Ecological and geographical notes on the genus *Mylia* in Japan

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It is difficult to give precise information about the distribution of two species which show striking similarities not only in morphological features but also in ecological amplitudes. The genus *Mylia* in Japan contains two species, *M. taylori* and *M. verrucosa*. The former is widely distributed in Europe, North America, Asia, etc., and the latter is known only from Asia. These species resemble each other superficially in the morpbological features except for perianths. When materials were not fertile, therefore, it had been said that the separation of these species could be established only with difficulty. At present, therefore, we have only superficial knowlege with respects to the ecology and geography of *Mylia* in Japan.

The present paper deals with the results obtained from careful examination of 152 specimes of *M. taylors* and233 of *M. verrucosa*, taking special note of the ecology and geography of the genus. The author is afraid that regional scantiness of collections, except Shikoku which is a home region to him, may brought about rather unsatisfactory result of study. However, if the present study contributes to the knowledge of the hepatic flora of Japan, his purpose would be accomplished.

I. Differentiation. K. Müller (1911) regarded *M. verrucosa* as an arctic-xerophytic type of *M. taylori* which has a wide distribution. However, the two species are mutually independent as valid species. Accordingly nor can *M. verrucosa* be regarded as a subspecies or variety of *M. taylori*.

In the two species of *Mylia* in Japan, the perianths, leaf-shapes, and oil-bodies are important diagnostic characters. When fertile, *M. verrucosa* is readily distinguished from *M. taylori* by the perianth which has the protuberances at the lower, inflated portion, while the perianth of *M. taylori* is totally smooth.

As pointed out by Hara (1956) and confirmed by Inoue (1958), the two species can be easily separated by the leaves alone. The leaves of *verrucosa* are rectangular to oblong-ovate and the dorsal margins are strongly reflexed, while those of *taylori* are usually widely ovate to occasionally orbicular with the dorsal margins slightly reflexed. As shown in Fig. 1, the leaf-shape, with the exception of the variation in leaf-size, is highly uniform in each species without the influence of environmental condition.

The difference in the size and number of oil-bodies is also a valuable separating feature between the two species: in *M. taylori* there are mostly 9−14 oil-bodies per cell that are 18−20×7−9μ; in *M. verrucosa* there are usually 16−26 oil-bodies per cell that are 15−17 ×6−8 μ. Thus *M. verrucosa* differs from *M. taylori* in the smaller and many oil-bodies. In addition to the differences in leaves, oil-bodies, and perianths, the difference in habits may be stressed as a diagnostic feature between the two species. When typically developed, *M. taylori* forms deep and dense mats, in which the individual plants are ascending, while *M. verrucosa* shows a prostrate growth with ascending apex. Such a difference in habits

Eig. 1. Leaves (×14) and median leaf-cells with oil-bodies (×366) of *M. verrucosa* (1−9) and *M. taylori* (10−17).

M. verrucosa − 1. Mt. Yupari, Hokkaido, *24659*. 2. Mt. Hayachine, N. E. Honshu, *8425*. 3. Mt. Iide, N. E. Honshu, *8745*. 4. Mt. Chogatake, M. Honshu, *21689*. 5. Mt. Komagatake (Kiso-koma), M. Honshu, *15551*. 6. Mt. Shiraga, Shikoku, *11423*. 7. Mt. Kirishima, Kyushu, *20502*. 8, 9. Mt. Kazigamori, Shikoku.

M. taylori − 10. Mt. Hakkoda, N. E. Honshu, *8132*. 11. Mt. Tenso, M. Honshu, *7755*. 12. Mt. Komagatake (Kai-Koma), M. Honshu, *21577*. 13. Mt. Komagatake (Kiso-koma), M. Honshu, *15575*. 14. Mt. Bukkyogatake, S. W. Honshu, *20899*. 15. Mt. Tsurugi, Shikoku, *17713*. 16, 17. Mt. Kazigamori, Shikoku.

will aid in separating the two species by naked eye from the mats in which the two species grow intermingled.

