THE NATURAL CHARACTERISTICS OF YAKU ISLAND

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THE ECOLOGICAL MEANING OF A COMPREHENSIVE SURVEY OF YAKU ISLAND

The Nature Conservation Society of Japan conducted a comprehensive survey of the natural features of Yaku Island with a project team under the auspices of Environment Agency in the fiscal year of 1983. Yaku Island is located 60 km from the southern edge of the Osumi Peninsula, Kyushu. It is a small island of almost a circular shape the diameter of which is about 28 km (EW) and 24 km (SN). On this small island, there are more than thirty mountains of over 1000 m in altitude with the highest peak being Mt. Miyanoura, 1935 m in alt.

When Japanese speak of Yaku Island, every one knows of Yokusugi (the Yaku cedar) which is a longlife tree supplying excellent quality timber. Yokusugi and its forests have been designated as a national natural monument, national park (Kirishima-Yaku N. P.), wilderness area (one of 5 W. A.’s) and biosphere reserve of the MAB/UNESCO (one of 4 B. R.’s).

Many researchers visited this island since before the war, and endemic species, dwarf varieties, etc. were found to be characteristic. The Ecological Society of Japan and a research group of Kyushu sent a resolution about and recommendation for the protection of the characteristic nature of the island to the Government several times. They referred to the laurel-leaved forest on the lower part as well as the Yakusugi forest. The laurel-leaved forest there may be a prototype of that in Eastern Himalaya. Clarification of the structure, composition, function, dynamics and history of such typical biological nature located in the southern limit of the warm-temperate region of Japan would enable interpretation of all of the features of the island ecosystem as a prototype of nature in Japan. This is the objective of

* Summary of a comprehensive survey of Yaku Island, south of Kyushu as the chairman of the Research Committee.
as well as the expectation to the comprehensive survey.

The island is situated in the southernmost part of the warm-temperate region of Japan, and north of the Ryukyu Islands. They are included in the Southwestern (Nansei) Islands in a broad sense. Clouds, mist and much rainfall are characteristic, caused by ascending air currents, under the strong influence of the Kuroshio (warm Pacific current) and frequent typhoons. The amount of rainfall is 3000~4000 \( \text{mm} \) on the coast and 8000~10000 \( \text{mm} \) in mountainous areas.

Deer and monkeys are endemic subspecies of the Japanese mainlands. There is a northern limit of the tropical dragonfly and a southern limit of a dragonfly endemic to the Japanese main islands. There are several endemic species and subspecies of cicada, butterflies, beetles and birds. There are 1200 spp. of higher plants and 600 spp. of bryophytes. Along the rivers, there are rheophytes as in the tropics.

**THE RESULTS OF THE SURVEY**

The greatest characteristics of this survey are its comprehensiveness and integration of various fields of science. There have been many survey reports on plants and vegetation, animals, geology, geomorphology, soils, meteorology, etc., however little integration has been found. This time similar differentiated studies were conducted by various disciplines. Furthermore, an attempt was made to integrate such interdisciplinary studies as a whole through debates as well as from existing knowlege.

One question was raised. A poster made by the Environment Agency indicated the greatest longevity of Yakusugi (Cryptomeria japonica on Yaku Island) to be 7,200 years. Discs obtained from living Yakusugi trees showed them to be well over 1,000 years in age. From these facts, 2~3,000 years at the greatest have been estimated by many people. It is difficult to exactly estimate the age of big trees with empty xylem.

All of Yaku Island was found to be covered by a pyroclastic flow deposited by the eruption of the Kikai caldera. The deposit had a thickness of 1 m at the deepest on the gentle slope of the ridge and 30~40 cm in the other places. There are some denuded sites on the slopes. The pyroclastic flow was estimated by radioactive carbon testing to be 6,300 years old. Fine particles of volcanic ash
were blown into the stratosphere when the volcano erupted, and pumice and other deposits are thought to cover the whole island as a pyroclastic flow deposit. Almost none of plants nor animals could survive under the pyroclastic flow deposit of 300˚ to 1,000˚C. Thus the maximum age of Yakusugi has to be less than 6,300 years.

Fig. 1 Okina-sugi (old man cedar). Photo by N. Higeta.

On the other hand, it was clarified by a geomorphological study that big landslides, erosion and mass movements have a cycle of about 1,000 years. From this point of view, the Yakusugi on the steep slope may be 1,000 years old at the greatest.

