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Broad-leaved evergreen forests in Central Japan in comparison with Eastern China

Vergleich zwischen immergrünen Laubwäldern in Zentraljapan und Ostchina

by

Yongchang SONG

1. INTRODUCTION

China and Japan are closely related neighbours separated only by a channel. There are only 460 miles between the two big cities Shanghai and Nagasaki. The lands of the two countries were connected in the ancient geological era until the end of the Tertiary. Then the rising of the sea level separated the islands of Japan from the mainland. The intimate interrelationship of the flora of China and Japan has been confirmed by many scientists (MAEKAWA 1974, CHENG 1984). However, the similarities of the vegetation, although discussed in many papers and books, were not yet demonstrated in detail. During 1984, I was very glad to have the op-

portunity to take part in the International Excursion on Vegetation through Japan. This excursion was especially organized by the International Society for Vegetation Science, the Commitee of the International Phytogeographical Excurions, and the Ecological Society of Japan. We were in central Japan from August 1st to 16th, and went over most of central Honshu. We saw not only all kinds of natural vegetations spreading over coastal to mountainous regions, but also the artificial forests throughout the urban, industrial, rural and highway areas of central Japan. The excursion was very impressive. It provided sufficient information for me to take a comparison between the broad-leaved evergreen forest of eastern China and central Japan, and to explore the relationship of the vegetations of the two countries.

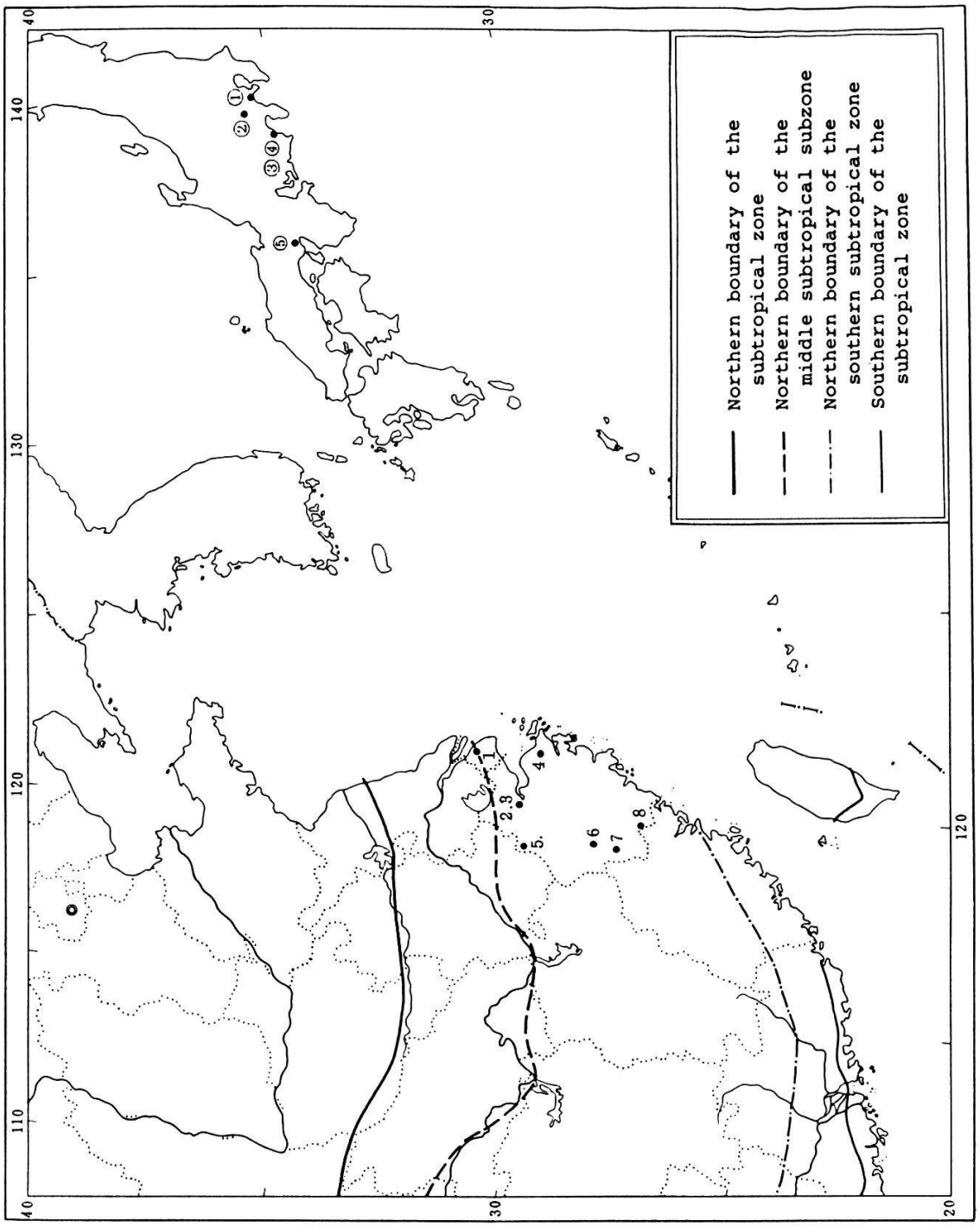
I would like to thank Prof. Miyawaki and his colleagues once more for the warm reception and considerate organization.

2. COMPARISON OF SEVERAL SAMPLE PLOTS OF BROAD-LEAVED EVERGREEN FOREST IN CHINA AND JAPAN

The broad-leaved evergreen forest is the zonal vegetation in central Japan, or is referred to the climatic climax. However, very few natural stands still survive, most of them were destroyed under the long-term human influence. We visited several especially protected renewed stands round the temples or shrines, e.g. Gokoku-Jinjya Shinto Shrine in Shizuoka, Kunozan Toshogu Shinto Shrine in Shizuoko, Tairyuji Temple on Mt. Futatabi in Kobe, and Kasuga Shrine in Nara. These broad-leaved evergreen forest stands are distributed over the foot hills or slopes with well-drained soil at an altitude below 400 m. The communities are well developed with joined crowns, the continuous ball-shaped crowns give a wavy appearance, the typical physionomy of broad-leaved evergreen forests. The communities are composed in general of four layers, i.e. two tree layers, one shrub layer, and one herb layer. The first tree layer is 12-20 m high and has 80-90% of coverage, while the second one is 8-10 m high and has 20-60% coverage. The shrub layer, about 4 m, 40-80% coverage, and the herb layer 0.8 m and 20-70% coverage. Table 1 shows the data collected from the five plots and Fig. 1 shows the location of

Fig. 1. The localities of the relevés in eastern China and central Japan
Abb. 1. Aufnahmeorte in Ostchina und Zentraljapan

1. Shanghai, 2. and 3. Hangzhou; 4. Ningbo, 5. and 6. Longtangshan, Changhua County, 7. Maoshan, Longquan County, 8. Wuyanling, Taishun County
Encircled numbers: 1. Enoshima Island, 2. Fujy City, 3. and 4. Shizuoka, 5. Kobe.



these plots. These plots are concerned with two main types of broad-leaved evergreen forest in central Japan, i.e. Machilus thunbergii, Castanopsis cuspidata var. sieboldii forests, and evergreen oak (Cyclobalanopsis) forests. The former largely spreads over the gentle slopes of the foot-hills in the coastal areas and alluvial plains, where the layer of the soil is rather thick and the habitat is of the intermediate form. The dominant species of tree layer is Machilus thunbergii or Castanopsis cuspidata var. sieboldii. Alternatively, the two species will live together in different ratios. The latter, most of evergreen oak forests, is largely in the inland area, while the dominant species composing the communities are Cyclobalanopsis spp., Castanopsis cuspidata, etc. (FUJIWARA 1981, MIYAWAKI 1979, 1980, 1984a, 1985, NUMATA 1974, NUMATA et al. 1972). Three of the plots, Polysticho-Perseetum thunbergii in Enoshima, Ardisio-Castanopsietum sieboldii in Fuji City, and Symploco glaucae - Castanopsietum sieboldii at the Kunozan Toshogu Shinto Shrine are of the type of Machilus thunbergii forest and Castanopsis cuspidata var. sieboldii forest. While the other two, Quercus (Cyclobalanopsis) myrsinaefoliae forest at the Gokoku Jinjya Shinto Shrine and Photinio-Castanopsietum cuspidatae at the Tairyuji Tmeple Mt. Futatabi are of the type of inland evergreen oak forest.

Table 1 shows that the broad-leaved evergreen forest in central Japan consists of 24-28 species in an area of 400 m^2. The dominant species of the tree layer are mainly evergreen species of Cyclobalanopsis, Machilus, Cinnamomum, however, Elaeocarpus and some deciduous trees are sometimes seen. The shrub layer consists of many species from Camellia, Eurya, Aucuba, Fatsia and Maesa. Species of ferns, Liliaceae, Cyperaceae and Myrsinaceae are frequent in the herb layer. The common lianas are Kadsura, Trachelospermum and Hedera. According to the data of these five plots the vascular plants involved with the broad-leaved evergreen forests are of 108 species, 54 families, and 84 genera. There are six families, eight genera, eleven species of ferns, as well as two families, two genera, and two species of Gymnosperms.

