Phytosociological Studies on the Vegetation at Kui Block Field, Hiroshima Prefecture, Japan

by

Tukasa HUKUSIMA

Laboratory of Nature Conservation, Faculty of Horticulture,
Chiba University

Introduction

In the lowlands of Japan, the small scale rock fields are found in some unique sites. "Block field" is the most interesting landscape of all the rock fields. It occurs in shallow valleys of gentle mountain slopes. It is a rock stream of medium to very large boulders. Presence of such block field is well known in Chugoku district of the southwestern Honshu Island. The Kui block field in Hiroshima Prefecture and Ohiwago block field in Yamaguchi Prefecture are the typical ones.

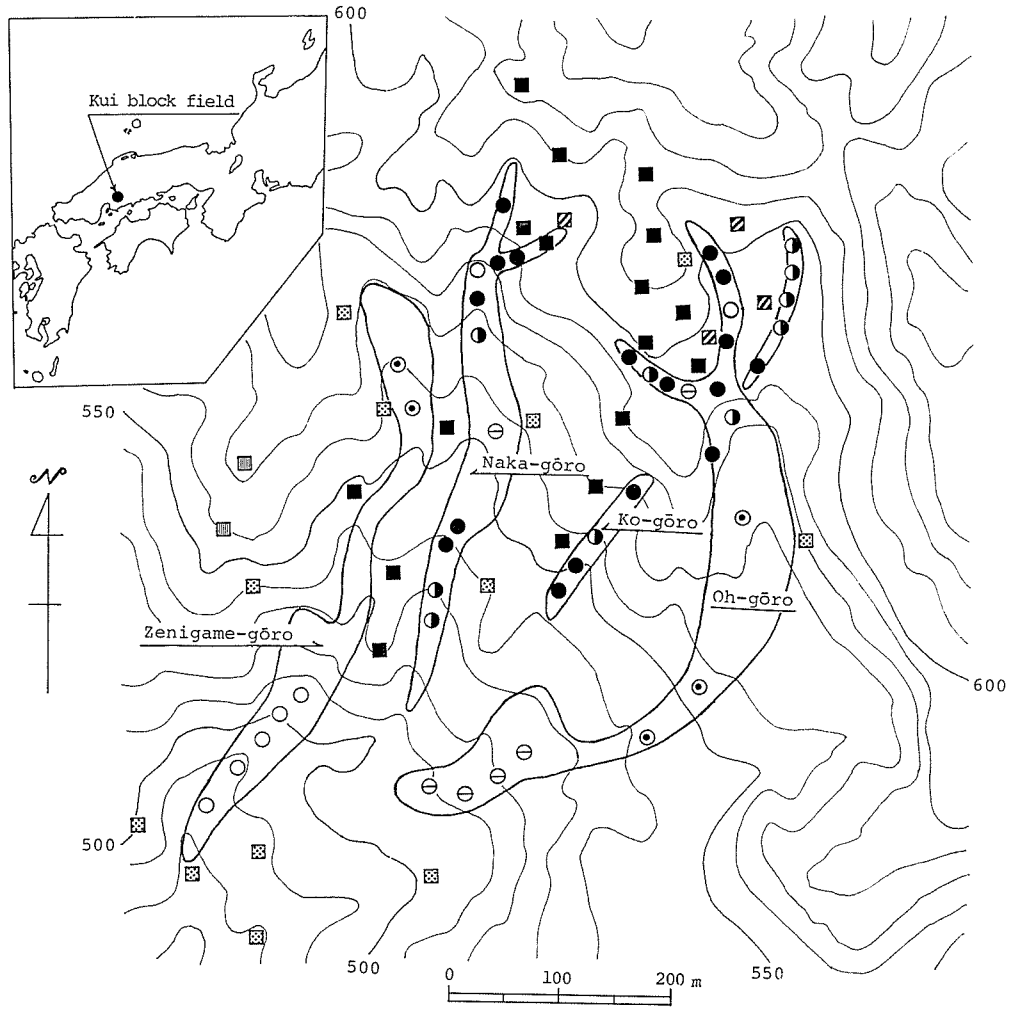
The first floristical studies on the vegetation of the block field was carried out by Hino & Oka (1952) at Ohiwago block field. They found following facts. Characteristically, the vegetation of Ohiwago included some species of higher elevations and comparatively large number of geophytes, relative to therophytes. Haruyama (1962) investigated the vegetation including rocky habitat (=block field) at Mt. Noro in Hiroshima Prefecture. The vegetation of the block field is distinguished from the surrounding ones by the high presen ce of deciduous and evergreen broad leaved plants and floristic composition. Haruyama subdivided the vegetation into following three types; *Cyclobalanopsis acuta-Ligustrum japonicum* comm., *Quercus serrata* comm. and *Q. serrata-Stauntonia hexaphylla* comm.

