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Journal of Forest Planning is a peer-reviewed periodical that publishes articles, reviews, and short communications. It covers all aspects of forest management, modeling, and assessment such as forest inventory, growth and yield modeling, remote sensing and geospatial information technologies for forest management, forest management planning, forest zoning, evaluation of ecosystem services, managerial economics, and silvicultural systems. Manuscripts regarding forest policy, forest economics, forest environmental education, landscape management, climate change mitigation and adaptation strategies, and drone applications for forest management are welcome. The Journal aims to provide a forum for international communication among forest researchers and forestry practitioners who are interested in the above-mentioned fields.

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CONTENTS

Short Communication

Short Communication

Vegetation Changes over Seven Years after Clear-cutting of Bamboo Culms

Shigeo Suzuki [1,*] and Nobukazu Nakagoshi [2]

ABSTRACT

The area of bamboo groves in southwest Japan, comprised mainly of *Phyllostachys pubescens*, has recently increased. An alternative to these abandoned bamboo groves is their transition to broad-leaved forests. The vegetation transition to broad-leaved forests observed several years after clear-cutting are very important. We investigated the change in species composition after repeating *P. pubescens* culm cutting. We established four quadrate plots (10 × 10 m): clear-cutting bamboo culms, thinning bamboo culms, and two control sites. Regenerated bamboo culms appeared the next spring after clear-cutting. We concluded that in absence of continuous culm cutting, bamboo recovers after 3 years. We then cut the recovered bamboo culms; this clear-cutting site began to change into a broad-leaved forest. We suggest that a *P. pubescens* grove can be transitioned to a broad-leaved forest, using continuous selective cutting of the revived bamboo culms over several years.

keywords: bamboo grove management, broad-leaved forest, clear-cutting, *Phyllostachys pubescens*

INTRODUCTION

The area of bamboo groves in southwest Japan, comprised mainly of *Phyllostachys pubescens* Mazel ex Houzeau de Lehaie, has increased over the past 30 years (e.g. Isagi and Torii, 1998; Suzuki and Nakagoshi, 2011). This rapid expansion of bamboo groves was caused by the abandonment of production groves of bamboo (Torii and Isagi, 1997) and adjacent woodland and cultivated land, because the invasive young bamboo shoots not be removed (Suzuki, 2010). Bamboo groves were originally planted to produce culms or edible young shoots; however, the need for these products has declined due to new materials and imports from China (Suzuki and Nakagoshi, 2011).

One method to halt the expansion of bamboo groves includes cutting off their culms (Ishida et al., 1999) and repeated cutting of bamboo culms (Fujii and Shigematsu, 2008).There have been studies on the control of the expansion of bamboo groves by killing bamboo culms by injecting or spreading weed killer (Egami et al., 2015; Nonaka, 2002). However, in these studies, vegetation changes after cutting an area of bamboo culms were not carefully inspected over several years. Fujii and Shigematsu (2008) said that the occurrence of new young bamboo shoots was seen under cutting bamboo culms for three years. As the bamboo groves transition to broad-leaved forests, it is necessary to observed occurrence of new bamboo culms and vegetation change after clear-cutting cutting by investigation term as long as possible.

In the present study, we investigated the change in species composition by repeating *P. pubescens* culm cutting, and we suggest the most effective method for a smooth transition from abandoned bamboo groves to broad-leaved forests.

METHODS

Study Area

We conducted the experiment in Genkotsu-yama Hill (175 m above sea level), located in neighbouring Sanbe dam, Oda City, Shimane Prefecture, western Japan (Fig. 1). There are secondary forests comprised of *Quercus serrata* Thunb. ex Murray and *Pinus densiflora* Sieb. et Zucc. On the southeast side of the hill, there were graves until the 1990s; after which *P. pubescens* invaded the gravesite and the adjacent secondary forests. The culm density of *P. pubescens* in the center of the grove was 5600 to 9700 ha^{-1}.

The annual mean precipitation and mean temperature from 1981 to 2010 were 1738.4 mm and 15.1 °C, respectively, based

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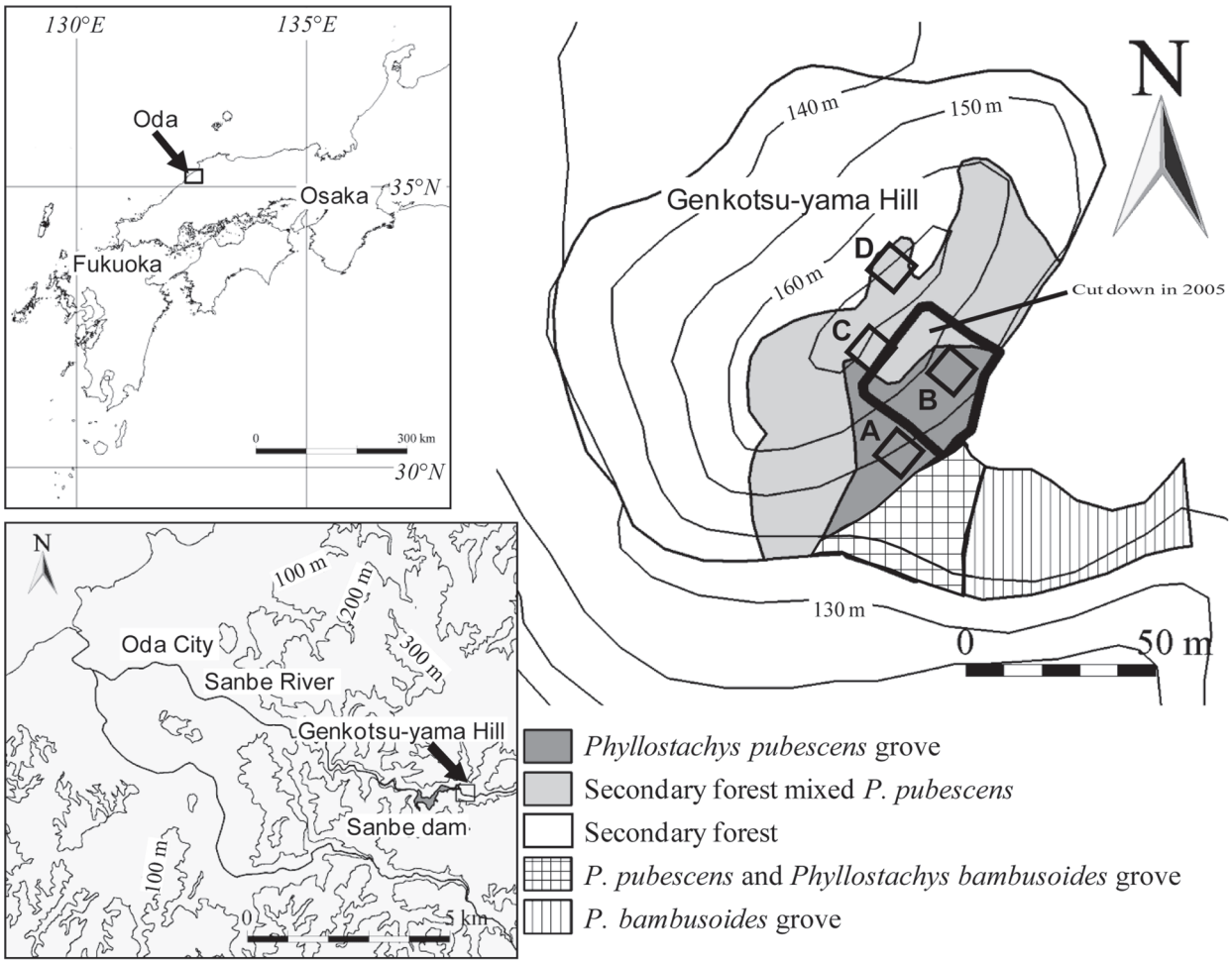

