

Woody Plant Flora of the Senbon-matsubara Coastal Forest in Numazu City, Central Japan

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Abstract The woody plant flora of the Senbon-matsubara coastal forest in Numazu City, Central Japan, is compiled based on the herbarium specimens collected since 1990. The taxa recorded in this flora are 131 species belonging to 53 families, which include arborescent trees, small shrubs, woody vines and bamboos in both native and cultivated conditions. Each taxon is followed by short comments on the distinction either native or cultivated and the density of trees. Floristic characteristics of this coastal forest was analysed by the comparison between the native woody flora of this coastal forest and that of Mt. Ashitaka. The species number mentioned above is one third of that of Mt. Ashitaka. Luxuriant growth of the maritime woody plants, such as *Pittosporum tobira*, *Daphniphyllum teijsmannii*, *Rhus succedanea*, *Ilex integra*, *Ilex rotunda*, *Cinnamomum japonicum*, *Vaccinium bracteatum* etc. is recognized and these species show that the Senbon-matsubara coastal forest has common species composition with the coastal forests of the central Honshu.

Key words: flora, woody plants, coastal forest, Japanese black pine, conservation.

Vascular plant floras of the distinguished areas, such as Mt. Fuji (Umemura, 1923), have usually been investigated based on the longterm field works in Japan. Generally speaking, these floras are composed of an integrated floral records from the past to the date of manuscript, during several decades, and seems to show the sum of changing flora in the area. On the other hand, floras may be compiled to make clear the up-to-date phase based on the intensive field works for a short time. Floral records in the latter case may offer useful clue to the conservation of native species where vegetations and the other environmental conditions are rapidly changing. The rapid changes of forest vegetations accompanied by the floral change have been observed in the south western part of Japan (Konta, 1997), in which drastic decline of the Japanese red pine, *Pinus densiflora*, and luxuriation of broad-leaved evergreen trees after the decline of the pines occurred.

The rapid change of the forest vegetations was also observed in the coastal forest mainly composed of Japanese black pine, *Pinus thunbergii*, at Senbon-matsubara in Numazu City in Central Japan (Fig. 1). This pine forest extends over about 10 km from the east to west as a belt along the Suruga Bay, and has the area of 90 ha. The pine trees have been repeatedly planted over 400 years. Dense plantation of the pine,

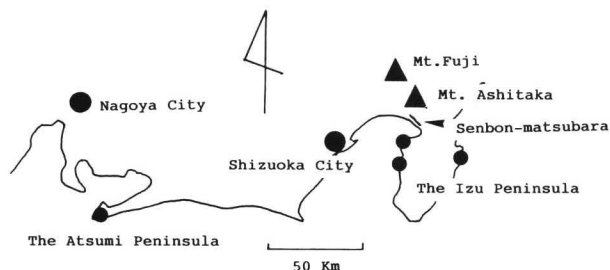


Fig. 1. Map showing the Senbon-matsubara, Mt. Ashitaka and coastal forests (●) in the Izu and the Atsumi Peninsula.

strong sea wind resulting drought of the forest soil and continuous human life to get firewood have maintained the pure pine forest with some maritime plants until 1950s. Environmental condition of the pure pine forest had entirely changed by the construction of high tide water control bank and the close of the firewood cutting after 1950s. It was suggested recently that old pine trees in this forest might be declining and the structure of this forest might change to broad-leaved evergreen one by invasion of many evergreen and deciduous trees, as well as expanding of plantation of both evergreen and deciduous trees (Konta *et al.*, 1996). I had interest in the woody flora of this coastal forest, because 1) it could be supposed that the present-day woody species invading into the pure stands of Japanese black pine trees might show fundamental woody floristic elements of natural coastal forests in the Pacific Ocean side of central Honshu, 2) it is useful to study woody flora of this changing pine forest for the plan of management of this coastal forest. Having these two interests in mind, I started field work in 1990. I have collected herbarium specimens of woody plants and investigated the growing condition which is either native or cultivated and density of each species. Woody plants collected were arborescent trees, small trees, shrubs, woody vines, and bamboos of both native and planted.

Enumeration of Species

The arrangement of families is according to Melchior (1964). Each species is followed by specimen number of F. Konta, distinction either native or cultivated, growing conditions including standing frequency and ages, distribution in the pine forest etc. I judged cultivated species or tree based on the sign of transplanting and the suggestion by Mr. Shizuo Iida, an officer of Shizuoka prefectural government, who has been engaged in the management of this forest for long time. Cultivated species is shown as cult. after specimen number. Specimens collected are preserved in the herbarium of National Science Museum, Tokyo (TNS). Abundance is shown by three grades: rare, frequent, and common.

