

Natural Regeneration of Conifers in Japan.

By

MASARU KAWADA.

Introduction.

This information is edited by the writer from the following original papers:

General Feature of Coniferous Forests in Japan. by Masaru Kawada.

On the Natural Regeneration of *Picea jezoensis* Carr. and *Abies sachalinensis* Fr. Schm. in Southern Karafuto (Saghalien). by Dr. Kentaro Nakamura, Tokyo Imperial University.

On the Natural Regeneration of the "Hiba" (*Thuopsis dolabrata* var. *Hondai* Makino) forest. by Kinjiro Akinaga, Forestry Experiment Station, Ministry of Agriculture and Forestry.

Some Notes on the Natural Regeneration of Conifers in the Mixed Self-generating Stands in Japan, especially for the "Sugi" (*Cryptomeria japonica* Don.) and for the "Momi" (*Abies firma* Sieb. et Zucc.). by Dr. Wataru Tarazaki, Forestry Experiment Station, Ministry of Agriculture and Forestry.

General Description of "Hinoki" (*Chamaecyparis obtusa* Sieb. et Zucc.) forests in "Kiso" district. by Ken-ichiro Nakamura, Director, Forestry Experiment Station, Imperial Forestry and Estate Bureau.

Natural Regeneration of the Pine Forest in Japan. by Masaru Kawada.

Japanese Empire is hanging from the north to south through very wide range of latitude, so that the climate differs with the parts of Japan, thus, in this information the coniferous forests are classified into next six types of forest vegetation. (A) northern xerophytic coniferous forest, (B) high mountain xerophytic coniferous forest, (C) mesophytic forest mixed with conifers and deciduous broad-leaved trees, (D) mesophytic forest mixed with conifers and evergreen broad-leaved trees, (E) temperate rain-forest with broad-leaved conifers belong to *Taxaceae*, and (F) strand pine forest. For the object to describe about the each type of forest vegetations it is necessary to divide the Japanese Empire to the following eleven regions, i.e., Karafuto, Hokkaido, northern Honshiu, central Honshiu, western Honshiu, Shikoku, Kiushiu, Taiwan, Chosen, Ogasawarajima, and Riukiu, but the last two regions are not significant to this present title.

General Feature of Coniferous Forests and Outline of Natural Regeneration of the Forests.

The number of kinds of conifers, including species and varieties, which are relatively important for forestry, is about 103, and those are classified as follows:

Genus	Number of Species and Varieties
<i>Abies</i>	13
<i>Chamaecyparis</i>	4
<i>Cryptomeria</i>	1
<i>Cunninghamia</i>	4
<i>Juniperus</i>	14
<i>Keteleeria</i>	1
<i>Larix</i>	3
<i>Libocedrus</i>	1
<i>Picea</i>	13
<i>Pinus</i>	17

(Continued)

Genus *	Number of Species and Varieties
<i>Pseudotsuga</i>	2
<i>Sciadopitys</i>	1
<i>Taiwania</i>	1
<i>Thuja</i>	1
<i>Thujopsis</i>	2
<i>Tsuga</i>	3
<i>Cephalotaxus</i>	5
<i>Podocarpus</i>	9
<i>Taxus</i>	4
<i>Torreya</i>	4
Total	103

(A) Northern xerophytic coniferous forest. The forest vegetations belong to this type mainly occur in the Karafuto and Hokkaido. Usually, this type of forest touches with the Japanese creeping pine (*Pinus pumila* Regel) at the upper limit. The dominant species of this forest vegetation are

Abies Mayriana Miyabe et Kudo

A. sachalinensis Mast.

A. Wilsonii Miyabe et Kudo

Larix dahurica var. *japonica* Maxim.

L. dahurica f. *ochrocarpa* Wils.

Picea Glehnii Mast.

P. Glehnii f. *chlorocarpa* Miyabe et Kudo

and *P. jezoensis* Carr.

The remarkable characteristic plants are

Dryopteris Amurensis Takeda

D. dilatata var. *oblonga* Takeda

Elquisetum sylvaticum L.

Stellaria jezoensis Maxim.

Corydalis gigantea var. *amurensis* Regel

Waldsteinia sibirica Tratt.

Angelica Maximowiczii Benth.

Corrus canadensis L.

Pirola renifolia Maxim.

Trientalis europea L.

Galium kamtschaticum var. *hirsutum* Takeda

Saussurea acuminata Turcz.

etc.

(From the report of forest vegetation survey of the school forest of Imperial University of Kyoto in Karafuto.)

Dr. Kentaro Nakamura, who is studying the natural regeneration of *Picea jezoensis* and *Abies sachalinensis* in southern Karafuto, contributes as follows:

"The stands are mostly virgin growth, the physiognomy of each stand looks more or less similar to an even-aged forest, but truly the ages of trees differs with through very wide range.

The larger trees have had a very slow growth in their youth for 40—130 years old and grown up vigorously after release from suppression, so that the shelter-wood system or the selection system is suitable to the dominant species, i. e., *Abies sachalinensis* and *Picea jezoensis*. On the other hand, a heavy cutting, almost equally to clear cutting causes the withering of the remaining mother trees or young growths, rapid invasion and predomination of rank weeds, fire devastation, etc.

The greater part of the stands is actually overmature and in order to promote its growth and to improve its structure, a part of trees, the diameters of which ranges some classes of diameter, must be taken out, otherwise, no growth of stand can be expected.

Thus, recently, except the numerous stands, for which, at present, the clear cutting system is applied, for the most part of stands the selection system is recommended and adopted."

The forests, which occur covering over the huge area of northern Chosen and the upper part of the main mountain ranges of the peninsula, including the following dominant species,

Abies holophylla Maxim.

A. nephrolepis Maxim.

Larix dahurica var. *coreana* Nakai

Picea jezoensis var. *hondoensis* Rehd.

P. koraiensis Nakai

and *Pinus koraiensis* Sieb. et Zucc.

have very similar physiognomy to that of this forest vegetation.

(B) High mountain xerophytic coniferous forest. The forests belong to this type occur mainly at the slopes of the high mountain ranges of central Honshu, and the summits of mountain ranges of Kiushiu and Shikoku. The dominant species of conifers occurring very commonly in the forest are

Abies homolepis Sieb. et Zucc.

A. Mariesii Mast.

A. Shikokiana Nakai

A. Veitchii Lindl.

A. Veitchii var. *olivacea* Shirasawa

Larix Kampferi Sarg.

Picea bicolor Mayr

P. bicolor var. *acicularis* Shirasawa et Koyama

P. bicolor var. *reflex* Shirasawa et Koyama

P. jezoensis var. *hondoensis* Rehd.

P. Koyamai Shirasawa

P. Maximowiczii Regel

Pinus koraiensis Sieb. et Zucc.

P. parviflora Sieb. et Zucc.

P. pentaphylla Mayr

Thuja Standishii Carr.

and *Tsuga diversifolia* Mast.

Generally, this forest vegetation is lined the upper limit by the scrub of creeping pine as same as the case of preceding forest vegetation. The marked characteristic of this forest vegetation is the fact that the number of species of dominant conifers is relatively numerous. In comparison of the northern xerophytic coniferous forest it is very remarkable that the species of dominant conifers are almostly quite different. The remarkable characteristic plants are

(Subordinate trees)

Acer Tschonoskii Maxim.

etc.

(Ground herbs)

Pteridophyllum racemosum Sieb. et Zucc.

Echinopanax japonicum Nakai

Cornus canadensis L.

Pirola renifolia Makino

Primula japonica A. Gray

Thymus Przewalskii var. *laxa* Nakai

Clintonia ulensis Trautv. et Mey

Streptopus japonicus Ohwi

Listera cordata, R. Br.

Platanthera Takedai Makino

etc.

Concerned with the topography, there is fundamental unequal condition between this type of forest vegetation and the northern xerophytic coniferous forest, i. e., while the northern forests are mostly standing on plain or the foot-mountain region with very gentle slope, but the topography of the high mountain forest is always rocky very steep. Caused by this fact, as the most reasonable system of natural regeneration of this forest, the selection cutting is adopted.

The forests occurring at the upper part of the main mountain ranges of Taiwan, including the following dominant species,

Abies Kawakamii Ito
Picea morisonicola Hayata
Pinus taiwanensis Hayata
 etc.

seem to be classified into this forest vegetation.

(C) Mesophytic forest mixed with conifers and deciduous broad-leaved trees. This forest vegetation mainly includes the forests, which occur from the northern Honshiu to central of it occupying the lower slopes of high mountains and the foot-mountain regions. In this forest the conifers associating normally with Japanese beech (*Fagus crenata* Blume) and Japanese oak (*Quercus crispula* Blume).

This forest vegetation plays the most important part for forestry in Japan. In the northern Honshiu

Cryptomeria japonica Don.

and *Thujopsis dolabrata* var. *Hondai* Makino

are the two dominant species, and in the central Honshiu

Cryptomeria japonica Don.

Chamaecyparis obtusa Sieb. et Zucc.

Ch. pisifera Sieb. et Zucc.

and *Abies firma* Sieb. et Zucc.

are the principal species. In the former part the centres of the forest vegetations of *Cryptomeria* and *Thujopsis* quite separate and there can be found frequently the consociations of each species, but in the latter the forests are mostly mixed.

