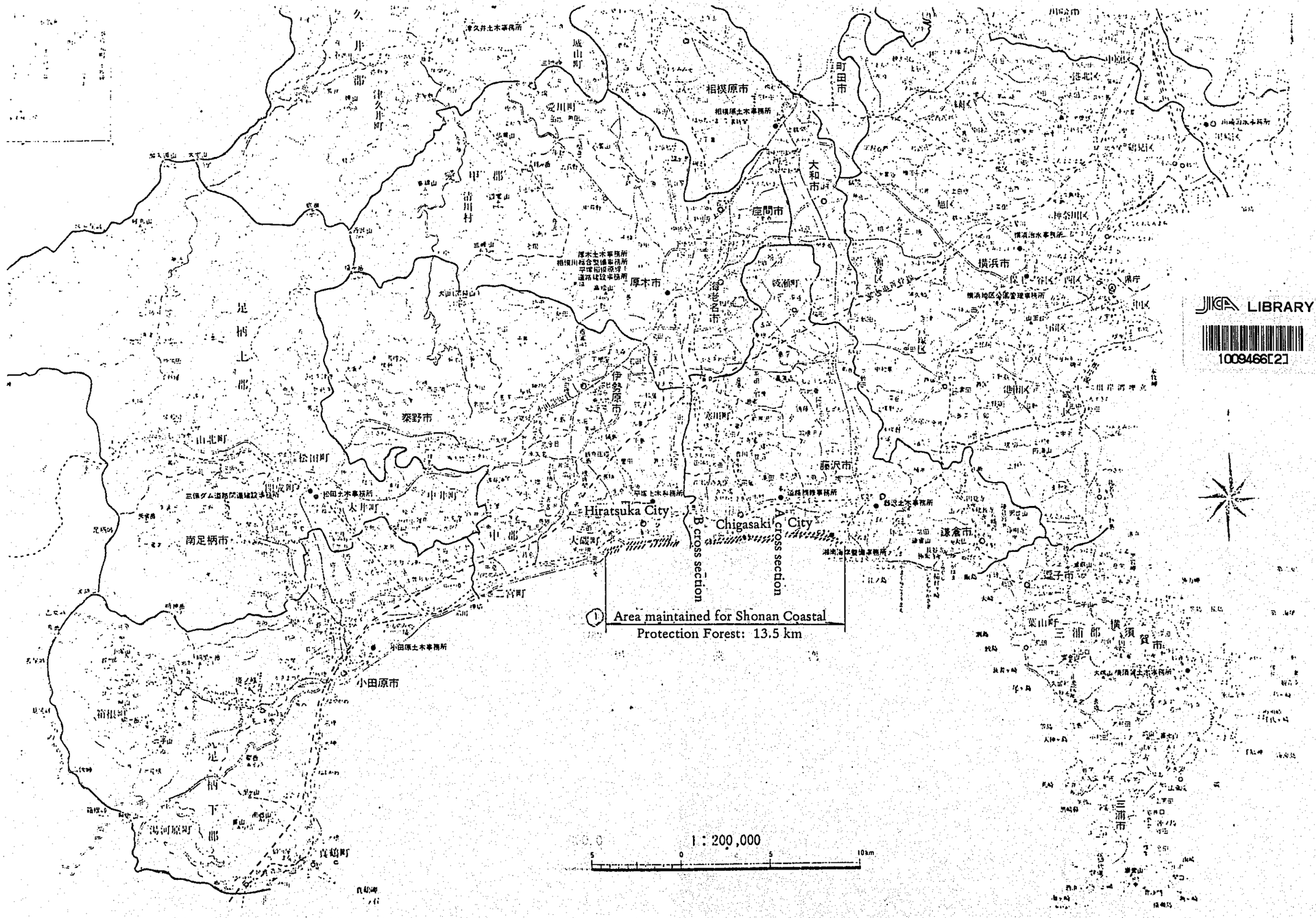
SHONAN COASTAL PROTECTION FOREST

October 1978

Kanagawa Prefecture



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History

(1) The Uotsuke Coastal Protection Forest was originally developed from 180 ha extending from Katase in Fujisawa City to Minami-hamatake in Hiratsuka City over a five year period beginning in 1930, as a coronation memorial project for the present emperor.

(2) In 1933, Japanese black pine (Pinus thunbergii) were planted along the newly constructed Shonan Promenade (the present National Highway Route 134) to prevent send drifts.

(3) Durign World War II from 1941 to 1945, maintenance and administration of protection forest was discontinued, and destructive stump-pulling for extraction of distilled turpentine oil occurred. After the war, because of shortage of fuel, the illegal cutting of the Japanese black pine did not stop and the erosion control forest which had grown was ruined as a result of disruption of ordinary life and corruption of morals leaving the efforts of twenty years in vain.

(4) The destruction of the protection forest caused the National Highway Route 134 to be buried by sand drifts, hindering traffic, and after a hasty order from Ceneral Headquarters of the Occupation forces, a government subsidy was obtained to begin replanting. In 1947, the area was also expanded to Higashi-hamatake in Oiso-cho, and efforts at restoration were made.