II. Ecology. (1) Substratum. The substratal features of these species are persented in Tables 1 and 2. Judging from the substratal features, it may be said that both species are rather acidiphilous. Their abundant occurrence on decayed woods indicates the acidiphilous nature of the species. In the case of occurrence on barks (mostly being restricted to trunk-bases), they are found on coniferous trees, such as *Cryptomeria japonica*, *Chamaecyparis obtusa*, *Tsuga sieboldii*, *T. diversifolia*, *Abies firma*, and *Pinus pumila*.

Table 1. Substratal feature of *M. taylori*

District	D. wood	Humus or soil	Trunk-base	Rock	Num. of specimen
N. E. Honshu	50 %	—	17 %	33 %	6
M. Honshu	—	39 %	—	61 %	23
S. W. Honshu	78 %	35 %	10 %	7 %	28
Shikoku	6 %	18 %	—	76 %	92
Kyushu	—	—	50 %	50 %	2
Japan	20 %	18 %	4 %	58 %	151

Table 2. Substratal feature of *M. verrucosa*

	D. wood	Humus or soil	Trunk-base	Rock	Num. of specimen
Hokkaido	60 %	—	—	40 %	10
N. E. Honshu	59 %	8 %	—	33 %	12
M. Honshu	78 %	12 %	4 %	6 %	84
S. W. Honshu	100 %	—	—	—	2
Shikoku	30 %	40 %	12 %	18 %	102
Kyushu	—	18 %	76 %	6 %	17
Japan	49 %	24 %	13 %	14 %	227

When saxicolous, these species grow generally on granite and chert but are never found on limestone.

With regard to the substratal preference, the two species seem to exhibit some contrast. On the basis of the author's observation as to the species in Shikoku, it may be said that *M. taylori* has some preference for rocks, while *M. verrucosa* has a marked preference for decayed woods. Such a corticolous nature of *M. verrucosa* may be facilitated its occurrence to calcareous regions. It is generally said that both species never occur in calcareous regions. However, the author observed *M. verrucosa* growing only on decayed woods at the calcareous sites on Mts. Torigata and Ishidate, Shikoku. These mountains are composed mainly of limestone. *M. taylori* is never found in such areas.

There is an extreme case in which *Clethra barbinervis* (Ryobu in Japanese) becomes the host tree of *M. verrucosa*. This deciduous tree has smooth and thin bark which is less

favorable for the growth of moss. The author observed such a case at an open site near Onami crater-lake on Mt. Kirishima, Kyushu. There, *M. verrucosa* forms health mats on the trunks and trunk-bases of the trees. From the fact noted above, it may be suggested that this hepatics can withstand comparatively xeric environmental conditions.

(2) Communities. Tables 3 and 4 show respectively the frequency of the prominent species associated with these two species. 40 species of Hepaticae were observed as companions of *M. taylori* and 54 species were determined as species associated with *M. verruccsa*. The difference in the number of the companions of the two species may be brought by the difference of the number of specimens treated. However, the result may possibly be true, judging from some differences of the habit and the subtratal preference between the two species. As already mentioned, in the growth form, *M. verrucosa* is postrate, growing on decayed woods, while *M. taylori* is ascending in dense mats, occurring on rocks. Accordingly, mats of the former are apt to facilitate the invasion of many other corticolous hepatics, while dense patches of the latter hardly permit that of other hepatics. Indeed, *M. taylori* grows often solely on moist and shaded rocks.

Table 3. Frequency of the prominent species associated with *M. taylori* (152 packets)

Lophozia porphyroleuca	11.84 %
Odontoschisma denudatum	9.21 %
Bazzania denudata ssp. *ovifolia*	7.86 %
Cephalozia media	6.71 %
Mylia verrucosa	6.71 %
Bazzania yoshinagana	6.57 %
Herberta hutschinsiae ssp. *schusteri*	5.92 %
Orthocaulis attenuatus	5.92 %
Lepidozia vitrea	5.26 %
Microlepidozia makinoana	5.26 %
Nowellia curvifolia	5.26 %
Scapania ampliata	5.26 %
Diplophyllum taxifolium	4.60 %
Lophozia incisa	3.94 %
Nipponolejeunea pilifera	3.94 %
Ptilidium pulcherrimum	3.94 %
Scapania parvitexta	3.94 %
Anastrophyllum michauxi	2.63 %
Bazzania bidentula	2.63 %
Blepharostoma trichophyllum	2.63 %
Other Hepaticae 20 spp.	1.97～0.65 %

