大井川上流における崩壊地での植生回復

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短　報

Vegetational Recovery of Landslide Scars in the Upper Reaches of the Oi River, Central Japan*

Toru NAKAMURA**

I. Introduction

This paper deals with the vegetational recovery of landslide scars on an area in the upper reaches of the Oi River, Shizuoka Prefecture, Japan. On landslide scars, it is difficult to establish plants because the soils are unstable. Therefore, only plant communities of selected species which can adapt to such conditions are able to become established.

Studies of the recovery process of vegetation on landslides, which include changes of species composition and environmental conditions, will be useful for land restoration in this area.

Although many investigations on vegetation on landslide scars have been conducted (*3*～*7*, *11*), only a few from a phytosociological viewpoint have been made.

In this paper, plant communities were arranged in order according to the development of vegetation on the landslide scars.

II. Study Area

The study area is located on the upper reaches of the Oi River on the Ikawa Instruction Forest of the University of Tsukuba (Fig. 1).

Annual mean-temperature and KIRA's warmth and cold indices are 8.6, 76.0, and −16.8℃, respectively. The annual precipitation is 2,500～3,500 mm (at the Mutake Lodge having an altitude of 900 m).

Since the area is located between the Fossa Magna and the Median Tectonic Line, the geology consists of the fractured, fragile Mesozoic group such as clay slate, sandstone, and shale. Gravel of various sizes is deposited loosely. Much gravel is crumbled spontaneously by freezing and thawing from winter to the beginning of spring. Landslide scars are distributed on slopes facing various directions. The slopes have a mean inclination of 35° and range 800～1,300 m in altitude. According to field observations and aerial photographs the mean density of scar in this area is 1.9 per ha (*1*). These landslide scars are covered by plant communities in various stages of primary succession and are surrounded by secondary forests.

The dominant species of the climax forest are *Tsuga sieboldii* CARR., *Abies firma* SIEB. et ZUCC. and *Fagus japonica* MAXIM., which are members of intermediate-temperate forest zone in Japan (*10*). However, natural vegetation dominated by these species is seldom seen because repeated landslide interrupt the vegetational recovery in this area. The slopes on which the landslides occur are dominated by secondary-hardwood forests.

III. Method

A phytosociological method (*2*) was adopted for the vegetation survey. Several homogenous stands of plant communities were chosen for the investigation. In each plant community, cover-abundance and sociability of all species were recorded. The data collected by the phytosociological method were treated with the method of MUELLER-DOMBOIS and ELLENBERG (*9*) by tabular comparison and summarizing into a differential table. The investigations were made from 1974 to 1981.

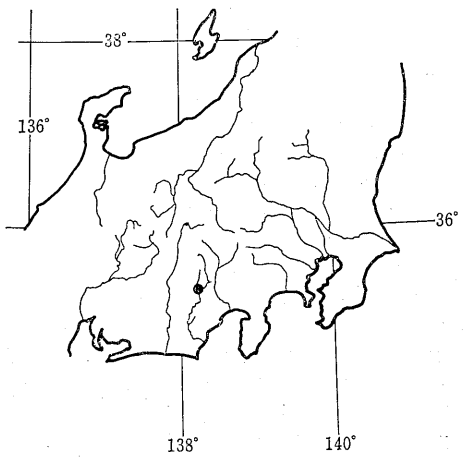

Fig. 1. Location of the study area

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** Inst. of Agr. & For., Univ. of Tsukuba, Tsukuba Science City, Ibaraki 305 筑波大学農林学系

IV. Result

From 113 relevés obtained from many landslide scars in the study area, one association containing two under units with four stand-groups and one community were identified (Table 1). These associations are as follows:

I. Cirsio-Campanuletum hondoensis MIYAWAKI, OHBA et MURASE 1964
  A. Typical under unit
    1) Typical stand-group
      i) *Polygonum cuspidatum* facies
      ii) *Boehmeria tricuspis* var. *unicuspis* facies
    2) *Clematis stans* stand-group
  B. *Miscanthus sinensis* under unit
    1) Typical stand-group
    2) *Clematis stans* stand-group
      i) Typical sub-stand group
      ii) *Salix bakko* sub-stand group

II. *Carpinus cordata-Acer mono* var. *marmoratum* f. *dissectum* community

The attributes of these vegetation units are as follows:

I. Cirsio-Campanuletum hondoensis MIYAWAKI, OHBA et MURASE *1964 (8)*

This association is one of typical vegetation on landslide scars in the cool-temperate zone of central Japan, and is distributed widely in this area. The species composition of these stands vary according to environmental conditions on the scars. The following under units are recognized in the association.

