Geographical distribution of *Sporidesmium goidanichii* in pine forests of Japan*

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The geographical distribution of a saprotrophic hyphomycete, *Sporidesmium goidanichii* was studied in pine forests of Japan. Using the data of 282 fungal communities of pine leaf litter collected over a wide range of climatic conditions, the relationships among two indexes of distribution of the species (constancy and abundance) and three climatic variables were analyzed by the multiple regression analysis. The results demonstrated that the mean annual air temperature and the mean annual range (the difference in monthly mean air temperatures between the coldest and warmest months at the study sites) were necessary variables for the prediction of the values of indexes of *S. goidanichii* in pine forests of Japan, while the mean annual precipitation was an unimportant factor. The distribution patterns of the fungus along the gradients of two temperature variables were analyzed graphically. The fungus has an optimal climatic area with high values of indexes where is restricted to the center of the warm temperate regions of the main islands. The relationship between the life strategy of the fungus and its temperature-dependent distribution pattern in Japan was also discussed.

Key Words——climate; geographical distribution; pine leaf litter; saprotrophic microfungi; substrate preference.

Geographical distribution of fungi is a particularly difficult subject to approach, as mycologists have repeatedly described (Bisby, 1933; Pirozynsky, 1968; Wicklow, 1981). In particular, the study of distributions of saprotrophic microfungi is complicated by the wide range of substrates on which such fungi can grow. As a result, one often hesitates to conclude that a species is absent from a given site. Further, it is often difficult to find minute and ephemeral fruiting structures of microfungi on substrates in a field study. Consequently, mapping methods applied to vascular plants or macrofungi (Lange, 1974; Arnold, 1997) prove inappropriate for studying distributions of saprotrophic microfungi. As a result, our knowledge of the distributions of saprotrophic microfungi does not compare to that on macro- or parasitic fungi (Arnold, 1997).

In studying effects of climate on the distributions of saprotrophic microfungi in pine forests of Japan, I was confronted these problems. After careful consideration, I devised the following new approach to this sort of investigation. Fallen pine needles decaying on the ground were selected as a common substrate among study sites, and the distributions of fungal species inhabiting their surface were studied. This enabled us to compare the fungal species inhabiting the ecologically same microhabitat among various climatic places, since pines are distributed almost throughout Japan. Moreover, climatological data were collected for the study sites and used along with location in the subsequent analyses of distribution. Such an approach was especially necessary in Japan, since geographical coordinates are inadequate for descriptions of microclimate in mountainous terrain.

This paper describes the results of analyses on geographical distribution of a saprotrophic fungus with the above-described approach. The relationship between *Sporidesmium goidanichii* (Rambelli) S. J. Hughes in pine forests of Japan and climatic conditions was investigated by analyzing the data on fungal communities obtained from 282 samples of pine leaf litter collected at 161 locations over a wide range of climatic conditions. The target species is saprotrophic, appears to have a strong preference to decaying needles of *Pinus densiflora* Siebold et Zucc., and persists on the surface of decaying needles over a considerably long period (Tubaki and Saitô, 1969). This last feature was considered important for the studies of climatic effects on the fungal distribution.

Materials and Methods

Distributions of *Pinus* species In Japan, native pines are widely distributed (Hayashi, 1960), and three two-leaf pines (*P. densiflora*, *P. thunbergii* Parlat. and *P. luchuensis* Mayr) are common within their own distribution ranges. Moreover, many introduced pines such as *P. sylvestris* L. or *P. mugo* Turra are widely planted in the Hokkaido district where indigenous pines (*P. pumila* Regel and *P. densiflora*) are rather restricted within narrow limits. Consequently, we could collect pine leaf litter throughout Japan.

The target fungus *Sporidesmium goidanichii* was selected as the target fungus in this study for the following reasons. Firstly, it is rarely missed on decaying pine needles observed under the microscope, even at low magnification (×4 or ×10 objective lens). This is due mainly to the large phragmoconidia (mostly 30–50 × 5–8 μm) of the species produced percurrently from the apices of conidiophores and often attached to the conidiophore on one side or other. Secondly, no other morphologically similar species have yet been found on decaying pine needles in Japan. Thirdly, the species appears to be widely distributed in leaf litter of Japanese pine forests (Tokumasu, 1981). Lastly, it persists on decaying needles for a long period (at least over one yr), so that its distribution pattern should reflect the incline of climatic conditions observed from north to south in Japan. Tubaki and Saitô (1969) found that this dematiaceous hyphomycete inhabits the surface of decaying needles of *P. densiflora* and forms a network of dark pigmented hyphae, though they described it as a new *Endophragmia* species, *E. alternata* Tubaki and Saitô. They also suggested that the species is an ecological equivalent to *Sympodiella acicola* Kendrick and *Troposporella monospora* (Kendrick) M. B. Ellis found on the F_1 layer needles of *P. sylvestris* L. in England. The latter two hyphomycetes were recognized as the species that quickly invade in freshly fallen needles from litter and persist there over one yr (Kendrick and Burges, 1962).

Collection of pine leaf litter A total 282 litter samples were collected from 161 locations throughout Japan from 1977 to 2001 (Appendix). The samples included the leaf litter of four indigenous and six introduced pine species. Macroclimatic conditions of the collection sites were extremely diverse, i.e., from subtropical to subarctic. The sites also varied in vegetation type and the degree of disturbance. In addition, the samples were collected in various seasons.

Intact leaf litter was collected from a 10×10 cm area of the forest floor where the O horizons were well developed. When the O horizon did not layer or was considerably disturbed, a mixture of needles of various degradation stages was collected from the ground surface. The collected samples were preserved at room temperature until it could be dealt with. When mycological observation was delayed, they were quickly air-dried to avoid the secondary growth of dormant fungi and bacteria just after collection.

Mycological observations In the laboratory ten needles from each of the following categories were selected from individual samples: freshly fallen, brown needles (indicated as L-type needles in this text); partly decomposed, faded needles (as OL-type needles); and decomposed, blackish needles of the upper part of the F_1 layer needles (as F_{11}-type needles). Sets of twenty needles were taken in several samples.

A washing method (Tokumasu, 1980) was consistently adopted for the pre-treatment of all samples in order to record active fungi just at the time of collection.

A set of two washed needles was placed on the surface of a weak cornmeal agar plate (Tokumasu, 1980)

and five or ten such plates per sample were prepared. The plates were incubated on the laboratory bench where light and temperature conditions were not precisely controlled. They were kept for one mo and observed using a light microscope at least four times at proper intervals; and fungi sporulating on and around each of the needles were recorded.

Factors selected The climatic elements representing the conditions of each collection site are follows: mean annual air temperature (AT); mean annual precipitation (AP); and mean annual range of monthly mean air temperatures (AR) which means the difference of monthly mean air temperature between the coldest and the warmest month in a given site. As the values of these elements of a given sampling site, those of the meteorological observatory that was the closest to the sampling site were used (Japan Meteorological Agency, 2001).

Processes of the crude data Crude data on the occurrence of the species in individual samples are shown in Appendix, and Table 1 in summary form.

Sporidesmium goidanichii occurred mainly on the OL- and F_{11}-type needles (Table 1), which agreed with the results of earlier studies (Tubaki and Saito, 1969; Tokumasu, 1981). Although it was recorded from the L-type needles (Table 1), the number of samples with the occurrence record of the fungus was about 20% and the number of colonized needles was only 13% in comparison with those of the OL- and F_{11}-type needles. In contrast, the numbers of samples and needles that the species was recorded were almost same between the OL- and F_{11}-type needles as shown in Table 1. In the final analysis, therefore, I excluded the data on the L type needles and the data of the OL- and F_{11}-type needles were integrated as a single datum for a sample.

For analyzing a relationship between the distribution of species and these climatic variables, 282 samples were classified into 11 groups based on the values of AT at the sites from which they were collected. The values of AT ranged from 4° to 26°, each group differing from the previous one by 2°C.

The values of species constancy and the species abundance (sense van Maanen et al., 2000) were calculated as the indexes of distribution of the species at every temperature range.

Species constancy was used as an index for representing the frequency of occurrence of the target species in the multiple unit communities (samples) taken from the community of a temperature range. It was calculated as follows:

Species constancy (%)=number of the samples of which the species was recorded/total number of samples examined × 100.

Species abundance was the proportion of the needles colonized by the species to the number of needles examined in the community of a temperature range. It was calculated as follows:

Species abundance (%)=number of needles colonized by the species/total number of needles examined × 100.

Statistical analysis The relationship between the species constancy and the climate factors was studied by

multiple regression analysis using the standardized data of the index and the climatic variables for 11 temperature ranges. The same procedure was also applied for analyzing the relationship between the species abundance and the climate variables.

The relationships between the constancy or abundance and individual climatic variables were also examined by making scatter diagrams to observe the distribution patterns along the gradients of climatic variables.

Analyses were performed using Microsoft Excel 2000 software. A P value of <0.05 was considered to be statistically significant.

