Distribution of Special Forest Vegetation in Heavy Snowy Region in Japan

by

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Introduction

As well known, the Country of Japan consists of four main islands, Hokkaido, Honshu, Shikoku and Kyushu and of innumerable small islands standing side by side from north-east (45°31′ N., 145°51′E.) to south-west (24°02′N., 122°56′ E.), it is located in the Western Pacific close to the East Asian Continent. Accordingly, the Country has a very wide range of climatic conditions, especially in temperature.

Another essential characteristic of her climate is high precipitation throughout the year all over the Islands.

Between the Islands and the Continent, there lies the Japan Sea, and the Islands front the Western Pacific on the south. The Islands have rather high mountain ranges in the central parts of narrow islands (see Fig. 1). The highest part of the mountain ranges is located in the central part of Honshu, so-called the North and the South Japanese Alps, reaching up to 3,000 m or more above sea level.

Due to the topographical characters, climate of the Islands considerably varies between the Japan Sea side and the Pacific side, especially in winter. These two climatic zones are called Ura-Nippon (facing the Japan Sea) and Omote-Nippon (facing to the Pacific) climates. Characteristics of both climatic zones are as follows:

1) In the summer season, both zones are under the influence of the Pacific

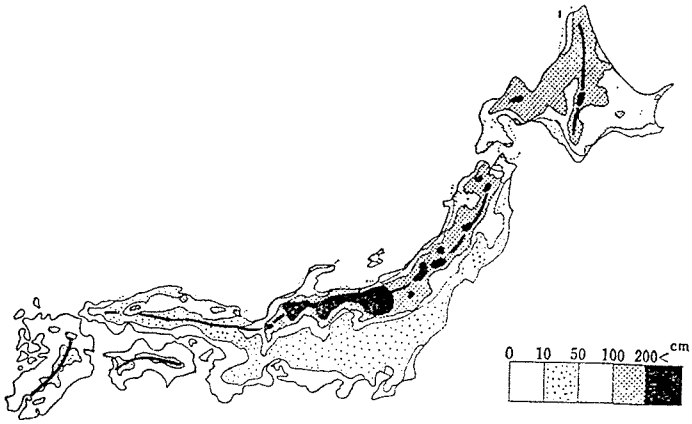

Fig. 1. Distribution of mean maximum snow depth of Japan.

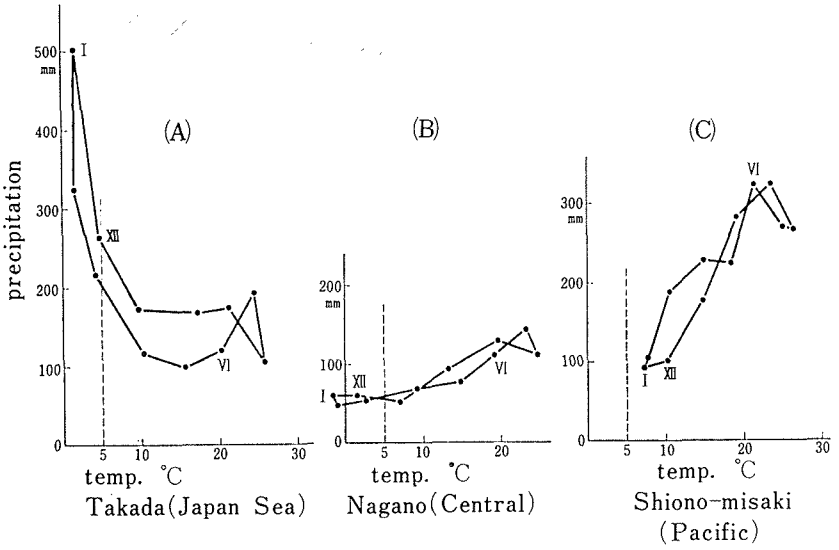

Fig. 2. Hythergraphs ot the Japan Sea, the Central and the Pacific climates.

Monsoon climate, and have a plenty of precipitation all over the Islands, except for a small part of northernmost peninsula near Soya Cape in Hokkaido. This part of Hokkaido is almost always exposed to the North Poler front.

2) In winter, the Monsoon recedes with the decrease in the number of high pressures on the Pacific, and high pressures on the East Asian Continent grow stronger, whereas low pressures appear on the North Pacific.

