

岩石海岸のカシワ林の植物社会学的研究

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Hiroki NAKANISHI*: Phytosociological Studies on *Quercus dentata* Scrubs of Rocky Coasts in Japan.

中西弘樹：岩石海岸のカシワ林の植物社会学的研究

Introduction

Coastal scrub vegetations are developed under the influence of salt spray brought by sea winds and occasionally show a wind-cut form in physiognomy. Stands of the scrub are usually in a deteriorated state occurring only on shallow soils on rocky slopes and sandy habitats. Along the coast in southern Japan, ever-green broad-leaved or sclerophyllous scrubs featuring *Pittosporum tobira* and *Quercus phillyraeoides* are widely distributed and have been phytosociologically studied by many authors (SUZUKI & HACHIYA 1951; YAMANAKA 1958; MIYAMOTO 1963, 1967; NAKANISHI & H. SUZUKI 1973; ITOW et al. 1974). On the other hand, deciduous scrubs dominated by *Quercus dentata* and *Q. mongolica* are found in northern Japan, especially on sand dunes in Hokkaido. But these scrubs have been destroyed by grazing, mowing and cutting, and many of these stands have been replaced by secondary herbaceous communities. The scrubs on sandy coasts in northern Japan were studied by TATEWAKI (1961), TUJII & YAMORI (1965) and OHBA, MIYAWAKI & TÜXEN (1973). The last authors established two associations for this scrub vegetation: the Angelico anomalaean-*Quercetum dentatae* and the Angelico anomalaean-*Quercetum mongolicae*. Specific studies for the *Quercus* scrub along the rocky coasts were undertaken by only a few authors (ISHIZUKA 1951; OKADA 1969). Plant geographical and syntaxonomical studies have never been made.

The aims of the present studies are to classify the *Quercus dentata* scrub vegetation of rocky coasts in Japan on a phytosociological basis using the method of the ZM school, and to describe the vegetation units with particular reference to the geographical factor.

I wish to express my sincere thanks to Prof. Emer. H. SUZUKI of Hiroshima University, under whose guidance the present studies were carried

out.

Area investigated and Methods

In the present study, I concentrated on sampling stands from the whole range of the *Quercus dentata* scrub as is occurred on rocky coasts in Japan. The 23 localities chosen for field investigation are shown in Fig. 1. The locality numbers coincide with NAKANISHI (1980) (see the Table 1 in NAKANISHI 1980). The additional localities shown the number with letter "N" are only listed in Table 1.

The study was carried out on the *Quercus dentata* scrub vegetation as it has developed on cliffs, slopes and outcrops along coastal areas.

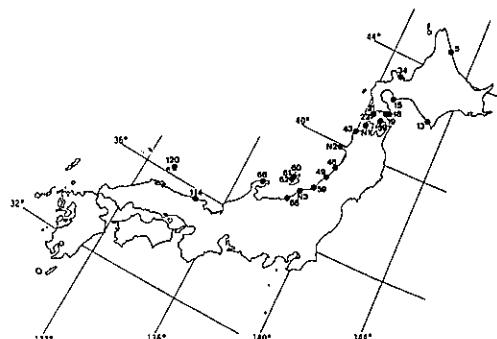


Fig. 1. Map showing the localities investigated.

Numerals on the map refer to the number of the localities shown in Table 1 of NAKANISHI (1980).

Table 1. Additional localities investigated

No.	Locality	Date of investigation
N1	Motowaki, Shiura-mura, Kitatsugaru-gun, Aomori Pref.	July 22. 1980
N2	Shiohama, Oga City, Akita Pref.	July 23. 1980
N3	Maze, Iwamuro-mura, Nishikanbara-gun, Niigata Pref.	July 25. 1980

*Ohte-machi 477-53, Nagasaki City 852, Japan 〒 852 長崎市大手町 477-53

The description and classification of the communities were made according to the ZM school of phytosociology (BRAUN-BLANQUET 1964; MUELLER-DOMBOIS & ELLENBERG 1974).

Classification

From 107 phytosociological records of the *Quercus dentata* scrub on rocky coasts, the following one alliance, two suballiances and five associations are classified.

All. *Quercion dentatae* all. nov. (Table 2)

Character species: *Quercus dentata*, *Quercus mongolica*. *Lonicera morrowii*.

Type association: Angelico anomalaе-Quercetum dentatae.

Distribution: San-in, Hokuriku, Tohoku and Hokkaido.

The natural *Quercus dentata* scrub vegetation is restricted to deteriorated stands where the natural climatic forests can not developed. These stands are found widely along coastal areas in northern Japan. The sandy coast *Quercus* scrub

vegetation is distributed from northern Tohoku to Hokkaido, but that along the rocky coast is distributed from the San-in District through Tohoku to the north. OHBA, MIYAWAKI & TÜXEN (1973) phytosociologically studied the scrub on the sandy coast in Hokkaido and suggested that the *Quercus* scrubs might be incorporated in an alliance. In the same district, the species composition of the rocky coast scrub is very similar to the one on sandy coast. The *Quercus dentata* scrubs along rocky coasts are incorporated into an alliance including the ones along sandy coasts.

The scrub of this rocky coast alliance is usually developed along the south-facing slopes which are exposed and sunny in the northern area. In the southern area, however, the scrub found on west-facing slopes are severely exposed to winter winds. The canopy of the scrub is occupied only by *Quercus dentata* and is occasionally associated with *Acer mono*, *Quercus mongolica* and *Viburnum dilatatum*. The herb layer is usually composed of many species.

Table 2. *Quercion dentatae*

- A. Suball. *Coccu* *orbiculati*-Quercenion: 1. *Albizia julibrissin*-Quercetum, 2. *Carici cuneatae*-Quercetum
B. Suball. *Celastris papillosi*-Quercenion: 3. *Angelico edulis*-Quercetum, 4. *Angelico ursinae*-Quercetum,
5. *Angelico anomala*-Quercetum

Cyrtomium falcatum	.	3	.	I	.	.	3	I	III	.	IV	Oniyabusotetsu
Sedum kamtschaticum	.	1	.	IV	I	I	3	I	III	.	Kirinso	
Luzula capitata	.	.	.	IV	r	I	3	.	.	.	Suzumenoyari	
Spodiopogon depauperatus	.	.	.	V	r	.	.	.	.	.	Miyanaaburasusuki	
Seseli libanotis var. japonica	.	.	.	V	I	.	.	.	.	.	Ibukibofu	
Dianthus superbus var. longicalycinus	III	3	.	V	I	.	.	.	.	.	Kawaranadeshiko	
Inula salicina var. asiatica	I	.	.	IV	I	.	.	.	.	.	Kasenso	
Cirsium japonicum	.	.	.	IV	I	.	.	.	.	.	Noazami	
Rhododendron japonicum	.	.	.	III	.	.	.	.	.	.	Rengetsutsuji	
Pinus densiflora	.	.	.	III	.	.	.	.	.	.	Akamatsu	
Lespedeza cuneata	.	.	.	III	.	.	.	.	.	.	Medohagi	
Akebia trifoliata	I	3	.	.	IV	.	.	.	.	.	Mitsubaakebi	
Dystaenia ibukiensis	II	1	.	.	III	.	.	.	.	.	Serimodoki	
Rosa multiflora	I	1	1	III	.	.	.	.	.	.	Noibara	
Wisteria floribunda	.	.	.	III	I	.	.	.	.	.	Fuji	
Euonymus sieboldianus	.	2	.	III	.	.	I	.	.	.	Mayumi	
Calamagrostis arundinacea var. brachytricha	.	.	.	III	.	.	I	.	.	III	Nogariyasu	
Sasa palmata	.	.	.	.	V	.	.	.	.	.	Chimakizasa	
Euonymus planipes	.	.	.	.	I	V	.	.	.	.	Ootsuribana	
Buglossoides zollingeri	.	.	.	.	I	V	.	.	.	.	Hotarukazura	
Picris hieracioides var. glabrescens	.	.	.	.	III	.	.	.	.	.	Kozorina	
Hemerocallis middendorffii	.	.	1	II	I	.	V	.	V	.	Ezozenteka	
Melica nutans	I	4	.	III	II	IV	V	V	V	II	IV	Komegaya
Artemisia montana	.	1	.	II	IV	V	IV	V	V	III	II	Oyomogi
Chrysanthemum yezoense	.	.	.	.	.	.	3	.	I	.	.	Kohamagiku
Sanguisorba tenuifolia var. alba	.	.	.	.	.	.	III	.	I	V	.	Nagabonoshirowaremoko
Chloranthus japonicus	.	.	.	.	.	.	IV	.	.	.	.	Hitorishizuka
Veratrum maackii var. Japonicum	.	.	.	.	.	.	IV	.	.	II	.	Shuroso
Lespedeza bicolor	.	2	.	.	I	.	II	I	I	IV	.	Yamahagi
Solidago virga-aurea var. gigantea	.	.	.	.	.	II	.	.	IV	.	II	Opakinokirinso
Achillea sibirica var. angustifolia	.	.	.	.	.	.	.	.	IV	.	I	Kitanokogiriso
Aralia cordata	.	.	.	.	.	.	.	.	IV	.	.	Udo
Pteridium aquilinum var. latiusculum	II	1	.	II	II	I	.	.	I	I	V	Marabi
Stellaria radians	.	.	.	.	.	.	.	.	V	.	.	Ezooyamahakobe
Vaccinium smallii	.	.	.	.	.	.	.	.	V	.	.	Oobasunoki
Galium kamtschaticum var. acutifolium	.	.	.	.	.	.	.	.	V	.	.	Oabayotsubamugura
Asarum heterotropoides	.	.	.	.	.	.	.	.	IV	.	.	Okuezosashin
Calamagrostis pseudo-phragmites	.	.	.	.	.	.	.	.	IV	.	.	Hossugaya
Carex pilosa	.	.	.	.	.	.	.	.	III	.	.	Sapporosuge
Carex siderosticta	.	.	.	.	.	.	.	.	V	.	.	Taganeso
Lysimachia clethroides	II	4	.	II	III	V	.	.	II	.	.	Okatoranoo
Actinidia arguta	.	.	.	.	.	.	.	.	.	.	III	Sarunashi
Arunchus dioicus var. kamtschaticus	.	.	.	.	.	.	.	.	.	.	III	Yamabukisomyoma
Smilacina Japonica	.	.	.	.	.	.	.	.	.	.	III	Yukizasa
Lastrea totta	.	.	.	.	r	.	.	.	.	.	III	Mizoshida
Disporum smilacinum	.	.	.	.	I	.	.	II	.	.	III	Chigoyuri
Ch. & diff. spp. of suballiance	.	.	.	.	.	.	.	.	.	.	.	.
Cocculus orbiculatus	I	2	1	II	III	V	.	1	.	.	.	Aotsurafuji
Smilax china	III	2	1	III	III	II	.	.	IV	.	.	Sarutorihibara
Ampelopsis brevipedunculata	I	2	1	.	II	I	.	.	I	.	.	Nobudo
Clematis terniflora	III	.	.	I	III	II	.	2	.	.	.	Senninso
Paederia scandens var. mairei	III	4	.	III	III	.	.	.	.	.	.	Hekusokazura
Pueraria lobata	.	.	1	III	III	.	.	.	.	.	.	Kuzu
Celastrus orbiculatus var. papillosum	.	.	.	.	II	V	.	2	IV	V	IV	Onitsuruumemodoki
Cirsium kamtschaticum	.	.	.	.	.	V	.	II	III	III	II	Chishimazami
Angelica edulis	.	.	.	.	.	III	IV	3	II	V	.	Amanyu
Morus bombycina	.	.	.	.	r	III	II	.	I	II	III	Yamaguwa
Sasa senanensis	.	3	.	.	.	III	II	.	IV	V	V	Kumaiwaza
Vitis coignetiae	.	.	.	.	.	III	.	II	I	I	IV	Yamabudo
Petasites japonicus var. giganteus	.	.	.	.	.	III	.	I	II	III	II	Akitabuki
Ch. spp. of alliance	V	4	3	V	V	V	4	4	V	V	V	Kashiwa
Quercus dentata	III	.	2	II	II	I	.	4	I	.	V	Hyotanboku
Lonicera morrowii	.	.	.	.	I	.	.	4	I	.	V	Mongorinara
Quercus mongolica	.	.	.	.	.	.	.	.	.	.	.	.
Ch. spp. of order & class	V	4	3	III	IV	II	.	.	III	IV	.	V
Viburnum dilatatum	I	4	2	I	III	I	.	.	I	.	.	Gamazumi
Polygonatum lasianthum	.	1	.	II	III	I	IV	1	.	.	.	Miyamanarukoyuri
Acer mono	.	1	.	II	III	I	IV	2	.	.	.	Itayakaede
Rhus ambigua	.	1	.	.	I	.	III	4	II	.	.	Tsutaurushi
Quercus mongolica var. grosseserrata	.	.	.	.	.	I	2	I	.	.	.	Mizunara
Tilia japonica	.	.	.	.	I	.	III	.	I	.	.	Shinanoki
Euonymus oxyphyllus	.	.	.	.	I	.	I	.	I	.	.	Tsuribana
Hydrangea petiolaris	.	.	.	.	.	.	I	.	I	.	I	Gotozuru
Companions	II	4	3	V	V	III	V	1	IV	V	V	III
Adenophora triphylla var. japonica	I	4	3	II	III	I	III	3	IV	I	I	III
Solidago virga-aurea var. asiatica	V	3	2	V	V	V	IV	4	.	III	III	I
Miscanthus sinensis	V	3	2	V	V	V	IV	2	IV	V	IV	I
Carex blepharicarpa	.	3	1	V	III	II	V	.	III	V	V	I
Thalictrum minus var. hypoleucum	II	3	3	III	V	V	.	.	III	V	V	V
Brachypodium sylvaticum	III	4	3	.	II	I	II	1	III	I	II	.
Galium verum var. asiaticum	.	.	.	.	I	I	II	1	I	II	.	I
Ligustrum obtusifolium	III	1	.	.	I	.	.	.	I	.	.	Kawaramatsuba
Polygonum sachalinense	.	.	.	.	I	.	.	.	I	.	.	Ibotanoki
Aster ageratooides var. ovatus	I	.	.	.	I	II	.	.	II	.	I	II
Osmunda japonica	.	1	.	.	r	.	.	.	.	II	.	Nokongiku
Viola kusanoana	.	.	.	I	.	.	I	.	I	.	I	Zenmai
	.	.	.	I	.	.	I	.	I	.	I	Otachitsubosumire