Results

General distribution *Sporidesmium goidanichii* was found in the wide latitudinal range of $24°-43°N$, from the Iriomote Island in Okinawa Pref. to Asahikawa City in Hokkaido (refer to Appendix).

The fungus was recorded from the needles of three Japanese pines (*P. densiflora*, *P. thunbergii*, and *P. luchuensis*) and three introduced pines (*P. banksiana* Lamb., *P. contorta* Dougl., and *P. mugo*).

The range of AT where the species occurred was $5.1-23.7°C$, the range of AR was $10.3-28.8°C$, and the range of AP was 1,000–4,600 mm.

These results indicated that the species is widely distributed in the regions of various climatic conditions.

Effects of climatic factors The result of the multiple regression analysis in which three explanatory variables were used for the prediction of the species constancy values was as follows:

$y = 2.813x_1 + 3.47x_2 + 0.482x_3 - 6.401$
$r^2 = 0.674$
$y =$ species constancy
$x_1 =$ mean annual air temperature
$x_2 =$ mean annual range
$x_3 =$ mean annual precipitation.

The result of ANOVA showed that this regression equation was practical for the prediction of species constancy values. The result of t test for standardized partial regression coefficients showed that the AT and the AR were necessary for the prediction of species constan-

cy values, while the AP was unnecessary for the prediction. The standardized partial regression coefficient of the AR was larger than that of AT.

The result of the multiple regression analysis for the species abundance value is as follows:

$y = 3.137x_1 + 3.733x_2 + 0.519x_3 - 9.891$
$r^2 = 0.744$
$y =$ species abundance
$x_1 =$ mean annual mean air temperature
$x_2 =$ mean annual range
$x_3 =$ mean annual precipitation.

The result of ANOVA showed that this regression equation was practical for the prediction of species abundance values. The results of the t test for standardized partial regression coefficients showed the same results to the case of the species constancy. Thus, the AT and the AR were necessary for the prediction of the dependent variable of the species abundance, while the AP was unnecessary for the prediction. The standardized partial regression coefficient of the AR was also larger than that of AT in this case.

These analyses indicated that the AR is a more responsible explanatory variable than the AT, since the standardized partial regression coefficient of the former was larger than that of the latter in both cases. They also showed that the AP is a less important factor that limits the distribution of *S. goidanichii* in the pine forests of Japan.

Relationships between two distribution indexes and AT and AR Figures 1 and 2 show the distribution of *S. goidanichii* along the gradient of mean annual air temperature. The distribution of the species constancy was approximated with a quadratic equation (Fig. 1). The distribution of the species abundance was also estimated with a quadratic equation (Fig. 2). The peaks of both regression curves occur around $14.5°C$ of AT, and intersect the horizontal axis at around $5°C$ and $23.7°C$.

Figures 3 and 4 show the distribution of *S. goidanichii* along a gradient of AR. The distribution of the species constancy was approximated with a quadratic equation (Fig. 3). The distribution of the species abundance was also estimated with a quadratic equation (Fig. 4). The peaks of both regression curves occur near $19.5°C$ of an-

Table 1. A summary of frequencies of cocurrence of *Sporidesmium goidanichii* for every pine species and degradation stage.

Pinus spp.	No. of samples examined	No. of samples from which the species was recorded	No. of samples from which the species was recorded[a]			No. of needles from which the species was recorded[b,c]		
			L	OL	F11	L	OL	F11
P. densiflora	75	60	14	53	53	57	310	335
P. thunbergii	111	97	20	91	90	66	627	583
P. luchuensis	62	17	2	12	13	2	27	33
other species	34	7	1	5	5	1	14	10
Total	282	181	37	161	161	126	978	961

[a] As a result of the χ^2 test, a significant difference was observed in the species constancy between the L- and OL-, and between the L- and F11- layer needles, while no diffrence was observed between the OL- and F11- layer needles.

[b] As a result of the χ^2 test, a significant difference was observed in the species abundance between the L- and OL-, and between the L- and F11- layer needles, while no diffrence was observed between the OL- and F11- layer needles.

[c] The total number of needles examined is 3,130.
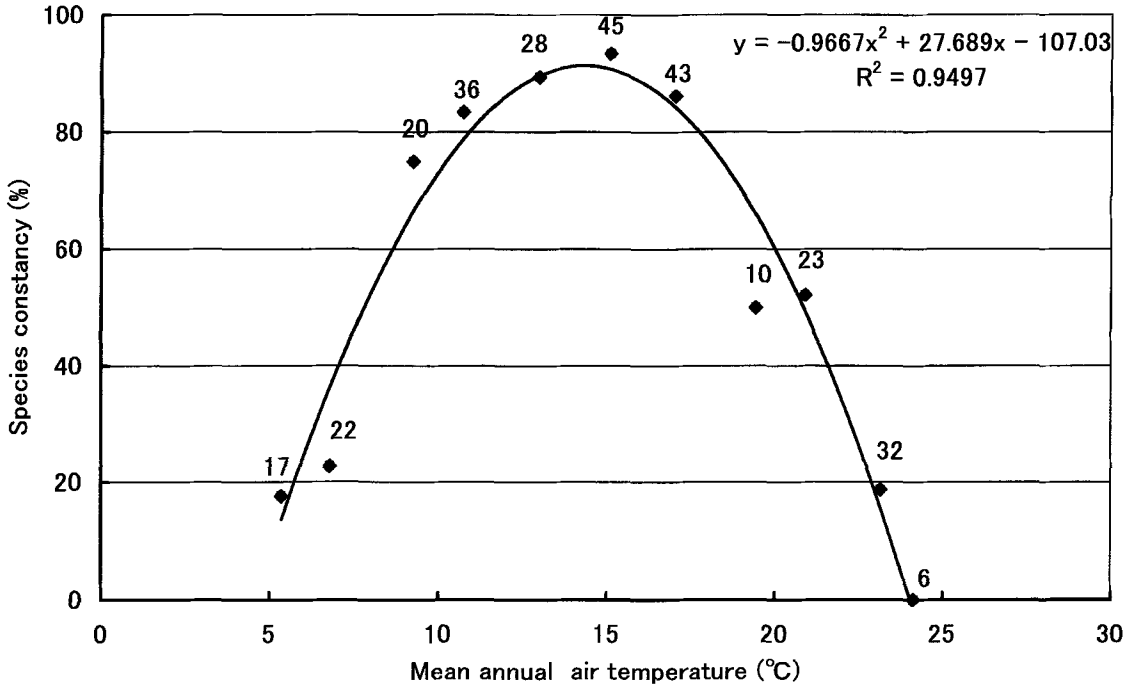
Fig. 1. Scatter diagram of species constancy over mean annual air temperatures. Figures show the sample size in each temperature range (the number of samples used for the calculation of averages). The equation presents the approximate curve.
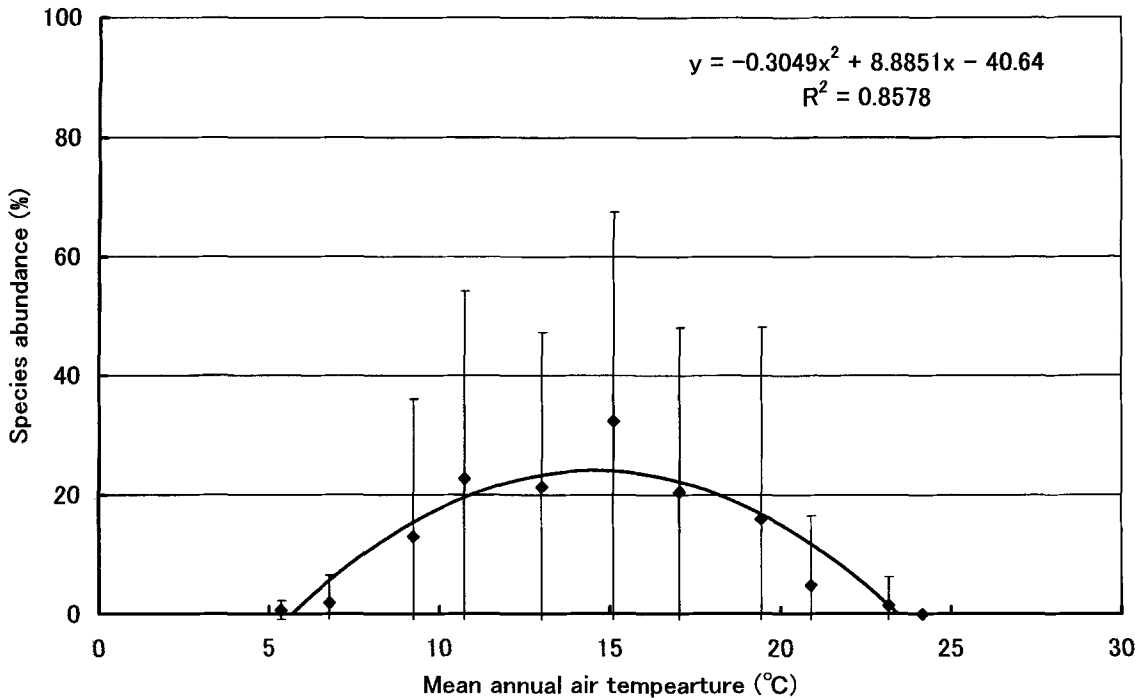
Fig. 2. Scatter diagram of species abundance over mean annual air temperature. Bars show the values of standard deviation of averages. The equation presents the approximate curve.

nual range, and intersect the horizontal axis at around 10°C and 29°C.