The purpose of this study is to explain the floristic composition and a distribution of the vegetation units at Kui block field.

The writer wishes to express his sincere thanks to Prof. Dr. Hyoji Suzuki of Hiroshima University, under whose guidance the present study was carrid out. Further earnest thanks are due to Prof. Dr. Keiji Takahashi of Chiba University and Prof. Dr. Satoru Kojima of Toyama University for their valuable advice and encouragement.

I. Area investigated

The study area is situated in the middle part of the southwestern Honshu (Chugoku district), Japan. The study site, Kui block field, (latitude 34° 32′N, longitude 133° 05′E), lies 20km north of Mihara City near the shore of the Setonaikai (Fig. 1). In the area, the block field is found in small and shallow valleys on the mid-slope of low mountains some of which continue to the ridges of Mt. Uneyama (698.5 m). The area is approximately 450m × 600m, ranging



Legend

○ I. Ligustrum obtusifolium-Wisteria brachybotrys comm.
II. Prunus grayana-Hydrangea petiolaris comm.
1. typical group
⊙ 1). typical subgroup
⊖ 2). Magnolia obovata subgroup
2. Ilex pedunculosa group
◑ 1). typical subgroup
● 2). Magnolia obovata subgroup
III. Pinus densiflora-Rhododendron reticulatum comm.
1. Blechnum nipponicum group
▨ 1). typical subgroup
▩ 2). Ardisia japonica subgroup
■ 3). Miscanthus sinensis subgroup
▥ 2. Cladonia rangiferina group

Fig. 1. Distribution of vegetation units in the investigated area

from 470 m to 570 m above sea level. The block field consists of four "gōro"s* (Fig. 1). Imamura (1963) investigated the Kui block field from the geographical

*) The gōro is the local name of the block field. In this paper, each block field is called gōro.

point of view, and reported the extent and the size of these gōros as follows;

	length	width
1. Zenigame gōro	550 m	35–65 m
2. Naka gōro	550 m	35 m
3. Ko gōro	150 m	35 m
4. Oh gōro	750 m	25–90 m

The gōros are exposed to S to SW. They appear to converge to one point at 500 m in elevation. The gōros lie in granodioritic region conforming to the underlying rocks around the area. Each of the gōro is always made up of a pile of abundant large boulders of nearly the same size ranging from 0.2 m to 2 m or more. The boulders have always fresh and hard surface showing no notable signs of weathering or disintegration.

II. Methods

The field investigation was carried out during the period from 1973 to 1975. In the present study, the general vegetation concept and the methodology of the Zürich-Montpellier school of phytosociology (Braun-Blaquet 1928, 1951, 1964) were followed. Later similar sample plots were grouped to construct synthesis table (Table 1.) which provides an objective method of checking the accumulated data for homogeneity and statistical validity. For each sample plot, such physical features as the slope, size and shape of boulders were recorded. Nomenclature for this paper follows; J. Ohwi (1972) for vascular plants and M. Iwatsuki & M. Mizutani (1972) for mosses.

III. Results

A. Vegetation in the gōro (Ref. Table 1)

Differential species: *Lygustrum obtusifolium*, *Rhus javanica*, *Smilax sieboldii*, *Parthenocissus tricuspidata*, *Callicarpa japonica*, *Deutzia crenata*, *Cocculus trilobus*, *Lonicera japonica*, *Thuidium kanedae*, *Plagiothecium nemorale*, *Isothecium subdiversiforme*, *Schizophragma hydrangeoides*, *Ophypogon japonicus*

In this area, this vegetation occurs only in the gōro. It is distinguished from the surrounding vegetation by the dominance of deciduous trees and species composition of the vegetation. A little accumulation of litter is found on the ground. Soil is not recognized due to the extreme lithic condition. Although the kind of the vegetation unit is found in the entire areas of the gōro, the main portion occurs in the Naka gōro, Ko gōro, the upper and lower parts of Oh gōro and a part of Zenigame gōro.