Table 4. Frequency of the prominent species associated with *M. verrucosa* (233 packets)

Cephalozia media	12.87 %
Scapania bolanderi	12.01 %
Microlepidozia makinoana	11.58 %
Blepharostoma trichophyllum	10.72 %
Lepidozia reptans	10.72 %
Bazzania albicans	8.15 %
Scapania ampliata	8.15 %
Odontoschisma denudatum	7.72 %
Lophozia cornuta	6.86 %
Lepidozia vitrea	6.43 %
Cephalozia leucantha	6.00 %
Bazzania denudata ssp. *ovifolia*	5.15 %
Mylia taylori	4.72 %
Bazzania bidentula	3.86 %
Jamesoniella autumnalis	3.86 %
Diplophyllum taxifolium	3.43 %
Lophozia porphyroleuca	3.43 %
Herberta hutschinsiae ssp. *schusteri*	3.00 %
Lophozia incisa	2.57 %
Tritomaria exsecta	2.57 %
Other Hepaticae 34 spp.	2.17～0.42 %

Prominent members occurring with *M. taylori* are *Bazzania denudata* ssp. *ovifolia*, *Cephalozia media*, and *Microlepidozia makinoana* throughout Japan, *Lophozia porphyroleuca* and *Orthocaulis attenuatus* in middle to northern Japan, and *Odontoschisma denudatum*, *Mylia verrucosa*, *Bazzania yoshinagana*, *Lepidozia vitrea*, *Nowellia curvifolia*, *Scapania ampliata*, *Diplophyllum taxifolium*, and *Herberta hutschinsiae* ssp. *schusteri* in south-western Japan.

Prominent companions of *M. verrucosa* are *Cephalozia media*, *Microlepidozia makinoana*, *Blepharostoma trichophyllum*, *Scapania ampliata*, and *Bazzania denudata* ssp. *ovifolia* throughout the country, *Lepidozia reptans*, *Cephalozia leucantha*, *Lophozia porphyroleuca*, and *Calypogeia neesiana* in middle to northern Japan, and *Scapania bolanderii* and *Lepidozia vitrea* in middle to south-western Japan.

III. Geographical distribution. (1) Horizontal distribution. The patterns of the horizontal distribution of these two species seem to be almost identical with each other. At present, however, the author can not clarify their significant patterns of distribution because of the regional scantiness of collections. With respect to the distribution of *Mylia* in Japan, Hokkaido poses us an interesting problem. Up to the present time, the species of *Mylia* recorded from Hokkaido by other authors is totally *M. verrucosa*. In 1955 Hattori reported the species from Mt. Apoi and in 1957 from Rishiri and Rebun Islands. Inoue (1958) recorded it from Mts. Apoi and Taisetsu. The author's specimens from Hokkaido were also *M. verrucosa*. It is natural that it occurs in Hokkaido, because the type locality of *M. verrucosa* is Saghalien. However, it is unnatural that *M. taylori* is not yet found there, judging from facts that the species ascends to higher elevations than *M. verrucosa* and that therefore it is likely to have a more resistibility to cold.

When one discuss the flora of a certain area, it is extremely difficult to decide the absence of a certain species from the flora. Especially in the case of bryophytes, such a determination may be impossible. There is a possibility that *M. taylori* may exist in Hokkaido. More abundant collections are needed to clarify this point.

(2) Vertical distribution. These two species are widely distributed throughout the deciduous forest and the coniferous forest zone. The vertical distribution is shown in Fig. 2. From this figure, it is seen that the range of the vertical distribution of *M. taylori*, as a whole, tends towards higher elevations than that of *M. verrucosa*. With respect to the vertical distribution, these two species occassionally display a few interesting features. When they are distributed on a mountain, the lowest limit of the occurrence is generally marked by *M. verrucosa*, and the highest limit by *M. taylori*. Further, though it may be an extreme case, there is an interesting fact that they are sometimes distributed within different ranges in elevation. Such a case has been known on Mts. Ishizuchi and Higashi-akaishi, Shikoku. On Mt. Higashi-akaishi, *M. verrucosa* is found at the elevation of 600−1200 m, and *M. taylori* is distributed at the elevation of 1300−1500 m. On Mt. Ishizuchi, *M. verrucosa* occurs at the elevation of 700−1100 m, and *M. taylori* grows at the elevation above 1400 m.