Correlation between climatic factors selected The correlations between climatic elements of the collection sites of 282 samples were performed by regression ana-

lyses, and a strong negative correlation was recognized between the AT and the AR ($r^2 = 0.8812$). There was a weak negative correlation between the AT and the AP ($r^2 = 0.4686$), and a similar correlation between the AR and the AP ($r^2 = 0.4075$).
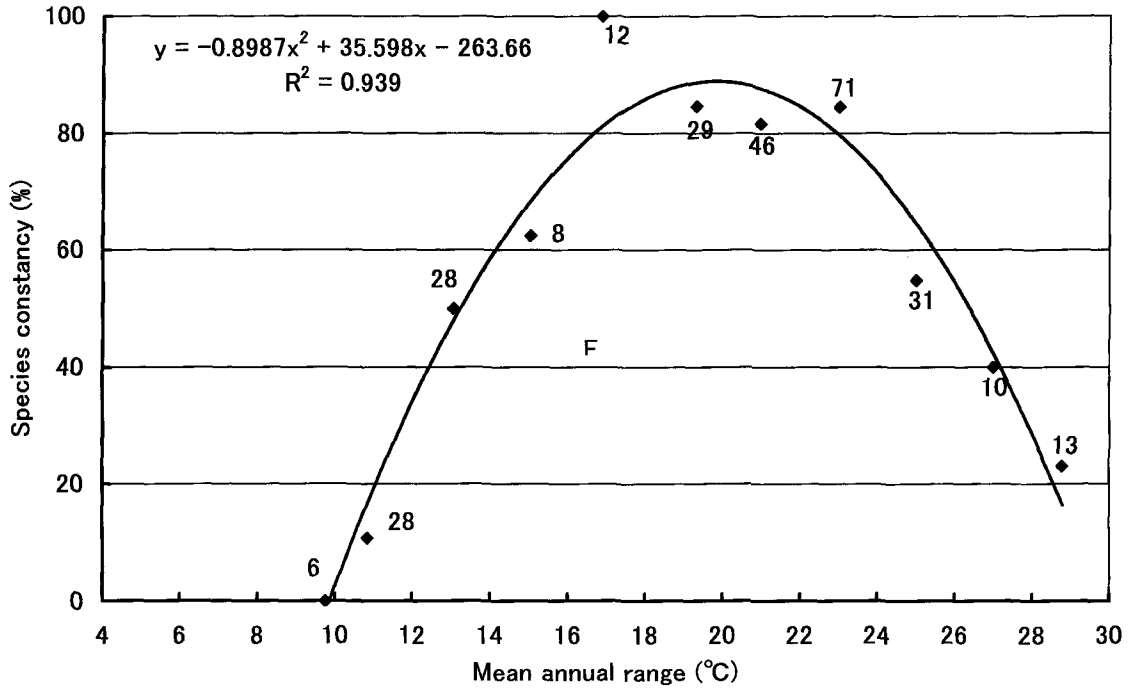
Fig. 3. Scatter diagram of species constancy over mean annual ranges. Figures show the sample size in each temperature range (the number of samples used for the calculation of averages). The equation presents the approximate curve.
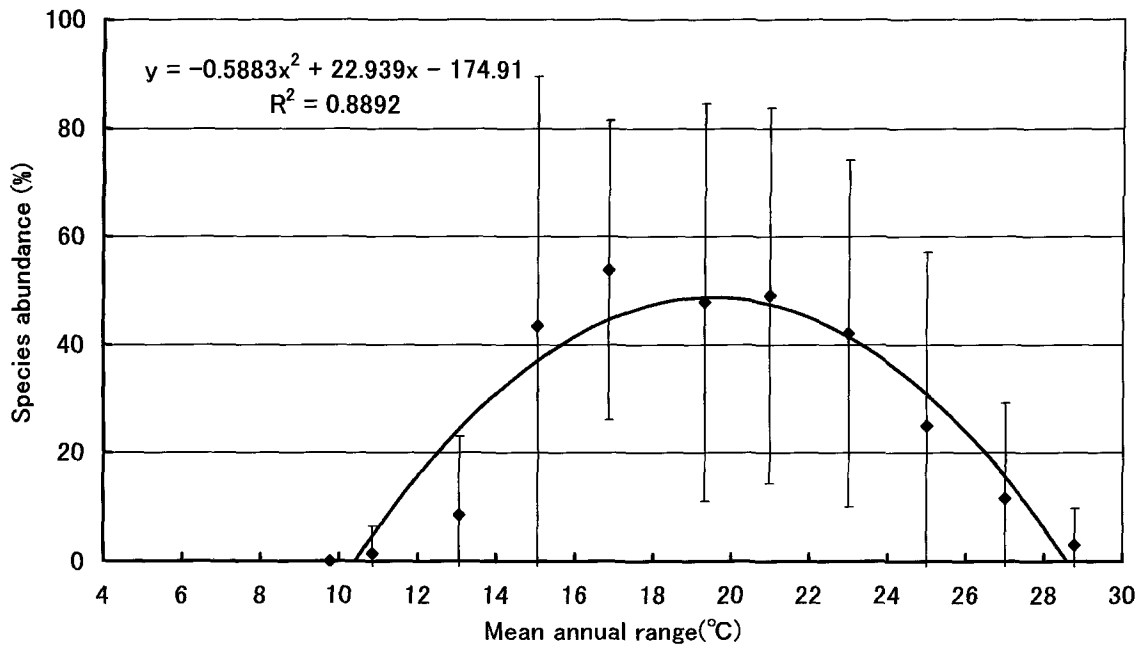
Fig. 4. Scatter diagram of species abundance over mean annual ranges. Bars show the values of standard deviation of averages. The equation presents the approximate curve.

Discussion

Climatic influences The results of the multiple regression analyses demonstrated that two temperature variables, mean annual air temperature and mean annual range would restrict the geographical distribution of *S. goidanichii* in the pine forests of Japan, while the

influence of the precipitation on the distribution is negligible. The humid climate of Japan that is brought by high precipitation occurring in all seasons should reduce the importance of precipitation as a limiting factor. In two effective temperature variables, the AR was to be a more important explanatory variable than the AT for the prediction of the dependent variables. The influence of the AR

on the distribution of the target species appears to be qualitatively different from that of AT, thought there is a strong negative correlation between these two factors. In order to estimate the concrete effects of individual factors on the distribution of the fungus, it will be necessary to study the phenology of the species in field and the physiological characters of it in culture.

The regression curves for the species constancy and the species abundance along the AT gradient and those along the AR gradient described a parabola (Figs. 1–4). It is apparent that the temperature ranges with large constancy and abundance values were almost same in both paired curves. This suggests that S. goidanichii has a climatic optimal region where the fungus occurs with high constancy and great abundance.

The optimal temperature range of the fungus is found in areas with a warm temperate climate such as the southwest regions of Honshu, Shikoku and Kyusyu. The distribution area of P. thunbergii and P. densiflora on whose needles the fungus occurred abundantly overlapped with this optimal zone for the fungus. In contrast, the fungus was not recorded the regions for which the values of AT and AR were comparatively extreme. For example, the fungus occurred sporadically on the needles of P. luchuensis which is restricted to the Nansei Islands (Table 1, Appendix). The Islands are characterized by an oceanic subtropical climate with a small annual range and high annual mean air temperature. The species was also recorded sporadically from the needles of introduced pines planted in the Hokkaido where the climate characteristics are exactly opposite to those of the Nansei Islands. These results suggest that the temperature factors are more important than the species of pines whose needles serve as substrate for the fungus.

These results agree in part with those obtained by van Maanen et al. (2000) in France who succeeded in demonstrating the effect of a regional climate gradient on the abundance of three fungi colonizing fallen pine needles by examining their distributions along two altitudinal transects. They noted that rainfall or/and temperature might be responsible for the distribution of the fungi they observed. The results of the present study suggested that among the major climate elements, temperature factors alone are responsible for the observed distribution of S. goidanichii. Probably, these different evaluations on the effect of precipitation on the distribution of coniferous leaf litter fungi result from macroclimatic differences between Japan and France.

