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Flora and Vegetation in a Protected Area for *Iris rossii* Baker (Iridaceae), a Threatened Plant in Hofu City, Yamaguchi Prefecture

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Abstract : *Iris rossii* Baker (Iridaceae) is one of the threatened plants growing in secondary grassland with sparse pine forest. The aim of this research is to investigate current status in a protected area for *I. rossii* population, and obtain knowledge for conservation of the population. The flora of vascular plants and vegetation were investigated in the protected area for *I. rossii* in Hofu City, Yamaguchi Prefecture. Investigations were mainly carried out in June and November 1990 at the three different habitats. As a result, a total of 153 species of 62 families were recorded in whole area. Only *Erigeron sumatrensis* was recorded as a naturalized plant species in the protected area in 1990. Species composition of the closed forest area, where no *I. rossii* were found, was different from those of the sparse forest area and the grassland area. Therophytes and hemicryptophytes were seen mainly in the grassland area. Nanophanerophytes, microphanerophytes, mega- and mesophanerophytes and lianas were mainly in the closed forest area. Two vulnerable species, *I. rossii* and *Calanthe discolor* listed in the Red Data Book and seven designated species including *I. rossii* listed in the national and quasi-national parks in Japan were found to have grown mainly in the grassland area and the sparse forest area.

Keywords : Conservation ecology, Flora, *Iris rossii*, Rural landscape, Sparse pine forest, Threatened plants, Vegetation management

Introduction

Iris rossii Baker (Fig. 1) is a perennial herbaceous plant growing in sparse pine forests. This species is widely distributed from Okayama Prefecture to Miyazaki Prefecture in southwest of Japan, Korea and northeastern China. There are some common species growing in both western Japan and continental East Asia such as *I. rossii*, *Lychnis kiusiana*, *Viola orientalis* and *Echinops setifer* (Hara, 1959). It is considered that these species spread out toward the south during glacial age when the

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Fig. 1. *Iris rossii* Baker in flowering in the protected area (April 20, 1991).

Japanese archipelago was still adjacent to the continent. It is difficult for *I. rossii* to colonize over the sea, because its seeds are dispersed by ants (Nakanishi, 1988). This species declined in recent Japan, might become extinct easily because of relatively short distance of dispersal. Therefore, some local populations of *I. rossii* were designated as a natural monument by the Japanese government.

A large portion of *I. rossii* populations are found in secondary grassland with sparse pine forest. This secondary grassland was developed as a result of grazing and mowing in Chugoku district (Miyawaki, 1983; Someya, *et al.*, 1989; Kamada, *et al.*, 1991). The area of such grassland is decreasing with the progressive succession owing to management abandonment resulted from organic fuel and fertilizer revolution since 1960s. Recently, *I. rossii* is listed as one of the vulnerable plant species in Japan (The

Investigation Committee for Important Plant Species in View of Protection in Japan, 1989). There are some scientific researches about *I. rossii* population (e.g. Horikawa, 1950; Suzuki, 1972). Few studies have done, however, especially on the habitat where *I. rossii* grows and their flora.

Vegetation structure in a certain area may reflect biotic and abiotic environments in the location, and the floristic composition shows potential vegetation in near future, with respect to secondary vegetation. Therefore we recorded the current status of *I. rossii* population and analyzed the characteristics of plant community in protected area of Hofu City for management of endangered plant populations.

Investigated Area and Methods

The protected area investigated in this study was in Nishinoura in Hofu City (131° 31'E, 34°00'N), southwest of Japan (Fig. 2). The area is located *ca.* 7km southwest from downtown of Hofu City. The annual precipitation in Hofu City is 1,610mm and the annual mean temperature is 15.6 °C, averaged over from six years records in 1987-1992 (Hofu City, 1993). The area is on a north-facing slope (mean inclination 18°) from 50m to 80m above sea level. The total area is about 5,600m^2.

There were three types of habitat in the protected area. The first was open grassland,

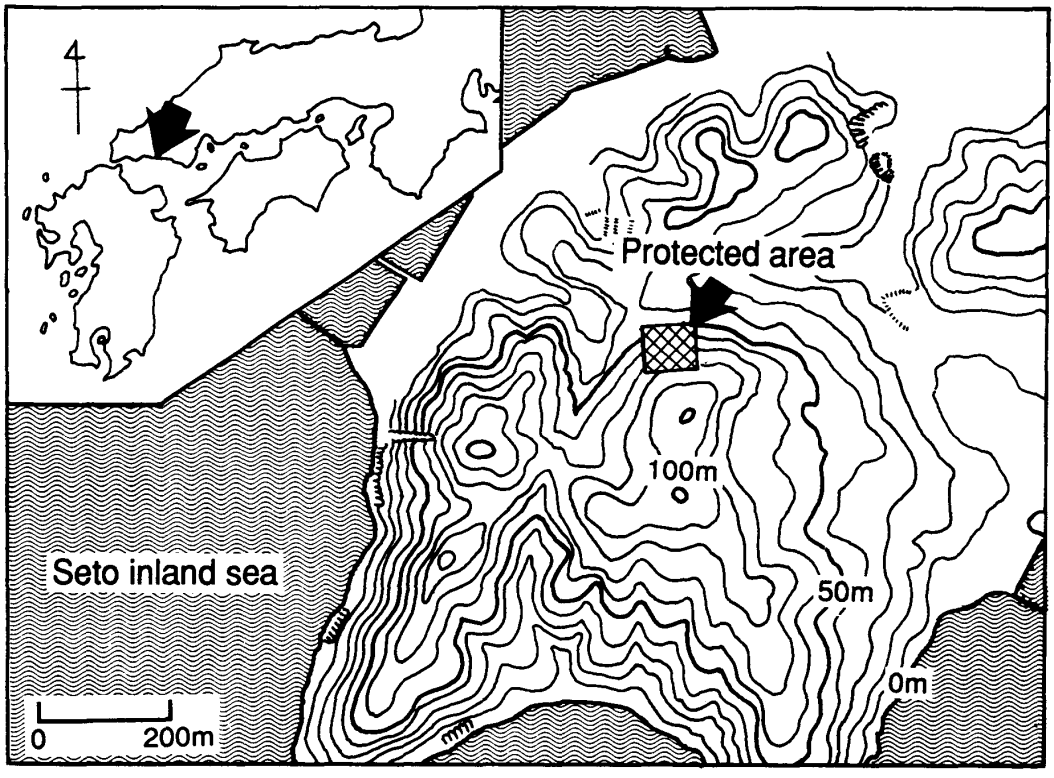

Fig. 2. Maps of the investigated area. The area is *ca.* 7km southwest from downtown of Hofu City in Yamaguchi Prefecture.

