

## Chapter V

### Results

#### Faunal study

Scolytidae were in subfamily Hylesininae (Tribe Hyorrhynchini and Polygraphini) and subfamily Scolytinae (Tribe Scolytoplatypodini, Ipini, Dryocoetini, Xyleborini, Cryphalini and Cothylini) whereas Platypodidae were in subfamily Tesserocerini (Tribe Diapodini) and subfamily Platypodinae (Tribe Platypodini). A total of 951 scolytid specimens and 519 platypodid specimens were collected from 4 different trapping methods, representing 68 species 20 genera in scolytids and 20 species 8 genera in platypodids. Fifty-five scolytid species (19 genera) and 19 platypodid species (7 genera) were found in MEF (Appendix B) while, 38 scolytid species (19 genera) and 12 platypodid species (7 genera) were found in DDF (Appendix D). The ten most abundant species in the MEF are *Xyleborus hirtus* (Hagedorn), *Gnatharus tibetensis* Wood and Yin, *Treptoplatypus solidus* (Walker), *Platypus quercivorus* Murayama, *Diapus quinquespinatus* Chapuis, *Treptoplatypus* sp., *Diapus* sp.n.1, *Platypus* sp.1, *Scolytoplatypus minimus* Hagedorn and *Xylosandrus crassiusculus* (Motschulsky). Whereas, the ten most abundant species in DDF are *Xylosandrus crassiusculus* (Motschulsky), *Xyleborus perforan* (Wollaston), *Coptodryas* sp.1, *Hypothenemus* sp.1, *Hypothenemus eruditus* Westwood, *Hypothenemus birmanus* (Eichhoff), *Coccotrypes carpophagus* Hornung, *Hypothenemus areccae* Hornung, *Xyleborus andrewesi* (Blandford) and *Cryphalus* sp.2.

New species, *Diapus* sp.n.1 and *Diapus* sp.n.2 were found in MEF whereas only *Diapus* sp.n.2 were found in DDF (Appendix F). Thirteen species of new records also found for the first time in Thailand (Appendix G).

The most species rich of scolytid genera in MEF are *Cyclorhipidion* (11 species) followed by *Coptodryas* (6 species) whereas only one species was found for the following genera; *Sueus*, *Polygraphus*, *Ozopemon*, *Gnatharus*, *Dryocoetiops*, *Cyrtogenius*, *Acanthotomicus* (Fig. 11). The most species rich of platypodid genera are *Platypus* (6 species) followed by *Diapus* (5 species) whereas only one species

was found for the following genera; *Euplatypus*, *Crossotarsus* and *Baiocis* (Fig. 12). The most species rich of scolytid and platypodid genera in DDF are *Hypothenemus* (7 species) followed by *Coccotrypes* (5 species), *Platypus* (4 species), *Treptoplatypus* (2 species) and *Diapus* (2 species) whereas only one species was found for the following genera; *Webbia*, *Gnatharus*, *Eccopterus*, *Cyrtogenius*, *Arixyleborus*, *Genyocerus*, *Euplatypus*, *Crossotarsus* (Figs. 13, 14).



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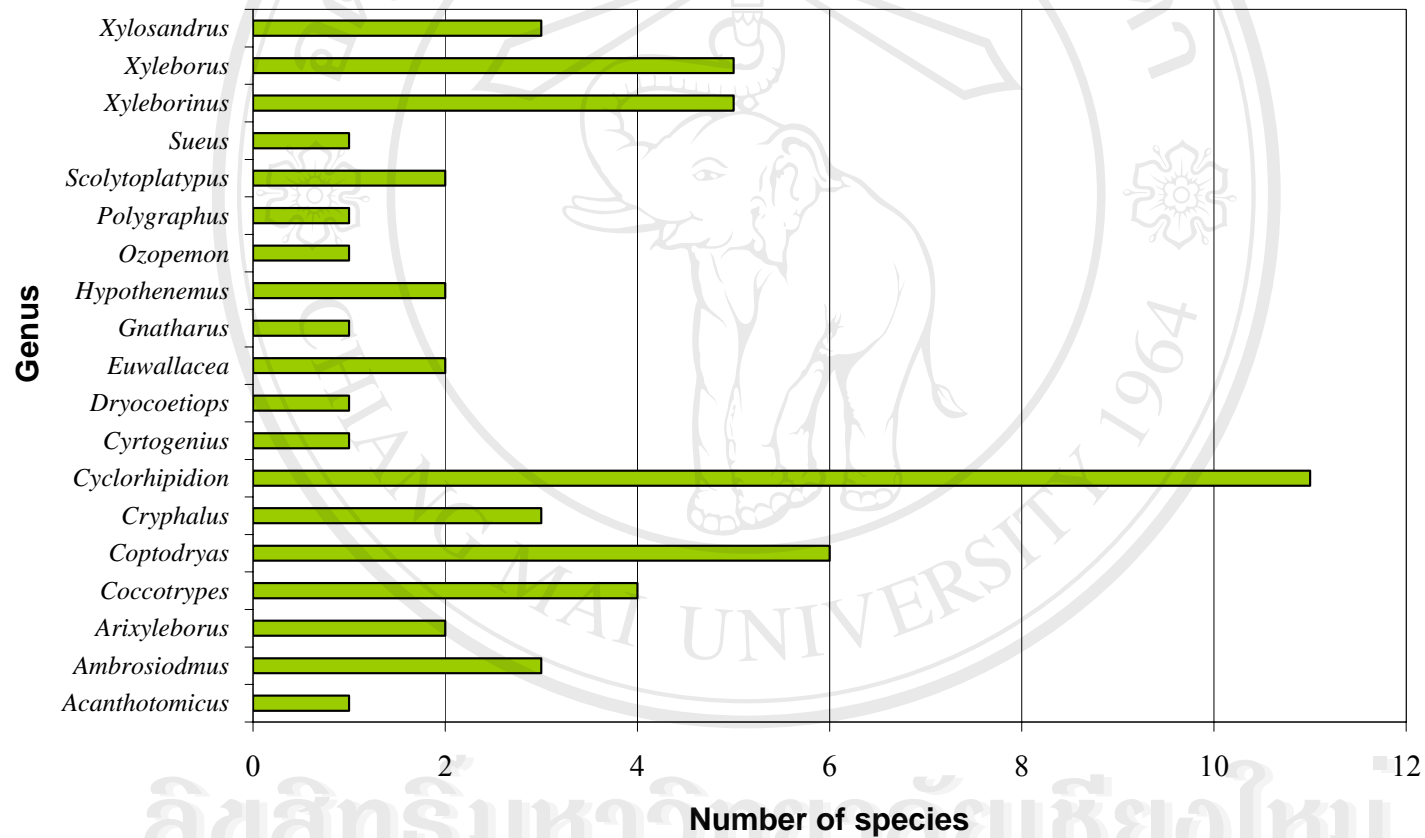


Figure 11 Number of species of Scolytidae collected in mixed evergreen forest from August 2004 to September 2005

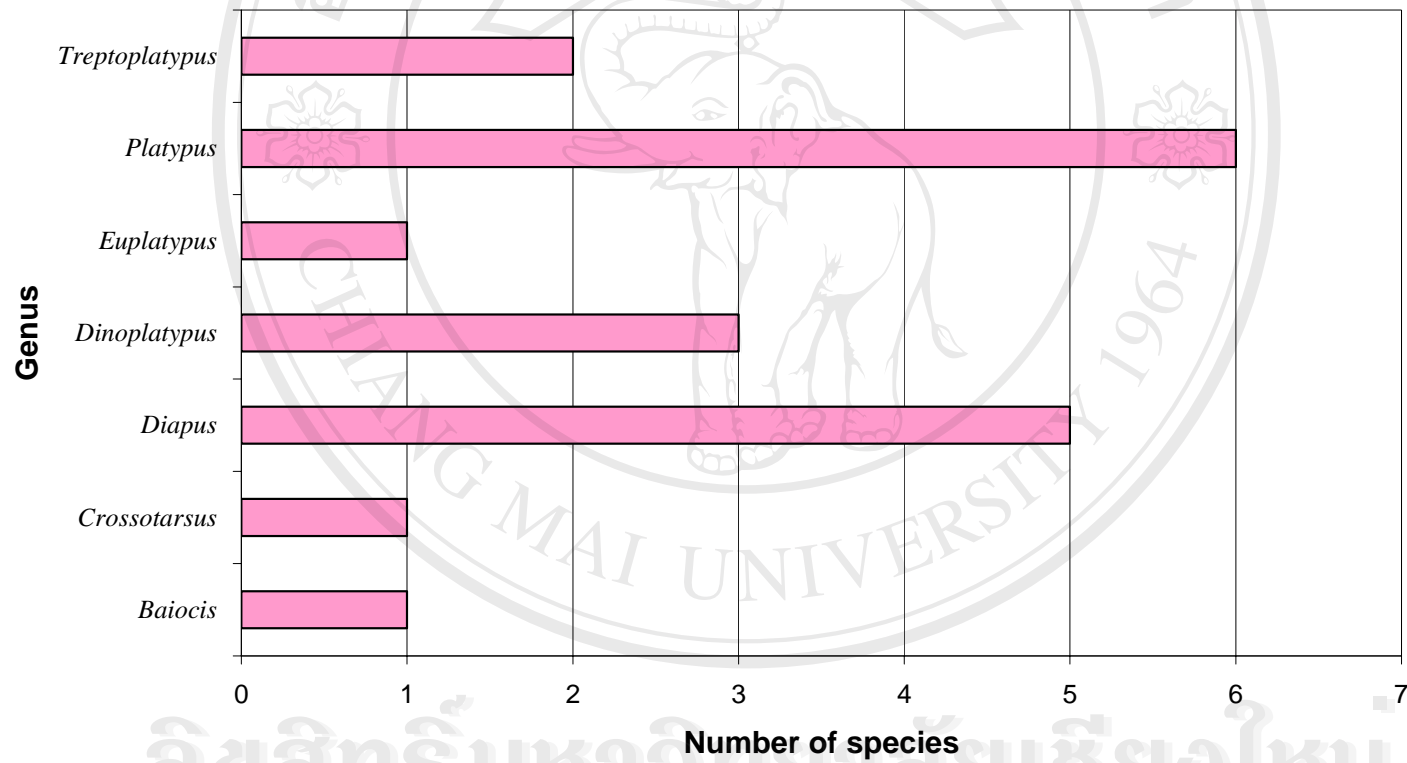


Figure 12 Number of species of Platypodidae collected in mixed evergreen forest from August 2004 to September 2005

