Misc. Inform. Univ. of Tokyo For. 71, 95–103 (2025)

List of wood-boring beetles (Coleoptera: Curculionidae; Scolytinae) captured by bait branches set on the forest floor in central Taiwan

Zi-Kai LIN*[1], Chun-Lin LI*[2], Li-Wei WU*[2,5], Yong PENG*[1,6],
Roger A BEAVER*[3], Ming-Jer TSAI*[2], Naoto KAMATA*[2,4,7]

Keywords: bark beetle, ambrosia beetle, subtropical forest, community, beetle fauna

台湾中央部において林床に設置した誘引枝で捕獲された穿孔虫類（甲虫目：ゾウムシ科キクイムシ亜科）のリスト

林子愷*[1]・李春霖*[2]・呉立偉*[2,5]・彭勇*[1,6]・
ロジャー A ビーバー*[3]・蔡明哲*[2]・鎌田直人*[2,4,7]

キーワード：樹皮下キクイムシ，養菌性キクイムシ，亜熱帯林，群集，甲虫相

Introduction

Community structure patterns of organisms provide valuable insights into the maintenance of healthy ecosystems. The subfamily Scolytinae comprises approximately 6,000 species organized into 11 tribes and over 247 genera (Kirkendall *et al*., 2015). This subfamily encompasses a variety of guilds, including bark beetles (*sensu stricto*), ambrosia beetles, as well as seed, fruit, and root feeders, some of which have significant economic and ecological impacts in the world (Raffa *et al*., 2015).

Taiwan is an island in East Asia with an area comparable to that of Kyushu Island, one of Japan's main islands. The climatic zones in Taiwan range from tropical to subtropical, with an elevation exceeding 4,000 m, resulting in diverse climatic zones that include tropical areas and tree-lines similar to tundra. This diversity contributes to Taiwan's rich biodiversity (Li *et al*., 2013).

＊1 Department of Forest Science, Graduate School of Agricultural and Life Sciences, The University of Tokyo
東京大学大学院農学生命科学研究科森林科学専攻
＊2 The Experimental Forest, College of Bio-Resources and Agriculture, National Taiwan University
国立台湾大学生物資源・農学院実験林
＊3 161/2 Mu 5, Soi Wat Pranon, T. Donkaew, A. Maerim, Chiangmai 50180, Thailand
タイ国チェンマイ省チェンマイ市メイリム区ドンガオ地区ソイワットプラノン 5-161/2
＊4 The University of Tokyo Hokkaido Forest, The University of Tokyo Forests, Graduate School of Agricultural and Life Sciences, The University of Tokyo
東京大学大学院農学生命科学研究科附属演習林北海道演習林
＊5 Present affiliation: Department of Life Science, College of Science, Tunghai University
現所属：東海大学理学院生命科学系（台湾）
＊6 Present affiliation: Chinese Academy of Sciences
現所属：中国科学院
＊7 Present affiliation: The University of Tokyo Chiba Forest, The University of Tokyo Forests, Graduate School of Agricultural and Life Sciences, The University of Tokyo
現所属：東京大学大学院農学生命科学研究科附属演習林千葉演習林

Beaver and Liu (2010) documented the subfamilies Scolytinae in Taiwan, reporting a total of 133 species. Subsequently, several additional papers have contributed to the understanding of this fauna (e.g., Lin and Beaver, 2024; Lin and Smith, 2024). To date, a total of 156 species of Scolytinae is known from Taiwan. Notably, a large-scale tree mortality event affecting *Cunninghamia lanceolata* in central Taiwan was presumably caused by scolytine beetles (Lin and Wu, 2010). However, most previous studies on the subfamilies Scolytinae in Taiwan have primarily concentrated on species descriptions, with limited investigation into the factors influencing community composition and their relationships with host plants.

In this study, we examined scolytine beetles attacking the branches of 14 species of woody plants within a *Machilus*-*Castanopsis* forest class in central Taiwan. These species were selected from the local flora to encompass a wide range of phylogenetic diversity. The results provide valuable insights into the community structure of scolytine beetles in central Taiwan and enhance our understanding of the relationships between the community structure of these beetles, their host plants, and environmental factors by comparing our findings with those from other areas studied using the same methodology.