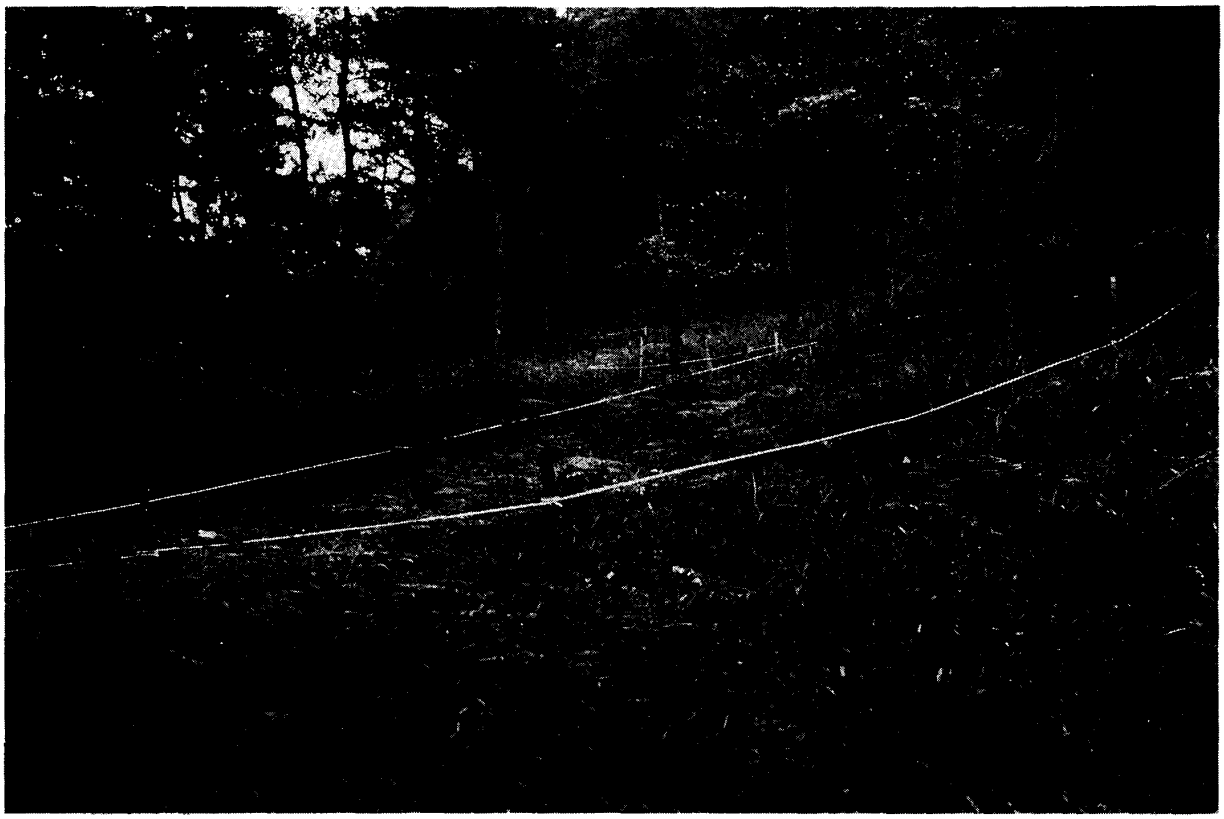

Fig. 3. Grassland and sparse mixed pine (*Pinus densiflora* and *P. thunbergii*) forest in the protected area (June 22, 1991).

the second was sparse forest with rich field layer of grasses, and the third was closed forest with dense shrub layer. Most part of the area was occupied by grassland and sparse pine forest mixed with *Pinus densiflora* and *P. thunbergii* (Fig. 3). Sparse forest and grassland were maintained by annual management for mowing in every February. The mowing had been carried out for produce organic compost before World War II in this region. Today, the mowing is succeeded not for compost but only for the conservation of *Iris rossii* population. Closed forest has been abandoned about 40 years ago. Main vegetation types around the protected area are secondary broad-leaved forests. Bamboo plantation of *Phyllostachys pubescens*, citrus orchards and plantations of *Cryptomeria japonica* are also in the north out of the protected area.

The distribution of *I. rossii* population in the protected area was mapped. It was necessary to understand the distribution in order to evaluate the population ecology of *I. rossii* and other species associated with it.

All vascular plants were recorded for each vegetation type of the grassland, the sparse forest and the closed forest area. Main investigations were taken place in June and November 1990, and additional investigations for unidentified species were carried out in April and July in 1991 and 1993.

In order to find out the characteristics of spatial structure, phytosociological survey

was carried out in the protected area (Braun-Blanquet, 1964). Phytosociological data was obtained in June and November 1990 for all plots, and in November 1990 for the plot W. Quadrats of 10m x 10m were used for vegetation structure including tree layers, and 1m x 1m were used for vegetation structure in field layer. A plot of 10m x 10m which contained *I. rossii* (plot P1) individuals was set up in the grassland in the center of the protected area, and another plot (Plot P2) without *I. rossii* was set up in close to plot P1. A 10m x 10m plot (Plot W) without *I. rossii* was set up in the closed forest. In plot P1, five small plots of 1m x 1m (plots Y1 to Y5) contained *I. rossii*, and other five plots of 1m x 1m (plots N1 to N5) without *I. rossii* were set up to compare with the former five plots.