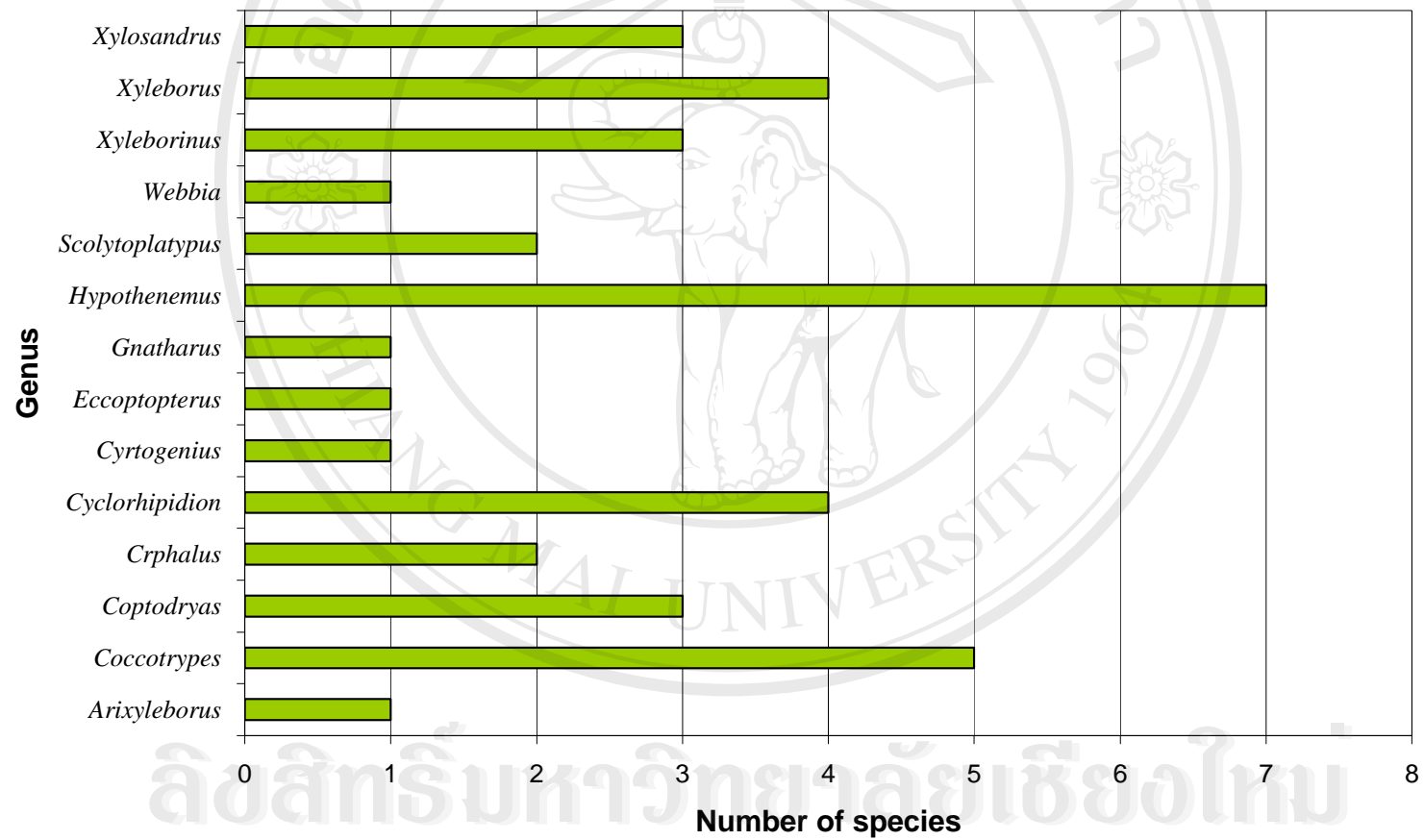


Figure 13 Number of species of Scolytidae collected in deciduous dipterocarp forest from January to December 2005

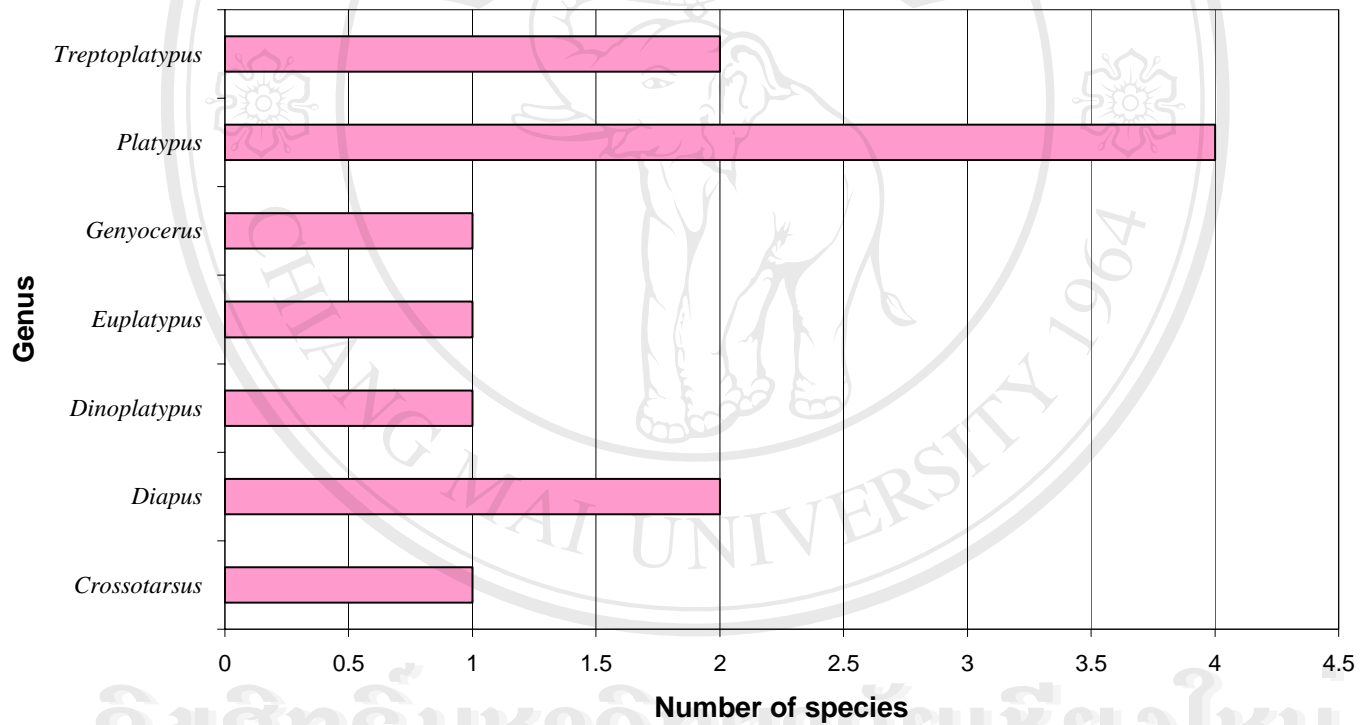
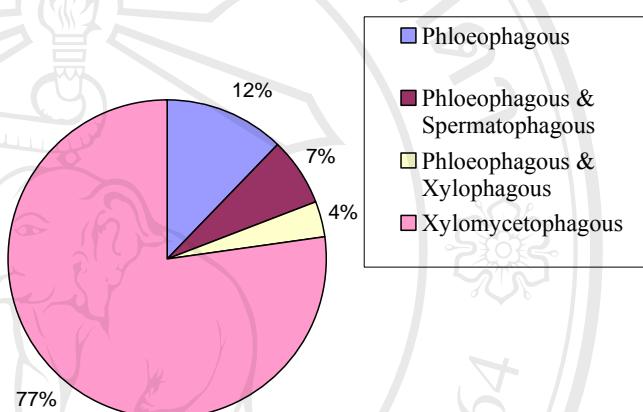


Figure 14 Number of species of Platypodidae collected in deciduous dipterocarp forest from January to December 2005

### The feeding types

All Platypodidae are xylomycetophagy while several feeding types are found among Scolytidae. Thus, all Scolytidae collected in this study were divided by their feeding type in each forest type (Fig. 15).

Mixed evergreen forest (August 2004 to September 2005)



Deciduous dipterocarp forest (January to December 2005)

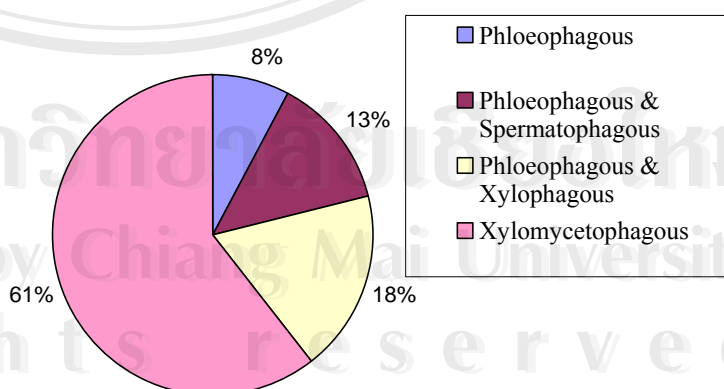


Figure 15 Feeding types of Scolytidae in MEF and DDF

### 1) Species diversity

Two standard indices were used to express the diversity of the forest types (Table 1). Fisher's alpha gave higher values in MEF whereas Simpson's gave higher values in DDF.

Table1 Species diversity indices of MEF and DDF

Forests	Number of species	$\alpha$	D
MEF	74	18.30	0.25
DDF	50	14.89	0.42

When  $\alpha$  = Fisher's alpha diversity index  
D = Simpson's diversity index

### 2) Species similarity

The similarity of the MEF and DDF faunas for Scolytidae and Platypodidae are different; 0.53 in Scolytidae and 0.71 in Platypodidae.

### 3) Multivariate analysis

The purpose of cluster analysis is to group objects based on the characteristics they possess and the solution is totally dependent upon the variables used as the basis for the similarity measure (Hair *et al.*, 1998). Two physical factors, temperature and/or relative humidity were used to classify species of both families by correlating species with the factors. For Scolytidae in MEF, the cluster dendrogram in Fig. 16 shown that there were two large groups of Scolytidae in MEF (27 species and 28 species). Each group was either dependent or independent of both factors while some species in both groups depend on only one factor; temperature or relative humidity. Among the species in MEF; 40% depend on both factors, 23.6% depend on relative humidity, 20% independent of both factors and 16.4% depend on temperature (Fig. 17, Table 2). Whereas species of Platypodidae in MEF were arranged into two large



groups; 10 and 9 species (Fig. 18). Both groups contain species that depend on humidity. Among the platypodid species in MEF; 31.5% depend on both factors, 31.6% depend on temperature, 21.1% independent of both factors and 15.8% depend on relative humidity (Fig. 19, Table 3).

For species in DDF, it was clear that two large groups of scolytids were arranged by dependence on both factors (Figs. 20, 21). Within the large groups, species can be arranged into 4 types; 31.6% dependant on both factors, 23.7% dependant on temperature, 23.7% dependant on relative humidity and 21% independent of both factors (Table 4). Cluster dendrogram of Platypodidae in DDF showed different result, two large groups were arranged by species that depend on temperature or depend on relative humidity (Figs. 22, 23). However, species can be arranged into 4 types; 33.3% dependant on temperature, 25% dependant on relative humidity, 25% independent of both factors and 16.7% dependant on both factors (Table 5).

But when using time as factors, varied results were presented in each family and forest type. For Scolytidae and Platypodidae in MEF (Figs. 24, 25), species were arranged into two groups depend on frequency of occurrence, that is infrequent and frequent found. Infrequent is defined as species that were found once, twice or particular months whereas frequent is defined as species that are found all year round. For DDF, Scolytidae (Fig. 26) were arranged into two groups, frequent and infrequent while Platypodidae (Fig. 27) arranged into two groups, aggregate and scattered occurrence. Aggregate is defined as species that were found in some period of the year, e.g. the first three months, two months before cold season or last three months while scattered is defined as species that were found in scattered months, e.g. found in January, March and October.

