林試研報 Bull. For. & For. Prod. Res. Inst. No. 314, 1981 11～19

Vegetation of the Alang-alang Grassland and Its Succession in the Benakat District of South Sumatra, Indonesia

By

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Summary : Understanding of the floristic composition and succession of the alang-alang grassland is prerequisite for afforestation in this area. The vegetation of existing and abandoned rubber estates was not studied. Exclusive of such rubber estates, the vegetation could be classified into four different types; *Axonopus*, alang-alang, secondary and natural forests. The alang-alang type was divided into three subtypes; alang-alang, alang-alang-*Eupatorium* and *Melastoma*-alang-alang subtypes. Each community type can be arranged into the scheme of the succession of the alang-alang grassland by the response to burning or tramping. A forest of the stage shifting from a pioneer tree community to climax vegetation was not observed in the area. It seems that the formation of forests with the climax species is very difficult because no mother trees of the climax species exist in the grassland. Therefore, the afforestation of valuable trees is important in the alang-alang area and so fundamental studies such as the ecological character, the dynamics of planted trees and the interaction between planted trees and other plants are necessary for successful afforestation in the grassland.

Introduction

In the Repubulic of Indonesia there are now 24 million hectares of grassland dominated by alang-alang[3] (*Imperata cylindrica*). Naturally, the grassland belongs to tropical rain forest zone, and had been covered with dense forest. The study on the floristic composition and its succession of the alang-alang grassland is not only ecologically interesting but also important to the fundamental for reforestation.

This article reports the vegetation and its succession at the Benakat district, South Sumatra province, based on the survey from July 2nd to July 29th, 1978.

Study site

The area study, about 500 thousand hectares in the Benakat district, is situated at 3°02′～4°25′ S. Lat., 103°07′～104°14′ E. Long., from 12 m to 122 m above sea level, and approximately 180 km southwest of Palembang, the capital of South Sumatra province (Fig. 1). According to the reference the climate of this area belongs to the A type which is a tropical climate. The climate in Muaraenim (27 m above sea level) and Prabumulih (36 m above sea level) is as follws : the annual temperature is about 26.5～27.0°C and annual precipitation is 3,020 mm and 2,411 mm (mean form 1965 to 1974) respectively. The monthly precipitation from June to September is less, compared with other months[10].

The area consists of undulated plateaus dissected by tributaries of the Musi river. The

Received October 28, 1980 造 林—53 Silviculture—53
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initial land form remains on top of the dissected plateaus. Although the area appears to be a typical flat plateau, the detailed land features are made up of valley bottoms, sloped hillsides and flat or gently sloping tops of plateaus. The geological structure is lower and middle Palembang formation in the Tertiary, with the main part consisting of the lower Palembang formation and mudstone. The soil type belongs to the red yellow podzol and the structure is very clayey with a high percentage of solid particles. The soil of the flat and sloping tops of the plateaus is very compact and shows poor permeability and generally a G horizon is formed near the soil surface.

The water permeability of the soil is better on the slopes and at the foot of the hillsides than at other parts. On the valley bottom and riparian fringes, the G horizon and spots of Mn precipitation are observed at lower or middle layers and the ground water level is also found at the lower layer of the soil. This water level is higher than at other parts of the area.

