Studies on the Peucedanion japonicae in the Ryukyu Islands*

——Phytosociological Studies of the Ryukyu Islands V——

by

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Introduction

The Ryukyu Islands are located in the southern part of Japan. They consist of many small islands which stretch from the southern end of Kyushu, Japan, to Taiwan for a distance of about 1300 km. The islands have a sub-tropical climate, characterized by high temperatures, heavy precipitation. In the area, many types of natural vegetation have been reserved. For instance, Quercetum miyagii-forest of Iriomote Island, Beilschmidio-Livistonetum chinensis-forest of Yonakuni Island, mangrove forest and others.

Although considerable attention has been paid to the vegetation of the Ryukyu Islands, comparatively little is known of the phytosociological analysis. Except for some studies of limited areas (MIYAWAKI 1972, MIYAWAKI et al. 1974, NIRO et al. 1971), the vegetation of the coastal rocky region has not been phytosociologically studied.

The earlier papers of this series on the vegetation of the Ryukyu Islands described the coral sand dune vegetation and the terraced coral vegetation (MIYAWAKI and K. SUZUKI 1976), Psychotrio manillensis-Acerion oblongi-forest (MIYAWAKI and K. SUZUKI 1976) and *Pinus lutchuensis*-forest (K. SUZUKI 1978). The present paper reports phytosociological studies on the grassland vegetation of the coastal rock and of the coastal screen, belonging to the order of the Peucedanion japonicae Ohba 1970. Most relevés of this paper refer to the field work data from the Department of Vegetation Science, Institute of Environmental Science and Technology, Yokohama National University under the leadership of Professor Akira MIYAWAKI.

I wish to express my thanks to Professor MIYAWAKI for suggesting this investigation as well as for constant guidance in the course of the work. Thanks are also due to Professor Shigeru IIZUMI of Tohoku University for his invaluable advice and encouragement.

I. Description of the Study Area

The sub-tropical Ryukyu Islands cover a total range of 8 degrees of lon-

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longitude, from 123°E to 131°E and over 7 degrees of latitude, from 24°N to 31°51′N (See Fig. 1). The islands are made of six groups of islands. These include the Yaeyama Islands, the Miyako Islands, the Amami Islands, the Tokara Islands and the Satsuma Islands. This paper is almost entirely concerned with the Amami Islands and the Okinawa Islands.

The climate of the investigated area is shown in Table 1 which summarizes the data for rainfall, mean temperature and mean of daily maximum temperatures, for a period of 29 years, from 1941 to 1970.

Geologically and phytosociologically, the terrain of the Ryukyu Islands are divided into two parts. The Psychotrio manillensis-Acerion oblongi-area is covered with the evergreen broadleaf forests of the Fico microcarpae-Pongamietum pinnatae, Macarango-Bischofietum and others.

The area is based on the habitat of limestones or rising coral. The Psychotrio manillensis-Acerion oblongi-area is distributed in the lower parts of the Ryukyu Islands and in the southern part of the Okinawa Islands. On the other hand, the Psychotrio-Castanopsion sieboldii-area is covered with *Castanopsis cuspidata* var. *sieboldii*, *Quercus miyagii*, and *Pinus lutchuensis*. The area, based on sandstones or slate of Tertiary, is distributed mostly in the highland and the mountains.