In order to compare the broad-leaved evergreen forests in eastern China with the central Japanese ones, we selected eight relevés in eastern China (Shanghai, Hangzhou, Ningbo, Changhua, Longquan and Taishun (see Fig. 1 and Table 2) and represent the various types of broad-leaved evergreen forests, spreading over different hills and mountains both in latitude and altitude. Some of them are close to the coast and the

Table 1. Record of vegetation in central Japan
Tab. 1. Vegetationsaufnahmen in Zentraljapan

Running No.		1	2	3	4	5
Locality of plots		E N	F U	K U	G O	K O
Size of plot(m)		100	400	600	400	225
Altitude (m)		65	185	180	-	400
Aspect of slope(°)		-	SE	-	SE	NE10
Degree of slope(°)		L	20	-	28	27
Height of tree layer-1 (m)		12	13	20	20	20
Cover of tree layer-1 (%)		80	80	80	90	80
Height of tree layer-2		8	8	12	8	12
Cover of tree layer-2		40	20	40	10	60
Height of shrub layer-1		3	4	5	3.5	6
Cover of shrub layer-1		70	40	40	80	60
Height of shrub layer-2		-	-	-	-	2
Cover of shrub layer-2		-	-	-	-	80
Height of herb layer		0.5	0.8	0.8	0.6	0.5
Cover of herb layer		40	20	40	40	70
Number of species		24	28	35	40	48
B1						
Machilus (Persea) thunbergii		4.4	.	1.2	.	.
Hedera rhombea	(L)	+.2	.	.	.	.
Kadsura japonica	(L)	+	.	.	.	.
Castanopsis cuspidata var.sieboldii		.	5.4	3.2	.	3.4
Cinnamomum japonicum		.	1.1	.	.	.
Elaeocarpus sylvestris var.ellipticus		.	.	4.3	.	.
Quercus acuta		.	.	1.1	.	1.2
Actinodaphe lancifolia		.	.	1.1	.	.
Fagara ailanthoides		.	.	+	.	.
Cryptomeria japonica(Kult.)		.	.	1.1	.	.
Carpinus laxiflora		.	.	.	.	1.1
Quercus(Cyclobalanopsis)myrsinaefolia		.	.	.	4.4	.
Castanopsis cuspidata		.	.	.	1.1	.
Ilex rotunda		.	.	.	2.1	.
Zelkova serrata		.	.	.	+	.
Cinnamomum camphora		.	.	.	1.2	.
B2						
Camellia japonica		2.2	.	1.2	.	+
Machilus thunbergii		1.2	+	.	.	.
Neolitsea sericea		1.2	.	.	.	.
Ficus erecta		1.2	.	.	.	.
Morus bombycis		+	.	.	.	.
Clerodendron trichotomum		+	.	.	.	.
Hedera rhombea	(L)	+	.	.	.	.
Akebia quinata	(L)	+	.	.	.	.
Castanopsis cuspidata var.sieboldii		.	1.2	.	.	2.3
Kadsura japonica	(L)	.	+	.	.	.
Quercus(Cyclobalanopsis) glauca		.	+	.	.	.
Symplocos glauca		.	.	3.3	.	.
Dendropanax trifidus		.	.	2.3	.	.
Cinnamomum japonicum		.	.	+.2	.	+
Cleyera japonica		.	.	1.1	.	.
Ilex crenata		.	.	+	.	.

Table 1 (continued)

Fagara ailanthoides		.	+	.	.
Carpinus laxiflora		.	.	.	1.1
Ilex integra		.	.	.	1.1
Kalopanax pictus		.	.	.	1.1
Ligustrum japonicum		.	.	.	1.1
Wisteria floribunda	(L)	.	.	.	+
Trachelosperum asiaticum	(L)	.	.	.	+
Lemmaphyllum microphyllum	(L)	.	.	.	+
Quercus myrsinaefolia		.	.	1.1	.
S					
Machilus thunbergii		+	+	1.2	.
					1.1
Camelia japonica		+	1.2	.	----
					1.1
Dendropanax trifidus		+	.	+	.
					2.3
Aucuba japonica		4.4	2.2	2.3	1.2 -----
					2.2
					1.2
Cinnamomum japonicum		1.2	1.2	+	1.2 -----
					1.1
Fatsia japonica		+.2	1.1	.	1.2 +
Kadsura japonica	(L)	.	+.2	.	. .
Euonymus japonicus		1.2	.	.	. .
Ficus erecta		+	.	1.2	+.2 .
Cocculus orbiculatus	(L)	+	.	.	. .
Neolitsea sericea		+	.	.	. .
					2.2
Eurya japonica		+.2	3.4	1.2	4.4 -----
					2.3
Thea(camellia) sinensis		.	1.2	.	. .
Pleioblastus chino		.	1.2	.	. .
					1.1
Quercus glauca		.	+.2	.	+ -----
					1.1
					2.2
Castanopsis cuspidana var.sieboldii		.	+	+	. -----
					3.4
Helwingia japonica		.	+	.	. +
Cleyera japonica		.	+	.	. .
Osmanthus heterophyllus		.	+	.	. .
Ilex rotunda		.	+	.	. .
					1.1
Ligustrum japonicum		.	+	+	1.2 -----
					1.2
Deutzia scabra		.	+	.	. .
Elaeocarpus sylvestris var. ellipticus		.	.	1.2	. .
Myrsine seguinii		.	.	2.3	. .
Daphniphyllum teijsmanni		.	.	+.2	. .
Podocarpus macrophyllus		.	.	+	. .
Ternstroemia gymnanthera		.	.	1.2	. .
Quercus salicina		.	.	+	. .
Elaeagnus glabra		.	.	+	. .

Table 1 (continued)

Maesa japonica		.	.	+.2	.	.
Parthenocissus tricuspidata	(L)	.	.	+	.	.
Dioscorea tokoro	(L)	.	.	+	.	.
Ilex integra		.	.	.	.	+
Viburnum dilatatum		.	.	.	.	+
Cinnamomum camphora		.	.	.	.	+
Euonymus oxyphyllus		.	.	.	.	1.1
Actinodaphne lancifolia		.	.	.	.	+
Acer palmatum		.	.	.	.	+
Cleyera japonica		.	.	.	2.2	+
Rhus sylvestris		.	.	.	.	+
Elaeagnus pungens		.	.	.	.	+
Viburnum erosum		.	.	.	+	+
Ilex pedunculosa		.	.	.	.	+
Callicarpa japonica		.	.	.	.	+
Smilax china	(L)	.	.	.	.	+
Michelia compressa		.	.	.	1.2	.
Chloranthus(Sarcandra) glaber		.	.	.	+.2	.
Trachelospermum asiaticum var.intermedium		.	.	.	+.2	.
Dendropanax trifidus		.	.	.	+	.
Rhododendron macrosepalum		.	.	.	1.1	.
Aristolochia kaempferi		.	.	.	+	.
Eriobotrya japonica		.	.	.	+	.
K.						
Piper kadzura	(L)	3.4	.	1.2	.	.
Machilus thunbergii		+	+	+	.	.
Camellia japonica		+	.	.	.	+
Fatsia japonica		+	+	.	.	.
Hedera rhombea	(L)	+	.	.	1.2	+
Liriope platyphylla		+	.	+	.	.
Trachelospermum asiaticum var.intermedium	(L)	+	1.2	1.2	2.2	3.4
Dioscorea tokoro	(L)	+	.	.	.	.
Ophiopogon jaburan		+.2	.	.	.	.
Disporum sessile		+	+	.	.	.
Akebia quinata	(L)	+.2	.	.	.	.
Celtis sinensis var.japonica		+	.	.	.	+
Pittosporum tobira		+	.	.	.	.
Ophiopogon japonicus var.caespitosus		.	1.2	.	.	.
Dryopteris bissetiana		.	+.2	.	.	1.1
Dryopteris erytheosoea		.	+.2	1.2	1.2	3.3
Thea sinensis		.	+.2	.	1.2	.
Ophiopogon ohwii		.	+.2	.	.	+
Kadzura japonica	(L)	+	+	.	+.2	+
Aucuba japonica		.	+	.	.	.
Damnacanthus indicus		.	+	2.2	2.2	.
Carex conica		.	+	.	.	.
Cymbidium goeringii		.	+	.	.	.
Ardisia japonica		.	+	+.2	.	2.3
Ardisia crenata		.	+	.	+	.
Ophiopogon planiscapus		.	+	.	.	.