The highest elevation known for *M. taylori* is 2850 m on Mt. Senjo, Nagano Prefecture, Middle Honshu, where it occurs on rocks or soil, and the lowest elevation is 850 m in Yokotani, Kami-gun, Kochi Prefecture, Shikoku, where it grows on soil. The highest elevation of the occurrence of *M. verrucosa* is 2750 m on Mt. Komagatake, Yamanashi Prefecture, middle Honshu, where it occurs on decayed woods, and the lowest elevation, on the basis of Hattori's report, is about 350 m on Mt. Apoi, Hokkaido, where it occurs on trunk-bases covered by humus. The lowest elevation of *M. verrucosa* known in the other regions except Hokkaido is 600 m in Befu, Kami-gun, Kochi Prefecture, where it occurs on decayed woods.

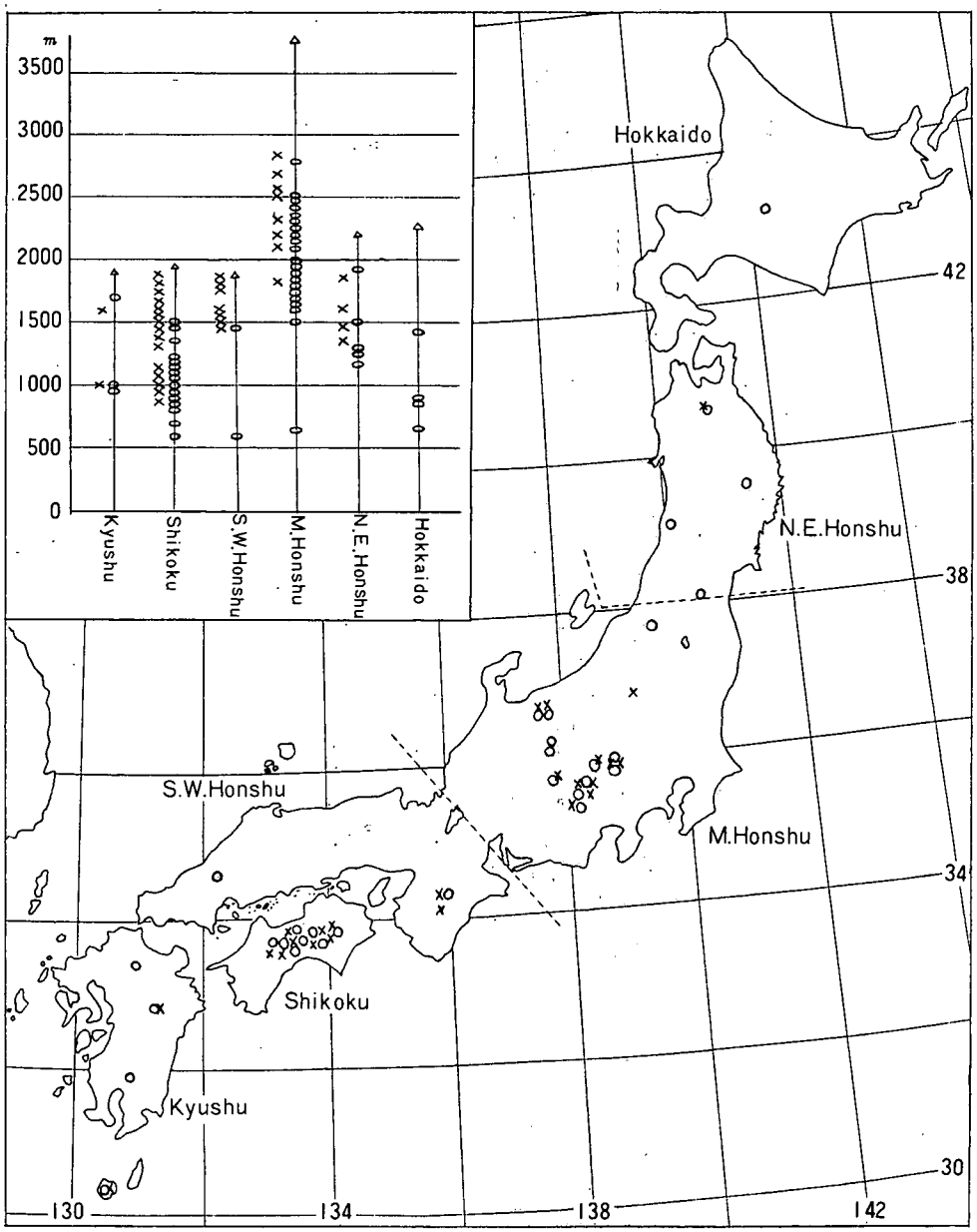

Fig. 2. Horizontal and vertical distribution of *M. taylori* (×) and *M. verrucosa* (○).

Specimens of *M. taylori*. **N. E. Honshu**. Pref. **Aomori**: Mt. Hakkoda (1400 m, on d. w.* *8123, ~24*; 1380 m, on t. b. *8132*). Pref. **Iwate**: Mt. Hayachine (1800 m, on r. *8508, ~09*). Pref. **Yamagata**: Mt. Zawo (1620 m, on d. w. *13511*).

M. Honshu. Pref. **Tokyo**: Mt. Tenso (1800 m, on r. *7754–7756*). Pref. **Yamanashi**: Mt. Koma (2750 m, on r. & h. *21564, ~65, ~72, ~73, ~74, ~78*). Pref. **Nagano**: Mt. Yatsu (2100 m, on h. S. Nakanishi, *13783*; 2200 m, on r. *16095*), Mt. Senjo (2500 m, on r.

* d. w. ……decayed wood, h. …… humus, s. ……soil, t. b. ……trunk-base, r. ……rook.

21397; 2850 m, on r. & s. *21434–21437*, *~46*), Mt. Koma (2200 m, on r. *15574*, *~75*), Mt. Osawadake (2550 m, T. Seki, *13892*). Pref. **Toyama**: Midagahara (2300 m, on r. *16463*, *~65*), Mt. Jodo (2820 m, on h. and s. *16443*, *~54*).