Sciadopitys verticillata Sieb. et Zucc.

Thuja Standishii Carr.

and *Thujopsis dolabrata* Sieb. et Zucc. (not var. *Hondai*) occur also in rather small number in the latter part.

On the species, such as *Cryptomeria japonica*, *Abies firma*, *Pinus densiflora*, which distributes through two forest vegetations, i. e., this vegetation and the mesophytic forest mixed with conifers and evergreen broad-leaved trees, will be summarized in following paragraphs.

The remarkable characteristic plants are

(Subordinate trees)

Cephalotaxus drupacea var. *nana* Rehd.

Thuja Standishii Carr.

Prunus serrulata var. *sachalinensis* Makino

Acer palmatum Thunb.

Aesculus turbinata Blume

etc.

(Shrubs)

Daphniphyllum humile Maxim.

Ilex Sagerokii subsp. *brevipedunculata* Makino

Daphne Miyabeana Makino

Aucuba japonica var. *borealis* Miyabe

Rhododendron Albrechtii Maxim.

etc.

(Ground herbs)

Blechnum nipponicum Makino

Dryopteris remotissima Koidz.

Phyllitis scolopendrium Newm.

Plagiogyria Matsumuraeana Makino
Sceptrocnide macrostachya Maxim.
Rodgersia podophylla A. Gray
Oxalis Acetosella var. *japonica* Makino
Cacalia farfaraefolia Sieb. et Zucc.
Lysichiton camtschatense Schott.
Symplocarpus foetidus Salisb.
Cardocrinum Glehni Makino
Lilium medeoloides A. Gray
 etc.

(From the report of forest vegetation survey of *Cryptomeria* forest by Akita District Forest Office.)

There are two species belong to *Thujaopsis* in Japan, the one is *Thujaopsis dolabrata* distributing mainly in central Honshiu, and the other is *Thujaopsis dolabrata* var. *Hondai* distributing mainly in northern Honshiu. Usually, the former is standing scattered in the mixed forest, but the latter occurs as dominant mixed with *Fagus*, and sometimes even as dominant of pure stand.

At present, the silvicultural systems of natural regeneration for *Thujaopsis dolabrata* var. *Hondai* are shelterwood system and selection system, but recently, it becomes to be recognized that the latter are more suitable for this species.

Mr. K. Akinaga, who has long continued his investigation about the natural regeneration of the forest of *Thujaopsis dolabrata* var. *Hondai*, contributes as follows: "this report has been drawn up as a results of the recent researches done by writer in the natural forest of *Thujaopsis dolabrata* var. *Hondai*, which are predominance in the northern Honshiu in Japan. It is composed of three parts dealing with the following subjects; 1) Reproductive conditions of the present natural forests; 2) General condition of reproduction in the experimental stand; 3) Reproductive habits of *Thujaopsis dolabrata* var. *Hondai*.

With regards to the first subject, the writer laid sample plots in a pure mature stand of this species, in a pure stand with structure of two storied form, and in a selection-like stand mixed with broad-leaved trees, to investigate firstly by what reproduction method the present stand have been regenerated, secondly under what conditions reproduction is going on.

With regards to the second subject, sample plots were laid in the same stand just used for the researches of the first subject, and the investigations were made chiefly on the influence exerted by the various degrees of crown canopies on the regeneration and the growth of seedlings of this species.

With regards to the third subject, special attention was paid chiefly for the characteristic habits of this species in its seed production, to the establishment and the propagation of its seedlings, and to the growth of this species.

The result, of these researches may briefly be summarized as follows:

The present pure-mature stand of this species was reproduced about 180—200 years ago with the reproduction period of 40 years under the shelter-wood system. The selection-like stand of this species mixed with broad-leaved trees was regenerated under the selection-like system in such a way, in which the selection cuttings were made at every 30 years, and the cuttings, were chiefly executed alternately for this species and broad-leaved trees one by one. The seed year of this species occurs every 5 years, and it is found that the seeds obtained in off-years contribute very little to the natural reproduction of this species.

For the natural reproduction of this species under the shelter-wood system, it is necessary to keep trees occupying 50 m.² in basal area per ha. after the first cutting, and it is also necessary to manage the forest during about 30 years, which is just corresponds to the period of regeneration in such a way, and even when the final cutting is finished, there must be still kept 23 m.² in basal area per ha. by the remaining trees.

Under the selection system, if conditioned as follows, i.e., the cutting of which must be repeated every 6—10 years, the annual yield of which must be 8 to 9 fm. in volume per ha., it is desirable that the stand should maintain the canopy corresponding to the 30 m.² in basal area, and to the volume of 350 fm. per ha."

Although, *Chamaecyparis obtusa* distributes in common through the mesophytic forest with deciduous broad-leaved trees and the forest with evergreen broad-leaved trees, the forests of "Kiso"

district, which situate in centre of central Honshiu, is the most popular one dominated by this species, and from the standpoint of physiognomy it is out of question to recognize that this forest belongs to this forest vegetation.

Mr. Ken-ichiro Nakamura, who has long studied about the *Chamaecyparis obtusa* and the forest of this species, contributes as follows: "the forests of *Chamaecyparis obtusa* in "Kiso" extend over mountainous regions in the central Honshiu, and cover the area of about 250,000 acres at the elevation of about 1,300-5,500 feet. The present forests in this district have naturally reproduced themselves from seed and without any tending after heavy selection felling in old times, and have about 4,500 cubic feet per acre of growing stock on the average (Maximum 15,000 cubic feet) and the age of stands in 200-250 years with 1-2 feet in average diameter.

I. Growing form of the forests.

Most of them are found in even-aged form, but rarely in uneven-aged. Mostly, at the slopes in climatic optimum this species grows in pure stands, and except the pure stands others in mixed, which are classified into the following six types:

(1) stands mixed with *Chamaecyparis obtusa* and *Ch. pisifera*. Both trees mix in groups or rarely sporadic and *Ch. pisifera* are found everywhere along the dale, *Ch. obtusa* at the slopes and ridges. This fact is probably due to the characteristic differences between two species in the characters of seed, endurance against diseases and demands for soil moisture.

(2) stands mixed with *Ch. obtusa* and *Thujaopsis dolabrata*. We find both the stands mixed in groups and sporadic between central and northern portions of this district.

(3) stands mixed with *Ch. obtusa* and *Thuja Standishii*. We find both the stands mixed in groups and sporadic at higher places between central and northern portions of this district.

(4) stands mixed with *Ch. obtusa* and *Sciaelopitys verticillata*. We find both on slopes and ridges between central and northern portions of this district.

(5) stands mixed with *Ch. obtusa*, *Abies firma*, *Picea jezoensis* var. *hondoensis*, *Pinus parviflora*, *Pinus koraiensis*, and *Abies Veitchii*. We find their sporadic mixture at the higher places, chiefly at the elevation of over 4,000 feet.

(6) stands mixed with *Ch. obtusa* and deciduous broad-leaved trees. We find chiefly such stands along the dale.

II. Sylvicultural characteristics of *Ch. obtusa*.

(1) These trees produce abundantly the crops of seed from 40-50 years onward, and the full crops occur every 3 to 5 years.

(2) The seedlings are so delicate that most of them wither during the dry season in the first year, therefore their natural distribution is limited in the district where relatively much rain falls in summer.

(3) They are half-tolerance, therefore natural reproduction is more difficult than *Abies* or *Picea*.

(4) They take kindly to clay soil and rather dry soil in deep.

(5) The mean temperature of air during the growing season is about 19-20°C.

III. Sylvicultural system of this forest.

The compilation of the working plans of the forests was completed about 25 years ago, rotation is 120 years and the sylvicultural system of them is the clear cutting system with artificial reproduction for the greater part of the district partly uniform system or selection system, but the clear cutting system tends to decrease at present, because we are finding disadvantages in this system."

(D) Mesophytic forest mixed with conifers and evergreen broad-leaved trees. Although, the flora of principal species of conifers are very similar to those of mesophytic forest mixed with conifers and deciduous broad-leaved trees, it is very naturally to think quite different environment between these two forest vegetations from the view point of the following two facts that the physiognomy of this forest is very characteristic caused by associating the evergreen broad-leaved trees, and *Tsuga Sieboldii* Carr., which occurs very scarcely in the preceding forest vegetation, associates as an important member of this forest vegetation. Moreover, the fact also makes remarkable contrast that there is some tendency of occurrence of consociation of conifers in the preceding vegetation, for

instances, the pure stands of *Cryptomeria japonica*, *Thuopsis dolabrata* var. *Hondai* in northern Honshiu, *Chamaecyparis obtusa* in central Honshiu, but in this vegetation the forests are mostly mixed, for instances, the forest mixed with *Cryptomeria japonica*, *Chamaecyparis obtusa*, *Abies firma*, *Tsuga Sieboldii*, *Sciadopitys verticillata*, and *Pseudotsuga japonica* Beisn. in Shikoku, and the forest mixed with *Abies firma*, *Tsuga Sieboldii*, *Pinus densiflora* Sieb. et Zucc. and *Picea polita* Carr. in Kiushiu.