The life strategy of S. goidanichii could be responsible for the observed high correlations of the species constancy and the species abundance with the two temperature variables of study sites. The species inhabits the surface of decaying needles in the L and F_1 layers of the O horizon and forms a dark reticulate hyphal network (Tubaki and Saitô 1969). Mitchell and Millar (1978) suggested that major source for the network former was nutrients in solution held by capillarity action between needles. Moreover, daily and seasonal fluctuations of temperature appear to be intense in this habitat, since the space in the surface layers of the O horizon is connected directly with the air outside. Thus, this environment may be very severe for common saprotrophic soil fungi, physically and nutritionally. However, S. goidanichii appears well-adapted to this extreme habitat. It is proper to classify the species as a stress-tolerant fungus that is characteristic of extreme environments (Dix and Webster, 1995). The species appeared to be also a slow-growing fungus because its colony diameters after one-month incubation at room temperature reached only about 10 mm on both 2% malt extract agar and Miura agar. This property may ensure a long persistence of the fungus in this habitat. At the same time, this perennial attribute may contribute to the close correlation between the distribution pattern of this species and annual mean climatic conditions of the study sites.

The regression curves (Figs. 1, 3) imply that the area with a climatically optimum area for the species is relatively small in Japan, and this might be a result of interspecific competition. Thus, there may be ecologically equivalents of S. goidanichii in both sides of its optimal range. Possible candidates would be stress-tolerant fungi that have distribution ranges partly overlapping that of S. goidanichii, as well as different optimum temperature ranges.

It appears to be important to study the distribution patterns of the ecological equivalents for determining concrete factors limiting the distribution of a target fungus. For example, van Maanen and Gourbiere (1997) studied the host and geographical distribution of two coniferous leaf litter fungi, Verticicladium trifidum Preuss (anamorph of Desmazierella acicola Lib.) and Thysanophora penicillioides (Roum.) Kendrick in the Western Europe and the countries ringing the Mediterranean Sea. They could compare the distributions of two species directly since both species are ecological equivalents, and find some pine litter in which both species coexisted. Based on this finding, they noted that inter-specific interaction is important as well as other factors of climate and coniferous species as major factors determining the distribution patterns of both species.

Distribution in other climatic regions   The latitudinal distributional range of this species observed in the pine forests of Japan cannot be always applicable to other geographic regions. The species has been recorded repeatedly in the British Isles from substrates other than pine needles at sites in latitudes north of Hokkaido (Ellis, 1976; Hughes, 1979; Kirk, 1982; Kirk and Spooner, 1984). It was also recorded in the tropics, on pine needles in Cuba (Castañeda et al., 1988). These records suggest that the actual latitudinal distribution range of the species is wider than that demonstrated in the present study.

It is remarkable that the kinds of major substrates from which this species were recorded are quite different between Japan and the Western countries. In Japan, the species occurs abundantly on pine needles decaying on the ground in the area where the annual mean air temperature is suitable for the species as proven by this study. In the British Isles, records of this species from decaying fallen pine needles are few, although there are

many studies on fungal successions associated with the decay of fallen pine needles following that of Kendrick and Burgess (1962). In contrast, this species has been reported frequently on the leave of broad-leaved trees in Great Britain, and Kirk (1982) noted that it appears to spread on a range of decaying leaf and stem types. In Japan, Yokoyama and Ito (1977) also noted "this fungus (*S. goidanichii*) is not uncommon in the evergreen oak forests of Japan". Judging from published years of these papers, the species identification was performed based on its morphology as the present study. However, its wider geographical distribution and records on various substrates leads one to suspect that the species should be divide into many geographically isolated populations or sibling species. Further analysis and consideration based on molecular data will be required to explain this regional differences in substrate preference.

Evaluation of study method In this study, a new approach was implemented for studying a large-scale distribution of saprotrophic microfungi. That is a semi-quantitative study of the distribution of a single fungus on a limited substrate with a wide geographical range. As a first investigation using this approach, the distribution of *S. goidanichii* was examined on fallen pine needles of pine forests in Japan. Accumulated data on the proportion of needles colonized by this fungus at the individual sites enabled us to calculate the values of the species constancy and the species abundance at each range of climatic variable divided at regular intervals and to analyze the correlation between the distribution of this saprotrophic fungus and climate factors by using multivariable analyses. The data were also analyzed graphically for understanding the distribution pattern of this fungus in Japan. Through these analyses, I could concretely select the climatic factors influencing on the distribution of the fungus, and understand the existence of climatically optimal area of the species and its range in Japan. Therefore, I consider that the present approach may be useful for the studies on the distribution of other saprotrophic microfungi.

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Appendix. Brief description of individual samples examined and occurrence of *Sporidesmium goidanichii* at each sample.

Sample No.	Locality (District)	Altitude (ca. m)	Lat. (°,'N)	Lon. (°,'E)	AM[a] (°C)	Ar[b] (°C)	Pre[c] (mm)	Pinus species	Number of needles / decay stage	No. of needles from which the fungus was recorded — Needle type		
										L	OL	F11
Nansei Islands												
2402	Taketomi-cho, Okinawa	25	24.24	123.51	23.5	10.8	2223.5	*luchuensis*	20	0	0	0
2403	Taketomi-cho, Okinawa	10	24.19	123.54	23.5	10.8	2223.5	*luchuensis*	20	0	0	0
2404	Ishigaki-shi, Okinawa	50	24.26	124.08	24.2	10.8	2307.0	*luchuensis*	20	0	0	0
2405	Simoji-cho, Okinawa	25	24.47	125.18	23.4	10.7	2067.9	*luchuensis*	10	0	0	0
2412	Taketomi-cho, Okinawa	50	24.22	123.45	23.4	10.3	2384.6	*luchuensis*	10	0	0	0
2413	Taketomi-cho, Okinawa	50	24.22	123.45	23.4	10.3	2384.6	*luchuensis*	10	0	1	4
2414	Taketomi-cho, Okinawa	25	24.16	123.53	23.5	10.8	2223.5	*luchuensis*	10	0	0	0
2415	Taketomi-cho, Okinawa	25	24.24	123.51	23.5	10.8	2223.5	*luchuensis*	10	0	0	2
2416	Ishigaki-shi, Okinawa	50	24.26	124.08	24.2	10.8	2307.0	*luchuensis*	10	0	0	0
2417	Taketomi-cho, Okinawa	10	24.23	123.51	23.5	10.8	2223.5	*luchuensis*	10	0	0	0
2418	Ishigaki-shi, Okinawa	75	24.22	124.11	23.8	10.8	2108.0	*luchuensis*	10	0	0	0
2419	Yonaguni, Okinawa	100	24.27	123.00	23.7	10.4	2392.2	*luchuensis*	10	0	0	0
2420	Taketomi-cho, Okinawa	75	24.17	123.52	23.5	10.8	2223.5	*luchuensis*	10	0	0	0
2421	Yonaguni-cho, Okinawa	100	24.27	123.00	23.7	10.4	2392.2	*luchuensis*	10	0	0	0
2422	Taketomi-cho, Okinawa	10	24.23	123.54	23.5	10.8	2223.5	*luchuensis*	10	0	0	0
2423	Ishigaki-shi, Okinawa	10	24.21	124.09	24.2	10.8	2108.0	*luchuensis*	10	0	0	0
2424	Ishigaki-shi, Okinawa	25	24.29	124.17	23.7	10.5	2187.9	*luchuensis*	10	0	0	0
2425	Ishigaki-shi, Okinawa	50	24.26	124.08	24.2	10.8	2307.0	*luchuensis*	10	0	0	0
2426	Ishigaki-shi, Okinawa	50	24.35	124.09	24.2	10.8	2108.0	*luchuensis*	10	0	0	0
2427	Ishigaki-shi, Okinawa	10	24.35	124.18	23.7	10.5	2187.9	*luchuensis*	10	0	0	0
2428	Yonaguni-cho, Okinawa	100	24.27	123.00	23.7	10.4	2392.2	*luchuensis*	10	0	1	0
2429	Yonaguni-cho, Okinawa	100	24.27	123.00	23.7	10.4	2392.2	*luchuensis*	10	0	0	0
2430	Taketomi-cho, Okinawa	25	24.23	123.52	23.5	10.8	2223.5	*luchuensis*	20	0	0	0
2431	Ishigaki-shi, Okinawa	50	24.26	124.08	24.2	10.8	2108.0	*luchuensis*	20	0	0	0
2502	Minamidaito-son, Okinawa	15	25.49	131.13	23.2	9.6	1665.5	*luchuensis*	10	0	0	0
2603	Okinawa-shi, Okinawa	50	26.22	127.49	22.2	12.4	1863.6	*luchuensis*	20	0	0	3
2604	Nishihara-cho, Okinawa	100	26.15	127.46	22.6	11.9	2059.1	*luchuensis*	20	0	0	0
2605	Tamagusuku-son, Okinawa	25	26.09	127.47	21.0	12.0	1944.0	*luchuensis*	10	0	0	0
2608	Higash-son, Okinawa	25	26.36	128.09	22.6	12.4	2098.2	*luchuensis*	10	0	1	0
2609	Yomitan-son, Okinawa	25	26.23	127.44	22.5	12.4	1775.1	*luchuensis*	10	0	0	0
2610	Kunigami-son, Okinawa	100	26.51	128.16	22.6	12.4	2474.5	*luchuensis*	10	0	0	0
2611	Kunigami-son, Okinawa	250	26.43	128.12	20.5	12.4	3146.9	*luchuensis*	10	0	2	1
2612	Okinawa-shi, Okinawa	50	26.22	127.49	22.2	12.4	1863.6	*luchuensis*	10	0	0	1
2613	Tamagusuku-son, Okinawa	25	26.09	127.47	21.0	12.0	1944.0	*luchuensis*	10	0	0	0
2615	Kunigami-son, Okinawa	200	26.42	128.11	20.5	12.4	3146.9	*luchuensis*	10	0	0	0