S. W. Honshu. Pref. **Nara**: Mt. Sanjo (1450 m, on d. w. *20751*; 1550 m, on t. b. *20664*, *20665*; 1580 m, on r. *20672*, *20674*), Mt. Misen (1500 m, on d. w. *20897*, *~99*, *20912*, *~13*, *~16*, *~17*, *~26*; 1550 m, on d. w. *20949*, *~53*; 1600 m; on d. w. *20960*, *~62*, *~63*; 1750 m, on d. w. *20984*; 1850 m, on b. *20986*; Mt. Bukkyo (1900 m, on d. w. *20997*, *21022–23025*, *21027–21029*; 1800 m, on h. *21051*).

Shikoku. Pref. **Tokushima**: Mt. Tsurugi (1530–1700 m, on r. *5338–5340*, *6731–6738*, *6877–6882*; 1750 m, on r. *17693*, *~94*, *17714*). Pref. **Ehime**: Mt. Higashi-akaishi (1300 m, on h. *18025*, *18026*; 1400 m, on r. *18069*; 1450 m, on d. w. *1699*; 1500 m, on h. *18097*), Mt. Sasagamine (1400 m, on r. *22042*; 1650 m, on t. b. *22077*, *~78*), Mt. Ishizuchi (1450 m, on s. *6047*, *~48*; 1800 m, on r. *6154*; 1850 m, on d. w. *16935*; 1900 m, on r. & d. w. *16934*, *~48*). Pref. **Kochi**: Mt. Kazigamori (930 m, on r. *23863*; 1150 m–1300 m, on r. *1526*, *2113*, *8958*, *8985*, *23863*, *~65*, *~66*, *23895–23902*, *23912*, *~18*, *~26*, *~27*, *~33*, *~34*, *23963–23969*, *~71*), Mt. Shiraga (1300 m, on r. *3408*, *3418*, *3483*), Mt. Kuishi, Nagaoka-gun, (1500 m, on r. *23240–23244*, *23248*, on h. *23277*, *23280*, *23308–23314*), Mt. Kanpu (1700 m, on r. *22199*, *22232*), Mt. Kanmuri~Heikedaira (1700 m, on r. *22326*, *~27*), Yokotani, Kami-gun (800 m, on s. *17296*), Mt. Kuishi, Tosa-gun (850 m, on r. *22999*, *23000*, *23003*, *~04*; 915 m, on r. or s. *22711*, *~12*, *22738*, *~40*, *~41*; 1160 m, on d. w. *22902*; 1170 m, on r. *22892*, *~95*, *~98*, *~99*), Mt. Sekko (915 m, on r. and s. *22711*, *~12*, *22738*, *~40*, *~41*).