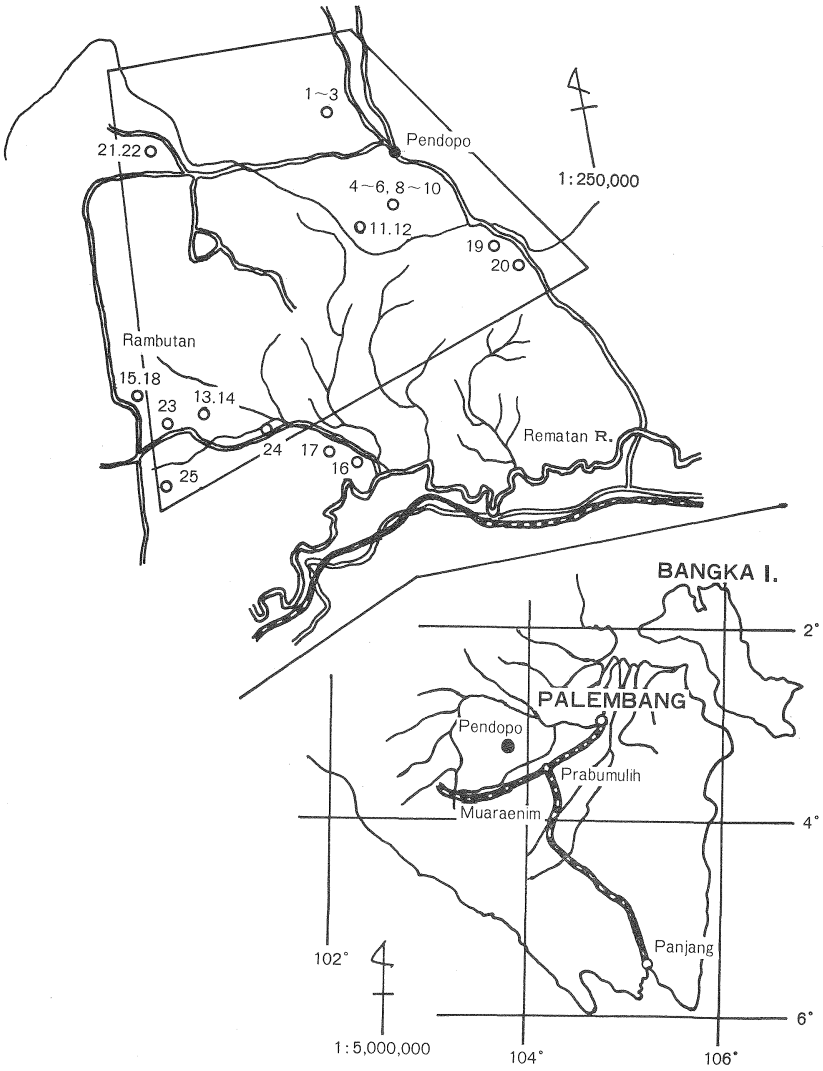

Fig. 1　Map of the studied area.

Table 1. The Braun-Blanquet Cover-Abundance Scale

Symbol	Cover (%) and abundance
5	Any number, with cover more than 3/4 of the reference area (> 75%)
4	Any number, with 1/2～3/4 cover (50～75%)
3	Any number, with 1/4～1/2 cover (25～50%)
2	Any number, with 1/20～1/4 cover (5～25%)
1	Numerous, but less than 1/20 cover, or scattered, with cover up to 1/20 (5%)
+	(Pronounced cross) few, with small cover

Little original vegetation exists due to frequent burning for shifting cultivation and pasturage. A natural forest with very high crowns (40～60 m) of *Lauraceae* and *Dipterocarpaceae* still exists near Rambutan. This natural forest suggests that the area had once been covered by the lowland tropical rain forest. On the other hand, secondary forests are found in some parts of the area, indicating that forests can be formed in this area.

Methods

The size of the quadrats employed was 2 m × 2 m for alang-alang, 5 m × 5 m for scrub and 5 m × 5 m or 10 m × 10 m for natural floor vegetation. The floristic composition was studied by the Braun-Blanquet's method[6] (Table 1).

At the same time, tree and grass height were measured. The natural forest floor vegetation was studied for comparison with alang-alang and scrub.

Results and discussion

1. Floristic composition and community types

The floristic composition is shown in Table 2. The vegetation of existing and abandoned rubber estates was not studied. Exclusive of such rubber estates, the vegetation could be classified into four different types; *Axonopus*, alang-alang (*Imperata*), secondary forest (scrub) and natural forest, which are shown in Table 2. The alang-alang type was divided into three subtypes; alang-alang, alang-alang—*Eupatorium* and *Melastoma*—alang-alang subtypes.

(A) *Axonopus compressus* type

This type exists along the roads from Pendopo to the neighbouring villages in the alang-alang grassland. The plant community mainly consisted of *Axonopus compressus* and a few other species such as *Mimosa*, *Paspalum* sp. and so on. This community is sod grass due to tramping by walkers, carts and cattle or due to over-grazing (Photo. 1). *Axonopus compressus* is a naturalized plant which was brought from tropical America for pastures and lawns[1].