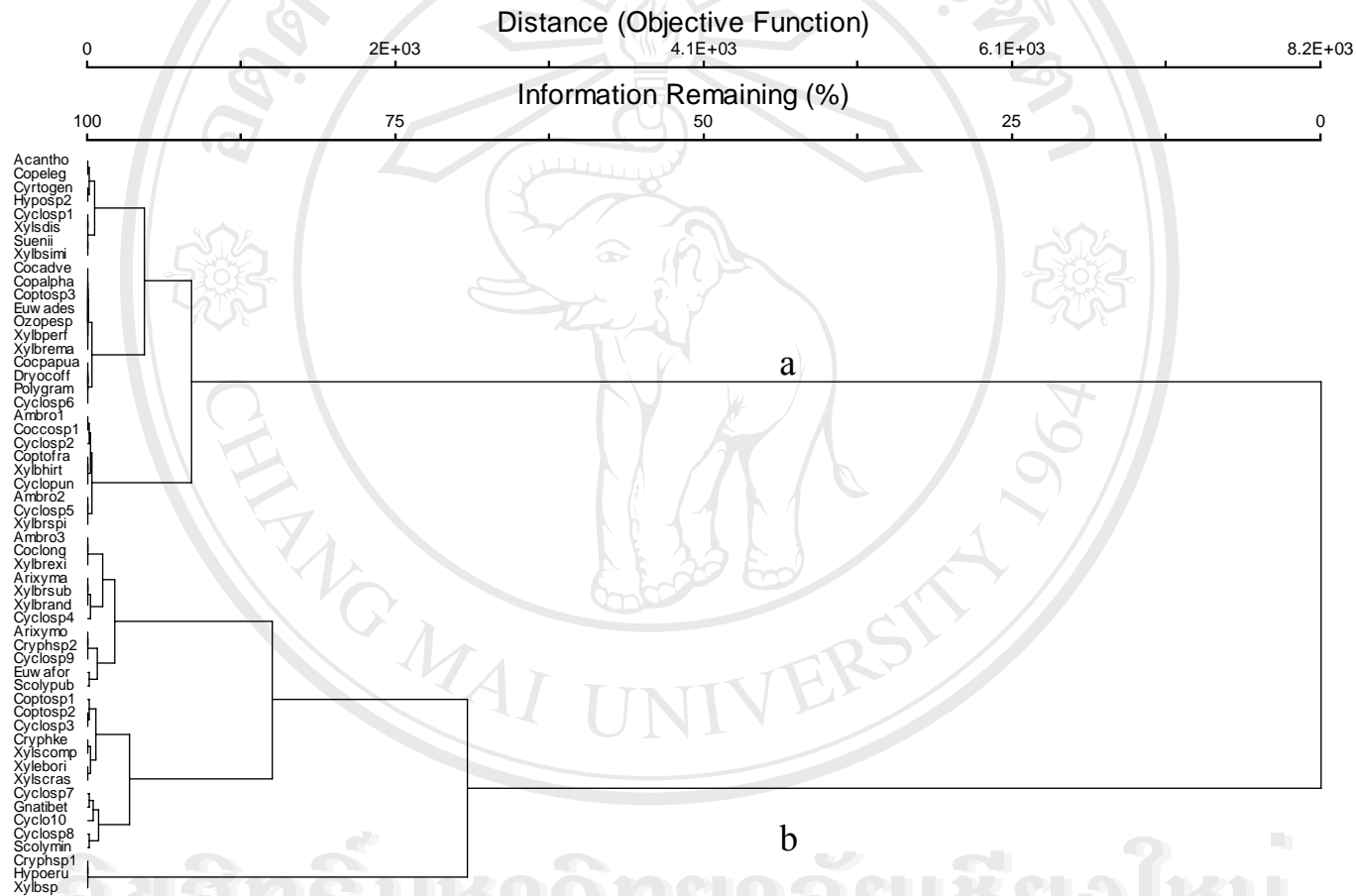


Figure 16 Cluster dendrogram of Scolytidae in mixed evergreen forest from August 2004 to September 2005 depend on high temperature (a) and low humidity (b)

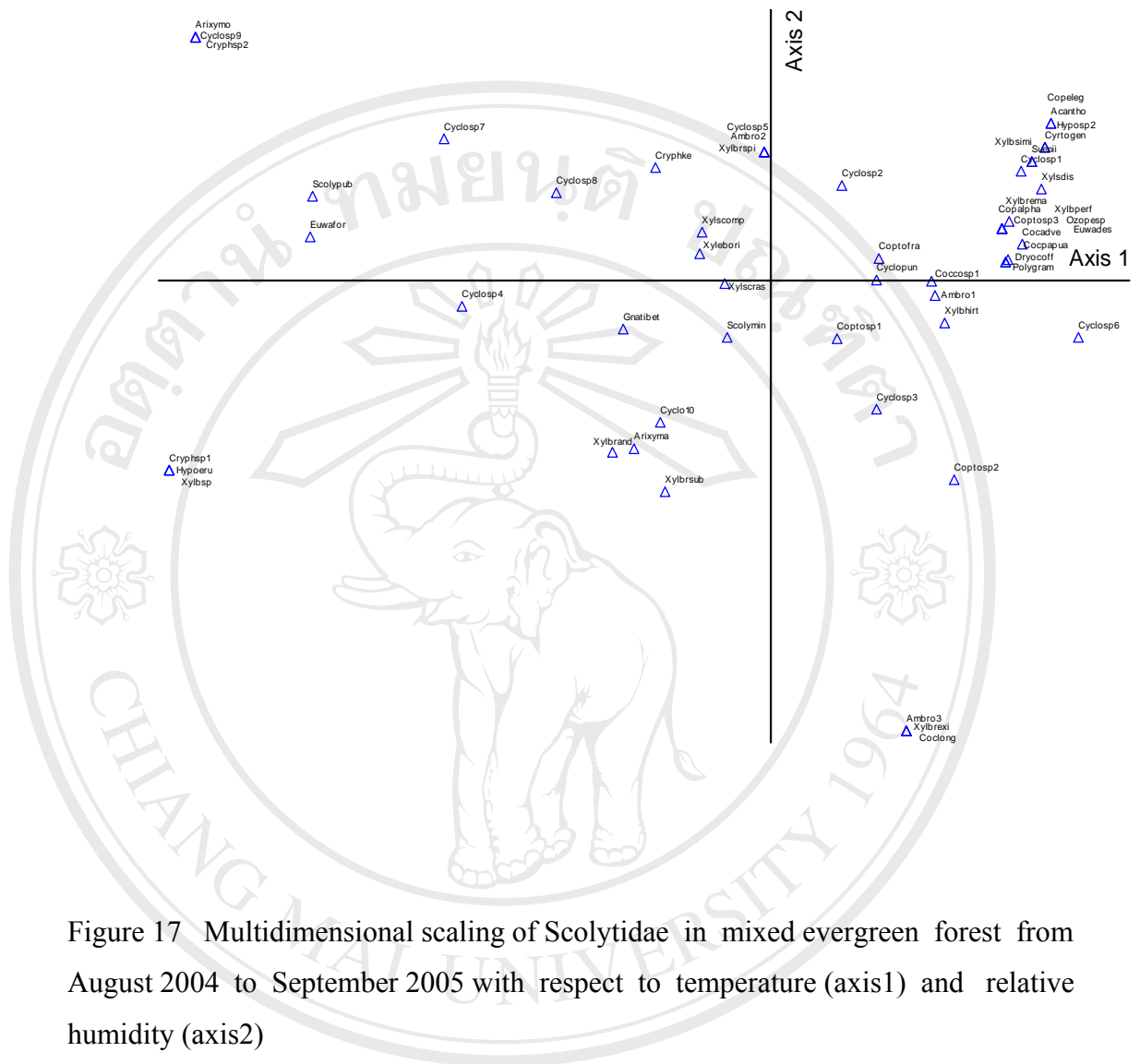


Figure 17 Multidimensional scaling of Scolytidae in mixed evergreen forest from August 2004 to September 2005 with respect to temperature (axis1) and relative humidity (axis2)

Table 2 Species of Scolytidae in mixed evergreen forest arranged by factor (s) (\* = new record for Thailand)

No.	Both factors	Temperature	Relative humidity	None
1	<i>Acanthotomicus</i> sp.	<i>Ambrosiodmus</i> sp.1	<i>Ambrosiodmus</i> sp.2	<i>Arixyleborus malayensis</i> *
2	<i>Coccotrypes advena</i>	<i>Ambrosiodmus</i> sp.3	<i>Arixyleborus</i> aff. <i>morio</i>	<i>Cryphalus</i> sp.1
3	<i>Coccotrypes papuanus</i>	<i>Coccotrypes longior</i>	<i>Cryphalus kesiyae</i>	<i>Cyclorhipidion</i> sp.10
4	<i>Coccotrypes</i> sp.1	<i>Coptodryas</i> sp.1	<i>Cryphalus</i> sp.2	<i>Cyclorhipidion</i> sp.4
5	<i>Coptodryas alpha</i> *	<i>Coptodryas</i> sp.2	<i>Cyclorhipidion</i> sp.5	<i>Gnatharus tibetensis</i> *
6	<i>Coptodryas elegans</i> *	<i>Cyclorhipidion</i> sp.3	<i>Cyclorhipidion</i> sp.7	<i>Hypothenemus eruditus</i>
7	<i>Coptodryas fragosus</i> *	<i>Cyclorhipidion</i> sp.6	<i>Cyclorhipidion</i> sp.8	<i>Scolytoplastypus minimus</i>
8	<i>Coptodryas</i> sp.3	<i>Xyleborinus exiguus</i>	<i>Cyclorhipidion</i> sp.9	<i>Xyleborinus andrewesi</i>
9	<i>Cyclorhipidion</i> aff. <i>punctatopilosus</i>	<i>Xyleborus hirtus</i>	<i>Euwallacea fornicatus</i>	<i>Xyleborinus subgranulatus</i> *
10	<i>Cyclorhipidion</i> sp.1		<i>Scolytoplastypus pubescens</i>	<i>Xyleborus</i> sp.
11	<i>Cyclorhipidion</i> sp.2		<i>Xyleborinus</i> sp.	<i>Xylosandrus crassiusculus</i>
12	<i>Cyrtogenius</i> sp.		<i>Xyleborinus spinipennis</i> *	
13	<i>Dryocoetiops coffeae</i> *		<i>Xylosandrus</i> aff. <i>compactus</i>	
14	<i>Euwallacea destruens</i> *			
15	<i>Hypothenemus</i> sp.2			
16	<i>Ozopemon</i> sp.			
17	<i>Polygraphus major</i>			
18	<i>Sueus niisimai</i>			
19	<i>Xyleborus</i> sp. <i>emarginatus</i> gr.			
20	<i>Xyleborus perforans</i>			
21	<i>Xyleborus similis</i>			
22	<i>Xylosandrus discolor</i>			

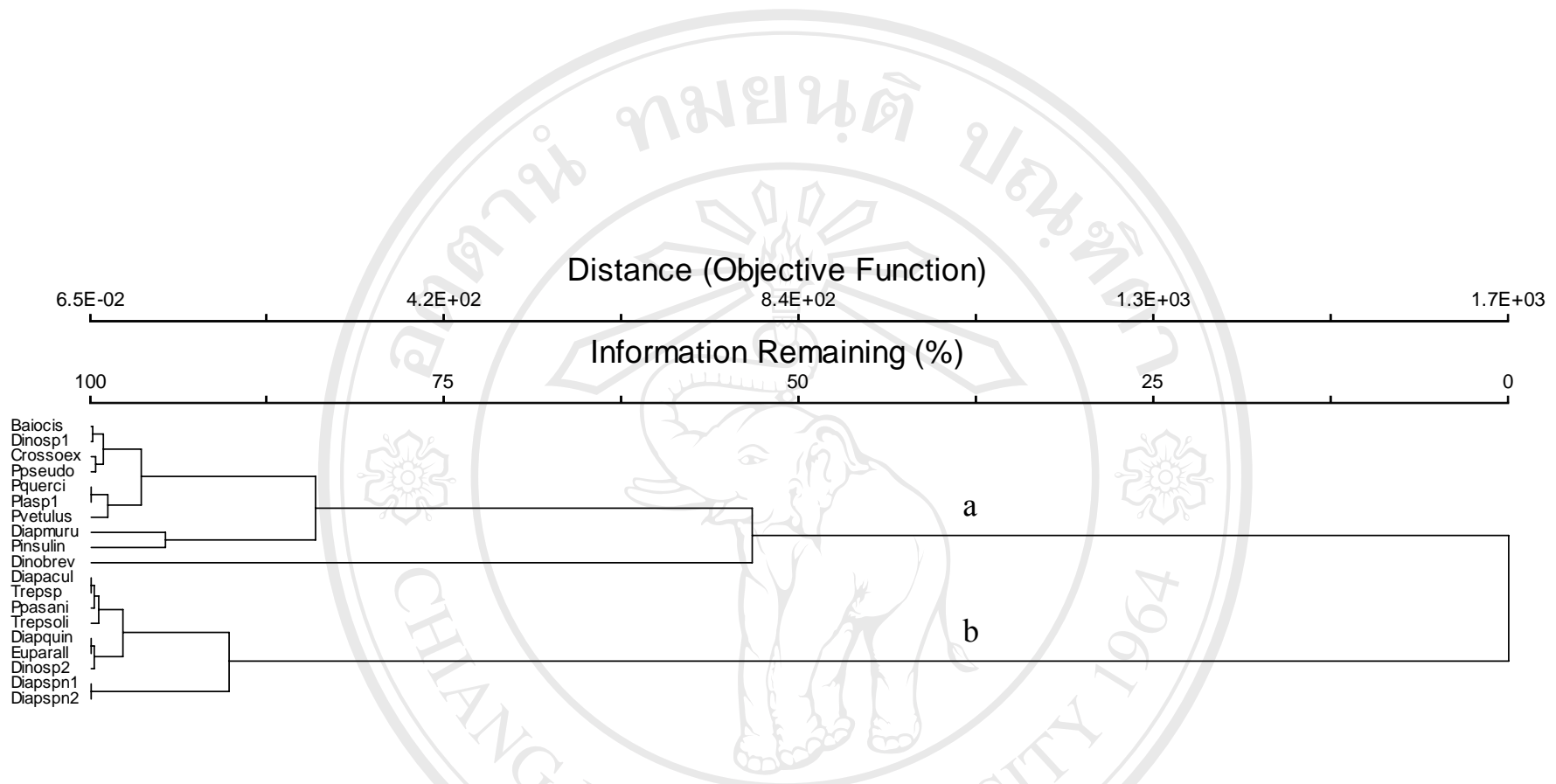


Figure 18 Cluster dendrogram of Platypodidae in mixed evergreen forest from August 2004 to September 2005 depend on low humidity (a) and high humidity (b)