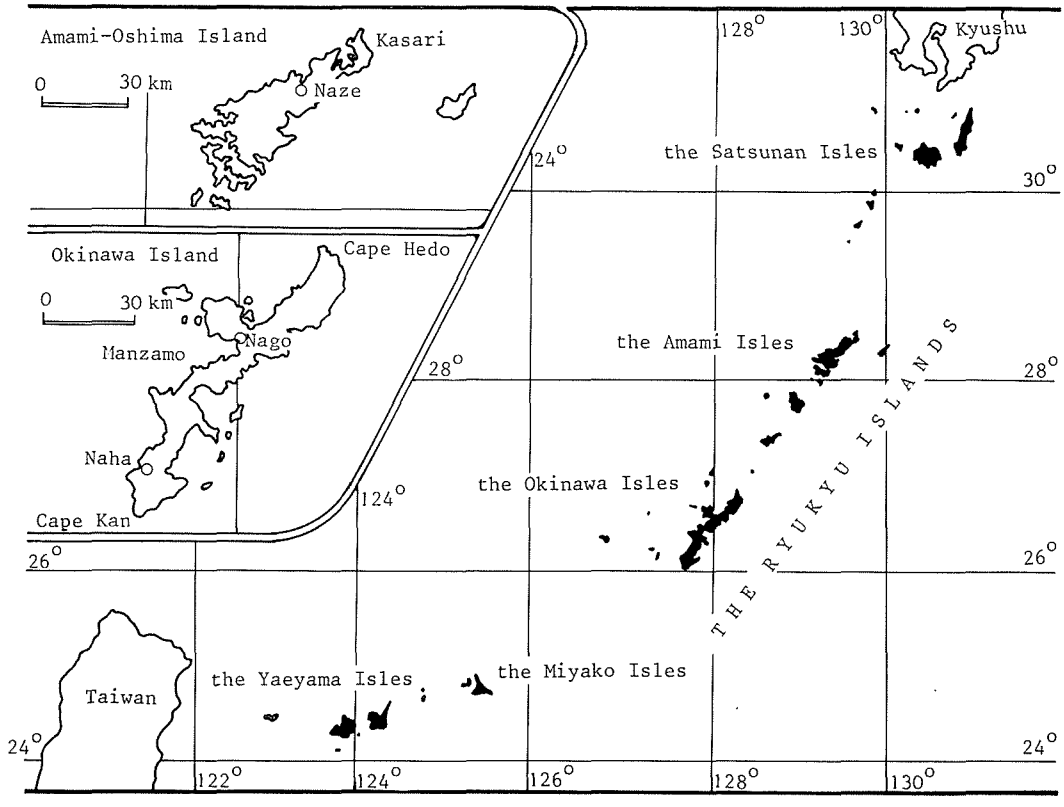

Fig. 1. Map showing the area investigated (the Ryukyu Islands)

Table 1 Climate of the Ryukyu Islands for the period 1941–1970

(i) Naze, Amami-oshima Island (28°23′N, 129°30′E, Altitude 2.8 m)

	month												year
	1	2	3	4	5	9	7	8	9	10	11	12	
Average mean temperature (°C)	14.2	14.5	16.5	19.6	22.4	25.3	28.1	27.8	26.6	23.0	19.8	16.2	21.2
Average maximum temperature (°C)	17.3	17.7	20.0	23.3	26.2	28.9	32.4	31.9	30.7	26.7	23.3	19.5	24.8
Amount of rainfall (mm)	178	170	191	204	368	452	215	325	311	237	219	169	3039

(ii) Naha, Okinawa Island (26°14′N, 127°41′E, Altitude 34.8 m)

	month												year
	1	2	3	4	5	6	7	8	9	10	11	12	
Average mean temperature (°C)	16.0	16.4	18.1	20.8	23.8	26.0	28.2	27.8	27.1	24.1	21.4	18.1	22.3
Average maximum temperature (°C)	18.8	19.2	21.1	23.8	26.6	28.7	31.1	30.6	30.1	27.1	24.3	20.8	25.2
Amount ot rainfall (mm)	122	116	154	142	244	320	174	253	152	149	151	140	2118

II. Methods

The present work was carried out on the vegetation that is found growing in the coastal rocky slope or the coastal screen. The vegetation was studied in accordance with the concepts and methods of the Zürich-Montpellier School (BRAUN-BLANQUET 1964, ELLENBERG 1956, MIYAWAKI 1964 etc.). These vegetations, which belong to the Peucedanion japonicae on a floristic basis, are classified according to Braun-Blanquet system in phytosociology, considering all the data available.

III. Results

1. Chrysanthemo crassi-Crepidiastretum lanceolati association nov.

(Table 2)

The grassland vegetation on the lower end of coastal rock in the Amami Isles, has been named Chrysanthemo crassi-Crepidiastretum lanceolati, which is characterized by *Chrysanthemum ornatum* var. *crassum* and *Cirsium brevicaule* var. *irumtiense*. This association is found at Kasari (Amami-oshima Island), Kanehira (Tokuno-shima Island). The association is from 20 cm to 60 cm high, and is composed of the charactristic species, *Crepidiastrum lanceolatum*, *Miscanthus sinensis*, *Lysimachia sikokiana* and some other species. The total coverage is from 30 to 90 per cent and varies with each relevé. The total number of species is from 6 to 8 with an average of 7 per relevé. The association is distributed on the unstable coastal screen, on which many rocks of sandstone and slate have been accumulated on account of efflorescence and landslide. Dominant species of the association is not always the same. Sometimes *Chrysanthemum ornatum* var. *crassum* is dominant, but at other times it may be *Miscanthus sinensis* or *Crepidiastum lanceolatum*.

Chrysanthemo crassi-Crepidiastretum lanceolati is the community, developing on the same habitat as the association Astero miyagii-Miscanthetum condensati Miyawaki et al. 1972 in the Ryukyu Isles.