In Yakushima island, which situates in the sea near southern end of Kiushiu, occurs a wonderful forest mixed with very old trees *Cryptomeria japonica*, *Chamaecyparis obtusa*, *Abies firma*, and *Tsuga Sieboldii*. Especially, it is very interesting and priceless facts for forest ecology in Japan, that there are standing scattered many gigantic trees of *Cryptomeria*, which are more than one thousand years old.

The remarkable characteristic plants of this forest vegetation are

(Subordinate trees)

Torreya nucifera Sieb. et Zucc.

Quercus acuta Thunb.

Q. stenophylla Makino

Daphniphyllum macropodum Miq.

Camellia japonica var. *spontanea* Makino

Eurya ochracea Szysz.

Stewartia monadelphica Sieb. et Zucc.

etc.

(Shrubs)

Illicium religiosum

Lindela Thunbergii Makino

Tetralenia foliosa Nees.

T. glauca Matsum.

Hydrangea virens Sieb.

Ilex pedunculosa Miq.

Eurya japonica Thunb.

Symplocos myrtacea Sieb. et Zucc.

Ligustrum japonicum Thunb.

Callicarpa mollis Sieb. et Zucc.

etc.

(Ground herbs)

Dryopteris acuminata Nakai

etc.

(Lianas)

Evonymus radicans Sieb.

etc.

(Epiphytes)

Hymenophyllum barbatum Miq.

Polypodium Okuboii Yatabe

etc.

Probably, the forests mixed with

Chamaecyparis formosensis Matsum.

Ch. obtusa Sieb. et Zucc.

Libocedrus macrolepis Benth. et Hook.

Pseudotsuga Wilsoniana Hayata

and *Taiwania cryptomerioides* Hayata

etc.

occur in Taiwan occupying the lower part or middle slope of high mountain regions, may be classified into this forest vegetation.

Cryptomeria japonica distributes through two forest vegetations of mesophytic forest with conifers, it distributes in two zones, one of which runs along the Japan sea side from the northern Honshiu to northern Kiushiu, and the other runs along Pacific ocean side arising from central Honshiu to south

eastern Shikoku and Yakushima island. At northern Honshu this species tends to occur as consociation, but at western Honshu, Shikoku, and Yakushima island occurs as a member of mixed stands as above mentioned.

In northern and western Honshu, and Shikoku, the silvicultural system of natural regeneration adopted, at present, is selection system, but in Yakushima island a very heavy cutting remaining only few old trees of *Cryptomeria* shows excellent success. This fact is observed as important problems of silviculture.

Abies firma also distributed through two mesophytic forests with conifers. At central Honshu it associates with deciduous broad-leaved trees, but at western Honshu, Shikoku, and Kiushiu associates mostly with *Tsuga sieboldii* and numerous species of evergreen broad-leaved trees. For all forests with *Abies firma*, the selection system is adopted.

Dr. W. Terazaki, the pioneer of investigator of natural regeneration of mixed forest in Japan, contributes as follows about "Sugi" (*Cryptomeria japonica*) and "Momi" (*Abies firma*).

"In the matters of the natural regeneration and the growth of the mixed stand of the conifers, especially the "Sugi" and the "Momi" and the broad-leaved trees, which occur largely in Japan Proper, I am attempting to note from the results of the experiments practised on the 104 sample plots of which areas cover from about 0.1 ha. to about 20 ha. and from the observations on the self-regenerating stands.

The needs of the present state on our forestry for the self-regenerating forests are the treatment and the management to yield an amount corresponding to the growth of a standing crop of each stand which assigned to a working circle.

In order to satisfy the above given requirements, I am going to study on the following subjects for the treatment and management:

1. On the structure of the formation of stand and its transformation by the natural selection and by the technical treatment;
2. On the method of the thinnings and selection cuttings to harmonize with the structure of the formation of the given stand and with its transformation;
3. On the standing crop of the self-regenerating stand and on its growth;
4. On the integration and the differentiation of the compartments of a working circle to be appropriate with the method of the thinnings and selection cuttings corresponding to the study of the above given 2 and 3;
5. On the distribution of tree-species, composing the self-regenerating stand with respect to the locality, especially, to the sides of slopes;
6. On the alternation and replacement of the above given tree-species on each side of slopes;
7. On the differentiation of the distribution, the alternation and replacement of the above given 5 and 6 with respect to the south-western and north-eastern parts in Japan Proper.

It will be suggested that almost of all above given studies need a long duration of time with the careful experiments and observations; thus, in order to make up conclusion for my assumption on the treatment and management for the self-regenerating stands, the duration of time, in which I am going to carry the experiments and observations on the sample plots, is very short one, but not to estimate the tendencies.

Experiments and observations make up the following estimations:

- a. The formation of stand varies with the distribution of the groups of trees on the stand and with the composition and the stratification of the canopy of each group.
- b. The thinnings and selection cuttings must be carried on to make up the harmonization for the composition and stratification of the canopy for each group of trees and for the distribution of each group of trees on the stand.
- c. The standing crop of the stand and its growth depends on the types of the formation of stand and on the distribution of each group of trees together with the composition and stratification of the canopy.
- d. The integration and the differentiation of the compartments of a working circle need to suit with the types of the formation of stand and with the natural differentiation of the land formation.
- e. The natural regeneration of the self-regenerating stand depends on the distribution, the alternation and replacement of tree-species on each side of slopes. We cannot success natural regeneration

of a given species without any consideration about the distribution, alternation and replacement of tree-species on each side of slopes; in addition, we can only hold the area of self-regeneration of a given species. On the planted or any other artificially formed area of a given species, we can only success for the natural regeneration on the area where the species are said to have been existed on the former time thereon, or are standing in the present time by the self-regeneration.

f. It is very interesting phenomena that in the region of the south-western part of Japan Proper, the groups of the "Sugi" are distributed only near the ravines and valleys of the sunny side, while on the shady side, the groups of the "Sugi" are distributed over on the side with those of the other conifers, such as the "Momi" and the "Hinoki" (*Chamaecyparis obtusa*). And on the sunny side, the groups of the "Akamatsu" occur on the crest while the groups of the "Momi", the "Hinoki", and the "Tsuga" on the next downward with the groups of broad-leaved trees, especially of the evergreen ones. Again, in the region of the north-eastern part of Japan Proper, the groups of the "Sugi" are distributed over the sunny side. While they occur on the crest or on the rocky part of the shady side with the groups of the "Hiba" (*Thuopsis dolabrata* var. *Hondai*), the "Nezuko" (*Thuja Standishii*) and the "Goyomatsu" (*Pinus parviflora*). And in the near parts of the ravines and the valleys there flourish the groups of the broad-leaved trees on both sides of the slope, and no conifer occurs. Thus far, I would like to venture to propose that in the cases of the natural regeneration and plantation of the "Sugi", we cannot success without any consideration on such a distribution of the groups of tree-species.

Hence, it may be assumed that either the natural or artificial regeneration will success only in the case where we can utilise the natural selection—the distributions, the alternations and replacements—within the association of the groups of tree-species."

(E) Temperate rain forest with broad-leaved conifers belong to *Taxaceae*. This forest vegetation occurs mainly in southern Kiushiu and the foot mountain region of northern Taiwan. The principal species dominating in this forest vegetation mostly belong to evergreen broad-leaved trees, such as *Quercus gilva* Blume., *Q. scenophylla* Makino, *Shiia Sieboldii* Makino, *Machilus Thunbergii* Sieb. et Zucc., *Distylium racemosum* Sieb. et Zucc., and as conifers

Podocarpus macrophyllus Don.

and *P. nagi* Pilg.

are principal species, but those are standing scattered in the forest.

The remarkable characteristic plants of this vegetation are

(Subordinate trees)

Actinodaphne longifolia Nakai

Camellia Sasanqua Thunb.

Turpinia ternata Nakai

Eurya ochnacea Szysz.

Ternstroemia japonica Thunb.

Heptapleurum octophyllum Forbes. et Hemsl.

etc.

(Shrubs)

Debregeasia edulis Wedd.

Villebrunea fruticosa Nakai

Fatsia japonica Decne. et Planch.

Maesa japonica Mor. et Zoll.

Rapanea neriifolia Mez.

Premna japonica Miq.

etc.

(Ground herbs)

Angiopteris suboppositifolia de Vris

Cheiropleuria bicuspidata Presl.

Cyathea boninsimensis Copel.

Dryopteris lepigera O. Kuntze

Polypodium Wrightii Mett.

Balanophora japonica Makino
Mitrastemon Yamamotoi Makino
Swertia Tashiroi Makino
Ligularia tussilaginea Makino
Phajus maculatus Lindl.
Ph. maculatus var. *minor* Franch
 etc.
 (Lianas)
Piper Futokadsura Sieb.
Ficus pumila L.
Stephania japonica Miers.
Anodendron leave Makino
Marsdenia tomentosa Morr. et Decne.
Psychotria serpens L.
Uncaria rhynchophylla Miq.
Lonicera affinis Hook. et Arn.
 etc.
 (Epiphytes)
Trichomanes auriculatum Blume
T. cuppressoides Desv.
Asplenium Nidus L.
Polypodium Buergerianum var. *stipitatum* Takeda
Lycopodium Sieboldii Miq.
Psilotum nudum Beauv.
Lysionotus paciflora Maxim.
Aerides japonicum Reichb.
 etc.