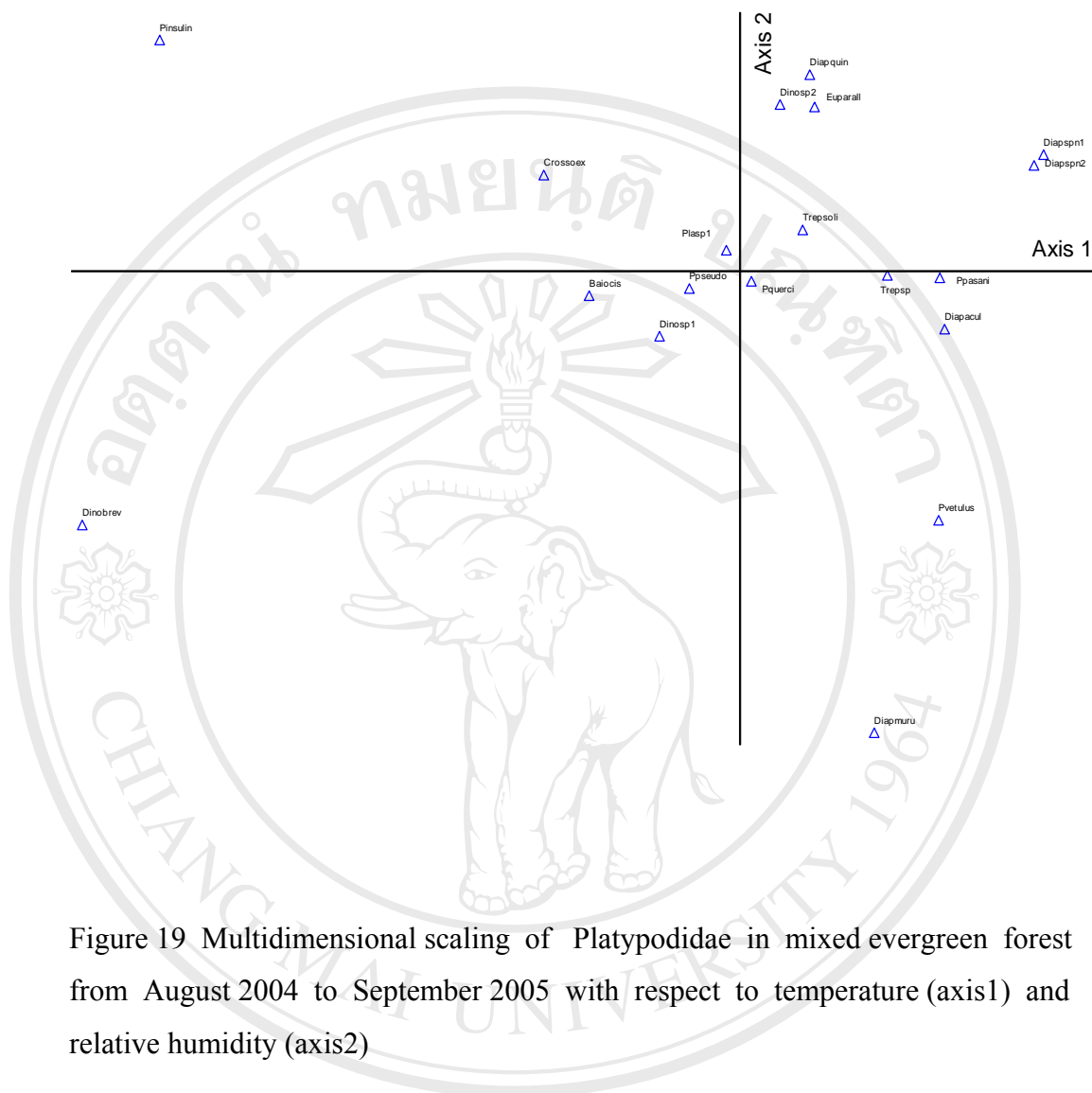


Figure 19 Multidimensional scaling of Platypodidae in mixed evergreen forest from August 2004 to September 2005 with respect to temperature (axis1) and relative humidity (axis2)

Table 3 Species of Platypodidae in mixed evergreen forest arranged by factor (s)

(\* = new record for Thailand, \*\* = new species)

No.	Both factors	Temperature	Relative humidity	None
1	<i>Diapus quinquespinatus</i>	<i>Diapus aculeatus</i> *	<i>Crossotarsus externedentatus</i>	<i>Baiocis orientalis</i>
2	<i>Diapus</i> sp.n.1 **	<i>Diapus?</i> <i>murudensus</i>	<i>Platypus insulindicus</i> *	<i>Dinoplatypus brevis</i>
3	<i>Diapus</i> sp.n.2 **	<i>Platypus</i> aff. <i>pasaniae</i>	<i>Platypus</i> sp.1	<i>Dinoplatypus</i> sp.1
4	<i>Dinoplatypus</i> sp.2	<i>Platypus quercivorus</i> *		<i>Platypus pseudospinulosi</i>
5	<i>Euplatypus parallelus</i>	<i>Platypus vetulus</i> *		
6	<i>Treptoplatypus solidus</i>	<i>Treptoplatypus</i> sp.		

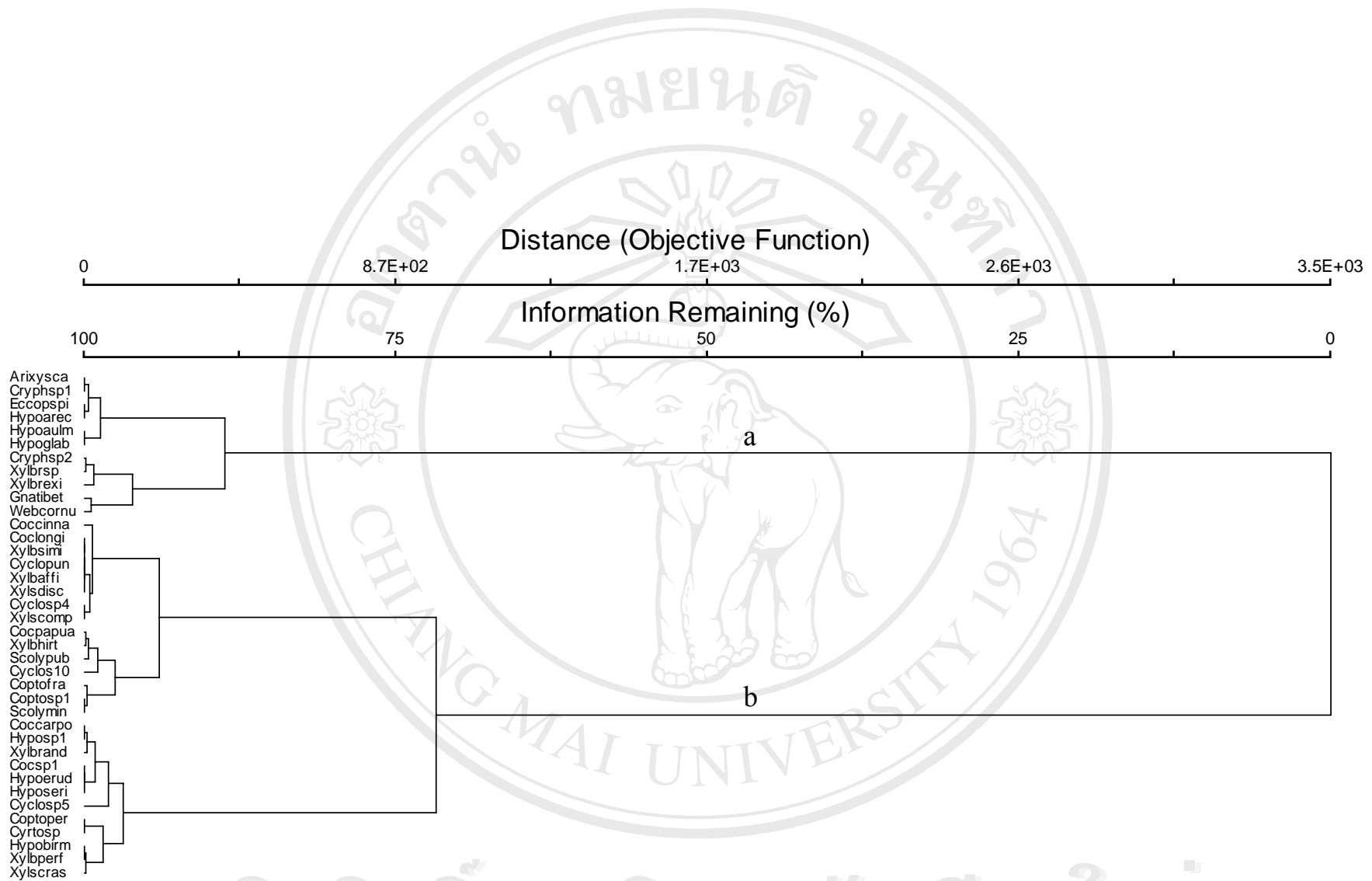


Figure 20 Cluster dendrogram of Scolytidae in deciduous dipterocarp forest from January to December 2005 depend on low humidity (a) and high temperature (b)



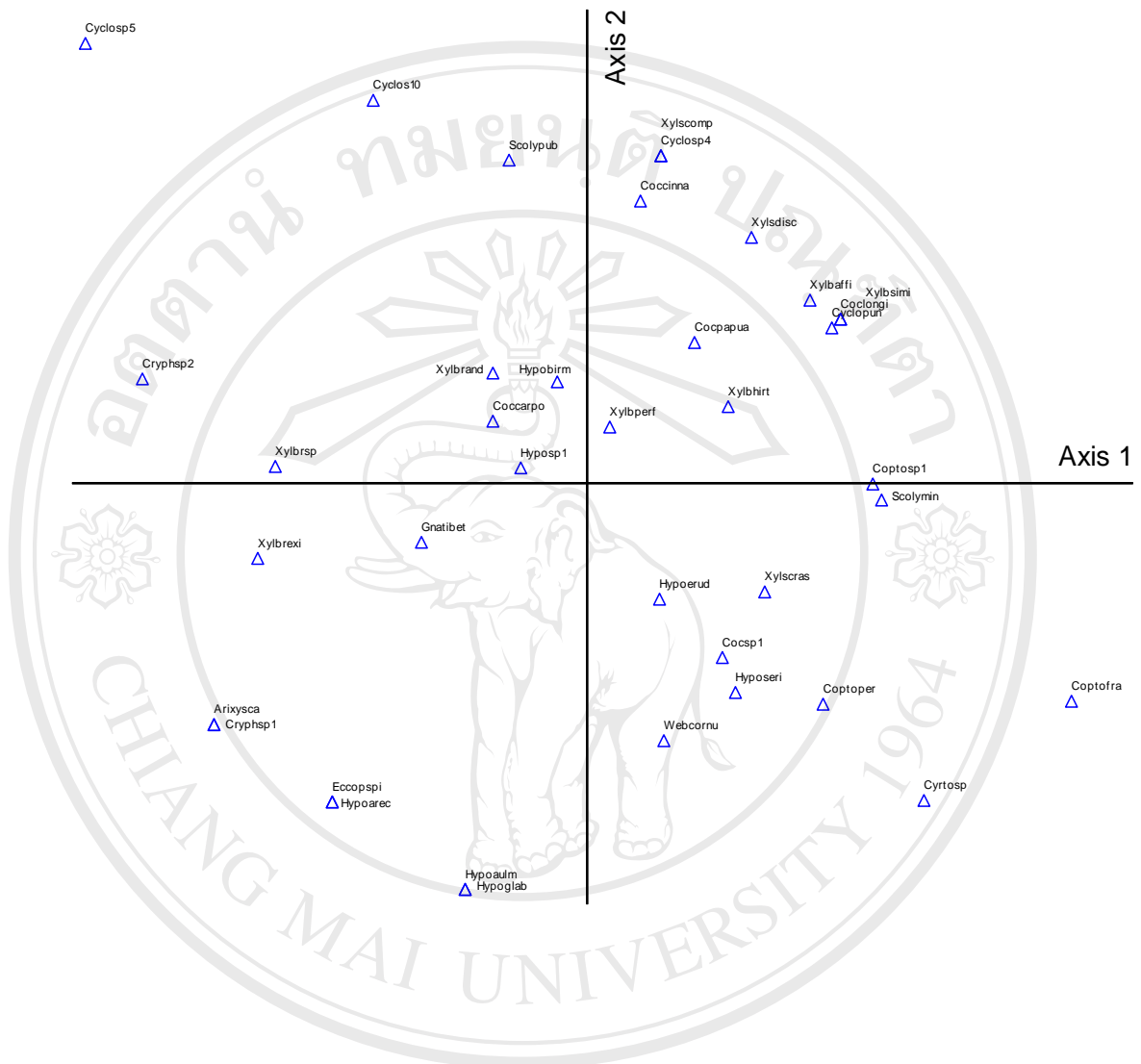


Figure 21 Multidimensional scaling of Scolytidae in deciduous dipterocarp forest from January to December 2005 with respect to temperature (axis1) and relative humidity (axis2)