In Hokkaido, the scrub floor is usually covered with *Sasa senanensis* over which tall herbs grow, such as *Angelica* spp., *Cirsium kamtschaticum* and *Petasites japonicus* var. *giganteus*. Under the *Sasa* layer, small herbs are sparsely found due to the low light intensity. Common species in the herb layer are *Adenophora triphylla* var. *japonica*, *Artemisia montana*, *Solidago virga-aurea* var. *asiatica*, *Carex blepharicarpa*, *Misanthus sinensis* and *Thalictrum minus* var. *hypoleucum*. Most of these plants are component species of the herb communities in the class *Misanthetea*. This may be due to the fact that the scrub floor has a comparatively low light intensity and the stands have only shallow soils.

Suball. *Coccu* *orbiculati*-*Quercenion* *dentatae* suball. nov. (Table 2)

Differential species: *Coccu* *orbiculatus*, *Smilax china*, *Ampelopsis brevipedunculata*, *Clematis terniflora*, *Paederia scandens* var. *mairei*, *Pueraria lobata*.

Type association: *Carici cuneatae*-*Quercetum*.

Distribution: San-in, Hokuriku and western side of Tohoku

The *Quercus dentata* associations are distributed in the southern part of the *Quercion* region and are clearly different from those of northern part by the floristic composition and the physiognomy of the scrub floor. The southern type is differentiated by many liana plants. The herb layer is composed chiefly of cliff herbaceous vegetation elements, but not by *Sasa*. This type of scrub is assigned to a new suballiance; *Coccu* *orbiculati*-*Quercenion*.

The scrub which has developed in more southern region often has several species of the *Camellieta* element, which is especially characteristic of the *Pittosporion* and includes *Cyrtomium falcatum*, *Pittosporum tobira* and *Euonymus japonicus*.

The suballiance includes the following two associations.

1. Ass. *Albizio julibrissin*-*Quercetum* *dentatae* ass. nov. (Table 3; Fig. 2)

Character & differential species: *Albizia julibrissin*, *Celtis sinensis* var. *japonica*, *Pittosporum tobira*.

Type record: Table 3, column no. 5.

Distribution: San-in and Hokuriku.

Synonym: *Quercus dentata*-*Viburunum carlesii* var. *bitschense* comm. (H. SUZUKI & NAKANISHI 1972), *Quercus dentata*-*Albizia julibrissin* comm. (NAKANISHI 1981).

This *Quercus dentata* scrub vegetation is not clearly characterized by any species. The floristic compositions of all stands are more or less different from each other due to somewhat unstable stands and geography. It is restricted to the southern part of the *Quercus dentata* scrub region and is often associated with some evergreen plants of the alliance *Pittosporion*. This scrub is differentiated from the other *Quercus dentata* scrubs by the presence of *Albizia julibrissin*, *Celtis sinensis* var. *japonica* and *Pittosporum tobira*. The former two species are deciduous tree species. On the floor of this scrub, *Brachypodium sylvaticum* and *Dianthus superbus* var. *longicalycinus* are more frequently found than in the other scrub vegetation. *Misanthus sinensis* constantly occurs here.

The distribution of the association is in the area of the Japan Sea side of central Japan (Fig. 2), from the Sado Island of Niigata Prefecture, through the Hokuriku District, to the Oki Islands of Shimane Prefecture in the San-in District. Some fragments of this association seem to extend to northern Kyushu. Although in the Sanin District the *Pittosporion* scrubs are also found, this deciduous *Quercus* scrub is restricted to the slopes which are severely influenced by the

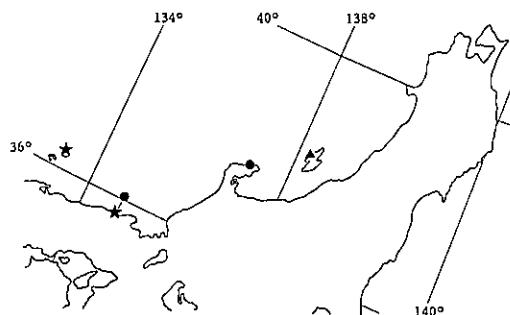


Fig. 2. Distribution of *Albizio julibrissin*-*Quercetum dentatae*. Subass. *festucetosum ovinae* (●), Subass. *epimedietosum semper-virens* (★), Subass. *euonymetosum japonici* (▲).

Table 3. *Albizio julibrissin*-*Quercetum dentatae*

1-a. Subass. *festucetosum ovinae*, 1-b. Subass. *epimedietosum sempervirens*
 1-c. Subass. *euonymetosum japonici*

Subassociation	1-a					1-b				1-c		
	1	2	3	4	5	6	7	8	9	10	11	12
Column number	120	120	120	114	114	68	68	68	114	61	61	61
Locality number	120	120	50	30	30	100	100	50	60	50	50	30
Altitude (m)	10	20	50	30	100	100	100	100	-	50	50	70
Distance from shoreline (m)	10	10	150	20	20	100	100	100	-	50	50	70
Slope aspect (°)	SW	NW	NW	E	E	NW	NW	NW	NW	SE	SE	S
	60	30	80			70	70	55	45	10	10	
Slope degree (°)	40	25	15	20	20	30	30	3	30	70	75	35
Height of shrub layer (m)	1	1.2	2.5	1.8	1.8	3	4	3	7	2	2	2.5
Coverage of shrub layer (%)	60	95	85	70	65	90	95	95	75	98	98	95
Height of herb layer (cm)	50	50	80	80	80	80	80	70	60	70	70	60
Coverage of herb layer (%)	60	15	40	70	70	90	65	65	50	10	5	15
Size of plot area (m²)	25	25	25	36	36	36	36	36	49	36	36	36
Number of species	19	20	22	20	18	33	39	34	38	16	16	15
Ch. & diff. spp. of association												
<i>Albizia julibrissin</i>	.	+	+2	+	12	22	11	12	+	.	11	.
<i>Celtis sinensis</i> var. <i>japonica</i>	.	.	+2	.	.	+	12	.	+	+	11	12
<i>Pittosporum tobira</i>	22	+	.	+	+	.	.	.	+	.	.	.
Diff. spp. of subassocoation												
<i>Festuca ovina</i>	12	+2	.	(+)	(+)	.	.	.	.	.	.	.
<i>Asparagus schoberioides</i>	+	+	.	+	+	.	.	.	.	.	.	.
<i>Carex breviculmis</i> var. <i>fibrillosa</i>	+	.	+2	+	+	.	.	.	.	.	.	.
<i>Piectranthus inflexus</i>	+	+2	+2	.	.	.	.	.	.	.	.	.
<i>Lysimachia mauritiana</i>	+	.	.	+	+	.	.	.	.	.	.	.
<i>Clematis terniflora</i>	+	.	+	+	+	.	.	.	.	.	.	.
<i>Artemisia japonica</i>	+	.	+2	+	+	.	.	.	.	.	.	.
<i>Prunus jamasakura</i>	.	.	.	.	.	+	22	22	+	.	.	.
<i>Epimedium sempervirens</i>	.	.	.	.	.	+2	+2	+	12	.	.	.
<i>Zanthoxylum piperitum</i>	.	.	.	.	.	+2	+	12	11	.	.	.
<i>Parthenocissus tricuspidata</i>	.	.	.	.	.	+2	+2	+	.	.	.	.
<i>Artemisia keiskeana</i>	.	12	.	.	.	+2	23	22	+	.	.	.
<i>Melica nutans</i>	.	+	.	.	.	12	12	33	+	.	.	.
<i>Sasa senanensis</i>	.	.	.	.	.	22	12	22	.	.	.	.
<i>Rubus palmatus</i>	.	.	.	.	.	12	+	+	.	.	.	.
<i>Hosta montana</i>	.	.	.	.	.	+	+	+	.	.	.	.
<i>Philadelphia satsumi</i>	.	.	.	.	.	+	+	+	.	.	.	.
<i>Aster scaber</i>	.	.	.	.	.	+	.	+	+	.	.	.
<i>Synurus palmatopinnatifidus</i>	.	.	.	.	.	+	+	+	+	.	.	.
<i>Rubus parvifolius</i>	.	.	.	.	.	+	+	+	+	.	.	.
<i>Euonymus japonicus</i>	.	.	.	.	.	+	+	+	+	33	33	33
<i>Cyrtomium falcatum</i>	.	.	.	.	.	+	+	+	+	+2	+2	+
<i>Festuca rubra</i>	.	.	.	.	.	+	+	+	+	+	+	Oniyabusotetsu
<i>Euonymus sieboldianus</i>	.	.	.	.	.	+	+	+	+	+	+	Ooushinokegusa
Ch. & diff. spp. of suballiance												
<i>Paederia scandens</i> var. <i>mairei</i>	+	.	+2	+	.	+	+2	+2	+	.	.	.
<i>Smilax china</i>	.	.	+2	+	+	+	+	+	.	.	.	.
<i>Cocculus orbiculatus</i>	+	.	.	.	.	+	+	+	.	.	.	Aotsuzurafuji
<i>Ampelopsis brevipedunculata</i>	.	.	+	.	.	+	+	+	.	.	.	Nobudo
<i>Pueraria lobata</i>	.	.	.	.	.	12	.	.	.	+	.	Kuzu
Ch. spp. of allinace												
<i>Quercus dentata</i>	33	33	55	44	44	55	44	44	44	55	55	55
<i>Lonicera morrowii</i>	12	+	+	.	.	.	.	.	.	+	+	.
Ch. spp. of order & class												
<i>Viburnum dilatatum</i>	.	.	.	.	.	12	+2	12	12	+	+	+
<i>Polygonatum lasianthum</i>	.	+2	.	.	.	.	.	.	.	+	+	Miyamanarukoyuri
<i>Rhus ambigua</i>	.	.	.	.	.	+2	.	.	.	.	.	Tsutausrushi
<i>Acer mono</i>	.	.	.	.	.	.	12	.	.	.	.	Itayakaede
Companions												
<i>Brachypodium sylvaticum</i>	+2	.	.	44	44	+2	12	22	22	+	+	12
<i>Miscanthus sinensis</i>	+2	+2	12	11	12	+2	+2	12	12	+	+	.
<i>Adenophora triphylla</i> var. <i>japonica</i>	+	+	.	.	.	+	+2	+	+	+	+	.
<i>Solidago virga-aurea</i> var. <i>asiatica</i>	.	+	.	.	.	+	+	+	+	+	+	Akinokirinso
<i>Lysimachia clethroides</i>	.	+	.	+	+	12	+2	12	+	.	.	.
<i>Dianthus superbus</i> var. <i>longicalycinus</i>	+	.	+	+	+	+	+	+	+	.	.	Kawaranadeshiko
<i>Thalictrum minus</i> var. <i>hypoleucum</i>	.	.	+	+	.	.	.	.	+	+	+	Akikaramatsu
<i>Ligustrum obtusifolium</i>	.	.	+	+	11	.	+	.	.	.	.	Ibotanoki
<i>Akebia trifoliata</i>	.	.	+	.	.	+	+	+	+	.	.	Mitsubaakebi
<i>Carex blepharicarpa</i>	.	.	.	.	.	22	44	44	.	.	.	+2 Shojyosuge
<i>Viola grypoceras</i>	.	+	.	.	.	+	+	.	.	.	.	Tachitsubosumire
<i>Pteridium aquilinum</i> var. <i>latiusculum</i>	.	.	+2	.	+	.	+2	.	.	.	.	Warabi
<i>Rosa multiflora</i>	.	.	+	+	.	+2	.	.	.	+	.	Noibara
<i>Chrysanthemum makinoi</i> var. <i>wakasaense</i>	.	.	.	+	11	.	+	+	+	.	.	Wakasahamagiku
<i>Dystaenia ibukiensis</i>	.	.	.	+	+	.	.	+	+	.	.	Serimodoki
<i>Spodiopogon sibiricus</i>	+	+	.	.	.	.	.	.	.	.	.	Oaaburasusuki
<i>Hypericum erectum</i>	+	+	.	.	.	.	.	.	.	.	.	Otogiriso
<i>Chrysanthemum okiense</i>	+	.	12	.	.	.	.	.	.	.	.	Okinoaburagiku
<i>Pinus thunbergii</i>	.	+	.	.	.	.	12	.	.	.	.	Kuromatsu