The following three subassociations are allied to Chrysanthemo crassi-Crepidiastretum lanceolati (See Table 2):

(i) Subassociation of Wedelia biflora

The subassociation, differentiated by *Wedelia biflora* and *Ischaemum aureum*, is developed in Tokuno-shima Island. Major components are *Miscanthus sinensis*, *Chrysanthemum ornatum* var. *crassum*, *Ischaemum aureum*, *Wedelia biflora* and *Arthraxon hispidus*. Coverage of *Miscanthus sinensis* is over 50 per cent. Its habitat is formed gradually by coral sands.

(ii) Subassociation of Wedelia chinensis

The subassociation of Wedelia chinensis is characterized by *Wedelia chinensis* and *Ixeris debilis* var. *liukiuensis*. Major components are grassland plants such as *Crepidiastrum lanceolatum*, *Lysimachia sikokiana*, *Chrysanthemum ornatum* var. *crassum* and creeping *Wedelia robsta*. Grade of dominance

Table 2. Chrysanthemo crassi-Crepidiastretum lanceolati

1-2: Subassociation of Wedelia biflora
3-4: Typical subassociation
5-7: Subassociation of Wedelia chinensis

No. of relevé:	11	2	3	4	5	6	7
Area of relevé (m^2):	15	15	1	9	9	8	3
Exposure:	NW	NW	N	E	—	—	—
Neigung (°):	15	15	20	70	5	—	10
Height of herb layer (cm):	60	60	20	50	30	30	50
Cover of herb layer (%):	95	95	80	30	60	40	60
Total no. of species:	6	8	7	8	7	7	8
Character & differential species of association:							
Chrysanthemum ornatum var. crassum	3·3	3·3	5·4	2·3	2·2	+·2	2·3
Cirsium brevicaule var. irumtiense	·	·	·	+	·	+·2	+
Differential species of subassociation:							
Wedelia biflora	+	1·2	·	·	·	·	·
Ischaemum aureum	2·2	2·2	·	·	·	·	·
Differential species of subassociation:							
Wedelia chinensis	·	·	·	·	3·3	3·3	3·3
Ixeris debilis var. liukiuensis	·	·	·	·	1·2	·	1·2
Character & differential species of alliance, order & class:							
Crepidiastrum lanceolatum	·	·	1·2	2·2	2·3	2·3	2·2
Miscanthus sinensis	4·4	4·4	2·2	·	·	+	+·2
Lysimachia sikokiana	·	·	·	+	+·2	1·2	+·2
Farfugium japonicum	+	·	+	·	·	·	·
Peucedanum japonicum	·	·	1·2	2·3	·	·	·
Desmodium heterocarpon var. buergeri	·	1·2	·	·	·	·	·
Pennisetum sordidum	·	·	+	·	·	·	·
Breynia officinalis	·	·	·	+	·	·	·
Setaria viridis var. pachystachys	·	·	·	·	·	·	+
Companions:							
Arthraxon hispidus	+	+	·	·	·	+	·
Paederia scandens	·	+	·	+	·	·	·
Rosa wichuraiana	·	+	·	·	+	·	·
Zoysia tenuifolia	·	·	·	2·2	·	·	·
Oxalis corniculata	·	·	·	·	+	·	·
Digitaria timorensis	·	·	+	·	·	·	·

Locality & date of relevé: 1-2 30.8.1973 Kaneku, Tokuno-shima Island (by A.Miyawaki, K.Suzuki, Y.Niiri & Y.Nakamura) 3-7 27.12.1973 Kasari, Amami-oshima Island (by A.M. et al.)

and sociability on *Wedelia chinensis* is 3•3. The differential species of the subassociation indicate a sunny habitat.

(iii) Typical subassociation

The typical subassociation has no distinguishing species and different from the other subassociations. It is most likely a pionieer-phase or decline-phase of the subassociation of Wedelia chinensis, which is a contact community.

2. Astero miyagii-Miscanthetum condensati Miyawaki et al. 1972

(Table 3)

The central and northern parts of Okinawa Island are widely covered with sandstones or slate of Tertiary rocks. At Cape Busena, Oku, Ie and Teniya, coastal rocky vegetations are developing. Astero miyagii-Miscanthetum condensati, characterised by *Aster miyagii*, is described by MIYAWAKI *et al.* (1972) on the relevés at Okinawa Island.

In the present paper, new data for the association are added to the proceeding data obtained by MIYAWAKI *et al.* (1972).