(5) In 1958, the ownership of the former naval maneuvers area at Tsujido in Fujisawa City was transferred from the State to the prefecture and with the changes in routing of National Highway Route 134, and over the four years from 1959 – 1962, the erosion control forest was developed for 50 m along the north side and for 70 m along the south side.

(6) With this, the Shonan Coastal Protection Forest seemed to accomplish the orginal purpose; however, great damage was inflicted by continuous typhoons from 1961 to 1966 and by abnormally arid conditions, and again a sparseness began to appear.

(7) Therefore, in order to plan radical mesures for the development of an excellent erosion control forest, the prefecture requested surveys and experiments from related authorities such as the Forest Experiment Station of the Ministry of Agriculture and Forestry, the Prefectural Forest Guidance Center, Tokyo Agriculture University and Japan University.

(8) In 1967, fundamental research and experiments were completed, determining the causes of withering and advising measures for present and future development. Improvements and extensive restoration work was alunched in 1969 and have been continued until now, with government subsidies for protective forest development and for improvements, etc., and with independent prefectural development.

(9) From 1938 – 1970, 32.8 ha of the protective forest were designated as preventing sand drifts. In 1972, 58.1 ha were designated as areas for protective artificial facilities to prevent sand drifts.

II. Area and Outline

(1) The Extent of the Protection Forest

The coastline extends from the right bank of Hikiji river at Kugenuma in Fujisawa City to near the entrance of the Seisho by-pass at Higashi-hamatake in Oiso-cho.
Length of coastline: 13.5 km.
Total length of protection forest: 11.4 km.
The width of the protection forest is 20 – 50 m along the south side and 30 – 140 m along the north side of the National Highway Route 134.

(2) Planting Conditions

Area planned: 98.3 ha
Planted area: 85.9 ha
Unplanted area: 12.4 ha

(3) Trees Planted

Japanese black pine: nearly 439,000 (1 year old to 54 years old) and broad-leaved trees (Japanese pittosporum, oobamasaki, etc.): 85,000 trees

(4) Artificial Facilities

Artificial sand dunes: 3,764 m
Construction to prevent sand drifts: 31,808 m
Wind break net (H = 1.5 – 3.5 m): 35,470 m, other

(5) Object of Protection

Extent of protection: 1 km to the north of National Highway Route 134.
Objects protected: public facilites (11 government and others); 6 schools; 7 parks and parking lots; and nearly 6000 residences.

III. Necessary Maintenance Tasks

Planting, construction of wind braks, sand accumulating work, prevention of sand drifting, prevention of damage by blight and noxious insects, construction of artificial sand dunes, etc.

IV. Measures for Maintenance and Preservation

(1) The Preservation of the Protection Forest

When the pine trees which are the main erosion control feature of the forest, conspicuously withered from 1961 to 1966, and damage became severe, surveys were requested from 1965 from related organizations such as the Forest Experiment Station of the Ministry of Agriculture and Forestry and the universities, etc., to determine the causes and the measures from diversified studies such as damage from blowing sand, sea breeze damages, damages by harmful insects (pine bark beetle). The protection and development of the forest was planned under this guidance and in 1969 extensive improvement and restoration work was launched, through government subidy and independently by the prefecture. At present, an expanded green protection forest has been largely developed. Studies and experiments included thinning, soil dressing, sand grass planting, mixed planting, windbreak net, fertilization, ground stream, damages by harmful insects. The results are shown in the following report.

(2) Durability of Erosion Control Facilities

A distinctive feature of the Shonan Coastal Protection Forest is that its distance from the shoreline is 15 – 70 m. Therefore damage such as from drifting sand, sea breezes, etc., and from typhoons is easily inflicted. Consequently, for the protection of the protection forest, a shelter fence (bamboo fence) to prevent drifting sand is used in addition to a wind break net to counteract the sea breezes were constructed. However, these are not permanent constructions, and their durability is for only as little as five years, causing expenses for maintenance and preservation to mount up. This reality is a concern.

(3) Pollution Countermeasures

Shonan Coast is within the metropolitan area, and as it is close to the big cities such as Tokyo and Yokohama, the area beyond has developed rapidly, with a large number of sightseers from a wide area, as well as from the local area. As a result, fires in the erosion control forest occur on an average of four times per year because of garbage and cigarettes thrown out by thoughtless people. As counter measures to these problems, appeals to "Stop Illegal Abandonment of Garbage," "Prevent fire." "Spirit of Love for the Forest" are made in an effort to conserve the natural environment.

V. Natural Conditions of the Shonan Coastline

(1) Temperature

In general, the average winter temperature is 3.6 – 7.5°C, with the lowest recorded temperature during the day of -1.5°C; the average summer temperature is 26°C; therefore, it may be said that the temperature is excellent for growth of plants. However, the temperature on the bare land reaches 40°C, resulting in severe conditions.