Materials and Methods

Study site

The study was conducted at the Xitou Nature Education Area, Experimental Forest, College of Bio-Resources and Agriculture, National Taiwan University (NTUEF), located in Nantou County, Taiwan (Figure 1A). The average annual temperature of the study area was 16.5℃ from 1941 to 2005, with average annual precipitation totaling 2,661.5 mm (NTUEF, 2009). According to Thornthwaite's climate classification, the area is categorized as an AB'ra' type (warm and humid climate) (Chen, 1957). The region is situated in the *Machilus*-*Castanopsis* Zone, where the natural vegetation primarily consists of evergreen species belonging to the families Lauraceae and Fagaceae. However, *Cryptomeria japonica* has been extensively planted since the establishment of the Experimental Forest under Tokyo Imperial University, resulting in a significant area of *C. japonica* plantation forests. Additionally, plantations of *Taiwania cryptomerioides* were also established during the era of NTUEF.

Bait branch

Three experiments were conducted at approximately two-month intervals from May to December 2019. The survey schedule, along with the average temperature and total precipitation for each survey period — calculated from weather data obtained at the Fenghuang Weather Station, Central Weather Bureau of Taiwan (https://www.cwb.gov.tw/V8/C/) — are presented in Table 1.

One representative species from each of the 14 orders (two gymnosperms and 12 angiosperms) was selected from the common tree species native to or planted in the Xitou Nature Education Area, ensuring

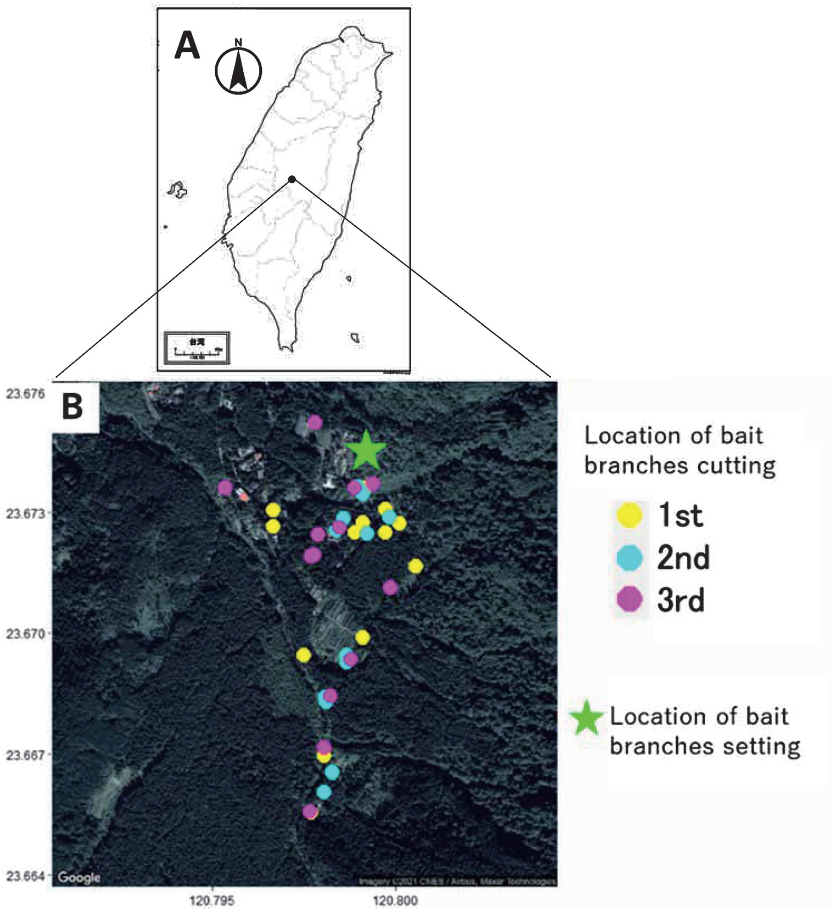

Figure 1 Study site for collecting scolytine beetles using bait branches in central Taiwan.
(A) Location of the Xitou Nature Education Area, Experimental Forest, College of Bio-Resources and Agriculture, National Taiwan University (NTUEF), situated in Nantou County, Taiwan.
(B) Locations of the trees from which bait branches were collected for the three experiments, as well as the positions where the bait branches were set.

that the selection was as phylogenetically diverse and evenly distributed as possible (Table 2). Notably, nine of the fourteen orders were also present in the previous study conducted at the University of Tokyo Chichibu Forest (Watanabe *et al*., 2014).