Results and Discussion

1. Flora in the protected area

The classification and order of the list in the end of this paper are followed in accordance with the several literatures (Tagawa, 1959; Kurata & Nakaike, 1979-1990; Ohwi & Kitagawa, 1983). Flora of the protected area was confirmed to have 153 species of 62 families: 10 of Pteridophyta, 4 of Gymnospermae, 22 of Monocotyledoneae, 117 of Dicotyledoneae (70 of Choripetalae and 47 of Gamopetalae). The numbers of species

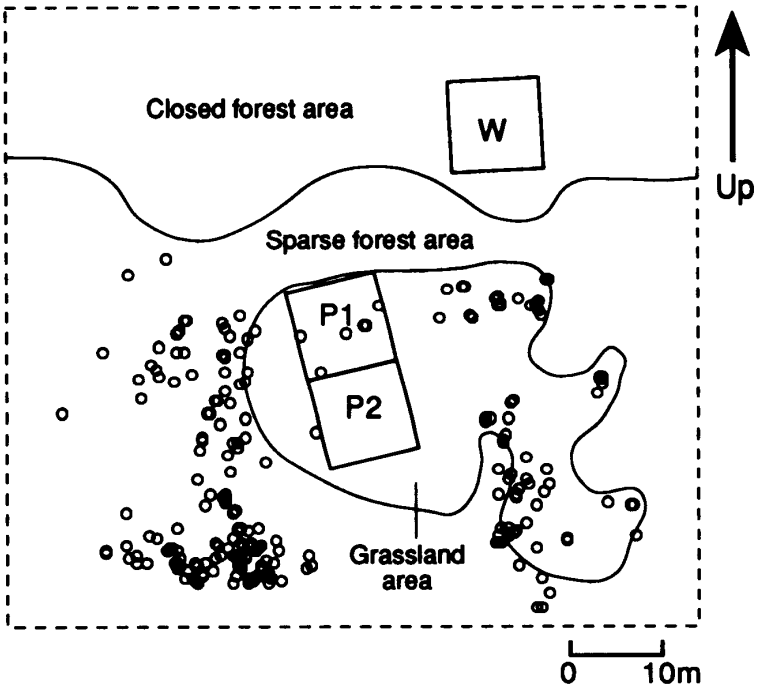

Fig.4. Distribution map of an *Iris rossii* population and location of three different habitats. Each circle shows an individual of *Iris rossii*. Broken line shows fence around the protected area. Plots P1, P2 and W are 10m x 10m plots whose phytosociological relevés were obtained. Ten 1m x 1m plots were set up in plot P1.

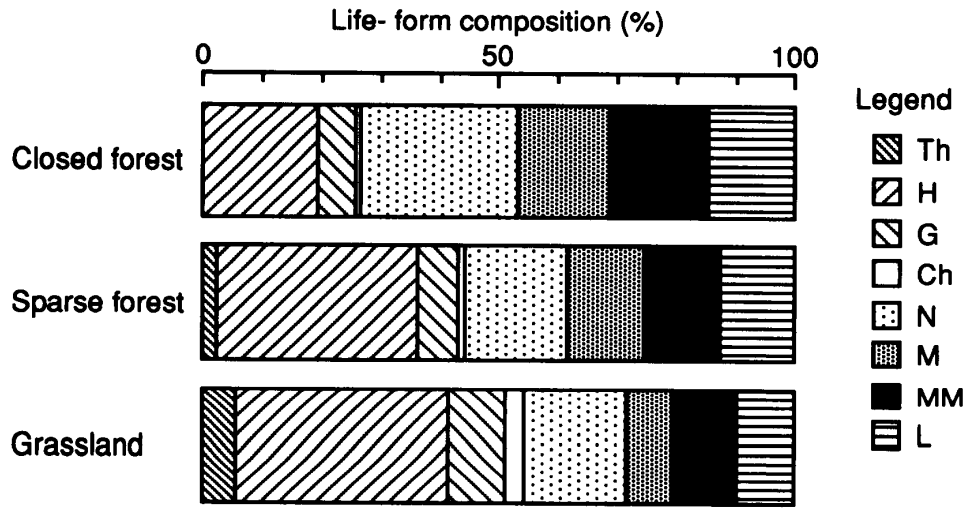

Fig. 5. Life-form spectra in three different habitats according to number of species. Abbreviation of life-forms; Th: therophytes, H: hemicryptophytes, G: geophytes, Ch: chamaephytes, N: nanophanerophytes, M: microphanerophytes, MM: mega- and mesophanerophytes, L: lianas (vines).

found were 92 in the grassland area, 86 in the sparse forest area, and 110 in the closed forest area. The numbers of woody plants were 41 in the grassland area, 44 in the sparse forest area, 78 in the closed forest area and 84 in whole area. Only *Erigeron sumatrensis* was recorded as a naturalized plant species in the protected area in 1990. All of others were domestic to Japan. These are summarized in Table 1.

The result of mapping of the distribution of *Iris rossii* population suggested that there were no *I. rossii* in the closed forest area and all individuals were distributed in the grassland and the sparse forest area (Fig. 4).

Species composition by life forms (Raunkiaer, 1934; Nakagoshi, 1985) was different in each habitat (Fig. 5). Therophytes (abbreviation: Th) and hemicryptophytes (H) were seen mainly in the grassland area. In the closed forest area, therophytes species was not found and only one species of hemicryptophyte was grown. Nanophanerophytes (N), microphanerophytes (M) and mega- and mesophanerophytes (MM) were found mainly in the closed forest area. Lianas (vines: L) were also found mainly in that area. Typical species growing in the grassland area were *Gentiana scabra* var. *buergeri*, *Swertia japonica*, *Aster ageratoides* var. *harae* forma *leucanthus* and *Sanguisorba officinalis*. These species are of therophytes and hemicryptophytes. Several evergreen broad-leaved trees such as *Ternstroemia gymnanthera*, *Cinnamomum japonicum* and *Actinodaphne lancifolia* were found in the closed forest area. Even in the grassland area, some evergreen broad-leaved species such as *Myrica rubra*, *Ilex integra*, *Dendropanax trifidus* and *Trachelospermum asiaticum* var. *intermedium* were found. This fact suggests that if the mowing will be stopped, the grassland area will change to evergreen broad-leaved forest where *I. rossii* is killed naturally.

Table 1. Number of species recorded in the protected area. Number of families are shown in parentheses.

	Grassland	Sparse forest	Closed forest	Whole area
Total	92(49)	86(45)	110(47)	153(62)
Pteridophytes	7(5)	8(6)	8(5)	10(6)
Gymnospermae	3(2)	2(1)	2(2)	4(3)
Monocotyledoneae	15(6)	11(5)	13(5)	22(6)
Dicotyledoneae	67(36)	65(33)	87(35)	117(47)
Woody plants	41(25)	44(25)	78(34)	84(36)
Naturalized plant	1(1)	0(0)	0(0)	1(1)

2. Noteworthy plants in protected area

There were seven noteworthy plant species including *I. rossii* from the viewpoint of conservation and landscape in the protected area (Fig. 6). Among the seven noteworthy plant species, *I. rossii* and *Calanthe discolor* were listed in Japanese Red Data Book (The Investigation Committee for Important Plant Species in View of Protection in Japan, 1989). All of seven species were listed as designated species (The Environment Agency, 1984). These seven noteworthy plant species had been typical components of rural landscape in this region. They were mainly distributed in the grassland area. An important fact is, these species coexist with *I. rossii* in the protected area, and they have been commonly found in rural area but decreased in recent decades. Decreasing of these species due to management abandonment such as mowing and burning of grassland in rural vegetation. Therefore, for conservation of these grassland species including *I. rossii* in the protected area, mowing is requisite management method. On the point of conservation, the protected area should be managed for species diversity of the rural landscape in this region.