(2) Precipitation

The average precipitation per year is 1,051 mm, giving servere conditions for plant growth.

Previous Five Year Monthly Average Precipitation

Unit: mm

Month	1	2	3	4	5	6	7	8	9	10	11	12	Total
Precipitation	23.2	44.8	57.7	84.9	93.1	122.2	139.6	74.3	154.0	124.7	107.5	25.1	1,051.1

(3) Wind Direction

From September to April, the wind comes most frequently from the North, and from May to August from the South (the side of the ocean), with a prevailingly northerly wind throughout the year. However, the are a conspicuous number of trees in the planted forest which are bent towards the Northeast, clearly indicating the intensity of the Southwest monsoons. Although not so frequent, the strong

Southwest winds from January to May greatly influence the movement of sand and growth of trees.
Refer to the attached diagrams on page

(4) Wind Velocity

The wind velocity is highest from March to August, and next highest from September to November. Yearly average velocity is from April to August, and as April is the time of new buds, the wind's influence on the vegetation is great.
Refer to the attached diagram on page

(5) Typhoons

For the 87 years from 1892 to 1977, there were 142 typhoons which are presumed to have affected the Shonan district. Sixty-three of these typhoons hit the western side of this area, and strong winds from the ocean are received directly. Because the Protection forest is on the spearhead position, estimates of actual danger from typhoons may not be made lightly.

(6) Drought

It might be thought that the affect of drought during winter in the Shonan district is large, but damage from drought is greater. A survey of the 81 years from 1898 to 1977 showed that summer rainful (April to September) of less than 900 mm occurred 26 times and aspecially severe summers with less than 700 mm precipitation occurred 8 times.

(7) Ground Water

As a result of carrying out measures concerning the ground water table, boring to the T.P + 6.25 m point confirmed a depth of 4.0 m from the ground surface, but it may be said that apparently the ground water table ranges from 3 to 5 m underground.

(8) The Grade of Sand and Drifiting Sand

The grade of sand at Shonan Coast is about 0 – 2.0 mm, and as 81 – 95 %is of an especially fine grade of 0.5 – 0.25 mm, the amount of sand drifting is great.
Refer to attached diagram on page

The drifting of the sand in the coastal area is influenced by the seasonal wind (the direction and velocity of the wind) and by the amount of rainfall; the blowing of the sand influences the degree of death or damage to the plants. The sand is blown at speeds of more than 5 m/sec. Sand is raised, pieces of paper are stirred up and branches are swung at speeds of 5.5 – 7.9 m/sec.

VI. Studies for the Preservation of the Shonan Coastal Protection Forest

(Carried out in fiscal years 1965 – 1973)

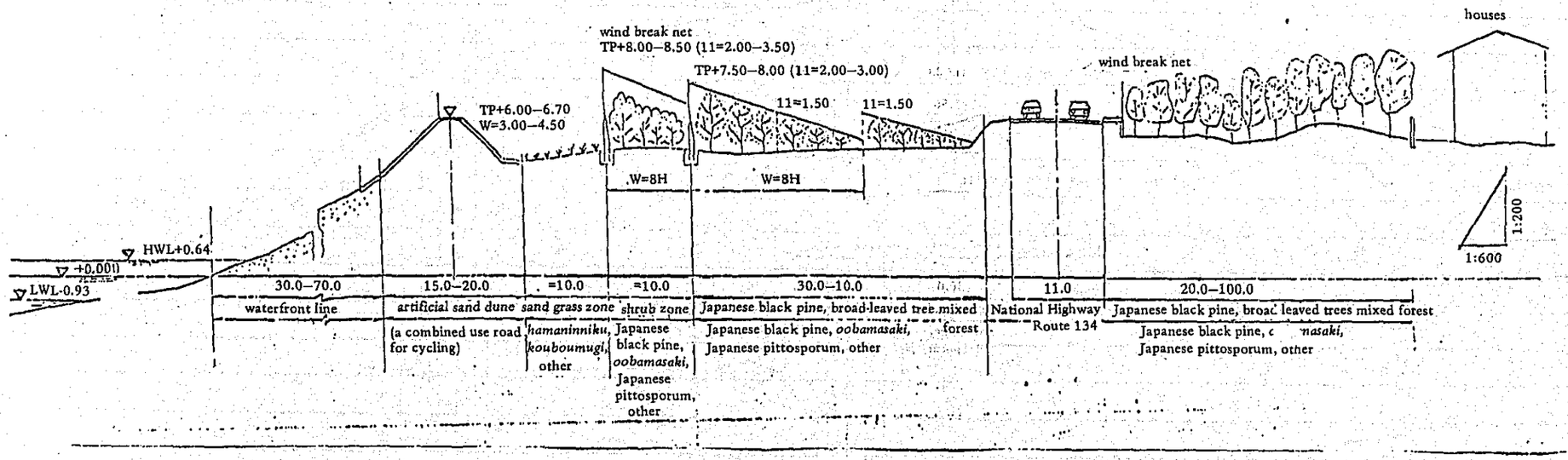
Item surveyed	Types of study	Contents of study
Study on the tending of the Japanese black pine forest	Thinning study	Final tree height: 4 – 5 m Number of trees included: 10,000 trees/ha Target density was 3,000 – 4,000 trees/ha, to be thinned three times every two years.
Study regarding withering and damage to the Japanese black pine root system	Soil dressing study	Carried out by observing 4 blocks of sand area and soil dressing area to a depth of 120 cm
Study of the introduction of plants to prevent sand drifting	*Sand grass planting study*	*Determined which sand grasses are suitable to divide the sand area from* the soil dressing area, and the extent of spreading, including method of introduction and maintenance planned for the water side of the artificial sand dunes
Effects of fertilization on the method of introduction and selection of suitable species	Mixed planting study	At five meter intervals (both length and breadth), a one meter wide strip was turned over, *Meranokishiron* (Myrica acacia) planted and fertilized properly
Study on the effects of the wind break net as a countermeasures to the ocean breezes	Wind break net study	Measurements of salinity in the air and on the surface of the sand area were taken according to a horizontal distribution to clarify the effectiveness of countering the ocean breezes
Study on the effectiveness of fertilizing to promote protection forest	Fertilization study	Scatter fertilization using 200 gper m^2 of solid pearl fertilizer No. 2 was carried out.
Ground water study at the Yanagi-shima area	Ground water study	The study of the ground water table, including current direction and speed and analysis of ground water for its permeability coefficient, etc., was carried out to determine its influence on the trees.
Study concerning the Japanese black pine core-eating insect	Insect damage study	A dead tree was cut and the bark peeled to study the type, density of paratism, growth condition, amount of area infested, discoloration condition under the bark and existing in the stump.
Artificial sand dune study	Artificial sand dune test	Using hydromechanics, high walls were made at the line fronting the forest zone for the purpose of decreasing the intensity of the sea breezes and damage from blowing sand. The artificial sand dunes were 30 m long, 2 m in height, 3 m wide at the top. Studies were made of the resulting protected areas.