<i>Elaeagnus umbellata</i>	:	.	+	+	:	.	+	.	.	.	.	.	.	.	Akigumi
<i>Lespedeza bicolor</i>	:	.	.	.	:	+	+	.	.	.	.	.	.	.	Yamahagi
<i>Ophiopogon japonicus</i>	:	.	.	.	:	+	.	.	11	.	.	.	.	.	Jyanohige
<i>Angelica pubescens</i>	:	.	.	.	:	.	+	+	.	.	.	.	.	.	Shishiudo
<i>Mallotus japonicus</i>	:	.	.	.	:	.	.	.	12	+	.	.	.	.	Akamegashiba
Other companions: in column no. 1. <i>Cynanchum wilfordii</i> (Koikema) +, in 2. <i>Viburnum carlesii</i> var. <i>bitchuense</i> (Chojigamazumi) 22, <i>Inula salicina</i> var. <i>asiatica</i> (Kasenso) +2, in 3. <i>Aster ageratoides</i> var. <i>ovatus</i> (Nokongiku) 33, <i>Lonicera japonica</i> (Suikazura) 12, <i>Oxalis corniculata</i> (Katabami) +, <i>Vitis ficifolia</i> var. <i>lobata</i> (Ebizuru) +, in 6. <i>Sedum kamtschaticum</i> (Kirinso) +2, <i>Zelkova serrata</i> (Keyaki) 12, in 7. <i>Akebia quinata</i> (Akebi) +, <i>Oplismenus undulatifolius</i> var. <i>japonicus</i> (Chijimizasa) +, <i>Ophiopogon planiscapus</i> (Oobajyanoohige) +, <i>Trachelospermum asiaticum</i> (Teikakazura) +, <i>Carex humilis</i> var. <i>nana</i> (Hosobahikagesuge) 12, in 8. <i>Artemisia montana</i> (Ooyomogi) +, <i>Patrinia villosa</i> (Otokoeshi) +, <i>Campanula punctata</i> (Hotarubukuro) +, <i>Dioscorea japonica</i> (Yamanoino) +, <i>Codonopsis lanceolata</i> (Tsuruninjin) +, <i>Eupatorium chinense</i> var. <i>simplicifolium</i> (Hiyodoribana) +, <i>Cerastium fischerianum</i> +, in 9. <i>Rhododendron kaempferi</i> (Yamatsutsuji) 22, <i>Ilex crenata</i> (Inutsuge) 12, <i>Carex lanceolata</i> (Hikagesuge) 12, <i>Struthiopteris niponica</i> (Shishigashira) +2, <i>Osmanthus japonica</i> (Zenmai) +, <i>Gentiana scabra</i> var. <i>buergeri</i> (Rindo) +, <i>Elaeagnus macrophylla</i> (Oobagumi) +, <i>Ardisia japonica</i> (Yabukoji) +, <i>Eurya japonica</i> (Hisakaki) 11, <i>Cinnamomum japonicum</i> (Yabunikkei) +, <i>Hydrangea luteovenosa</i> (Kogakuutugi) +, <i>Spiraea obtusa</i> (Tangoiwagasa) +, in 10. <i>Rubia jesoensis</i> (Ooakane) +, in 12. <i>Hemerocallis middendorffii</i> (Ezozenteika) +.															

northwesterly wind in winter.

By the difference of floristic composition and edaphic conditions, this association is distinguished into three subassociations.

1-a. Subass. *festucetosum ovinae*

Differential species: *Festuca ovina*, *Asparagus schoberioides*, *Carex breviculmis* var. *fibrillosa*, *Plectranthus inflexus*, *Lysimachia mauritiana*, *Clematis terniflora*, *Artemisia japonica*.

Distribution: Shimane and Hyogo Prefectures.

This subassociation is the southernmost type of this association. The stands are on rocky slopes with shallow soils. The canopy of the scrub is never closed by *Quercus dentata* and the height is 1 to 2.5 m. Consequently, the herbaceous community elements of the rocky coasts, such as *Festuca ovina*, *Artemisia japonica* and *Lysimachia mauritiana*, are often found on the floor.

1-b. Subass. *epimedietosum sempervirens*

Differential species: *Prunus jamasakura*, *Epimedium sempervirens*, *Zanthoxylum piperitum*, *Parthenocissus tricuspidata*, *Artemisia keiskeana*, *Melica nutans*, *Sasa senanensis*, *Rubus palmatus*, *Hosta montana*, *Philadelphus satsumi*, *Aster scaber*, *Rubus parvifolius*, *Synurus palmatopinnatifidus*.

Distribution: Hyogo and Ishikawa Prefectures.

This subassociation is developed on the upper parts of cliffs at altitude of 50 to 100 m. Consequently, the scrub is scarcely influenced by salt spray in spite of receiving heavy winds. The occurrences of *Rubus parvifolius*, *R. palmatus* and *Zanthoxylum piperitum* may, however, indicate unstable conditions of these stands. Habitats of

these scrub are provided with moist deeper soils, so that many herbaceous species are found. The frequent occurrence of ever-green herbs, such as *Carex* spp., ferns, *Epimedium sempervirens* and *Ophiopogon japonicus* are especially conspicuous. The number of component species is very great, 36.0 on the average. The record (column no. 9) from Hyogo Prefecture is somewhat different from the others, but is obviously included in this subassociation.

1-c. Subass. *euonymetosum japonici*

Differential species: *Euonymus japonicus*, *Cyrtomium falcatum*, *Festuca rubra*, *Euonymus sieboldianus*.

Distribution: Niigata Prefecture (Sado Is.)

The present subassociation which is the northernmost type of the association is developed on the south-facing slope. *Euonymus japonicus* and *Cyrtomium falcatum*, which are differential species of this subassociation, are also character species of the alliance *Pittosporion tobirae*. The first species is the only ever-green shrub in this deciduous scrub vegetation. Due to the steep slopes of 35 to 75 degrees, the undergrowth coverage is poor, 5 to 15 %. The number of component species is 15.7 on the average.

2. Ass. *Carici cuneatae-Quercetum dentatae*

ass. nov. (Table 4; Figs. 3 and 4)

Character & differential species: *Carex stenostachys* var. *cuneata*, *Potentilla togashii*, *Prunus apetala* var. *pilosa*, *Saussurea nipponica* var. *muramatsui*.

Type record: Table 4, column no. 19.

Distribution: Hokuriku and western side of Tohoku.

Synonym: *Quercus dentata*-*Acer mono* thicket (YOSHIOKA 1964), *Quercus dentata*-*Tilia japonica* comm. (OKADA 1969).

This *Quercus dentata* scrub, especially in Sado Island, has been studied by several authors (YOSHIOKA 1957, 1964; OKADA 1969; HONMA 1972), but has not been treated phytosociologically based on the method of the ZM school.

The present association is characteristically associated with the many endemic species which are restricted to the Japan Sea side of northern Honshu. The floor is usually densely covered with graminoides species (*Carex blepharicarpa*, *C. stenostachys* var. *cuneata* and *Festuca rubra*). In the shrub layer, *Quercus dentata* is a dominant species. *Viburnum dilatatum* and *Acer mono* also commonly occur. *Euonymus sieboldianus* and *Prunus apetala* var. *pilosa* are often found. These shrubby species are not abundant, except for *Quercus dentata*. The scrub is constantly associated with many liana plants such as *Cocculus orbiculatus*, *Clematis terniflora*, *Pueraria lobata* and *Paederia scandens* var. *mairei*, but they are not abundant. In natural conditions this *Quercus dentata* scrub is closely related to the *Acer mono*- or the *Zelkova serrata*-forests. These communities floristically resemble each other, but are physiognomically and ecologically different. The latter two forests developed on the more favored stands, that is less exposed and with deeper soils. This association is divided into the following three subassociations.

2-a. Subass. *festucetosum rubrae*

Differential species: *Festuca rubra*, *Seseli libanotis* var. *japonica*, *Dianthus superbus* var. *longicalycinus*, *Spodiopogon depauperatus*, *Sedum kamtschaticum*, *Luzula capitata*, *Inula salicina* var. *asiatica*, *Cirsium japonicum*, *Rhododendron japonicum*, *Lespedeza cuneata*, *Pinus densiflora*.

Distribution: Niigata Prefecture (Sado Is.).

This subassociation is commonly found on west-facing coastal slopes on Sado Island. The stands are usually on gravelly outcrops. Such stands permit the occurrence of the plant of the order Sedo-Festucetalia in the herb layer whose coverage is 30 to 85 %, average 65 %. *Festuca rubra* is usually dominant and some other species

are constantly found, but not abundant. The scrub is occasionally developed close to the *Pinus densiflora* secondary forests, so that *Pinus densiflora* and *Rhododendron japonicum* have invaded there.