I-A Typical under unit

This under unit appears in an earlier stages of the vegetational recovery of landslide scars and is composed of 5.7 species, on average, which are scattered all over the landslides. The under unit is divided into two stand-groups, typical and *Clematis stans* stand-groups.

I-A-1 Typical stand-group

This group occurs in the earliest stage of the vegetational development on landslide scars. In the stand, either *Cirsium purpuratum* MATSUM., *Polygonum cuspidatum* SIEB. et ZUCC., or *Boehmeria tricuspis* MAKINO var. *unicuspis* MAKINO invade newly-formed landslides and build up a community in most cases. Once a pioneer community is established by one of these three species, it contributes to gravel stability. Then, these and other species such as *Campanula punctata* LAM. var. *hondoensis* OHWI and *Artemisia princeps* PAMP. come into the community. The poor stands dominated by *Cirsium purpuratum* and/or *Polygonum cuspidatum* and by *Boehmeria tricuspis* var. *unicuspis* are the facies of *P. cuspidatum*, and of *B. tricuspis* var. *unicuspis*.

I-A-2 *Clematis stans* stand-group

This stand-group, which is another of the typical under units, occupies the stands on convex topography. Plants on convex slopes are damaged little by being buried with falling gravel. This stand-group contains a larger number of species, 8.5, than does the typical one with 4.8.

I-B *Miscanthus sinensis* under unit

This under unit has a more developed vegetation than the typical under unit in respect to a number of species and higher vegetation. These stands occupies the margins of landslides. Since the margins are near to the source of seeds, the plants migrate and are rapidly established in the stand.

The under unit is differentiated by the species of *Miscanthus sinensis* ANDERSS. and *Aster ageratoides* TURCZ. var. *ovatus* NAKAI. Establishment of *M. sinensis* on the landslide scars is important because it stabilizes a stand which woody species can invade and grow therein.

This under unit is divided into two stand-groups.

I-B-1 Typical stand-group

This stand-group is distinguished from the other stand-group of this under unit by lacking the differential species of the *Clematis stans* stand-group. If vegetational recovery is not interrupted, this stand develops during the five years after a landslide.

In the stands of this stand-group, *Leucosceptrum japonicum* KITAM. et MURATA f. *barbinerve* KITAM. et MURATA and *Hydrangea involucrata* SIEB. et ZUCC. are often distinctive on humid sites.

I-B-2 *Clematis stans* stand-group

This stand-group is differentiated by *Clematis stans* SIEB. et ZUCC. and *Sedum aizoon* L. var. *floribundum* NAKAI which also are differential species of the *Clematis stans* stand-group of the typical under unit. This is the most developed vegetation on landslides in the area, and shows the highest values in the number of species (13.3 on average) and vegetation height.

Some stands of this stand-group contain many woody species such as *Salix bakko* KIMURA, *Carpinus japonica* BL., *C. tschonoskii* MAXIM. and so forth, and are recognized as the *S. bakko* sub-stand group. These are the most developed vegetation on landslides and will be followed by other woody communities. This sub-stand group develops mainly on the talus cone of the lower parts of landslides.