These noteworthy species were as follows:

Iris rossii Baker (Iridaceae)

This species is listed for the reasons of advance of succession and collection for horticulture in Red Data Book. This is also listed as a designated species. The reasons for listing were the regionally limited distribution, the rarity in number of individuals and the characteristic species of visual landscape. On the other hand, there is an artificial reason as a target plant for collection.

Epipactis thunbergii A. Gray (Orchidaceae)

A perennial orchid in mesic grassland. Distributing from Hokkaido to Kyushu in Japan, Korea and Ussuri in Russian in the Far East, and northeastern provinces in China. Flowering from June to July. This species is listed as a designated species for a characteristic species of moist meadow and the characteristic species of visual landscape. There are several individuals only in the grassland in the protected area.

Fig. 6. Four of noteworthy plants in the protected area. A: *Epipactis thunbergii* (June 22, 1991), B: *Calanthe discolor* (April 25, 1992), C: *Swertia japonica* (November 3, 1990), D: *Gentiana scabra* var. *buergeri* (November 3, 1990).

Calanthe discolor Lindl. (Orchidaceae)

An evergreen perennial orchid in forest. Native to Japan. Broadly distributing from Hokkaido to Kyushu (including Honshu and Shikoku). Flowering from April to May. This species had been common to rural forest and fallen into endangered species by plant collection for horticulture, then it was listed into Red Data Book. This is also selected as designated species for a characteristic species of landscape and a target for collection. The population in the protected area are also collected, and it was once thought that have been extinct from this area. Several individuals were reconfirmed in the grassland area in 1991.

Cymbidium goeringii (Reichb. fil.) Reichb. fil. (Orchidaceae)

An evergreen perennial orchid in forest. Distributing from Hokkaido to Kyushu and China. Flowering from March to April. This species is listed as a designated species for a character species of landscape and target for collection. There are several individuals in the grassland and the closed forest in the protected area.

Swertia japonica (Schult.) Makino (Gentianaceae)

An annual / biennial herb in grassland. Distributing from Hokkaido to Kyushu, Korea and China. Flowering from October to November. This species is listed as a designated species for target of plant hunting. There are several individuals only in the grassland in the protected area.

Gentiana scabra Bunge var. *buergeri* (Miq.) Maxim. (Gentianaceae)

A perennial herb in grassland. Distributing from Hokkaido to Kyushu. Flowering from October to November. This species is listed as a designated species for a character species of visual landscape. There are several individuals only in the grassland in the protected area.

Platycodon grandiflorum (Jacq.) A. DC. (Campanulaceae)

A perennial forb in grassland. Distributing from Hokkaido to Kyushu, Korea, northern and northeastern China, Ussuri in Russian in the Far East and its vicinities. Character species of Miscanthetea sinensis (Miyawaki, 1983). Flowering from August to September. This species is selected as designated species for a character species of landscape and target of plant hunting. There are several individuals in the grassland and the sparse forest in the protected area.

3. Vegetation in protected area

The species composition of investigated community in the protected area was shown in Tables 2 and 3. *Pinus densiflora* dominated in tree layer in all plots. *Pleioblastus chino* var. *viridis* and *Miscanthus sinensis* dominated in field layer of all plots except plot W. In plot W, *Gleichenia japonica* dominated in field layer. Abundance and composition of species of plot P1 was similar to those of plot P2, but was different from those of plot W. There were dense sub-tree and shrub layers in plot W which included broad-leaved trees such as *Myrica rubra*, *Symplocos lucida* and *Rhus trichocarpa*. This suggests that development of *I. rossii* was inhibited by shady canopy of broad-leaved trees especially

Table 2. Species composition of 10m x 10m plots in the protected area in June and November, 1990. P1: plot contained *Iris rossii*, P2 and W: plots without *Iris rossii*. Values are dominance and sociability in the ZM school.