2-b. Subass. *akebietosum trifoliatae*

Differential species: *Akebia trifoliata*, *Dystaenia ibukiensis*, *Rosa multiflora*, *Wisteria floribunda*, *Euonymus sieboldianus*, *Calamagrostis arundinacea* var. *brachytricha*.

Distribution: Niigata, Yamagata, Akita and Aomori Prefectures.

This subassociation is the commonest and widest spread type of the association *Carici-Quercetum*. The stands are exposed by wind, but not salt spray. The height of this scrub is taller; some are 6 to 7 m in height and the number of component species is more than the other sub-associations. Some stands of the subassociation are facing south and in sunny conditions so that

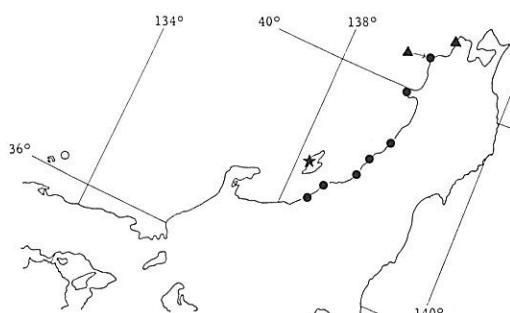


Fig. 3. Distribution of *Carici cuneatae*-*Quercetum dentatae*. Subass. *festucetosum rubrae* (●), Subass. *akebietosum trifoliatae* (★), Subass. *euonymetosum planipes* (▲).



Fig. 4. *Carici cuneatae*-*Quercetum dentatae* at the Oga Peninsula in Akita Prefecture, Tohoku.

Table 4. *Carici cuneatae-Quercetum dentatae*2-a. Subass. *festucetosum rubrae*, 2-b. Subass. *akebietosum trifoliat*

Subassociation	2-a																	2-b																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17					
Column number	60	60	60	60	60	60	60	59	59	59	46	46	46	62	62	66	66	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60					
Locality number	40	30	25	25	30	30	10	30	50	30	15	17	17	10	10	75	75	20	15	30	30	10	20	60	30	30	10	10	10	10	10	10	10						
Altitude (m)	80	55	80	80	55	40		20	60	100	150	50	60	60	20	10	10	10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20						
Distance from shoreline (m)	NW	NW	W	W	SW	NW	NW	SE	S	SE	SE	SE	SE	SE	SE	SE	S	SW	NW	NW	W	W	SW	NW	NW	SE	S	SE	SE	SE	S	SW							
Slope aspect (°)	25	30	15	15	10	15	20	25	15	10	10	15	10	10	25	25	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40						
Slope degree (°)	2	4	1	12	2	12	18	6	6	5	4	4	4	4	6	6	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6						
Height of shrub layer (m)	100	85	95	100	98	100	90	80	80	95	98	98	98	98	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95						
Coverage of shrub layer (%)	60	80	30	40	50	50	50	70	70	50	50	50	50	50	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60						
Height of herb layer (cm)	80	65	75	85	30	80	45	80	80	98	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90						
Coverage of herb layer (%)	49	49	4	9	25	9	9	49	49	49	25	25	25	25	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36					
Size of plot area (m^2)	20	25	16	20	21	18	24	29	31	25	34	32	33	25	23	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22					
Number of species																																							
Ch. & diff. spp. of association																																							
<i>Carex stenostachys</i> var. <i>cuneata</i>	12	11	11	22	+2	22	12	12	22	33	22	22	22	22	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33				
<i>Potentilla togasii</i>	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Saussurea nipponica</i> var. <i>muramatsui</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Prunus apetala</i> var. <i>pilosa</i>	.	.	.	.	.	.	.	.	12	+	12	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Diff. spp. of subassociation																																							
<i>Festuca rubra</i>	23	33	44	33	33	12	12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Seseli libanotis</i> var. <i>japonica</i>	+2	12	+	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Dianthus superbus</i> var. <i>longicalycinus</i>	+	+2	+	+	+	+2	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Spodiopogon depauperatus</i>	(+)	+2	+2	+2	.	+2	.	+2	22	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Sedum kamtschaticum</i>	+2	.	+	+	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Luzula capitata</i>	.	+	.	+	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Inula salicina</i> var. <i>asiatica</i>	.	+	+	+	+	+	+	+2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Cirsium japonicum</i>	.	+	+	+	+	+	+	+	+2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Rhododendron japonicum</i>	.	.	.	(+)	11	33	12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Lespedeza cuneata</i>	+	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Pinus densiflora</i>	.	.	.	.	.	.	.	11	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Akebia trifoliata</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Dystaenia ibukiensis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Rosa multiflora</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Wisteria floribunda</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Euonymus sieboldianus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Calamagrostis arundinacea</i> var. <i>brachytricha</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Euonymus planipes</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Cirsium kamtschaticum</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Sasa palmata</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Buglossoides zollingeri</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Morus bombycina</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Angelica edulis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Picris hieracioides</i> var. <i>glabrescens</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ch. & diff. spp. of suballiance																																							
<i>Cocculus orbiculatus</i>	.	+2	.	.	+	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Paederia scandens</i> var. <i>mairei</i>	.	.	.	+	+	+	+	+	+	.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+					
<i>Pueraria lobata</i>	(+)	.	+	.	+	(+)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Clematis terniflora</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Ampelopsis brevipedunculata</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ch. spp. of alliance																																							
<i>Quercus dentata</i>	55	55	55	55	55	55	55	44	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	44	44	44	44	44		
<i>Lonicera morrowii</i>	(+)	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Quercus mongolica</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ch. spp. of order & class																																							
<i>Viburnum dilatatum</i>	.	+	+	(+)	.	.	.	+	12	+	12	+	12	+	12	+	12	+	12	+	12	+	12	+	12	+	12	+	12	+	12	+	12	+	12				
<i>Acer mono</i>	.	+	+	.	.	.	.	11	11	+	.	11	11	+	.	11	11	+	11	11	+	11	11	+	11	11	+	11	11	+	11	11	+	11	11	+	11	11
<i>Polygonatum lasianthum</i>	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Rhus ambigua</i>
<i>Tilia japonica</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Euonymus oxyphyllus</i>	.	.																																					

ae, 2-c. Subass. *euonymetosum* planipes

Plectranthus inflexus	.	.	.	.	.	.	.	+	+2	+	+2	+2	.	.
Serratula coronata var. insularis	.	.	.	.	.	.	.	+	+	+	+	.	.	.
Abelia spathulata var. stenophylla	.	.	.	.	.	.	+	+	+	+2	+	12	.	.
Aster ageratoides var. ovatus	.	.	.	.	.	12	12	23	.	.	.	.	.	.
Ceitis sinensis var. japonica	.	.	.	.	.	+	.	.	.	.	.	12	11	11
Weigela coraeensis	.	.	.	.	.	+2	.	.	.	.	.	.	.	.
Carex humilis var. nana	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hemerocallis middendorffii	+2	12	.	.	.	.	+	+	+2	+	.	+	.	.
Zanthoxylum schinifolium	.	.	.	.	.	.	+	+	+2	+	+2	+2	.	.
Patrinia villosa	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Chloranthus serratus	.	.	.	.	.	.	.	+	+2	+	+2	+2	.	.
Liriope platyphylla	.	.	.	.	.	.	.	.	.	.	+	+2	+2	.
Vicia fauriei	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Zelkova serrata	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Angelica decursiva	.	.	.	.	.	.	.	+	+2	+2	+2	.	.	.
Rhus javanica	.	.	.	.	.	.	.	.	.	.	+	+	.	.
Lespedeza cyrtobotrya	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Veronica kiusiana var. maritima	.	+	.	+	.	.	+2	.	.	.	.	.	+2	.
Partehnocissus tricuspidata	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Allium grayi	.	.	.	.	.	.	+2	+	.	+	.	.	.	.
Lespedeza bicolor	.	.	.	.	.	.	+	.	.	+	.	.	.	.
Angelica pubescens	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Machilus thunbergii	.	.	.	.	.	.	.	+	+	+	.	.	.	.
Aralia elata	.	.	.	.	.	.	.	+	+	+	.	.	.	.
Athyrium niponicum	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Neolitsea sericea	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Campanula punctata	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Conioselinum kamtschaticum	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aconitum sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Zanthoxylum piperitum	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eurya japonica	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Achillea ptarmica var. macrocephala	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gaultheria verum var. asiaticum	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rubia jescoensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Allium schoenoprasum var. foliosum	+2	+	.	.	.	.	.	.	.	.	.	.	.	.
Sedum oryzifolium	+2	+2	.	.	.	.	.	.	.	.	.	.	.	.
Leibnitzia anandria	.	.	.	.	.	.	+	.	.	.	.	.	.	+
Sasa sp.	.	.	.	.	.	.	.	+2	+2	.	.	.	.	.
Viola kusanoana	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Dioscorea tokoro	.	.	.	.	.	.	.	.	+	+	.	.	.	.
Rubia akame	.	.	.	.	.	.	.	.	+	.	(+)	.	.	.
Oplismenus undulatifolius var. japonicus	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Cyrtomium falcatum	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Scilla scilloides	.	.	.	.	.	.	.	.	.	.	.	.	+	+
Asparagus schoberioides	.	.	.	.	.	.	.	.	.	.	.	.	+2	.
Dioscorea japonica	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Ligustrum obtusifolium	.	.	.	.	.	.	.	.	.	.	.	.	.	+2
Agastache rugosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rubus parvifolius	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polygonum sachalinense	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Allium victorialis var. platyphyllum	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Malus baccata var. mandshurica	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vicia bifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Disporum smilacinum	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Other companions: in column no. 2. *Fraxinus lanuginosa* (Kobanoton 8. *Rosa wichuraiana* (Terihanoibara) +2, in 9. *Spiraea japonica* var. *nata* (Sumiresaishin) +, *Veratrum maackii* var. *japonicum* (Syuroso) *bia quinata* (Akebi) +, in 18. *Ophiopogon japonicus* (Jyanohige) +, in 27. *Abelia spathulata* (Tsukubaneutsugi) +2, *Rhododendron kaempferi* +, *Dryopteris varie* var. *setosa* (Itachishida) +, *Hosta montana* so) 12, *Astilbe thunbergii* var. *congesta* (Toriashishoma) 12, *Prunus* +2, *Pourthiae villosa* (Watagekanatsuka) +, in 30. *Malus sieboldii* *dispalata* (Kasasuge) 12, in 36. *Vicia japonica* (Hirohakusafuji) +, *auriculata* var. *kamtschatica* (Mimikomori) 12, *Smilax riparia* var.

many herbaceous species most of which are the elements of the inland glassland of *Misanthetetea* invade the floor whose cover degree is high, 80 to 98 %. The stands, observed at Yuza in Yamagata Prefecture, are constantly associated with *Machilus thunbergii* in the shrub layer and may have been derived from seeds carried there by birds. The *Machilus thunbergii* forest is luxuriantly developed near the coast of this region. Typical

scrub of this subassociation are found in Tsuruoka of Yamagata Prefecture.

2-c. Subass. *euonymetosum planipes*

Differential species: *Euonymus planipes*, *Cirsium kamtschaticum*, *Sasa palmata*, *Buglossoides zollingeri*, *Morus bombycis*, *Angelica edulis*, *Picris hieracioides* var. *glabrescens*.

Distribution: Aomori Prefecture.