(B) Alang-alang (*Imperata cylindrica*) type

This community consisted of alang-alang, *Borreria* sp., *Hyptis capitata*, *Polygala paniculata* and so on (Table 2). Each sample plot had a great similarity in floristic composition. According to the life form, the ability of sprouting after burning, the grass or tree height and the mode of life of the species, this community can be classified into three different subtypes.

(a) Alang-alang subtype

This subtype with *Axonopus compressus* developed in an areas where little influence of tramping or grazing was observed. However, this community was given frequent burning which stimulates grass sprouting. For that reason, the dominant species was alang-alang but

Table 2. Floristic composition of alang-alang

Vegetation type	A	B a	B a	B a	B a	B b	B b	B b	B b	B b	B b	B b
Field number of relieve	26	4	4′	5	25	2	2′	3	3′	10	10′	11
Topography*	PU	PU	PU	PU	PU	PL	PL	D	D	D	D	PL
Aspect	—	—	—	18	—	213	213	213	213	—	—	40
Gradient	0	0	0	3	0	11	11	13	13	0	0	3
Number of species	4	18	20	16	11	25	20	21	18	13	16	15
Quadrat size (m²)	4	4	4	4	4	4	4	4	4	4	4	4
Axonopus compressus	**5****											
	5											
Imperata cylindorica		**60**	**60**	**100**	**75**	**115**	**115**	**75**	**120**	**100**	**120**	**140**
		5	**4**	**5**	**4**	**2**	**4**	**5**	**5**	**5**	**5**	**5**
Lantana camara		50	95			80	80	30	75			160
		1	2			2	2	+	1			1
Melastoma affine			25	3		40	55	25	40	85	130	
			+	+		1	2	1	2	+	2	
Eupatorium odoratum						**110**	**85**	**75**	**115**	**200**	**220**	**240**
						2	**2**	**2**	**2**	**2**	**2**	**5**
Paspalum sp.	40	35	35	55	35							
	+	+	3	+	+							
Fimbristylis dichotoma		50	75	90	66					90	65	
		2	1	+	+					+	+	
Borreria latifolia		35	20	80	20	10	15	15		95		
		2	2	+	1	+	+	+		+		
B. setidens			15	60	5	15	15	5	65	50		
			+	+	+	1	2	+	+	+		
Polygala paniculata		30	60			40	20					34
		+	+			+	+					+
Hyptis capitata		60	50	80	75	30	30	20	15	65	78	
		2	+	2	+	+	+	+	+	+	+	
Sphenomeris sp.		10	10	10		25	5	15	5			20
		+	+	1		+	+	+	+			+
Clibadium surinamense						35	50		13	105		
						1	+		+	1		
Callicarpa arborea								25				125
								+				+
Euphorbia glochidion								25				
								+				
Macaranga javanica												
M. sp.						5	5					4
						+	+					+
M. triloba												
M. gigantea												
Breynia racemosa												
Ficus sp.												
Dillenia obovata												
Schima wallichii												
Spatholobus sp.												
Lasianthus sp.												
Plectronia sp.												
Galearia filiformis												
Helicia robusta												
Aporosa aurita												
Aporosa sp.												
Memecylon multiflorum												
Dacryodes rostrata												

A : *Axonopus compressus* grassland, B : Alang-alang grassland, C : Secondary forest, D : Natural forest
a : : *Imperata cylindrica* subtype, b : *Imperata cylindrica-Eupatorium odoratum* subtype, c : *Melastoma affine-Imperata cylindrica* subtype.