Results of study	Contents of plan to be implemented	Researching organization
Withering of lower branches decreased, strength of tree good, with power to resist various types of damage. Excellent results obtained	Number of times and amount for thinning First time: 30% Second time: 30% Period: once between 3 to 4 years Ages of trees: 10 – 20 years old	Ministry of Agriculture and Forestry Forest Experiment Station
The growth in the soil dressing area is better than in the sand area, with the greatest difference in growth occurring at 30 – 40 cm in depth, with differences at greater depths small.	To carry out partial and whole soil dressing to a depth of about 0.3 m	Same as above
The differences of growing conditions between the sand area and the soil dressing area mark the sand grass *hamaninniku* as the best, with *gyogishiba* following. Kouboumugi spreads nearly two years after planting.	Partial soil dressing method. Suitable transplanting time for *kouboumugi* and *gyogishiba* is early spring, and for *hamaninniku*, between November and December.	Same as above
Comparatively excellent results were obtained; however, at the beginning, as these plants would easily engulf the Japanese black pine, thinning was necessary	Adapting the actual results, a Japanese black pine mixed planting forest may be cultivated with plants such as Japanese pittosporum (*masaki*).	Same as above
Wind velocity and salinity of the air at levels lower than the full height of the net were markedly decreased, schowing great effect.	The effect is sufficiently large to encourage aggressive adaptation from the present and in the future to protect and promote the growth of the protection forest.	Same as above
Little effect was seen after measuring the results of fertilization	It is desired to judge only after further experiments	Same as above
The greatest influence on changes of ground water was shown by the development of the surroundings	It is necessary to study any reciprocity between the ground water table in the flooding area studied and the height of the Sagami river water level.	Tokyo Agriculture University
This was not a large problem, as the insects are not the cause of withering or direct damage; however, because the strength of the tree is weakened, an important influence is shown. Therefore it is necessary to know the formation of the larvae and to study the precise time the adult insect will appear, using effective preventative insect repellent. It is also necessary to be aware of any appearance of sudden, abnormal withering or discoloration of the pine.	As a preventative insect repellent, *Sumichion* emulsion diluted 500 – 700 times is to be applied at the stage when the adult insect develops its wings	Prefectural Forestry Experiment Station
Japanese black pine located behind the sand dune received partial effects of the sea breezes and blowing sand, and compared to the trees outside the test area, were quite protected, showing clear effectiveness.	The sand dunes are to be installed at locations not greatly affected by high seas. Vegetation cover is used for the surface of the sand dunes. In the future, the use of a concrete surface on the sand dunes would prevent erosion by pounding waves.	Ministry of Agriculture and Forestry Forestry Experiment Station

Diagram of a Typical Cross Section of the Shonan Coastal Protection Forest Plan

Reduced scale height 1/200
breadth 1/600

A–A Section



Cross-section of Soil Diagram (Estimated)