It was impossible for endemic flora and fauna to occur for several thousand
years. Several new species were found in the survey of 1983. The deer (Yaku-deer) and monkeys (Yaku-monkey) are morphologically different from deer and monkeys living on the main islands of Japan. The time necessary for the occurrence of such genetic differences varies from case to case, however, 6,000 years or so is not enough time for such differentiation. Therefore, the characteristic flora and fauna of Yaku Island have to be the offspring of plants and animals that survived under the overhang of cliffs, etc. covered by the hot pyroclastic flow deposit 6,000 years ago.

THE RIDDLE OF YAKUSUGI

As an example of big trees, Dipterocarpaceae in the tropical rain forest is often referred to due its huge growth of 70 m or so, but its age is unknown. The biggest trees in the world are Tsuga in the western USA. The Sequoia are also big trees. Their age has been estimated to be about 3,000 years at the greatest. The age of temperate trees is usually estimated by counting the number of tree
rings. This is different from the big trees in the tropical rain forest which have no tree rings. However, the age of Yakusugi trees is very difficult to estimate as mentioned earlier. Cryptomeria trees more than 1,000 years old are called Yakusugi, and those less than 1,000 years are called Kosugi (small Cryptomeria) in Yaku Island. The reason why there are many Kosugis 200~300 hundred years old is that there might have been many seedlings left after the cutting of many trees by feudal lord Shimazu during the Tokugawa period (1603~1867).

The width of the year rings of Yakusugi is less than 1 mm, and the timber is very hard. However, when it is planted along the sea coast of Yaku Island or on the lowland of Kagoshima Prefecture (southern Kyushu) the timber becomes soft with wide annual rings. The origin of Yakusugi is the Fagus crenata zone (the cool - temperate zone), though the southernmost distribution of Fagus crenata did not reach Yaku Island even during the ice age. Even in the montane zone, Yakusugi in mild microhabitat grows fast and straight. However, the typical growth of Yakusugi is not so tall with many branches on the top under strong influence of frequent typhoons. Severe environmental conditions are necessary for the growth of Yakusugi, so the estimation of tree age is quite impossible based on ring thickness.

Cryptomeria japonica has many races, and they have been planted from northern Honshu to southern Kyushu. In natural forests of Cryptomeria japonica, it sometimes grow mixed with Fagus crenata. Those temperate conifers including Chamaecyparis obtusa, etc. broadened their distribution from the Fagus crenata region as the center. It spread to the southern part of Kyushu during the ice age when the annual mean temperature was 8°C lower than at present. Before the arrival of Fagus crenata on Yaku Island, the ice age ended, and it retreated to the north.

During the ice age, the sea level dropped about 120 m according to one theory. If so, Yaku Island had a land bridge with the Osumi Peninsula of Kyushu, and it was convenient for the migration of plants and animals.

In terms of vegetational zonation, the zone less than 800 m is the laurel-leaved forest zone (Distylium racemosum, Castanopsis cuspidata var. sieboldii and Quercus salicina), 800~1,200 m is the ecotone of laurel-leaved forest and coniferous forest (Distylium racemosum, Quercus salicina, Q. acuta, Cryptomeria japonica, Tsuga
sieboldii and Abies firma) and 1,200~1,700 m is the coniferous forest zone (mainly Cryptomeria japonica with some broad-leaved trees such as Trochodendron aralioides, Kalopanax pictus and Stewartia monadelpha). Because Fagus crenata did not reach Yaku Island, Cryptomeria japonica covers the montane deciduous broad-leaved forest zone. In the upper zone, higher than 1,500 m, many Cryptomeria trees are withering and are less than 10 m in height. The Cryptomeria japonica forest zone is different from cold-temperate Abies veitchii-Abies mariesii zone. It is very similar to the vegetational zonation of the Nepal Himalaya area (Numata 1966) where the Abies wallichii-Tsuga dumosa forest zone (cool-temperate in its freezing resistance characteristics - Sakai and Malla 1981) grows above the evergreen oak zone.

The vegetation of Yaku Island, particularly Cryptomeria japonica forests and laurel-leaved forests, is designated as a National Park and Biosphere Reserve located between the Ryukyu Islands and Kyushu. The secret characteristic nature of Yaku Island was solved to some extent by our survey in 1983 (Environment Agency 1984).

REFERENCES