Fig. 1 Study area.

on data from the nearest meteorological observatory in Oda (35° 11.4′ N, 132° 29.8′ E).

Field Experiment

We established four quadrate plots (10 × 10 m; Fig. 1). Plot A was the control site for the *P. pubescens* groves without cutting, Plot B was the site of cutting all *P. pubescens* culms, Plot C was the site of thinning the 67% of *P. pubescens* culms in the secondary forest mixed with bamboo, and Plot D was the control site for secondary forest mixed with bamboo. Plot B was set up in the center of the site of cutting all *P. pubescens* culms so as not to be affected as much as possible from residual bamboo groves.

We surveyed the plant species composition in all strata (Braun-Blanquet, 1964) and all tree diameters at breast height (DBH) before cutting in September 2005. After this survey, bamboo culms were cut down in the area showed in Fig. 1 (ca. 80 m^2; Plot B and a part of Plot C).

After cutting, we surveyed the plant species composition and all tree's DBH in June 2006, September 2006 (Plot B only), June 2007, and September 2008. Over these 3 years, we left each plot undisturbed.

In September 2008 (after the survey), we cut down all of the *P. pubescens* culms in Plot B. Subsequently, we cut down all of new *P. pubescens* culms after survey of every year through 2012. We also surveyed plant species composition and all tree's DBH in September 2009, August 2010, September 2011 (Plot B only), and August 2012.

Analysis

We compared coverage rates of every layer and survey period. We calculated and compared the number of culms per DBH and the total cross-sectional areas at breast height for *P. pubescens* and other tree species in each plot.

All plant species in the survey plots were classified with respect to life form. Species number with respect to the classification was compared among survey periods.

RESULT

Change in Total Cross-Sectional Area at Breast-Height in *P. pubescens*

After clear-cutting (Fig. 2a), *P. pubescens* returned the next spring with a large number of thin new culms in Plot B (aver-

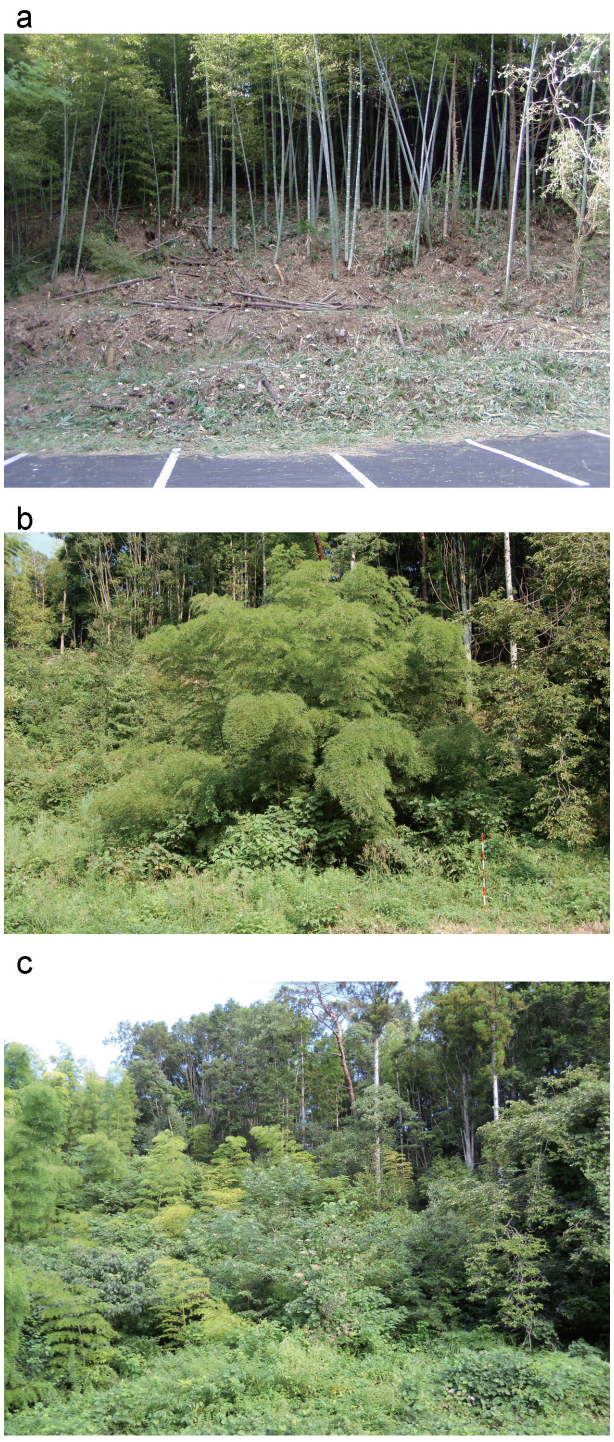

Fig. 2 Pictures of Plot B in cutting of 2005 (a), 2008 (b), and 2012 (c).