Kyushu. Pref. **Oita**: Mt. Sobo (1580 m, on r. *17506*). Pref. **Kagoshima**, Yakushima (1000 m, on t. b. *11684*, *~85*).

Specimens of *M. verrucosa*. **Hokkaido.** Mt. Yupari (680 m, on d. w. *24624*; 720 m, on d. w. *24633–35*; 850 m, on d. w. *24659*; 860 m, on d. w. *24671*, *~72*; 1400 m, on r. *24822*, *~25*, *~27*, *~36*).

N. E. Honshu. Pref. **Aomori**: Mt. Hakkoda (1250 m, on d. w. *7930*; 1280 m, on d. w. *7965*, *~73*; 1900 m, on d. w. *8166*, *~68*; 1500 m, on d. w. *8425*). Pref. **Yamagata**: Mt. Chokai (1180 m, on r. *13607*, *~10*).

M. Honshu. Pref. **Fukushima**: Mt. Iide (1500 m, on h. *8745*), Mt. Hiuchi (on t. b. H. Ando, *13880*). Pref. **Saitama**: Mt. Siroiwa (1890 m, on d. w. *7626*, *~27*). Pref. **Tokyo**: Mt. Tenso (1700 m, on r. *7800*), Mt. Kumotori (1800 m, on d. w. *7495–7498*; 1830m, on d. w. *7533*; 1820 m, on d. w. *7525*; 1900 m, on d. w. *7569*). Pref. **Toyama**: Mt. Tateyama (E. Nokubo *13789*); Kurobe (670–700 m, on r. H. Ando, *13871*). Pref. **Yamanashi**: Mt. Koma (2100 m, on d. w. *21453*, *21454*; 2250 m, on d. w. *21494*; 2750 m, on d. w. *21518*), near Sensui Pass (2250 m, on d. w. *21484*, *~86*, *~91*, *~92*), Mt. Howo (1940 m, on d. w. S. Nakanishi, *13877*), Hirokawara (1900 m, on d. w. *13778*). Pref. **Nagano**: Mt. Nagakabe (2000 m, on d. w. *21634*, *21635*), Mt. Chogatake (2400–2450 m, on d. w. *21696*, *21712*; 2450–2500 m, on d. w. *21687–21689*, *21696*), Kamikochi (1560 m, on d. w. *21835*, *~36*), Akagawara~Kitazawa Pass 1600 m, on d. w. *21290*, *21292–21296*, *21297*, *21313*; 1750 m, on r. *21335*; 1800 m, on d. w. *21340*, *~48*, *21352–21354*; 1900 m, on d. w. *21358–21360*, *~64*). Mt. Koma (1900 m, on d. w. *15490*, *~94*, *~96*; 2000–2100 m, on d. w. *15550*, *~51*, *~67*; on t. b. *15965*, *~66*; 2200 m, on d. w. *15578*, *15928*, *~32*, *~34*, *~35*, *~42*; 2300 m, on d. w. & h. *15168*, *15886*, *~88*, *~91*, *~92*, *~96*, *15949*; 2350m, on d. w. *15897*), Mt. Yatsu (1650–1700 m, on s. *15976*; 1890 m, on r. S. Nakanishi, *13872*; 1950 m, on d. w. *16083*; 2150 m, on h. S.

Nakanishi, *13876*; 2350 m, on s. S. Nakanishi, *13874*; 2270 m, on r. S. Nakanishi, *13876*; 2350 m, on h. & d. w. *16376*, ~*82*; 2400 m, on d. w. *16202*, ~*07*), Mt. Osawadake (1170–1900 m, on d. w. T. Seki, *13893* a).