Following similar experiments conducted in Chiang Mai, Thailand (Saowaphak *et al*., 2025), one large branch from each target species, approximately 8 cm in diameter, was cut with a handsaw (Figures 1B, 2A), tagged, and deployed on the forest floor of a *Liquidambar formosana* plantation (23.6744° N, 120.7992° E, 1,154 m a.s.l.) (Figures 1B, 2B), adjacent to a natural forest, a *C. japonica* plantation, and a bamboo garden where various species of bamboo indigenous to Asia were planted.

Table 1 Dates of setting and retrieving bait branches at the Xitou Nature Education Area, Experimental Forest, College of Bio-Resources and Agriculture, National Taiwan University, located in Nantou County, Taiwan, in 2019.

	Setting	Retrieving	No. days exposed	Temperature*1	Rainfall*2
1st	May 23	Jul 15–21	53–59	22.8℃	859.5 mm
2nd	Jul 25	Sep 11–17	48–54	23.1℃	795.5 mm
3rd	Sep 19	Nov 24–Dec 04	66–76	19.5℃	94.0 mm

*1: Average of daily mean temperature until the first date of retrieving
*2: Sum total of precipitation until the first date of retrieving
Weather data source: Fenghuang Weather Station, The Central Weather Bureau of Taiwan (https://www.cwb.gov.tw/V8/C/).

Table 2 Woody plant species with their order and family names used in bait branch experiment at the Xitou Nature Education Area, Experimental Forest, College of Bio-Resources and Agriculture, National Taiwan University, Nantou County, Taiwan, in 2019.

Order	Family	Species	Abbreviation
Pinales	Cupressaceae	*Taiwania cryptomerioides*	TC
Ginkgoales	Ginkgoaceae	*Ginkgo biloba*	GB
Proteales	Proteaceae	*Helicia formosana*	HF
Ericales	Ericaceae	*Rhododendron formosanum*	RF
Lamiales	Lamiaceae	*Clerodendrum trichotomum*	CT
Apiales	Araliaceae	*Schefflera octophylla*	SO
Saxifragales	Altingiaceae	*Liquidambar formosana*	LF
Sapindales	Sapindaceae	*Sapindus saponaria*	SS
Crossosomatales	Staphyleaceae	*Turpinia formosana*	TF
Rosales	Ulmaceae	*Zelkova serrata*	ZS
Fagales	Myricaceae	*Morella rubra*	MR
Malpighiales	Phyllanthaceae	*Bischofia polycarpa*	BP
Laurales	Lauraceae	*Neolitsea sericea*	NS
Magnoliales	Magnoliaceae	*Michelia compressa*	MC

After 53-76 days of exposure to beetle attacks, the bait branches were collected and examined in a shed nearby using the same protocol as Saowaphak *et al*. (2025). Each branch was cut into small pieces measuring 5-10 cm in length, and the circumference at the center of each piece was measured using a measuring tape before debarking. Portions smaller than 2 cm in diameter were classified as twigs. For portions larger than 2 cm in diameter, holes created by beetles were marked with a waterproof pen after carefully scrutinizing the surfaces of the outer bark, inner bark, and sapwood. In the case of twig portions, insects were searched for without debarking. Insects within the galleries were collected using different sizes of fishing lines, which were used to push out the insects after the bark and wood were dissected into small enough pieces to avoid overlooking the gallery.

Insects obtained from each gallery were assigned a unique identification number and preserved in 99% ethanol in a single microcentrifuge tube. The information for each collection, including the collection date,