This *Quercus* scrub is observed in the northern-

eriko) +, in 4. *Elaeagnus umbellata* (Akgumi) +, in 7. *Lespedeza pilosa* (Nekohagi) +, in 8. *Lathyrus* tomentosa (Onihosobashimotsuke) +, *Asplenium incisum* (Toranooshida) +, in 10. *Viola vaginata* +, in 11. *Lilium auratum* (Yamayuri) +, in 14. *Arisaema urashima* (Urashimaso) +, in 16. *Akebia quinata* +, in 19. *Sanicula chinensis* (Umanomitsuba) +, in 26. *Polygonatum macranthum* (Oonarukoyuri) +, in 28. *Boehmeria* sp. (Yabumao sp.) 12, *Poa sphondyloides* (Ichigotsuna-ko) +, in 29. *Carex pachygyna* (Sasahosuse) 12, *Epimedium cremeum* (Kibanaikiso) +, in 30. *Sargentsia sargentii* (Ooyamazakura) 11, *Commelina communis* (Tsuyukusa) +², *Lastrea totta* (Mizoshida) (Zumi) 11, *Osmunda japonica* (Zenmai) +, in 32. *Carex conica* (Himekansuge) +, in 34. *Carex stipularis* +, in 37. *Cystopteris fragilis* (Nayoshida) +, in 38. *Rumex acetosa* (Suiba) +, in 39. *Cacalia ussuriana* (Shiojide) +, *Agropyron tsukushinense* var. *transiens* (Kamijoqusa) +.

most locations in the Cocculo-Quercenion dentatae. Some elements of the northern type of the *Quercus dentata* scrub; *Celastrion papillosi* are found. In the shrub layer, *Celastrus orbiculatus* var. *papillosum*, *Cocculus orbiculatus* and *Vitis ficifolia* var. *lobata* which are liana plants constantly occur. Unlike the other sub-associations, tall herbs such as *Cirsium kamtschaticum*, *Angelica edulis* and *Artemisia*

montana grow in the herb layer of this sub-association.

Suball. *Celastrio papillosoi-Quercenion dentatae*
suball nov. (Table 2)

Character & differential species: *Celastrus orbiculatus* var. *papillosum*, *Cirsium kamtschaticum*, *Angelica edulis*, *Morus bombycina*, *Sasa senanensis*, *Vitis coignetiae*, *Petasites japonicus* var. *giganteus*.

Table 5. Angelico edulis-Quercetum dentatae

	3-a. Subass. hemerocallietosum middendorffii,															3-b. Subass. festucetosum ovinae									
Subassociation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20					
Column number	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	39	39	39	39					
Locality number	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	39	39	39	39					
Altitude (m)	25	25	50	40	40	35	35	50	55	70	70	70	70	70	70	70	20	20	-	-					
Distance from shoreline (m)	50	50	100	-	-	-	-	-	-	150	150	100	100	100	100	100	5	5	-	-					
Slope aspect (°)	SW	SW	SW	SW	SW	SW	SW	W	SW	W	SW	NM	-	-	NM	-	-	-	-	-					
Slope degree (°)	25	25	30	20	20	20	20	80	70	80	45	-	-	-	50	-	-	-	-	-					
Height of shrub layer (m)	20	20	10	20	-	-	3	5	5	5	5	0	0	0	5	0	0	0	0	-					
Coverage of shrub layer (%)	4	5	6	7	7	2	2	3	3	3	7	45	3	8	8	9	09	11	16	15					
Height of herb layer (cm)	90	95	90	85	95	80	80	75	90	95	90	85	90	90	90	80	85	95	95	95					
Coverage of herb layer (%)	80	80	80	100	100	100	80	100	100	90	90	80	80	100	70	-	20	50	50	-					
Size of plot area (m²)	90	90	90	100	90	90	80	90	90	100	100	100	100	95	90	-	85	70	98	98					
Number of species	10	12	16	17	15	11	10	14	14	13	13	17	12	16	15	16	10	15	16	15					
Diff. spp. of subassociation																									
Hemerocallis middendorffii	12	12	33	22	22	+2	12	12	+2	12	12	12	12	12	12	+2	+2	.	.	.	Ezoenteika				
Melica nutans	+2	.	+	+2	+2	12	.	+2	12	+	+	+	+	+	+	+2	+2	.	.	.	Komegaya				
Artemisia montana	.	+2	+2	22	+	.	.	.	+2	+2	12	12	12	12	12	+2	.	.	.	.	Oyonomogi	
Vitis coignetiae	.	.	+	+	+	+	.	.	+	+	+	+	+	+	+	+2	+	.	.	.	Yamabudo				
Sasa senanensis	.	.	.	.	.	.	.	.	55	55	55	55	55	55	55	.	.	.	.	.	Kumazasa	
Festuca ovina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	44	33	44	44	Ushinokogusa	
Quercus mongolica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	(+)	+12	22	.	.	Mongorinara	
Chrysanthemum yezoense	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	12	+2	12	.	.	Kohamagiku	
Luzula capitata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	Suzumenojari	
Sedum kamtschaticum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+2	+	4	.	.	Kirinse	
Ch. & diff. spp. of suballiance																									
Celastrus orbiculatus var. papillosum	+	+2	+2	12	12	+2	.	+	+2	+2	12	+	+2	+2	+2	+2	+2	.	22	+2	Onitsurumemodoki				
Angelica edulis	.	+	+	+	+	+	.	+2	12	+2	12	+	+	+	+	12	.	+	+2	12	Amanyu				
Morus bombycis	.	+	+	12	11	.	12	11	.	12	11	+	+	+	+	.	.	.	.	.	Yamaguwa	
Cirsium kamtschaticum	.	+	+	1	1	.	.	.	.	.	.	+2	+	+	+	+	.	.	.	.	Chishimazami	
Petasites japonicus var. giganteus	.	+	22	1	1	.	.	.	.	.	+2	1	1	1	1	1	.	.	.	.	Akitabuki	
Ch. spp. of alliance																									
Quercus dentata	55	55	55	55	55	55	55	44	44	44	55	55	55	55	55	44	55	55	55	55	Kashiwa				
Ch. spp. of order & class																									
Acer mono	12	+	22	12	11	+	+	+	+	11	.	11	12	12	12	12	12	12	12	12	Itayakade				
Rhus ambigua	.	.	12	+2	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	Tsutsurushi				
Thlaspi japonica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Shinaneki	
Quercus mongolica var. grosseserrata	.	+	+	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Mizunara				
Polygonatum lasianthum	.	+	+	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Miyamanerukoyuri				
Euonymus oxyphyllus	.	+	+	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Tsuribana				
Euonymus sieboldianus	.	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Nayumi				
Companions																									
Carex blapharicarpa	44	44	44	44	44	22	12	+2	+2	+2	+2	22	+2	22	12	+2	.	+	+2	.	Shojoysuge				
Adenophora triphylla var. japonica	+2	12	+2	+2	+2	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	Tsuriganejinjin				
Mischanthus sinensis	23	22	+2	33	22	44	22	22	22	22	22	22	22	22	22	22	22	22	22	22	Susuki				
Solidago virga-aurea var. asiatica	+2	.	+	+2	+2	+2	12	12	12	12	12	12	12	12	12	12	12	12	12	12	Akinokirinso				
Rhus javanica	.	+	+	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Nurude				
Solidago virga-aurea var.-gigantea	.	+	+	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Oeakinokirinso				
Lespedeza bicolor	.	+	+	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Yamahagi				
Artemisia iwayomogi	.	+	+	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Iwayomogi				
Festuca rubra	.	+	+	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Oushinokogusa				
Chrysanthemum weyrichii	.	+	+	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Pirengiku				
Sorbus matsumurana	.	+	+	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Uraijironakanamado				
Rhus trichocarpa	.	+	+	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Yamaurushi				
Vicia japonica	.	+	+	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Hirohakusuji				
Lactuca indica var. laciniata	.	+	+	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Akinonogeshi				
Clematis terniflora	.	+	+	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Senninsuo				
Other companions: in column no. 7. Maackia amurensis var. buergeri (Inuenju) +, in 12. Leucothoe grayana var. oblongifolia (Hanahirinoko) +, in 14. Prunus sargentii (Oyamazakura) +, in 18. Pteris hieracoides var. glabrescens (Kozorina) +, in 20. Brachypodium sylvaticum (Yamakomojigusa) +, Cocculus orbiculatus (Aotsuzurafujii) +2.																									

Type association: Angelico anomalaee-Quercetum dentatae

Distribution: Northernmost Tohoku and Hokkaido.

This suballiance is distributed in the northern part of the Quercion dentatae region. It is more common in southern Hokkaido than in northern Hokkaido where it is rarely found. Unlike the preceding suballiance, the floor of this scrub vegetation is usually covered with *Sasa senanensis* and such tall herbs as *Angelica edulis*, *Cirsium kamtschaticum* and *Petasites japonicus* var. *giganteus* which grow out from *Sasa* layer. The occurrence of liana plants is poorer here than in the other suballiance. Only *Celastrus orbiculatus* var. *papillosum* and *Vitis coignetiae* are found.

This suballiance includes the following three associations.

3. Ass. Angelico edulis-Quercetum dentatae ass. nov. (Table 5; Fig. 5)

Character & differential species: same of the suballiance.

Type record: Table 5, column no. 8.

Distribution: northernmost Tohoku and western central Hokkaido.

This *Quercus* scrub is developed on exposed headlands where only deteriorated stands are found. Its floristic composition is comparatively poor; 10 to 17 species per quadrat. The scrub is differentiated by the absence of some common species found in other *Quercus dentata* scrub, such as *Viburnum dilatatum*, *Thalictrum minus* var. *hypoleucum* and *Lysimachia clethroides*. On the contrary, *Rhus ambigua*, *Acer mono* and *Angelica edulis* are more frequent in this scrub than in other associations. The distribution area of the

scrub overlaps the area of the *Angelica ursinae*-*Quercetum*, but the scrub can not be assigned to the association. From these distinctive feature of the species composition and the ecology, this scrub can be regarded as an association; *Angelico edulis*-*Quercetum*.

This association is subdivided into two sub-associations.

3-a. Subass. *hemerocallietosum middendorffii*

Differential species: *Hemerocallis middendorffii*, *Melica nutans*, *Artemisia montana*, *Vitis coignetiae*, *Sasa senanensis*.

Distribution: western central Hokkaido.

Constantly present undergrowth species include *Adenophora triphylla* var. *japonica*, *Carex blepharicarpa*, *Melica nutans* and *Hemerocallis middendorffii*. Many of these plants may be tolerant of the aridity. This subassociation grows luxuriantly at the environs of Otaru, western central Hokkaido. This scrub is divided into the following two parts due to the difference in the floor vegetation type. But between these parts, the difference of distribution and floristic condition, except the occurrence or the absence of *Sasa senanensis*, is not found.

3-b. Subass. *festucetosum ovinae*

Differential species: *Festuca ovina*, *Quercus mongolica*, *Chrysanthemum yezoense*, *Luzula capitata*, *Sedum kamtschaticum*.

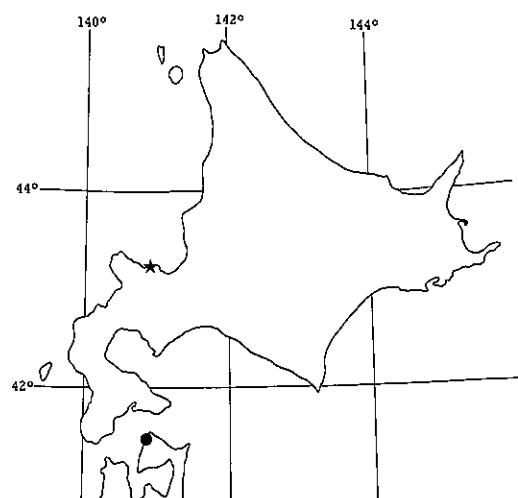


Fig. 5. Distribution of *Angelico edulis*-*Quercetum dentatae*. Subass. *hemerocallietosum middendorffii* (●), Subass. *festucetosum ovinae* (★).

Distribution: Aomori Prefecture.

This subassociation is developed at the top of cliffs. The stands are on rocky places covered with shallow soils. This scrub is constantly associated with only *Quercus dentata* and *Q. mongolica* in the shrub layer, whose height is 0.9 to 1.6 m. In the herb layer, *Festuca ovina* is dominant. *Miscanthus sinensis* and *Rhus ambigua* are common.