Cycadaceae

Cycas revoluta Thunb., 17465, cult., rare, young.

Ginkgoaceae

Ginkgo biloba L., 18109, cult., rare.

Pinaceae

Abies firma Siebold et Zucc., 18111, cult., rare, several young trees only.

Cedrus deodara Loud., 17445, cult., rare.

Pinus densiflora Siebold et Zucc., 17440, cult., rare.

Pinus thunbergii Parl., 17413, 18073, 18142, cult. and native, common.

Cupressaceae

Juniperus chinensis L., 18080, cult., rare.

Podocarpaceae

Podocarpus macrophyllus (Thunb.) D. Don, 18050, cult. and native, common.

Myricaceae

Myrica rubra Siebold et Zucc., 17470, cult., rare.

Juglandaceae

Juglans mandshurica Maxim. var. *sachalinensis* (Miyabe et Kudo) Kitam., 18005, rare.

Betulaceae

Alnus sieboldiana Matsumura, 17411, 18074, 18022, common in west part of forest.

Fagaceae

Castanea crenata Siebold et Zucc., 18093, frequent.

Castanopsis sieboldii (Makino) Hatusima ex Yamazaki et Mashiba, 17466, 18116, 18138, 18160, frequent.

Lithocarpus edulis (Makino) Nakai, 17458, 18079, cult., common.

Quercus acuta Thunb., 18061, rare.

Quercus acutissima Carr., 17409, common in west part of forest.

Quercus glauca Thunb. ex Murray, 17447, 17414, 18020, cult. and native, common.

Quercus phillyraeoides A. Gray, 17438, cult. and native (not collected), common.

Quercus serrata Thunb. ex Murray, 17405, 18026, common.

Ulmaceae

Aphananthe aspera (Thunb.) Planch., 18099, 18033, common.

Celtis sinensis Pers var. *japonica* (Planch.) Nakai, 17446, common.

Zelkova serrata (Thunb.) Makino, 18145, common.

Moraceae

Ficus ereca Thunb., 17462, 18027, 18016, common.

Morus australis Pair., 17461, frequent.

Magnoliaceae

Magnolia grandiflora L., 18106, cult., rare.

Schizandraceae

Kadzura japonica (Thunb.) Dunal, 18013, 18055, common.

Illiciaceae

Illicium anisatum L., 18019, rare.

Lauraceae

Cinnamomum camphora (L.) Presl, 17475, 18042, cult. and native, common.

Cinnamomum japonicum Siebold ex Nakai, 18010, 18038, cult. and native, common.

Litsea coreana Lev., 18014, 18068, common.

Machilus thunbergii Seek. et Zucc., 17457, 18075, rare.

Neolitsea sericea (Bl.) Koidz, 17474, common.

Berberidaceae

Mahonia japonica (Thunb.) DC., 18113, rare.

Nandina domestica Thunb., 18125, rare.

Lardizabalaceae

Akebia quinata (Thunb.) Decne., 17418, common.

Akebia trifoliata (Thunb.) Koidz., 17437, common.

Theaceae

Camellia japonica L., 17427 cult. and native (not collected), common.

Camellia sasanqua Thunb., 17563, cult., common.

Camellia sinensis (L.) O. Ktze., 17426, rare.

Eurya emarginata (Thunb.) Makino, 17434, cult., frequent.

Eurya japonica Thunb., 17430, common.

Ternstroemia gymnanthera (Wight et Arn.) Beddome, 18086, cult. and native (not collected), frequent.

Saxifragaceae

Deutzia crenata Siebold et Zucc., 18071, common.

Hydranga macrophylla (Thunb. & Murray). f. *macrophylla* 18017, 18045, cult., frequent.

Pittosporaceae

Pittosporum tobira (Thunb. ex Murray) Aiton, 18004, 17433, 18043, cult., and native, common.

Rosaceae

Eryobotrya japonica (Thunb.) Lindl., 17467, cult., rare.

Pourthiaea villosa (Thunb.) Decne. var. *laevis* (Thunb.) Stapf., 17471, 18065, frequent.

Prunus jamasakura Sieb. ex Koidzumi, 17443, frequent.