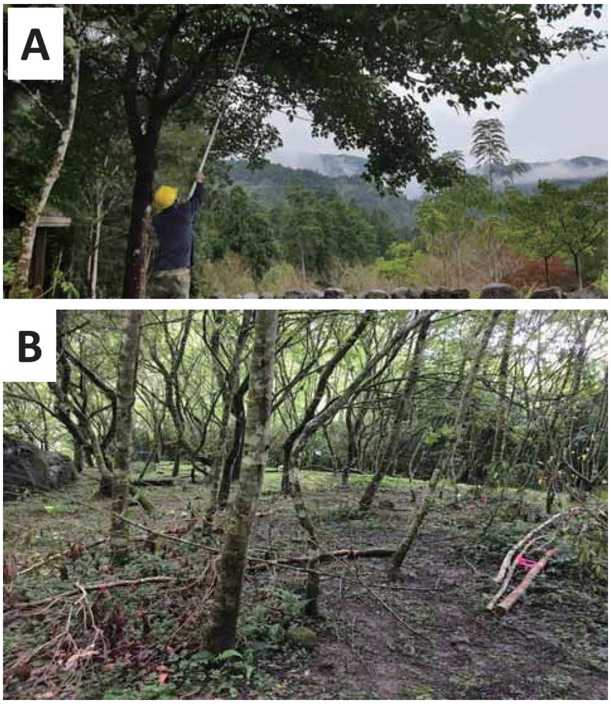

Figure 2 Collecting a bait branch from the target plant species (A) and the forest floor of a *Liquidambar formosana* plantation, where bait branches were deployed and exposed to beetle attacks (B).

host tree species, and the diameter of the branch, from which each specimen was collected, was recorded separately for further analysis.

The insect samples were then transported back to the laboratory at Graduate School of Agricultural and Life Sciences, the University of Tokyo for sorting into morphospecies. Voucher specimens of all species were identified by RAB.

Results

During the three experiments, a total of 3,494 galleries were examined. Among these, 2,094 galleries were identified as having been created by beetles belonging to the subfamily Scolytinae. Of these, 855, 932, and 307 galleries were recorded from the first, second, and third experiment, respectively (Table 3). In total, 26 scolytine species were collected. The number of species were 18, 20, and 9 from the first, second, and third experiment, respectively. No individuals belonging to the subfamily Platypodinae or the family Bostrichidae were collected. One individual from the family Bothrideridae and six from the family Passandridae were collected, which were included in the category "Empty galleries".

The overall beetle abundance was greatest in *Liquidambar formosana*, followed by *Sapindus saponaria*

Table 3 Summary of coleopteran species belonging to the subfamily Scolytinae within the family Curculionidae captured from baited branches placed on the forest floor in 2019 at the Xitou Nature Education Area, Experimental Forest, College of Bio-Resources and Agriculture, National Taiwan University, Nantou County, Taiwan.

Tribe	Insect species	Total	1st	2nd	3rd
Dryocoetini	*Coccotrypes longior* (Eggers)	2		2	
Dryocoetini	*Coccotrypes* sp.	1		1	
Hyorrhynchini	*Sueus niisimai* (Eggers)	337	32	90	215
Polygraphini	*Polygraphus* sp. nr. *pterocaryi* Yin & Huang	4	2		2
Scolytoplatypodini	*Scolytoplatypus mikado* Blandford	2	2		
Scolytoplatypodini	*Scolytoplatypus pubescens* Hagedorn	535	227	242	66
Xyleborini	*Ambrosiodmus asperatus* (Blandford)	7		7	
Xyleborini	*Ambrosiodmus rubricollis* (Eichhoff)	176	98	62	16
Xyleborini	*Ambrosiophilus subnepotulus* (Eggers)	37	21	16	
Xyleborini	*Beaverium magnus* (Niisima)	25	16	9	
Xyleborini	*Cnestus nitidipennis* (Schedl)	2		2	
Xyleborini	*Diuncus corpulentus* (Eggers)	34	12	22	
Xyleborini	*Euwallacea fornicatus* cx (Eichhoff)	8	1	7	
Xyleborini	*Euwallacea interjectus* (Blandford)	8	2	6	
Xyleborini	*Hadrodemius comans* (Sampson)	1	1		
Xyleborini	*Leptoxyleborus sordicauda* (Motschulsky)	8	1	7	
Xyleborini	*Microperus latesalebrinus* Smith, Beaver & Cognato	1			1
Xyleborini	*Microperus* sp.	5	5		
Xyleborini	*Planiculus bicolor* (Beeson)	2		2	
Xyleborini	*Xylosandrus brevis* (Eichhoff)	11	3	7	1
Xyleborini	*Xylosandrus compactus* (Eichhoff)	1			1
Xyleborini	*Xylosandrus crassiusculus* (Motschulsky)	251	79	172	
Xyleborini	*Xylosandrus formosae* (Wood)	16	7	8	1
Xyleborini	*Xylosandrus germanus* (Blandford)	601	342	255	4
Xyleborini	*Xylosandrus jaintianus* (Schedl)	8	2	6	
Xyleborini	*Xylosandrus morigerus* (Blandford)	2		2	
	Subtotal	2,085	853	925	307
	missing specimens	7	2	5	
	Total (with scolytine beetles)	2,092	855	930	307
	Empty galleries	1,401	536	706	159
	Total galleries examined	3,493	1,391	1,636	466
	No. of species	26	18	20	9