It is better to say, the natural regeneration for conifers in this forest vegetation is only the small part of the problem of natural regeneration of the forest of evergreen broad-leaved trees. At present, for such forest the selection system tends to be adopted.

(F) Strand pine forest. In Japan, which has very very long coast line, everywhere there are many case concerned with the problems to establish or to protect strand forests, which are indispensably necessary for defence of sea wind, windblown sand, and the invasion of sand dunes.

It is very interesting fact that four main types of this forest vegetation can be seen. The first type, which occurs in southern Kiusiu, is dominated by *Pinus Thunbergii* Parl. associating with numerous evergreen broad-leaved trees and shrubs, the second type, which occurs covering over the great part of strand regions of Japan, is dominated by stands mixed with *Pinus Thunbergii* and *Pinus densiflora* associating with both evergreen and deciduous broad-leaved trees and shrubs, the third type, which continuously occurs touching to the north end of the second type, is dominated by *Pinus densiflora* associating with numerous deciduous broad-leaved trees, and the last type, which occurs in the most northern part of Honshiu, is dominated, at present, by *Pinus Thunbergii* associating with species of deciduous broad-leaved trees such as *Quercus*, *Acer*, and *Castanea*, but it is very remarkable fact that the *Pinus Thunbergii* dominating actually in this last type are mostly planted long time ago or the descendants of the planted one.

It is convenient to describe the general feature of pine forest, and its silvicultural system in Japan, in this paragraph.

In Japan, there are numerous numbers of indigenous species belong to *Pinus*, but among them *Pinus densiflora* Sieb. et Zucc. and *P. Thunbergii* Parl. are the most important species for forestry. The former is the most common inland species and the latter is also the most common strand species.

The forests of *Pinus densiflora* are distributed from the northern Honshiu to southern Kiusiu, therefore, at a glance there can be found no characteristics of environment of this forests, but the greater part of forests of this species showing very excellent physiognomies are included in the cold mountainous regions, thus broadly, it can be thought that the climate of cold dry winter is favorable for the forest of *Pinus densiflora*. But actually this species has very wide spreading distribution, as

above mentioned, so due to the various environments, the physiognomies of stands are considerably unequal one another, and there are very marked two kinds of forest of this species, i.e., the one is the warm plain type and the other is cold high type.

Due to the very high adaptable habit for environment of those two species, the natural regeneration of the pine forest can be done very easily, and this fact makes a very remarkable contrast for the silviculture of *Pinus sylvestris*, for which the natural regeneration is rather more difficult in Europe. Caused by the strongly sun-loving habit, the selection system for *Pinus densiflora*, except the case of extraordinary strong grade, are generally not suitable for this species, and normally the wide strip system of clear cutting or uniform shelter-wood system are applied. The strand forest of *Pinus Thunbergii* is often treated under uniform shelter-wood system with frequently repeated thinnings or very narrow strip cutting, rarely selection system with heavy cutting, because, the light-demanding habit of *Pinus Thunbergii* is slightly more tolerant than *Pinus densiflora* and it is necessary to avoid clear cutting system to protect such strand forest.

Summary.

- 1) There are six types of forest vegetations with conifers in Japan.
- 2) Among them for the two xerophytic coniferous forests, i.e., northern and high mountainous, the selection system is adopted.
- 3) In the two mesophytic forests, which play the most important part of forestry in Japan, the forests of *Thujopsis* and the forests of *Cryptomeria* in northern Honshiu, the forests of *Abies* mixed with deciduous broad-leaved trees and the forests of *Chamaecyparis* mixed with various conifers and deciduous broad-leaved trees in central Honshiu, the forests mixed with various conifers and deciduous broad-leaved trees in western Honshiu, the forests mixed with various conifers, including *Cryptomeria* or *Chamaecyparis*, and evergreen broad-leaved trees in Shikoku, the forests mixed with mainly *Abies*, *Pinus*, and *Tsuga*, excluding *Cryptomeria* and *Chamaecyparis*, and evergreen broad-leaved trees in central Kiushiu, and the wonderful mixed forest of conifers in Yakushima island are the principal representatives showing excellent physiognomies.
- 4) Concerned with natural regeneration, for the forests of *Thujopsis* in northern Honshiu, and the forests of *Chamaecyparis* in central Honshiu the shelter-wood system and selection system are adopted. Except the forest in Yakushima island, for which a kind of shelter-wood system with very heavy cutting is adopted, for all other forests selection system is adopted.
- 5) For the forests of *Pinus densiflora* mostly clear-cutting system, some times shelter-wood system with very heavy cutting are adopted, and for the strand forest of *Pinus Thunbergii* mostly shelter-wood system or narrow strip system, rarely selection system with heavy cutting are adopted.
- 6) Recently, it becomes to be acknowledged that to keep the stand, which is actually mixed with conifers and broad-leaved trees, as mixed one is absolutely necessary for success of natural regeneration of such forests.
- 7) It can not be neglected, except the areas occupied by the coniferous forest, which are treated under the silvicultural systems of natural regeneration, there still remain huge areas of forest treated under clear cutting system and plantation.
- 8) In Chosen and Taiwan there are very large areas of coniferous forest, but at present, the problems regarding to natural regeneration are not yet out of experiment.

General Feature of Coniferous Forests in Japan.

By

MASARU KAWADA.

1) Regions. For the object of this information, it is necessary to divide the Japanese Empire to the following eleven regions, that is, Karafuto (K), Hokkaido (H), Northern Honshiu (N. Ho), Central Honshiu (C. Ho), Western Honshiu (W. Ho), Shikoku (Sh), Kiushiu (Ki), Taiwan (T), Chosen (Ch), Ogasawarajima (O), and Riu'iu (R), but the last two regions are not significant to this present title.

2) Species. In Japan there are numerous indigenous species of Coniferae, and the distributions of the species are also very complex. The names of species recognized as relatively important trees for forestry are as follows:

Species	Distributions										
	K	H	N.Ho	C.Ho	W.Ho	Sh	Ki	T	Ch	O	R
<i>Abies firma</i> Sieb. et Zucc.	—	—	—	×	×	×	×	—	—	—	—
<i>A. holophylla</i> Maxim.	—	—	—	—	—	—	—	—	×	—	—
<i>A. homolepis</i> Sieb. et Zucc.	—	—	—	×	—	×	—	—	—	—	—
<i>A. homolepis</i> var. <i>umbellata</i> Wils.	—	—	—	×	—	—	—	—	—	—	—
<i>A. Kawakamii</i> Ito	—	—	—	—	—	—	—	×	—	—	—
<i>A. Mariesii</i> Mast.	—	—	×	×	—	—	—	—	—	—	—
<i>A. Mayriana</i> Miyabe et Kudo	—	×	—	—	—	—	—	—	—	—	—
<i>A. nephrolepis</i> Maxim.	—	—	—	—	—	—	—	—	×	—	—
<i>A. sachalinensis</i> Mast.	×	×	—	—	—	—	—	—	—	—	—
<i>A. shikokiana</i> Nakai	—	—	—	—	—	×	—	—	—	—	—
<i>A. Veitchii</i> Lindl.	—	—	—	×	—	—	—	—	—	—	—
<i>A. Veitchii</i> var. <i>olivacea</i> Shirasawa	—	—	—	×	—	—	—	—	—	—	—
<i>A. Wilsonii</i> Miyabe et Kudo	×	—	—	—	—	—	—	—	—	—	—
<i>Chamaecyparis formosensis</i> Matsum.	—	—	—	—	—	—	—	×	—	—	—
<i>Ch. obtusa</i> Sieb. et Zucc.	—	—	—	×	×	×	×	×	—	—	—
<i>Ch. obtusa</i> f. <i>formosana</i> Hayata	—	—	—	—	—	—	—	×	—	—	—
<i>Ch. pisifera</i> Sieb. et Zucc.	—	—	—	×	—	—	—	—	—	—	—
<i>Cryptomeria japonica</i> D. Don.	—	—	×	×	×	×	×	—	—	—	—
<i>Cunninghamia Kawakamii</i> Hayata	—	—	—	—	—	—	—	×	—	—	—
<i>C. Konishii</i> Hayata	—	—	—	—	—	—	—	×	—	—	—
<i>C. sinensis</i> R. Br.	—	—	—	—	—	—	—	×	—	—	—
<i>Juniperus chinensis</i> L.	—	—	—	×	—	—	×	—	×	—	—
<i>J. chinensis</i> var. <i>sargentii</i> Henry	×	×	×	—	—	—	—	—	—	—	—
<i>J. communis</i> L.	×	—	—	—	—	—	—	—	—	—	—
<i>J. communis</i> var. <i>montana</i> Ait.	×	—	—	—	—	—	—	—	—	—	—
<i>J. communis</i> var. <i>nipponica</i> Wils.	—	—	×	×	—	—	—	—	—	—	—
<i>J. conferta</i> Parl.	×	×	×	×	—	—	—	—	—	—	—

(Continued)

Continued)