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Table 4 Species of Scolytidae in deciduous dipterocarp forest arranged by factor (s) (\* = new record for Thailand)

No.	Both factors	Temperature	Relative humidity	None
1	<i>Coccotrypes papuanus</i>	<i>Coccotrypes</i> sp.1	<i>Coccotrypes carpophagus</i>	<i>Arixyleborus</i> aff. <i>scabripennis</i>
2	<i>Coccotrypes longior</i>	<i>Coptodryas</i> aff. <i>perparlus</i>	<i>Cryphalus</i> sp.	<i>Cryphalus</i> sp.1
3	<i>Coccotrypes?</i> <i>cinnamomi</i>	<i>Coptodryas fragosus</i> *	<i>Cyclorhipidion</i> sp.10	<i>Eccoopterus spinosus</i>
4	<i>Coptodryas</i> sp.1	<i>Cyrtogenius</i> sp.	<i>Cyclorhipidion</i> sp.5	<i>Gnatharus tibetensis</i> *
5	<i>Cyclorhipidion</i> aff. <i>punctatopilosus</i>	<i>Hypothenemus eruditus</i>	<i>Hypothenemus birmanus</i>	<i>Hypothenemus areccae</i>
6	<i>Cyclorhipidion</i> sp.4	<i>Hypothenemus seriatus</i>	<i>Hypothenemus</i> sp.1	<i>Hypothenemus aulmanni</i>
7	<i>Xyleborus affinis</i>	<i>Scolytoplatypus minimus</i>	<i>Scolytoplatypus pubescens</i>	<i>Hypothenemus glabripennis</i>
8	<i>Xyleborus hirtus</i>	<i>Webbia cornutus</i>	<i>Xyleborinus andrewesi</i>	<i>Xyleborinus exiguus</i>
9	<i>Xyleborus perforans</i>	<i>Xylosandrus crassiusculus</i>	<i>Xyleborinus</i> sp.	
10	<i>Xyleborus similis</i>			
11	<i>Xylosandrus</i> aff. <i>compactus</i>			
12	<i>Xylosandrus discolor</i>			

Table 5 Species of Platypodidae in deciduous dipterocarp forest arranged by factors(s) (\* = new record for Thailand, \*\* = new species)

No.	Both factors	Temperature	Relative humidity	None
1	<i>Diapus aculeatus</i> *	<i>Euplatypus parallelus</i>	<i>Crossotarsus externedentatus</i>	<i>Genyocerus diaphanus</i>
2	<i>Diapus quinquespinatus</i>	<i>Platypus vetulus</i> *	<i>Diapus</i> sp.n.1 **	<i>Platypus quercivorus</i> *
3		<i>Treptoplatypus solidus</i>	<i>Platypus insulindicus</i> *	<i>Platypus</i> sp.1
4		<i>Treptoplatypus</i> sp.		

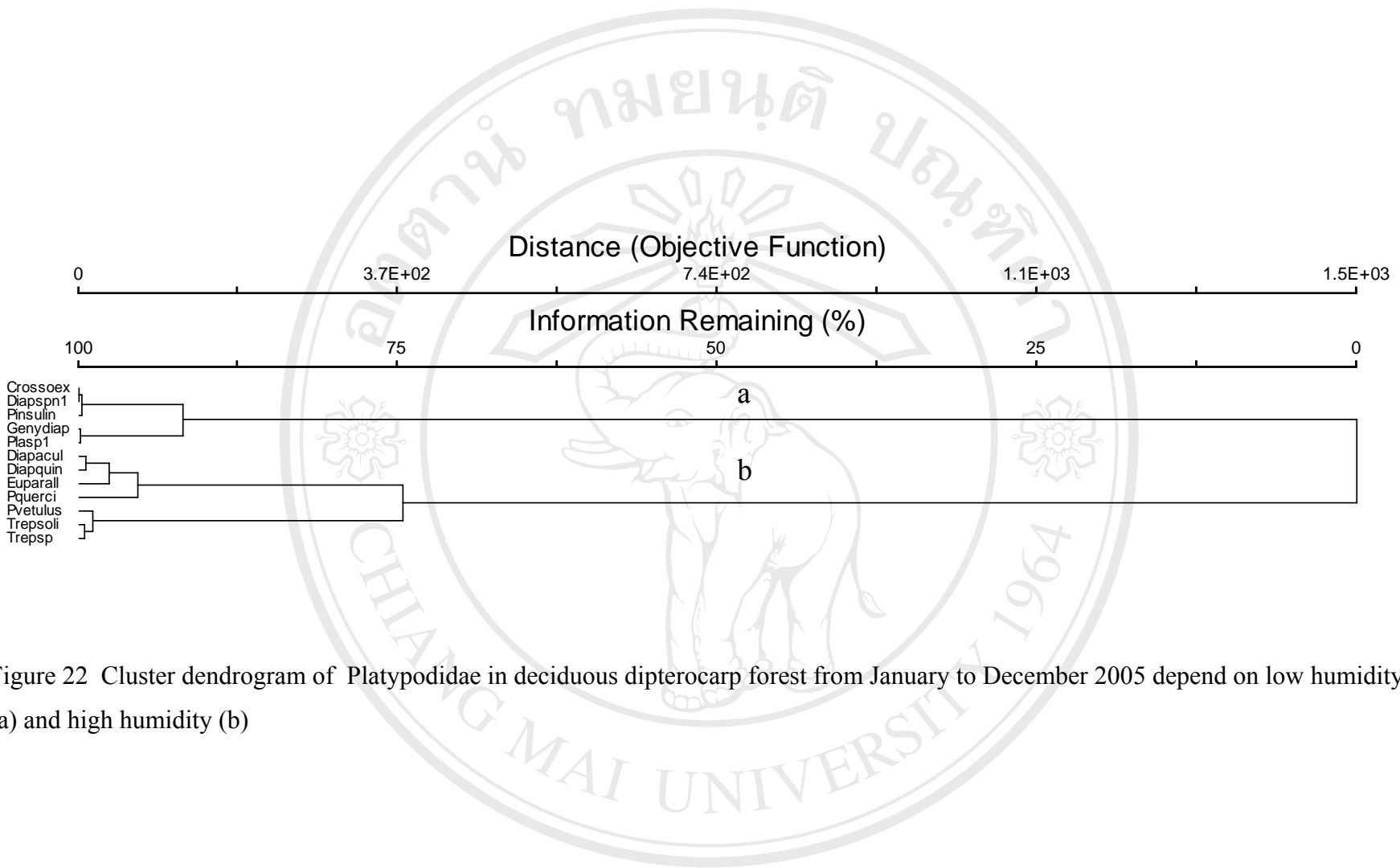
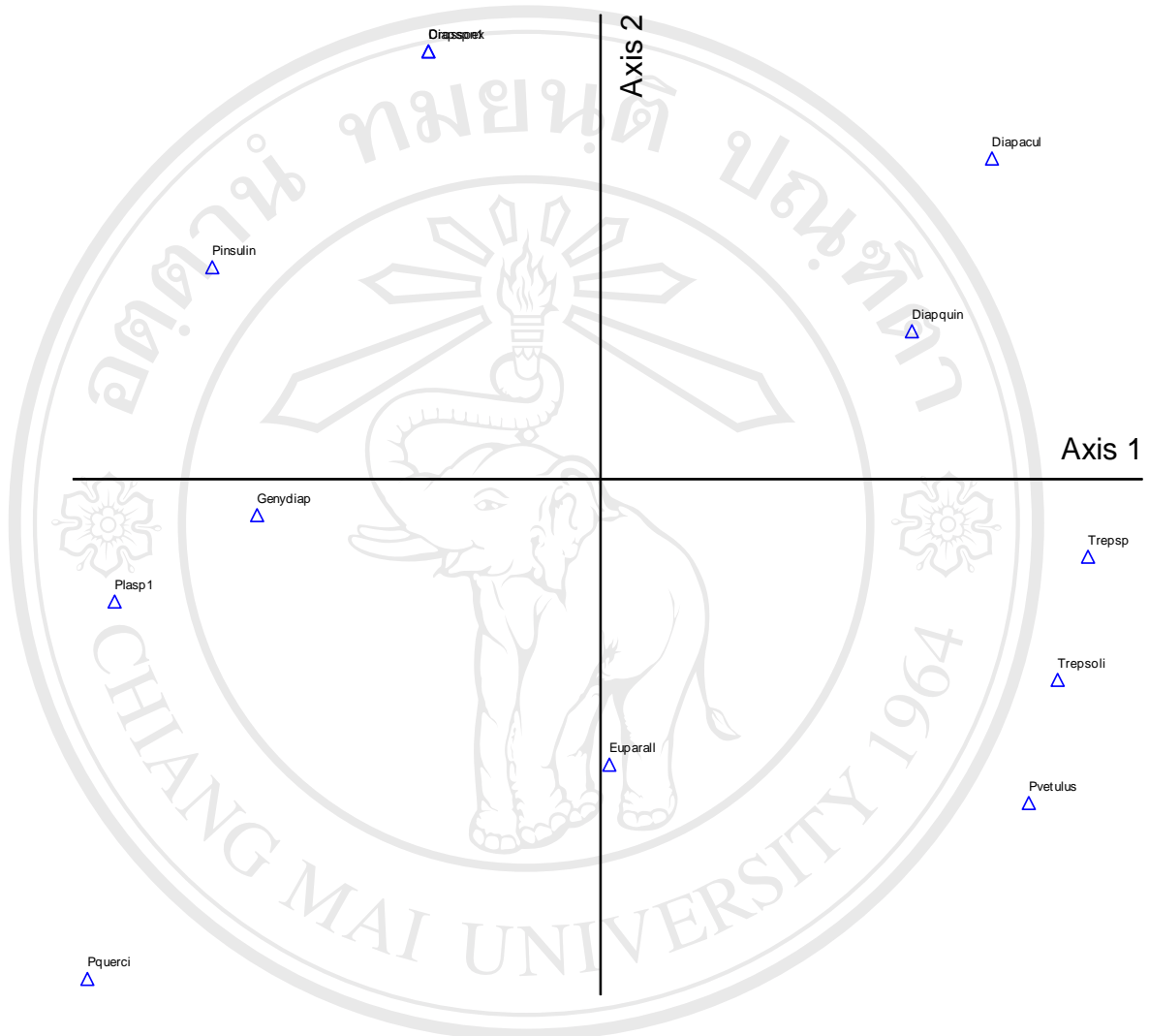


Figure 22 Cluster dendrogram of Platypodidae in deciduous dipterocarp forest from January to December 2005 depend on low humidity (a) and high humidity (b)



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Figure 23 Multidimensional scaling of Platypodidae in deciduous dipterocarp forest from January to December 2005 with respect to temperature (axis1) and relative humidity (axis2)