Prunus lannesiana (Carr.) Wilson cv., 17442, frequent.

Prunus mume (Sieb.) Sieb. et Zucc., 17444, cult., frequent.

Prunus speciosa (Koidz.) Nakai, 17403, frequent.

Prunus × *yedoensis* Matsumura, 17410, 17436, cult., common.

Rhaphiolepis indica (L.) Lindl. ex Ker var. *umbellata* (Thunb. ex Murray) Ohashi, 17450, cult. and native (not collected), frequent.

Rosa multiflora Thunb., 18070, common.

Rosa wichuraiana Crepin, 18034, common.

Rubus hirsutus Thunb., 17420, common.

Rubus palmatus Thunb., 18130, 18136, frequent in west part of forest.

Rubus parvifolius L., 18032, common.

Rubus trifidus Thunb., 17400, common.

Leguminosae

Albizia julibrissin Durazz., 18098, frequent.

Indigofera pseudotinctoria Matsumura, 18035, common.

Pueraria lobata (Willd.) Ohwi, 18002, common in west.

Robinia pseudoacacia L., 17412, 18088, 18036 cult., common.

Wisteria floribunda (Willd.) DC., 18089, frequent.

Euphorbiaceae

Mallotus japonicus (Thunb.) Muell. Arg., 18001, 18030, 18047, common.

Daphniphyllum teijsmannii Zoll. ex Kurz, 17468, 18053, 18148 cult. and native, common.

Rutaceae

Citrus natsudaoidai Hayata, 18014, cult., rare.

Zanthoxylum piperitum DC., 18133, frequent.

Simaroubaceae

Ailanthus altissima Swingle, 18087, cult., rare.

Meliaceae

Melia azedarach L., 18060, cult., rare.

Coriariaceae

Coriaria japonica A. Gray, 18095, rare, only in west part of forest.

Anacardiaceae

Rhus javanica L.var. *roxburghii* (DC) Rehder et Wits., 18006, 18041, common.

Rhus succedanea L., 17432, cult. (not collected) and native, common.

Aceraceae

Acer palmatum Thunb., 17472, 18084, cult., rare.

Aguifoliaceae

Ilex crenata Thunb., 18108, cult. and native (not collected), rare.

Ilex integra Thunb., 17429, 18078, 18158, cult. and native, common.

Ilex rotunda Thunb., 17454, 18040, 18009, cult. and native, common.

Celastraceae

Celastrus orbiculatus Thunb., 18091, common.

Euonymus japonicus Thunb., 17456, cult. (not collected) and native, common.

Euonymus sieboldianus BL., 18064, common.

Staphyleaceae

Euscaphis japonica (Thunb.) Kanitz, 18097, rare.

Vitaceae

Parthenocissus tricuspidata (Sieb. et Zucc.) Planch., 18091, 17476, common.

Vitis thunbergii Siebold et Zucc, 18015, 18067, frequent.

Malvaceae

Hibiscus syriacus L., 18015, cult., rare.

Sterculiaceae

Firmiana simplex (L.) W. F. Wight, 18037, 18007, cult., rare.

Elaeagnaceae

Elaeagnus macrophylla Thunb., 18132, frequent.

Elaeagnus pungens Thunb., 17453, 18096, common.

Elaeagnus umbellata Thunb., 17404, 18028, 18090, common.

Flacourtiaceae

Idesia polycarpa Maxim., 18056, rare.

Cornaceae

Aucuba japonica Thunb., 17448, common.

Cornus macrophylla Wallich, 18146 cult., rare.

Araliaceae

Aralia elata (Miq.) Seeman, 18031, frequent.

Dendropanax trifidus (Thunb.) Makino, 18114, frequent.

Fatsia japonica (Thunb.) Decne. et Planch., 17408, common.

Hedera rhombea (Miq.) Bean, 17423, common.

Kalopanax pictus (Thunb.) Nakai, 17460, frequent.

Ericaceae

Rhododendron indicum (L.) Sweet, 18150, cult., frequent.

Rhododendron oomurasaki Makino, 17473, cult., frequent.

Vaccinium bracteatum Thunb., 18011, common.

Myrsinaceae

Ardisia crenata Sims., 18025, 17455, common.

Ardisia japonica (Thunb.) Blume, 17459, common.

Ebenaceae

Diospyros kaki Thunb., 17407, 18062, cult., rare.