For the floristic composition, the vegetation was characterized by the high presence of the differential species mentioned above. The most important components of this vegetation with high presence and dominance are deciduous and evergreen lianas which are DL and EL in life form in the Table 1. In addition to this, the luxuriant growth of the following species is the most distinct characteristic, namely *Lindera glauca*, *Wisteria brachybotrys*, *Rosa multiflora*, *Akebia trifoliata*, *Vitis saccharifera*, *Cephalotaxus harringtonia* and *Dicranum*

nipponense. This vegetation is physiognomically characterized by the presence of *Lindera strychnifolia* and *Quercus serrata*.

This vegetation consists of the following two communities as follow.

I. *Lygustrum obtusifolium-Wisteria brachybotrys* community

Number of stands: 6
Average and range of number of species: 21 (18–26)

This type lacks the differential species. Moreover, it almost lacks the tree and the subtree layers. The number of its component species are fewer than the next community, but it is characterized by the lianas occurring with high presence and dominance. *Lindera glauca* and *Ligustrum tschonoskii* form a loose shrub layer. The herb layer includes such lianas as *Schizophragma hydrangeoides*, *Wisteria brachybotrys* and *Smilax sieboldii*.

According to the author's field data, typical stands are restricted to the upper part of the Naga gōro and lower part of the Zenigame gōro. In these gōros, the size of the boulders is generally very large, their diameter being from 1 m to 2 m. The vegetation occurs between boulders because there is usually a wide gap between two neighbouring boulders.

II. *Prunus grayana-Hydrangea petiolaris* community (39 stands)

Differential species: *Prunus grayana*, *Calamagrostis tashiroi*, *Euonymus oxyphyllus*, *Wisteria floribunda*, *Abelia apothulata*, *Zanthoxyllum schinifolium*, *Pleopeltis thunbergiana*, *Hydrangea petiolaris*, *Trachelospermum asiaticum*

This community was recognized by high presence of the differential species above, and is composed of the nucleus of the vegetation in the gōro. Moreover, it has many important component species of pine forest except the *Cladonia rangiferina* group. Examples include *Ilex crenata*, *Acanthopanax sciadophylloides*, *Pourthiaea villosa* var. *laevis*, *Viburnum erosum*, *Clethra barbinervis*, *Pertya scandens*. The stratification is well developed. In the tree layer, *Quercus serrata* grows vigorously. The subtree layer is dominated by *Lindera strychnifolia* followed by *Prunus grayana*, *Lindera glauca* and *Rhus javanica*. *Lygustrum obtusifolium* is the only dominant species in the shrub layer. The herb layer consists of mainly *Hydrangea petiolaris* and *Trachelospermum asiaticum*; both of them are lianas. In the moss layer, *Hypnum pulmaeforme*, *Thuidium kanedae*, *Plagiothecium nemolare* and *Isothecium subdiversiforme* are constant on the boulders.

This community may be further subdivided into two groups and four subgroups, reflecting microhabitat condition such as arrangement and size of the boulders, and difference in kind and amount of litter. The greatest possible attention, therefore, has been paid to the microenvironmental characteristics.

II–1. typical group

Although this group is characterized by the presence of the differential species of thc community II, it does not have its own differential species. Well-deve-

loped occurrences of lianas such as *Hydrangea petiolaris* and *Trachelospermum asiaticum* are a remarkable feature of this group comparing to the *Ilex pedunculosa*-group of the same community. This group develops in the middle part of the gōro and forms an island community. In this group, a small amount of deciduous litter is characteristically deposited in gaps of the boulders which have flat tops in general.