age DBH = 1.4 cm; Fig. 3). However, the height of the culms was below 2 m; they covered the shrub and herb layer with high coverage rate (Fig. 4). The total cross-sectional area at breast height of *P. pubescens* in Plot B was 118 cm^2 in June 2006 (Fig. 5); after 3 years, it increased to 749 cm^2. However, in 2008, the total cross-sectional area at breast height of other tree species in Plot B was 51 cm^2.

After 2008, we cut the recovered *P. pubescens* culms in Plot B. Other tree species (*Rhus javanica* L. var. *roxburghii* (DC.) Rehder et Wils., *Quercus glauca* Thunb. ex Murray, *Firmiana simplex* (L.) W. F. Wight, among others; Appendix) were allowed to grow. In 2012, the total cross-sectional area at breast height of *P. pubescens* and other tree species was 3 cm^2 (only one culm; Fig. 3) and 366 cm^2, respectively (Fig. 4).

In Plot C, a section of *P. pubescens* culms was cut in September 2005. The total cross-sectional area at breast height of *P. pubescens* decreased from 2,669 to 814 cm^2 (Fig. 5). Subsequently, the *P. pubescens* culms recover till 2009 (991 cm^2) by recruitment. Although six *P. pubescens* culms died between 2009 and 2010, total cross-sectional area was decreased. In 2011 and 2012, a new culm grew every year and total cross-sectional area of *P. pubescens* was increased between 2010 and 2012.

In Plots A and D, there were few changes in the total cross-sectional area.

Species Composition and Coverage Rate

Before cutting, *P. pubescens* occupied the tree layer in Plots A and B. In Plots C and D, *P. pubescens*, *Quercus sessilifolia* Blume, and *Q. serrata* competed in the tree layer. In Plot C, *P. pubescens* occupied the sub-tree layer (Appendix).

The tree layer in Plot B disappeared and the coverage rates of the sub-tree layer in Plot C decreased from 80% to 30% as *P. pubescens* culms were cut (Fig. 4). The coverage rate of the herb layer in Plot B decreased from 95% to 20% with the destruction due to clear-cutting.

In Plot B, the coverage rate of the herb layer recovered after September 2006 (Fig. 4). The coverage rates of the shrub and sub-tree layer recovered in 2008. This recovery was initiated by the recruitment of *P. pubescens* culms. After the selective cutting of 2008, the coverage rates of the shrub layer were between 15% and 35%. The height of the shrub layer rose to 8.4 m in 2012 (Appendix).

In Plot C, the coverage rate of sub-tree layer was decreased by selective cutting of *P. pubesces* between 2005 and 2006. Thereafter, the coverage rates of sub-tree layer and shrub layer changed among 20% and 40%, and the coverage rates of herb layer little change in 1% or 2%. The coverage rate of all layers in Plots A and D decreased very little over 7 years (Fig. 4).

Regarding species composition, the number of species present increased from 25 to 57 in Plot B, the spring after the cutting (Fig. 6); these were mainly annual and perennial herbs, especially, *Sasa veitchii* (Carriere) Rehder var. *tyugokensis* (Makino) S. Suzuki and *Nandina domestica* Thunb., dominated by recovered *P. pubescens* culms (Appendix). In 2007, annual herb and perennial herb species decreased from seven to two and 15 to seven, respectively (Fig. 6). However, *Q. glauca*, *Morus australis* Poir., *Castanea crenata* Sieb. et Zucc., *Zanthoxylum ailanthoides* Sieb et Zucc., and *Rubus* spp. increased through 2008 (Appendix). *P. pubescens* recovered over their species. Before selective cutting in 2008, they covered other emergence and residual species. The surveys in 2006 and 2007 were conducted in June, but no major difference was found in the emerging species.

After selective cutting, the species number at plot B recovered to 56 in 2009 (Fig. 6). After this, the species number