Table 1 (continued)

Arachniodes aristata		.	.	3.3	.	.
Ardisia pusilla		.	.	2.2	.	.
Parthenocissus tricuspidata	(L)	.	.	+.2	.	+
Arisaema urashima		.	.	+	.	.
Quercus acuta		.	.	.	.	+
Quercus glauca		.	.	.	.	+
Smilax china		.	.	.	.	1.1
Viburnum erosum		.	.	.	+	+
Pertya scandens		.	.	.	.	+
Stauntonia hexaphylla	(L)	.	.	.	.	+
Oplismenus undulatifolius var.japonicus		.	.	.	.	+
Vaccinium smallii var.glabrum		.	.	.	.	+
Dryopteris pacifica		.	.	.	.	1.1
Akebia trifoliata	(L)	.	.	.	.	+
Hydrangea hirta		.	.	.	.	+
Arundinaria pygmaea var.glabra		.	.	.	.	+
Polygonatum lasianthum		.	.	.	.	+
Euonymus alatus f.ciliato-dentatus		.	.	.	.	+
Carex lanceolata		.	.	.	.	+
Tripterospermum japonicum		.	.	.	.	+
Quercus myrsinaefolia		.	.	.	+.2	.
Michelia compressa		.	.	.	1.2	.
Microlepia marginata		.	.	.	2.3	.
Arachniodes amabilis		.	.	.	1.2	.
Ophiopogon japonicus		.	.	.	+	.
Liparis nervosa		.	.	.	+.2	.
Rubus buergeri		.	.	.	+.2	.
Diplazium subsinuatum		.	.	.	+.2	.
Polystichum polyblepharum		.	.	.	+	.
Elaeagnus glabra		.	.	.	+.2	.
Gleichenia japonica		.	.	.	1.2	.
Ilex crenata		.	.	.	+	.
Thelypteris glanduligera		.	.	.	+.2	.
Trachycarpus fortunei		.	.	.	+	

Locality and researcher:

No. 1: Polysticho-Perseetum thunbergii), Enishima Island.
MIYAWAKI et al. 1984: Vegetation der Insel Enoshima.

No. 2: Ardisio-Castanopsietum sieboldii, Fuji City.
NAKAMURA 1984

No. 3: Symploco glaucae - Castanopsietum sieboldii. Kunozan, Pref. Shizuoka.
KONTA and MASUZAWA 1984.

No. 4: Quercus myrsinaefolia-forest. Gokoku-Jinjya, Pref. Shizuoka.
KONTA and MASUZAWA 1984

No. 5: Photinio-Castanopsietum cuspidatae. Mt. Futatabi, Kobe.
NAKANISHI 1984

Table 2. Record of vegetation in eastern China
Tab. 2. Vegetationsaufnahmen Ostchinas

Running No.	1	2	3	4	5	6	7	8
Locality of plots	S H	H Z	H Z	N B	L T	S C	M S	W Y
Size of plot(m)	400	400	400	400	400	400	225	600
Altitude (m)	60	145	120	210	825	750	1045	910
Aspect of slope(°)	-	SE20	NW	SE30	NW35	SE30	NE45	NW20
Degree of slope(°)	-	26	30	30	45	32	43	45
Height of tree layer-1(m)	12-15	20-30	16-22	17-23	11-21	10-15	15-20	16-26
Cover of tree layer-1 (%)	70	35	35	40	40	60	75	40
Height of tree layer-2(m)	8-10	7-12	4-10	9-13	4-9	6-10	5-6	10-15
Cover of tree layer-2 (%)	20	40	30	50	30	70	5	60
Height of tree layer-3	5-6	3-5	-	6-8	-	-	-	4-9
Cover of tree layer-3	10	20	-	5	-	-	-	40
Height of shrub layer	1.5-3.5	0.5-1.5	0.5-2.0	1-2	0.5-2.5	1-5	2-4	1-3.5
Cover of shrub layer	45	30	20	25	40	5	80	40
Height of herb layer	<1	0.5	0.5	>1	>1	0.8	0.8	<1
Cover of herb layer	35	50	15	25	30	70	5	20
Number of Species	16	78	29	61	39	56	38	76
B	**	**	**	**	**	**	**	**
Machilus thunbergii	61.2	.	2.3	.	.	.	11.2	11.9
Cinnamomum japonicum	11.0	.	.	.	.	.	.	.
Ligustrum sinense	8.3	.	.	.	.	.	.	.
Pyrus calleryana	7.5	.	.	.	.	.	.	.
Mallotus japonicus	4.3	.	.	.	.	.	.	.
Ulmus parvifolia	4.0	.	.	.	.	.	.	.
Pittosporum tobira	1.0	.	.	.	.	.	.	.
Liquidambar formosana	.	23.2	.	9.2	.	.	.	.
Cyclobalanopsis myrsinaefolia	.	21.9	.	8.7	.	.	.	.
Phyllostachys pubescens	.	16.1	10.8	.	.	.	.	.
Quercus acutissima	.	14.4	.	.	.	.	.	.
Cinnamomum camphora	.	11.1	.	.	.	.	.	.
Schima superba	.	7.0	2.3	11.4	18.7	12.9	.	1.7
Ilex purpurea	.	1.8	.	.	.	.	.	.
Cyclobalanopsis glauca	.	1.3	10.7	.	11.1	.	7.4	1.1
Dalbergia hupeana	.	1.3	.	.	.	.	.	1.6
Clerodendron cyrtophyllum	.	1.3	.	.	.	.	.	.
Castanopsis carlesii	.	.	36.9	9.7	.	.	.	.
Castanopsis sclerophylla	.	.	14.4	.	.	.	.	.
Lithocarpus glaber	.	.	11.2	3.2	.	.	.	.
Osaenthus marginatus	.	.	4.5	.	.	.	.	.
Prunus spinulosa	.	.	2.3	.	.	.	.	.
Cinnamomum pedunculatum	.	.	2.3	.	.	.	.	.
Symplocos stellaris	.	.	2.3	.	.	.	.	0.5
Neolitsea aurata var.chekiangensis	.	.	+	.	.	3.2	.	4.6
Csatanopsis fargesii	.	.	.	46.0	.	.	.	.
Lithocarpus henryi	.	.	.	3.1	.	7.5	.	.
Celtis biondii	.	.	.	2.9	.	.	.	.
Styrax suberifolia	.	.	.	2.9	.	.	.	.
Eurya auricata	.	.	.	2.9	.	.	.	.
Cyclobalanopsis gracilis	.	.	.	.	24.4	.	.	.
Rhododendron latoucheae	.	.	.	.	10.9	6.9	.	4.8
Eurya nitida	.	.	.	.	7.8	.	.	3.7

Table 2 (continued)

Toxicodendron succedaneum	.	.	.	.	7.0	.	.	.
Nyssa sinensis	.	.	.	.	4.1	.	.	4.5
Ilex rotunda	.	.	.	.	3.3	.	.	.
Quercus glandulifera(Q.serrata)	.	.	.	.	2.8	.	.	.
Acanthopanax evodiaefolius	.	.	.	.	2.4	.	.	.
Carpinus fargesii	.	.	.	.	2.0	.	.	1.8
Pieris polita	.	.	.	.	1.9	3.6	.	.
Rhododendron ovatum	.	.	.	.	1.8	5.4	.	4.0
Ilex wilsonii	.	.	.	.	1.8	.	.	.
Cstanopsis eyrei	.	.	.	.	.	22.2	.	5.4
Fagus longipetiolata	.	.	.	.	.	5.3	.	.
Cleyera japonica	.	.	.	.	.	4.2	.	.
Vaccinium sprengelii	.	.	.	.	.	3.3	.	1.4
Vaccinium bracteatum	.	.	.	.	.	3.2	.	.
Picrasma quassioides	.	.	.	.	.	2.1	.	.
Halesia macgregorii	.	.	.	.	.	2.1	.	.
Sorbus dunnii(?)	.	.	.	.	.	2.0	.	.
Pterostyrax corymbosa	.	.	.	.	.	1.6	.	.
Itea chinensis var.oblonga	.	.	.	.	.	1.6	.	2.5
Ilex sp.	.	.	.	.	.	1.5	.	.
Elaeocarpus japonicus	.	.	.	.	.	1.5	.	4.0
Ilex elmerrilliana	.	.	.	.	.	1.4	.	.
Eurya rubiginosa var.attenuata	.	.	.	.	.	1.2	.	.
Daphniphyllum oldhami	.	.	.	.	.	1.2	.	0.7
Schoepfia jasminodora	.	.	.	.	.	1.2	.	.
Cyclobalanopsis nubium	.	.	.	.	.	1.0	.	.
Fokienia hodginsii	.	.	.	.	.	1.0	.	.
Cyclobalanopsis stewardiana	.	.	.	.	.	1.0	.	.
Symplocos anomala	.	.	.	.	.	1.0	.	.
Photinia glabra	.	.	.	.	.	1.0	.	.
Dendropanax dentiger	.	.	.	.	.	1.0	.	1.4
Cstanopsis tibetana	.	.	.	.	.	.	43.0	.
Lithocarpus hancei	.	.	.	.	.	.	12.6	.
Choerospondias axillaris	.	.	.	.	.	.	10.0	.
Litsea elongata	.	.	.	.	.	.	8.7	1.5
Sloanea sinensis	.	.	.	.	.	.	7.1	.
Castanopsis lamontii	.	.	.	.	.	.	.	14.2
Rhododendron championii	.	.	.	.	.	.	.	6.5
Rhododendron maresii	.	.	.	.	.	.	.	5.1
Dendrobanthamia angustata	.	.	.	.	.	.	.	4.2
Camellia cuspidata	.	.	.	.	.	.	.	1.8
Rhaphiolepis indica	.	.	.	.	.	.	.	1.6
Hovenia dulcis	.	.	.	.	.	.	.	1.5
Acer oliverianum	.	.	.	.	.	.	.	1.4
Machilus leptophylla	.	.	.	.	.	.	.	1.1
Alniphyllum fortunei	.	.	.	.	.	.	.	1.0
Photinia beauverdiana var.lofau.	.	.	.	.	.	.	.	1.0
Prunus phaeosticta	.	.	.	.	.	.	.	0.8
Lithocarpus polystachya	.	.	.	.	.	.	.	0.8
Myrica rubra	.	.	.	.	.	.	.	0.7
Meliosma oldhami var.sinensis	.	.	.	.	.	.	.	0.5
S	**	**	**	**	**	**	**	**
Machilus thunbergii	34.3	8.7	+	.	.	+	5.1	5.6
Phyllostachys congesta	21.7	.	.	.	.	.	.	.
Eurya emarginata	20.6	.	.	.	.	.	.	.