Localities of Astero miyagii-Miscanthetum condensati are mostly in the Okinawa Isles. The association is found on the coastal screen, accumulated sands, stones, crags, etc. On the limited terrace of a steep coastal slope, sands and soils are accumulated, so that Astero miyagii-Miscanthetum condensati is developed on the habitat. The association is from 10 cm to 50 (100) cm high. Its major components are *Crepidiastrum lanceolatum*, *Miscanthus sinensis* var. *condensatus*, *Aster miyagii*, *Dianella ensifolia*, *Carex oahuensis* var. *robusta* and *Zoysia tenuifolia*. The total number of species varies from 7 to 19 (9 on average).

Astero miyagii-Miscanthetum codensati association is divided into the following two subassociations:

(i) Subassociation of Zoysia tenuifolia

This subassociation is developed at Cape Busena, Oku and Ie in Okinawa Isles and is differentiated by *Zoysia tenuifolia*. The habitat, is screen strewn with stable crage or slopes with shallow soils, exposing bases of sandstones.

(ii) Typical subassociation

The typical subassociation, having no distinguishing species, grows at Teniya, Kayo, Ikeya and Ie, Okinawa Islands. After the dominat species of the subassociation is *Miscanthus sinensis* var. *condensatus* and the distribution is coastal screen, accumulated many soils and sands. (See Photo. 1, Table 3)

3. Astero asa-gray-Zoysietum tenuifoliae association nov.

(Table 4)

Astero asa-gray-Zoysietum tenuifoliae is characterized by *Aster asa-gray*. The species of high presence value is *Zoysia tenuifolia*, *Cirsium brevicaule*, *Ischaemum aureum* and *Farfugium japonicum*. The assiciation is collected at Beech Manzamo, Okinawa Island.

Astero asa-gray-Zoysietum tenuifoliae is found on the

Table 3. Astero miyagii-Miscanthetum condensati
1-10:Subassociation of Zoysia tenuifolia, 11-20:Typical subassociation

No. of relevé:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Area of relevé(m^2):	3	1.5		6	2	6	2		6	60	25	25	5		2	25	3	4	15	
Exposure:	W	W	S	SE	E	SE	E	NE	E	S	SE	SE	SE	SE	E	NE		S	N	S
Slope(°):	70	20	70	25	30	20	35	35	30	40	60	50	45	15	30	10		45	45	35
Height of herb layer(cm):	10	10	10	30	30	30	35	50	30	30	30	30	30	40	40	100	30	40	30	50
Cover of herb layer(%):	80	85	50	85	60	70	80	70	80	80	25	30	70	85	75	90	80	75	40	90
Total no. of species:	4	6	6	4	5	7	9	12	12	19	5	6	7	6	8	8	8	7	11	19
Character species of association:																				
Aster miyagii	4·4	4·4	3·3	·	+·2	·	+·2	+	+	+	+	+	+	+	+	+	·	+	·	1·2
Differential species of subassociation:																				
Zoysia tenuifolia	2·2	2·2	1·2	+·2	+·2	2·2	3·3	1·2	+·2	+·2	·	·	·	·	·	·	·	·	·	·
Character & differential species of alliance,oder & class:																				
Crepidiastrum lanceolatum	+	+	+	1·2	2·2	+·2	2·2	2·3	1·2	3·3	2·2	1·2	1·2	1·2	2·2	+	1·2	2·2	2·3	2·2
Miscanthus sinensis var. condensatus	·	·	·	2·2	4·4	3·3	2·2	3·3	2·2	4·4	1·2	3·3	4·4	5·4	3·3	4·4	4·4	5·4	2·2	4·4
Dianella ensifolia	·	·	·	·	·	·	·	2·2	+	·	·	·	1·2	·	+	2·2	+	1·2	·	+
Carex oahuensis var. robusta	·	·	·	·	·	+	·	·	·	+	·	·	+·2	+	·	+·2	2·2	1·2	1·2	1·2
Farfugium japonicum	·	·	·	·	·	·	+	·	+	1·2	·	·	·	·	+	·	·	·	·	3·3
Peucedanum japonicum	·	·	·	·	+·2	·	+	+	·	1·2	·	·	·	·	·	·	·	·	2·2	1·2
Ischaemum aureum	·	·	·	3·3	·	·	·	+	1·2	1·2	·	·	·	·	·	·	·	·	·	+·2
Lilium longiflorum	+	1·2	+	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Cirsium brevicaule	·	+	·	·	·	·	·	·	·	+	·	·	·	·	·	·	·	·	·	1·2
Companions:																				
Raphiolepis umbellata var. liukiuensis	·	·	·	·	·	+	·	·	·	·	+	+	·	+	1·2	1·2	·	·	·	·
Digitaria henryi	·	+	+	·	·	·	·	·	·	·	+	+	·	·	·	·	·	·	+·2	·
Galactaria tashiroi	·	·	·	·	·	2·2	·	·	·	·	·	·	·	·	1·2	·	·	·	·	+
Liriope tawadae	·	·	·	·	·	·	·	+	·	1·2	·	·	·	·	·	·	·	·	·	2·2
Carex warburgiana	·	·	·	·	·	·	·	+	1·2	·	·	·	·	·	·	·	·	·	·	·
Solidago virga-aurea var. insularis	·	·	·	·	·	·	+	·	+	·	·	·	·	·	+	·	·	·	·	·
Apluda mutica	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	+·2	·	1·2	·	·
Fimbristylis cymosa var. spathacea	·	·	·	·	·	·	+	·	·	+	·	·	·	·	·	·	·	·	·	·
Eurya emarginata	·	·	·	·	·	·	·	+	·	+	·	·	·	·	·	·	·	·	·	·
Psychotria sepens	·	·	·	·	·	·	·	+	·	+	·	·	·	·	·	·	·	·	·	·
Sphenomeris biflora	·	·	·	·	·	·	·	+	·	·	·	·	·	·	+	·	·	·	·	·
Ipomoea gracilis	·	·	·	·	·	·	·	·	·	+·2	·	·	·	·	·	·	·	·	·	+
Viola utchinensis	·	·	·	·	·	·	·	·	·	+	·	·	·	·	·	·	·	·	·	+
Sphenomeris chusana	·	·	·	·	·	·	·	·	·	+·2	·	·	·	·	·	·	·	·	·	+
Scutelaria rubropunctata	·	·	·	·	·	·	·	·	+	·	·	·	·	·	·	·	·	·	·	+
Ophiopogon jaburan	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	+·2	·	·	·	+
Eupatorium luchuense	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	+	·	·	·