and *Turpinia formosana*, whereas the number of insect species collected from each plant species was greatest in *T. formosana* (15 species) (Table 4). Only two species were collected from *Taiwania cryptomerioides* as well as *Ginkgo biloba* followed by *Zelkova serrata*. The data for each of the three experiments are shown in Appendix (Tables S1-S3).

Acknowledgements

We extend our thanks to Dr. Chih-Kai Yang from the Department of Forestry of National Pingtung University of Science and Technology for his invaluable advice in selecting plant species from the Xitou Nature Education Area, NTUEF. This study was supported by Grants-in-Aid for Scientific Research from the Japan Society for the Promotion of Science to NK (23255011, 16H02760).

Table 4 Abundance of coleopteran species belonging to the subfamily Scolytinae within the family Curculionidae captured from each baited branch species placed on the forest floor in 2019 at the Xitou Nature Education Area, Experimental Forest, College of Bio-Resources and Agriculture, National Taiwan University, Nantou County, Taiwan.

Tribe	Insect species	Total	Plant species													
			TC	GB	HF	RF	CT	SO	LF	SS	TF	ZS	MR	BP	NS	MC
Dryocoetini	*Coccotrypes longior* (Eggers)	2							1		1					
Dryocoetini	*Coccotrypes* sp.	1									1					
Hyorrhynchini	*Sueus niisimai* (Eggers)	337	3			24	1		5	19	15	13	7	6	220	24
Polygraphini	*Polygraphus* sp. nr. *pterocaryi* Yin & Huang	4													4	
Scolytoplatypodini	*Scolytoplatypus mikado* Blandford	2				2										
Scolytoplatypodini	*Scolytoplatypus pubescens* Hagedorn	535			2	39			234	124	52			63	21	
Xyleborini	*Ambrosiodmus asperatus* (Blandford)	7			1	1		1			2				1	1
Xyleborini	*Ambrosiodmus rubricollis* (Eichhoff)	176		4	4	7	16	8	30	14	21	6	10	4	10	42
Xyleborini	*Ambrosiophilus subnepotulus* (Eggers)	37				2	1		3		5		4		3	19
Xyleborini	*Beaverium magnus* (Niisima)	25							1	1					4	19
Xyleborini	*Cnestus nitidipennis* (Schedl)	2				1				1						
Xyleborini	*Diuncus corpulentus* (Eggers)	34				6	1		5	6	16					
Xyleborini	*Euwallacea fornicatus* cx (Eichhoff)	8								4		1				3
Xyleborini	*Euwallacea interjectus* (Blandford)	8						1	1	3						3
Xyleborini	*Hadrodemius comans* (Sampson)	1							1							
Xyleborini	*Leptoxyleborus sordicauda* (Motschulsky)	8							2		6					
Xyleborini	*Microperus latesalebrinus* Smith, Beaver & Cognato	1													1	
Xyleborini	*Microperus* sp.	5									4					1
Xyleborini	*Planiculus bicolor* (Beeson)	2								2						
Xyleborini	*Xylosandrus brevis* (Eichhoff)	11			5	1				2	2		1			
Xyleborini	*Xylosandrus compactus* (Eichhoff)	1												1		
Xyleborini	*Xylosandrus crassiusculus* (Motschulsky)	251			14	18	5	3	65	77	63			1	2	3
Xyleborini	*Xylosandrus formosae* (Wood)	16			1		1		2	2	7				2	1
Xyleborini	*Xylosandrus germanus* (Blandford)	601	2	13	34	53	54	16	72	102	137	4	12	1	12	89
Xyleborini	*Xylosandrus jaintianus* (Schedl)	8				6					1		1			
Xyleborini	*Xylosandrus morigerus* (Blandford)	2				1	1									
	Subtotal	2,085	5	17	61	161	80	29	422	357	333	24	35	76	280	205
	missing specimens	7		1	1					1	3					1
	Total (with scolytine beetles)	2,092	5	18	62	161	80	29	422	358	336	24	35	76	280	206
	Empty galleries	1,401	46	93	160	91	74	19	176	150	320	49	32	33	96	62
	Total galleries examined	3,493	51	111	222	252	154	48	598	508	656	73	67	109	376	268
	No. of species	26	2	2	7	13	8	5	13	13	15	4	6	6	11	11

