

Plant Indicators Relating to Silviculture in Japan.

By

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(1) From the standpoint of recognizing woodland as vegetation composed of many plant communities, the treatment of forests based upon ecological foundations for the silviculture is, at present, the general tendencies in Japan. This tendency is clear judging from the vegetation surveys for state forest since 1928.

(2) The classification of the forest vegetation based on forest ecology and the treatment of forest on the basis of forest ecology can be determined by the result of the vegetation survey. But, under the present state of this survey the following great divisions of forest vegetation can be acknowledged:

- I. Regions dominated by cold xerophytic forest formations (*Abies*, *Picea*, and *Betula* formation group).
- II. Regions dominated by high mountain xerophytic forest formations (*Tsuga*, *Abies*, *Picea* and *Betula* formation group).
- III. Regions dominated by summer green mesophytic forest formations (*Cryptomeria*, *Thujaopsis*, *Chamaecyparis*, *Abies*, deciduous *Quercus* and *Fagus* formation group).
- IV. Regions dominated by evergreen mesophytic forest formations (*Abies*, *Tsuga*, evergreen *Quercus*, and *Shiia* formation group).
- V. Regions dominated by temperate rain forest formations (*Shiia*, *Distylium*, *Machilus*, *Polocarpus* and evergreen *Quercus* formation group).
- VI. Regions dominated by coast sand-dune forest formations (*Pinus* and *Quercus* formation group).
- VII. Regions dominated by subtropical oceanic forest formations (*Colophyllum*, *Livistonia*, and *Pandanus* formation group).

(3) Although, there are not so many examples of plant indicators regarding to silviculture, several species can be described as following paragraphs.

(4) Climatic indicators. The following species, i. e. *Abies Mayriana* Miyabe et Kudo, *A. sachalinensis* Mast., *Picea jezoensis* Carr., and *P. Glehnii* Mast. in the region I, *Abies Mariesii* Mast., *A. Veitchii* Lindl., *Picea jezoensis* Carr. var. *hondoensis* Rehd., and *Tsuga diversifolia* Maxim. in the region II, *Fagus crenata* Blume., and *Quercus crispula* Blume. in the region III, *Tsuga Sieboldii* Carr. and *Shiia Sieboldii* Makino in the region IV are the typical species indicating the climates of each region. In addition to these, there are also some examples indicating special climatic condition in forest as follows:—

- i) Climbers. The abundant occurrence of this life-form and Epiphytes, which is described in the next article, indicates the wet condition of air in Japan, as well as in the tropical rain-forest. Among these species belong to this life-form, *Schizophragma hydrangeoides* Sieb. et Zucc. has very wide range of habitat extending from the region III to V. The representatives of the region III are *Parthenocissus Thunbergii* Nakai, *Berchemia racemosa* Sieb. et Zucc., *Hydrangea scandens* Maxim., and *Schizandra nigra* Maxim. The representatives of the region V are *Uncaria rhynchophylla* Miq., *Lonicera affinis* Hook. et Arn., *Marsdenia tomentosa* Morr. et Decne., *Anodendron laeve* Maxim., and *Ficus nipponica* Franch. et Sav. The well-known poisonous Ivy (*Rhus Toxicodendron* L. var. *vulgaris* Pursch. f. *radicans* Engl.) appears in the regions III and IV. Generally, however, it seems that the Climbers as moisture indicator is not so sensitive as epiphytes.
- ii) Epiphytes and Pseudo-epiphytes. Due to the great rain-fall and very high humidity of air, numerous species of these life-forms grow in Japan. *Usnea longissima* Ach. in the region I and II, *Cyclophorus linearifolius* C. Chr., *Polypodium annuifrons* Makino, and *P. japonicum*

Maxon. in the region III, *Bulbophyllum Drymoglossum* Maxim., *B. inconspicuum* Maxim., and *Polypodium Makinoi* C. Chr., in the regions IV and V, *Aerides japonicum* Reichb. f. *Luisia teres* Blume., *Asplenium Nidus* L., and *Trichomanes auriculatum* Blume. in the region V are the representatives of climatic indicators in each region. It is very interest fact the most northern end of distribution of *Drymoglossum microphyllum* C. Chr. contacts with the southern end of that of *Cyclophorus linearifolius* C. Chr. The abundance of *Hymenophyllum* species which appears from the region III to V, indicates the degree of humidity, and the heights of its occurrence on the bark of tree-boles indicates the limit of layer of moist air wherein this species can live. Consequently, these facts indicates the changes of moisture conditions from forest floor to upwards. In the region of V, the fact that *Cyclophorus lingua* Desv. remains alone on the bark of tree-boles while the other epiphytic species disappeared, indicates the air condition is becoming to dry.

