C−2.4 Studies on the Decline of Mountain Forest and Acid Deposition

Contact person Takashi Yoshitake
Chief of Meteorological Hazard
Forestry and Forest Products Research Institute
Forestry Agency - Ministry of Agriculture, Forestry and Fisheries
1 Matsuno-sato, Kukizaki-machi, Ibaraki 305, Japan
Tel:+81-298-73-3211 Fax:+81-298-74-3720

Total Budget for FY1993-FY1995 14, 364, 000 Yen(FY 1995;4, 741, 000Yen)

Abstract

In Mt. Nantai the existence of dead trees of *Betula ermanii, Abies veitchii, A. mariesii* and *Tsuga diversifolia* in the natural forest were clear. Because Mt. Nantai signs of frost damage on dead twigs of *B. ermanii* were recognized, the frost damage on tips of dead twigs in *B. ermanii* was recognized as one of causes of the death. Furthermore, damages by glaze and thunder were presented as a cause of death in *A. veitchii.* Remarkable damage of trees by deer in Mt. Nantai were found and especially *Abies homolepis* was seriously damaged in the natural forest. We collected and analyzed fog, rain and stemflow during warm seasons in 1993 and 1994. By results, existences of acid fog and acid rain at 1, 700 m above sea level at Mt. Nantai were recognized. Among the samples, a fog having pH 3. 2, SO_4 density 66 mg/l and NO_3 density 49 mg/l were found. Leaves of *B. ermanii* discolored region of the leaf margin or whole on surface of the leaf and an unusual defoliation of *B. ermanii* has been seen during the growing season, late in August, every year .

Key Words Forest Decline, Acid Fog, SO_4, NO_3, *Betula Ermanii*

Intoroduction

In Mt. Nantai the existence of dead trees of *Betula ermanii, Abies veitchii, A. mariesii* and *Tsuga diversifolia* in the natural forest were clear. Because signs of frost damage on dead twigs of *B. ermanii* were recognized, the frost damage on tips of twigs in *B. ermanii* was recognized as one of causes of the death. Moreover , in Mt. Shirane, Mt. Tarou, and Mt. Ohmanako the existence of dead trees of the evergreen coniferous forests were clear. Eepecially, in Mt. Shirane the existence of dead trees of *Betula ermanii , Abies veitchii* and *A. mariesii* in the natural forest were clear.

Investigated Location and Survey Method

Investigated locations were in the northern areas of Tochigi and Gunma

prefectures as in Fig 1. We went up to realize the conditions of declining trees, 3-4 times of field surveys every months from june to october in 1993 were made in addition to the interpretation of declining areas by the aerial photographs.

On condition of declining, locations, directions, tree species and declined shapes, presence or absence of mycelial strands of *Armillaria mellea*, and also presence or absence of frost damages were invetigated. In addition, gazaerd rain , fog, stemflow and water drops attached on wet leaves by rain or mist during the days of the survey were measured by pH meter (Advatec-Horiba CARDY), for grasping presence or absence of acid deposition. Chemical analysis of fog, rain, and stemflow were measured by ion chromatography, and atomic absorption spectrophotometry.

Result

Investigated areas were located in mountainous ranges of the southwestern direction from Happouga-Hara in Tochigi Prefecture to Mt. Akagi in Gunma Prefecture as the south end and in those areas, possibilities having deposited pollutants in the air were presumed when the polluted air on the Kanto plains was blown by the south to east winds(2). Those areas are also often covered with fog in July and August and are strongly blown up on their southeastern slopes by typhoon when the typhoon moves towards the north directed to the Sea of Japan. Places with the appearance of fog and the exposing to the southeastern wind were recognized in areas of declining trees. Declining or shot damaged trees of groups or single trees were often found as damaged condition in each area.

Mt. Shirane

Damaged areas of declining *Betula ermanii* was distributed in fairly large scale as about 60 ha reported in a newspaper. Those areas were located at north-east-southern slopes at Mt. Shirane to crest lines at Midaga-Ike, Mt. Goshiki and ridges forwarding to southeast over both prefectures (1). We recognized marks of the forest damage on twigs of dead trees at eastern slope of Mt. Shirane, at southern slopes of Mt. Goshiki and Zazen, and mycelial strands of *Armillaria mellea* at the basal part on trunks of declined trees quite often. In addition, insect damages by *Dineura vivididorsta* in autumn of 1990 and condition to 1991 were found in about 25 ha of *B. ermanii* forest surrounding Goshiki-Numa swamp where looked like healthy forest was dstributed. Dead trees of *Abies veitchii* and *Sorbus commixa* gnawed by deer's from the gate way of the mountain road over to Suge-Numa to Mt. Goshiki, Mt. Maeshirane and the refusing cabin were found.