grassland, secondary and natural forests

B	B	B	B	B	B	B	B	B	B	C	C	C	C	C	C	D	D	D	D
b	b	b	c	c	c	c	c	c	c	C	C	C	C	C	C	D	D	D	D
12	14	13	8	8′	1	1′	9	9′	6	19	24	20	21	22	23	15	18	16	17
PU	PL	PU	PL	PL	PU	PU	PL	PL	D	PU	PU	PU	PL	PU	PU	PU	PL	PU	PU
40	48	48	189	189	—	—	120	120	198	—	—	—	223	—	—	—	75	335	—
1	10	5	12	12	0	0	21	21	13	0	0	0	5	0	0	0	20	4	0
20	11	8	15	17	20	19	21	26	22	40	24	55	19	14	37	48	36	68	42
4	4	4	4	4	4	4	4	4	4	25	25	50	25	25	25	100	100	25	25
			35	25	20				18	65		5							
			+	1	+				+	+		+							
80	**150**	**160**	**135**	**165**	**135**	**145**	**115**	**100**	**135**	150	140		85	50					
5	**5**	**5**	**5**	**5**	**5**	**5**	**5**	+	**5**	2	2		1	+					
	8		**140**	**165**	**110**	**130**	**135**	**160**	**160**	135	200			430					
	+		**4**	**3**	**2**	**1**	**2**	**2**	**3**	+	+			+					
4	6		**140**	**190**	**115**	**150**	**185**	**220**	**245**	200	250	5	200	500					
+	+		**2**	**3**	**1**	**2**	**3**	**5**	**5**	3	2	+	2	1					
180	**220**	**166**	100	250	180	225	245	200	245	8	80		5		150				
2	**2**	**4**	+	3	2	2	1	3	1	+	+		+		+				
45			50	25															
+			+	+															
74			90				55		5				15						
+			+				+		+				+						
55			25	40		30	100	95	15	8									
2			2	1		+	+	+	+	+									
			10		40	14		5	18	5			3						
			+		2	2		+	+	+			+						
40			50	20	70	40	35	25	30										
+			+	+	+	+	+	+	+										
	50	53		90	110	110		45	45										
	+	+		+	+	1		+	+										
9	3		10		20		22	5	15										
+	+		+		+		+	+	+										
								30	8				400	400					
								+	+				5	5					
	270	300								77	580		700	200					
	3	4								+	3		5	3					
	6	3			10	10		15		5			7		55				
	+	+			+	+		+		+			+		+				
						10				10	350		5		500				
						+				+	2		+		2				
5					5		3				250		5		350				
+					+		+				2		+		4				
															600				
															1				
															600				
															2				
										160	5	100							
										+	+	1							
110													500	750				1,800	
+													1	4				1	
											300	60						1,800	
											2	1						1	
										10		350				50	160	150	1,100
										+		3				+	+	+	2
																225	75		
																+	+		
																27	45		
																+	+		
																100	100		
																+	+		
																100		200	120
																+		1	1
																		200	200
																		+	+
																		300	1,200
																		1	1
																		300	700
																		+	+
																		5	500
																		+	+
																		700	600
																		2	+

* PU : Upper plateau, PL : Lower plateau, D : Depression,

** Upper layer : Tree or grass height, Under layer : Dominance.

the grass height was considerably short.

Eupatorium odoratum was not mixed in the community (Photo. 2). In relation to topography, this community mainly appeared at the flat part of wide ridge and in flat valley bottoms.

(b) Alang-alang—*Eupatorium odoratum* subtype

This subtype is characteristically stratified into two layers. The upper layer of the community consisted of *Eupatorium odoratum* and alang-alang formed the lower layer (Photo. 3). This community occurred on gentle slopes where the influence of tramping as well as grazing is much rarer than with the alang-alang subtype.

The scrubs, *Lantana camara, Melastoma affine,* and so on, were invading this community as the influence of burning is much less than with the alang-alang subtype. However, these scrubs are short and their importance value is low.

(c) *Melastoma affine*—alang-alang subtype

The floristic composition of this type was almost the same as the *Eupatorium odoratum* subtype (Table 2). In rarely burned areas or in areas where burning is prevented by topographic features, however, the height of scrub is almost the same as that of alang-alang or *Eupatorium odoratum* or higher than the latter. In addition, the importance value of scrub is high.

The grass height of alang-alang was rather high, but its vigor was weak because it was shaded by the scrub (Photo. 4). As described above, alang-alang existed in all of the three subtypes. This anemochore species propagates rapidly and widely after germination owing to the vigorous rhizomes similar to *Miscanthus sinensis* and *M. sacchariflorus*[7)9)]. After burning or over-grazing, the regeneration takes place easily and rapidly by sprouting from the rhizomes which have many reserve substances for growth. Furthermore, even after rhizome are cut into pieces by cultivation, each small piece of rhizomes left behind forms a new plant.