Oleaceae

Forsythia viridissima Lindl., 18082, cult., frequent.

Ligustrum japonicum Thunb. f. *pubescens* (Kaidz.) Murata, 18048, rare.

Ligustrum lucidum Ait., 17407, 18018, cult., rare.

Ligustrum obtusifolium Siebold et Zucc., 18096, frequent.

Ligustrum ovalifolium Hassk., 18052, 18029, common.

Osmanthus fragrans Lour. var. *amantiacus* Makino, 18107, cult., frequent.

Osmanthus heterophyllus (G. Don) P.S. Green, 18131, rare.

Apocynaceae

Gardenia jasminoides Ellis, 18121, cult. (not collected) and native, rare.

Nerium indicum Mill., 18022, 18076, 18021 cult., common.

Trachelospermum asiaticum (Sieb. et Zucc.) Nakai, 18118, common.

Rubiaceae

Gardenia jasminoides Ellis, 18121, cult. (not collected) and native, rare.

Damnacanthus indicus Garetn, f., 18118, frequent.

Verbenaceae

Callicarpa japonica Thunb., 18049, rare.

Clerodendron trichotomum Thunb., 18063, common.

Solanaceae

Lycium chinense Mieler, 17417, cult., rare.

Scrophulariaceae

Paulownia tomentosa (Thunb.) Steud., 18024, rare.

Caprifoliaceae

Abelia × *grandiflora* (Andre) Rehder, 18012, cult., common.

Lonicera japonica Thunb., 18057, frequent.

Viburnum dilatatum Thunb., 18072, frequent.

Viburnum odoratissimum Ker-Gawler var. *awabuki* (K. Koch) Zabel, 18008, cult., frequent.

Weigela coraeensis Thunb. f. *alba* (Voss) Rehder, 18077, rare.

Compositae

Pertya scandens (Thunb.) Sch.-Bip., 18156, common in west part of forest.

Liliaceae

Smilax china L., 17419, frequent.

Yucca recurvifolia Salisb., 18105, cult., rare.

Palmae

Trachycarpum wagnerianus Becc., 17451, 18122, cult., rare.

Trachycarpus fortunei (Hook.) H. Wendl., 17449, 18139, cult., frequent.

Gramineae

Phyllostachys heterocycla (Carr.) Milf., 18103, cult., rare.

Phyllostachys nigra Munno var. *henonis* (Bean) Stapf, 18151, cult., frequent in west part of forest.

Pleioblastus chino (Fr. et Sav.) Makino, 17366, 17425, common.

Discussion

In this flora, 131 woody species belonging to 53 families were listed including planted trees. Native woody plants were 88 species belonging to 36 families. Many maritime species were recorded in this flora and, on the other hand, a few species growing mountain areas distant from the coast were included. These native woody flora was compared with the flora of Mt. Ashitaka (Sugimoto, 1962) to clarify the characteristics of natural woody plant flora of the Senbon-matsubara coastal forest.

Mt. Ashitaka, 1507 m in altitude, is an old volcano towering in the north of the Senbon-matsubara coast. Vegetation at the foot of the mountain belongs to an evergreen laurel forest of the warm temperate zone and many evergreen broad-leaved trees are growing. This foot area is about 5 km from the Senbon-matsubara coast and there is no coastal vegetation. The flora of Mt. Ashitaka consists of native 241 woody species belonging to 59 families. Species number of native woody plants in the Senbon-matsubara coastal forest is about one third of that in Mt. Ashitaka. Some families recorded in the latter are absent, or some others have very much fewer species in the former. For example, *Cephalotaxaceae*, *Taxaceae*, *Cupressaceae*, *Taxodiaceae*, *Betulaceae*, and *Aceraceae* are absent from the former. No species belonging to these families is maritime plants. In the following families, couples of numerals connected by hyphen in parentheses after each family names show the number of species in both flora (the first numeral is in Mt. Ashitaka); *Rosaceae* (28-11), *Celastraceae* (8-3), *Ericaceae* (15-1), and *Caprifoliaceae* (17-4). On the other hand, the couples of numerals in each family noted below show that similar species number occur in both areas; *Fagaceae* (11-7), *Ulmaceae* (2-3), *Moraceae* (4-2), *Lauraceae* (8-5), *Leguminosae* (8-4), *Euphorbiaceae* (2-2), *Cerastraceae* (8-3), *Vitaceae* (3-2), *Elaeagnaceae* (5-3), and *Verbenaceae* (3-2). All families found in the Senbon-matsubara coastal forest are common with the Mt. Ashitaka except *Podocarpaceae*.