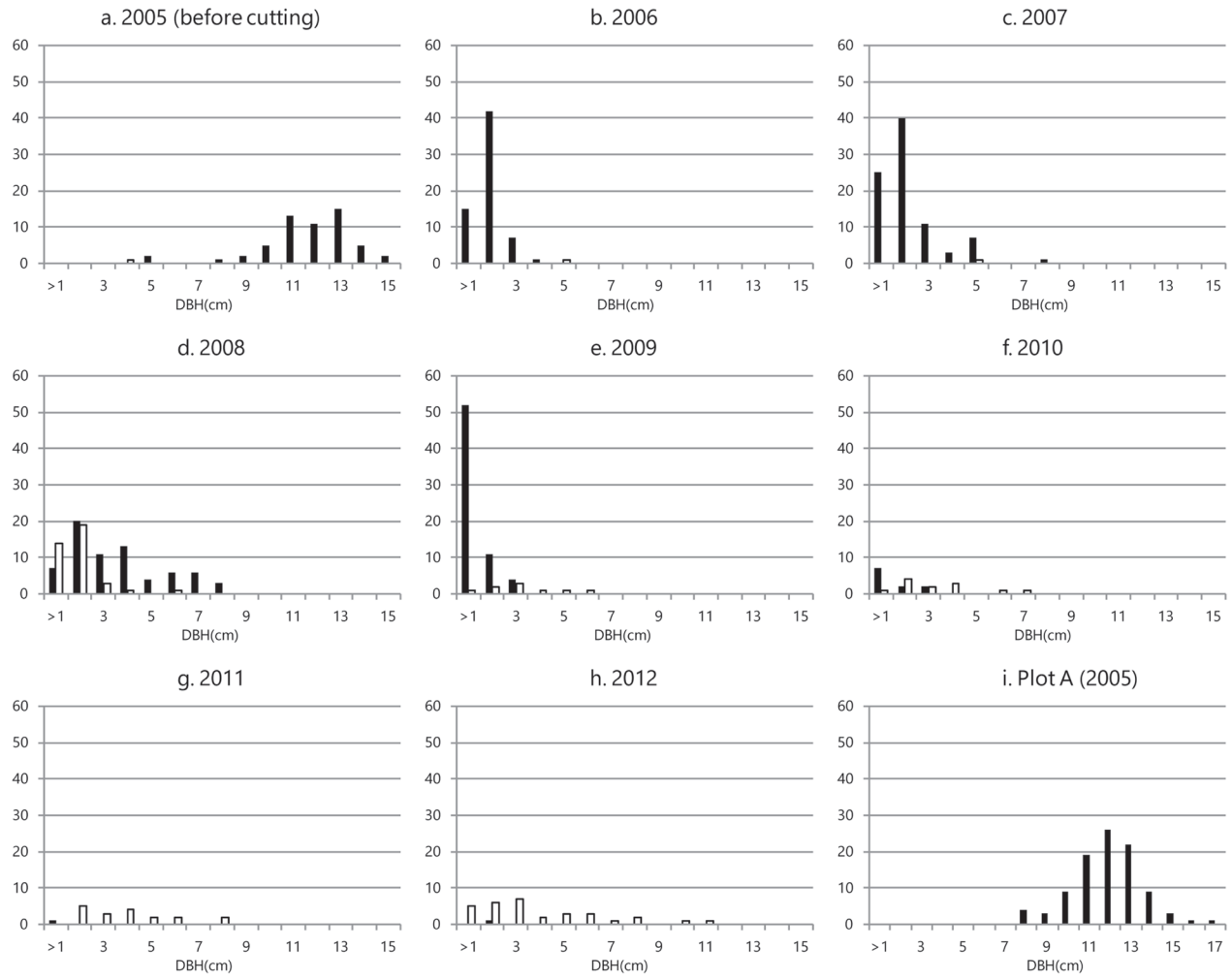

Fig. 3 The histogram of diameters at breast height of *Phyllostachys pubescens* culms (solid) and other trees (outline) in Plot B.

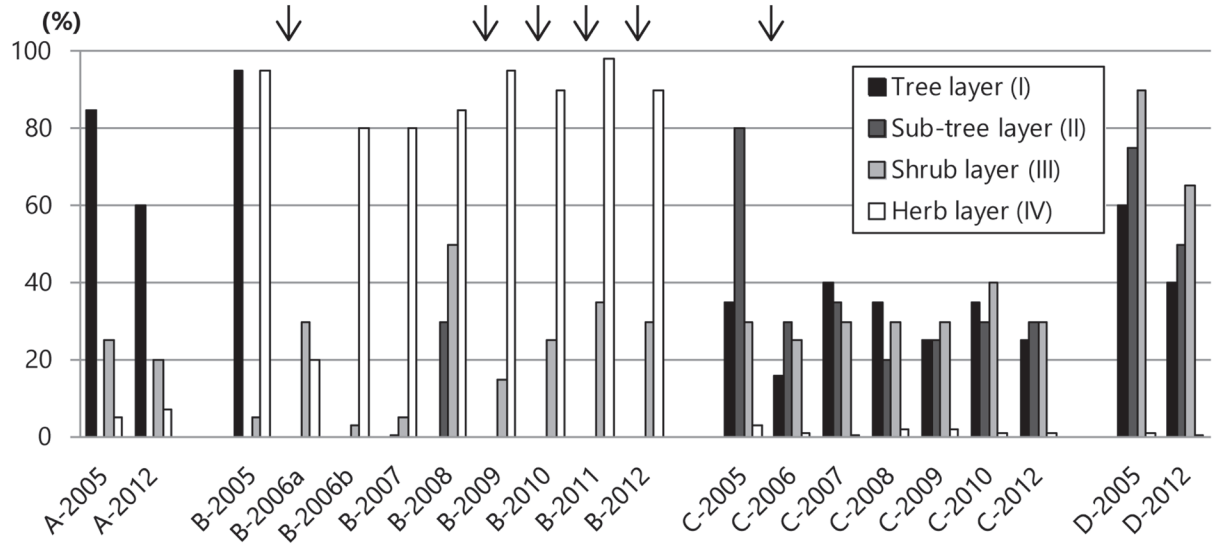

Fig. 4 Vegetation cover rate in each layer. The arrows show the cutting *Phyllostachys pubescens* culms. 2006a and 2006b designated Jun 2006 and Sep 2006, respectively.