Table 2 (continued)

Mallotus japonicus	18.2	.	.	.	.	.	.	.
Euonymus japonicus	5.1	.	.	.	.	.	.	.
Ardisia japonica	.	8.8	+	0.8	4.8	.	.	.
Clerodendron cyrtophyllum	.	7.7	.	.	.	.	.	.
Indocalamus tessellatus	.	7.4	.	.	.	2.7	.	.
Cinnamomum camphora	.	6.4	.	0.8	.	.	.	.
Cyclobalanopsis myrsinaefolia	.	6.3	.	4.9	.	.	.	.
Serissa foetida	.	6.1	.	.	.	.	.	.
Phyllostachys glauca	.	5.4	.	.	.	.	.	.
Schima superba	.	4.4	0.6	7.9	5.3	3.5	2.9	1.6
Pleiblastus amarus	.	3.5	.	.	.	.	.	.
Premna microphylla	.	3.4	.	.	.	.	.	.
Dalbergia hupeana	.	3.3	.	.	+	.	.	1.1
Damnacanthus indicus	.	3.1	+	.	.	.	.	.
Callicarpa bodinieri	.	2.6	.	.	.	.	.	.
Rhododendron ovatum	.	1.6	0.6	.	2.4	14.1	.	1.7
Quercus acutissima	.	1.5	.	.	.	.	.	.
Liquidambar formosana	.	1.4	.	.	.	.	.	0.5
Styrax japonica	.	1.4	.	.	.	.	.	.
Glochidion puberum	.	1.4	.	.	.	.	.	.
Lindera glauca	.	1.2	.	.	.	+	.	.
Toxicodendron sylvestre	.	1.1	.	0.8	.	.	.	.
Elaeagnus pungens	.	1.1	.	.	.	.	.	.
Syzygium buxifolium	.	1.1	12.2	2.1	.	2.1	.	.
Gardenia jasminoides	.	0.9	.	.	.	.	.	.
Lespedeza bicolor	.	0.8	.	.	.	.	.	.
Eurya japonica	.	0.8	.	.	.	.	.	.
Rubus hirsutus	.	0.6	.	.	.	.	.	.
Diospyros kaki	.	0.6	.	.	.	.	.	.
Celtis tetrandra subsp.sinensis	.	0.6	.	.	.	.	.	.
Acer buergerianum	.	0.6	.	.	.	1.0	.	.
Aralia chinensis	.	0.6	.	.	.	.	.	.
Cyclobalanopsis glauca	.	0.5	8.8	3.4	.	.	.	3.5
Symplocos caudata(S.prunifolia)	.	0.5	2.0	2.2	.	.	.	1.1
Vaccinium bracteatum	.	0.5	.	.	.	.	.	1.1
Vaccinium sprengelii	.	0.5	+	.	.	.	.	.
Maesa japonica	.	0.5	21.1	2.8	.	.	2.9	1.1
Camellia sinensis	.	0.3	.	.	.	.	.	.
Euscaphis japonica	.	0.3	.	.	.	.	.	.
Rubus corchorifolius	.	0.3	.	.	.	.	.	.
Indigofera tinctoria	.	0.3	.	.	.	.	.	.
Aphananthe aspera	.	0.3	.	.	.	.	.	.
Castanopsis sclerophylla	.	0.3	+	.	.	.	.	.
Rhus chinensis	.	0.3	.	.	.	.	.	.
Castanea seguinii	.	0.3	.	.	.	.	.	.
Pistacia chinensis	.	0.3	.	.	.	.	.	.
Ilex purpurea	.	0.3	.	.	.	.	.	.
Neolitsea aurata var.chekiangensis	.	.	21.8	1.4	.	2.7	.	0.5
Eurya nitida	.	.	15.6	.	11.1	+	.	4.3
Castanopsis carlesii	.	.	10.2	.	.	.	.	.
Prunus spinulos	.	.	2.0	3.5	.	.	.	.
Phoebe sheareri	.	.	2.0	.	.	.	.	.
Lithocarpus glaber	.	.	0.6	1.4	.	.	.	.
Cinnamomum pedunculatum	.	.	0.6	.	.	+	13.3	4.9
Osmanthus marginatus	.	.	0.6	.	.	.	.	.

Table 2 (continued)

Elaeagnus umbellata	.	.	0.6	.	.	.	.	.
Camellia cuspidata	.	.	(+)	.	.	2.2	42.5	1.6
Litsea coreana var.sinensis	.	.	(+)	0.8	2.9	.	.	.
Symplocos setchuensis	.	.	(+)	+	.	.	.	.
Loropetalum chinensis	.	.	(+)	2.1	.	1.0	.	.
Camellia fraterna	.	.	.	28.1	.	2.7	.	.
Castanopsis fargesii	.	.	.	3.4	.	.	.	.
Eurya auricata	.	.	.	2.7	.	.	.	.
Ardisia crenata	.	.	.	1.4	.	3.3	6.6	0.5
Meliosma rigida	.	.	.	1.4	.	.	.	.
Ilex wilsonii	.	.	.	1.4	.	.	.	.
Elaeocarpus glabripelatus	.	.	.	1.4	.	.	.	.
Eurya rubiginosa var.attenuata	.	.	.	1.4	.	8.1	.	.
Acer oliverianum	.	.	.	1.4	.	.	.	.
Litsea elongata	.	.	.	1.4	.	.	2.9	0.5
Tricalysis dubia	.	.	.	1.4	.	.	.	.
Ilex buergeri	.	.	.	0.8	.	.	.	.
Rhaphiolepis indica	.	.	.	0.8	.	2.5	.	.
Symplocos glauca	.	.	.	0.8	.	.	.	.
Symplocos stellaris	.	.	.	0.8	2.4	3.4	.	3.2
Cunninghamia lanceolata	.	.	.	0.8	.	.	.	0.7
Styrax suberifolia	.	.	.	0.8	.	.	.	.
Cinnamomum subavenium	.	.	.	0.8	.	2.7	.	.
Lithocarpus henryi	.	.	.	0.8	.	6.1	.	.
Daphniphyllum oldhami	.	.	.	0.8	.	1.3	.	.
Symplocos anomala	.	.	.	0.8	.	.	.	.
Symplocos lancifolia	.	.	.	+	.	.	.	.
Cyclobalanopsis gracilis	.	.	.	.	10.6	1.0	.	0.5
Toxicodendron succedaneum	.	.	.	.	10.1	.	.	.
Acanthopanax evodiaefolia	.	.	.	.	10.0	.	.	.
Ilex rotunda	.	.	.	.	5.8	.	.	.
Rhododendron latoucheae	.	.	.	.	5.8	1.0	.	1.2
Carpinus fargesii	.	.	.	.	3.8	.	.	1.3
Pieris polita	.	.	.	.	2.9	6.1	.	.
Meliosma myriantha	.	.	.	.	2.9	.	.	.
Dendropanax dentiger	.	.	.	.	2.9	1.3	2.2	3.9
Sapium japonicum	.	.	.	.	2.9	.	.	.
Rubus hupehensis	.	.	.	.	2.4	.	.	.
Pittosporum illicioides	.	.	.	.	2.4	.	2.2	.
Stachyurus chinensis	.	.	.	.	2.4	.	.	.
Polygala arillata	.	.	.	.	2.4	.	.	.
Meliosma flexuosa	.	.	.	.	2.4	.	.	.
Corylopsis sinensis	.	.	.	.	+	.	.	.
Itea chinensis var.oblonga	.	.	.	.	.	6.0	.	4.3
Castanopsis eyrei	.	.	.	.	.	5.9	.	4.5
Thysanospermum diffusum	.	.	.	.	.	4.7	.	.
Halesia macgregorii	.	.	.	.	.	3.2	2.2	.
Elaeocarpus japonicus	.	.	.	.	.	2.2	.	5.4
Rhododendron simsii	.	.	.	.	.	1.3	.	1.7
Fokienia hodginsii	.	.	.	.	.	1.3	.	.
Photinia glabra	.	.	+	.	.	1.3	.	1.7
Erythroxylum kunthianum	.	.	.	.	.	1.3	.	.
Lasianthus lancilimbus	.	.	.	.	.	1.3	.	.
Fagus longipetiolata	.	.	.	.	.	1.0	.	.
Fraxinus chinensis	.	.	.	.	.	+	.	.