Abbreviations: TC, *Taiwania cryptomerioides* ; GB, *Ginkgo biloba* ; HF, *Helicia formosana* ; RF, *Rhododendron formosanum* ; CT, *Clerodendrum trichotomum* ; SO, *Schefflera octophylla* ; LF, *Liquidambar formosana* ; SS, *Sapindus saponaria* ; TF, *Turpinia formosana* ; ZS, *Zelkova serrata* ; MR, *Morella rubra* ; BP, *Bischofia polycarpa* ; NS, *Neolitsea sericea* ; MC, *Michelia compressa*

Reference

Beaver, R.A., and Liu, L.Y. (2010). An annotated synopsis of Taiwanese bark and ambrosia beetles, with new synonymy, new combinations and new records (Coleoptera: Curculionidae: Scolytinae). Zootaxa 2602 (1). doi: 10.11646/zootaxa.2602.1.1.

Chen, C.-S. (1957). Climatic classification and zones. Monograph of the Experimental Forest, National Taiwan University No.7: 174p.

Kirkendall, L.R., Biedermann, P.H.W., and Jordal, B.H. (2015). "Chapter 3 - Evolution and Diversity of Bark and Ambrosia Beetles," in Bark Beetles, eds. F.E. Vega & R.W. Hofstetter. (San Diego: Academic Press), 85-156.

Li, C.-F., Chytry, M., Zeleny, D., Chen, M.-Y., Chen, T.-Y., Chiou, C.-R., et al. (2013). Classification of Taiwan forest vegetation. Applied Vegetation Science 16 (4): 698-719. doi: 10.1111/avsc.12025.

Lin, C.-S., and Beaver, R.A. (2024). Review of the genus *Indocryphalus* Eggers, 1939 (Coleoptera, Curculionidae, Scolytinae) in Taiwan with a new species. Taiwania 69 (2): 257-265. doi: 10.6165/tai.2024.69.257

Lin, C.-S., and Smith, S.M. (2024). Review of the genus *Microperus* Wood, 1980 (Coleoptera, Curculionidae, Scolytinae) of Taiwan with the description of two newly recorded species and the first description of males of six species. Taiwania 69 (2): 151-167. doi: 10.6165/tai.2024.69.151

Lin, C.-S., and Wu, W.-J. (2010). Scolytid species (Coleoptera: Curculionidae: Scolytinae) in China-fir (Cunninghamia lanceolata) in the Nei-Mou-Pu Tract of the NTU Experimental Forest. Formosan Entomologist 30: 203-218.

NTUEF (Experiment Forest, College of Bioresources and Agriculture, National Taiwan University) (2009) Meteorological Data in the Experimental Forest of College of Bioresources and Agriculture of National Taiwan University from 1941 to 2005. NTUEF, Special Bulletin 26: 1- 86.

Raffa, K.F., Grégoire, J.-C., and Staffan Lindgren, B. (2015). "Chapter 1 - Natural History and Ecology of Bark Beetles," in Bark Beetles, eds. F.E. Vega & R.W. Hofstetter. (San Diego: Academic Press), 1-40.

Saowaphak, T., Sanguansub, S., Buranapanichpan, S., Buranapanichpan, A., Beaver, R.A., and Kamata, N. (2025). List of wood-boring beetles (Coleoptera: Bostrichidae, Curculionidae; Platypodinae, and Scolytinae) captured by bait branches set on the forest floor of a lower montane forest in northern Thailand. Miscellaneous Information of the University of Tokyo Forests 71: 71-82.

Watanabe, K., Murakami, M., Hirao, T., and Kamata, N. (2014). Species diversity estimation of ambrosia and bark beetles in temperate mixed forests in Japan based on host phylogeny and specificity. Ecological Research 29 (2): 299-307. doi: https://doi.org/10.1007/s11284-013-1123-0.

Supplementary materials are available in UTokyo Repository.

URI: https://doi.org/10.15083/0002010640