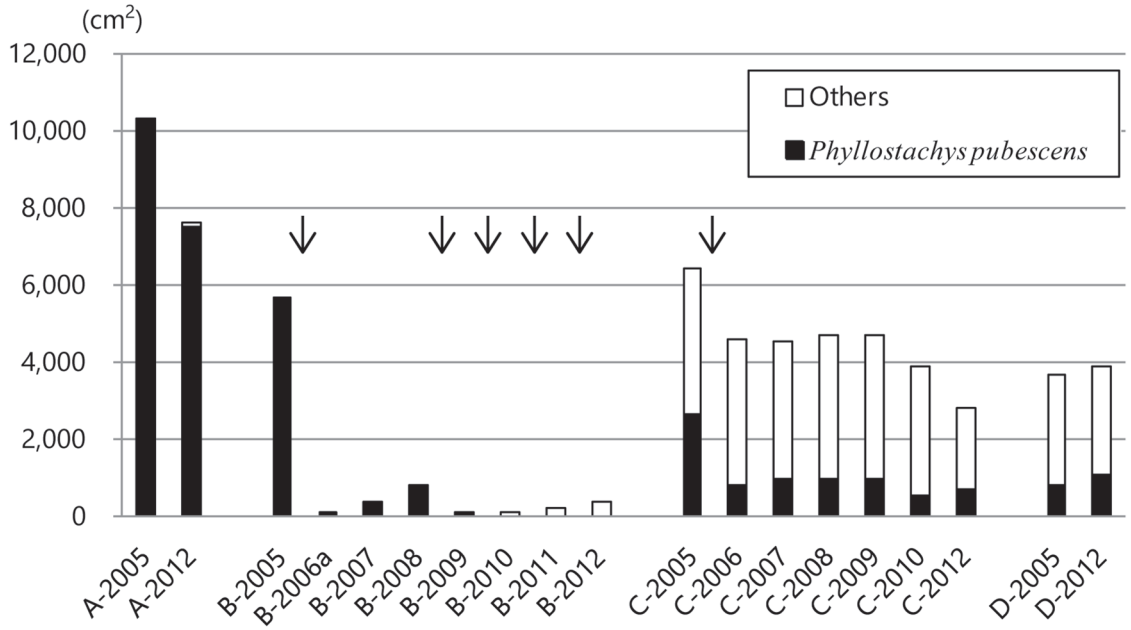

Fig. 5 Total cross-sectional area of *Phyllostachys pubescens* and other woody species. The arrows show the cutting *P. pubescens* culms. The arrows show the cutting *Phyllostachys pubescens* culms. 2006a and 2006b designated Jun 2006 and Sep 2006, respectively.

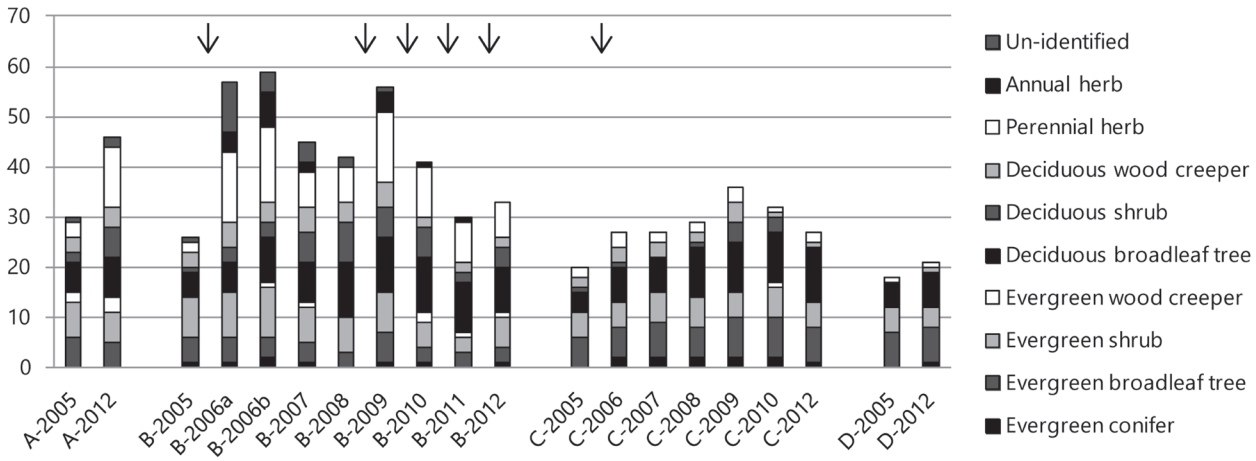

Fig. 6 Number of species in each life form. The arrows show the cutting *Phyllostachys pubescens* culms. 2006a and 2006b designated Jun 2006 and Sep 2006, respectively.

decreased as *Clethra barbinervis* Sieb. et Zucc., *Mallotus japonicus*, *R. japanica* var. *roxburghii*, *Celtis sinensis*, *Firmiana simplex*, and *Deutzia crenata* grew in the shrub layer and *S. veitchii* var. *tyugokensis* covered the herb layer in Plot B (Appendix).

In Plot C, the species number increased slightly (Fig. 6); however, some *Z. ailanthoides*, *Q. serrata*, and *P. densiflora* individuals died owing to diseases, in Plots C and D. This affected the cross-sectional area at breast height (Fig. 5).

In Plot A, the species of perennial herbs increased (Fig. 6). This plot also had increased brightness due to cutting of *P. pubscens* culms in an adjacent area.

DISCUSSION

Regenerating bamboo culms appeared the spring after cutting. In first year after cutting, bamboo culms became thin (Fig. 3). Ishida et al. (1999), Fujii and Shigematsu (2008) and Abe and Shibata (2009) reported the same events. The regenerated bamboo culms were abandoned till fall of 2008, three years after cutting all *P. pubescens* culms. They covered other emergence and residual species. The same transitions have been reported by Fujii and Shigematsu (2008). Therefore, *P. pubescens* came back as at the beginning of the cutting, if regenerating bamboo culms were abandoned.

We find one thin culms in Plot B till 2012, three years after selective cutting recovery bamboo culms every year (Fig. 3), although it took as much distance as possible from remaining bamboo grove. Ishida et al. (1999) documented recruiting new culms in two years after cutting all bamboo culms. Fujii and Shigematsu (2008) documented recruiting new culms in three years after cutting all bamboo culms. It is thought that the rhizomes of *P. pubescens* survive for several years after cutting the above ground part. When changing vegetation from bamboo groves, continuous *P. pubescens* culm cutting is needed for suppression of bamboo culms during several years, over than three years.