II–1–1). typical subgroup

Number of stands: 5
Average and range of number of species: 34 (24–39)

This subgroup is found on the upper part of the Zenigame gōro and middle part of the Oh gōro where, in general, the width of the gōro increases. The size of boulders ranges from 1 m to 3 m in diameter. In the stands of this subgroup, the component species occur sparsely in the tree, subtree and shrub layers in most cases. The development of the moss layer is rather poor. Mosses grow only on sides of boulders where the micro-habitat is cool and humid because of shaded conditions.

II–1–2). *Magnolia obovata* subgroup

Differential species: *Magnolia obovata, Disporum smilacinum, Entodon salivantii, Evodiopanax innovans*

Number of stands: 7
Average and range of number of species: 43 (31–57)

This subgroup is the most stable forest which represents the forest in the Kui block field. It occurs mainly on the lower part of the Oh gōro. Occassionally it is found in the upper part of the Oh gōro as in the well as middle part of the Naka gōro. The size and the shape of boulders are similar to the preceding subgroup, but distinguished from it by the mode of arrangement of boulders which are closely imbricated. According to the writer's observation, the deposition of the litter was found on and between the boulders, where occasionally the vegetation develops on the boulders. Although this subgroup is characterized by the above mentioned species, the rare occurrence of several hygrophilous species such as *Zelkova serrata, Celtis sinensis, C. jessoensis, Dryopteris polylepis* and *Torreya nucifera* are characteristic. This is probably due to the better availability of moisture. Underground water is evidently present here, as sound of water flow is heard in the lower part of the Oh gōro.

The tree layer consists of *Magnolia obovata* and *Quercus serrata. Lindera strychinifolia, L. glauca* and *Rhus javanica* are abundant in the subtree layer. On the boulders, the herb layer predominantly consists of lianas. The moss layer is always on the boulders.

II–2. *Ilex pedunculosa* group

Differential species: *Ilex pedunculosa, Eurya japonica, Tripterospermum japonicum, Rhododendron kaempferi, R. reticulatum, Castanea crenata*

In general, this group occupies the narrow gōro and margin of the wider gōro, where bottoms of the boulders are rarely buried in the soil. It is characterized by the presence of the constant and differential species essentially of pine forest. The height of the tree layer is generally shorter than that of the previous group. The lianas decrease in these sites. In these stands, the size of the boulder is apparently smaller than in the preceding group. Their size ranges from 0.3 m to 1.0 m in diameter. The shape is variable. Each boulder, except its upper surface, is abundantly covered with the pine litter because this group is surrounded by the pine forest. On the litter layer, seedling of *Rhododendron kaempferi* and *R. reticulatum* are found occasionally.

II–2–2). typical subgroup

Number of stands: 10
Average and range of number of species: 39 (32–52)

This subgroup occurs in upper and lower parts of the Naka gōro, the Ko gōro and upper part of the Oh gōro. In this forest, the development of the layers of tree and subtree is poor and their height is low. Usually the boulders have rounded tops. Among the boulders the litter accumurates thickly. The size of boulders ranges from 0.3 m to 0.5 m in diameter.

II–2–2). *Magnolia obovata* subgroup

Differential species: *Magnolia obovata*, *Disporum smilacinum*, *Entodon sullivantii* var. *versicolor*, *Evodiopanax innovans*
Number of stands: 17
Average and range of number of species: 43 (33–51)

This subgroup is characterized by the same differential species as those of the preceding subgroup: *Magnolia obovata* subgroup under typical group. In addition, *Eurya japonica*, *Rhododendron kaempferi* and *R. recticulatum* grow abundantly. It is closest to the pine forest out of all the vegetation units in the gōro. In the sites, the size of the boulders is larger than that in the preceding subgroup of the same group. Most of the boulders have flat tops. On and among the boulders, the pine litter is seen abundantly. Stratification is generally well developed.

B. Vegetation around the gōro (Ref. Table 1.)

The forest around the gōro consists usually of pine forest which covers large areas. Bush of *Arundinaria pygmaea* var. *glabra* develops well along a path as well as fringe areas of the goro. It is, however, closely related to the pine forest in florisitc composition. The soil formation is usually good throughout the area.