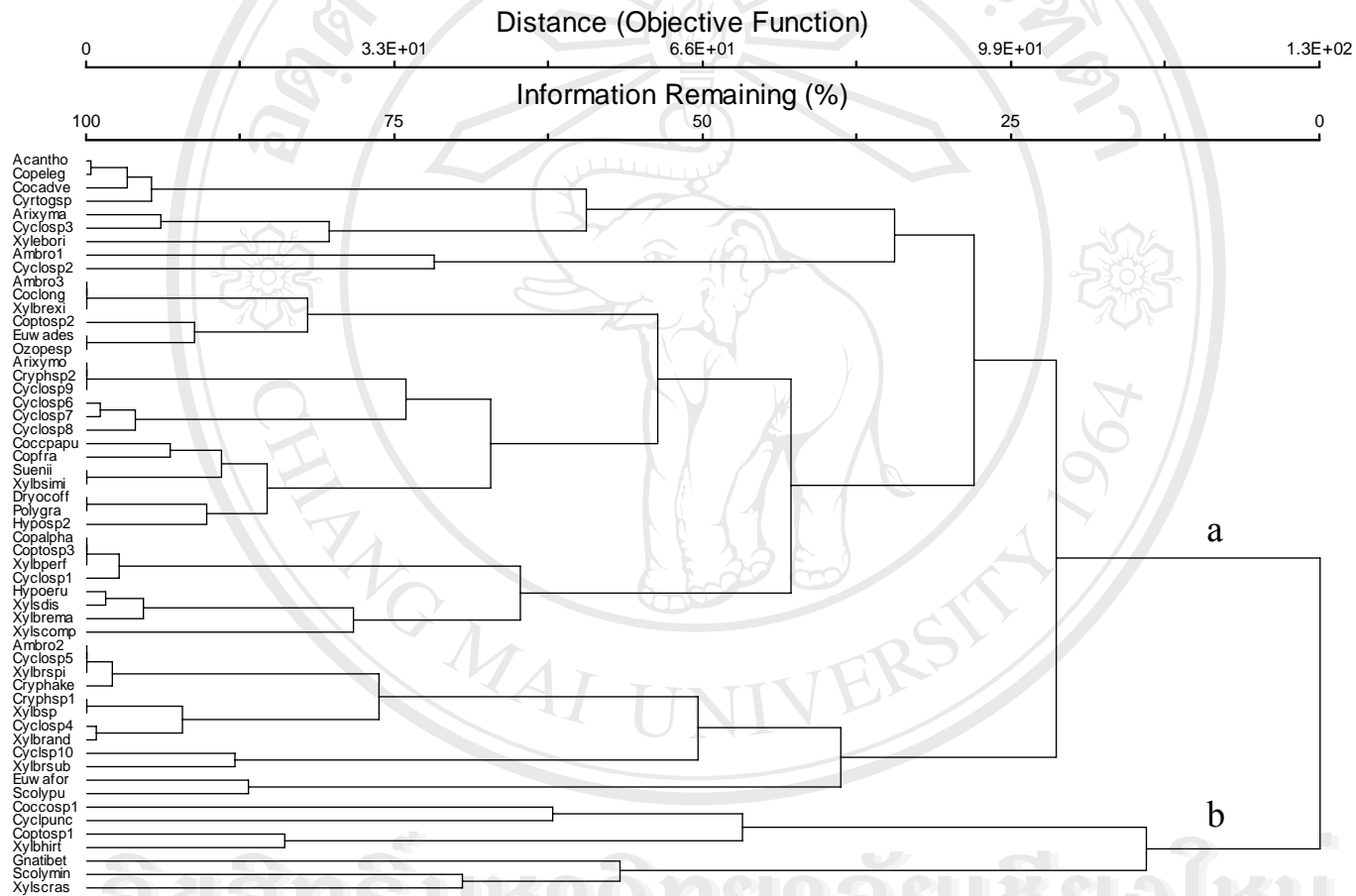


Figure 24 Cluster dendrogram of Scolytidae in mixed evergreen forest when using time as factor  
 ( a = infrequent, b = frequent)

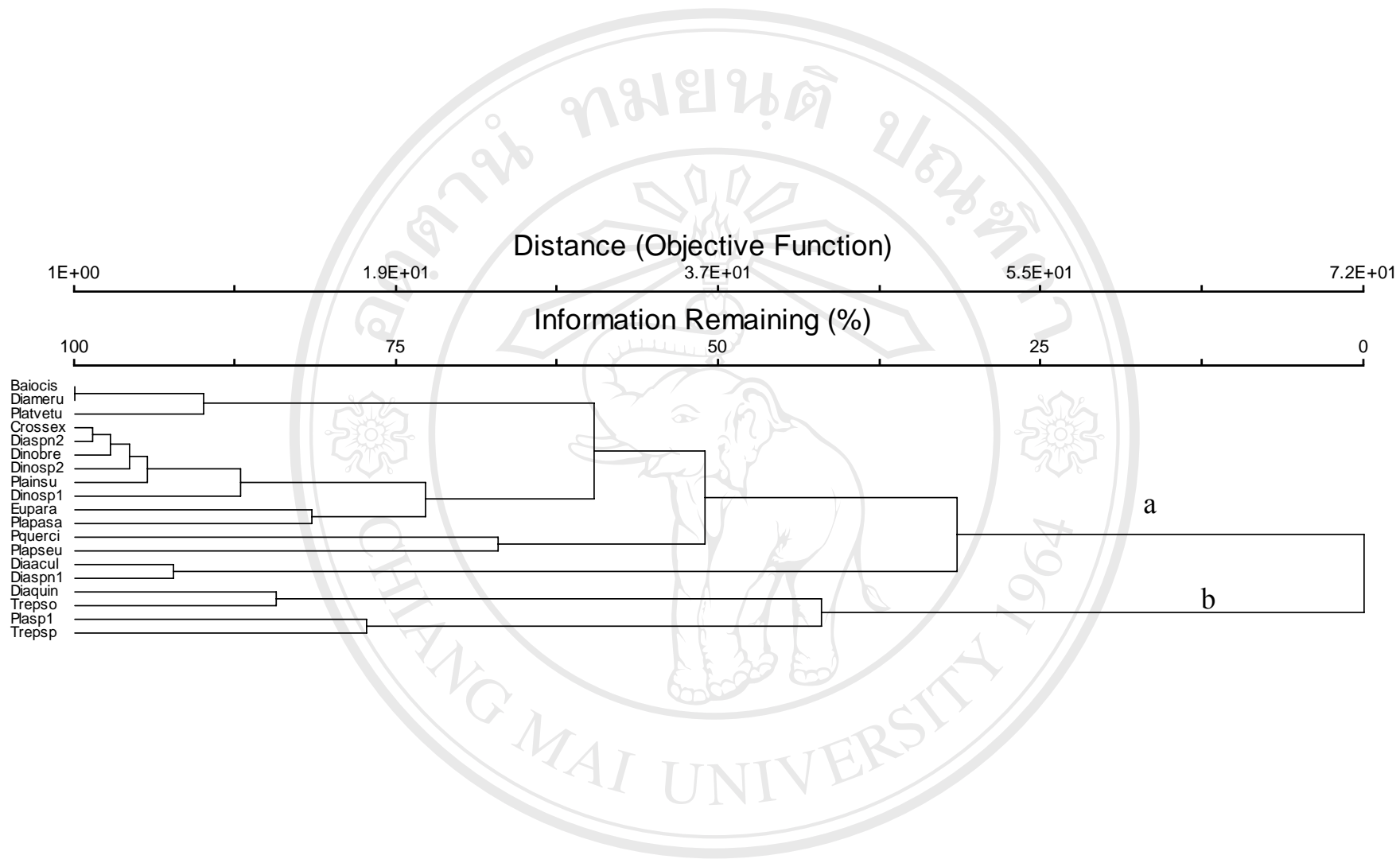


Figure 25 Cluster dendrogram of Platypodidae in mixed evergreen forest when using time as factor ( a = infrequent, b = frequent)

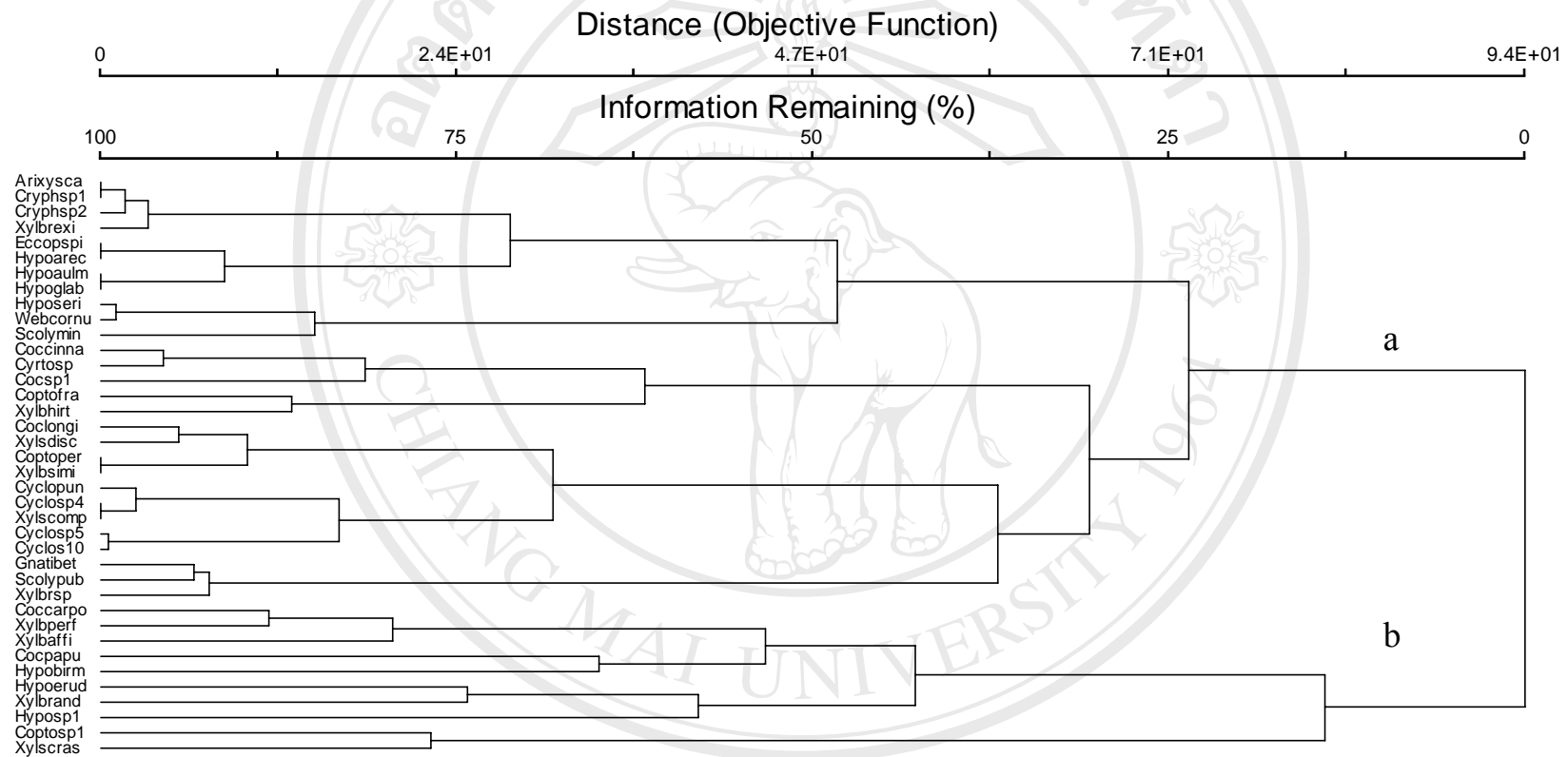


Figure 26 Cluster dendrogram of Scolytidae in deciduous dipterocarp forest when using time as factor ( a = infrequent, b = frequent)