In Plot B, many species, mainly herb species and pioneer trees, were covered after the cutting *P. pubscens* culms (Fig. 6, Appendix). Herb species and *N. domestica* increased between September 2005 and September 2006. However, after the size of recovery bamboo culms increased between 2007 and 2008 (Fig. 3), they declined because they were shaded by *P. pubescens*. After selective cutting of recovery bamboo culms, pioneer tree species grew and *S. veitchii* var. *tyugokensis* dominated the herb layer (Fig. 5, Appendix) because *P. pubescens*, which had shaded them, was removed. However, the height and species composition of Plot B were not similar to those of Plot D or C which were the broad-leaved forest or the bamboo and broad-leaved tree mixed woodlands, because the pioneer tree species, *M. japonicas*, *R. japonica* var. *roxburghii* and *C. sinensis*, dominated in plot B but *Q. sessilifolia* and *Q. serrata* dominated in plot C or D (Appendix). Thus, we considered that it will take some time to form broad-leaved forests from bamboo groves.

The number of emerging species of perennial herbs increased in Plot A (Fig. 4.) were became the sunlight brightened the forest floor, because the cover rate of the tree layer decreased due to the death and breakage of *P. pubescens* culms during this period (Fig. 5) and that bamboo culms in adjacent area were clear cut.

When renaturalization from a *P. pubescens* grove to a broad-leaved forest, we recommend to continue the selective cutting of revived bamboo culms for several years.

ACKNOWLEDGEMENTS

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Appendix The plant species composition in examination plots

Plot		A	A	B	B	B	B	B	B	B	B	B	C	C	C	C	C	C	C	D	D
Survey date		a	i	a	b	c	d	e	f	g	h	i	a	b	d	e	f	g	i	a	i
Tree layer (I)	Heigth (m)	13	18	19									18.5	20	20	23	23	20	20	18.8	22
	Total coverage(%)	85	60	95									35	16	40	35	25	35	25	60	40
Sub tree layer (II)	Heigth (m)						7.1	8					11.7	18	13.5	12	13.5	12	12	12.5	15
	Total coverage(%)						0.5	30					80	30	35	20	25	30	30	75	50
Shrub layer (III)	Heigth (m)	5	5	4	5.4	4	3.7	4	5	6.3	7.4	8.4	3.3	8.8	5	5.5	8.8	5.4	7	6.8	6.5
	Total coverage(%)	25	20	5	30	3	5	50	15	25	35	30	30	25	30	30	30	40	30	90	65
Herb layer (IV)	Heigth (m)	0.5	0.5	2	1.2	1.8	0.8	1.6	2	1.2	1.5	2.3	0.6	0.2	0.5	0.5	0.5	0.5	0.5	0.6	0.5
	Total coverage(%)	5	7	95	20	80	80	85	95	90	98	90	3	1	0.5	2	2	1	1	1	0.5
Number of species		30	46	26	57	59	45	42	56	41	30	33	20	27	27	29	36	32	27	18	21
Phyllostachys pubescens	I	5･5	4･5	5･5									2･3		1･2	3･2				2･2	
	II						+	3･3					5･5	2･2	1･2	1･1	2･2	1･1	2･2	1･1	2･3
	III				1･1		1･1	1･2		1･2		+					1･1				
	IV				1･1	4･3	3･4	1･1	2･3	+	+										
Quercus glauca	I														2･2	2･1	2･2	2･2	2･1		
	II												1･1	1･1	1･1	1･1	1･1	1･1	2･1		
	III		1･1		1･1	1･1	1･1	1･1	1･1	1･1	1･1	1･1	+	1･1			1･2	+	1･1		
	IV	+	+	+	+		+	+	+	+				+	+					+	+
Eurya japonica	III	2･3	1･2										1･2	1･1	2･2	1･1	1･2	1･1	2･3	2･2	2･3
	IV	2･2	1･2	+	+	+	+	+	+	+		+					+				
Smilax china	III							+		+			+			+					
	IV	+	+	+	+	+	+	+	+			+		+	+	+	+	+	+		+
Ligustrum japonicum	III	+								+			+				+	+	+		
	IV		+		+	+	+	+	+			+			+	+	+				+
Camellia japonica	II														1･1					1･1	
	III		1･2										2･2	1･1	2･2	1･1	1･2	1･1	2･2	3･3	2･3
	IV	2･2		+	+	+			+					+	+	+	+	+	+		+
Clethra barvinervis	II												1･1		1･1					1･2	2･3
	III								+	+	1･1	1･2			+	1･1	+	1･1	1･1	1･2	2･2
	IV		+	+				+	1･1											+	
Ardisia japonica	IV	+		+	+		+	+					+	+	+	+	+	+	+	+	+
Mallotus japonicus	III									1･2	2･2	1･2									
	IV		+		+	+	+	+	+	+	+				+	+	+	+	+		
Zanthoxylum ailanthoides	I												2･1	1･1	1･2	1･1	2･2				
	III							1･1	+												
	IV		+			+	+	+		+	+	+			+	+	+	+	+		
Castanea crenata	I																				2･2
	III			+			+	1･1	1･1	1･1	2･1	1･1									
	IV	+		+		+		+						+				+	+		
Rhus trichocarpa	III							+		+	+							+	+		
	IV		+		+	+	+	+	+						+	+	+	+	+		
Neolitsea sericea	III	2･2	1･2										+		+						
	IV	1･2	+	+			+		+				+	+		+	+	+	+		
Carex lanceolata	IV	+･2	+		+	+		+	+	+	+			+	+	+	+				
Quercus sessilifolia	I												2･2		2･2	2･1		2･2	2･2	1･1	
	II												2･1	1･1	1･2	1･1	2･2	1･1	2･1		
	III	+											+	1･1	1･1	1･1	1･1		1･2		1･1
	IV	+			+									+	+		+	+	+		
Quercus serrata	I												1･1	1･1	2･2	2･1	2･2	2･2	2･1	3･3	2･2
	II												1･1								
	III												+								
	IV	+			+										+	+	+	+	+		
Illicium anisatum	III	1･1											1･1	1･1	1･1	1･1	1･1	+	1･1	1･1	
	IV								+							+		+	+		+
Albizia julibrissin	IV		+		+	+	+	+	+	+					+	+	+		+		
Pinus densiflora	I													1･1	1･1	1･1	1･1	2･2			
	IV				+	+	+		+	+		+					+				
Acer palmatum	II																			1･1	1･1
	III												+	1･1	1･1	1･1	1･1	1･1	1･1		
	IV		+											+	+	+	+	+	+		
Camellia sinensis	IV	+	+	+	+	+	+		+			+			+	+					
Nandina domestica	III			1･2																	
	IV		+	1･3	1･1	1･1	1･1	+	+	+	+	+									
Sasa veitchii var. *tyugokensis*	IV			5･5	1･2	2･2	1･2	1･2	3･3	4･4	4･4	4･5				+					
Oplismenus undulatifolius	IV		+		+	+	+	1･2	1･1	+	+	+									
Mitchella undulata	IV		+										+	+	+	+	+	+	+	+	
Trachycarpus fortunei	III			1･1	+				1･1	1･1											
	IV					+	+	+			+	1･1									
Rhus javanica var. *roxburghii*	III								1･1	1･2	2･2	2･2									
	IV				+	+	+	+	1･1	1･1	+						+				