4. Ass. *Angelico ursinae-Quercetum dentatae* ass. nov. (Table 6, Figs. 6 and 7)

Character & differential species: *Angelica ursina*, *Chloranthus serratus*, *Artemisia keiskeana*.

Type record: Table 6, column no. 20.

Distribution: Southern Hokkaido.

Synonym: *Quercus dentata-Morus bombycina* comm. (ISHIZUKA 1951).

Like the next association, *Angelico anomala*-*Quercetum*, this association is dominated by *Sasa senanensis* on the floor. *Angelica ursina* which is a character species of this association is ecologically vicarious with *A. anomala* which is the one of the next association. Therefore, these two association physiognomically resemble each other, but their floristic composition and geographical range are clearly different.

The shrub floor is divided into two layers, one is 80 to 100 cm in height and is covered with *Sasa senanensis*. Furthermore, *Adenophora triphylla* var. *japonica*, *Artemisia montana* and *Cirsium kamtschaticum* are frequently found there. The other layer is below 30 cm and is occasionally dominated by *Carex blepharicarpa*. The common occurrence of *Chloranthus* spp. is remarkable. This association is classified into two subassociations.

4-a. Subass. *hemerocallietosum middendorffii*

Differential species: *Hemerocallis middendorffii*, *Chloranthus japonicus*, *Smilax china*, *Petasites japonicus* var. *giganteus*, *Plectranthus inflexus*, *Lonicera morrowii*, *Veratrum maackii* var. *japonicum*, *Sanguisorba tenuifolia* var. *alba*.

Distribution: Matsumae Peninsula.

This subassociation is distributed in southernmost Hokkaido. The height of the scrub varies with the habitat condition. The scrub remained on the terrace scarp along the coast of the Kameda Peninsula is 6.5 to 7 m in height. The scrub

Table 6. Angelico ursinae-Quercetum dentatae

4-a. Subass. hemerocallietosum middendorffii, 4-b. Subass. achill

Subassociation	4-a														
Column number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Locality number	22	22	22	22	21	21	21	18	18	18	18	18	19	19	19
Altitude (m)	8	8	8	8	30	30	25	10	10	10	10	10	10	50	50
Distance from shoreline (m)	30	30	30	30	50	50	100	50	50	50	50	50	100	100	100
Slope aspect (°)	S	SE	S	-	SE	SE	SE	SW	SW	SW	SW	SW	SW	SW	SE
Slope degree (°)	20			50	45	30	45	45	45	55	55	50	20	20	30
Height of shrub layer (m)	1	5	5	0	25	20	30	20	20	25	25	25	10	10	30
Coverage of shrub layer (%)	45	4	3	3	5	6	7	7	7	65	65	7	2	2	25
Height of herb layer (cm)	95	95	95	90	85	95	90	98	98	98	98	95	95	95	95
Coverage of herb layer (%)	80	70	80	80	90	90	70	80	70	80	80	80	40	40	50
Size of plot area (m²)	95	95	95	95	100	100	100	100	100	100	100	100	100	100	100
Number of species	18	28	36	36	49	49	49	49	49	64	64	56	25	25	25
Ch. & diff. spp. of association	19	17	16	15	24	21	23	21	30	25	30	26	18	20	24
Angelica ursina	22	12	+	+	12	+2	+2	12	12	12	12	+2	+	+2	+2
Chloranthus serratus	+	.	.	.	+	+	+	.	+	+2	+	+	.	.	.
Artemesia keiskeana	.	.	.	.	.	.	.	12	.	12	.	.	+2	+2	22
Diff. spp. of subassociation	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hemerocallis middendorffii	.	+2	12	12	12	23	12	12	12	+2	12	12	22	22	12
Chloranthus japonicus	12	12	+2	+	+2	.	+2	.	+2	+2	+	+2	.	.	.
Smilax china	+	.	.	+	+2	+	+2	+	+	.	.	+	.	+	+2
Petasites japonicus var. giganteus	23	.	12	12	+2	12	11	.	+2	.	12	.	.	.	.
Plectranthus inflexus	+	.	.	+	+	+	+	.	+	+2	+	+	.	.	.
Lonicera morrowii	12	.	(+)	.	+2	+	+	+	.	+	.	+	.	.	.
Veratrum maackii var. japonicum	.	.	.	.	.	.	.	.	12	12	+2	12	+2	+	+2
Sanguisorba tenuifolia var. alba	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Achillea sibirica var. angustifolia	.	.	.	.	.	.	.	.	+	.	+	+	+2	12	+2
Aralia cordata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Solidago virga-aurea var. gigantea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lespedeza bicolor	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Misanthus sinensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Artemesia japonica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sedum kamtschaticum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Ch. & diff. spp. of suballiance	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sasa senanensis	33	44	44	44	12	55	23	55	55	55	55	55	55	.	.
Celastrus orbiculatus var. papillosum	12	12	+2	+2	.	.	+	+2	+2	.	+	+2	.	.	+2
Cirsium kamtschaticum	.	.	+	+	+	+	.	.	+	+	.	.	+	+	.
Angelica edulis	.	.	.	.	.	.	.	.	+	+	+	+	.	.	+
Vitis coignetiae	.	+	.	+	+	.	.	+	.	+	.	+	.	.	.
Morus bombycina	+	.	.	.	.	.	.	+	.	+	.	+	.	.	.
Ch. spp. of alliance	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Quercus dentata	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
Quercus mongolica	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.
Ch. spp. of order & class	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Viburnum dilatatum	.	.	(+)	.	+2	11	.	.	+2	.	+	.	.	11	11
Rhus ambigua	.	+2	+	12	22	.	.	.	.	.	.	.	.	.	.
Euonymus sieboldianus	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.
Polygonatum lasianthum	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Quercus mongolica var. grosseserrata	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.
Hydrangea petiolaris	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.
Tilia japonica	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Companions	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Artemesia montana	12	+2	+2	+2	+2	+	+2	12	+	+2	12	+2	.	+2	+2
Carex blepharicarpa	12	12	+2	22	33	33	44	.	.	.	.	33	33	22	.
Adenophora triphylla var. japonica	+	+	.	.	.	(+)	+2	+	12	.	+2	+2	+2	+2	+2
Thalictrum minus var. hypoleucum	+	+	.	.	+	+	.	+	+2	+	+2	+2	.	.	+2
Solidago verga-aurea var. asiatica	(+)	+	.	.	+2	(+)	+	+	.	.	+	+2	+	+	+
Aster scaber	.	.	.	.	+	(+)	.	.	.	+	.	+	+2	+2	+2
Brachypodium sylvaticum	.	.	+	.	.	.	.	+	.	+	+	+2	+2	.	+2
Lysimachia clethroides	.	+	+2	+2	+	(+)	.	.	+	.	.	.	.	.	.
Pleurospurum camtschaticum	.	.	.	.	.	.	.	+	+2	+2	+	+	.	.	+2
Anthriscus sylvestris	.	.	.	.	.	.	.	+	.	+	+	+	.	.	.
Polygonum sachalinense	.	.	.	.	12	+2	.	.	.	+2	.	+2	.	.	.
Maianthemum dilatatum	.	.	.	.	.	.	.	+2	+2	+2	+2	12	.	.	.
Carex caryophyllea var. microtricha	.	.	.	.	.	.	.	+2	+2	+2	+2	.	.	.	.
Smilax riparia var. ussuriensis	.	.	.	.	.	.	.	+	+	+	+2	.	.	.	.
Pteridium aquilinum var. latiusculum	.	+	.	+	.	.	+	.	+	.	.	.	.	.	.
Galium verum var. asiaticum	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.

etosum angustifoliae

4-b							
16	17	18	19	20	21	22	
19	15	15	15	15	15	15	
35	25	25	25	25	25	10	
100	45	40	45	45	50	45	
SE	SW	SW	SW	SW	S	S	
30	10	10	10	10			
30	25	25	25	25	20	30	
2	4	35	5	4	5	4	
95	100	95	95	98	100	100	
50	80	80	70	70	80	60	
100	100	100	95	95	100	35	
25	25	25	36	36	36	36	
18	17	17	21	19	18	20	

12	12	+	+	12	+2	12	Ezonyu
.	+	+	+	.	.	.	Futarishizuka
+2	.	+	+	+	.	.	Inuyomogi
23	.	.	.	.	.	.	Ezozenteika
.	.	.	.	.	.	.	Hitorishizuka
.	.	.	.	.	.	.	Sarutoribara
.	.	.	.	.	.	.	Akitabuki
.	.	.	.	.	.	.	Yamahakka
.	.	.	.	.	.	.	Hyotanboku
.	.	.	.	.	.	.	Syuroso
+2	.	.	.	.	.	.	Nagabonowaremoko
.	+	+	+	.	.	+	Kitanokogiriso
.	+	+	+2	+	.	.	Udo
.	+	.	.	+	+	12	Ooakinokirinso
.	+	+	+	+	+	+	Yamahagi
.	+	.	.	+	+	+	Susuki
.	•	.	+	+	.	+	Otokoyomogi
.	•	.	+	+	.	12	Kirinso
.	55	55	44	55	55	12	Kumaizasa
12	+2	+	+2	+	+2	12	Onitsurumemodoki
+	+	.	.	+	.	+	Chishimaaazami
.	+	+	+	+	+	+	Amanyu
.	•	+	.	•	•	•	Yamabudo
.	•	+	.	•	•	•	Yamaguwa
55	55	55	55	55	55	55	Kashiwa
.	•	•	•	•	•	•	Mongorinara
+	11	+	+	.	11	.	Gamazumi
.	•	•	•	•	•	•	Tsutaurushi
+	•	•	•	•	•	•	Mayumi
•	•	•	•	•	•	•	Miyamanarukoyuri
•	•	•	•	•	•	•	Mizunara
•	•	•	•	•	•	•	Gotozuru
•	•	•	•	•	•	•	Shinanoki
+2	+2	12	+2	12	+2	12	Oyomogi
33	12	+2	23	12	+	22	Shojoysuge
+2	12	12	+2	.	12	+	Tsuriganeninjin
.	+	+2	+2	12	+	+	Akikaramatsu
+2	.	+	+	+	.	+	Akinokirinso
+2	.	•	•	•	•	•	Shirayamagiku
+2	.	•	•	•	•	•	Yamakamojigusa
.	•	•	•	•	•	•	Okatoranoo
.	•	•	•	•	•	•	Ookasamochi
.	•	•	•	•	•	•	Shaku
.	•	•	•	•	•	•	Ooitadori
.	•	•	•	•	•	•	Maizurusuo
.	•	•	•	•	•	•	Cyashibasuge
.	•	•	•	•	•	•	Shiode
.	•	•	•	•	•	•	Warabi
.	•	•	•	•	•	•	Kawarayomogi

developed on exposed rocky slopes is low, only 2 to 2.5 m in height. The latter scrub type lacks *Sasa senanensis* is the herb layer, but *Carex blepharicarpa* and *Hemerocallis middendorffii* are co-dominant.

4-b. Subass. achilletosum angustifoliae

Differential species: *Achillea sibirica* var. *angustifolia*, *Aralia cordata*, *Solidago virga-aurea* var. *gigantea*, *Lespedeza bicolor*, *Miscanthus sinensis*, *Artemisia japonica*, *Sedum kamtschaticum*.

Distribution: Muroran.

This *Quercus dentata* scrub occurs on the south-facing steep slopes 20 to 30 degrees. The shrub layer is composed of *Quercus dentata*, *Viburnum dilatatum*, *Celastrus orbiculatus* var.