Plot	P1		P2		W
Month	June	Nov.	June	Nov.	Nov.
Number of species	39	48	35	36	54
Species					
Iris rossii	+·2	+·2	·	·	·
Pleioblastus chino var. *viridis*	4·5	4·5	3·3	4·3	1·2
Miscanthus sinensis	2·3	2·3	4·5	4·5	1·2
Pinus densiflora	2·2	2·2	4·3	4·3	2·2
Rhus trichocarpa	1·3	1·1	1·3	+·3	1·2
Smilax china	1·2	1·2	+·2	1·2	1·2
Pleridium aquilinum var. *latiusculum*	2·3	2·3	2·3	1·2	+
Lespedeza bicolor forma *acutifolia*	+·2	+·2	1·2	+·2	1·1
Carex fernaldiana	1·3	+	1·3	1·2	+
Rhododendron kaempferi	+	+	+·3	1·3	+
Dioscorea japonica	+·2	+	+	+	+
Eupatorium chinense var. *simplicifolium*	+	+·2	+	+	+
Paederia scandens var. *mairei*	+	+	+·2	+	+
Gleichenia japonica	+	+	+	+	4·3
Quercus serrata	+	+	+	+	2·1
Eurya japonica	+	+	+	+	1·1
Viburnum erosum	+	+	+	+	+
Ilex crenata	+	+	+	+	+
Amelanchier asiatica	+	+	+	+	+
Dicranopteris pedata	+	+	+	+	+
Atractylodes japonica	+·2	+	+·2	+·2	·
Solidago virga-aurea var. *asiatica*	+	+	+·2	+·2	·
Ainsliaea apiculata	+	+	+·2	+	·
Calamagrostis arundinacea var. *brachytricha*	+	+	+·2	+	·
Symplocos lucida	·	+	1·1	1·1	1·2
Vitis flexuosa	+	·	+	+	+
Euscaphis japonica	·	+	+	+	+
Ardisia japonica	·	+	+	+	+
Osmunda japonica	1·1	1·1	·	·	+
Rubus palmatus	+	+	·	·	+
Struthiopteris niponica	+	+	·	·	+
Rhamnus crenata	+	+	·	·	+
Vaccinium bracteatum	+	+	·	·	+
Akebia trifoliata	+	+	·	·	+
Vaccinium japonicum	+	+	·	·	+
Aster scaber	·	+	+	+·2	·
Pourthiaea villosa var. *laevis*	+	+	·	·	·
Sphenomeris chinensis	+	+	·	·	·
Callicarpa japonica	+	+	·	·	·
Polygala japonica	+	+	·	·	·
Viola violacea	+	+	·	·	·
Aletris spicata	+	·	+	·	·
Swertia japonica	·	+	·	+·2	·
Gentiana scabra var. *buergeri*	·	+	·	+·2	·
Vaccinium oldhamii	·	+	·	+	·
Rhododendron reticulatum	·	+	·	·	+
Patrinia villosa	·	·	+	+	·
Thelypteris glanduligera var. *elatior*	·	·	+	+	·
Prunus jamasakura	+	·	·	·	·
Viola grypoceras	·	+	·	·	·
Vitis ficifolia var. *lobata*	·	+	·	·	·
Youngia japonica	·	+	·	·	·
Aeginetia indica var. *gracilis*	·	+	·	·	·
Platycodon grandiflorum	·	·	+·2	·	·
Ophiopogon jaburan	·	·	+	·	·
Cirsium japonicum	·	·	+	·	·
Carpesium glossophyllum	·	·	+	·	·
Rosa wichuraiana	·	·	·	+	·
Galium kikumugura	·	·	·	+	·
Plectranthus inflexus	·	·	·	+	·
Myrica rubra	·	·	·	·	2·1
Callicarpa mollis	·	·	·	·	1·2
Farfugium japonicum	·	·	·	·	+·2
Ficus erecta	·	·	·	·	+·2
Acanthopanax sciadophylloides	·	·	·	·	+
Dendropanax trifidus	·	·	·	·	+
Dioscorea septemloba	·	·	·	·	+
Zanthoxylum schinifolium	·	·	·	·	+
Rhus javanica	·	·	·	·	+
Ligustrum japonicum	·	·	·	·	+
Stauntonia hexaphylla	·	·	·	·	+
Cinnamomum japonicum	·	·	·	·	+
Daphniphyllum teijsmannii	·	·	·	·	+
Trachelospermum asiaticum var. *intermedium*	·	·	·	·	+
Rubus buergeri	·	·	·	·	+
Hedera rhombea	·	·	·	·	+
Dryopteris erythrosora	·	·	·	·	+
Fatsia japonica	·	·	·	·	+
Parthenocissus tricuspidata	·	·	·	·	+
Actinodaphne lancifolia	·	·	·	·	+
Mallotus japonicus	·	·	·	·	+
Clerodendron trichotomum	·	·	·	·	+
Oplismenus undulatifolius var. *japonicus*	·	·	·	·	+

Table 3. Species composition of 1m x 1m plots in the protected area in June and November, 1990. Y1 to Y5: plots contained *Iris rossii*, N1 to N5: plots without *Iris rossii*.

Plot	Y1		Y2		Y3		Y4		Y5		N1		N2		N3		N4		N5	
Month	J	N	J	N	J	N	J	N	J	N	J	N	J	N	J	N	J	N	J	N
Number of species	13	15	12	17	15	18	14	13	14	13	8	15	14	17	15	17	10	11	16	18
Species																				
Iris rossii	+	+	1·1	1·1	1·1	1·1	1·1	1·1	1·1	1·1	·	·	·	·	·	·	·	·	·	·
Pleioblastus chino var. *viridis*	3·3	4·3	4·5	4·5	3·3	4·3	3·3	4·3	4·4	5·5	4·5	4·5	5·5	5·5	4·5	5·5	3·2	4·3	4·5	5·5
Miscanthus sinensis	1·2	1·2	2·3	2·3	1·3	1·2	2·2	2·2	·	·	1·2	1·2	1·2	3·2	3·3	3·3	2·2	2·2	2·2	2·2
Rhododendron kaempferi	·	1·2	1·2	1·2	+	+	1·1	1·2	1·1	1·1	1·1	+	1·2	1·2	1·1	1·1	·	+	+	1·1
Lespedeza bicolor forma *acutifolia*	1·2	1·2	2·2	1·2	1·1	1·1	1·2	1·2	1·2	1·2	+	+	+	1·1	·	·	1·1	1·1	+	1·1
Carex fernaldiana	1·3	1·2	1·2	1·1	1·2	1·2	1·2	+	1·2	1·2	·	·	+·2	+	+·2	1·2	·	·	1·1	1·1
Rhus trichocarpa	1·1	+	+	+	1·1	1·1	1·2	+	·	·	2·2	+	1·2	1·2	1·1	+	+	·	·	·
Quercus serrata	1·1	1·1	+	1·1	1·1	1·2	·	·	+	·	·	·	1·1	1·2	1·1	1·1	·	+	1·1	1·1
Pinus densiflora	+	+	·	·	+	+	+	·	+	+	·	·	+	+	·	+	+	+	+	+
Pteridium aquilinum var. *latiusculum*	·	·	1·1	2·1	1·1	·	1·1	1·1	1·1	·	1·1	1·1	·	·	·	·	2·2	2·2	2·2	1·1
Eupatorium chinense var. *simplicifolium*	·	·	·	·	·	1·2	·	·	·	·	+	+	+	+	+	+	+	+	1·1	+
Eurya japonica	·	·	·	·	+	+	+	+	·	·	·	·	1·1	·	+	+	·	·	+	+
Ilex crenata	+	+	·	+	·	·	+	+	·	·	1·1	1·1	·	+	·	·	·	·	·	·
Solidago virga-aurea var. *asiatica*	·	·	+	+	·	·	·	+	+	+	·	+	·	·	·	·	+	+	·	·
Atractylodes japonica	·	·	1·2	1·2	·	·	1·1	1·1	·	·	·	·	·	1·2	·	·	·	·	1·1	1·1
Paederia scandens var. *mairei*	·	·	·	·	+	+	·	·	+	+	·	·	·	·	+	+	·	+	·	·
Dioscorea japonica	·	·	·	·	+	·	·	·	+	·	·	·	+	+	+	·	·	·	1·1	+
Struthiopteris niponica	·	+	+	1·2	·	·	·	·	·	·	·	·	·	·	+	1·2	·	·	·	·
Akebia trifoliata	·	·	·	·	·	·	+	·	+	+	·	+	·	+	·	·	·	·	·	·
Ainsliaea apiculata	+	+	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	·	+
Osmunda japonica	·	·	·	·	+	+	·	·	·	·	·	·	·	·	1·1	1·1	·	·	·	·
Rubus palmatus	·	·	·	·	·	·	·	·	+	+	·	·	·	·	·	·	·	·	+	+
Gleichenia japonica	·	·	·	·	·	·	·	·	·	·	·	·	+	1·1	1·1	+	·	·	·	·
Vaccinium japonicum	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	+	+	+
Amelanchier asiatica	+	+	·	+	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Polygala japonica	+	+	·	·	·	·	·	·	·	·	·	·	+	·	·	·	·	·	·	·
Viburnum erosum	+	·	·	·	·	·	·	·	·	·	·	·	·	·	+	+	·	·	·	·
Symplocos lucida	·	·	·	+	·	·	·	·	·	+	·	1·1	·	·	·	·	·	·	·	·
Viola violacea	·	·	·	·	+	+	·	·	·	·	·	·	·	·	·	·	·	·	·	+
Dicranopteris pedata	·	·	·	·	·	·	·	·	·	·	·	·	+	+	·	1·2	·	·	·	·
Rhododendron reticulatum	·	·	·	+	·	·	·	·	·	·	·	+	·	·	·	·	·	·	·	·
Smilax china	·	·	·	·	·	1·1	·	·	·	·	·	·	·	·	·	+	·	·	·	·
Swertia japonica	·	·	·	·	·	+	·	·	·	·	·	+	·	·	·	·	·	·	·	·
Viola grypoceras	·	·	·	·	·	·	·	·	·	·	·	+	·	+	·	·	·	·	·	·
Rhamnus crenata	·	·	·	·	·	·	·	·	·	·	·	·	+	1·2	·	·	·	·	·	·
Vaccinium bracteatum	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	+
Calamagrostis arundinacea var. *brachytricha*	·	+	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	+
Euscaphis japonica	·	·	·	1·1	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Vaccinium oldhamii	·	·	·	·	·	1·1	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Ardisia japonica	·	·	·	·	·	+	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Aletris spicata	·	·	·	·	·	·	+	·	·	·	·	·	·	·	·	·	·	·	·	·
Gentiana scabra var. *buergeri*	·	·	·	·	·	·	·	+	·	·	·	·	·	·	·	·	·	·	·	·
Prunus jamasakura	·	·	·	·	·	·	·	·	+	·	·	·	·	·	·	·	·	·	·	·
Aster scaber	·	·	·	·	·	·	·	·	·	+	·	·	·	·	·	·	·	·	·	·
Youngia japonica	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	·	·	·	·	·
Vitis ficifolia var. *lobata*	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	·
Vitis flexuasa	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·