Appendix (continued)

Plot		A	A	B	B	B	B	B	B	B	B	B	C	C	C	C	C	C	C	D	D
Survey date		a	i	a	b	c	d	e	f	g	h	i	a	b	d	e	f	g	i	a	i
Miscanthus sinensis	IV		+		+	+		+	+	+	+	+									
Styrax japonica	II																				1・1
	III							+		+	1・1	1・1									1・1
	IV		+							+						+			+		
Morus australis	III							1・1													
	IV			+		+	+		1・1	+	+	+									
Celtis sinensis ver. *japonica*	III			+			+	+	1・1	1・1	1・1	1・1									
	IV					+			+												
Cryptomeria japonica	I													1・1	1・1	1・1		1・1	2・1		
	II																1・1				
	IV			+		+											+				
Dioscorea japonica	III							+	+		+	+									
	IV				+	+	+		+	+	+	+									
Pleioblastus chino var. *viridis*	III								+				+								
	IV													+	+		+	+	+	+	
Rubus buergeri	IV	+	+	+	+	+		+	1・1												
Wisteria floribunda	III														+						
	IV	+	+	+				+						+			+				
Callicarpa mollis	III	+	+									+									
	IV		1・2	+			+	+	+			+									
Aucuba japonica	III	2・2	1・2	+									+		+						
	IV	+	1・2	+										+				+			
Akebia trifoliata	IV		+		+	+	+		+					+	+						
Lonicera japonica	IV		+			+	+			+	+	+						+			
Pteridium aquilinum var. *latiusculum*	IV				+	+	+		+	+	+	+									
Ilex pedunculosa	I																			1・2	2・2
	II																				2・2
	III																			+	1・2
	IV					+										+	+	+	+		
Rubus palmatus	IV		+		+	+	1・2		+	+								+			
Pueraria lobata	III										+	1・1									
	IV		+			+			+	+	1・1	1・1									
Farfugium japonicum	IV			+	+	+		+	+	+											
Gardenia jasminoides	IV					+		+	+	+	1・1	+									
Ilex macropoda	II															1・1					
	III													+		1・1	1・1	+	+		+
	IV																+				
Symplocos lucida	III																		+		+
	IV														+		+	+	+	+	
Liriope platyphylla	IV	+	+	+									+								+
Compositae sp.1	IV		+		+	+	+	+													
Disporum sessile	IV		+		+		+							+			+				
Vaccinium oldhamii	IV		+		+		+										+	+			
Elaeagnus pungens	IV			+	+	+	+							+							
Cirsium sp.	IV				+	+	+	+	+												
Viola grypoceras	IV				+	+	+	+	+												
Artemisia princeps	IV				+	+	+		+	+											
Stenactis annuus	IV				+		+		+	+	+										
Rubus illecebrosus	IV					+	1・2	+	1・2	+											
Firmiana simplex	III							+	1・1	1・1	2・1	1・1									
Parthenocissus tricuspidata	IV	+			+	+							+								
Evodiopanax innovans	IV	+														+		+	+		
Rabdosia inflexa	IV		+		+	+			+												
Lindera umbellata	III												+								
	IV		+					+						+							
Zanthoxylum schinifolium	IV				+											+	+	+			
Solidaga altissima	IV					+	+	+	+												
Callicarpa japonica	III									+											
	IV					+	+	+		+											
Coccukus trilobus	III										+										
	IV						+	+	+		+										
Vitis thunbergii	IV						+	+								+	+				
Deutzia crenata	III								+	+	1・1	1・1									
	IV											+									
Fern sp.	IV	+	+	+																	
Rubus crataegifolius	IV		+						2・3	+											
Machilus thunbergii	III		1・1																		
	IV																+	+			
Schisandra nigra	IV			+	+		+														

Appendix (continued)