II. *Carpinus cordata-Acer mono* var. *marmoratum* f. *dissectum* community

This community is a secondary forest surround-

Table 1. Differential table

Association (Community)	(I) Cirsio-Campanuletum hondoensis MIYAWAKI, OHBA, et MURASE 1964							(II) *Carpinus cordata-Acer mono* var. *marmoratum* f. *dissectum* community
Under unit	(A) Typical under unit				(B) *Miscanthussinensis* under unit			
Stand-group	(1) Typical stand-group			(2) *Clematis stans* stand-group	(1) Typical stand-group	(2) *Clematis stans* stand-group		
Facies/Sub-stand group	(i) *Polygonum cuspidatum* facies	(ii) *Boehmeria tricuspis* var. *unicuspis* facies	(iii) Main part			(i) Typical sub-stand group	(ii) *Salix bakko* sub-stand group	
Vegetation height (m): mean	0.4	0.6	0.8	0.7	1.2	1.3	4.1	13.4
Number of species: range	1~2	2~3	3~13	7~15	5~19	4~19	7~36	34~60
Number of species: mean	1.8	2.4	5.7	8.5	11.1	10.5	20.4	44.3
Number of relevés	5	5	26	11	27	23	9	7
Characteristic and differential species of Association (I) and Facies (i)								
Cirsium purpuratum MATSUM.	III+	·	IV+-5	III+-5	V+-5	V+-3	III+-3	·
Polygonum cuspidatum SIEB. et ZUCC.	V1-5	·	III+-4	II+-3	III+-5	III+-4	III+-1	·
Characteristic and differential species of Association (I) and Facies (ii)								
Boehmeria tricuspis MAK. var. *unicuspis* MAK.	·	V+-5	V+-5	V+-5	V+-5	V+-5	V+-4	·
Artemisia princeps PAMP.	·	II+-2	IV+-5	III+-2	V+-4	V+-4	IV+-2	·
Campanula punctata LAM. var. *hondoensis* OHWI	·	·	II+-2	III+-1	II+-3	IV+-3	IV+-1	·
Youngia denticulata KITAM.	·	I+	II+	II+-1	III+-1	I+-1	I+	·
Differential species of under unit (B)								
Miscanthus sinensis ANDERSS.	·	·	·	·	V+-4	V+-5	V+-4	II+
Aster ageratoides TURCZ. var. *ovatus* NAKAI	·	·	·	·	III+-3	III+-3	V+-2	·
Differential species of stand-group (2)								
Clematis stans SIEB. et ZUCC.	·	·	·	V+-3	·	V+-4	V+-3	·
Sedum aizoon L. var. *floribundum* NAKAI	·	·	·	II+-1	·	II+-1	IV+-1	·
Differential species of sub-stand group (ii)								
Salix bakko KIMURA	·	·	·	·	·	·	IV+-4	·
Carpinus tschonoskii MAXIM.	·	·	·	I+	·	·	III+-I	II+
Carpinus japonica BL.	·	·	·	I+	·	·	IV+-1	II+-1
Actinidia arguta PLANCHON	·	·	·	·	·	·	III+-2	·

Stachyurus praecox SIEB. et ZUCC.	·	·	·	·	I +	·	II +−1	I +
Euptelea polyandra SIEB. et ZUCC.	·	·	·	·	r +	·	II 1−2	·
Senecio nikoensis MIQ.	·	·	·	·	·	·	III +−1	·
Differential species of Community (II)								
Carpinus cordata BL.	·	·	·	·	·	·	r 1	V +−4
Quercus mongolica FISCH. var. *grosseserrata* REHD. et WILS.	·	·	·	·	I +	I +	·	V +−3
Acer mono MAXIM. var. *marmoratum* HARA f. *dissectum* REHD.	·	·	·	·	·	r +	·	V 1−2
Acer capillipes MAXIM.	·	·	·	·	·	·	II +	V +−3
Akebia trifoliata KOIDZ.	·	·	·	·	·	r +	I +	V +−2
Lindera umbellata THUNB.	·	·	·	·	·	·	I +	V +−1
Meliosma myriantha SIEB. et ZUCC.	·	·	·	·	·	·	I +	V 1−3
Schizandra repanda PADLK.	·	·	·	·	·	I +−2	·	IV +−1
Abies firma SIEB. et ZUCC.	·	·	·	·	·	·	·	IV +−3
Torreya nucifera SIEB. et ZUCC.	·	·	·	·	·	·	·	IV +−2
Viburnum wrightii MIQ.	·	·	·	·	·	·	·	IV +−2

ing the landslides, and is characterized by many woody plants such as *Carpinus cordata* BL., *Quercus mongolica* FISCH. var. *grosseserrata* REHD. et WILS., *Acer capillipes* MAXIM., and so forth, the common species for secondery forest in this area.