Table 2 (continued)

Camellia oleifera	.	.	.	.	.	+	.	.
Lindera erythrocarpa	.	.	.	.	.	+	.	.
Castanopsis tibetana	.	.	.	.	.	.	8.2	.
Sloanea sinensis	.	.	.	.	.	.	4.5	.
Cyclobalanopsis nubium	.	.	.	.	.	.	4.4	.
Castanopsis lamontii	.	.	.	.	.	.	.	14.9
Ilex trifolia	.	.	.	.	.	.	.	2.8
Photinia beauverdiana	.	.	.	.	.	.	.	2.6
Lindera strychnifolia	.	.	.	.	.	.	.	2.3
Camellia chekiang-oleosa	.	.	.	.	.	.	.	2.3
Lasianthus chinensis	.	.	.	.	.	.	.	2.1
Viburnum sympodiale	.	.	.	.	.	.	.	2.1
Rhododendron championae	.	.	.	.	.	.	.	2.1
Adinandra glischroloma	.	.	.	.	.	.	.	1.8
Machilus leptophylla	.	.	.	.	.	.	.	1.7
Bredis sinensis	.	.	.	.	.	.	.	1.1
Lithocarpus polystachya	.	.	.	.	.	.	.	0.8
Dendrobanthamia angustata	.	.	.	.	.	.	.	0.7
Lithocarpus hancei	.	.	.	.	.	.	.	0.7
Cinnamomum appelianum	.	.	.	.	.	.	.	0.5
Hydrangea paniculata	.	.	.	.	.	.	.	0.5
Acer davidii	.	.	.	.	.	+	.	0.5
Sarcandra glabra	.	.	.	.	.	.	.	0.5
Illicium lanceolatum	.	.	.	.	.	.	.	0.5
Ilex oldhami	.	.	.	.	.	.	.	0.5
Alniphyllum fortunei	.	.	.	.	.	.	.	0.5
K	*	**	*	**	**	**	**	**
Phytolacca americana	2.2	.	.	.	.	.	.	.
Galium bungei	1.1	.	.	.	.	.	.	.
Solanum lyratum	1.1	.	.	.	.	.	.	.
Semiaquilegia adoxoides	1.1	.	.	.	.	.	.	.
Dryopteris championii	.	38.9	2.1	.	.	.	.	.
Lophatherum gracile	.	8.1	.	.	.	.	2.8	4.6
Poa sphondylodes	.	7.5	.	.	.	.	.	.
Aster ageratoides	.	7.8	.	2.3	.	.	.	.
Carex sp.1.	.	5.6	1.2	11.3	2.1	8.2	5.4	.
Arachniodes amabilis	.	5.0	.	.	.	.	.	.
Pteridium aquilinum	.	4.3	.	.	.	.	.	.
Polygonum sp.	.	3.3	.	.	.	.	.	.
Oldenlandia auricularia	.	3.0	.	.	.	.	.	.
Arthraxon hispidus	.	2.6	.	.	+	.	.	1.9
Achyranthes bidentata	.	2.0	.	.	.	.	.	.
Scutellaria indica	.	1.5	.	.	.	.	.	.
Carex sp.2.	.	1.5	.	11.3	2.2	.	.	.
Lysimachia christanae	.	1.0	.	.	.	.	.	.
Ainsliaea fragrans	.	1.0	.	.	.	.	.	.
Commelina communis	.	1.0	.	.	.	.	.	.
Arisaema heterophyllum	.	1.0	.	.	.	.	.	.
Ophiopogon japonicus	.	1.0	.	2.2	.	.	.	2.8
Desmodium oxyphyllum	.	1.0	.	.	.	.	.	.
Atemisia anomala	.	0.8	.	.	.	.	.	.
Antenoron filiforme	.	0.8	.	.	.	.	.	.
Cardamine lyrata	.	0.5	.	.	.	.	.	.
Liriope graminifolia	.	.	1.2	.	.	.	2.8	.
Oplismenus undulatifolius	.	.	1.1	.	.	+	.	.

Table 2 (continued)

Woodwardia japonica	.	.	1.1	25.7	.	19.7	35.0	12.7
Hicriopteris glauca	.	.	.	16.3	.	45.8	.	8.6
Arachniodes pseudo-aristata	.	.	.	13.0	.	.	.	.
Cyrtomium balansae	.	.	.	4.2	.	.	.	.
Miscanthus sinensis	.	.	.	2.3	.	.	.	.
Rubus buergeri	.	.	.	2.3	.	.	.	.
Alpinia japonica	.	.	.	2.3	.	.	.	.
Lactuca sororia var. pilipes	.	.	.	2.2	.	.	.	.
Rhus chinensis	.	.	.	2.2	.	.	.	.
Liquidambar formosana	.	.	.	2.2	.	.	.	.
Colysis elliptica	.	.	.	+	.	.	.	.
Parathelypteris glanduligera	.	.	.	.	2.2	.	.	.
Viola sp.	.	.	.	.	+	.	.	.
Hicriopteris laevissima	.	.	.	.	.	5.5	.	.
Dryopteris decipens	.	.	.	.	.	5.0	.	.
Lycopodium serratum	.	.	.	.	.	5.0	.	1.9
Plagiogyria dannii	.	.	.	.	.	3.1	.	.
Selaginella moellendorfii	.	.	.	.	.	2.5		
Arachniodes amoena	.	.	.	.	.	.	22.2	4.6
Dryopteris fuscipes	.	.	.	.	.	.	13.7	.
Dryopteris sp.	.	.	.	.	.	.	8.2	.
Archniodes simplicior	.	.	.	.	.	.	4.5	1.9
Lepisorus obscure-venulosus	.	.	.	.	.	.	2.8	.
Asplenium sarellii (?)	.	.	.	.	.	.	2.8	.
Plagiogyria stenopters	.	.	.	.	.	.	.	20.9
Plagiogyria euphlebia	.	.	.	.	.	.	.	9.4
Carex cruciata	.	.	.	.	.	.	.	9.4
Plagiogyria distinctissima	.	.	.	.	.	.	.	5.4
Rubus pacificus var.ningpoensis	.	.	.	.	.	.	.	5.4
Polygonatum cyrtonema	.	.	.	.	.	.	.	2.8
Pyrrosia sheareri	.	.	.	.	.	.	.	1.9
Paris polyphylla	.	.	.	.	.	.	.	1.9
Elatostema stewardii	.	.	.	.	.	.	.	1.9
Phyllagathis cavaleriei	.	.	.	.	.	.	.	1.9
	*	**	*	*	*	**	*	*
L								
Smilax china	+	21.8	1.1	2.1	1.1	1.0	+	1.1
Mucuna pachwashanica	+	.	.	.	.	.	.	.
Trachelospermum jasminoides	.	34.7	1.1	2.7	.	3.5	.	1.1
Millettia reticulata	.	18.0	.	.	.	.	+	1.1
Parthenosissus tricuspidata	.	14.4	.	0.8	.	.	+	.
Ficus pumila	.	3.7	.	.	1.1	.	.	.
Dioscorea sp.	.	3.6	.	.	.	.	.	.
Ficus sarmentosa var.henryi	.	1.9	1.1	.	.	.	+	+
Paederia scandens	.	1.9	.	.	.	.	+	.
Holboellia coriacea	.	.	1.1	.	.	.	.	.
Euonymus radicans	.	.	+	.	.	.	+	.
Stauntonia leucantha	.	.	.	2.7	.	2.5	.	.
Lonicera macrantha	.	.	.	0.8	.	1.0	.	.
Smilax arisanensis	.	.	.	0.8	.	.	.	.
Ampelopsis cantoniensis	.	.	.	0.8	.	.	.	.
Kadsura longipedunculata	.	.	.	.	2.1	.	.	.
Hedera nepalensis var.sinensis	.	.	.	.	+	.	.	.
Actinida chinensis	.	.	.	.	+	.	.	.
Stauntonia duclouxii	.	.	.	.	.	+	+	1.1

Table 2 (continued)

Smilax sieboldii	.	.	.	.	.	+	.	.
Morinda umbellata	.	.	.	.	.	.	+	.
Paederia scandens var.tomentosa	.	.	.	.	.	.	+	.
Lysionotus pauciflorus	.	.	.	.	.	.	+	.
Vitis sp.	.	.	.	.	.	.	+	.
Thysanospermum diffusum	.	.	.	.	.	.	.	1.1
Smilax glabra	.	.	.	.	.	.	.	1.1
Smilax ovalifolia	.	.	.	.	.	.	.	+
Sargentodoxa cuneate	.	.	.	.	.	.	.	+
Akebia trifoliata	.	.	.	.	.	.	.	+
Zanthoxylum cuspidatum	.	.	.	.	.	.	.	+
Celastrus chingii	.	.	.	.	.	.	.	+
Dalbergia hancei	.	.	.	.	.	.	.	+

Locality and researcher:

No. 1: Machilus thunbergii-forest in Jingshan island, Shanghai.
ZHOU 1984

No. 2: Cyclobalanopssis myrsinaefolia-forest in Lingyin Temple, Hangzhou. CHEN 1965

No. 3: Castanopsis carlesii-forest in Yunqi Temple, Hangzhou.
SONG 1962, not published)

No. 4: Castanopsis fargesii-forest in Tiantong Temple, Ningbo.
SONG et al. 1985, not published

No. 5: Cyclobalanopsis gracilis-forest in Longtangshan, Changhua County.
CHEN and SONG 1965

No. 6: Castanopsis eyrei, Schima superba-forest in Longtangshan, Changhua County
SONG et al. 1963, not published

No. 7: Castanopsis tibetana-forest in Maoshan, Longquan.
SONG et al. 1964 (not published)

No. 8: Castanopsis lamontii-forest in Wuyanling, Taishun.
SONG et al. 1982.