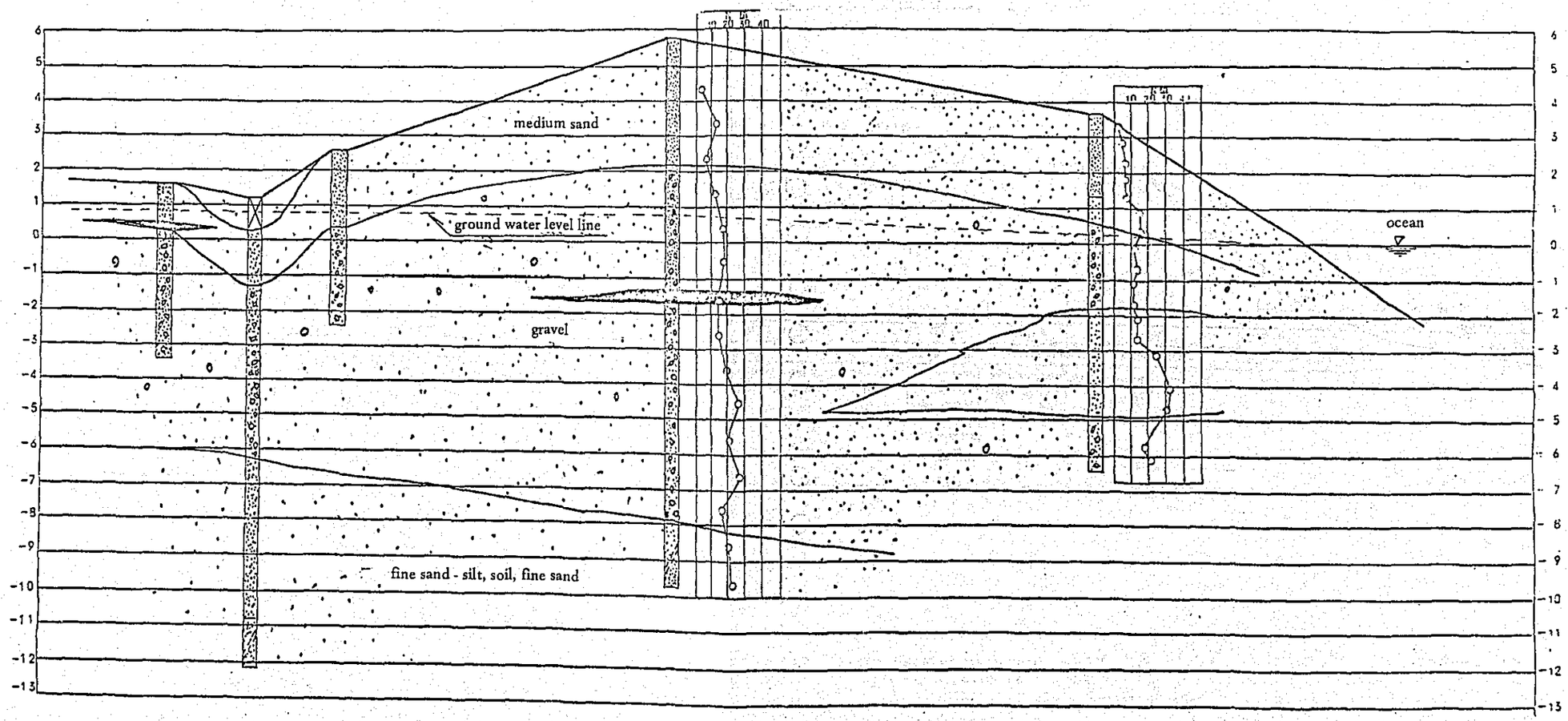
s = height 1 : 100 , breadth 1 : 500

Chigasaki City Yanagishima City District

B-B Section

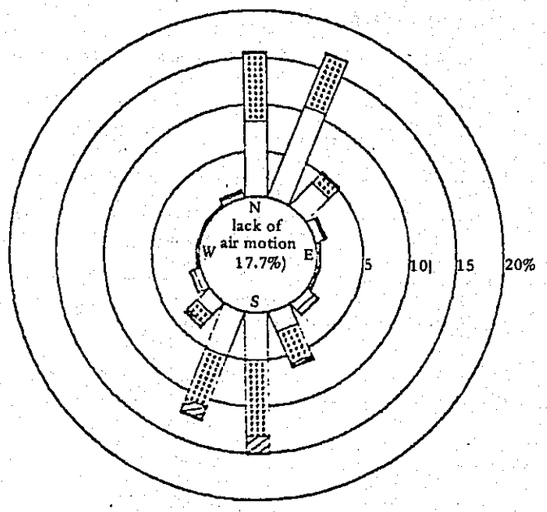
Machanical Composition of Soil Sample in Coastal Region

