130221* (HIRO), **Prf. Kagoshima:** *Watanabe, R. 94801* (TNS), *–1140120* (HIRO), *–C6004351, C6004362* (HYO).

Appendix 2. Collection dates and number of specimens of *Pilotrichopsis dentata*.

Collection date	Number of specimens	Collection date	Number of specimens
1830s	1	1960s	26
1890s	1	1970s	40
1900s	4	1980s	27
1910s	15	1990s	11
1920s	16	2000s	12
1930s	20	2010s	15
1940s	7	2020s	1
1950s	79	Unknown	2

Appendix 3. Number of specimens of *Pilotrichopsis dentata* by Prefecture*.

Prefecture	Number of specimens	Prefecture	Number of specimens	Prefecture	Number of specimens
Hokkaido	0	Ishikawa	0	Okayama	1
Aomori	0	Fukui	0	Hiroshima	5
Iwate	0	Yamanashi	8	Yamaguchi	0
Miyagi	0	Nagano	3	Tokushima	14
Akita	4	Gifu	1	Kagawa	0
Yamagata	0	Shizuoka	4	Ehime	4
Fukushima	0	Aichi	6	Kochi	21
Ibaraki	6	Mie	11	Fukuoka	5
Tochigi	3	Shiga	0	Saga	4
Gunma	5	Kyoto	0	Nagasaki	4
Saitama	65	Osaka	9	Kumamoto	4
Chiba	0	Hyogo	9	Ooita	0
Tokyo	10	Nara	25	Miyazaki	18
Kanagawa	13	Wakayama	11	Kagoshima	4
Niigata	0	Tottori	0	Okinawa	0
Toyama	0	Shimane	0		

*Ministry of Internal Affairs and Communications of Japan. National Local Government Code. (Ministry of Internal Affairs and Communications of Japan, 2025)

Appendix 4. Number of specimens of *Pilotrichopsis dentata* collected from limestone sites in Japan.

Names of places where limestone sites are distributed (Prefectures)	Number of specimens
Mt. Buko (Saitama)	25
Mt. Futago (Saitama)	13
Mt. Ishidateyama (Tokushima)	5
Mt. Mitsumine (Saitama)	5
Mt. Kosyo (Fukuoka)	4
Kamino Valley, Byoubu Rock (Nara)	3
Mt. Tenso (Tokyo)	3
Mt. Torigatayama (Kochi)	3
Mt. Yokogura (Kochi)	3
Mt. Komono (Mie)	2
Mt. Shiraiwa (Saitama)	2
Mt. Yuno (Mie)	2
Mt. Adati (Fukuoka)	1
Mt. Ishidate (Kochi)	1
Mt. Kano (Gunma)	1
Mt. Kuishi (Kochi)	1
Kitou area (Tokushima)	4
Total	78

Appendix 5. Number of specimens of *Pilotrichopsis dentata* collected from *Fagus crenata* forests in Japan.

Names of places where *Fagus crenata* forests are distributed (Prefectures)	Number of specimens
Mts Tanzawa (Kanagawa)	9
Mt. Kohya (Wakayama)	7
Mt. Oodaigahara (Nara)	6
Mt. Tsukuba (Ibaraki)	5
Mt. Ryogami (Saitama)	2
Mt. Shiraiwadake (Akita)	2
Mt. Amagi (Shizuoka)	1
Mt. Gomadan (Wakayama)	1
Mt. Ishizuchisan (Tokushima)	1
Mt. Kaikoma (Nagano)	1
Mt. Kintoki (Kanagawa)	1
Mt. Kongo (Osaka)	1
Mt. Nonobori (Mie)	1
Mt. Ooyama (Kanagawa)	1
Mt. Rokko (Hyogo)	1
Mt. Ryugamori (Akita)	1
Mt. Tara-dake (Saga)	1
Mt. Usimawari (Wakayama)	1
Mt. Wagadake (Akita)	1
Nikko Three Mountains (Tochigi)	1
Total	45