Appendix. (Continued)

No.	Locality	n	Lat	Long				Host				
2616	Tamagusuku-son, Okinawa	25	26.09	127.47	21.0	12.0	1944.0	*luchuensis*	10	0	0	0
2617	Kunigami-son, Okinawa	75	26.43	128.10	20.5	12.4	3146.9	*luchuensis*	10	0	0	0
2618	Kunigami-son, Okinawa	350	26.43	128.13	20.0	12.4	3146.9	*luchuensis*	10	0	0	0
2619	Okinawa-shi, Okinawa	50	26.22	127.49	22.2	12.4	1863.6	*luchuensis*	10	1	0	0
2620	Onna-son, Okinawa	50	26.30	127.54.23	21.7	13.6	2043.7	*luchuensis*	10	1	2	8
2621	Onna-son, Okinawa	100	26.26	127.47.37	21.7	13.6	2043.7	*luchuensis*	10	0	2	2
2701	Ogasawara-mura, Tokyo	10	27.05	142.12	23.2	9.8	1340.8	*luchuensis*	20	0	0	0
2702	Ogasawara-mura, Tokyo	10	27.04	142.12	23.2	9.8	1340.8	*luchuensis*	20	0	0	0
2707	China-cho, Kagoshima	100	27.22	128.33	22.3	12.3	1923.5	*luchuensis*	10	0	0	0
2708	Tokunoshima-cho, Kagoshima	300	27.44	128.59	19.9	13.2	1964.4	*luchuensis*	10	0	0	0
2709	Ogasawara-mura, Tokyo	75	27.03	142.12	22.6	9.8	1340.8	*luchuensis*	10	0	0	0
2710	Ogasawara-mura, Tokyo	10	27.06	142.12	23.2	9.8	1340.8	*luchuensis*	10	0	0	0
2711	Ogasawara-mura, Tokyo	100	27.07	142.13	22.4	9.8	1340.8	*luchuensis*	10	0	0	0
2803	Sumiyo-son, Kagoshima	5	28.15	129.24	21.5	13.2	2212.9	*luchuensis*	10	0	2	0
2804	Uken-son, Kagoshima	100	28.17	129.18	20.7	13.2	2212.9	*luchuensis*	20	0	0	1
2806	Naze-shi, Kagoshima	100	28.23	129.29	20.9	13.8	2869.0	*luchuensis*	20	0	4	1
2807	Kasari-cho, Kagoshima	100	28.30	129.41	20.9	13.8	2869.0	*luchuensis*	10	0	0	0
2808	Naze-shi, Kagoshima	100	28.24	129.29	20.9	13.8	2869.0	*luchuensis*	10	0	0	0
2809	Setouchi-cho, Kagoshima	200	28.13	129.18	20.1	13.2	2212.9	*luchuensis*	10	0	0	0
2810	Sumiyo-son, Kagoshima	5	28.15	129.25	21.3	13.2	2212.9	*luchuensis*	10	0	0	0
2812	Kasari-cho, Kagoshima	40	28.28	129.43	21.3	13.8	2869.0	*luchuensis*	10	0	2	0
2813	Kasari-cho, Kagoshima	40	28.28	129.43	21.3	13.8	2869.0	*luchuensis*	10	0	0	0
2815	Sumiyo-son, Kagoshima	5	28.15	129.24	21.5	13.2	2212.9	*luchuensis*	10	0	0	0
2816	Naze-shi, Kagoshima	50	28.24	129.28	21.2	13.8	2869.0	*luchuensis*	10	0	5	1
2817	Uken-son, Kagoshima	200	28.18	129.16	20.1	13.2	2212.9	*luchuensis*	10	0	0	1
2818	Uken-son, Kagoshima	100	28.17	129.18	20.7	13.2	2212.9	*luchuensis*	10	1	4	7
2819	Naze-shi, Kagoshima	100	28.23	129.29	20.9	13.8	2869.0	*luchuensis*	10	0	1	1
3001	Yaku-cho, Kagoshima	50	30.14	130.33	20.0	14.9	3231.2	*thunbergii*	20	4	19	16
3003	Yaku-cho, Kagoshima	200	30.15	130.35	19.0	14.9	3231.2	*thunbergii*	10	2	10	10
3004	Yaku-cho, Kagoshima	100	30.17	130.25	19.6	14.9	3231.2	*thunbergii*	10	0	0	0
3005	Yaku-cho, Kagoshima	100	30.17	130.25	19.6	14.9	3231.2	*thunbergii*	10	0	0	0
3006	Kamiyaku-cho, Kagoshima	100	30.26	130.28	18.8	15.5	4478.5	*thunbergii*	10	0	0	0
3007	Kamiyaku-cho, Kagoshima	5	30.24	130.26	19.4	15.5	4478.5	*thunbergii*	10	0	9	4
3008	Yaku-cho, Kagoshima	5	30.16	130.25	20.1	14.9	3231.2	*thunbergii*	10	1	9	9
3009	Yaku-cho, Kagoshima	50	30.14	130.33	20.0	14.9	3231.2	*thunbergii*	10	0	0	1
Kyushu												
3101	Miyazaki-shi, Miyazaki	1	31.48	131.28	17.4	18.6	2898.3	*thunbergii*	10	0	0	0
3102	Miyazaki-shi, Miyazaki	400	31.47	131.26	15.3	20.0	2531.3	*densiflora*	10	0	8	9
3103	Miyazaki-shi, Miyazaki	400	31.47	131.26	15.3	20.0	2531.3	*densiflora*	10	0	1	7
3105	Fuchiage-cho, Kagoshima	10	31.31	130.30	17.3	18.9	2291.3	*thunbergii*	10	5	10	10

Appendix. (Continued)

3106	Fuchiage-cho, Kagoshima	10	31.31	130.21	17.3	18.9	2291.3	*thunbergii*	10	3	9	10
3107	Ebino-shi, Miyazaki	1100	31.57	130.52	10.4	20.4	4582.2	*densiflora*	20	0	0	0
3108	Makizono-cho, Kagoshima	700	31.53	130.52	12.1	20.9	2604.4	*densiflora*	10	9	10	8
3109	Sata-cho, Kagoshima	100	31.02	130.41	18.0	19.0	2263.8	*thunbergii*	10	0	7	9
3110	Ei-cho, Kagoshima	5	31.14	130.29	17.9	18.7	2163.7	*thunbergii*	10	0	1	0
3111	Sakurajima-cho, Kagoshima	100	31.36	130.38	17.7	19.9	2279.0	*thunbergii*	10	0	0	0
3112	Sendai-shi, Kagoshima	50	31.50	130.12	16.6	20.7	2361.1	*Pinus* sp.	10	0	0	0
3113	Miyakonojo-shi, Miyazaki	150	31.57	131.52	16.2	20.7	2470.9	*thunbergii*	10	0	8	10
3114	Ibusuki-shi, Kagoshima	5	31.09	130.35	18.0	19.0	2393.8	*thunbergii*	10	0	8	9
3115	Kaseda-shi, Kagoshima	5	31.28	130.20	17.3	18.9	2291.3	*thunbergii*	10	0	5	9
3116	Kaimon-cho, Kagoshima	300	31.11	130.32	18.0	19.0	2393.8	*thunbergii*	10	2	7	2
3118	Fuchiage-cho, Kagoshima	20	31.29	130.20	17.2	18.9	2291.3	*thunbergii*	10	0	10	10
3119	Ibusuki-shi, Kagoshima	5	31.09	130.35	18.0	19.0	2393.8	*thunbergii*	10	0	5	7
3120	Oosaki-cho, Kagoshima	10	31.26	131.03	17.1	19.2	2248.5	*thunbergii*	10	0	8	6
3121	Sata-cho, Kagoshima	100	31.02	131.41	18.0	19.0	2263.8	*thunbergii*	10	2	8	8
3122	Kanoya-shi, Kagoshima	5	31.20	130.48	17.0	19.7	2275.8	*thunbergii*	10	0	0	0
3123	Miyazaki-shi, Miyazaki	5	31.51	131.27	17.7	20.0	2531.3	*thunbergii*	10	0	9	5
3124	Ebino-shi, Miyazaki	1150	31.32	130.52	10.1	20.4	4582.2	*densiflora*	10	0	1	8
3201	Hitoyoshi-shi, Kumamoto	200	32.10	130.47	14.7	21.8	2435.7	*densiflora*	20	14	17	10
3202	Hitoyoshi-shi, Kumamoto	150	32.12	130.46	15.2	21.8	2435.7	*densiflora*	10	10	9	10
3203	Futsu-cho, Nagasaki	400	32.43	130.18	14.8	21.1	2252.3	*densiflora*	20	0	12	3
3205	Sadowara-cho, Miyazaki	5	32.00	131.29	17.1	20.3	2498.2	*thunbergii*	10	0	1	0
3301	Karatsu-shi, Saga	5	33.27	131.01	14.9	20.1	1922.6	*thunbergii*	10	0	9	1
3308	Kanzaki-cho, Saga	50	33.21	130.22	15.6	22.2	1888.1	*densiflora*	10	0	3	10
3309	Yufuin-cho, Ooita	710	33.15	131.18	10.8	22.2	1984.5	*densiflora*	10	0	2	7
3310	Kokonoe-machi, Ooita	900	33.15	131.18	9.4	21.9	1870.1	*densiflora*	10	0	9	5