All communities on landslides finally develop into this type of forest. Scars also often originate in this type of forest.

V. Discussion and Conclusion

A successional sequence of the vegetation units on landslide scars is given in Figure 2. *Polygonum cuspidatum* or *Boehmeria tricuspis* var. *unicuspis* facies occur on newly-formed bare surfaces of landslide scars first. Then the main part of the typical stand-group follows.

On convex areas, the typical sub-stand group of the *Clematis stans* stand-group of the *Miscanthus sinensis* under unit develops after the *C. stans* stand-group of the typical under unit.

The strait and concave areas are covered by the typical sub-stand group of the *C. stans* stand-group of the *M. sinensis* under unit after the typical stand-group of this under unit after the typical stand-group of this under unit. *Salix bakko* sub-stand group of the *C. stans* stand-group occurs as the final stage of succession on landslides.

The degree of vegetational recovery indicates

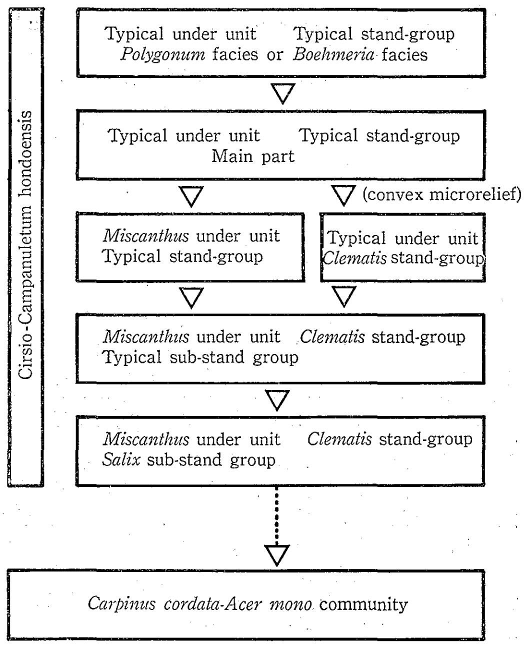

Fig. 2. Development of vegetation on landslide scars

the amplitude and frequency of gravel movement in this area. In other words, the earlier stages of the vegetation development indicate the stands on which gravel movements occur more frequently. If the succession is not interrupted, stands of *Carpinus cordata* and *Acer mono* MAXIM. var. *marmoratum* HARA f. *dissectum* REHD. grow in the area.

The process of vegetational recovery is recognized as a change of vegetation units which are identified by the species composition of the units. The vegetational recovery of landslide scars proceeds with increases of species number and vegetation height.

It becomes clear that it is usefull for a diagnosis and an assesment of the state of vegetation recovery to know the vegetation units in a landslide scar with phytosociological survey.

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* Japanese with English summary

** Only in Japanese

(Received June 24, 1983)

学会記事

○昭和59年度「朝日賞」候補推薦のお知らせ

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今年度は原則として，昭和59年1月1日から同12月31日までに完成または完成予定の業績を対象としますが，長年にわたる業績にも贈ることができます。また賞は，正賞を賞牌とし，別に副賞（賞金：1件につき100万円）を贈ります。

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なお，応募の際には，日本林学会事務局（Tel. 03-261-2766）までご連絡ください。

○第365回編集委員会の記録

と　き：昭和59年7月12日（木）　15：00～17：00

ところ：日本林業技術協会本館会議室

出席者：南雲委員長，西川，生原，金沢，横山，森川，八木，野淵，太田の各委員，酒井，芝野の両主事，事務局より清水

議　事：1）論文などの審査状況
2）論文などの審査者の決定
3）66巻8号，9号，10号の掲載論文の承認および決定
4）その他