Around Mt. Nantai

Betula ermanii were dying on the southeastern slope around the top of Mt. Nantai. Dead trees and shoot damages were found at around mountain tops of Mt. Ohmanako, Mt. Komanako and Mt. Taro located at the north side of Mt. Nantai and also along Shizu forest road running east to west on the north slope of Mt. Nantai.

At the same time, presumable wind fall site of conifers of *A.veitchii* and *Tsuga diversifolia* at Mt. Sannou-boushi and also a windfall sites at Mt. Mitake by the aerial photographs were recognized.

Cause of damages on trees around Mt. Nantai were in Table 1. Various tree species and damaged shapes were found as shown in Table 1. Table 2 is a result of an analysis in rain on Mt. Nantai in 1994. Level of mineral elements in fog were Table 3. The most highest concentration of SO_4 in fog was 66 mg/l . By spray of this fog , color of the petals on the morning glory changed. Fig 2 is a result of an analysis in stemflow in 1993. *Betula ermanii* on Mt. Nantai discolored like the Fig 3, late in August, every year.

Furthermore, damages by lightning and thunder were presented as a cause of death in *A. veitchii.* Remarkable damage of trees by deer in Mt. Nantai were found and especially *Abies homolepis* was seriously damaged in the natural forest.

References

(1)Jun-ichi HASEGAWA:Nihon no seibutu 3, 25～28, 1989
(2)Kentaro MURANO: Study on aerosol 6, 171～176, 1991

Table 1 Cause of damages on trees at mountain areas

Mt.	Sea lebel(m)	Tree species	Cause of decling
Shirane	2578	*A.veitchii*	Frost damage. Wind damage. Deer. Fungi
		B.ermanii	Frost damage . Fungi
Nantai	2484	*A.veitchii*	Frost damage. lightning thunder. Deer.
		B.ermanii	Frost damage. Fungi
		T.diversifolia	Frost damage. Fungi
		A.mariesii	Regeneration Wave
Ohmanako	2375	*A.veitchii*	Wind damage.
		B.ermanii	Wind damage.
komanako	2323	*A.veitchii*	Wind damage. Regeneration Wave
		B.ermanii	Wind damage
Taro	2367	*A.veitchii*	Wind damage. Regeneration Wave
		A.mariesii	Regeneration Wave
Keicho	1765	*T.diversifolia*	Wind damage.
		B.ermanii	Wind damage.
Akagi	1674	*B.ermanii*	Wind damage. Fungi. Girdling
		Q.crispula	Wind damage

Table 2 Element Concentrations in rain
the seventh station of Mt,Nantai (mg/l)(1994)

	June		July	
	21～29	29～8	8～15	15～22
SO_4	2.20	3.10	1.40	1.10
NO_3	1.40	1.60	1.20	1.40
CL	0.53	0.46	0.07	0.09
NH_4	0.28	0.01	0.17	0.36
Ca	6.10	6.60	3.70	8.90
Na	0.80	0.70	0.30	0.40
K	0.30	0.60	0.20	0.10

Table 3 Level of Mineral Elememts in fog of Mt,Nantai (mg/l)

	pH	SO_4	NO_3	CL	NH_4	Ca	Na	K	Mg
'93.8.19	4.2	2.63	1.18	0.98	0.24	0.74	0.4	0.19	-
'94.6.21	5.6	0.8	1.6	2.2	0.07	5.9	3.4	26.7	2.4
'94.7.15	3.3	66.0	49.0	5.6	19.4	8.6	2.8	1.1	3.0