Sample No.	Gravel (< 2mm) %	Fine Soil (< 2mm) % Coarse Sand (2–0.25mm)	Fine Sand (0.25–0.05mm)	Very Fine Sand (0.05–0.01mm)	Clay < 0.001mm	Colloid Clay < 0.002mm	Particle size of 0.5–0.25mm in Coarse Sand %
1-1	0.2	48.0	35.1	1.7	15.2	13.9	92.4
2	0.3	66.1	13.0	1.1	19.8	19.0	81.3
3	0.1	32.2	46.7	1.7	9.4	17.4	88.4
4	0.0	58.5	34.2	0.2	7.1	7.0	92.1
5	0.0	43.1	52.0	0.1	4.8	4.6	95.1



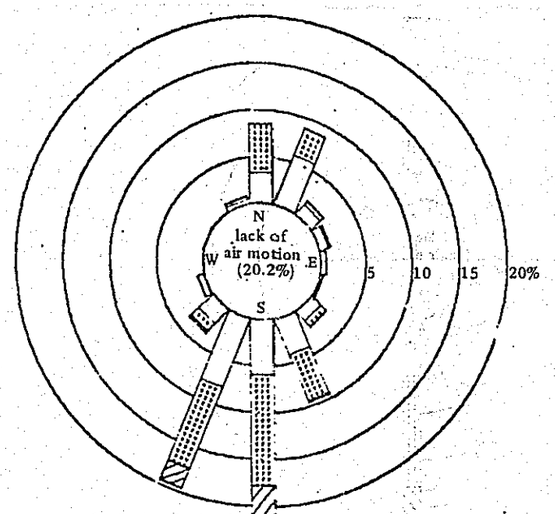
Diagrams Showing Direction of Wind According to Wind Velocity

Yearly wind direction diagram



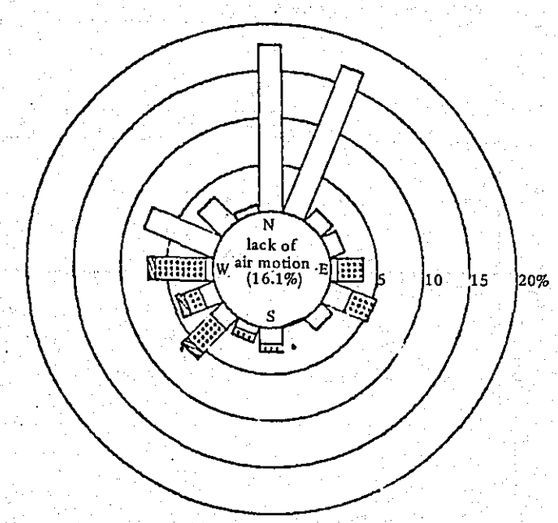
Winds from the N - NNE and 5 occur frequently, with other directional winds occurring less often

Summer (June – August) wind direction diagram



Northerly winds are decreased and southeerly winds very frequent. Easterly and northwesterly winds occur infrequently.

Winter (December to February) wind direction diagram



Weak winds of under 5 m/s are most frequently from the North. Those over 5 m/s are frequently from the East and Southwest.

Wind velocity
(M/SEC)

0.3 – 5.0

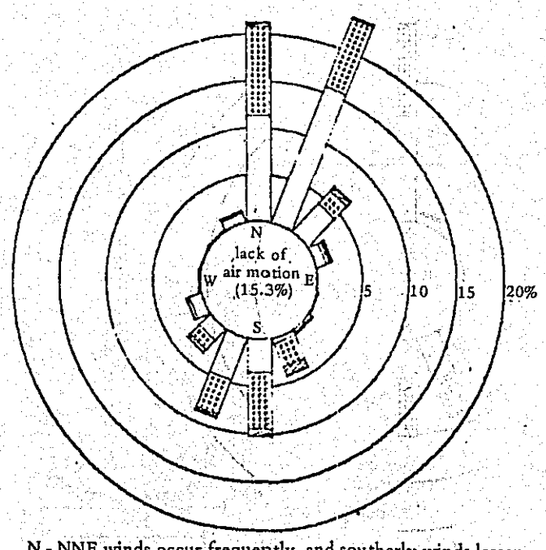
5.0 – 10.0

10.0 – 15.0

15.0 – 20.0

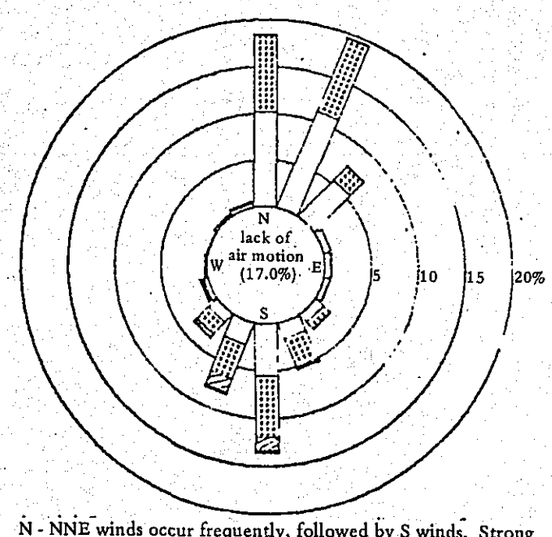
G.E. 20.0

Autumn (September – November) wind direction diagram



N - NNE winds occur frequently, and southerly winds lessen. Winds of more than 15 m/s occur from the North and South, showing southerly low pressure & typhoons. With the occurrence of low pressure, strong winds occur from the North as well.