Shikoku

3204	Tosashimizu-shi, Kochi	25	32.47	132.52	16.9	19.7	2445.4	*thunbergii*	20	0	7	4
3206	Tosashimizu-shi, Kochi	5	32.49	132.57	16.9	19.7	2445.4	*thunbergii*	10	0	0	1
3307	Kochi-shi, Kochi	5	33.30	133.35	16.8	21.1	2591.0	*thunbergii*	10	0	7	7
3425	Oomishima-cho, Ehime	50	34.15	133.01	15.4	21.2	1142.4	*thunbergii*	10	0	9	9
3311	Matsuyama-shi, Ehime	100	33.51	132.47	16.2	21.5	1339.1	*densiflora*	10	0	6	5

Chugoku

3413	Masuda-shi, Shimane	200	34.38	131.43	14.1	21.4	1605.7	*densiflora*	20	0	14	20
3414	Shyuho-cho, Yamaguchi	200	34.14	131.19	13.5	21.8	2024.7	*densiflora*	10	0	1	0
3415	Hagi-shi, Yamaguchi	20	34.24	131.25	15.4	20.6	1728.8	*thunbergii*	10	0	8	9
3418	Hagi-shi, Yamaguchi	10	34.27	131.24	15.4	20.6	1728.8	*thunbergii*	10	0	0	0
3426	Higahihirosima-shi, Hiroshim	250	34.24	132.44	12.9	23.3	1503.8	*densiflora*	10	0	8	3
3419	Geihoku-cho, Hiroshima	800	34.42	132.10	9.4	23.1	2364.7	*densiflora*	10	0	3	0
3433	Niimi-shi, Okayama	350	34.57	133.34	12.4	23.1	1393.7	*densiflora*	10	0	8	6

Appendix. (Continued)

No.	Location							Species				
3502	Taishya-machi, Shimae	10	35.26	132.38	14.4	21.3	1695.0	*thunbergii*	10	0	10	4
3503	Daisen-cho, Tottori	850	35.24	133.32	9.6	22.2	2653.0	*thunbergii*	10	1	6	1
3515	Tottori-shi, Tottori	20	35.27	134.15	14.5	22.8	1938.2	*densiflora*	10	0	0	3
3525	Tottori-shi, Tottori	50	35.32	134.14	14.3	22.8	1938.2	*thunbergii*	10	0	1	10
Kinki												
3302	Mihama-cho, Wakayama	5	33.53	135.08	16.5	20.9	1335.4	*thunbergii*	20	4	19	16
3303	Hongu-cho, Wakayama	50	33.50	135.46	15.1	21.4	2823.8	*thunbergii*	10	1	7	9
3304	Shirahama-cho, Wakayama	10	33.50	135.46	16.8	20.1	1729.5	*thunbergii*	10	0	8	3
3305	Shirahama-cho, Wakayama	25	33.40	135.20	16.8	20.1	1729.5	*thunbergii*	10	0	0	0
3306	Kushimoto-cho, Wakayama	50	33.26	135.46	17.1	18.6	2509.5	*thunbergii*	10	0	3	0
3312	Kushimoto-cho, Wakayama	50	33.26	135.46	17.1	18.6	2509.5	*thunbergii*	10	0	0	0
3313	Shirahama-cho, Wakayama	25	33.40	135.20	16.8	20.1	1729.5	*thunbergii*	10	0	4	5
3315	Hongu-cho, Wakayama	50	33.50	135.45	15.1	21.4	2823.8	*thunbergii*	10	0	4	1
3316	Susami-cho, Wakayama	30	33.33	135.29	16.8	20.1	2242.7	*thunbergii*	10	0	10	10
3317	Shirahama-cho, Wakayama	25	33.40	135.20	16.8	20.1	1729.5	*thunbergii*	10	0	5	1
3318	Shirahama-cho, Wakayama	5	33.38	135.24	16.8	20.1	1729.5	*thunbergii*	10	0	3	7
3405	Yoshino-cho, Nara	200	34.23	135.50	13.8	23.0	1459.6	*densiflora*	10	0	1	4
3408	Wazuka-cho, Kyoto	300	34.50	135.57	12.1	22.7	1508.8	*densiflora*	10	0	5	4
3409	Kobe-shi, Hyogo	400	34.43	135.11	13.8	22.3	1264.7	*densiflora*	10	2	9	5
3416	Ago-cho, Mie	50	34.18	136.49	15.3	21.4	1940.1	*thunbergii*	10	0	2	0
3427	Koya-cho, Wakayama	450	34.14	135.34	12.5	22.8	1850.7	*densiflora*	10	0	0	0
3435	Daio-cho, Mie	20	34.17	135.54	16.1	21.4	1940.1	*thunbergii*	10	0	4	2
3436	Nara-shi, Nara	140	34.40	135.44	14.7	22.8	1348.5	*thunbergii*	10	0	7	10
3437	Seidan-cho, Hyogo	2	34.20	134.45	15.3	21.4	1414.8	*thunbergii*	10	0	0	0
3438	Seki-cho, Mie	100	34.51	136.23	15.5	22.0	1691.7	*densiflora*	20	4	19	16
3507	Kumihama-cho, Kyoto	10	35.39	134.55	14.1	23.5	1983.4	*thunbergii*	10	0	1	3
3510	Wachi-cho, Kyoto	200	35.14	135.25	12.5	23.2	1747.5	*densiflora*	10	0	1	0
3522	Miyazu-shi, Kyoto	5	35.34	135.11	14.3	22.9	1744.1	*thunbergii*	10	9	10	10
Cubu (Tokai)												
3404	Shimoda-shi, Shizuoka	100	34.41	138.57	15.9	17.9	1819.1	*thunbergii*	10	0	7	5
3406	Shimoda-shi, Shizuoka	100	34.40	138.57	15.9	17.9	1819.1	*thunbergii*	10	0	4	8
3407	Hamamatsu-shi, Shizuoka	100	34.46	137.37	15.8	20.9	1862.9	*thunbergii*	10	0	9	10
3417	Shizuoka-shi, Shizuoka	10	34.55	138.23	16.4	20.2	2311.0	*thunbergii*	10	0	2	2
3434	Atsumi-cho, Aichi	5	33.36	137.04	15.8	21.1	1628.8	*thunbergii*	10	0	1	4
3509	Yoro-cho, Gifu	50	35.20	136.31	15.2	23.1	1937.1	*thunbergii*	10	0	0	2
3518	Shimizu-shi, Shizuoka	10	35.00	138.32	16.4	19.9	2340.1	*thunbergii*	10	0	6	1
Chubu (Hokuriku)												
3506	Tsuruga-shi, Fukui	10	35.39	136.03	15.4	22.3	2016.9	*thunbergii*	10	0	9	5
3523	Oono-shi, Fukui	150	35.58	136.37	13.5	24.9	2755.9	*densiflora*	10	2	8	5
3602	Oshimizu-machi, Ishikawa	5	36.50	136.45	14.2	23.0	2012.7	*thunbergii*	10	0	7	3

Appendix. (Continued)