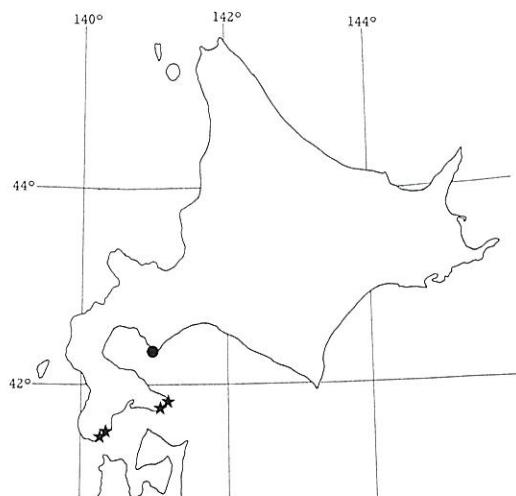


Fig. 6. Distribution of Angelico ursinae-Quercetum dentatae. Subass. hemerocallietosum middendorffii (●), Subass. achilletosum angustifoliae (★).



Fig. 7. Angelico ursinae-Quercetum dentatae at the Chikyu-misaki Cape in Muroran, Hokkaido.

Polygonum filiforme	.	.	.	.	.	.	+2	.	+2	+	+	.	.	.
Rumex acetosa	.	.	.	.	.	.	+	.	+2	+	+	.	.	.
Disporum smilacinum	.	.	.	.	.	.	+	.	+2	+	+	.	.	.
Rhododendron kaempferi	.	.	.	.	.	.	+2	+2	+2	12	.	.	.	.
Ligularia stenocephala	.	.	.	.	.	.	.	.	.	.	+2	+	+	+
Wisteria floribunda	+	.	.	.	+	.	+	.	.	.	+	+	+	+
Rubus parvifolius	+	+	.	.	.	+	.	.	.	.	.	.	.	.
Arunchus dioicus var. kamtschaticus	.	.	.	.	12	+2	12	.	.	.	.	.	.	.
Pourthiae villosa var. laevis	.	.	.	.	.	.	+	+	.	.	.	.	.	.
Magnolia kobus var. borealis	+	.	.	.	+	.	.	.	.	.	.	.	.	.
Cacalia hastata var. orientalis	.	.	.	.	.	+	.	+	.	.	.	.	.	.
Geum aleppicum	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Festuca rubra	.	.	.	.	.	.	.	+	+	.	.	.	.	.
Carex conica	.	.	.	.	.	.	.	.	.	.	+2	.	.	.
Osumanda japonica	.	.	.	.	.	.	.	.	.	.	.	+2	.	.

Other companions: in column no. 2. Asparagus schoberioides (Kijikakushi) +, in 8. Equisetum arvenne natifidus var. indivisus (Yamabokuchi) +, in 11. Agrimonia pilosa (Kimmizuhiki) +, Viola kusanoana keiskei (Suzuran) +2, in 14. Ampelopsis brevipedunculata (Nobudo) +, in 15. Ligustrum obtusifolium var. brachytricha (Nogariyasu) +, in 19. Picris hieracioides var. glabrescens (Kozorina) +, Chrysanthemum niponicum (Inuwarabbi) +, in 22. Plantago asiatica (Oobako) +2.

papillosum and *Lespedeza bicolor*. But the latter three species are scarce and do not grow up to the *Quercus dentata* canopy. *Sasa senanensis* densely covers the herb layer whose height is 60 to 80 cm. *Angelica ursina* and *A. edulis* which are tall herbs grow out of the herb layer. With distance increasing from the shoreline this scrub is replaced by the *Acer mono* forest and next by *Quercus mongolica* var. *grosseserrata* forest.

5. Ass. Angelico anomalae-Quercetum dentatae TATEWAKI ex OHBA, MIYAWAKI et TÜXEN 1973. (Table 7, Fig. 8)

Character & differential species: *Angelica anomala*, *Moehringia lateriflora*, *Convallaria keiskei*, *Malanthemum dilatatum*.

Distribution: Eastern side of central Hokkaido and northern Hokkaido.

Synonym: *Quercus dentata-Sasa nipponica* comm. (TAKAHASHI et OKABE 1968).

In central to northern Hokkaido, the *Quercus dentata* or *Q. mongolica* scrubs develop luxuriantly on the dunes, but are rarely found on the rocky coasts. These *Quercus* scrubs on the dunes in Hokkaido where studies by TATEWAKI (1961) and by OHBA, MIYAWAKI & TÜXEN (1973) who established two associations and four sub-associations for it. The number of records are not yet sufficient nor has the floristic variation been clearly investigated. The scrub which was recorded from the rocky coast in Samani and Omu can be incorporated in the Angelico anomalae-Quercetum, but one is unable to assign it to any subassociations of their system. The *Angelica*

anomalae-Quercetum which is the northern type of *Quercus dentata* scrub is distributed in central to northern Hokkaido. But in the southern Hokkaido it is replaced by the Angelico ursinae-Quercetum.

The floor of this association is usually dominated by *Sasa senanensis*. *Angelica anomala* and *Thalictrum minus* var. *hypoleucum* are constantly scattered and grow over the *Sasa* layer, under which some small herbs such as *Convallaria keiskei* and *Moehringia lateriflora* are found. This association is classified into the following two subassociations.

5-a. Subass. quercetosum mongolicae

Differential species: *Quercus mongolica*, *Hemerocallis middendorffii*, *Stellaria radians*, *Galium kamtschaticum* var. *acutifolium*, *Vaccinium smallii*, *Pteridium aquilinum* var. *latiusculum*, *Asarum heterotropoides*, *Calamagrostis pseudo-phragmites*, *Carex pilosa*, *Euonymus oxyphyllus*.

Distribution: Kitami (Omu).

This subassociation is severely influenced by sea winds, so that the overall height is lower, 1.2 to 1.7 m. The number of component species is 20, 3 on the average. In the shrub layer, *Quercus mongolica* which resembles *Q. dentata* in appearance is often dominant. The habitats of this subassociation are on gentle slopes with no outcrops. Although floristic differences are not apparent, the scrub can be divided into two types by the floor appearance. One is characterized by low light intensity and sparse undergrowth. The other has a dense floor dominated by *Sasa*

.	.	.	.	.	.	Mizuhiki
.	.	.	.	.	.	Suiba
.	.	.	.	.	.	Chigoyuri
+2	.	.	.	.	.	Yamatsutsuji
+	.	.	.	.	.	Metakarako
.	.	.	.	.	.	Fuji
.	.	.	.	.	.	Nawashiroichigo
.	.	.	.	.	.	Yamabukishoma
+	.	.	.	.	.	Kamatsuka
.	.	.	.	.	.	Kitakobushi
.	.	.	.	.	.	Yobusumaso
.	.	.	.	.	.	Odaikonso
+	.	.	+	.	.	Ooushinokekusa
+	.	.	:	:	:	Himekansuge
.	+	:	:	:	+	Zenmai

se (Sugina) +2, in 9. *Synurus palmatopis*-(*Ootachitsubosumire*) +, in 13. *Convallaria* (*Ibotanoki*) +, *Calamagrostis arundinacea*. *themum yezoense* (*Kohamagiku*) +, in 21.

senanensis.

5-b. Subass. *caricetosum siderostictae*

Differential species: *Carex siderosticta*, *Rhus ambigua*, *Sanguisorba tenuifolia* var. *alba*, *Viburnum dilatatum*, *Acer mono*, *Angelica edulis*, *Aster scaber*, *Lespedeza bicolor*, *Lysimachia clethroides*, *Sedum kamtschaticum*, *Lastrea totta*, *Disporum smilacinum*, *Actinidia arguta*, *Smilacina japonica*, *Calamagrostis arundinacea* var. *brachytricha*, *Aruncus dioicus* var. *kamtschaticus*.

Distribution: Samani.

The present subassociation is developed on wet stands located at 20 to 30 m above the sea level on the slope of the coastal terrace. Since the scrub is scarcely influenced by salt spray, the area is rich

in species (29.2 spp. per quadrat on an average) and inland species have often invaded the floor. The height of the scrub is greater, 5 to 8 m than the previous subassociation. In the shrub layer, *Viburnum dilatatum*, *Acer mono* and *Lespedeza bicolor* are common but with low dominance. The *Quercus dentata-Sasa nipponica* community described by TAKAHASHI & OKABE (1968) in the Enrum Cape, Hidaka may be incorporated in this subassociation due to floristic and geographical similarity.

Discussion

The coastal scrub vegetation of the Japanese mainland can be divided into two types. One is the southern type: ever-green broad-leaved scrubs, the alliance *Pittosporion tobirae*, which is usually composed by some characteristic shrubs. This scrub occurs luxuriantly on the coastal areas of the Camellietea region. The other is the northern type: deciduous scrubs, the alliance *Quercion dentatae*, which is constantly associated with only one shrub; *Quercus dentata*. The *Quercion* scrubs are distributed from the San-in District through Hokuriku and Tohoku to Hokkaido. In the Sanin and Hokuriku Districts where the coastal scrubs of the southern type are also developed, the *Quercion* scrubs are restricted to limited stands. These stands are rocky slopes which are severely influenced by the northwesterly wind in winter. Consequently, scrubs of the southern type can not developed there.

The *Quercion* scrubs is lacking along the Sanriku Coast, that is the eastern side of Tohoku. This may be due to the submerged shoreline, namely the ria coast, which is scarcely influenced by salt spray. In place of it, some inland shrubby species such as *Taxus cuspidata*, *Thujopsis dolabrata* and *Juniperus chinensis* var. *sargentii* are occasionally developed on the coastal rocky slopes.

The range of the *Quercion* scrubs extends more southward on rocky coasts than on sandy coasts (Fig. 9). Scrubs which have developed on sand dunes are found from the northern Tohoku to Hokkaido. The reason is not clear, but it may be due to the mesophytic character of *Quercus dentata*. The sand dunes may be to dry to prevent high evaporation from large leaves of this species.

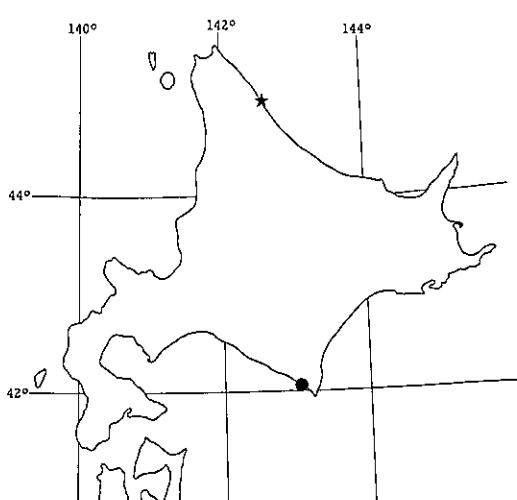


Fig. 8. Distribution of *Angelico anomalaean-Quercetum dentatae*. Subass. *querchetosum mongolicae* (●), Subass. *caricetosum siderostictae* (★).