Such winter disposition of main atomospheric pressures is called "high west and low east". All biotic communities on the Japan Sea coast suffer through out the winter from cold and moist northwest winds blowing from Asian Continent. It brings us very heavy snowfall every winter and the snow covers a half of the Islands.

As mentioned above, the Japan Sea lies between the Japanese archipelago and the Continent, and a warm current called Tsushima Current runs from southwest to northeast along the Japan Sea coast of the Islands. The cold and dry seasonal winter wind originated from high pressures in the Asian Continent, blows across the Japan Sea and catches a large amount of moisture from the warm current. Reaching the Japan Sea coast of the Islands, the wind becomes cold and wet. It then runs over the steep and high mountains, and heavy snowfall is brought about in the Ura-Nippon region. While the seasonal wind blowing across the main range of mountains in the central part of Honshu, it looses moisture and the dry wind runs down to the Pacific coast. So the two climates in winter are in share contrast i. e. wet and snowy on the Japan Sea side and no precipitation and dry on the Pacific side.

In short, the main characteristic of climate of the Ura-Nippon region is the heavy snow covering over five months till next spring comes. This climatic phenomenon especially in winter strongly affects both the vegetation and the human life.

We have, for instance, many species of tall coniferous tree species in warm

and cool-temperate zones on the Japanese archipelago, such as *Abies filma, A. homolepis,Picea polita, Tsuga Sieboldii, Torreya nucifera, Podocarpus macrophilla, P.nagi, Cephalotaxus drupacea, Sciadopitys verticillata, Thujopsis dolabrata, Cryptomeria japonica, Chamaecyparis obtusa* and some species of *Pinus* mixed in evergreen and deciduous broad-leaved forests, but almost all tall coniferous trees are distributed in temperate forests on the Pacific side. Only *Cryptomeria japonica* (Sugi) appears in the region on the Japan Sea side, and forms small groups in broad-leaved forests. As to the human life, people living in the snowy regions endure the cold and wet winter, when traffic is sometimes interrupted by the heavy snowfall even in this modern and civilized century.

I. Main Characteristics of Deep Snow Cover against Vegetation

Deep snow cover on the ground has two opposite characters. Deposited snow on the ground is a very porous material, consisting of small ice crystals and dispersed tiny air chambers. Therefore the snow is a very excellent material to prevent the conduction of low atmospheric temperature in winter. In fact it is known that plants which are buried under the snow over 50 cm, in depth, are not damaged by the low temperature in winter.

On the other hand, layers of deposited snow gives weight on plant bodies or the objects buried under the snow. Sometimes, when heavy wet snow falls on the objects such as tree crowns or electric poles, and huge amount of snow is accumulated on them, the stems and branches break, and trees and poles bend under the heavy weight. This phenomenon is called 'the damages caused by statical pressure of snow.'

Dynamical pressure of snow in the mountain is an avalanche, which flows down along steep slopes with a high speed and breaks down trees, forests and other objects on its course to the foothill.

Those two opposite characters of snow, one is protection against low temperature and the other is dynamical pressure, have much influence upon the vegetations, distributed in the regions of the Japan Sea side, where high precipitation is brought about in winter as we have seen (see Fig. 2).

The influence of snow cover upon vegetations can be categorized as follows:

1) Absence of subalpine forest zone in some heavy snow-covered districts.
2) Special evergreen undergrowth of beech forest in cool-temperate forest zone on the Japan Sea side.
3) Special distribution of vegetation on the course of avalanche.

II. Absence of Subalpine Forest Zone in Some Heavy Snow-Covered Districts

In cool-temperate and subalpine zones, almost all species of tall deciduous broad leaved trees can bear the snow pressure, whereas almost all species of tall coniferous trees are too weak to bear it.

Cryptomeria japonica is an only exceptional species that can grow in snowy regions enduring the high pressure of snow (see above), and is distributed in small groups in cool-temperate beech forests on the Japan Sea side.

Maintaining creeping life form, in young stage this species of tree can grow without breaking its stem or branches during its young period. After it grows tall, the stem is bent upward just above the soil surface supporting another part of stem vertically. This life-form has a good resistance against strong pressure of snow. As the other species of coniferous tall tree species do not take such a form, they are unable to endure the strong pressure of snow cover. Especially main tree species in subalpine coniferous forest, *Abies spp.* are very weak against the pressure caused by gliding snow along slopes or deep snow cover. It seems that Japanese alpine fir cannot live with a creeping life-form in snowy districts.