Species	Distributions											
	K	H	N.Ho	C.Ho	W.Ho	Sh	Ki	T	Ch	O	R	
<i>J. conferta</i> var. <i>maritima</i> Wils.	—	—	—	×	—	—	—	—	—	—	—	
<i>J. formosana</i> Hayata	—	—	—	—	—	—	—	×	—	—	—	
<i>J. formosana</i> var. <i>concolor</i> Hayata	—	—	—	—	—	—	—	×	—	—	—	
<i>J. luchuensis</i> Koidz.	—	—	—	—	—	—	—	—	—	—	×	
<i>J. procumbens</i> Sieb.	—	—	—	—	—	—	×	—	—	—	×	
<i>J. rigida</i> Sieb. et Zucc.	—	×	—	×	×	—	—	—	—	—	—	
<i>J. squamata</i> Ham.	—	—	—	—	—	—	—	×	—	—	—	
<i>J. taxifolia</i> Hook. et Arn.	—	—	—	×	—	—	—	—	—	×	×	
<i>Keteleeria Davidiana</i> Beissn.	—	—	—	—	—	—	—	×	—	—	—	
<i>Larix dahurica</i> var. <i>japonica</i> Maxim.	×	×	—	—	—	—	—	—	—	—	—	
<i>L. dahurica</i> f. <i>ochrocarpa</i> Wils.	×	—	—	—	—	—	—	—	—	—	—	
<i>L. dahurica</i> var. <i>coreana</i> Nakai	—	—	—	—	—	—	—	—	×	—	—	
<i>L. Kaempferi</i> Sarg.	—	—	—	×	—	—	—	—	—	—	—	
<i>Libocedrus macrolepis</i> Benth. et Hook.	—	—	—	—	—	—	—	×	—	—	—	
<i>Picea bicolor</i> Mayr	—	—	—	×	—	—	—	—	—	—	—	
<i>P. biolor</i> var. <i>acicularis</i> Shirasawa et Koyama	—	—	—	×	—	—	—	—	—	—	—	
<i>P. bicolor</i> var. <i>reflexa</i> Shirasawa et Koyama	—	—	—	×	—	—	—	—	—	—	—	
<i>P. Glehnii</i> Mast.	×	×	—	×	—	—	—	—	—	—	—	
<i>P. Glehnii</i> f. <i>chlorocarpa</i> Miyabe et Kudo	—	×	—	—	—	—	—	—	—	—	—	
<i>P. Glehnii</i> var. <i>Tei</i> Makino	—	—	—	×	—	—	—	—	—	—	—	
<i>P. jezoensis</i> Carr.	×	×	—	—	—	—	—	—	—	—	—	
<i>P. jezoensis</i> var. <i>hondoensis</i> Rehd.	—	—	—	×	—	—	—	—	×	—	—	
<i>P. koraiensis</i> Nakai	—	—	—	—	—	—	—	—	×	—	—	
<i>P. Koyamai</i> Shirasawa	—	—	—	×	—	—	—	—	—	—	—	
<i>P. Maximowiczii</i> Regel.	—	—	—	×	—	—	—	—	—	—	—	
<i>P. morrisonicola</i> Hayata	—	—	—	—	—	—	—	×	—	—	—	
<i>P. polita</i> Carr.	—	—	—	×	—	×	×	—	—	—	—	
<i>Pinus amamiana</i> Koidz.	—	—	—	—	—	—	×	—	—	—	—	
<i>P. Armandii</i> Franch.	—	—	—	—	—	—	—	×	—	—	—	
<i>P. cembra</i> var. <i>manchurica</i> Mast.	—	×	—	—	—	—	—	—	—	—	—	
<i>P. densiflora</i> Sieb. et Zucc.	—	—	×	×	×	×	×	—	×	—	—	
<i>P. densiflora</i> f. <i>umbraculifera</i> Miyoshi	—	—	—	×	—	—	—	—	—	—	—	
<i>P. formosana</i> Hayata	—	—	—	—	—	—	—	×	—	—	—	
<i>P. hakuodensis</i> Makino	—	—	×	—	—	—	—	—	—	—	—	
<i>P. koraiensis</i> Sieb. et Zucc.	—	—	×	×	—	—	—	—	×	—	—	
<i>P. leucosperma</i> Maxim.	—	—	—	—	—	—	—	—	×	—	—	
<i>P. luchuensis</i> Mayr	—	—	—	—	—	—	—	—	—	—	×	
<i>P. Massoniana</i> Don.	—	—	—	—	—	—	—	×	—	—	—	
<i>P. parviflora</i> Sieb. et Zucc.	—	×	×	×	×	×	×	—	—	—	—	
<i>P. pentaphylla</i> Mayr	—	×	×	×	—	—	—	—	—	—	—	
<i>P. pumila</i> Regel.	×	×	×	×	—	—	—	—	—	—	—	
<i>P. taiwanensis</i> Hayata	—	—	—	—	—	—	—	×	—	—	—	
<i>P. Thunbergii</i> Parl.	—	—	×	×	×	×	×	—	×	—	—	

(Continued)

Species	Distributions										
	K	H	N.Ho	C.Ho	W.Ho	Sh	Ki	T	Ch	O	R
<i>P. Uyematsui</i> Hayata	—	—	—	—	—	—	—	×	—	—	—
<i>Pseudotsuga japonica</i> Beissn.	—	—	—	—	×	×	—	—	—	—	—
<i>P. Wilsoniana</i> Hayata	—	—	—	—	—	—	—	×	—	—	—
<i>Sciadopitys verticillata</i> Sieb. et Zucc.	—	—	—	×	×	×	×	—	—	—	—
<i>Taivania cryptomerioides</i> Hayata	—	—	—	—	—	—	—	×	—	—	—
<i>Thuja Standishii</i> Carr.	—	—	×	×	—	—	—	—	—	—	—
<i>Thujopsis dolabrata</i> Sieb. et Zucc.	—	—	—	×	×	—	—	—	—	—	—
<i>T. dolabrata</i> var. <i>Hondai</i> Makino	—	×	×	—	—	—	—	—	—	—	—
<i>Tsuga diversifolia</i> Mast.	—	—	×	×	×	×	×	—	—	—	—
<i>T. formosana</i> Hayata	—	—	—	—	—	—	—	×	—	—	—
<i>T. Sieboldii</i> Carr.	—	—	—	×	×	×	×	—	—	—	—
<i>Cephalotaxus argotaenia</i> Pilg.	—	—	—	—	—	—	—	×	—	—	—
<i>C. drupacea</i> Sieb. et Zucc.	—	—	×	×	×	×	×	—	—	—	—
<i>C. drupacea</i> var. <i>nana</i> Rehd.	—	×	×	×	×	—	—	—	—	—	—
<i>C. drupacea</i> var. <i>nana</i> f. <i>astringens</i> Nakai	—	—	—	×	—	—	—	—	—	—	—
<i>C. Wilsoniana</i> Hayata	—	—	—	—	—	—	—	×	—	—	—
<i>Podocarpus costalis</i> Presl.	—	—	—	—	—	—	—	×	—	—	—
<i>P. formosanus</i> Dumm.	—	—	—	—	—	—	—	×	—	—	—
<i>P. macrophyllus</i> D. Don.	—	—	—	×	×	×	×	—	—	—	×
<i>P. nagi</i> Pilg.	—	—	—	—	×	×	×	×	—	—	×
<i>P. nagi</i> var. <i>angustifolia</i> Makino	—	—	—	—	—	—	—	×	—	—	—
<i>P. Nakaii</i> Hayata	—	—	—	—	—	—	—	×	—	—	—
<i>P. nankoensis</i> Hayata	—	—	—	—	—	—	—	×	—	—	—
<i>P. neriiifolius</i> D. Don.	—	—	—	—	—	—	—	×	—	—	—
<i>P. philippinensis</i> Foxw.	—	—	—	—	—	—	—	×	—	—	—
<i>Taxus chinensis</i> Rehd.	—	—	—	—	—	—	—	×	—	—	—
<i>T. cuspidata</i> Sieb. et Zucc.	×	×	×	×	×	×	—	×	×	—	—
<i>T. cuspidata</i> var. <i>ambrauculifera</i> Makino	—	—	—	×	—	—	—	—	—	—	—
<i>T. cuspidata</i> var. <i>chinensis</i> Rehd. et Wils.	—	—	—	—	—	—	—	×	—	—	—
<i>Torreya nucifera</i> Sieb. et Zucc.	—	—	—	×	×	×	×	—	×	—	—
<i>T. nucifera</i> var. <i>articulata</i> Miyoshi	—	—	—	×	—	—	—	—	—	—	—
<i>T. nucifera</i> var. <i>radicans</i> Nakai	—	—	—	×	—	—	—	—	—	—	—
<i>T. nuda</i> Miyoshi	—	—	—	×	—	—	—	—	—	—	—

3) Kinds of forest vegetations with conifers. From the stand point of synecology the forest vegetations with conifers in Japan may be classified into the following six types:

- A. Northern xerophytic coniferous forest.
- B. High mountain xerophytic coniferous forest.
- C. Mesophytic forest mixed with conifers and deciduous broad-leaved trees.
- D. Mesophytic forest mixed with conifers and evergreen broad-leaved trees.
- E. Temperate rain-forest with broad-leaved conifers belong to *Taxaceae*.
- F. Strand pine forest.