Consequently, at places abandoned after shifting cultivation or burning, alang-alang is built up much more easily than other competitors which invade or sprout at the same time. However, according to Ōga & Numata[8)], Symington[11)] and Barnard[2)], this species faded rapidly under the canopy.

The scrubs, *Melastoma, Lantana* and so on, are easily established by sprouting, although these species lose their sprouting ability due to the exhaustion of reserve substance after frequent burnings. However, in rarely burned areas, the height of scrub is higher than that of alang-alang. In such places, the sprouts of stumps grow fast without branches and quickly exceed the height of alang-alang. This growth habit utilizes solar radiation to a great extent.

The sprouts from the stump of the *Eupatorium odoratum*, which is an anemochore and a forb, do not develop as easily as alang-alang but more easily than sprouts of the scrub. So it seems that such a life habit of *Eupatorium odoratum* markes the occurrence of this community possible. This subtype occurred most widely among the three subtypes.

(C) Secondary forest

In the alang-alang area where the influence of burning or tramping is comparatively small, a community of pioneer trees consisting of *Mallotus* sp. *Macaranga gigantea, Callicarpa arborea, Dillenia obovata* and so on was found and many kinds of secondary forests which are different in successional stage existed in this area. Some of alang-alang and *Eupatorium odoratum* survived, but a large majority of species were dying or dead under the canopy. These pioneer trees were established rapidly near natural forests, especially along the roads in the natural forests. In this case, the community of pioneer trees was built up before alang-alang invaded

(Photo. 5, 6).

(D) Natural forest

The study of natural forest was not carried out. The floor vegetation under the canopy which consisted of *Lauraceae*, *Leguminosae* and *Dipterocarpaceae* was essentially different than the vegetation of grassland (Table 2). In addition to the floristic composition, the floor vegetation mainly consisted of species of trees.

2. **The scheme of succession in the area**

As shown in Fig. 2, each community type can be arranged by response to burning or tramping. The period of successional change from one community to another one could not be studied. However, according to SYMINGTON[11] and BARNARD[2], under condition of no burning, the vigor of alang-alang becomes weak within two or three years and it fades as pioneer tree species grow rapidly. But the successional patterns vary with the initial stage and the circumjacent condition[5]. Some communities such as the *Axonopus compressus* type and the alang-alang subtypes will not be revived to tree communities within two or three years, because they become very simple through repeated burning and tramping.

The forests of transitional stage shifting from a pioneer tree community to climax vegetation did not exist in this area. This suggests that the formation of the forest with climax species is very difficult because no mother trees of the climax species exist in the grassland. Therefore, the afforestation of valuable or climax species is very important in areas of the alang-alang type. But the direct afforestation of climax species will be very difficult in this area, for the soil of this grassland is poor as compared with natural forests[4] and also the vegetation is different from the floor vegetation of natural forests (Table 2).

So then, fundamental studies, such as the ecological character, the dynamics of plant