We have two main species of fir in subalpine zone, i. e. *Abies Mariesii* Mast. and *A. Veitchii* Lindl. Roughly speaking, *A. Veitchii* is distributed in the subalpine zone on the Pacific side, where the amount of snow deposit is very scanty. In the inland districts of the central Honshu, mixed stands of both species of fir trees are often found, whereas on the Japan Sea side of Honshu, especially in the northeast part of Honshu, called Ou-District, only *A. Mariesii* can make pure stands of subalpine forest. But on the so-called Dewa-Sankai (Dewa mountains), where snow cover is the deepest in Japan, the absence of subalpine coniferous zone has been already confirme.

The Dewa-Sankai directly faces the Japan Sea and is far from the Continent across the Sea. Northwest winds blowing from the Continent, takes a lot of humidity on its way to Honshu across the Japan Sea, and brings about considerable amount of snow in the mountainous districts. Snow pressure increases rapidly with the increases in depth of snow. *A. Mariesii* is stronger against snow pressure than *A. Veitchii*, but in these high snow-covered districts, where snow cover reaches over, 4–5 m all species of subalpine coniferous tree completely disappear due to the high pressure of snow.

Some ecologists have another opinion about the absence of subalpine zone in snowy regions. They pointed out the reasons as follows:

a) strong northwest wind,
b) shortage of vegetation period caused by elongation of snow melting period, and
c) cool temperature during the snow melting period, and so on.

Most of these reasons for explaining the absence of subalpine coniferous zone, however, might be refutable. If the reasons were valid, the elevation of all the distributed climatic forest zones would be lowered; the absence of an only zone could not be seen.

At the elevation where the coniferous forest zone has disappeared, oak species following creeping life-form named *Quercus mongolica var. undulatifolia* Kitamura et Horikawa (Miyama-Nara in Japanese) mixed with other deciduous shrubs is distributed up to the alpine shrub communities, such as *Pinus pumila*, *Junuperus sibilica var. nipponica*, etc. Cool-temperate zone which touches the subalpine shrub formed with oak communities consist of *Fagus crenata*, but the beech is also bent strongly at the lower part of stem and forms a very dense stand, gradually decreasing its stand-height up to the border of upper zone. The shrub formed with subalpine oak communities and mixed with *Alnus Maximowiczii*, *Acer Tschnoskii* and other shrub species was termed as "Quasi-Alpine

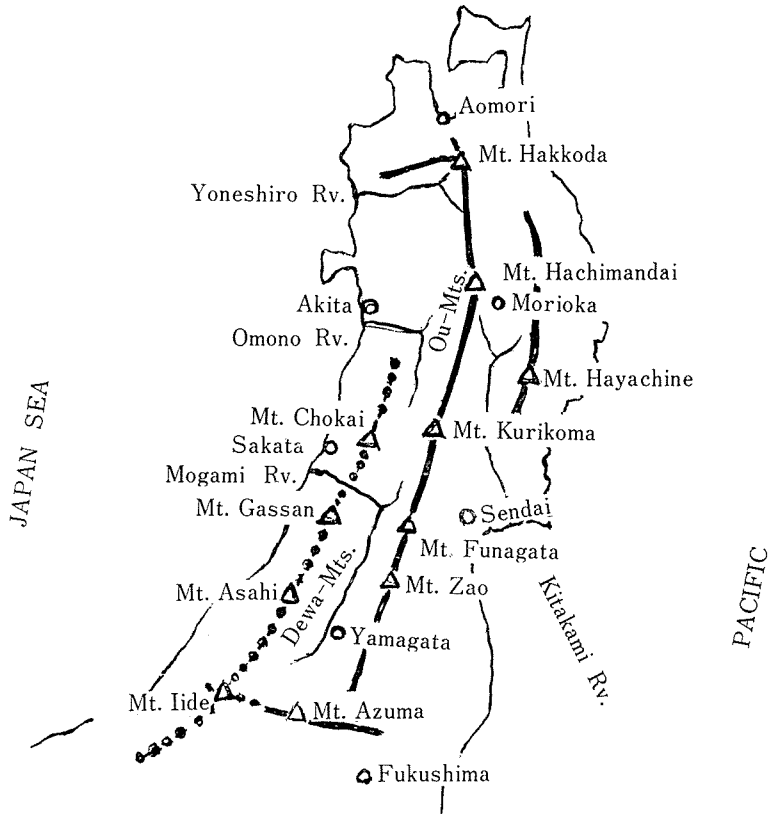

Fig. 3. Distribution of subalpine coniferous forests in Ou-District.
.....area of non coniferous forests
———area with coniferous forests

Zone" by Dr. Shidei in 1956.