* Coverage abundance scale after Braun-Blanquet
** relative importance value

others are inland. The communities of these eight plots are categorized by the dominant species into Machilus thunbergii-forest, Cyclobalanopsis myrsinaefolia-forest, Castanopsis carlesii-forest, Castanopsis fargesii-forest, Cyclobalanopsis lamontii-forest, and Castanopsis tibetane-forest.

The apparent similarities of broad-leaved evergreen forests between central Japan and eastern China are shown in Tables 1 and 2. The communities mostly consist of two tree layers, one shrub layer, and one herb layer. However, the typical mature broad-leaved evergreen forest in eastern China has five layers. There are three tree layers, the height of the first layer is 20-25 m, 40% coverage, the second 8-15 m, 50% coverage, and the third 4-7 m, 40% coverage. The height of the shrub layer is only 2-3 m, coverage around 30%, and the herb layer is about 1 m high and sparse, coverage around 10%.

The major constituent species for the tree layers of the broad-leaved evergreen forests in eastern China are species of Fagaceae, Lauraceae and Theaceae, while species of Lauraceae, Theaceae, Symplocaceae, and Ericaceae are the major ones for the shrub layer. Species from Pteridophyta, Cyperaceae, Liliaceae, Myrsinaceae are the dominants of the herb layer. Obviously, the constituent families of broad-leaved evergreen forests in eastern China and central Japan are very alike, especially the dominant families are identical. Furthermore, many identical or corresponding species could be found in the regions compared. The identical species are as follows:

Cyclobalanopsis (Quercus) glauca
C. marsinaefolia
Cinnamomum camphora
C. japonicum
Machilus (Persea) thunbergii
Toxicodendron (Rhus) sylvestre
Ilex rotunda
Elaeagnus pungens
Pittospermum tobira
Camellia (Thea) sinensis
Cleyera japonica
Eurya japonica
Symplocos glauca
Measa japonica
Ardisia japonica
A. crenata
Damnacanthus indicus
Akebia trifoliata
Smilax china
Rubus buergeri
Sarcandra (Chloranthus) glabra
Parthenocissus tricuspidata
Arachniodes amabilis
Ophiopogon japonicus
etc.

The following list shows the corresponding species:

Eastern China	Central Japan
Castanopsis carlesii	C. cuspidata var. sieboldii
Cyclobalanopsis gracilis	Quercus (Cyclobalanopsis) acuta
Camellia fraterna	Camellia japonica
Neolitsea aurata var. chekiangensis	Neolitsea sericea (also found in Shanghai
Ligustrum lucidum	Ligustrum japonicum
Dendropanax dentiger	Dendropanax trifidus
Daphniphyllum oldhami	Daphniphyllum teijsmannii
Stauntonia duclouxii	Stauntonia hexaphylla
Ficus beecheyana	Ficus erecta
Trachelospermum jasminoides	T. asiaticum var. intermedium
Hedera nepalensis var. sinensis	Hedera rhombea
etc.	

Thus it can be seen that the floristic composition of the broad-leaved evergreen forest in the two regions also has an evident resemblance. Many communities also interrelate, such as the Machilus thunbergii-forest of Jinshan Island in Shanghai and Machilus thunbergii-forest of Enoshima Island in Kanagawa, the Cyclobalanopsis myrsinaefolia-forest of Lingyin Temple in Hongzhou and Quercus(Cyclobalanopsis) myrsinaefolia-forest of Gokoku-Jinjya Shinto Shrine, Castanopsis carlesii-forest of Yunqi Temple in Hangzhou and Ardisio-Castanopsietum sieboldii-forest in Fuji City, etc.

As a whole, the floristic composition of the broad-leaved evergreen forest in eastern China especially in its southern part is far more complex than in central Japan. More than 40 species of vascular plants can be found in a sample plot of 400 m^2, probably as many as 80 species can be seen. We had a record of 252 species of vascular plants from these eight sample plots. They belong to 81 families and 161 genera, the diversity of communities is therefore evident as compared to central Japan. More species of Fagaceae, Lauraceae and Theaceae in the tree layer are distinguished in the broad-leaved evergreen forest of eastern China. For the Castanopsis, six species have been recognized, i.e. C. sclerophylla, C. eyrei, C. carlesii, C. lamontii, C. tibetane and C. armata; more than four species of Lithocarpus have been recognized, i.e. L. glaber, L. hancei, L. henryi and L. polystachya; more than seven species of Cyclobalanopsis have been discerned up to now, i.e. C. glauca, C. gracilis, C. stewardii, C. myrsinaefolia, C. gilva, C. nubium and C. multinervis. Besides there are various species of Hamamelidaceae, Elaeocarpaceae and Magnoliaceae. In the shrub layer there are more species of Fagaceae and Lauraceae. There are more than six species easily found in the genera

Eurya, i.e. E. emarginata, E. nitida, E. loquaiana, E. muricata, E. rubiginosa and E. japonica. It is worthwhile to point out that there are various species of Ericaceae, Symplocaceae and Rubiaceae, up to now these species do not occur in the broad-leaved evergreen forests of central Japan.

As the broad-leaved evergreen forests in eastern China have not been classified according to the Braun-Blanquet system, a comprehensive comparison with central Japan is limited. Based on the dominant and diagnostic species the broad-leaved evergreen forests in eastern China will be classified into several types. Some of them are identical to, or related with, communities in central Japan, such as Machilus thunbergii-forest, Cyclobalanopsis myrsinaefolia-forest, Cyclobalanopsis gilva-forest, Cyclobalanopsis gracilis-forest, Castanopsis carlesii-forest, some of them are unique in eastern China, e.g. Castanopsis fargesii-forest, Castanopsis eyrei - Schima superba-forest, Castanopsis lamontii-forest, Castanopsis tibetana-forest, Castanopsis armata-forest, Castanopsis fordii - C. fabri - C. fissa-forest, and Altingia gracilis-forest, etc. The syntaxonomy of the broad-leaved evergreen forests in eastern China is more complicated and requires further study in detail.

3. DISCUSSION

1. As the above results show, the broad-leaved evergreen forests in eastern China have many similarities with those in central Japan, but they are somehow distinct from each other. First of all, we have to look at the geographical background to these vegetations so as to find the causative factors.

Both central Japan and eastern China are located in the monsoon **climate** region, they have the moist temperate climate of Köppen climate types "Cf". Consequently, the major characteristics of the broad-leaved evergreen forest for both regions share identities in many aspects. However, the southeastern part of eastern China faces the sea, while the northwestern part extends inland. During the summer, it is under the influence of the strong southeastern monsoon wind, and the moist current from the ocean brings plenty of rainfall to this region. On the other hand,

during the winter, it is controlled by the Siberian high pressure, the dry cold wave from Siberia and the Mongolian plateau brings drought and cold. Therefore, the northwestern inland part is colder and drier, and the southeastern coastal part is more humid and warmer. As we know both sides of central Japan face the sea, during the summer, the southeastern monsoon wind brings a great quantity of rain to the Pacific side, the condition is similar with eastern China. During the winter, however, although central Japan is controlled by the Siberian cold wave too, the cold current is changed to some extent when passing by the Japanese Sea, and is further blocked by the central highlands. As a consequence, it gives the Japanese Sea side more rainfall and turns that area into a wet and snowy region in the winter. Therefore the annual temperature range in eastern China is greater than in central Japan, in general the continentality is also greater (Table 3).

The broad-leaved evergreen forest in Japan may extend in the north to 38°NL, on the contrary to the northern border of this forest in eastern China only reaches 32°NL. The shift of broad-leaved evergreen forest in Japan is 6° latitude further to the north than in China. However, due to the difference in latitude, the broad-leaved evergreen forests in China consist of more tropical and subtropical components, as well as species tolerant to drought and cold. In addition, there is a distinguishing feature in the topography of eastern China. A large part of the region in eastern China is mountainous and hilly, except for some deltas, plains and basins, the altitude is mostly 700-1000 m, and the peaks of mountains are always between 1500-200 m, therefore, they do not prevent the spreading of broad-leaved evergreen forests as the big mountains in central Japan do. Moreover these mountains are deeply cut, with numerous rivers and streams, the habitats are variegated, so that various types of plants tend to be conserved or even differentiated. This is one of the reasons why the constituents of broad-leaved evergreen forests in China are more diversified than in Japan.

2. The relationship of broad-leaved evergreen forests between the two regions might be analyzed by their background of **flora.** Both the flora of eastern China and central Japan belong to the Sino-Japanese floral region of the Holarctic floral kingdom. Therefore, the components of broad-leaved evergreen forests of the two regions have some identities, many families, genera, and species are the same.