ID	Location										
3701	Itoigawa-shi, Niigata	2	37.02	137.50	14.1	23.2	2764.4	*thunbergii*	10	0	0	0
3702	Suzu-shi, Ishikawa	50	37.31	137.19	12.3	22.7	2040.2	*densiflora*	10	0	7	4
3704	Kakizaki-machi, Niigata	2	37.16	138.23	13.2	23.1	2250.1	*thunbergii*	10	0	6	10
3705	Maki-machi, Niigata	2	37.48	139.50	12.8	23.5	1745.3	*thunbergii*	10	0	9	5
3706	Anamizu-machi, Ishikawa	70	37.14	137.00	13.5	23.3	2064.4	*thunbergii*	10	2	8	8
Chubu (Koshin)												
3511	Kawaguchiko-machi, Yamanashi	1000	35.14	138.25	9.5	22.6	1565.7	*densiflora*	10	0	0	0
3512	Kawaguchiko-machi, Yamanashi	1300	35.14	138.25	7.7	22.6	1565.7	*densiflora*	10	0	0	0
3517	Nagasaka-cho, Yamanashi	700	35.51	138.22	10.8	24.5	1298.5	*thunbergii*	10	0	10	6
3528	Hara-mura, Nagano	1100	35.55	138.17	8.9	24.5	1298.5	*densiflora*	10	0	4	8
3529	Ashiwada-mura, Yamanashi	910	35.30	138.40	10.4	22.6	1565.7	*densiflora*	10	0	5	5
3609	Karuizawa-machi, Nagano	900	36.20	138.38	8.4	23.8	1215.0	*densiflora*	10	0	0	1
3610	Azusagawa-mura, Nagano	600	36.20	138.38	11.5	24.9	1024.1	*densiflora*	10	0	0	5
3612	Sanada-machi, Nagano	1330	36.31	138.21	6.3	25.4	1220.9	*densiflora*	10	0	0	0
3625	Azumi-mura, Nagano	1000	36.07	137.39	8.5	23.8	2000.8	*densiflora*	20	0	11	0
3626	Miasa-mura, Nagano	800	36.33	137.54	9.0	24.8	1093.2	*densiflora*	10	0	0	0
3631	Sanada-machi, Nagano	1330	36.31	138.21	6.3	25.4	1220.9	*densiflora*	10	0	0	3
3633	Sanada-machi, Nagano	1330	36.31	138.21	6.3	25.4	1220.9	*densiflora*	10	0	0	0
3634	Mimaki-mura, Nagano	700	36.19	138.20	9.9	24.7	1014.3	*densiflora*	10	0	10	9
Kanto (Izu Islands)												
3319	Hachijo-machi, Tokyo	80	33.06	139.47	18.4	16.3	3182.3	*thunbergii*	10	0	2	0
3420	Miyake-mura, Tokyo	25	34.04	139.29	17.4	16.7	2948.4	*thunbergii*	10	0	0	3
3421	Miyake-mura, Tokyo	300	34.06	139.32	15.7	16.7	2948.4	*thunbergii*	10	0	4	8
3422	Miyake-mura, Tokyo	10	34.04	139.29	17.5	16.7	2948.4	*thunbergii*	10	0	2	3
3423	Miyake-mura, Tokyo	300	34.06	139.32	15.7	16.7	2948.4	*thunbergii*	10	0	6	9
3424	Miyake-mura, Tokyo	100	34.03	139.33	16.9	16.7	2948.4	*thunbergii*	10	0	6	1
3428	Miyake-mura, Tokyo	300	34.06	139.32	15.7	16.7	2948.4	*thunbergii*	10	1	10	10
3429	Miyake-mura, Tokyo	200	34.06	139.33	16.3	16.7	2948.4	*thunbergii*	10	1	6	10
3430	Miyake-mura, Tokyo	10	34.03	139.29	17.5	16.7	2948.4	*thunbergii*	10	2	8	2
3431	Miyake-mura, Tokyo	20	34.03	139.33	17.4	16.7	2948.4	*thunbergii*	10	0	10	5
Kanto												
3410	Tateyama-shi, Chiba	5	35.00	139.52	16.0	19.9	1774.0	*thunbergii*	10	0	7	2
3411	Tateyama-shi, Chiba	2	34.57	139.49	16.0	19.9	1774.0	*thunbergii*	20	0	0	1
3412	Chikura-machi, Chiba	10	34.58	139.58	16.0	19.9	1774.0	*thunbergii*	20	6	14	11
3432	Tateyama-shi, Chiba	5	34.58	139.45	16.0	19.9	1774.0	*thunbergii*	10	0	9	7
3504	Takane-cho, Yamanashi	800	35.51	138.26	10.2	24.2	1191.3	*densiflora*	10	0	1	7
3505	Urawa-shi, Saitama	50	35.52	139.41	14.6	22.9	1338.0	*thunbergii*	10	0	7	5
3513	Maruyama-machi, Chiba	5	35.10	140.19	15.8	19.9	1774.0	*thunbergii*	20	0	13	15
3514	Ichinomiya-machi, Chiba	10	35.22	140.24	14.9	21.1	1926.9	*thunbergii*	20	0	11	18
3524	Kamogawa-shi, Chiba	50	35.08	140.05	14.9	19.8	1781.6	*thunbergii*	10	8	10	9

Appendix. (Continued)

ID	Location											
3530	Chiyoda-ku, Tokyo	25	35.32	134.14	16.1	21.2	1481.0	*thunbergii*	10	0	6	9
3531	Chiyoda-ku, Tokyo	25	35.32	134.14	16.1	21.2	1481.0	*thunbergii*	10	0	6	10
3532	Samukawa-machi, Kanagawa	10	35.22	139.23	16.1	20.5	1602.5	*thunbergii*	10	6	10	10
3536	Hatoyama-machi, Saitama	100	35.59	138.18	13.4	22.8	1367.3	*densiflora*	10	0	9	10
3606	Makabe-machi, Ibaragi	700	36.14	140.06	10.4	21.6	1229.9	*densiflora*	10	7	10	1
3607	Matsuida-machi, Gunma	600	36.21	138.45	10.5	22.7	1232.0	*densiflora*	10	1	8	9
3608	Matsuida-machi, Gunma	500	36.21	138.45	10.5	22.7	1232.0	*strobus*	10	0	0	0
3611	Ogawa-machi, Saitama	200	36.03	139.14	12.8	22.8	1367.3	*densiflora*	10	0	3	1
3614	Tanuma-machi, Tochigi	50	36.23	139.36	13.4	22.7	1222.7	*densiflora*	10	0	6	1
3615	Tanuma-machi, Tochigi	100	36.23	139.36	13.1	22.7	1222.7	*densiflora*	10	0	0	0
3617	Oota-shi, Gunma	200	36.19	139.23	12.8	23.1	1180.4	*densiflora*	10	2	5	2
3618	Oota-shi, Gunma	200	36.19	139.23	12.8	23.1	1180.4	*thunbergii*	10	0	6	9
3619	Ooarai-machi, Ibaragi	20	36.17	140.34	13.3	22.1	1353.0	*thunbergii*	10	5	6	6
3622	Tsukuba-shi, Ibaragi	50	36.09	140.08	13.8	22.1	1154.4	*densiflora*	10	0	4	2
3627	Takasaki-shi, Gunma	90	36.19	139.59	14.7	22.8	1213.0	*densiflora*	20	0	12	16
3628	Makabe-machi, Ibaragi	300	36.14	140.05	12.8	21.6	1229.9	*densiflora*	10	2	5	7
3629	Tsukuba-shi, Ibaragi	50	36.07	140.06	14.0	22.4	1286.7	*densiflora*	10	1	6	9
3630	Tsukuba-shi, Ibaragi	50	36.07	140.06	14.0	22.4	1286.7	*densiflora*	10	0	0	3
3632	Makabe-machi, Ibaragi	200	36.15	140.06	13.4	21.6	1229.9	*densiflora*	10	0	0	3
3637	Kitaibaragi-shi, Ibaragi	5	36.46	140.45	13.2	19.9	1481.1	*thunbergii*	10	0	2	1
3641	Fukaya-shi, Saitama	100	36.11	139.17	14.7	22.6	1283.9	*densiflora*	10	0	4	10
Tohoku												
3635	Hanawa-machi, Fukushima	400	36.59	140.27	10.3	23.8	1422.1	*densiflora*	10	0	10	8
3636	Iwaki-shi, Fukushima	700	36.57	140.36	10.3	23.8	1422.1	*densiflora*	10	0	5	3
3703	Kitashiobara-mura, Fukushima	800	37.39	140.05	7.3	24.7	1795.1	*densiflora*	10	0	1	0
3801	Kesen-numa-shi, Miyagi	10	38.40	141.36	10.7	22.7	1370.6	*thunbergii*	10	0	1	1
3802	Kesen-numa-shi, Miyagi	50	38.54	141.32	10.7	22.7	1370.6	*densiflora*	10	1	5	8
3803	Senmaya-cho, Iwate	100	38.56	141.24	10.4	24.5	1127.4	*densiflora*	10	0	0	0
3804	Ichinoseki-shi, Iwate	100	38.57	141.13	11.0	24.5	1562.5	*densiflora*	10	0	0	0
3805	Sendai-shi, Miyagi	140	38.15	140.51	11.5	22.7	1243.1	*densiflora*	10	0	0	8
3806	Sendai-shi, Miyagi	140	38.15	140.51	11.5	22.7	1243.1	*densiflora*	10	0	0	0
3807	Hiraizumi-cho, Iwate	50	38.59	141.07	11.0	24.5	1252.9	*thunbergii*	10	0	5	10
3808	Matsushima-machi, Miyagi	10	38.22	141.05	11.3	22.6	1199.0	*thunbergii*	10	0	0	1
3809	Sendai-shi, Miyagi	140	38.15	140.51	11.5	22.7	1243.1	*densiflora*	10	1	6	10
3901	Tenno-machi, Akita	10	39.50	140.02	11.0	24.0	1354.0	*thunbergii*	10	0	10	6
3902	Oga-shi, Akita	50	39.58	139.45	10.7	24.0	1484.0	*thunbergii*	10	0	6	6
3903	Kisakata-machi, Akita	2	39.14	139.54	12.6	22.8	1676.9	*thunbergii*	10	0	0	0
3904	Yuza-machi, Yamagata	50	39.14	139.54	12.5	23.8	1858.4	*thunbergii*	10	0	3	7
3905	Kitakami-shi, Iwate	100	39.18	140.57	10.2	25.2	1275.1	*densiflora*	10	0	1	3
3906	Yokote-shi, Akita	200	39.18	140.35	9.7	26.2	1581.2	*densiflora*	10	1	2	0