Comparison of native species between the two floras shows that following 25 species grow only in the Senbon-matsubara coastal forest; *Podocarpus macrophyllus*, *Quercus phillyraeoides*, *Aphananthe aspera*, *Kadzura japonica*, *Cinnamomum camphora*, *Litsea coreana*, *Ternstroemia gymnanthera*, *Pittosporum tobira*, *Rhaphiolepis indica*, *Prunus lannesiana*, *Prunus speciosa*, *Rubus trifidus*, *Daphniphyllum teijsmanii*, *Rhus succedanea*, *Ilex integra*, *Ilex rotunda*, *Euonymus japonicus*, *Vitis thunbergii*, *Elaeagnus macrophylla*, *Elaeagnus umbellata*, *Dendropanax trifidus*, *Fatsia japonica*, *Vaccinium bracteatum*, *Ardisia japonica* and *Ligustrum ovalifolium*.

It seems that some in the above listed species are coastal plants which characterize the woody plant flora of the Senbon-matsubara Coastal forest. Among 25 species above listed, 21 species except *Prunus lannesiana*, *Vitis thunbergii*, and *Elaeagnus umbellata*, are recorded in natural forest or coastal forest reserve in the Izu Peninsula (Konta, 1981). On the other hand, Kurauchi (1969) listed up such woody species as cited below in the coastal forest in the Atsumi Peninsula which belongs the same climatic zone with the Senbon-matsubara coastal forest; *Pinus thunbergii*, *Castanopsis sieboldii*, *Cinnamomum japonicum*, *Machilus thunbergii*, *Neolitsea sericea*, *Camellia japonica*, *Ternstroemia gymnanthera*, *Pittosporum tobira*, *Mallotus japonicus*, *Daphniphyllum teijsmanii*, *Ilex integra*, *Elaeagnus macrophylla*, *Dendropanax trifidus*, *Ligustrum japonicum*, *Ardisia crenata*, and *Damnacanthus indicus*. All these species are also found in the Senbon-matsubara coastal forest and most of them occur in the coastal forest in the Izu Peninsula (Fig. 1). It is concluded, therefore, that the woody flora of Senbon-matsubara coastal forest is same with natural coastal forests on the

Pacific Ocean side of Honshu in the warm temperate zone.

Most part of this pine forest with dense evergreen broad-leaved trees seem to have been formed during 50 years after the construction of the high tide water control bank and the close of firewood cutting, although there have been some small evergreen broad-leaved forests among the pine forests (Sugimoto, 1948).

For the establishment of the plan of treatment of this coastal forest, the conservation of the pine forest seems very important (Konta *et al.*, 1997) and the treatment of both native and cultivated species should be considered. From this view point, three problems should be pointed out. Firstly, there are many broad-leaved arborescent species conflicting with pine trees by high growing speed, big crowns occupying large areas as well as high standing density. Among these species, *Rhus succedanea* and *Lithocarpus edulis* seem most problematic. Native trees of *Aphananthe aspera*, *Celtis sinensis*, *Ilex rotunda* etc. and planted *Cinnamomum camphora* and *Prunus yezoensis* also have similar problems though their density is not high. Secondly, high density of *Robinia pseudoacacia* and *Alnus sieboldiana* seem to change the mycorrhizal fungal flora. Thirdly, woody vines such as *Pueraria lobata*, *Parthenocissus japonica*, *Hedera rhombea* etc. injure pine trees. It is the most serious problem that young and small pine trees are covered by a mat of vines of these species. It is important that the permanent control including cutting of particular trees and vines should be carried out for the conservation. Based on the analyses on woody plant flora and vegetations, a conservation plan of the Senbon-matsubara coastal forest was submitted to Numazu City in 1997. Reservation of some communities of maritime woody plants such as *Cinnamomum japonicum*, *Daphniphyllum teijsmanii*, *Pittosporum tobira*, *Rhus succedanea*, and *Ilex rotundifolia*, and some small forests with old aged evergreen trees such as *Daphniphyllum teijsmanii*, *Cinnamomum japonicum*, *Castanopsis sieboldii*, *Machilus thunbergii* etc. as well as old aged *Pinus thunbergii* forest should be established according to the conservation plan (Konta *et al.*, 1997).

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