A) Northern xerophytic coniferous Forest. The forest vegetations belong to this type mainly occur in the Karafuto and Hokkaido. Usually, this type of forest touches with the Japanese creeping pine (*Pinus pumila*) at the upper limit. The dominant species of this forest vegetation are *Abies Mayriana*,

A. sachalinensis, *A. Wilsonii*, *Larix dahurica* var. *japonica*, *L. dahurica* f. *ochrocarpa*, *Picea Glehnii*, *P. Glehnii* f. *chlorocarpa* and *P. jezoensis*.

The forests, which occur covering over the huge area of northern Chosen and the upper part of the main mountain ranges of the peninsula, including the following dominant species, *Abies holophylla*, *A. nephrolepis*, *Larix dahurica* var. *coreana*, *Picea jezoensis* var. *hondoensis*, *P. koraiensis*, *Pinus koraiensis*, and *P. leucosperma*, have very similar physiognomy to that of this forest vegetation.

As an example of this forest vegetation a forest situating in Karafuto is selected, and the brief floristic composition is listed as follows:

(Life forms)	Species	Exclusiveness
Notes: The numbers of exclusiveness represent the characteristicity of the species to the vegetation, that is confined to the vegetation (5), seldom met with outside it (4), rather more oftenly found in it (3), found equally in and outside it (2), rather more oftenly found outside it (1).		
(Dominant trees)		
	<i>Abies Mayriana</i> Miyabe. et Kudo	
	<i>Picea jezoensis</i> Carr.	
(Ground herbs)		
	<i>Dryopteris Amurensis</i> Takeda	4.
	<i>D. dilatata</i> A. Gray var. <i>oblonga</i> Takeda	4.
	<i>D. Linnaeana</i> C. Chr.	3.
	<i>D. phegopteris</i> C. Chr.	2.
	<i>Equisetum sylvaticum</i> L.	5.
	<i>Lycopodium obscurum</i> L. f. <i>fabellatum</i> Takeda	2.
	<i>Stellaria jezoensis</i> Maxim.	4.
	<i>Aconitum pseudolaeve</i> Nakai f. <i>genuinum</i> Nakai	3.
	<i>Anemone debilis</i> Fisch.	2.
	<i>Corydalis gigantea</i> Trautv. et May. var. <i>amurensis</i> Regel.	5.
	<i>Waldsteinia sibirica</i> Tratt.	4.
	<i>Oxalis Acetosella</i> L.	3.
	<i>Circaea alpina</i> L.	2.
	<i>Angelica Maximowiczii</i> Benth.	5.
	<i>Cornus canadensis</i> L.	4.
	<i>Pirola renifolia</i> Maxim.	4.
	<i>Trientalis europea</i> L.	4.
	<i>Galium kamtschaticum</i> Stell. var. <i>hirsutum</i> Takeda	5.
	<i>Saussurea acuminata</i> Turcz.	5.
	<i>Ephippianthus Schmidtii</i> Reichb.	3.
	<i>Goodyera Schlechtendalana</i> Reichb. f.	2.

(From the report of forest vegetation survey of the training forest of Imperial University of Kyoto in Karafuto.)

B) High mountain xerophytic coniferous forest. The forests belong to this type occur mainly at the slope of the high mountain ranges of central Honshu, and the summits of mountain ranges of Kiushiu and Shikoku. The dominant species of conifers occurring very commonly in the forests are *Abies homolepis*, *A. Mariesii*, *A. Shikokiana*, *A. Veitchii*, *A. Veitchii* var. *olivacea*, *Larix Kaempferi*, *Picea bicolor*, *P. bicolor* var. *acicularis*, *P. bicolor* var. *repleta*, *P. jezoensis* var. *hondoensis*, *P. Koyamai*, *P. Maximowiczii*, *Pinus koraiensis*, *P. parviflora*, *P. pentaphylla*, *Thuja Standishii* and *Tsuga diversifolia*. Generally, this forest vegetation is lined the upper limit by the scrub of creeping pine as same as the case of preceding forest vegetation. The marked characteristics of this forest vegetation is the fact that the number of species of dominant conifers is relatively numerous. In comparison of the northern xerophytic coniferous forest and this forest vegetation, it is very remarkable that the species of

dominant conifers are almostly quite different.

The forests occurring at the upper parts of the main mountain ranges of Taiwan, including the following dominant species *Abies Kawakamii*, *Picea morrisonicola*, *Pinus taiwanensis* etc. seem to be classified into this forest vegetation.

As an example of this forest vegetation, a forest situating at central Honshu is selected, and its brief floristic composition is listed as follows:

(Life forms)	Species	Exclusiveness
(Dominant trees)		
	<i>Abies Mariesii</i> Mast.	
	<i>A. Veitchii</i> Lindl.	
	<i>Larix Kaempferi</i> Sarg.	
	<i>Picea jezoensis</i> Carr. var. <i>hondoensis</i> Rehd.	
	<i>Pinus koraiensis</i> Sieb. et Zucc.	
	<i>Tsuga diversifolia</i> Mast.	
(Subordinate trees)		
	<i>Betula Ermanii</i> Cham. var. <i>communis</i> Koidz.	3.
	<i>Sorbus Aucuparia</i> L.	2.
	<i>Acer palmatum</i> Thunb. subsp. <i>Matsumurae</i> Koidz.	2.
	<i>A. Tschonoskii</i> Maxim.	4.
(Ground herbs)		
	<i>Dryopteris dilatata</i> A. Gray var. <i>deltoidea</i> Takeda	2.
	<i>D. mutica</i> C. Chr.	2.
	<i>D. phegopteris</i> C. Chr.	2.
	<i>Pazonia japonica</i> Miyabe et Takeda	3.
	<i>Pteridophyllum ranceosum</i> Sieb. et Zucc.	4.
	<i>Oxalis Acetosella</i> L. var. <i>japonica</i> Makino	3.
	<i>Viola biflora</i> L.	3.
	<i>Echinopanax japonicum</i> Nakai	4.
	<i>Cryptotaeniopsis Tanakae</i> Boiss.	2.
	<i>Cornus canadensis</i> L.	4.
	<i>Shortia soldanelloides</i> Makino var. <i>genuina</i> Makino f. <i>typica</i> Makino	2.
	<i>Pirola renifolia</i> Makino	4.
	<i>Vaccinium Vitis-Idaea</i> L.	2.
	<i>Primula japonica</i> A. Gray	4.
	<i>Trientalis europaea</i> L.	3.
	<i>Thymus Przewalskii</i> Nakai var. <i>laxa</i> Nakai	4.
	<i>Galium gracile</i> Bunge.	2.
	<i>Patrinia palmata</i> Maxim. var. <i>typica</i> Makino	2.
	<i>Cacalia adenostyloides</i> Franch. et Sav.	3.
	<i>Leontopodium japonicum</i> Miq.	2.
	<i>Deschampsia flexuosa</i> Trin.	2.
	<i>Clintonia udeensis</i> Trautv. et Mey.	4.
	<i>Maianthemum bifolium</i> DC.	2.
	<i>Metanartheceum luteo viride</i> Maxim.	2.
	<i>Paris quadrifolia</i> L. var. <i>obovata</i> Regel. et Til.	3.
	<i>Streptopus japonicus</i> Ohwi.	4.
	<i>Dactylotale maculosa</i> Miyaba et Kudo	3.
	<i>Listea cordata</i> R. Br.	4.
	<i>Platanthera Takedai</i> Makino	4.

mainly includes the forests, which occur from the northern Honshiu to central Honshiu occupying the lower slopes of high mountains and the foot-mountain regions. In this forest the conifers associating normally with Japanese beech (*Fagus crenata* Blume) and Japanese oak (*Quercus crispula* Blume).

This forest vegetation plays the most important part for forestry in Japan. In the northern Honshiu *Cryptomeria japonica* and *Thujopsis dolabrata* var. *Hondai* are the two dominant species, and in the central Honshiu, *Cryptomeria japonica*, *Chamaecyparis obtusa*, *Ch. pisifera*, and *Abies firma* are the principal species. In the former part the centres of forest vegetations of *Cryptomeria* and *Thujopsis* quite separate and there can be found frequently the consociations of each species, but in the latter the forests are mostly mixed. *Seiadopitys verticillata*, *Thuja Standishii*, and *Thujopsis dolabrata* occur also in rather small number in the latter part. At the Japan sea side *Cryptomeria* often associates with *Thujopsis dolabrata* var. *hondai* or *Thuja Standishii*, but at the Pacific ocean side it associates with *Chamaecyparis obtusa* or *Abies firma*. In this forest vegetation *Abies firma* scarcely associates with *Tsuga Sieboldii*, while in the mesophytic forest mixed with conifers and evergreen broad-leaved trees, which is described in next paragraph, associates mostly with *Tsuga Sieboldii*.

The forests of Japanese red pine (*Pinus densiflora*) are distributed from the northern Honshiu to southern Kiushiu, therefore, at a glance there can be found no characteristics of environment of this forests, but the greaterpart of forests of red pine showing very excellent physiognomy are included in the region of this forest vegetation.