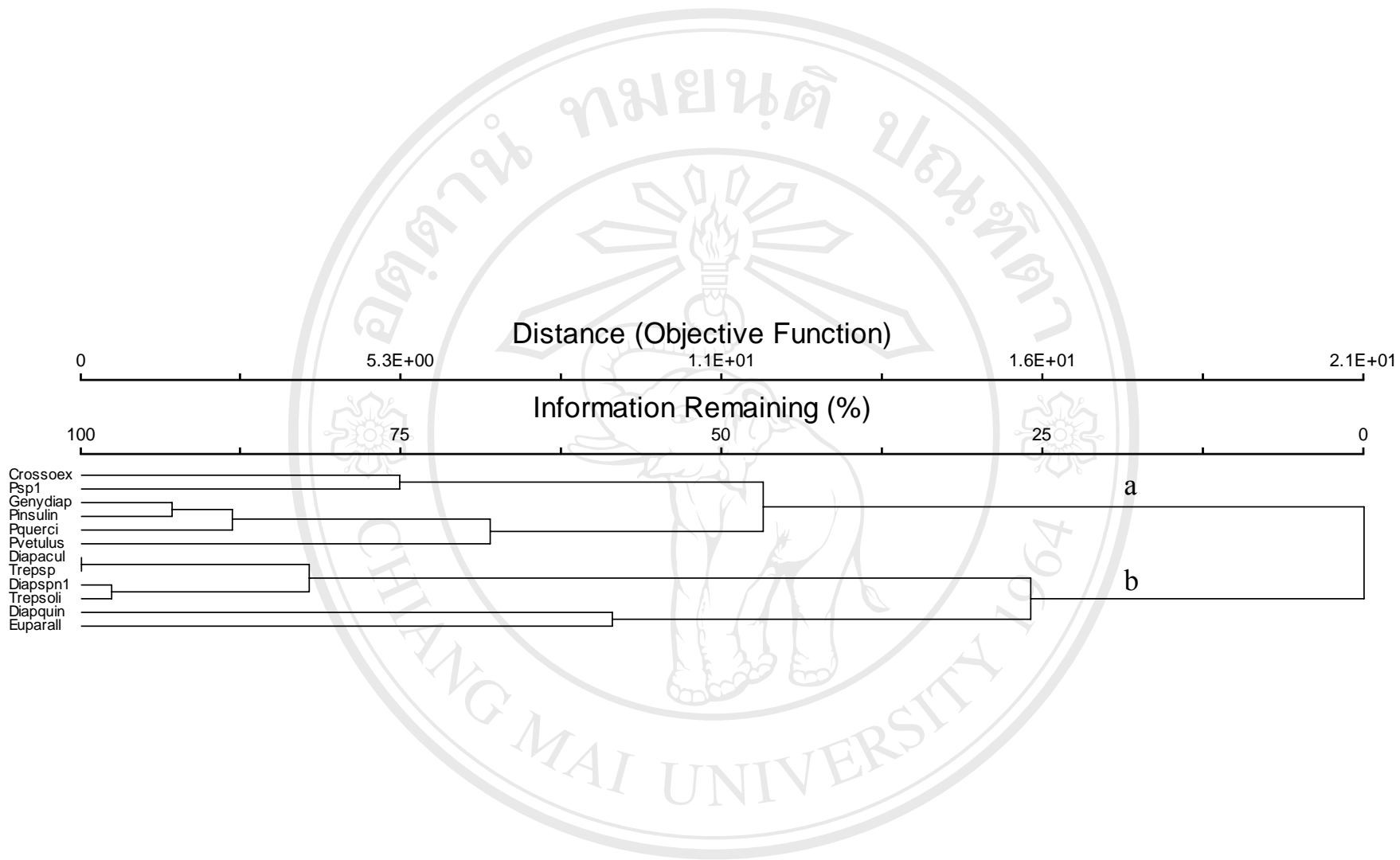


Figure 27 Cluster dendrogram of Platypodidae in deciduous dipterocarp forest when using time as factor

( a = aggregate occurrence, b = scattered occurrence )





#### 4) Different species

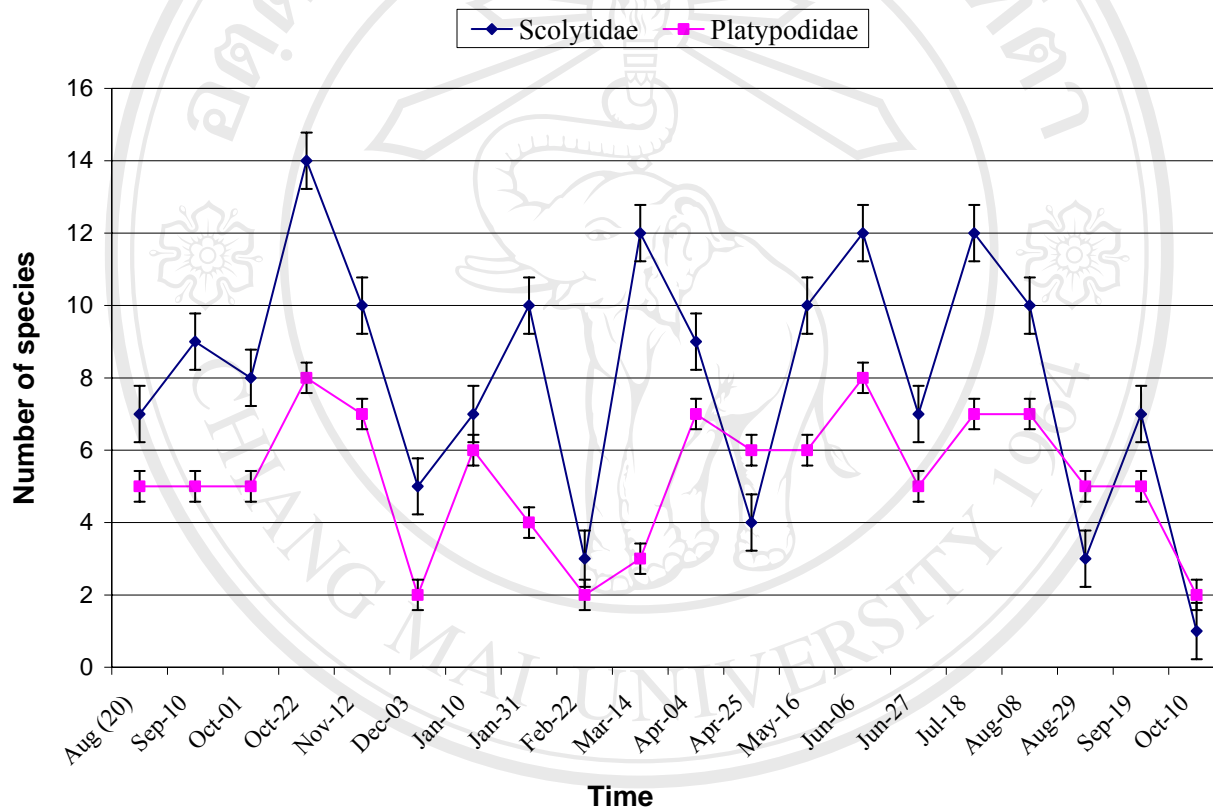
##### 4.1) Quantities

The highest number of species of Scolytidae in the MEF was in 4<sup>th</sup> collection (14 species) and the lowest number was in 20<sup>th</sup> collection (1 species) whereas Platypodidae had the highest number of species in 4<sup>th</sup> and 14<sup>th</sup> collection (8 species); the lowest number was in 6<sup>th</sup>, 9<sup>th</sup> and 20<sup>th</sup> collection (2 species) (Fig. 28). The highest number of individuals of Scolytidae was in 14<sup>th</sup> collection (75 individuals); the lowest number was in 20<sup>th</sup> collection (1 individual). The highest number of individuals of Platypodidae was in 4<sup>th</sup> collection (101 individuals); the lowest number was in 6<sup>th</sup> collection and 20<sup>th</sup> collection (3 individuals) (Fig. 29)

For DDF, the highest number of species of Scolytidae was in 3<sup>rd</sup> collection (15 species) and the lowest number was in 12<sup>th</sup> collection (1 species) whereas, the highest number of platypodid species were collected in 1<sup>st</sup>, 2<sup>nd</sup>, 6<sup>th</sup> and 10<sup>th</sup> collection (4 species) (Fig. 30). However, no species of Platypodidae were found in 7<sup>th</sup>, 13<sup>th</sup>, 14<sup>th</sup> and 16<sup>th</sup> collection. Most individuals of Scolytidae were found in 16<sup>th</sup> collection (51 individuals) and fewest individuals were found in 12<sup>th</sup> collection (5 individuals). Most individuals of Platypodidae were collected in 10<sup>th</sup> collection (12 individuals) and no individuals of Platypodidae were found in 7<sup>th</sup>, 13<sup>th</sup>, 14<sup>th</sup> and 16<sup>th</sup> collection (Fig. 31).

##### 4.2) Species accumulation curves

The calculated species accumulation curves of the DDF & MEF was shown in Fig. 32. The MEF accumulation curve shows the steeper increase in species at the beginning of the curve. The seventeenth collection in MEF was 74 species and the 16<sup>th</sup> collection in DDF was 50 species. The curves lead to a similar slope at the end of collection and reach to plateau by the 17<sup>th</sup> collection.



← 2004 → ← 2005 →

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Figure 28 Number of species of Scolytidae and Platypodidae collected in mixed evergreen forest from August 2004 to September 2005

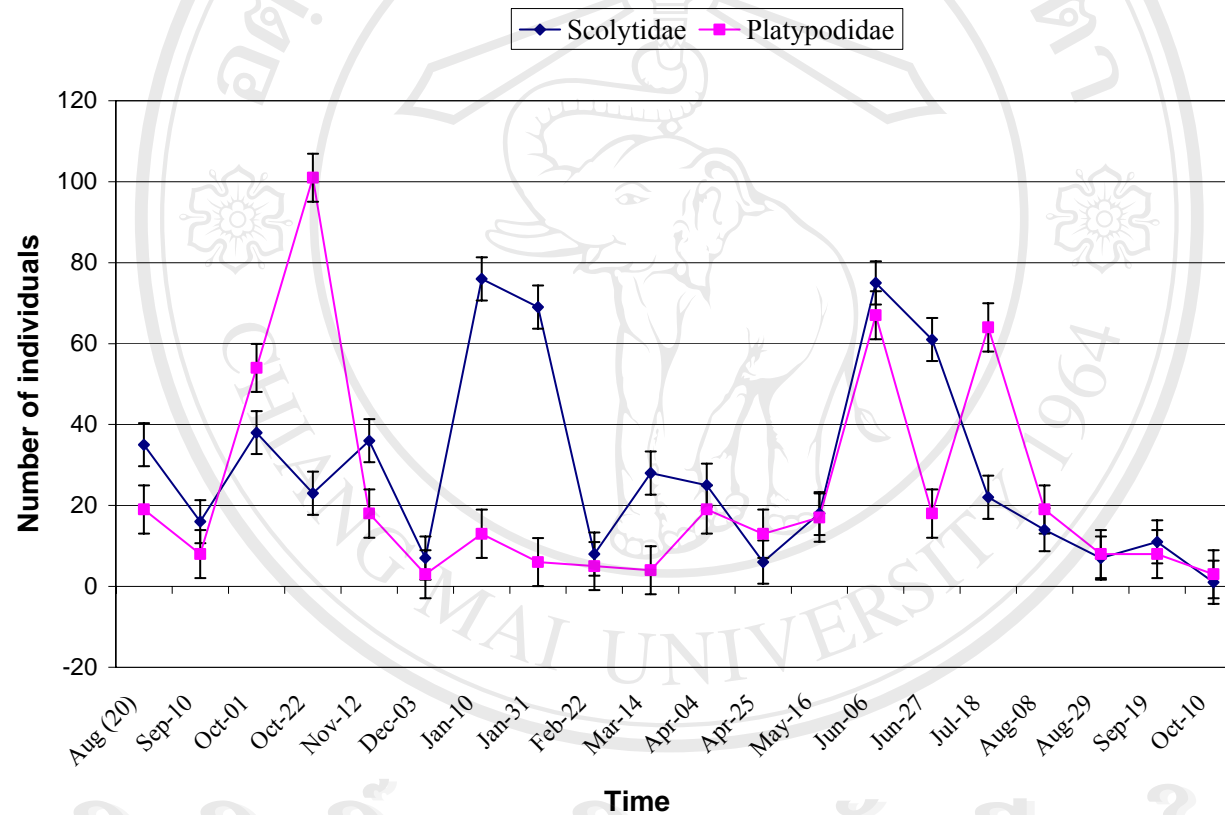


Figure 29 Number of individuals of Scolytidae and Platypodidae collected in mixed evergreen forest from August 2004 to September 2005