Additional species present *(3) Hedyotis coreana +,(6) Cinnamomum doederleinii +, (7) Ischaemum aristatum +, (9) Eurya japonica + ,Juniperus lutchuensis +, (10) Sporobolus fertilis var. pallidiorus +, Planchonella obovata +, (14) Evodia glauca +, (17) Pandanus tectorius +, Ficus superba var. japonica +, (18) Allium macrostemon +, (19) Cyrtomium falcatum +, Glochidion obovatum +,Lepisorus thunbergianus +,Luisia teres +,Setaria viridis var.pachystachys +,(20) Cocculus trelobus*

Locality & date of relevé : 1-3,12 12.1.1972. Cape Busena,Okinawa Island (by K.Suzuki,K.Fujiwara & S.Tamaki), 4-7,9,15 16.1.1972. Cape Busena,Okinawa Island (by K.S. & S.T.), 8 16.1.1972. Oku,Okinawa Island (by K.S. & S.T.), 10,20 13.1.1973. Ie,Okinawa Island (by A.Miyawaki, Y.Niro & K.F,), 13,14,17,18 17.1.1972. Kaya, Okinawa Island (by K.S. & S.T.), 16 17.1.1972. Yakena,Okinawa Island (by A.M.,K.F. & Y.Nakamura), 19 13.1.1973. Nago, Okinawa Island (by A.M. & Y.N.).

Table 4. Astero asa-gray-Zoysietum tenuifoliae (1-8), Viola utchinensis-Adiantum capillus-veneris-community (9-12) and Portulaca pilosa ssp. okinawensis-Zoysia tenuifolia-community (13-14).