III. *Pinus densiflora-Rhododendron reticulatum* community (34 stands)

Differential species: *Pinus densiflora*, *Juniperus rigida*, *Lyonia ovalifolia* var. *elliptica*

Physiognomically this community is characterized by a vigorous development of *Pinus densiflora* in tree layer which ranges from 5 m to 18 m all in height. From the floristic composition, this community corresponds to the Association, Rhododendro reticulati-Pinetum densiflorae after Toyohara & H. Suzuki (1975). As a lower their unit of the association, this community coincides closely with the *Acanthopanax sciadophylloides*-subassociation. This community is characterized by the high presence and great dominance of the three differential species mentioned above. At the same time they are the character species of higher vegetation units, e. g. suballiance and alliance or m ore. Besides them, the ericaceous species such as *Vaccinium oldhamii* and *V. smallii* var. *glabrum* grow more luxuriantly here than in the former communities in the gōro. *Ilex pedunculosa*, *Eurya japonica*, *Tripterospermum japonicum*, *Rhododendron kaempferi*, *R. reticulatum* and *Castanea crenata* which are restricted to the group II–2. unit of the community in the gōro are prominent in this community. Most of them are dominant species of the subtree and shrub layers of the pine forest. The most conspicuous features of this community are the decrease of most lianas and remarkable increase of evergreen as well as ericaceous plants. These are the fundamental differences between the vegetation on gōro and the pine forest.

Pieris japonica, though constant species of the pine forest in inland areas, rarely grows in this site presumably due to human impacts. In these areas local people seem to have been eradicating the species because of its toxicity to cattles.

This community is subdivided into the following two groups based on the floristic composition and habitat conditions.

III–1. *Blechnum nipponicum* group

Differential species: *Blechnum nipponicum*, *Cymbidium goeringii*, *Brotherella henonii*, *Pteridium aquilinum* var. *latiusculum*

This group is found extensively in the main area of pine forest. Besides the differential species, it is characterized by the occurrences of the following species; *Ilex crenata*, *Acanthopanax sciadophylloides*, *Pourthiaea villosa* var. *laevis*, *Viburnum erosum*, *Clethra barbinervis* and *Pertya scandens* (in species group 7), *Lindera strychnifolia* and *L. glauca* (in species group 11), *Prunus jamasakura*, *Sorbus japonica* and *Ilex serrata* (in species group 13).

This group includes three subgroups which are associated with their respective habitats.

III–1–1). typical subgroup

Number of stands: 4
Average and range of number of species: 25 (24–26)

The distribution of this subgroup is mostly limited to the fringes of the upper the part of the gōro where it adjoins the *Ilex pedunculosa* group in the gōro. A comparison of the floristic composition of the present subgroup with former group

shows a considerable difference. It should be noted that the same kind of boulders as those in the gōro are found sporadically on the ground in this subgroup. The boulders are always present in the A_2 horizon as well. Based on the facts mentioned above, it may be said that in this subgroup the gōro have been buried under soil and litter of pines.

III–1–2). *Ardisia japonica* subgroup

Differential species: *Ardisia japonica*, *Styrax japonica*
Number of stands: 11
Average and range of number of species: 31 (24–40)

Its occurrences are mostly limited to the lower part of gentle slopes or flat topography; it occurs and rarely in the middle part of slopes or concave sites. In general, soils are mesic in moisture with deeper development of profiles. Although it lies frequently in contact with the typical subgroup of the same group, we cannot find the occurrence of boulders on the ground.

III–1–3). *Miscanthus sinensis* subgroup

Differential species: *Miscanthus sinensis*, *Leucobryum neilgherrense*
Number of stands: 17
Average and range of number of species: 28 (21–42)

The range of this subgroup extends from the flattend ridge to middle part of slopes. In this subgroup the coverage and height of the pine trees, which is the dominant species in the tree layer, become less and shorter than in the preceding two subgroups. This subgroup is rich in some xerophylous and heliophilous species such as *Juniperus rigida* and *Hypnum plumaeforme*. It rarely occurs on the upper part of steep slopes where it adjoins the *Cladonia rangiferina* group.