Table 7. Angelico anomalae-Quercetum dentatae

	5-a						5-b						
Subassociation	1	2	3	4	5	6	7	8	9	10	11	12	
Column number	5	5	5	5	5	5	13	13	13	13	13	13	
Locality number	7	7	7	8	10	10	20	20	30	30	20	20	
Altitude (m)	30	30	30	40	45	-	-	-	-	50	50		
Distance from shoreline (m)	SW	SW	SW	NW	NW	NW	NW	NW	NW	SW	SW	SW	
Slope aspect (°)	75	75	35	40	40	40	40	40	60	60	70	70	
Slope degree (°)	20	20	20	20	10	10	30	30	25	25	25	25	
Height of shrub layer (m)	1.4	1.3	1.7	1.7	1.2	1.2	6	6	8	8	5	5	
Coverage of shrub layer (%)	100	100	100	90	85	80	90	98	100	100	95	95	
Height of herb layer (cm)	60	60	60	60	60	60	60	60	70	70	80	80	
Coverage of herb layer (%)	20	20	25	15	95	95	80	60	98	100	90	90	
Size of plot area (m²)	16	16	16	16	16	16	49	49	49	49	36	36	
Number of species	19	20	21	18	21	20	35	24	33	25	31	27	
Ch. & diff. spp. of association													
Angelica anomala	+2	12	+2	+2	+2	+2	+2	+2	+2	+22	12	Ezonoyoroigusa	
Moehringia lateriflora	+2	.	+	.	+2	+2	.	.	+	+	.	Oyamafusuma	
Convallaria keiskei	+2	+2	+2	12	.	.	+	+	+2	.	.	Suzuran	
Maianthemum dilatatum	.	.	.	.	12	12	+2	+2	+2	23	12	Maizurusu
Diff. spp. of subassociation													
Quercus mongolica	+	22	12	55	22	12	.	.	.	.	.	Mongorinara
Hemerocallis middendorffii		+2	12	+2	12	12	.	.	.	.	.	Ezozenteika
Stellaria radians	+	12	+	+	12	+2	.	.	.	.	.	Ezooyamahakobe
Galium kamtschaticum var. acutifolium	+	+	+	+	12	+2	.	.	.	.	.	Oobayotsubamugura
Vaccinium smallii	12	.	+	+	+	+2	.	.	.	.	.	Oobasunoki
Pteridium aquilinum var. latiusculum	.	+	+	22	12	12	.	.	.	.	.	Warabi
Asarum heterotropoides	+2	+	+	12	.	.	.	.	.	.	.	Okuezosaishin
Calamagrostis pseudo-phragmites	.	+	+	+	+2	+2	.	.	.	.	.	Hosugaya
Carex pilosa	.	+2	12	+2	.	.	.	.	.	.	.	Carex pilosa
Euonymus oxyphyllus	.	+	+	+	+	+2	.	.	.	.	.	Tsuribana
Carex siderosticta	.	.	.	.	.	.	+2	+2	+	+	+2	Taganese
Rhus ambigua	.	.	.	.	.	.	23	12	12	12	12	Tsutaushishi
Sanguisorba tenuifolia var. alba	.	.	.	.	+	.	+2	+2	+	22	12	Nagabonoshirowaremoko
Viburnum dilatatum	.	.	.	.	.	.	+22	+2	+2	+2	+	Gamazumi
Acer mono	.	.	.	.	.	.	11	12	+	+	11	Itayakaede
Angelica edulis	.	.	.	.	.	.	+	+	12	+	+2	Amanyu
Aster scaber	.	.	.	.	.	.	+	+	2	+	+	Shirayamagiku
Lespedeza bicolor	.	.	.	.	.	.	+	+	11	+	+	Yamahagi
Lysimachia clethroides	.	.	.	.	.	.	+	+	+	+	.	Okatoranoo
Sedum kamtschaticum	.	.	.	.	.	.	+2	+	+	+	.	Kirinso
Lastrea totta	.	.	.	.	.	.	+2	+	.	.	.	Mizoshida
Disporum smilacinum	.	.	.	.	.	.	+	+	+	.	.	Chigoyuri
Actinidia arguta	.	.	.	.	.	.	12	.	.	.	.	Sarunashi
Smilacina japonica	.	.	.	.	.	.	+	+	+	.	.	Yukizasa
Calamagrostis arundinacea var. brachytricha	:	..	..	..	..	.	..	..	..	.	.	Nogariyasu
Aruncus dioicus var. kamtschaticus	:	..	..	..	..	.	..	..	..	..	.	Yamabukishoma
Ch. & diff. spp. of suballiance													
Sasa senanensis	22	12	33	44	33	22	22	23	55	55	33	33	Kumaizasa
Celastrus orbiculatus var. papillosum	12	+2	.	12	12	.	+	+2	+	+2	12	12	Onitsurumemodoki
Cirsium kamtschaticum	.	+	+	.	.	+	.	+	Chishimaazami
Petasites japonicus var. giganteus	.	+	+	.	.	+	..	+	Akitabuki
Vitis coignettiae	+	.	12	+2	+	.	.	.	Yamabudo
Morus bombycina	Yamagawa
Ch. spp. of alliance													
Quercus dentata	55	55	55	22	33	44	55	55	55	55	55	55	Kashiwa
Ch. spp. of order & class													
Hydrangea petiolaris	12	.	.	.	+	.	.	Gotozuru
Tilia japonica	+	.	.	Shinanokī
Companions													
Thalictrum minus var. hypoleucum	+	+	+2	+	+2	+2	12	12	+2	+	+2	12	Akikaramatsu
Adenophora triphylla var. japonica	+2	+2	+	2	12	.	+	+2	Tsuriganeninjin
Melica nutans	+2	+2	+	+2	+	.	.	.	Komegaya
Artemisia montana	+	..	+	+	+	+	Oyomogi
Carex blapharicarpa	.	..	+2	.	12	12	.	..	+2	.	.	.	Shojoysuge
Miscanthus sinensis	+	..	+	+2	+2	Susuki
Polygonum sachalinense	.	..	+	+	+	.	Oitadori
Brachypodium sylvaticum	.	..	+	Yamakamojigusa
Leucothoe grayana var. oblongifolia	+	+	Handahirinoki
Equisetum arvense	+	Sugina
Anthriscus sylvestris	+	Shaku
Athyrium pycnosorum	+	Miyamashikeshida
Onoclea sensibilis	+2	+	Koyawarabi
Cardamine leucantha	+2	+	Konronso
Viburnum opulus var. calvescens	12	Kanboku
Primula jepaea var. pubescens	+2	12	Ezoosakuraso
Solidago virga-aurea var. gigantea	Oakinokirinso
Calathea auriculata var. kamtschatica	Mimikomori
Veratrum maackii var. japonicum	Shuroso
Calathea hastata var. orientalis	Yobusumaso
Phryma leptostachya var. asiatica	Haedokuso
Maackia amurensis var. buergeri	Inuenju
Betula maximowicziana	Udaikanba
Other companions: in column no. 1. Solidago virga-aurea var. asiatica (Akinokirinso) +2, Festuca rubra (Oushinokegusa) +, Vicia kusanoana (Kusafuji) +, in 6. Anaphalis margaritacea var. angustior (Yamahahako) +, in 7. Trillium kamtschaticum (Oobananoenreiso) +, in 9. Smilax riparia var. ussuriensis (Shioide) +, Agrimonia pilosa (Kimmizuhiki) +, Calamagrostis epigeios (Yamaawa) +, Viola kusanoana (Ootachitsubosumire) +, in 11. Lysimachia vulgaris var. davurica (Kusaredama) +2, Fraxinus lanuginosa (Kobanotoneriko) +, Achillea sibirica var. angustifolia (Kitanokogiriso) +, Galium verum var. asiaticum (Kawaramatsuba) +, in 12. Chloranthus serratus (Futarishizuka) +, Plectranthus inflexus (Yamahakka) +.													

The *Quercus dentata* scrubs extend from the Asian Continent and Korea to Japan with other deciduous *Quercus* forests. The Korean Peninsula was connected to western Japan during recent geological time. The frequent occurrence of the continental elements in these *Quercus* woods attests to it. Although western Japan is located near Korea, the *Quercus dentata* scrub is not developed there. The scrub is not successful in competition with the Pittosporion scrub in western and southern Japan.

From the floristic composition and distribution point of view, the alliance *Quercion dentatae* belongs to the order *Quercetalia serrato-grosseserratae* and to the class *Fagetea crenatae*.

Summary

1. The present study was undertaken to classify and describe the *Quercus dentata* scrub of rocky coasts in Japan on the basis of the vegetation concept and method of the ZM school.
2. The investigations were carried out in 23 localities. From the 107 phytosociological records obtained, the following syntaxonomical system was accomplished.

A11. *Quercion dentatae*.

I. Subass. *Coccullo orbiculati-Quercenion dentatae*.

1. Ass. *Albizio julibrissin-Quercetum dentatae*.

1-a. Subass. *festucetosum ovinae*.

1-b. Subass. *epimedietosum sempervirens*.

1-c. Subass. *euonymetosum japonici*.

2. Ass. *Carici cuneatae-Quercetum*

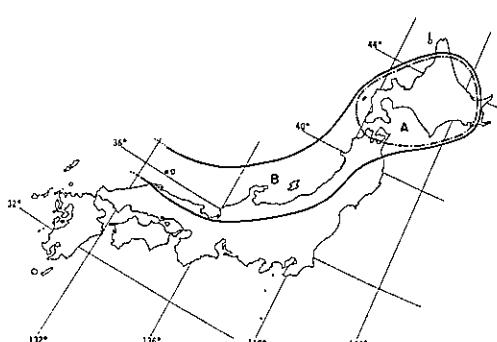


Fig. 9. Distribution range of the *Quercus dentatae* scrub on sand dunes (A) and on rocky coasts (B).

dentatae.

2-a. Subass. *festucetosum rubrae*.

2-b. Subass. *akebietosum trifoliatae*.

2-c. Subass. *euonymetosum planipes*.

II. Suball. *Celastrio papillosi-Quercenion dentatae*.

3. Ass. *Angelico edulis-Quercetum dentatae*

3-a. Subass. *hemerocallietosum middendorffii*

3-b. Subass. *festucetosum ovinae*.

4. Ass. *Angelico ursinae-Quercetum dentatae*

4-a. Subass. *hemerocallietosum middendorffii*

4-b. Subass. *achilletosum angustifoliae*.

5. Ass. *Angelico anomalae-Quercetum dentatae* TATEWAKI ex OHBA, MIYAWAKI et TÜXEN 1973.

5-a. Subass. *quercetosum mongolicae*.

5-b. Subass. *caricetosum siderostictiae*.

3. The distribution of the *Quercus dentata* scrub was discussed.

4. The *Quercion dentatae* which is newly described, includes *Quercus dentata* scrub developed on sand dunes, and belongs to the order *Quercetalia serrato-grosseserratae* and to the class *Fagetea crenatae*.

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- (* in Japanese, ** in Japanese with English or German summary)

摘要

1. 海岸の崖地、傾斜地、露岩地などの岩石海岸に発達するカシワ林について植物社会学的な研究を行った。得られた107の植生調査資料から次に示した1群団、2亜群団、5群集、12亜群集を区分し、記載した。
- カシワ群団（新）
 - I. カシワーアオツヅラフジ亜群団（新）
 1. カシカーネムノキ群集（新）(a. ウシノケグサ亜群集, b. トキワイカリソウ亜群集, c. マサキ亜群集)
 2. カシワーミチノクホンモンジスグ群集（新）
 - (a. オオウシノケグサ亜群集, b. ミツバアケビ亜群集, c. オオツリバナ亜群集)
 - II. カシワーオニツルウメモドキ亜群団（新）
 3. カシワーアマニュウ群集（新）(a. エゾゼンティカ亜群集, b. ウシノケグサ亜群集)
 4. カシワーエゾニュウ群集（新）(a. エゾゼンティカ亜群集, b. キタノコギリソウ亜群集)
 5. カシワーエゾノヨロイグサ群集 (a. モンゴリナラ亜群集, b. タガネソウ亜群集)
 2. 岩石海岸のカシワ林は、山陰の一部から北陸、東北、北海道に分布するが、砂丘のカシワ林は東北北部と北海道に限られる。これは東北以南の砂丘が、カシワ林の成立にとって乾燥しすぎるためだと思われる。
 3. カシワ林は朝鮮半島から日本列島へ分布を拡大してきたものと考えられる。朝鮮半島に近い西日本にカシワ林があまり発達していないのは、トベラ群団に属する常緑の海岸林が旺盛なためであろう。
 4. 新たに設定されたカシワ群団は、東北北部から北海道の砂丘に発達するカシワ林の群集も含み、上級単位はミズナラーコナラオーダー、ブナクラスに属する。

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○ 西宮市教育委員会 日野神社社叢の保全に関する調査報告書 昭和58年3月31日発行。B5版、236頁。非売品。

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(里見信生)