Table 3. Climatic conditions at some stations in eastern China and central Japan

	Name of places	Locality	Altitude of station(m)	Minimum monthly temp.	Maximum monthly temp.	Annual average temp.	Annual temp. range	Accumulated temp. >10 c	Warmth Index
Eastern China	Shanghai	31°10'N 121°26'E	4.5	3.3	27.9	15.7	24.6	4947.3	130.2
	Hangzhou	30°19'N 120°12'E	7.2	3.6	28.7	16.1	25.1	5067.7	134.9
	Ningbo	29°55'N 121°35'E	25.0	4.1	28.3	16.2	24.2	5079.7	135.7
	Tengxi	29°43'N 118°17'E	146.7	3.7	28.3	16.3	24.6	5151.0	136.8
	Jinghua	29°07'N 119°39'E	64.1	4.9	29.6	17.4	24.7	5520.4	148.7
	Suichang	28°37'N 119°19'E	238.8	5.1	27.8	16.8	22.7	5300.3	141.5
	Longquan	28°05'N 119°08'E	198.4	6.4	28.0	17.6	21.6	5605.1	151.7
	Pucheng	27°55'N 118°32'E	283.3	6.2	27.9	17.5	21.7	5510.5	149.7
Japan	Tokyo			4.1	26.7	15.0	22.6		120.8
	Yokohama			4.1	25.8		21.7		123.7
	Shizuoka			5.7	26.4	15.7	20.7		128.7
	Osaka	34°39'N 135°32'E		4.5	28.0	15.6	23.5		128.4
	Sakata			0.9	24.7		23.8		92.7
	Takata			1.7	25.9	13.0	24.2		103.2
	Toyama			1.9	25.9		24.0		102.8

$$\text{Continentality} = \frac{1.7 \times \text{annual temperature range}}{\sin(\text{NL} + 10)} - 14$$

Tab. 3. Klimabedingungen an verschiedenen Orten Ostchinas und Zentraljapans

Coldness Index	Continentality	Annual rainfall	Share of rainfall in seasonal(%)				Source of data
			XII,I,II Winter	III,IV,V Spring	VI,VII,VIII Summer	IX,X,XI Autumn	
-2.1	49.5	1128.5	13	28.4	36.8	21.8	Climatic data of China 1951-1970
-1.4	51.9	1400.7	14.1	30.9	32.7	22.3	''
-0.9	50.1	1361.3	13.7	26.2	33.2	26.9	''
-1.3	51.4	1642.8	13.3	38.6	34.3	13.8	''
0	52.6	1404.8	14.0	39.2	31.0	15.8	''
0	47.8	1521.1	13.5	36.9	34.0	15.7	''
0	45.5	1752.2	13.2	40.0	34.4	12.4	''
0	46.0	1838.7	13.8	41.4	33.1	11.7	''
-1.1		1503	11.4	24.3	32.3	32.0	Numata(1974)
							Fujiwara(1981)
		2355	10.7	28.1	36.7	24.6	Numata(1974)
-0.6	42.8	1390	11.0	27.1	35.3	26.6	Nakanishi(1984)
							Fujiwara(1981)
-7.4		3038	43.1	14.0	16.4	26.5	Numata(1974)
0(?)							Fujiwara(1981)

The common species shared by the two regions, except those mentioned above, are as follows.

The major evergreen trees and shrubs:

Cyclobalanopsis gilva
Quercus phillyraeoides
Lithocarpus glaber
Elaeocarpus sylvestris var. ellipticus
E. japonicus
Lindera praecox
Ilex crenata
I. purpurea
I. integra
I. latifolia
Podocarpus nagi
P. macrophylla
Distyllum racemosum
Myrica rubra
Prunus spinulosa
Photinia glabra
Eurya emarginata
Ternstroemria gymnanthera
Symplocos glauca
S. lancifolia
S. prunifolia
Elaeagnus glabra
etc.

Deciduous trees and shrubs:

Zelkova serrata
Aphananthe aspera
Magnolia sieboldii
Quercus variabilis
Q. serrata
Styrax japonica
Cornus controversa
Mallotus japonicus
Albizia julibrissin
Rhus (Toxicodendron) succedanea
Rhus sylvestris
Euscaphis japonica
Idesia polycarpa
Deutzia scabra
Callicarpa japonica
Symplocos chinensis
Viburnum dilatatum
V. erosum
Helwingia japonica
etc.

Herbs, ferns, and dwarf shrubs:

Ophiopogon japonicus
Reineckia carnea
Liriope platyphylla
Cymbidium goeringii
Gleichenia glauca
Dicranopteris linearis
Parathelypteris (Thelypteris) glanduligera
Dryopteris lacera
Woodwardia japonica
Ardisia crispa
Skimmia japonica
etc.

Evergreen and deciduous lianas:

Akebia quinata
Ficus pumila
Ampelopsis brevipedunculata
Cayratia japonica
Uncaria rhynchophylla
Paederia chinensis
Pueraria lobata
Humulus japonicus
Dioscorea tokoro
etc.

On the other hand, there are some families, genera, and species in one region distinct from the other. Some families occur in eastern China but not in central Japan, such as: Nyssaceae, Erythroxylaceae, Annonaceae, etc. Genera that occur in eastern China but not in central Japan are:

Manglietia, Liriodendron, Calycanthus, Sassafras, Phoebe, Altingia, Liquidambar, Fortunearia, Sycopsis, Ormosia, Dalbergia, Pistacia, Schima, Alniphyllum, Halesia, Alyxia, Emmenopterys, etc.

The following genera occur in Japanese broad-leaved evergreen forests, but not, or very rarely, in eastern China: Fatsia, Aucuba etc. As the species found only in one region are much more numerous, they will not be listed here.

The relationship of the flora in the two regions can be recognized in historical perspective. Before the Pliocene the Japanese Islands were connected with the mainland China, the plants of the two regions tended to intermigrate uninterruptedly, therefore the fossils of remaining ancient plants in eastern China such as Ginkgo, Metasequoia, Glyptostrobus, Cunninghamia, Keteleeria, Pseudolarix, Engelhardtia, Eucommia, Liriodendrom, Sassafras, Tetracentron, Fortunearia, Liquidambar, Pistacia, Nyssa, Campthotheca, etc. are found in the cretaceous and tertiary stratum in Japan. During the quartenary period, after the separating of the Japanese Islands from the mainland, the flora of each region began to develop on its individual basis, therefore the constituents of the flora of the two regions are not only closely related, but also can be distinguished from each other. As for community classification it may be appropriate to divide the broad-leaved evergreen forests of eastern China and central Japan on the level of community class. This problem must be further studied.

3. By the comparison and analysis above, one should see the major characteristics of the broad-leaved evergreen forests of central Japan and eastern China as quite alike. They are of the same climatic climax type by the climax concept, and may unquestionably be attributed to the identical bioclimate vegetation zone. But there is some confusion about the terminology of the bioclimate vegetation zone. The majority of the Japanese scientists called the broad-leaved evergreen forests warm temperate forest (NAKANO 1942, SUZUKI 1963) or warm temperate broad-leaved evergreen forest (KIRA et al. 1978, MIYAWAKI 1967, 1984, NUMATA et al. 1972) or temperate broad-leaved evergreen forest (SATOO 1983). While most of the Chinese scientists referred to them as subtropical evergreen broad-leaved forests (HOU 1983, SONG 1983, WU 1980). The two terms have been applied by the scientists of various countries all over the world. OVINGTON (1983) and WALTER (1979) applied the term "warm and temperate

forest", while SCHMID (1949), SCHMITHUESEN (1976) and GULISASHVILI (1983) preferred the term "subtropical broad-leaved evergreen forest". The differences come from the understanding of the word "subtropics". One point of view is to confine the "subtropics" to a narrow transitional zone surrounding the tropics, while the broad transit zone between the tropics, subtropics, and temperate zone is referred to as warm temperate zone, consequently the broad-leaved evergreen forests are recognized as the climatic climax for the warm temperate zone. The other point of view refers the subtropics in a wide sense to the broad transitional zone between tropics and temperate zone. It is held by most Chinese scientists who defined subtropics as a region, which is slightly cold during the winter, so that most of the thermophilic plants grow poorly, the frost-free season persists more than eight months, there are two crops per year, the accumulated temperature (higher or equal to $10^{\circ}C$) is $4.500^{\circ}C$ to $8.000^{\circ}C$, the average temperature of the northern part during the coldest month is $2^{\circ}C$, and $16^{\circ}C$ in the southern part. The average extreme temperature ranges over -10 to $5^{\circ}C$ (ZHU 1958). By these criteria the subtropical zone of eastern China has its northern boundary over the Qinling Mountains and Huai River, i.e. along $33^{\circ}NL$, and in the south it reaches from the central Taiwan to the estuary of Zhujiang River, passing Yangjiang, Gaozhou, and the west of the Guangxi Autonomous Region to the southern part of Yunnan (Fig. 1). There is a discrepancy of view in China on the range of the subtropical zone, especially for the southern border, but all tend to admit that it is an independent zone. As the zone covers approximately 10° latitude from north to south, a great deal of difference in climate, soil, and vegetation occurs. Therefore the zone is often divided into several subzones, i.e. the southern subtropical, middle subtropical, and northern subtropical. Each subzone has its own climatic climax, such as subtropical broad-leaved evergreen forests with tropical elements, so-called monsoon broad-leaved evergreen forests for the southern subzone, the typical broad-leaved evergreen forest for the middle subzone, mixed broad-leaved deciduous and evergreen forests for the southern subzone.