No. of relevé:	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Area of relevé(m^2):	15	9	–	–	–	9	9	–	–	–	–	–		
Exposure:	N						N		N	NE	NE	N		
Slope(°):	5	–	–	–	–	–	5	–	85	60	70	80		
Height of herb layer (cm):	15	15	20	15	15	20	15	15	15	20	25	15		
Cover of herb layer (%):	80	85	80	85	80	85	85	70	85	85	85	80		
Total no. of species:	7	8	8	9	9	11	11	11	10	12	13	14	(3.9)	(5.8)
Character species of association:														
Aster asa-gray	4·4	3·3	4·3	3·3	3·3	3·3	4·4	3·3	·	·	·	·	·	·
Differential species of community:														
Viola utchinensis	·	·	·	·	·	·	·	·	1·2	+·2	+·2	+	·	·
Adiantum capillus-veneris	·	·	·	·	·	·	·	·	1·2	1·2	+	+·2	·	·
Amitostigma lepidum	·	·	·	·	·	·	·	·	·	·	+	+	·	·
Differential species of community:														
Portulaca pilosa ssp. okinawensis	·	·	·	·	·	·	·	·	·	·	·	·	III*(2-+)*	II*(2-+)*
Digitaria henryi	·	·	·	·	+	·	·	·	·	·	·	·	II*(1-+)*	II*(1-+)*
Differntial species of community:														
Setaria viridis var. pachystachys	·	·	·	·	·	·	·	·	·	·	·	·	·	V*(+)*
Sedum oryzifolium	·	·	·	·	·	·	·	·	·	·	·	·	·	V*(3-+)*
Differential species of community:														
Zoysia tenuifolia	·	2·2	+	1·2	1·2	2·2	1·2	+·2	3·3	2·2	2·3	2·2	V*(5-3)*	V*(5-2)*
Character & differential species of alliance,order & class:														
Cirsium brevicaule	+	+·2	+	+·2	+	+·2	+	1·2	+	·	·	·	·	I*(+)*
Crepidiastrum lanceolatum	·	·	+	·	+	+	·	+	1·2	2·2	2·2	1·2	·	+*(+)*
Ischemum aureum	+·2	·	1·2	·	1·2	+	·	+	+	+	+	+·2	·	·
Farfugium japonicum	+	+	+	1·2	+	+	+·2	+	·	·	·	·	·	·
Peucedanum japonicum	·	+	·	·	·	·	+	+	·	+	+	+	·	I*(+)*
Carex oahuensis var. robusta	·	·	·	·	·	·	1·2	+·2	+·2	+	+	+	·	·
Lilium longiflorum	+	·	·	·	·	+	+	+	·	·	·	+	II*(+)*	·
Miscanthus sinensis var. condensatus	·	·	·	·	·	·	·	·	·	1·2	1·2	·	·	·
Lysimachya sikokiana	·	·	·	·	·	·	·	·	·	·	·	·	III*(+)*	III*(+)*
Pennisetum sordidum	·	·	·	·	·	·	·	·	·	·	·	·	II*(1-+)*	II*(+)*
Sedum formosanum	·	·	·	·	·	·	·	·	·	·	·	·	II*(1-+)*	·
Belamcanda chinensis	·	·	·	·	·	·	·	·	·	·	·	·	·	I*(+)*
Companions:													·	·
Scaevola taccada	·	·	·	+	·	+	+	·	·	+	+	+	·	·
Maytenus diversifolia	+	·	+	·	+	·	+	+	·	·	·	·	·	·
Fimbristylis cymosa var. spathacea	·	·	·	·	·	+	·	·	+	+	+	+	·	·
Galactia tashiroi	+·2	+·2	·	·	·	+	+	·	·	·	·	·	·	·
Osteomeles anthyllidifolia	·	·	·	·	·	·	·	·	+	+	+	+	·	·
Hedyotis coreana	·	·	·	·	·	·	·	·	+	+	·	+	III*(+)*	I*(+)*
Tylophora tanakae	·	·	+·2	+	·	+	·	·	·	·	·	·	·	·
Liriope tawadae	·	+	·	+·2	·	·	·	·	·	·	·	·	·	·
Lepturus repens	·	+	·	+	·	·	·	·	·	·	·	·	·	·
Boemeria gagantea	·	·	·	·	·	·	·	·	·	·	·	·	II*(+)*	I*(+)*
Asparagus cochinchinensis	·	·	·	·	·	·	·	·	·	·	·	·	II*(+)*	+*(+)*

Additional species present *(7) Ajuga pygmaea +, (8) Cycas revoluta +, (11) Polygala japonica +.*

Locality & date of relevé : 1-12 12.1.1972. Manzamo, Okinawa Island (by K.Suzuki & S.Tamaki)
13 total no. of relevé : 8, Hazaki & Yagi-jima, Amami-oshima Island (by A.Miyawaki et al.)
14 total no. of relevé : 15, Hazaki & Yagi-jima, Amami-oshima Island (by A.M. et al.)

Photo. 1. Astero miyagii-Miscanthetum condensati in the northern part of Okinawa Island.

upper terraced coral slope, somewhat weathering. In the stand, soils are accumulated on the slit or hollow of coastal rocks.

The association is from 15 cm to 20 cm high, and has a plant cover of from 70 per cent to 85 per cent. Total number of the species is from 7 to 11 (7 on average). The charcteristic species, *Aster asa-gray*, is a species peculiar to the Amami Isles and the Okinawa Isles. With regard to the distribution, Astero asa-gray-Zoysietum tenuifoliae may be found not only in the Okinawa Isles but also in the Amami Isles.

4. *Viola utchinensis-Adiantum capillus-veneris*-community
(Table 5)

Viola utchinensis-Adiantum capillus-veneris-community is differentiated by *Viola utchinensis*, *Adiantum capillus-veneris* and *Amitostigma lepidum*. The community is from 15 cm to 25 cm high and from 80 per cent to 85 per cent in plant cover. Major components are *Zoysia tenuifolia*, *Crepidiastrum lanceolatum*, *Ischaemum aureum*, *Carex oahuensis* var. *robusta*, *Fimbristylis cymosa* var. *spathacea*, *Osteomeles anthyllidifolia* and the differential species. Total number of species is from 10 to 14 (12 on average).