Plot		A	A	B	B	B	B	B	B	B	B	B	C	C	C	C	C	C	C	D	D
Survey date		a	i	a	b	c	d	e	f	g	h	i	a	b	d	e	f	g	i	a	i
Aralia elata	IV			+		+			+												
Paederia scandens	IV				+				+								+				
Acanthopanax sciadophylloides	IV				+									+				+			
Crassocephalum crepidioides	IV					+	+		+												
Clerodendrum trichotomum	IV							+	+								+				
Rubus corchorifolius	III							1・1													
	IV							+			+	+									
Hydrocotyle sibthorpioides	IV								+	+		+									
Blechnum niponicum	IV	+	+																		
Trachelispermum asiaticum	IV	+								+											
Prunus jamasakura	IV	+												+							
Trichosanthes cucumeroides	III		+																		
	IV		+		+																
Dryopteris erythrosora	IV		+							+											
Humulus japonicus	IV				+	+															
Oxalis corniculata	IV				+	+															
Torilis japonica	IV				+	+															
Viola sp.1	IV				+	+															
Viola sp.2	IV				+	+															
Commelinacommunis	IV					+			+												
Clematis terniflora	IV					+					+										
Rosa multiflora	IV						+			+											
Eupatorium fortunei	IV								1・1	+											
Boehmeria nippononivea	IV										+	+									
Quercus variabilis	I																			1・1	
	IV																+				
Cleyera japonica	III																			2・2	2・3
Magnolia obovata	I																			2・2	2・2
	II																			1・1	
Fraxinus lanuginosa f. *serrata*	IV	+																			
Hydrangea hirta	IV	+																			
Isachne globosa	IV	+																			
Kadsura japonica	IV	+																			
Platycarya strobilacea	IV	+																			
Aphananthe aspera	IV		+																		
Ficus nipponica	IV		+																		
Hedera rhombea	IV		+																		
Heloniopsis orientalis	IV		+																		
Iris japonica	IV		+																		
Viburnum dilatatum	IV		+																		
Arisaema sp.	IV				+																
Cayratia japonica	IV				+																
Compositae sp.2	IV				+																
Compositae sp.3	IV				+																
Osmunda japonica	IV				+																
Pieris japonica	IV				+																
Taraxacom sp.	IV				+																
Vicia hirsuta	IV				+																
Ardisia crenata	IV					+															
Digitaria timorensis	IV					+															
Echinochloa crus-galli var. *caudata*	IV					+															
Ixeris dentata	IV					+															
Lamium alba var. *barbatum*	IV					+															
Lespedeza cyrtobotrya	IV					+															
Melampyrum lazum var. *nikkoense*	IV					+															
Stachyurus praecox	III							+													
Viburnum erosum var. *punctatum*	III							+													
Conyza sumatrensis	IV								+												
Dryopteris lacera	IV								+												
Stellaria diversiflora	IV								+												
Thalictrum simplex var. *brevipes*	IV										+										
Pourthiaea villosa var. *laevis*	IV											+									
Reynoutria japonica	IV											+									
Rhododendron obtusum var. *kaempferi*	IV																+				
Calanthe discolor	IV																		+		
Skimmia japonica	III																			1・1	
Chamaecyparis obtusa	III																				1・1

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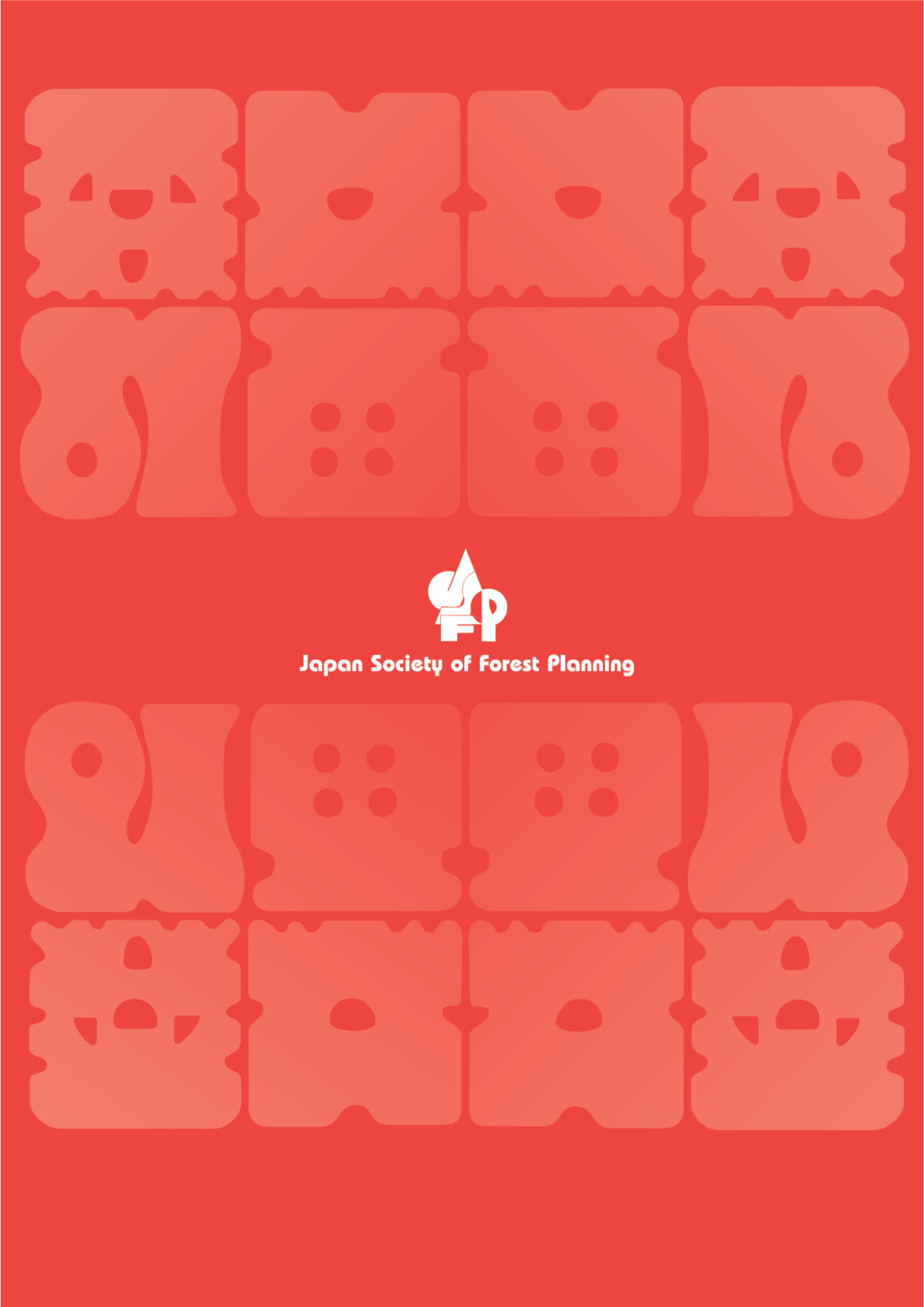

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