Because of the confusion in the application of the term "subtropics", MEUSEL et al. (1965) have proposed the term "meridional" for the broad transitional zone between tropical and temperate zone. They were supported by HAEMET AHTI et al. (1974) and SCHROEDER (1983). HAEMET-AHTI et al. (1974) have further divided the meridional zone into four subzones

by the criteria of the annual biotemperature, they are: northern meridional subzone with 12-14°C (mean annual biotemperature); middle meridional subzone with 14-16°C; southern meridional subzone with 16-18°C; and "subtropical" (hemimeridional) subzone with 18-25°C.

There are some drawbacks in the word "meridional" itself, just as HAE-MET-AHTI et al. (1974) has pointed out, "in French it is used in common language to mean southern and in the Soviet Union and elsewhere it has been applied to denote the sectorial vegetation divisions (meridional zonation, e.g. KOMAROV 1922) or other longitudinal formations", therefore this term is not generally accepted yet. However, the idea that the meridional zone is an independent bioclimate vegetation zone and can be divided into some subzones, is very agreeable to us.

Our point of view is, it will be a difficult task to substitute the long used term "subtropical" and "warm temperate" with other terms. The word "association" in vegetation science is in the same case, it was given different meanings by various schools. As an appropriate term generally acceptable is not available, the only feasibility is to demand that the authors give the term an explicit definition for the conveniency of comparison, so as to have a consistent view. For this reason I would like to present a Table here (Table 4, in the supplementary appendix) to show the correspondence of the bioclimate vegetation zone between China and Japan to facilitate the further study on this problem.

SUMMARY

Based on vegetation relevés of Polysticho-Perseetum thunbergii, Ardisio-Castanopsietum sieboldii, Symploco glaucae-Castanopsietum sieboldii, Quercus myrsinaefolia-forest and Photinio-Castanopsietum cuspidatae in **central Japan**, and of Machilus thunbergii-forest, Cyclobalanopsis myrsinaefolia-forest, Castanopsis carlesii-forest, Castanopsis fargesii-forest, Cyclobalanopsis gracilis-forest, Castanopsis eyrei, Schima superba-forest, Castanopsis tibetana-forest and Castanopsis lamontii-forest in **eastern China**, the broad-leaved evergreen forests of both regions were compared. The results show that structure and plant composition of broad-leaved evergreen forests of both regions are very similar. In both regions there are many identical or vicarious species and interrelating plant communities, e.g. Machilus thunbergii-forest, Cyclobalanopsis myrsinaefolia-forest, Castanopsis carlesii-forest and Castanopsis cuspidata-forest etc. The floristic composition of broad-leaved evergreen for-

ests in eastern China, especially in its southern part, is much more complex than in central Japan. The similarities and variations are analyzed and the terminology of the bioclimate vegetation zones are discussed.

ZUSAMMENFASSUNG

Anhand von Vegetationsaufnahmen der Gesellschaften Polysticho-Perseetum thunbergii, Ardisio-Castanopsietum sieboldii, Symploco glaucae-Castanopsietum sieboldii, Quercus myrsinaefolia-Wald und Photinio-Castanopsietum cuspidatae in **Zentraljapan**, und Machilus thunbergii-Wald, Cyclobalanopsis myrsinaefolia-Wald, Castanopsis carlesii-Wald, Castanopsis fargesii-Wald, Cyclobalanopsis gracilis-Wald, Castanopsis eyrei, Schima superba-Wald, Castanopsis tibetana-Wald und Castanopsis lamontii-Wald in **Ostchina**, wurden die immergrünen Laubwälder beider Regionen verglichen. Die Ergebnisse zeigen, dass Struktur und Pflanzenzusammensetzung sehr ähnlich sind. In beiden Regionen kommen z.B. Machilus thunbergii-, Cyclobalanopsis myrsinaefolia-, Castanopsis carlesii- und Castanopsis cuspidata-Wald vor. Die Pflanzenzusammensetzung der immergrünen Laubwälder ist vor allem im Süden Ostchinas komplizierter als in Zentraljapan. Die Ursachen wurden untersucht, und die Terminologie der klimatischen Vegetationszonen wurde am Schluss diskutiert.

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Table 4. Comparison of the bioclimatic vegetation zones in China and Japan
Tab. 4. Bioklimatische Vegetationszonen in China und Japan

Author	Names of the bioclimatic vegetation									
Wu (1980)	Tropical monsoon & rain forest region	Subtropical broad-leaved evergreen forest region			Warm-temperate broad-leaved deciduous forest region		Temperate mixed needle and broad-leaved forest region		Cold-temperate needle-leaved forest region	
		Southern subtr.monsoon broad-leaved evergreen forest zone	Middle subtr.broad-leaved evergreen forest zone	Northern subtr.mixed broad-leaved deciduous evergreen forest zone	Southern warm-temperate broad-leaved deciduous forest zone	Northern warm-temperate broad-leaved deciduous forest zone	Southern temp.MNBF zone	Northern temp.MNBF zone	Southern cold-temperate needle-leaved deciduous forest zone	
Hou (1983)	Tropical seasonal rain forest region	Subtropical evergreen broad-leaved forest region			Temperate deciduous broad-leaved forest region				Cold-temperate deciduous needle-leaved forest region	
	Tropical broad-leaved rain forest and Tropical broad-leaved semi-evergreen forest	Broad-leaved evergreen forest of the transitional zone	Broad-leaved evergreen forest of the subtropical zone	Broad-leaved deciduous forest of the subtropical zone	Broad-leaved deciduous forest of the temperate zone		Mixed broad-leaved deciduous and needle-leaved evergreen forest of the temperate zone		Needle-leaved deciduous forest of the cold-temperate zone.	
Miyawaki (1967)		(Subtropical zone)	(Warm-temperate zone) Evergreen broad-leaved forest		Summer green broad-leaved forest				Subalpine coniferous forest	
		Camellietea japonicae			Fagetea crenatae				Vaccinio-Piceetea	
Kira (1949)		Subtropical rain forest	Laurel forest	Warm-temperate deciduous forest	Temperate deciduous forest				Coniferous forest	
Nakano (1942)		Subtropical forest	Warm-temperate forest		Cool-temperate forest				Subarctic forest	
Numata et al.(1972)		Evergreen broad-leaved forest region			Summergreen broad-leaved forest region				Subalpine,subarctic region.	
Song	Tropical (seasonal) rain forest	Subtropical broad-leaved evergreen forest			Temperate broad-leaved deciduous forest				Boreal needle leaved forest	
	Equa.	Midd.	North.	Southern subtropical transitional broad-leaved evergreen forest	Middle subtropical broad-leaved evergreen forest	Northern subtropical mixed broad-leaved evergreen deciduous forest	Southern temperate broad-leaved deciduous forest	Middle temperate broad-leaved deciduous forest	Northern temperate mixed needle and broad-leaved forest	Southern	Middle	Northern
Eastern China				Warm-loving species of Castanopsis,Cryptocarya forest. Warm loving species of Castanopsis,Schima wallidii forest Warm-loving species of Castanopsis,Machilus forest	Cyclobalanopsis glauca+ Castanopsis sclerophylla forest:Castanopsis eyrei +Schima superba forest: Cstanopsis cerlesii+Cstanopsis fargesii forest: Cyclobalanopsis gracilis+ Cyclobalanopsis nubium forest:Castanopsis tibetana forest: Castanopsis lamontii+Lithocarpus hancei forest: Castanopsis fordii+C.fabri+C. fissa forest: Altingia gracilis forest.	Warm-loving deciduous species of Quercus+ Cyclobalanopsis glauca+Cstanopsis sclerophylla+ Lithocarpus glaber forest.	Quercus acutissima forest: Quercus variablis forest.	Quercus liaotungensis forest	Quercus mongolica forest: Pinus koraiensis+Tilia amurensis+Betula costata forest:Pinus koraiensis+ Abies holophylla+Carpinus cordata forest.	Larix gmelini forest		
Japan				Psychotrio-Castanopsion sieboldii. Psychotrio manillensis-Acerion oblongi.	Maeso japoncae-Catanopsion sieboldii: Quercion acuto-myrsinaefoliae: Rhaphiolepiss-Quercion phyllyraeoides.	Tsuga sieboldii forests: Abies firma forests.	Fagus crenata forests: Fagus japonica forest: Pterocarya rhoifolia forest: Ulmus davidiana-Fraxinus mandshurica forest.			Abies mariesii-A.veitchii forests: Mixed forest of Thuja standishii and Tsuga diversifolia Larix leptolepis forests: Thickets of Quercus mongolica var.undulatifolia (Nanoquercetum): Betula ermani thickets: Picea jesoensis-Abies sachalinensis forests:Picea glehnii forests.		