The present community is observed at Beach Manzamo, Okinawa Island. *Viola utchinensis-Adiantum capillus-veneris*-community is developed on the steep seashore slope (aspect: N-NW, slope: 60–80°), which does not dry since it receives no sunlight (SeeTable 4)

5. *Portulaca pilosa* ssp. *okinawensis-Zoysia tenuifolia*-community.

(Table 5)

Portulaca pilosa ssp. *okinawensis-Zoysia tenuifolia*-community is a grassland vegetation, which is differentiated by *Portulaca pilosa* ssp. *okinawensis* and *Digitaria henryi*, with *Zoysia tenuifolia* as a dominant species.

The community was recognized by MIYAWAKI *et al.* (1974), as a grassland vegetation on the steep slope at Naze, Amami-oshima Island.

Zoysia tenuifolia grows closely on the narrow strip of steep slopes. Then, the total number of species in the community is limited to 3–9. The next two undercommunities are allied to *Portulaca pilosa* ssp. *okinawensis-Zoysia tenuifolia*-community.

Typical undercommunity has no distinguishing species. Undercommunity of *Sedum oryzifolium* is differentiated by *Sedum oryzifolium* and *Setaria viridis* var. *pachystachys*. The undercommunity of *Sedum oryzifolium* is found on the more stable habitat, containing some sands and soils.

6. *Nephrolepis auriculate-Peperomia japonica*-community

(Table 4)

Nephrolepis auriculata-Peperomia japonica-community, differentiated by *Nephrolepis auriculata*, *Peperomia japonica* and *Boehmeria gigantea*, is distributed on the stable hollow of the coastal slope or the coastal screen.

The community was collected at Hazaki, Amami-oshima Island (MIYAWAKI *et al.* 1974).

The habitat of the community contains considerable amount of soil in which for a long time after rain. The community is made up of some nitrophilous plants like *Boehmeria gigantea*.

7. *Belamcanda chinensis-Miscanthus sinensis* var. *condensatus*-community

(Table 5)

Belamcanda chinensis-Miscanthus sinensis var. *condensatus*-community is differentiated by *Thelypteris acuminata*, *Belamcanda chinensis*, *Ormocarpum cochichinense* and *Rubus sieboldii*. The community is from 1.2 m to 2.0 m high and average number of species is 28 The habitat is nutritious and contains many stones.

The *Belamcanda chinensis-Miscanthus sinensis* var. *condensatus*-community is a taller coastal grassland vegetation than the other. From the phytosociological or environmental point of view, *Belamcanda chinensis-Miscanthus sinensis* var. *condensatus*-community is not independent as an association because it does not have a characteristic species, so that the community is not recognized as an association (See Table 5).

8. Pennisetetum sordidum Miyawaki et al. 1974

(Table 5)

Pennisetetum sordidum is characterized and differentiated by *Pennisetum sordidum*, *Asparagus cochinensis* and *Leucas javanica*. The association was settled by MIYAWAKI *et al.* (1974).