As an example of this forest vegetation, a forest situating in northern Honshiu is selected, and its brief floristic composition is listed as follows:

(Life forms)	Species	Exclusiveness
(Dominant trees)		
	<i>Cryptomeria japonica</i> D. Don.	
	<i>Fagus crenata</i> Blume.	
	<i>Quercus crispula</i> Blume.	
(Subordinate trees)		
	<i>Cephalotaxus drupacea</i> Sieb. et Zucc. var. <i>nana</i> Rehd.	4.
	<i>Thuja Standishii</i> Carr.	4.
	<i>Carpinus laxiflora</i> Blume.	2.
	<i>Cercidiphyllum japonicum</i> Sieb. et Zucc.	2.
	<i>Magnolia obovata</i> Thunb.	2.
	<i>Micromela alnifolia</i> Koehne.	2.
	<i>Prunus Grayana</i> Maxim.	3.
	<i>P. serrulata</i> Lindl. var. <i>sachalinensis</i> Makino	4.
	<i>Acer distylum</i> Sieb. et Zucc.	2.
	<i>A. micranthum</i> Sieb. et Zucc.	2.
	<i>A. palmatum</i> Thunb.	4.
	<i>Aesculus turbinata</i> Blume.	4.
	<i>Meliosma myriantha</i> Sieb. et Zucc.	2.
	<i>Kalopanax innovans</i> Miq.	2.
	<i>K. riciniifolium</i> Miq. var. <i>typicum</i> Nakai	2.
	<i>Styrax japonicum</i> Sieb. et Zucc.	2.
	<i>S. Obassia</i> Sieb. et Zucc.	2.
	<i>Fraxinus Sieboldiana</i> Blume. var. <i>serrata</i> Nakai	2.
(Shrubs)		
	<i>Corylus rostrata</i> Ait. var. <i>Sieboldiana</i> Maxim.	2.
	<i>Lindera unbellata</i> Thunb.	2.
	<i>Hydrangea paniculata</i> Sieb. var. <i>floribunda</i> Regel.	2.
	<i>Hamamelis japonica</i> Sieb. et Zucc.	2.
	<i>Skimmia japonica</i> Thunb.	2.
	<i>Daphniphyllum humile</i> Maxim.	4.

(Continued)

(Life forms)

Species	Exclusiveness
<i>Ilex macropoda</i> Miq.	2.
<i>I. Sugeroki</i> Maxim. subsp. <i>brevipedunculata</i> Makino	4.
<i>Stachyurus praecox</i> Sieb. et Zucc.	2.
<i>Daphne Miyabeana</i> Makino	4.
<i>Aucuba japonica</i> Thunb. var. <i>borealis</i> Miyabe	4.
<i>Clethra barbinervis</i> Sieb. et Zucc.	2.
<i>Rhododendron Albrechtii</i> Maxim.	4.
<i>Callicarpa japonica</i> Thunb.	2.
<i>Clerodendron trichotomum</i> Thunb.	2.
<i>Diervilla hortensis</i> Sieb. et Zucc.	3.
<i>Viburnum dilatatum</i> Thunb. f. <i>pilosum</i> Nakai	2.
<i>Sasa senanensis</i> Rehd.	3.
(Ground herbs)	
<i>Adiantum pedatum</i> L.	3.
<i>Athyrium acrostichoides</i> Diels.	2.
<i>A. Vidalii</i> Nakai	2.
<i>Blechnum nipponicum</i> Makino	4.
<i>Diplazium squamigerum</i> Christ.	2.
<i>Dryopteris africana</i> C. Chr.	2.
<i>D. crassirhizoma</i> Nakai	3.
<i>D. mutica</i> C. Chr.	2.
<i>D. remotissima</i> Koidz.	4.
<i>D. viridescens</i> O. Kuntze.	2.
<i>Matteuccia orientalis</i> Trev.	2.
<i>Phyllitis scolopendrium</i> Newm.	4.
<i>Plagiogyria Matsumuraeana</i> Makino	4.
<i>Polystichum aculeatum</i> Schott. var. <i>ovato-paleaceum</i> Kodama	1.
<i>Chloranthus japonicus</i> Sieb.	2.
<i>Ch. serratus</i> Roem. et Sch.	2.
<i>Elatostema umbellatum</i> Blume var. <i>involutratum</i> Makino	2.
<i>Laportea bulbifera</i> Wedd.	2.
<i>Sceptrocnide macrostachya</i> Maxim.	4.
<i>Asarum Sieboldii</i> Miq.	2.
<i>Polygonum Thunbergii</i> Sieb. et Zucc. var. <i>typicum</i> Franch. et Sav.	2.
<i>Stellaria diversiflora</i> Maxim.	2.
<i>Hydrangea macrophylla</i> DC. f. <i>acuminata</i> Wils.	2.
<i>Rodgeria polophylla</i> A. Gray	4.
<i>Filipendula kamtschatica</i> Maxim.	4.
<i>Oxalis Acetosella</i> L. var. <i>japonica</i> Makino	4.
<i>Impatiens Noli-tangere</i> L.	2.
<i>I. Textori</i> Miq.	2.
<i>Panax japonicum</i> C. A. Mey. f. <i>typicum</i> Nakai	2.
<i>Angelica polyclada</i> Franch.	3.
<i>Heracleum lanatum</i> Michx.	2.
<i>Salvia nipponica</i> Miq.	2.
<i>Phryma leptostachya</i> L.	2.
<i>Golium trifloriforme</i> Kom.	2.
<i>Cacalia bulbiphora</i> Maxim.	2.
<i>C. delphinifolia</i> Sieb. et Zucc.	2.
<i>C. farfaraefolia</i> Sieb. et Zucc.	4.

(Continued)

(Life forms)	Species	Exclusiveness
	<i>C. hastata</i> L. var. <i>glabra</i> Ledeb.	3.
	<i>Arisaema amplissimum</i> Blume.	3.
	<i>Lysichiton camtschatense</i> Schott.	4.
	<i>Symplocarpus foetidus</i> Salisb.	4.
	<i>Cardiocrinum Glehni</i> Makino	4.
	<i>Disporum sessile</i> D. Don.	2.
	<i>Hosta japonica</i> Asch. et Graebn. var. <i>coerulea</i> Makino	2.
	<i>Lilium auratum</i> Lindl.	3.
	<i>L. medeoloides</i> A. Gray	4.
	<i>Paris tetraphylla</i> A. Gray	2.
	<i>Trillium apetalum</i> Makino	2.

(From the report of forest vegetation survey of Akita District Forest Office).

D) Mesophytic forest mixed with conifers and evergreen broad-leaved trees. This forest vegetation develops covering the western Honshiu, Shikoku, and Kiushiu. Although, the flora of principal species of conifers are very similar to those of mesophytic forest mixed with conifers and deciduous broad-leaved trees, it is very naturally to think quite different environment between these two forest vegetations, from the view point of the following two facts that the physiognomy of this forest is ultimately characteristic caused by associating the evergreen broad-leaved trees, and *Tsuga Sieboldii*, which occurs very scarcely in the forest mixed with conifers and deciduous broad-leaved trees, associates as an important member of this forest vegetation. Moreover, the fact also makes remarkable contrast that there is some tendency of occurrence of consociation in the former vegetation, for instances, the pure stands of *Cryptomeria japonica*, *Thujopsis dolabrata* in northern Honshiu, *Chamaecyparis obtusa* in central Honshiu, but in this vegetation the forests are mostly mixed, for instances, the forest mixed with *Cryptomeria japonica*, *Chamaecyparis obtusa*, *Abies firma*, *Tsuga Sieboldii*, *Sciadopitys verticillata*, and *Pseudotsuga japonica* in Shikoku, and the forest mixed with *Abies firma*, *Tsuga Sieboldii*, *Pinus densiflora* and *Picea polita* in Kiushiu.

In Yakushima island, which situates in the sea near southern Kiushiu, occurs a wonderful forest mixed with very old trees of *Cryptomeria japonica*, *Chamaecyparis obtusa*, *Abies firma*, and *Tsuga Sieboldii*. Especially, it is very interesting and priceless facts for forest ecology in Japan, that there are standing scattered many gigantic trees of *Cryptomeria*, which are more than one thousand years old.

Probably, the forest mixed with *Chamaecyparis formosensis*, *Ch. obtusa*, *Libocedrus macrolepis*, *Pseudotsuga Wilsoniana*, and *Taiwania cryptomerioides* etc. occurs in Taiwan occupying the lower part or middle slopes of high mountain regions, may be classified in this forest vegetation.

As an example of this forest vegetation, a forest situating in central Kiushiu is selected, and its brief floristic composition is listed as follows:

(Life forms)	Species	Exclusiveness
(Dominant trees)		
	<i>Abies firma</i> Sieb. et Zucc.	
	<i>Picea polita</i> Carr.	
	<i>Pinus densiflora</i> Sieb. et Zucc.	
	<i>Tsuga Sieboldii</i> Carr.	
	<i>Shiia Sieboldii</i> Makino	
(Subordinate trees)		
	<i>Torreya nucifera</i> Sieb. et Zucc.	4.
	<i>Carpinus laxiflora</i> Blume.	2.