Spring (March – May) wind direction diagram

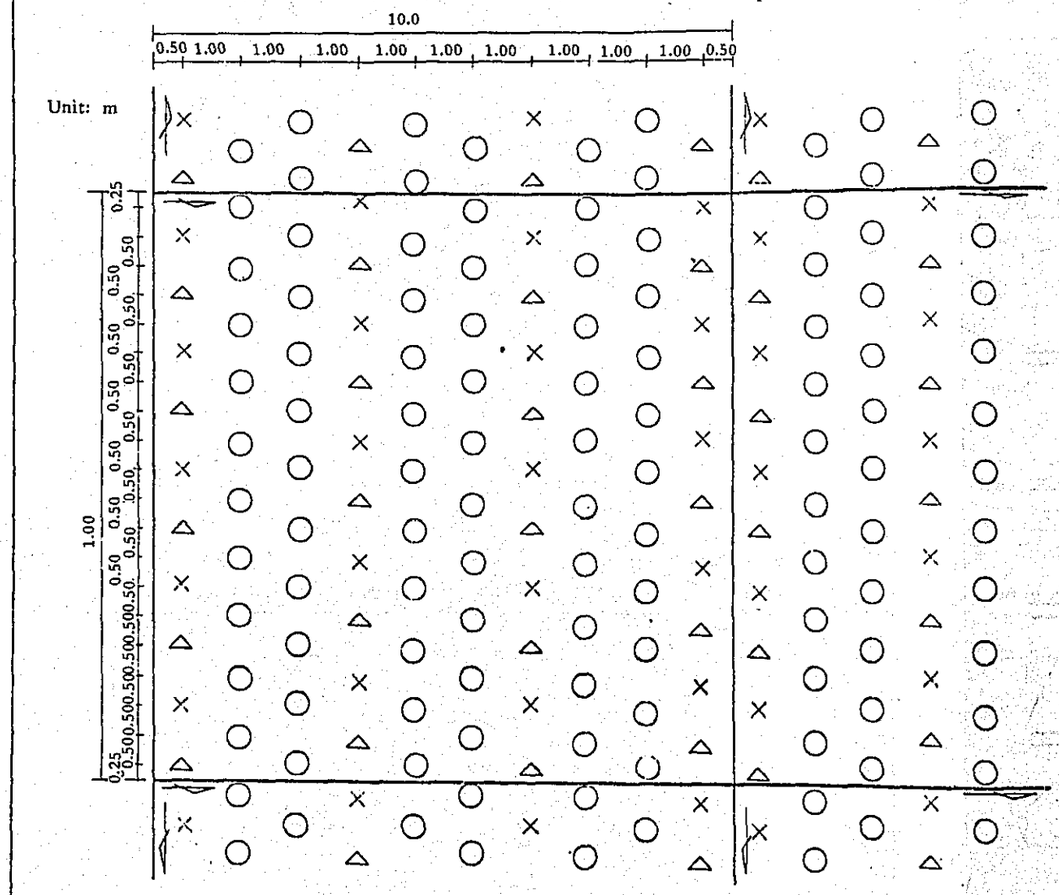


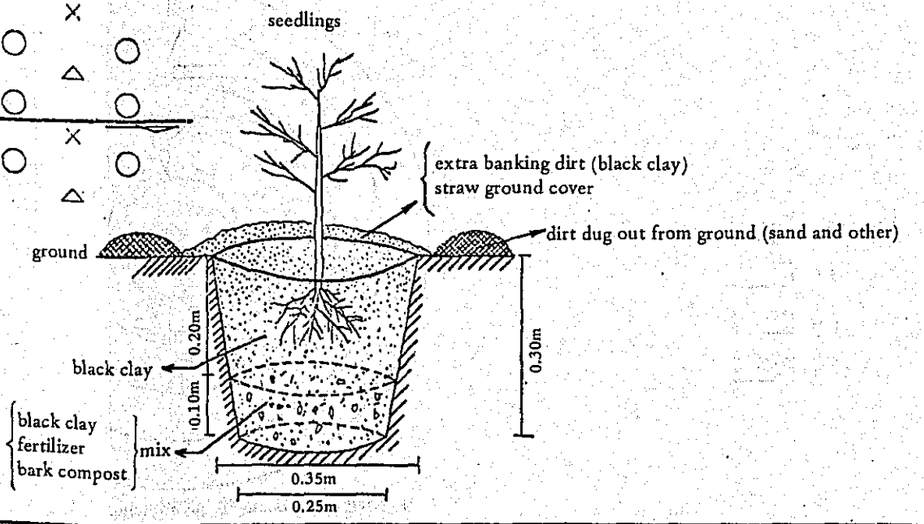
N - NNE winds occur frequently, followed by S winds. Strong winds of more than 15 m/s are frequently from the S - SW.