III–2. *Cladonia rangiferina* group

Differential species: *Cladonia rangiferina*, *C. aggregata*, *Amelanchier asiatica*
Number of stands: 2
Average and range of number of species 16–21

This group is similar in floristic composition to the *Cladonia rangiferina* variant under the *Acanthopanax sciadophylloides*-subassociation described by Toyohara & H. Suzuki (1975). Two lichen species are characteristic differential species of this group. The occurrence of the group is limited to steep mountain ridges with intense insolation. The soil usually lacks A horizon because of an intense erosion by rainfall, exposing the B horizon directly. The growth of pine is poor showing stunted forms in the subtree layer. The constituents of the herb layer such as *Miscanthus sinensis* and *Lespedeza bicolor* forma *acutifolia* occur at the bottom of pine trees forming patches. In the moss layer, two lichen species mentioned above and *Hypnum plumaeforme* are usually found forming mats on the ground. Although the number of component species of this group is less

than that in the other group of this community, *Amelanchier asiatica* which is widely distributed on pine forest in the southwestrn Honshu is recognized only in this group.

IV. Discussion

As the result of this investigation, the vegetation in the gōro which has shallow organic matter layer is characterized by the luxuriant growth of deciduous broad leaved trees, lianas and mosses. The component species of the vegetation include many elements of mantle community. On the other hand, the pine forest around the gōro includes some coniferous trees, many evergreen broad leaved trees, and ericaceous plants. Lianas and mosses occurring in the pine forest always comprise part of constituents of the vegetation in the gōro.

The arrangement of all stands belonging each vegetation units on the present study is shown in the Fig. 1. The vegetation in the gōro is classified into five vegetation units. Although the formation and distribution of each unit is determined by many factors, the nature of the gōro (especially width of gōro, size, shape and arrangement of boulders) and influences from surrounding forest (supply of pine litter and soil) are evidently of particular importance.

In the center of a large gōro, large boulders with flat tops lie complicatedly one upon another. On the other hand, the small and roundish boulders are distributed on the verge of a large gōro or in a narrow gōro. In intermediate areas between the former two, the boulders show somewhat intermediate features of the two. The pine forest supplies a large quantities of pine litter in verge of and narrow gōro. The litter accumulates thickly to show slow decomposition forming thick A_0 layer. In addition, in some areas, the soil forms around the forest is washed in occasionally accumulates among the boulders. At the center of a wide gōro, the litter which originates from deciduous broad leaved trees, occurs sparsely and thinly among the boulders. Although we can find the accumulation of the litter, it is decomposed easily and forms thin organic matter horizon in some places.

Based on the distribution and habitat condition of each vegetation unit, the writer tried to elucidate the phytosociological relationships between each unit and their successional trend as shown in the Fig. 2.

According to this, we can recognize several stages from the center to the verge of the gōro. But in the narrow gōro, some stages may be missing. The first stage is the rock field where we cannot find the deposition of litter nor growth of higher plants. In this stage, habitats are extremly dry being exposed to the solar heat owing to lack of the shelter. Mosses are the only plants which can grow sparsely under such circumstances. They grow on the perpendicular sides of the boulders where they are protected by the shade of boulders. The second stage is the liana community (I. comm.) which forms mantle community. In this stage, a small amoun of litter accumulates among the boulders. The component species of this stage have to tolerate the organic matter layer through which they spread their shallow root system. The third stage may include two directions. One is a verge or narrow gōro type which is composed of small boulders, where the II–2–1) subgroup is distributed. The othoer is the one occuring