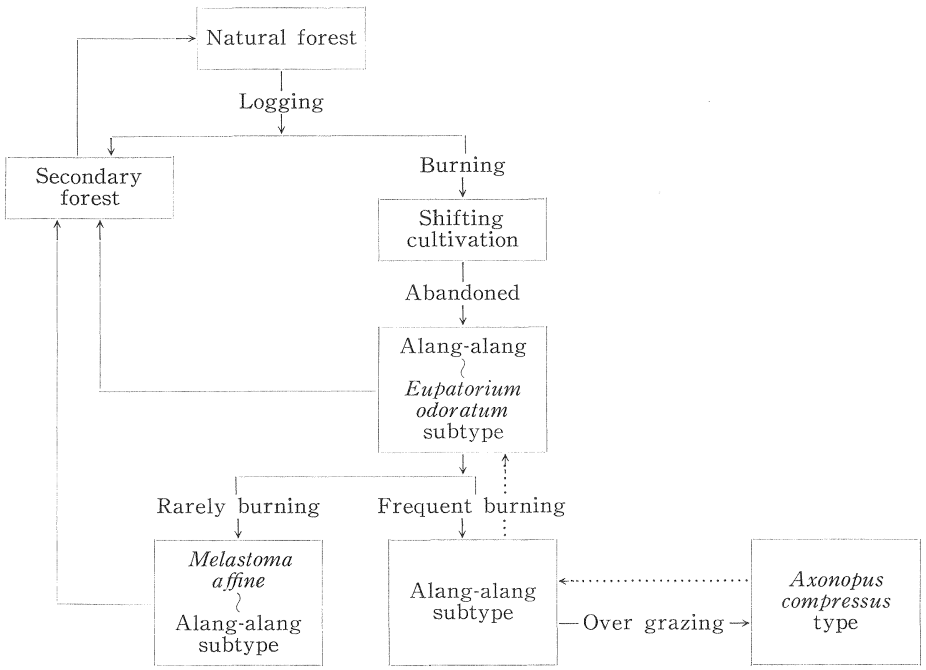

Fig. 2 The scheme of succession in the alang-alang area.

succession, the growth characteristics of planted trees, their shade tolerance and the interaction between planted trees and other plants, are necessary for successful grassland afforestation.

Acknowledgements

I wish to express my sincere appreciation to Mr. HIDAYAT, a member of the Forest Research Institute, Indonesia, who assisted me so generously throughout the survey. Sincere gratitude is also expressed to BAPAK NEDI and other staff of the Herbarium Bogoriense who gave good assistance with identification.

The cooperation of Dr. N. HASHIMOTO and Dr. K. ARIMITU in taking data of the soil survey is greatly appreciated. I wish to express thanks to Dr. K. SAKAGUCHI and Mr. T. OHARA who made all the necessary arrangements for my survey.

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南スマトラのアラン・アラン草原における植生とその遷移

谷　本　丈　夫(1)

摘　　要

インドネシア共和国には2,400 haの焼畑に由来するアラン・アラン草原があるといわれている[3]。これらの草原はいずれも熱帯降雨林気候下にあって，かつては広大な森林地帯であったと思われる。したがって，これらの草原の種構成や遷移系列を明らかにすることは，生態学的に興味あるばかりでなく，森林造成などの基礎として造林学的にも重要である。

筆者はこのような観点から1978年7月2日から29日まで，南スマトラ州ブナカット地区においてアラン・アラン草原の植生調査を行い，種構成や遷移系列について検討した。

調査地はFig. 1に示すとおり，パレンバンより180 kmほど離れたプンドポを中心とする約5万haである。

植生調査はTable 1に示したように，被度と頻度の両方を考慮したブラウン・ブランケの優占度法で行った[6]。また，同時にそれぞれの植物の草丈も測定した。方形区の大きさは，アラン・アラン草原では2 m×2 m，木本期の群落では5 m×5 mおよび10 m×10 mを採用した。

(1)　種組成と群落型区分

ゴム園およびゴム園放置跡の植生は調査できなかった。この系列の群落型を除くと，わが国のメヒシバに近縁の *Axonopus compressus* を中心とする芝生状の草原，チガヤ草原（アラン・アラン），二次林，そして天然林の4つの群落型，さらにチガヤ草原（アラン・アラン）は，丈の低いアラン・アランだけが目につく亜型，上層部に *Eupatorium odoraeum*，下層から中層にかけてアラン・アランが生育し，二段の階層をもつ *Eupatorium odoratum*—アラン・アラン亜型，同じく上層にノボタンの近縁種である *Melastoma affine* やわが国でもシチヘンゲなどと呼ばれ栽培されている *Lantana* などが生育し，その下層にアラン・アランが存在する *Melastoma*—アラン・アラン亜型の3つに細分できた。

(2)　アラン・アラン草原の遷移系列

前記の群落型は，火入れと踏圧の加わり方の相違によってもたらされている。これらの人為的取扱いと生育する植物の生態的特性とから，それぞれの群落型の関係はFig. 2のように整理することができる。一つの群落型から次の群落型への時間的変化は検討できなかった。アラン・アランの活力は，火入れを行わなければ，先駆樹種の急速な生長により2～3年で低下するか枯死するといわれている[2)11)]。しかし，植生遷移の進行は群落周辺の条件によって，さまざまな形態をとり[5]，たとえば *Axonopus compressus* 型やアラン・アラン亜型のように，強くそして長期にわたって人為の影響を受け，著しく単純になってしまった群落では，そのひろがりの大きさからみて2～3年程度で木本群落に移行できるとは思われない。また，この地方では先駆樹種の森林から極相樹種へ移行中の森林はみることができなかった。これは付近に極相林を形成する樹種の母樹のなくなった広大なアラン・アラン草原では，極相樹種による森林形成に非常に長い時間を要するためであろう。