On the relevé of Hazaki, Amami-oshima Island, the total number of species

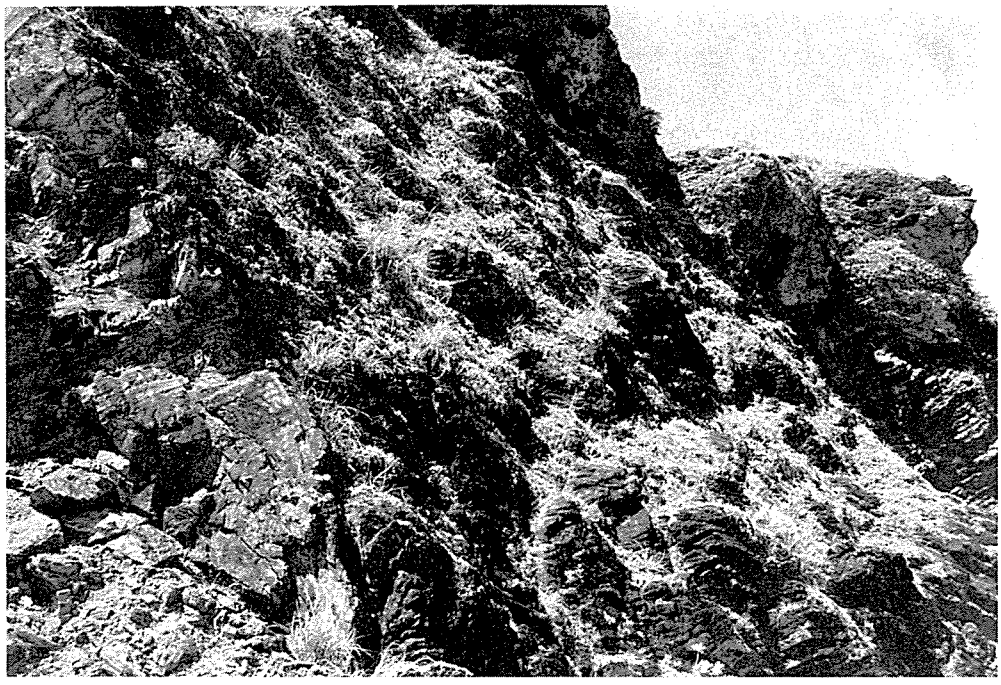

Photo. 2 Pennisetetum. sordidum in Amami-Oshima Island.

Table 6. Zonation of the coastal grassland vegetation in Amami Isles

slope	habitat	community
cliff	unstable slope	Pennisetetum sordidum
	gentle slope	*Portulaca pilosa* ssp. *okinawensis-Zoysia tenuifolia* community
	depressed ground	*Nephrolepis auriculata-Peperomia japonica*-community
screen	unstable ground	Chrysanthemo chinensis-Crepidiastretum lanceolati
	stable ground	*Belamcanda chinensis-Miscanthus sinensis* var. *condensatus*-community

Table 7. Zonation of the coastal grassland vegetation in the Okinawa Isles.

slope	habitat	community
cliff	unstable slope	Pennisetetum sordidum
	gentle slope	Astero asa-gray-Zoysietum tenuifoliae
	depressed ground	*Viola utchinensis-Adiantum capilus-veneris*-community
screen	unstable ground	Astero miyagii-Miscanthetum condensati
	stable ground	*Belamcanda chinensis-Miscanthus sinensis* var. *condensatus*-community

is from 4 to 13 (8.6 on average). *Pennisetum sordidum*, which is a dominant component species of the association, belongs to Gramineae. It develops strong roots and lives gregariously. Accordingly erosion or movement of soil are almost stopped in spite of the steep slope. This results in the formation of many irregular steps. Pennisetetum sordidum is very common on the coastal sandstone slopes in teh Ryukyu Islands, including the fragmental phase.

9. Peucedanion japonicae Ohba 1970
(Table 5)

In the Ryukyu Islands, the phytosociological survey of coastal rocky slope and coastal screen vegetation was carried out and 97 relevés were examined. Through the method of phytosociological tables, 97 relevés were divided into four associations and four communities. They also contained five subassociations and two undercommunities (See Table 5).

In Amami Isles and the Okinawa Isles, the zonation of the coastal grassland vegetation in response to stabilitats are as Table 6, 7.

These four associations and four communities, which are developed on the coastal slope of the Ryukyu Islands, are summarized in table 5. According to the phytosiciological comparision, these communities are grouped into the "alliance" of Peucedanion japonicae Ohba 1970 and the "order" of Lysimachietalia mauritianae Nakanishi et H. Suzuki 1975.

The alliance and the order are characterized and differentiated by *Crepidiastrum lanceolatum*, *Carex oahuensis* var. *robusta*, *Peucedanum japonicum*, *Cirsium brevicaule* and others.

The above order falls into the "class" of Miscanthetea sinensis Miyawaki et Ohba 1970.

Summary

The present study was designed to obtain phytosociological information of the vegetation on the coastal rocky slope on the coastal screen in the Ryukyu Islands which form the southern end of Japan.

As a result of the investigation, it was possible to establish four plant associations and four communities, which fall into the following alliance, order and class.

class: Miscanthetea sinensis Miyawaki et Ohba 1970
  order: Lysimachietalia mauritianae Nakanishi et H. Suzuki 1975
    alliance: Peucedanion japonicae Ohba 1970
      associations and communities:
        1. Chrysanthemo crassi-Crepidiastretum lanceolati new association
        2. Astero miyagii-Miscanthetum condensati Miyawaki et al. 1972
        3. Astero asa-gray-Zoysietum tenuifoliae new association

4. Pennisetetum sordidum Miyawaki et al. 1974
5. *Viola utchinensis-Adiantum capillus-veneris*-community
6. *Portulaca pilosa* ssp. *okinawensis-Zoysia tenuifolia*-community
7. *Nephrolepis auriculata-Peperomia japonica*-community
8. *Belamcanda chinensis-Miscanthus sinensis* var. *condensatus*-community

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