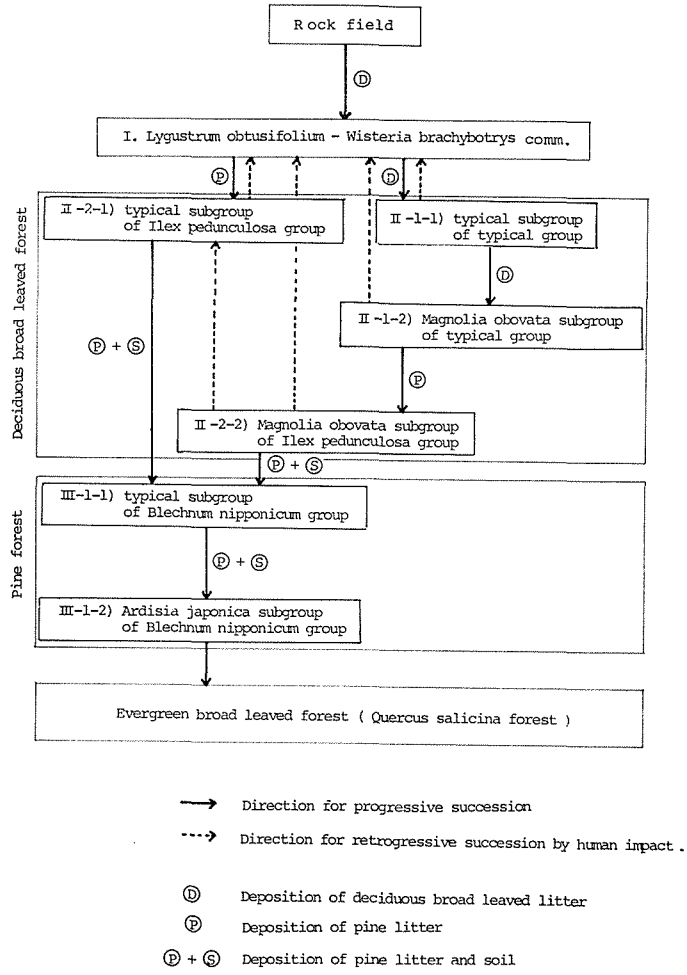


Fig. 2. Phytosociological relationship among the vegetation units in the Kui block field and their successional trend

in the middle of a gōro where II–1–1) subgroup occurs. They accumulate different kinds of litter. The former accumulates the pine needles and the latter is made up of deciduous litter. The former will proceed directly to the III–1–1) subgroup of pine forests with the increase of pine litter and inflow of soil. The latter will develop to the substantial type of deciduous broad leaved forests in the gōro, (II–1–2) subgroup owing to the accumulation of somewhat deep organic matter which originates from deciduous trees. This type of deciduous forest may be regarded as an edaphic climax forest in the gōro. The formation fo organic matter layer in stands of this subgroup is more conspicuous than that of the II–1–1) subgroup. In the stand of this subgroup, the II–1–2) subgroup forms occasionally thin HA horizon. The II–1–2) subgroup will be changed to the II–2–2) subgroup if enough deposition of pine litter and soil takes place. The II–2–2) subgroup will move to the III–1–1) subgroup, if the same trend further continues. The III–1–1) subgroup is composed of most of the components species of pine

forest. Most of the elements of the gōro, except *Lindera glauca*, *L. strychnifolia* and *Cephalotaxus harringtonia* which show stagnant growth in the pine forest, will disappear as the succession progresses. That subgroup seems to change to the III–1–2) subgroup with continuous deposition of litter and soil for a long time. In this area, the climatic climax forest seems to be evergreen oak forest of *Quercus salicina*. This conclusion is based on the fact ascertained from the remnant forest of a Shintō shrine in the vicinity. Without the human impacts, III–1–2) subgroup of pine forest will attain that forest.

The direction of rretrogessive succession is determined mainly by human impacts. It seems tha such impact is due to the cutting. Although the impact causes damages to the plants, the condition of organic matter which supports vegetation development does not change so much. According to Fig. 2., most of the directions move toward the liana community (I-comm), but it would not proceed to the rock field. The retrogressive succession from pine forests to deciduous broad leaved forest would not take place, because each vegetation unit in the pine forest has already well established soils.

The component species of the vegetation in the gōro, especially tree plants, can tolerate shallow organic matter which retains moisture for plants. In contrast the pine forest includes many plants which have perpendicular roots. Those species, therefore, do not grow in the sites where large boulders lie one upon another. On the other hand, the verge and the small gōro, where boulders are small in size, and soil and litter accumulate among the boulders, provide some component species of the pine forest such as *Eurya japonica* and *Ilex pedunculosa* with favourable habitats to grow.

The ecological characteristics of plants and features of the gōro (arrangement, size and shape of boulders) are very important factores to define the development and distribution of vegetation units.