(Continued)

(Life forms)

Species	Exclusiveness
<i>Quercus acuta</i> Thunb.	4.
<i>Q. stenophylla</i> Makino	4.
<i>Magnolia obovata</i> Thunb.	2.
<i>Prunus Maximowiczii</i> Rupr.	2.
<i>P. serrulata</i> Lindl. var. <i>spontanea</i> Makino	2.
<i>Daphniphyllum macropodum</i> Miq.	4.
<i>Acer micranthum</i> Sieb. et Zucc.	3.
<i>A. Sieboldianum</i> Miq. var. <i>typicum</i> Maxim. subvar. <i>microphyllum</i> Koidz.	2.
<i>Camellia japonica</i> L. var. <i>spontanea</i> Makino	4.
<i>Eurya ochracea</i> Szysz.	4.
<i>Stewartia monodelpha</i> Sieb. et Zucc.	4.
<i>Acanthopanax sciadophylloides</i> Franch. et Sav.	2.
<i>Cornus controversa</i> Hemsl.	2.
<i>Styrax japonicum</i> Sieb. et Zucc.	3.
(Shrubs)	
<i>Illicium religiosum</i> Sieb. et Zucc.	4.
<i>Lindela Thunbergii</i> Makino	4.
<i>Tetradenia foliosa</i> Nees.	4.
<i>T. glauca</i> Matsum.	4.
<i>Hydrangea virens</i> Sieb.	4.
<i>Skimmia japonica</i> Thunb.	2.
<i>Rhus trichocarpa</i> Miq.	2.
<i>Ilex crenata</i> Thunb. var. <i>typica</i> Loes. f. <i>genuina</i> Loes.	2.
<i>I. macrocarpa</i> Miq.	2.
<i>I. pedunculosa</i> Miq.	4.
<i>Eonymus oxyphyllus</i> Miq.	2.
<i>E. striata</i> Loes.	2.
<i>Eurya japonica</i> Thunb.	3.
<i>Xolisma elliptica</i> Nakai	3.
<i>Ardisia japonica</i> Blume.	2.
<i>Symplocos myrtacea</i> Sieb. et Zucc.	4.
<i>Ligustrum japonicum</i> Thunb.	4.
<i>Callicarpa mollis</i> Sieb. et Zucc.	4.
<i>Mitchella repens</i> L. var. <i>undulata</i> Makino	1.
<i>Viburnum dilatatum</i> Thunb. f. <i>pilosulum</i> Nakai	2.
(Ground herbs)	
<i>Dryopteris acuminata</i> Nakai	4.
<i>Viola Selkirkii</i> Pursh.	1.
<i>Lysimachia japonica</i> Thunb.	2.
<i>Crawfordia japonica</i> Sieb. et Zucc.	2.
<i>Gentiana scabra</i> Bunge var. <i>Buergeri</i> Maxim.	3.
<i>Ainsliaea apiculata</i> Sch. Bip.	3.
<i>Disporum sessile</i> D. Don.	2.
<i>Smilax China</i> L.	2.
<i>Calanthe discolor</i> Lindl.	2.
<i>C. tricarinata</i> Lindl.	2.
<i>Cymbidium virens</i> Lindl.	2.
<i>Goodyera Schlechtendalana</i> Reichh. f.	2.
<i>Peristylus viridis</i> Lindl.	1.
(Lianas)	

(Continued)

(Life forms)	Species	Exclusiveness
	<i>Cocculus trilobus</i> DC.	2.
	<i>Schizandra nigra</i> Maxim.	2.
	<i>Schizaphragma hydrangeoides</i> Sieb. et Zucc.	2.
	<i>Rhus Toxicodendron</i> L. var. <i>vulgaris</i> Pursch. f. <i>radicans</i> Engl.	2.
	<i>Eurymyza radicans</i> Sieb.	4.
	<i>Vitis amurensis</i> Rupr. var. <i>Coignetii</i> Nakai	2.
	<i>Actinidia callosa</i> Lindl. var. <i>arguta</i> Makino	2.
	<i>Hedera japonica</i> Tabler.	3.
	<i>Trachelospermum asiaticum</i> Nakai var. <i>intermedium</i> Nakai	3.
(Epiphytes)		
	<i>Hymenophyllum barbatum</i> Miq.	4.
	<i>H. Wrightii</i> Bosch.	3.
	<i>Davallia Mariesii</i> Moore.	3.
	<i>Polypodium lineare</i> Thunb.	3.
	<i>P. Okuboii</i> Yatabe	4.
	<i>Lycopodium serratum</i> Thunb. var. <i>javanicum</i> Makino	3.

E) Temperate rain forest with broad-leaved conifers belong to *Taxaceae*. This forest vegetation occurs mainly in southern Kiushiu and the foot mountain region of northern Taiwan. The principal species dominating in this forest vegetation mostly belong to evergreen broad-leaved trees, and as conifers *Podocarpus macrophyllus* and *P. nagi* are principal species but these are standing scattered in the forest.

As an example of this forest vegetation, a forest situated in southern Kiushiu is selected, and its brief floristic composition is listed as follows:

(Life forms)	Species	Exclusiveness
(Dominant trees)		
	<i>Podocarpus macrophyllus</i> D. Don.	
	<i>P. nagi</i> Pilg.	
	<i>Quercus gilva</i> Blume.	
	<i>Q. stenophylla</i> Makino	
	<i>Shiia Sieboldii</i> Makino	
	<i>Machilus Thunbergii</i> Sieb. et Zucc.	
	<i>Distylium racemosum</i> Sieb. et Zucc.	
	<i>Nauclea racemosa</i> Sieb. et Zucc.	
(Subordinate trees)		
	<i>Actinodaphne longifolia</i> Nakai	4.
	<i>Cinnamomum japonicum</i> Sieb.	3.
	<i>Camellia japonica</i> L. var. <i>spontanea</i> Makino	3.
	<i>C. Sasangua</i> Thunb.	5.
	<i>Turpinia ternata</i> Nakai	4.
	<i>Eurya ochracea</i> Szysz.	4.
	<i>Ternstroemia japonica</i> Thunb.	4.
	<i>Heptapleurum octophyllum</i> Forbes. et Hemsl.	4.
(Shrubs)		
	<i>Debregeasia edulis</i> Wedd.	4.
	<i>Villebrunea fruticosa</i> Nakai	4.
	<i>Fatsia japonica</i> Decne. et Planch.	4.

(Continued)

(Life forms)	Species	Exclusiveness
	<i>Maesa japonica</i> Mor. et Zoll.	4.
	<i>Rapanea nerifolia</i> Mez.	4.
	<i>Premna japonica</i> Miq.	4.
(Ground herbs)		
	<i>Angiopteris suboppositifolia</i> de Vris.	5.
	<i>Cyathea boninsimensis</i> Copel.	5.
	<i>Asplenium unilaterale</i> Lam.	4.
	<i>A. Wrightii</i> Eat.	4.
	<i>Cheiropleuria bicuspidata</i> Presl. var. <i>integrifolia</i> Eat.	4.
	<i>Cyclophorus adnascens</i> Desv.	4.
	<i>Diplazium lanceum</i> Presl.	4.
	<i>D. Wichurae</i> Diels.	4.
	<i>Dryopteris africana</i> C. Chr.	2.
	<i>D. lepigera</i> O. Kuntze.	4.
	<i>D. ochthodes</i> C. Chr.	4.
	<i>Microlepia marginata</i> C. Chr.	4.
	<i>Polypodium ellipticum</i> Thunb. var. <i>pothifolium</i> Makino	4.
	<i>P. ensatum</i> Thunb.	4.
	<i>P. Wrightii</i> Mett.	5.
	<i>Polystichum amabile</i> J. Sm.	4.
	<i>Pteris cretica</i> L. var. <i>albolineata</i> Hook.	4.
	<i>P. hachijoensis</i> Nakai	4.
	<i>P. quadriaurita</i> Retz.	4.
	<i>P. Wallichiana</i> Ag.	4.
	<i>Woodwardia orientalis</i> Sw.	4.
	<i>Osmunda bromeliifolia</i> Copel.	4.
	<i>Balanophora japonica</i> Makino	4.
	<i>Polygonum chinense</i> L. var. <i>Thunbergianum</i> Meisn.	3.
	<i>Mitrastemon Yamamotoi</i> Makino	5.
	<i>Swertia Tashiroi</i> Makino	5.
	<i>Ophiorrhiza japonica</i> Blume.	4.
	<i>Ligularia tussilaginea</i> Makino	4.
	<i>Pinellia tripartita</i> Schott.	4.
	<i>Alpinia japonica</i> Miq.	4.
	<i>Phajus maculatus</i> Lindl.	5.
	<i>P. maculatus</i> Lindl. var. <i>minor</i> Franch.	5.
(Lianas)		
	<i>Piper Futokadsura</i> Sieb.	4.
	<i>Ficus pumila</i> L.	4.
	<i>Stephania japonica</i> Miers.	4.
	<i>Anodendron laeve</i> Makino	4.
	<i>Marsdenia tomentosa</i> Morr. et Decne.	4.
	<i>Psychotria serpens</i> L.	4.
	<i>Uncaria rhynchophylla</i> Miq.	4.
	<i>Lonicera affinis</i> Hook. et Arn.	4.
(Epiphytes)		
	<i>Trichomanes auriculatum</i> Blume.	4.
	<i>T. cupressoides</i> Desv.	4.