- iii) Autonomous plants. Among this life-form, *Cacalia auriculata* DC. var. *kamtschatica* Koidz., *Spiraea media* Fr. Schm. var. *mombetsusensis* Card., and *Dryopteris setosa* Kudo in the region I, *Eupatorium sachalinense* Makino, *Lysichiton camtschatense* Schott., *Dryopteris mutica* C. Chr., *D. dilatata* A. Gray var. *deltoidea* Takeda, *Matteuccia orientalis* Trev., *M. Struthiopteris* Todaro., *Phyllitis scolopendrium* Newm., and *Plagiogyria Matsumuraeana* Makino in the regions I, II, and III, *Cacalia palmata* Makino, *Rodgersia podophylla* A. Gray, *Adiantum pedatum* L., and *Dryopteris crassirhizoma* Nakai in the region III, *Plagiogyria eruphlebia* Mett., and *P. japonica* Nakai in the region IV, *Ligularia tussilaginsa* Makino, *Maesa japonica* Mor. et Zoll., *Phajus maculatus* Lindl., *Angiopteris suboppositifolia* de Vris, *Osmunda bromeliacifolia* Copel., *Dryopteris lipigera* O. Kuntze, and *Polypodium ellipticum* Thunb. var. *pothifolium* Makino are the important species representing the general climatic characteristics of each region.
- iv) Particular examples. The occurrences of *Rosa rugosa* Thuub. and *Artemisia Stelleriana* Bess. on coast sanddune, and *Chimaphila umbellata* Nutt. in strand forest indicate special climate, which shows very cold temperature as that of northern Japan for a short time in winter. On the other hand, the occurrences of *Wedelia prostrata* Hemsl. on sand-dune, and the *Saccolabium Matsuran* Makino growing as epiphytes on the bark of *Pinus Thunbergii* Parl. in strand forests indicate the climate characterized by very humid summer which is very common in far more southern part of Japan. Therefore, these indicators occurring in same strand pine forest on the sea coast near Tokyo is very important criterion for determining the climate in this district.

(5) Edaphic indicators. There are only few examples of forest vegetation obviously affected by edaphic condition in order to the great rainfall and very heavy showers in Japan. However, there are some plants which may be regarded as edaphic indicators. In Hondo there is some tendency of occurring of *Fraxinus* species in or near limestone region, but as for *Fraxinus mandshurica* Rupr. in Hokkaido such tendency can not be observed as in the case in Hondo. Deciduous *Quercus* species, for instance, *Quercus serrata* Thunb. commonly predominates in Gneiss region. *Buxus japonica* Muell. Arg. occurs some times in limestone region but it is not considered as general tendency. *Camptosorus sibiricus* Rupr. is very keen indicator of limestone, and *Corylopsis spicata* Sieb. et Zucc. is reported as associator of serpentine rocks by some botanists. In a large area of naturally regenerated forest in the region III, it is frequently found that *Chamaecyparis obtusa* Sieb. et Zucc. particularly dominates on the rocky parts. From this fact it may be thought that this species is a indicator showing relatively thin soil. The following species can be said as the standards of indicators of hydrogen ion concentration of soils in central Honshu:—

- (a) Indicators showing relatively high value of PH (5.5-6.0): *Campanula punctata* Lam. var. *typica* Makino, *Oldenlandia diffusa* Roxb., *Impatiens Textorii* Miq., *I. Noli-tangere* L., *Polygonum sagittatum* L. var. *americanum* Meisn. f. *Sieboldi* Makino.
- (b) Indicators showing intermediate value of PH (5.0-5.5): *Aster leiophyllus* Franch. et Sav. *Lysimachia clethroides* Duby., *Pirola japonica* Sieb., *Rosa coptophyllus* A. Gray. *Carex lanceolata* Boott.
- (c) Indicators showing relatively low value of PH (4.5-5.0): *Phryma leptostachya* L. *Salvia nipponica* Miq., *Chloranthus serratus* Roem. et Sch., *Hosta japonica* Asch. et Graebn. var. *corulea* Makino, *Athyrium yokoscence* Christ.