1980年10月28日受理

(1) 造　林　部

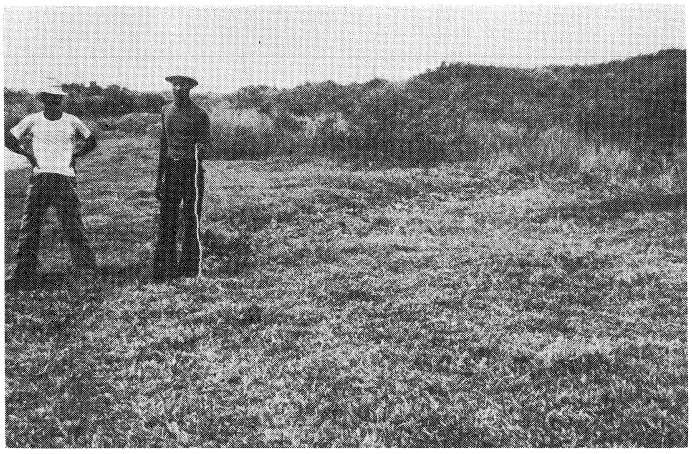

Photo. 1　*Axonopus compressus* type.

Photo. 2　Alang-alang (*Imperata cylindorica*) subtype.

Photo. 3　*Eupatorium odoratum* (upper layer)—Alang-alang (middle or lower layer) subtype.

Photo. 4 *Melastoma affine* (upper layer)—Alang-alang (middle or lower layer) subtype.

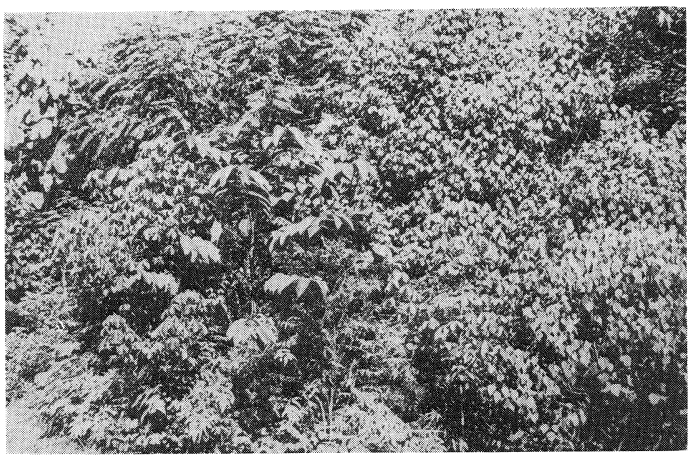

Photo. 5 Secondary forest. In this area there are many kinds of secondary forest which are different in successional stage.

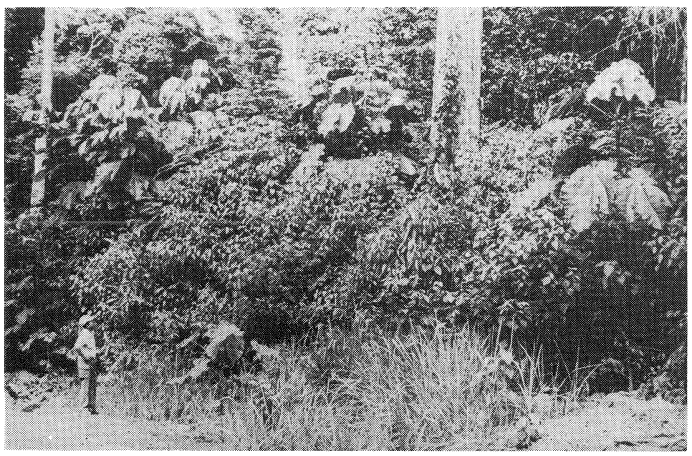

Photo. 6 Secondary forest along the roads in the natural forest.