In terms of nature conservation of this block field, special attention has to be paid to the following facts:

1). The block field is not suitable for tree plantation of *Cryptomeria japonica*, because soil is extremely shallow on this habitat while *Cryptomeria japonica* with deep root system requires deep and well developed soil.
2). The area has unique deciduos forests which are cleary distingushed from other pine forests surrounding the block field.
3). The block field and the surrounding area provide interesting examples of various stages of succession.
4). The block field has unique landscape which is worth preservation both from geological as well aesthetic point of view.

According to the above mentioned points, it should be utilized as the natural education area for the people. To accomplish the aim, the present situation in and around the block field needs to be maintained. It seems important to stop the supply of pine litter and incoming soils from surrounding areas to avoid change of vegetation from II–2–1)→III–1–1) and II–1–2)→II–2–2)→III–1–1). For this purpose the following measures should be taken: avoid clear cuttings, upbring ing of shrub layer such as *Arundinaria pygmaea* var. *glabra* which is distributed

around the block field to protect the inflow of soil and litter, and cutting branches of pine tree around the block field.

Summury

1. The present study is concerned with the vegetation in and around the Kui block field which is situated in the middle part of the southwestern Honshu. The vegetation of the area consists of three types with different landscape.
2. The vegetation data are summarized in a phytosociological table. It is subdivided into 3 communities including 4 groups and 7 subgroups. The system is explained ecologically.
3. The vegetation in the block field is composed of the two communities both of which have shallow organic layer. They are characterized by the luxuriant growth of lianas and mosses. The vegetation is classified into five units. The formation and distribution of each unit are determined mainly by the characteristic feature of the gōro (width of gōro, size, shape and arrangement of boulders) and influence from surrounding pine forest (i. e. supply of pine litter and soil). The vegetation outside the gōro is classified into four units.
4. Based on the distribution and habitat conditions of each unit, the writer tried to the elucidate the phytosociological relationship among the units and their successional trend (Fig. 2). According to this, we can recognize several stages from the center to the verge of the gōro.
5. As to the practical use of the block field, it is recommended that the area should be preserved for educational purposes as it provides good examples of different successional stages of vegetation.

References

BRAUN-BLANQUET, J. 1964. Pflanzensoziologie. 3. Aufl. Wien.

ELLENBERG, H. 1956. Grundlagen der Vegetationsgliederung Teil 1, Aufgaben und Methoden der Vegetationskunde. Einführung in die Phytologie von H. Walter, Ⅳ-1. Sututtgart.

HARUYAMA, K. 1960. The vegetation of Mt. Noro, Province, Aki. Ann. Rep. of the Sotokugakuen, Hiroshima, Vol. I: 67–79.

HINO, I. and K. Oka 1952. Vegetation of Ooiwago, Yamaguchi Prefecture. Bull. Fac. Agr. Yamaguchi Univ. No. 3: 145–161.

IMAMURA, S. 1963. A study on some Felsenmeere found in west Chugoku, Japan. Sci. Rep. of Geol. 12: 257–274.

SUZUKI, T. und M. ARAKANE 1968. Gefäßpflanzenflora von der Kuzyûvulkangruppe Sci. Res. the Kujuu, 87–123, Oita.

TOYOHARA, G. and H. Suzuki 1975. A phytosociological study of pine forest in Itsukushima (Miyajima) Island and its neighboring area of the mainland of Honshu. Land and Life in Itsukushima. 119–131. Hiroshima.

Photo 1. A general view of the forest vegetation in and around the Kui block field. The secondary forest of *Pinus densiflora* is developed on the convex site and broad leaved deciduous forest dominated by *Quercus serrata* occurs in the concave site.

Photo 2. The contrast between broad leaved deciduous forest in the block field and pine forest around the site.

Photo 3. Landscape of the gōro. Rock field where only moss and lichen species occur is shown in the center of this picture.

Photo 4. In the gōro, vegetation develops inbetween boulders. *Prunus grayana* grows in the center of this picture.

Photo 5. Inside the broad leaved deciduous forest in the gōro. The vegetation belongs to the *Magnolia obovata* subgroup of typical group under the *Prunus grayana-Hydrangea petiolaris* community.

Photo 6. Secondary forest of *Pinus densiflora* surrounding the gōro belongs to the *Ardisia japonica* subgroup of the *Blechnum nipponicum* group under the *Pinus densiflora-Rhododendron reticulatum* community.