- (6) Seral Indicator.

- i) Indicators of stabilization. Several species, except *Lysichiton camtschatense* Schott. growing in marshy soil and *Eupatorium sachalinense* Makino, *Spiraea media* Fr. Schm. var. *mombetsuensis* Card. which habitually predominate in open fields, described in preceding paragraph as climatic indicators of autonomous plants mostly correspond with the indicators of stabilized stage. In addition to the above species *Asperula odorata* L. in the regions I, II, and III, *Ilex rugosa* Fr. Schm. and *Oxalis Acetosella* L. var. *japonica* Makino in the region III, *Ainsliaea apiculata* Sch. Bip., *Aucuba japonica* Thunb., *Urtica Thunbergiana* Sieb. et Zucc., *Calanthe discolor* Lindl., and *Optismenus undulatifolius* Beauv. var. *japonicus* Koidz. in the regions III and IV, are known as indicators of the most mesic condition.

On the contrary, the exotic species *Erigeron linifolius* Willd., *E. canadensis* L. etc. and *Lactuca denticulata* Maxim. var. *typica* Maxim. are the most marked pioneers which invade just after the cutting of forest.

- ii) Plants as indicators of favourable conditions for invasion of important coniferous seedlings. Perfect coverings of lichens or mosses on forest floor are known generally as a evidence of very good preparation for invasion of tree seedlings. Moreover, there are some species indicating similar cases. In the region of coast sand-dunes the growing of predominance of *Indigofera pseudo-tinctoria* Matsum. in place of *Ischaemum antheophoroides* Miq. var. *eristachyum* Honda shows the environment becoming very favourable for invasion of *Pinus Thunbergii* Parl. In the region III, the fact that *Solidago Virgaurea* L. yields its life to *Disporum smilacium* A. Gray shows the coming up of good conditions in which *Abies firma* Sieb. et Zucc. can invade. In the same region the seedlings of *Cryptomeria japonica* Don. associate with fading *Rosa palmatus* Thunb., dwarfed forms of *Hydrangea scandens* Maxim. and *Rhus Toxicodendron* L. var. *vulgaris* Pursch. f. *radicans* Engl., seedlings of *Viburnum furcatum* Blume., *Stachyurus praecox* Sieb. et Zucc., and *Hydrangea paniculata* Sieb. var. *floribunda* Regel. It is very remarkable that the seedlings of *Thujopsis dolabrata* Sieb. et Zucc. var. *Hondai* Makino associate especially with *Clintonia Udensis* Trautv. et Mey. which is only exception of the same species as with the case of *Cryptomeria japonica* Don.

(7) Species as indicators. Both the predominance of *Miscanthus sinensis* Anders. and *Pueraria hirsuta* Matsum. show generally the deep soil and these vegetations are recognized as indicators of favourable conditions for plantation of *Cryptomeria japonica* Don., but higher *Miscanthus sinensis* shows deeper soil. A vast area of bamboo bushland dominated by *Sasa senanensis* Rehd. and the like appears in many places through whole regions of II, III, and in parts of the region I. At present the ecological conditions of such vegetation is not known yet. But it can be said according to many facts that the predominance of this vegetation indicates rather deeper soil. In west part of Hondo, Shikoku and Kiushiu, the abundant occurrences of *Dicranopteris dichotoma* Bernh., *D. glauca* Nakai show more or less xeric condition of soil. The disappearance of *Usnea longissima* Ach. from the branches and boles of trees in cold or high mountain region is a very keen indication of the attacks of SO₂ gas from copper mine or sulphur mine. *Quercus dentata* Thunb. very common in Japan and *Epilobium angustifolium* L. in northern part of Japan are considered as the marked fire indicators.