The shrub formed with oak community is distributed mainly in the subalpine zone of Dewa-Sankai in Ou-District, but local distributions of the community are also found in the Japan Sea climate, where they usually have considerable amount of accumulation of snow.

III. Special Evergreen Undergrowth of Beech Forest

As already mentioned, many species of evergreens grow high or subhigh in the warm-temperate zone. However, the evergreen species in cool-temperate zone are mixed with some other species, change their life-form into dwarf and creeping type and make an invasion into beech forest as undergrowth. In winter they are protected from low temperature by thick snow cover. Some of such species are shown in the table on Page 124.

The creeping shrub-typed evergreen species are distributed very widely along the snowy districts of the Japan Sea climate up to the northern part of Hon-

		genus	snowless district	snowy district
evergreen	conifer	*Cryptomeria*	*C. japonica* (スギ)	var. *radicans* (アシオスギ)
		Abies	*A. veitchii* (シラベ)	*A. mariesii* (アオモリトドマツ)
		Torreya	*T. nucifera* (カヤ)	var. *fruticosa* (チャボガヤ)
		Cephalotaxus	*C. harringtonia* (イヌガヤ)	var. *nana* (ハイイヌガヤ)
		Taxus	*T. cuspidala* (イチイ)	var. *nana* (キャラボク)
	broad-leaf	*Aucuba*	*A. japonica* (アオキ)	var. *borealis* (ヒメアオキ)
		Daphniphyllum	*D. macropodium* (ユズリハ)	var. *humile* (エゾユズリハ)
		Ilex	*I. integra* (モチノキ)	*I. leucoclada* (ヒメモチ)
			I. crenata (イヌツゲ)	var. *paludosa* (ハイイヌツゲ)
		Camellia	*C. japonica* (ツバキ)	*C. rusticana* (ユキツバキ)
	sasa	*Sasa*	*S. nipponica* (ミヤコザサ)	*S. kurilensis* (チシマザサ)
			S. borealis (スズタケ)	*S. palmata* (チマキザサ)

shu, i. e. Ou-District (see Fig. 3).

It can be said that the border of two regions, one is beech forest with evergreen undergrowth and the other is beech forest without it, is on the line where the mean maximum depth of snow accumulation is about 50 cm. The snow depth of about 50 cm is the minimum snow cover to prevent the low temperature form penetrating through the snow deposit.

These shrub-typed evergreen tree species have been used from old times as ornamental trees in Japanese gardens.

IV. Special Distribution of Vegetations on the of Courses. Avalanche

So-called "ground avalanches" occur along slopes of mountains covered with heavy snow in every early spring just after the snow began to melt. This type of avalanche takes a fixed course where special vegetations are found.

The avalanches course can be divided into three parts. The upper part, where the avalanche is originated, becomes naked and rocky, and no vegetations are found there. But other parts, i. e. middle and lower parts, have deep soil gathered from the upper part of the slope.

In the middle part, where the avalanche runs down grow only bushes consisting of deciduous broad-leaved species with creeping life-form. Some maple species, *Weigera hortensis*, *Alnus hiruta*, *Morus bombycis*, etc. are common plants there. In the lower part, where huge mass of snow is accumulated, melting period is delayed till late spring or early summer, and the vegetation period is short. Even shrub forming communities cannot grow there. In addition to the fact the lower part is well irrigated with melting snow, and only tall perennial grass communities appear. The communities consist of many tall grass species within high density, and the family of Chrysanthemum is most common. Creeping shrub and tall perennial grass communities are the special and permanent local edaphic communities along the avalanches course.

Summary

In snowy districts of the Japan Sea side, some special local plant communities are found in relation to deep snow cover and its strong pressure.

a) Absence of coniferous subalpine zone due to strong pressure of snow cover was found in Dewa-Sangun in Ou-District, and the zone is occupied by the the creeping shrub-type oak community.

b) In cool-temperate beech forests some of evergreen coniferous and broad-leaved tall tree species and tall Sasa with creeping life-from grow as under-growth, and are protected from coldness by snow cover.

c) On the permanent course of avalanche deciduous broad-leaved shrub communities and perennial tall grass vegetations are dominant.

References

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