evergreen trees, and could not grow in the closed forest. There were no remarkable differences in species composition between 1m x 1m plots series with *I. rossii* (Y1 to Y5) and those without it (N1 to N5). Main species in 1m x 1m plots were *Lespedeza bicolor* forma *acutifolia*, *Rhus trichocarpa*, *Carex fernaldiana*, *Rhododendron kaempferi*, *Pteridium aquilinum* var. *latiusculum*, *Quercus serrata* and *Eupatorium chinense* var. *simplicifolium* except the above mentioned three dominant species. Many of these species are common to another local population of *I. rossii* in Hiroshima Prefecture (Suzuki, 1972), however, tree species are seemed to be less developed in the protected area.

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The List of Plants in Protected Area

Legends - 1. The order and names of species were referred to Tagawa (1959) and Kurata & Nakaike (1979-1990) for ferns and Ohwi & Kitagawa (1983) for seed plants.

2. The keys to abbreviation after name are as follows; G: Grassland area, SF: Sparse forest area, CF: Closed forest area.

3. The key placed last is life form after Raunkiaer (1934) and Nakagoshi (1985).

PTERIDOPHYTA

Osmundaceae

Osmunda japonica Thunb., Zenmai (G, SF, CF), H

Lygodiaceae

Lygodium japonicum (Thunb.) Sw., Kanikusa (SF), L(G)

Gleicheniaceae

Dicranopteris pedata (Houtt.) Nakaike, Koshida (G, SF, CF), G

Gleichenia japonica Spr., Urajiro (G, SF, CF), G

Pteridiaceae

Sphenomeris chinensis (Linn.) Maxon, Horashinobu (G, SF, CF), H

Pteridium aquilinum (Linn.) Kuhn var. *latiusculum* (Desv.) Underw. ex Heller, Warabi (G, SF, CF), G

Aspidiaceae

Dryopteris erythrosora (Eaton.) O. Kuntze, Benishida (CF), H

Thelypteris glanduligera (Kunze) Ching var. *elatior* (Eaton.) Kurata, Kohashigoshida (G), H