Chart of Standard Planting Procedures for Japanese Black

Reduced scale 1/100

per 100 m²





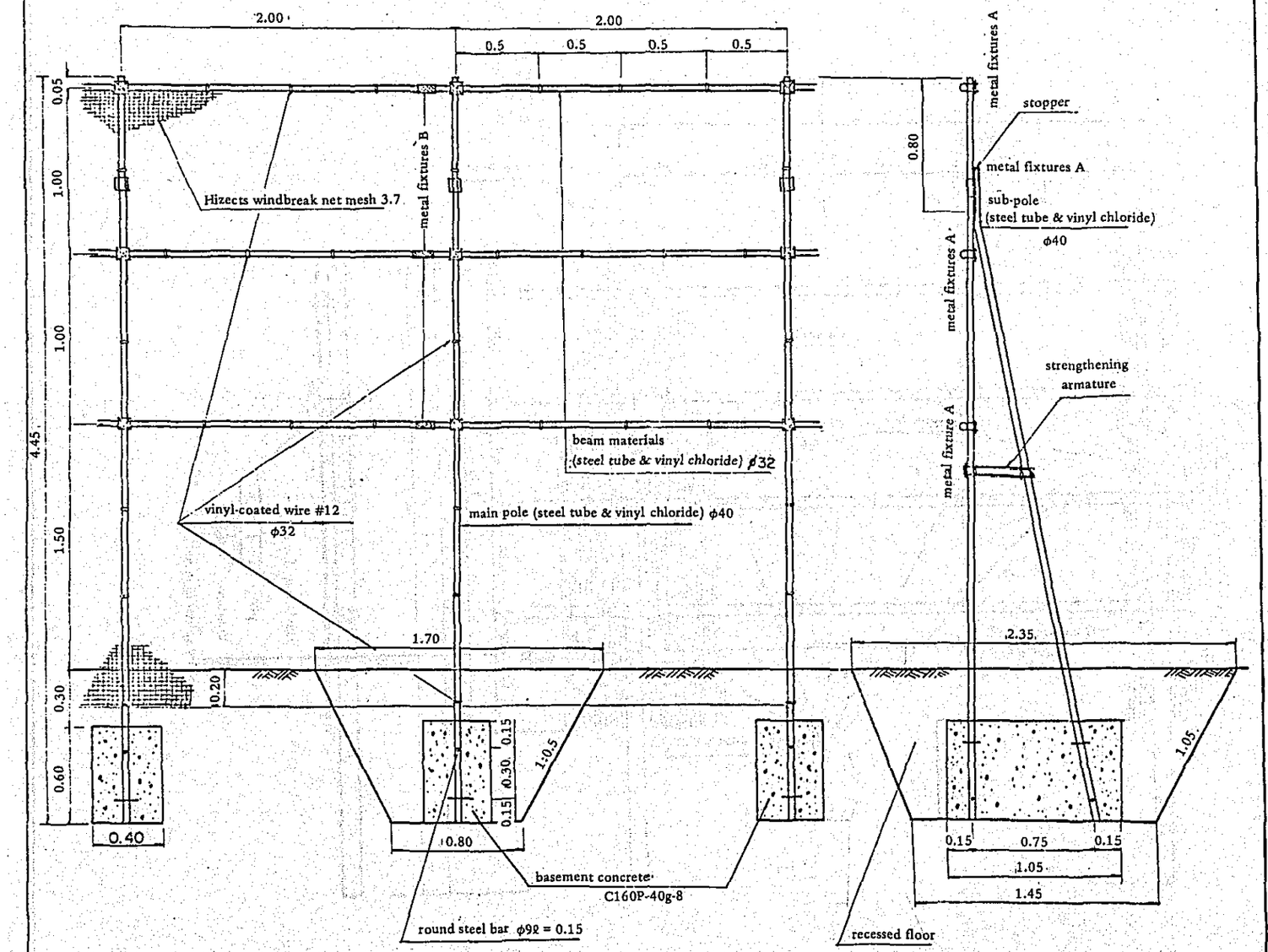
Material Calculation Table

Name	Shape/size	Calculation formula	Total amount
Japanese black pine	3 years old H=more than 4.5mm		60 trees
Japanese pittasporum	H=30cm		20 trees
Oobamasaki	H=60cm		20 trees
Chikaratsubu #1	N-P-K 6-4-3	For use with Japanese black pine 150 g/tree	9.0 kg
Chikaratsubu #3	N-P-K 3-6-4	for use with Japanese pittasporum, *oobamasaki* 150 g/tree	6.0 kg
Superphosphate		20 g/tree	2.0 kg
Bark compost		1 kg/tree	100 kg
Rice plant straw	for ground cover	200 g/tree	20 kg
Black clay	for soil dressing	0.027 m³/tree	2.7 m³

Windbreak Net | Reduce scale 1/30

Unit: m

per 10.0 m



Name Protection Fence	H = 1. 5 M	Reduced scale	1/20			

unit

per 10.0 m