S. W. Honshu. Pref. **Nara**; Mt. Sanjogatake (1450 m, on d. w. *2075*). Pref. **Hiroshima**: Sandan-kyo (600 m, on d. w. H. Ando *67176* in HIRO).

Shikoku. Pref. **Tokushima**: Higashi-iyayama-mura (1000 m, on h. *15215*), Mt. Kunimi (1350 m, on t. b. *23375–23381*). Pref. **Ehime**: Mt. Higashi-akaishi, (600 m, on r. *17913*; 1100–1200 m, on d. w. *1907*, *17960*, ~*65*, ~*66*, *18005*), Mt. Nishi-akaishi (700–800 m, *24870*, ~*71*, ~*98*), Mitsumori Pass (900–1000 m, on humus-covered rock, T. Yamanaka, *9356*), Mt. Sasagamine (1350 m, on h. *22024*, ~*25*, ~*29*, ~*30*; 1400 m, on r. *22041*), Omogo (700–800 m, on d. w. or s. *10372*, *17050*, ~*51*, ~*53*, ~*58*, ~*61*, ~*68*). Pref. **Kochi**: Befu, Kami-gun (550–600 m, on d. w. *18491*), Mt. Ishidate (1150 m, on h. *18573–18576*; 1200 m, on d. w. *19193*, ~*94*, *19289*, ~*90*; 1250 m, on h. *18595–18597*), Mt. Shiraga (1150 m, on t. b. *11422*, ~*23*), Kokitagawa~Mitsumori Pass (1050 m, on s. or h. *22434*, ~*37*, ~*39*; 1130 m, on s. *22405–22409*; 1180 m, on s. *22347*, ~*48*, ~*82*), Mt. Kazigamori (930 m, on d. w. *23866*; 1120–1150 m, on r. *23888*, ~*89*, ~*91*, *23898–23900*, *23912–23914*, *23918*, ~*19*, ~*26*, ~*33*; 1200–1220 m, on r. *8985*, *23966*). Mt. Kuishi, Nagaoka-gun (1050 m, on t. b. *23161–23164*; 1400 m, on h. *23195*, ~*96*, ~*99*; 1500 m, on r. or h. *23254*, ~*59*, ~*66*, ~*67*, ~*70*, ~*71*, ~*73*, ~*80*, *23305*, ~*06*), Mt. Kuishi, Tosa-gun (850 m, on d. w. *23035*, ~*37*; 1000 m, on d. w. *22833*, ~*36*, *22888–22890*; 1165 m, on d. w. *22903*), Mt. Torigata (200 m, on d. w. *23476*, ~*79*, ~*82*).

Kyushu. Pref. **Fukuoka**: Mt. Hiko (950 m, on t. b. *26306*). Pref. **Oita**: Mt. Sobo (1700 m, on r. *19515*). Pref. **Kagoshima**: Mt. Kirishima (1250 m, on t. b. & s. *20476*, ~*77*, ~*79*, ~*80*, ~*91*, ~*97*, *20500–20502*, ~*09*, ~*10*, ~*12*, ~*13*). Yakushima, Kosugidani~Hananoego (*3044*).

Summary

In the present paper are reviewed the diagnostic characters, ecological amplitudes, and geographical distributions of the two species of *Mylia* in Japan.

1. These two species have important distinguishing characters in the perianths, the leaf-shapes, and the oil-bodies.

2. Judging from the substratal features, both species are acidiphilous and never occur on limestone. They exhibit some contrast as to the substratal preference. Generally speaking, *M. taylori* has a preference for rocks and *M. verrucosa* has a marked preference for decayed woods.

3. Both species are widely distributed from the deciduous forest to the coniferous forest zone. The patterns of the horizontal distribution of these species seem to be almost identical with each other. With respect to the vertical distribution, however, *M. taylori* tends apparently towards higher elevation than *M. verrucosa*.

The authour wishes to express his sincere gratitudes to Prof. Yoshiwo Horikawa of Hiroshima University, for his kind guidance and suggestions.

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(Received September 29, 1965)