Cyclosorus acuminatus (Houtt.) Nakai ex H. Ito, Hoshida (SF, CF), H

Blechnaceae

Struthiopteris niponica (Kunze) Nakai, Shishigashira (G, SF, CF), H

SPERMATOPHYTA

GYMNOSPERMAE

Podocarpaceae

Podocarpus macrophyllus (Thunb.) Lamb., Inumaki (CF), MM

Pinaceae

Pinus densiflora Sieb. et Zucc., Akamatsu (G, SF, CF), MM

Pinus thunbergii Parlat., Kuromatsu (G, SF), MM

Taxodiaceae

Cryptomeria japonica (Linn. fil.) D. Don, Sugi (G), MM

ANGIOSPERMAE

MONOCOTYLEDONEAE

Gramineae

Pleioblastus chino (Franch. et Savat.) Makino var. *viridis* (Makino) S. Suzuki, Nezasa (G, SF, CF), N
Calamagrostis arundinacea (Linn.) Roth var. *brachytricha* (Steud.) Hack., Nogariyasu (G, SF, CF), H
Oplismenus undulatifolius (Ard.) Roemer et Schultes var. *japonicus* (Stend.) Koidz., Kochijimizasa (CF), H
Miscanthus sinensis Anderss., Susuki (G, SF, CF), H
Cyperaceae
Fimbristylis dichotoma (Linn.) Vahl, Tentsuki (G), Th
Carex stenostachys Franch. et Savat., Nishinohonmonjisuge (G, SF), H
Carex fernaldiana Lév. et Van., Itosuge (G, SF, CF), H
Carex floribunda (Korsh.) Meinsh, Hikagesuge (CF), H
Carex mollicula Boott, Himeshirasuge (CF), H
Carex lenta D. Don, Nakirisuge (SF, CF), H
Liliaceae
Ophiopogon jaburan (Kunth) Lodd., Noshiran (G), H
Ophiopogon japonicus (Linn. fil.) Ker-Gawl., Janohige (CF), G
Aletris luteoviridis (Maxim.) Franch., Nogiran (G), H
Aletris spicata (Thunb.) Bureau et Franch., Sokushinran (G), H
Smilax china Linn., Sarutoriibara (G, SF, CF), L(N)
Dioscoreaceae
Dioscorea japonica Thunb., Yamanoimo (G, SF, CF), L(G)
Dioscorea quinqueloba Thunb., Kaededokoro (SF), L(G)
Dioscorea septemloba Thunb., Kikubadokoro (SF, CF), L(G)
Iridaceae
Iris rossii Baker, Ehimeayame (G, SF), H
Orchidaceae
Epipactis thunbergii A. Gray, Kakiran (G), G
Calanthe discolor Lindl., Ebine (G), G
Cymbidium goeringii (Reichb. fil.) Reichb. fil., Shunran (G, CF), G

DICOTYLEDONEAE
CHORIPETALAE
Salicaceae
Salix sieboldiana Blume, Yamayanagi (CF), M
Myricaceae
Myrica rubra Sieb. et Zucc., Yamamomo (G, SF, CF), MM
Juglandaceae
Platycarya strobilacea Sieb. et Zucc., Nogurumi (G), MM
Fagaceae
Quercus glauca Thunb., Arakashi (CF), MM

Quercus serrata Thunb., Konara (G, SF, CF), MM
Castanea crenata Sieb. et Zucc., Kuri (G, SF), MM
Moraceae
Ficus erecta Thunberg, Inubiwa (G, SF, CF), M
Santalaceae
Thesium chinense Turcz., Kanabikiso (G), H
Polygonaceae
Polygonum cuspidatum Sieb. et Zucc., Itadori (SF), H
Lardizabalaceae
Akebia quinata (Thunb.) Decaisne, Akebi (CF), L(M)
Akebia trifoliata (Thunb.) Koidz., Mitsubaakebi (G, SF, CF), L(M)
Stauntonia hexaphylla (Thunb.) Decaisne, Mube (SF, CF), L(M)
Menispermaceae
Sinomenium acutum (Thunb.) Rehd. et Wils., Tsuzurafuji (CF), L(N)
Cocculus orbiculatus (Linn.) Forman, Aotsuzurafuji (G, SF, CF), L(N)
Lauraceae
Cinnamomum japonicum Siebold ex Nakai, Yabunikkei (CF), MM
Neolitsea sericea (Blume) Koidz., Shirodamo (CF), MM
Actinodaphne lancifolia (Sieb. et Zucc.) Meisn., Kagonoki (CF), MM
Pittosporaceae
Pittosporum tobira (Thunb.) Ait., Tobera (CF), N
Rosaceae
Potentilla fragarioides Linn. var. *major* Maxim., Kijimushiro (G, SF), H
Rubus buergeri Miquel, Fuyuichigo (SF, CF), N
Rubus palmatus Thunb., Nagabamomijiichigo (SF, CF), N
Rubus hirsutus Thunb., Kusaichigo (CF), N
Sanguisorba officinalis Linn., Waremoko (G), H
Agrimonia japonica (Miq.) Koidz., Kinmizuhiki (G), H
Rosa multiflora Thunb., Noibara (G, SF, CF), N
Rosa wichuraiana Crép., Terihanoibara (G, CF), N
Prunus jamasakura Sieb. ex Koidz., Yamazakura (G, CF), MM
Prunus spinulosa Sieb. et Zucc., Rinboku (SF), M
Eriobotrya japonica (Thunb.) Lindl., Biwa (CF), M
Amelanchier asiatica (Sieb. et Zucc.) Endl., Zaifuriboku (G, CF), M
Pourthiaea villosa (Thunb.) Decne. var. *laevis* (Thunb.) Stapf, Kamatsuka(G, SF, CF), M
Leguminosae
Albizia julibrissin Durazz., Nemunoki (CF), M
Lespedeza cyrtobotrya Miq., Marubahagi (G, SF, CF), N
Lespedeza bicolor Turcz. forma *acutifolia* Matsum., Yamahagi (G, SF, CF), N
Wisteria floribunda (Willd.) DC., Fuji (G, CF), L(MM)
Wisteria brachybotrys Sieb. et Zucc., Yamafuji (CF), L(MM)

Rutaceae
Zanthoxylum schinifolium Sieb. et Zucc., Inuzansyo (G, SF, CF), N
Zanthoxylum ailanthoides Sieb. et Zucc., Karasuzansyo (CF), MM
Polygalaceae
Polygala japonica Houtt., Himehagi (G), H
Euphorbiaceae
Daphniphyllum teijsmannii Zoll., Himeyuzuriha (SF, CF), MM
Mallotus japonicus (Thunb.) Muell. Arg., Akamegashiwa (SF, CF), MM
Anacardiaceae
Rhus succedanea Linn., Haze (SF, CF), MM
Rhus trichocarpa Miq., Yamaurushi (G, SF, CF), M
Rhus javanica Linn., prop., Nurude (SF, CF), M
Aquifoliaceae
Ilex crenata Thunb., Inutsuge (G, SF, CF), N
Ilex rotunda Thunb., Kuroganemochi (CF), MM
Ilex integra Thunb., Mochinoki (G, SF, CF), MM
Celastraceae
Celastrus orbiculatus Thunb., Tsuruumemodoki (CF), L(M)
Euonymus alatus (Thunb.) Sieb. forma *ciliato-dentatus* (Franch. et Savat.) Hiyama, Komayumi (SF, CF), N
Euonymus japonicus Thunb., Masaki (CF), N
Staphyleaceae
Staphylea bumalda (Thunb.) DC., Mitsubautsugi (CF), M
Euscaphis japonica (Thunb.) Kanitz, Gonzui (G, SF, CF), M
Rhamnaceae
Rhamnus crenata Sieb. et Zucc., Isonoki (G, CF), N
Vitidaceae
Vitis ficifolia Bunge var. *lobata* (Regel) Nakai, Ebizuru (G, CF), L(M)
Vitis flexuosa Thunb., Sankakuzuru (G, CF), L(M)
Ampelopsis brevipedunculata (Maxim.) Trautv., Nobudo (SF), L(M)
Parthenocissus tricuspidata (Sieb. et Zucc.) Planch., Tsuta (G, CF), L(M)
Theaceae
Ternstroemia gymnanthera (Wight et Arn.) Beddome, Mokkoku (CF), MM
Eurya japonica Thunb., Hisakaki (G, SF, CF), M
Violaceae
Viola violacea Makino, Shihaisumire (G, SF), H
Viola kusanoana Makino, Ootachitsubosumire (SF), H
Viola grypoceras A. Gray, Tachitsubosumire (G), H
Elaeagnaceae
Elaeagnus pungens Thunb., Nawashirogumi (CF), N
Haloragidaceae