Appendix. (Continued)

3909	Yamada-machi, Iwate	200	39.25	142.00	10.1	22.2	1523.1	*densiflora*	20	0	1	3
3911	Morioka-shi, Iwate	300	39.44	141.14	9.2	25.3	1259.5	*densiflora*	20	0	6	6
3912	Morioka-shi, Iwate	200	39.42	141.03	10.1	25.3	1259.5	*densiflora*	20	0	1	0
3914	Taro-cho, Iwate	80	39.44	141.59	10.7	21.2	1325.0	*densiflora*	20	0	0	0
3917	Miyamori-mura, Iwate	300	39.19	141.24	8.9	25.3	1179.3	*densiflora*	10	0	3	3
3918	Yokote-shi, Akita	200	39.18	140.34	9.7	26.2	1581.2	*densiflora*	10	0	2	7
3919	Honjo-shi, Akita	20	39.18	140.24	11.4	23.6	1837.0	*thunbergii*	10	0	10	9
3920	Tenno-machi, Akita	20	39.53	139.59	10.9	24.0	1354.0	*thunbergii*	10	0	8	5
3921	Kisakata-machi, Akita	500	39.09	139.58	9.6	22.8	1676.9	*densiflora*	10	0	1	5
3922	Konoura-machi, Akita	20	39.16	139.56	12.6	22.8	1676.9	*thunbergii*	10	0	1	0
4001	Hirosaki-shi, Aomori	50	40.36	140.28	10.0	25.3	1157.8	*thunbergii*	10	1	2	2
4002	Kazuno-shi, Akita	250	40.11	140.45	8.2	25.9	1318.8	*densiflora*	10	0	1	7
4003	Kuroishi-shi, Aomori	200	40.38	140.44	8.9	24.9	965.5	*densiflora*	10	0	0	0
4006	Nango-mura, Aomori	200	40.23	141.31	8.9	23.4	1010.5	*densiflora*	10	0	0	0
4007	Misawa-shi, Aomori	10	40.46	141.25	10.1	23.5	998.8	*thunbergii*	10	0	1	1
4008	Shyariki-mura, Aomori	20	40.57	140.22	9.6	23.3	1283.7	*thunbergii*	10	0	10	8
4009	Hachimori-machi, Akita	20	40.24	139.59	11.2	23.5	1464.7	*thunbergii*	10	0	7	5
4010	Noshiro-shi, Akita	10	40.11	140.02	11.1	24.3	1471.6	*thunbergii*	10	0	10	5
4011	Hachimori-machi, Akita	20	40.24	139.59	11.2	23.5	1464.7	*thunbergii*	10	0	8	10
4012	Noshiro-shi, Akita	10	40.11	140.02	11.1	24.3	1471.6	*thunbergii*	10	0	9	10
4014	Kizukuri-machi, Aomori	10	40.52	140.17	10.5	23.3	1306.3	*thunbergii*	10	0	8	6
4103	Higashidoori-mura, Aomori	300	41.23	141.27	8.0	21.9	1216.4	*densiflora*	10	0	0	0
4104	Higashidoori-mura, Aomori	300	41.23	141.27	8.0	21.9	1216.4	*thunbergii*	10	0	0	0
4105	Higashidoori-mura, Aomori	10	41.25	141.28	9.7	21.9	1216.4	*thunbergii*	10	0	0	0
Hokkaido												
4106	Esashi-cho, Hokkaido	10	41.50	140.80	9.9	23.5	1159.3	*thunbergii*	10	0	2	0
4205	Kushiro-shi, Hokkaido	5	42.58	144.22	5.9	23.5	1045.2	*mugo*	10	0	0	0
4206	Kushiro-shi, Hokkaido	30	42.58	144.24	5.9	23.5	1045.2	*mugo*	10	0	0	1
4302	Asahikawa-shi, Hokkaido	110	43.45	142.21	6.8	28.8	1046.3	*contorta*	10	0	1	0
4303	Asahikawa-shi, Hokkaido	110	43.45	142.21	6.8	28.8	1046.3	*banksiana*	10	0	0	0
4305	Asahikawa-shi, Hokkaido	110	43.45	142.21	6.8	28.8	1046.3	*sylvestris*	20	0	0	0
4306	Asahikawa-shi, Hokkaido	110	43.45	142.21	6.8	28.8	1046.3	*contorta*	20	0	4	2
4307	Asahikawa-shi, Hokkaido	110	43.45	142.21	6.8	28.8	1046.3	*banksiana*	20	1	0	0
4308	Asahikawa-shi, Hokkaido	110	43.45	142.21	6.8	28.8	1046.3	*strobus*	20	0	0	0
4311	Asahikawa-shi, Hokkaido	110	43.48	142.17	6.8	28.8	1046.3	*sylvestris*	10	0	0	0
4312	Asahikawa-shi, Hokkaido	110	43.45	142.21	6.8	28.8	1046.3	*contorta*	10	0	2	2
4313	Asahikawa-shi, Hokkaido	110	43.45	142.21	6.8	28.8	1046.3	*banksiana*	10	0	0	0
4314	Shibetsu-cho, Hokkaido	10	43.41	145.07	5.7	24.9	1114.6	*mugo*	10	0	0	0
4315	Teshikaga-cho, Hokkaido	100	43.37	144.27	4.4	27.9	838.7	*mugo*	10	0	0	0
4317	Asahikawa-shi, Hokkaido	110	43.75	142.35	6.8	28.8	1046.3	*sylvestris*	10	0	0	0

Appendix. (Continued)

					a)	b)	c)						
4318	Asahikawa-shi, Hokkaido	110	43.75	142.35	6.8	28.8	1046.3	*contorta*	10	0	0	0	0
4322	Tsurui-mura, Hokkaido	75	43.08	144.20	5.3	26.4	1085.0	*banksiana*	10	0	0	6	2
4323	Higashimokoto-mura, Hokkaido	100	43.51	144.22	5.7	27.4	773.0	*banksiana*	10	0	0	0	0
4324	Shibechya-cho, Hokkaido	70	43.22	144.26	5.1	26.8	1034.0	*banksiana*	10	0	0	1	3
4325	Teshikaga-cho, Hokkaido	270	43.37	144.27	4.4	27.9	838.7	*pumila*	10	0	0	0	0
4326	Koshimizu-cho, Hokkaido	20	43.52	144.28	5.7	27.4	753.8	*strobus*	10	0	0	0	0
4327	Nakashibetsu-cho, Hokkaido	50	43.32	144.58	5.2	25.3	753.8	*mugo*	10	0	0	0	0
4328	Shibetsu-cho, Hokkaido	10	43.41	145.07	5.5	24.0	1117.0	*mugo*	10	0	0	0	0
4329	Teshikaga-cho, Hokkaido	130	43.29	144.27	4.8	25.3	1027.0	*mugo*	10	0	0	0	0
4330	Abashiri-shi, Hokkaido	20	43.59	144.13	6.3	25.6	773.2	*mugo*	10	0	0	0	0
4331	Kitami-shi, Hokkaido	60	43.47	143.53	5.8	28.7	748.5	*sylvestris*	10	0	0	0	0
4332	Kushiro-shi, Hokkaido	85	43.05	144.20	5.3	26.4	1085.0	*mugo*	10	0	0	0	0
4333	Kitami-shi, Hokkaido	60	43.47	143.53	5.8	28.7	1045.2	*sylvestris*	10	0	0	0	0
4401	Teshio-cho, Hokkaido	50	44.49	142.48	6.1	25.7	877.3	*sylvestris*	10	0	0	0	0
4402	Teshio-cho, Hokkaido	50	44.53	141.49	6.1	25.7	877.3	*sylvestris*	10	0	0	0	0
4403	Teshio-cho, Hokkaido	50	44.51	141.54	6.1	25.7	877.3	*sylvestris*	10	0	0	0	0
4406	Tokoro-cho, Hokkaido	70	44.07	144.05	5.8	27.4	690.0	*mugo*	10	0	0	0	0
4505	Rishirifuji-cho, Hokkaido	400	45.15	141.25	4.7	24.3	924.3	*pumila*	10	0	0	0	0

a) Annual mean air temperature
b) Annual range
c) Annual precipitation