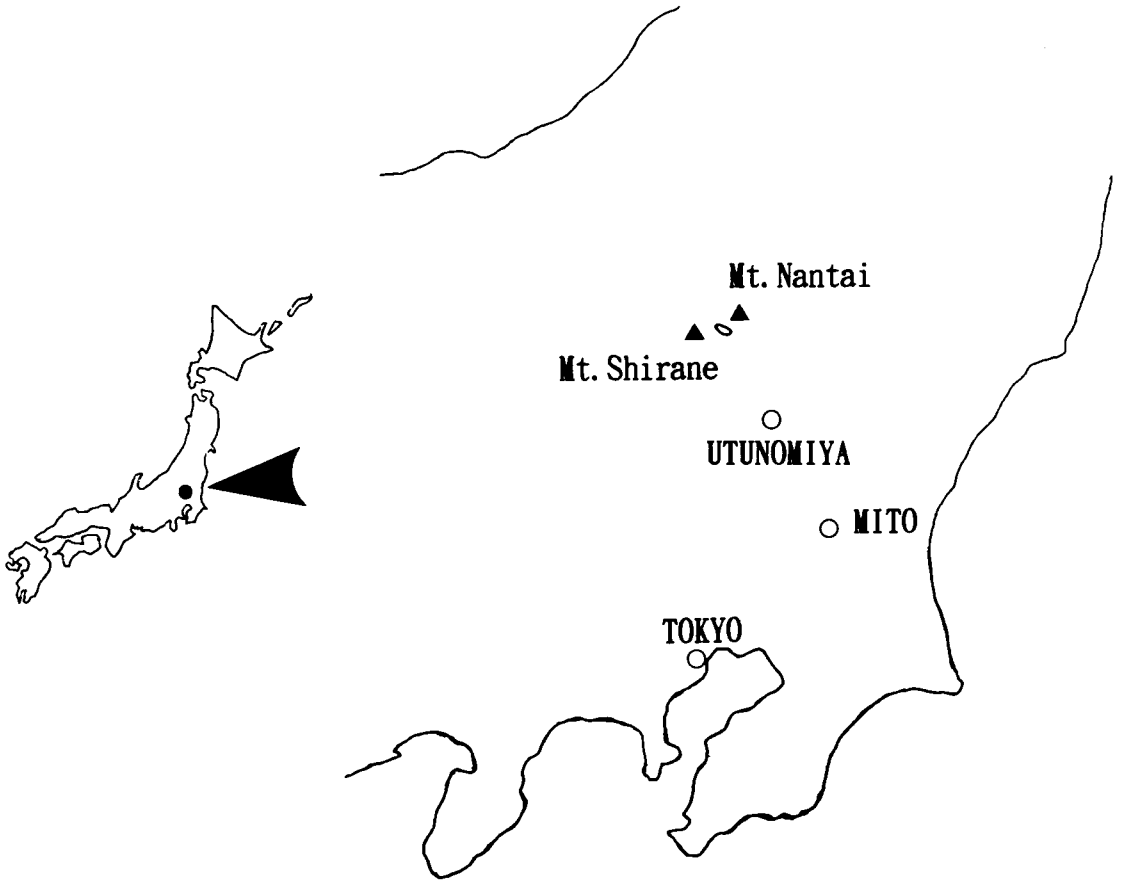

Fig 1 Location of reserch stand

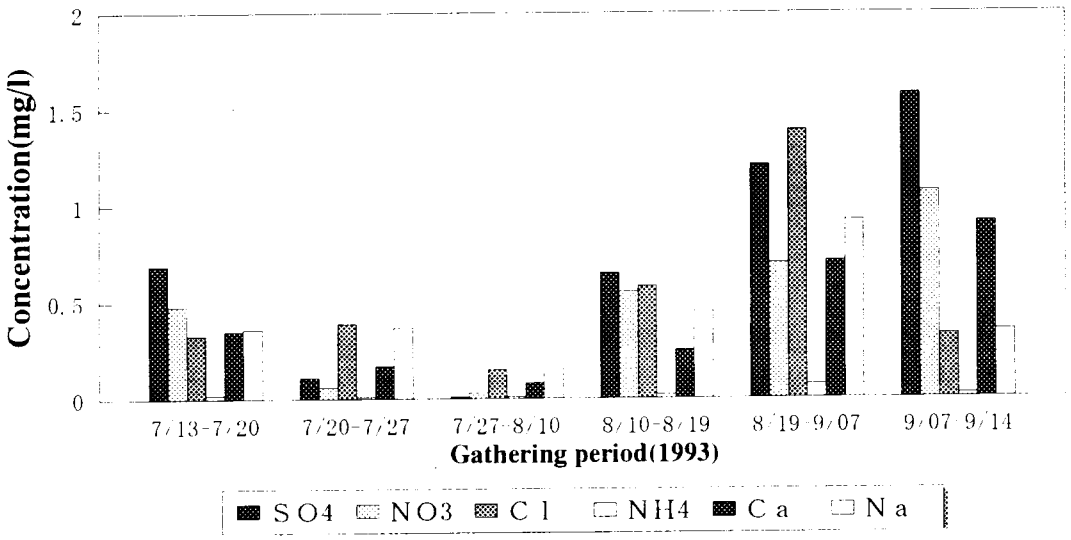

Fig 2 Element Concentration in Stem flow (Mt.Nantai)(1993)

Fig 3 Injured Leaf of *Betula ermanii*