Haloragis micrantha (Thunb.) R. Br., Arinotogusa (G), Ch
Araliaceae
Aralia elata (Miq.) Seemann, Taranoki (SF, CF), M
Hedera rhombea (Miq.) Bean, Kizuta (SF, CF), L(MM)
Fatsia japonica (Thunb.) Decne. et Planch., Yatsude (CF), N
Dendropanax trifidus (Thunb.) Makino, Kakuremino (G, SF, CF), MM
Acanthopanax sciadophylloides Franch. et Savat., Koshiabura (SF, CF), M
Umbelliferae
Cryptotaenia japonica Hassk., Mitsuba (SF), H

GAMOPETALAE
Clethraceae
Clethra barbinervis Sieb. et Zucc., Ryobu (CF), M
Pyrolaceae
Pyrola japonica Klenze, Ichiyakuso (G), Ch
Ericaceae
Rhododendron kaempferi Planch., Yamatsutsuji (G, SF, CF), N
Rhododendron reticulatum D. Don., Kobanomitsubatsutsuji (G, SF, CF), N
Lyonia ovalifolia (Wall.) Drude var. *elliptica* (Sieb. et Zucc.) Hand.-Mazz., Nejiki (CF), M
Vaccinium bracteatum Thunb., Shashanbo (G, CF), N
Vaccinium oldhamii Miquel, Natsuhaze (G, SF, CF), N
Vaccinium japonicum Miq., Akushiba (G, SF, CF), N
Myrsinaceae
Ardisia japonica (Thunb.) Blume, Yabukoji (G, SF, CF), Ch
Primulaceae
Lysimachia clethroides Duby, Okatorano-o (G, SF), H
Ebenaceae
Diospyros kaki Thunb., Kakinoki (SF, CF), MM
Symplocaceae
Symplocos lucida Sieb. et Zucc., Kuroki (G, SF, CF), M
Oleaceae
Ligustrum japonicum Thunb., Nezumimochi (CF), N
Gentianaceae
Swertia japonica (Schult.) Makino, Senburi (G), Th
Gentiana scabra Bunge var. *buergeri* (Miq.) Maxim., Rindo (G), H
Apocynaceae
Trachelospermum asiaticum (Sieb. et Zucc.) Nakai var. *intermedium* Nakai, Teikakazura (G, SF, CF), L(MM)
Verbenaceae
Callicarpa japonica Thunb., Murasakishikibu (G, CF), N
Callicarpa mollis Sieb. et Zucc., Yabumurasaki (G, SF, CF), N

Clerodendron trichotomum Thunb., Kusagi (SF, CF), M
Labiatae
Salvia japonica Thunb., Akinotamuraso (G, SF), H
Plectranthus inflexus (Thunb.) Vahl ex Benth., Yamahakka (G, SF, CF), G
Orobanchaceae
Aeginetia indica Linn. var. *gracilis* Nakai, Nanbangiseru (G, SF), Th
Rubiaceae
Gardenia jasminoides Ellis forma *grandiflora* (Lour.) Makino, Kuchinashi (CF), N
Paederia scandens (Lour.) Merrill var. *mairei* (Léveillé) Hara, Hekusokazura (G, SF, CF), L(N)
Galium kikumugura Ohwi, Kikumugura (G, SF, CF), H
Caprifoliaceae
Viburnum wrightii Miq., Miyamagamazumi (CF), N
Viburnum erosum Thunb., Kobanogamazumi (G, SF, CF), N
Weigela floribunda (Sieb. et Zucc.) K. Koch, Yabuutsugi (CF), N
Lonicera japonica Thunb., Suikazura (CF), N
Valerianaceae
Patrinia villosa (Thunb.) Juss., Otokoeshi (G, SF, CF), H
Cucurbitaceae
*Melothria japonic*a (Thunb.) Maxim., Suzumeuri (G), Th
Campanulaceae
Adenophora triphylla (Thunb.) A. DC. var. *japonica* (Regel) Hara, Tsuriganeninjin (G, CF), H
Platycodon grandiflorum (Jacq.) A. DC., Kikyo (G, SF), G
Compositae
Carpesium glossophyllum Maxim., Sajigankubiso (G, SF), H
Ainsliaea apiculata Sch. Bip., Kikkouhaguma (G, SF, CF), H
Eupatorium chinense Linn. var. *simplicifolium* (Makino) Kitam., Hiyodoribana (G, SF, CF), H
Solidago virga-aurea Linn. var. *asiatica* Nakai, Akinokirinso (G, SF, CF), H
Erigeron sumatrensis Retz., Ooarechinogiku (SF), Th
Aster scaber Thunb., Shirayamagiku (G, SF, CF), H
Aster ageratoides Turcz. var. *harae* (Makino) Kitam. forma *leucanthus* Honda, Yamashirogiku (G), H
Farfugium japonicum (Linn.) Kitam., Tsuwabuki (SF, CF), H
Atractylodes japonica Koidz. ex Kitam., Okera (G, SF), H
Cirsium japonicum DC., Noazami (G, SF), H
Serratula coronata Linn. var. *insularis* (Iljin) Kitam., Tamuraso (SF), H
Ixeris dentata (Thunb.) Nakai, Nigana (SF, CF), H
Lactuca sororia Miq., Murasakinigana (CF), H
Youngia japonica (Linn.) DC., Onitabirako (G), Th