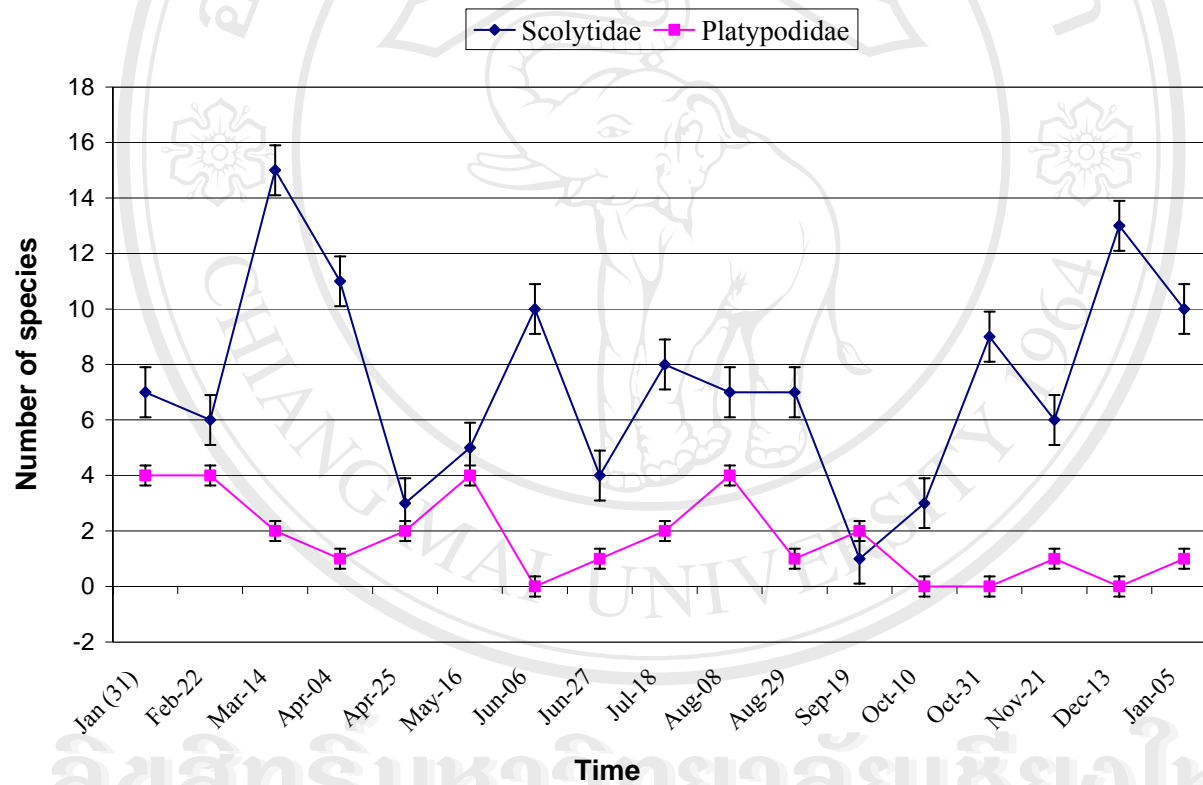


Figure 30 Number of species of Scolytidae and Platypodidae collected in deciduous dipterocarp forest from January to December 2005

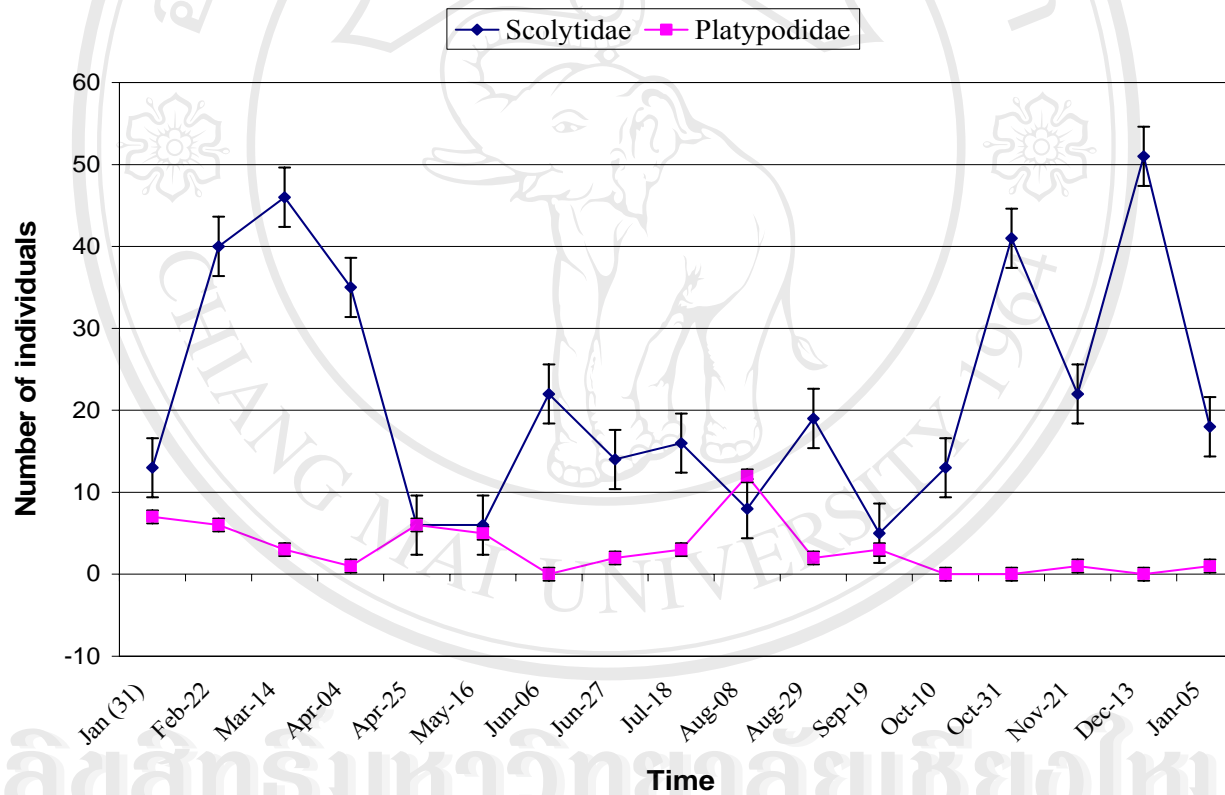


Figure 31 Number of individuals of Scolytidae and Platypodidae collected in deciduous dipterocarp forest from January to December 2005

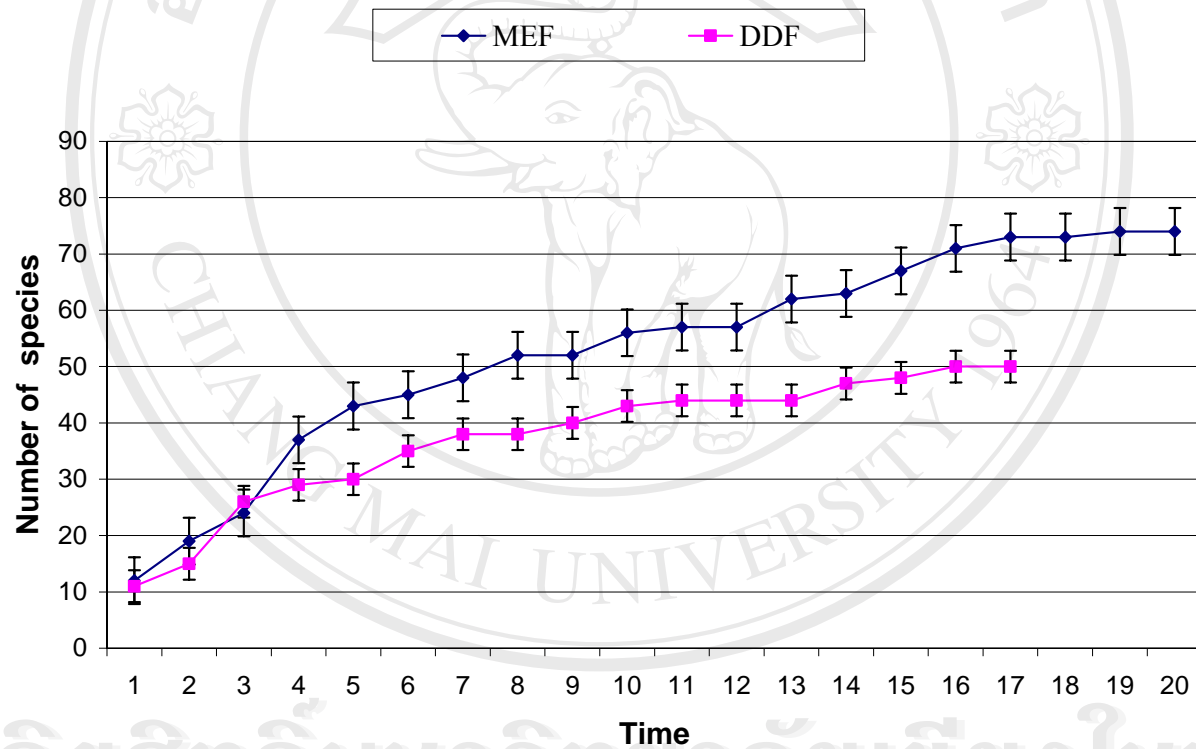


Figure 32 Species accumulation curves of the different forests, deciduous dipterocarp forest and mixed evergreen forest

#### 4.2) Trapping methods

Different trapping methods yielded significantly different ( $P < 0.05$ ) number of species (Table 7). For MEF, Scolytidae were arranged into three groups, the highest mean was from ethanol trap with mixed solution; the lowest mean was from FIT with mixed solution while Platypodidae were arranged into three groups with the highest mean from ethanol trap and lowest mean from FIT with mixed solution. In DDF, Scolytidae were arranged into three groups, the highest mean was from ethanol trap with mixed solution and FIT for the lowest mean whereas Platypodidae were arranged into two groups with the highest mean from ethanol trap and lowest mean from FIT with mixed solution. In general, most species of Scolytidae (41 species in MEF and 24 species in DDF) and Platypodidae (18 species in MEF and 11 species in DDF) were collected from Ethanol trap. However, the ethanol trap with ethylene glycol collected similar amount of scolytid species in DDF. The fewest species in MEF and DDF were collected from FIT with Ethylene glycol (Fig. 33).

Table 7 Mean number of species collected in mixed evergreen and deciduous dipterocarp forest using four trapping types (Remark: EG = Ethylene glycol)

	MEF		DDF	
	Scolytidae	Platypodidae	Scolytidae	Platypodidae
ETOH	3.700 <sup>b</sup>	4.150 <sup>c</sup>	2.117 <sup>ab</sup>	1.058 <sup>b</sup>
ETOH+EG	3.714 <sup>b</sup>	2.000 <sup>b</sup>	3.353 <sup>b</sup>	1.000 <sup>b</sup>
FIT	2.650 <sup>ab</sup>	0.750 <sup>a</sup>	1.529 <sup>a</sup>	0.176 <sup>a</sup>
FIT+EG	1.285 <sup>a</sup>	0.285 <sup>a</sup>	2.176 <sup>ab</sup>	0.058 <sup>a</sup>



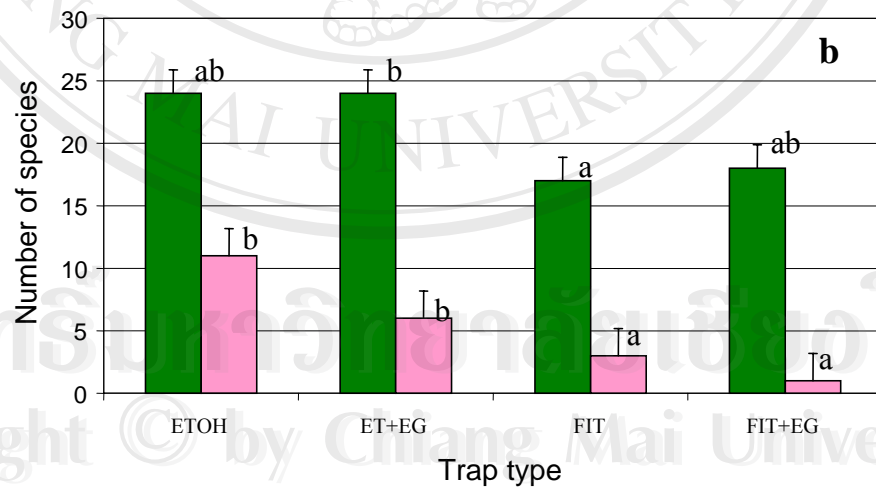
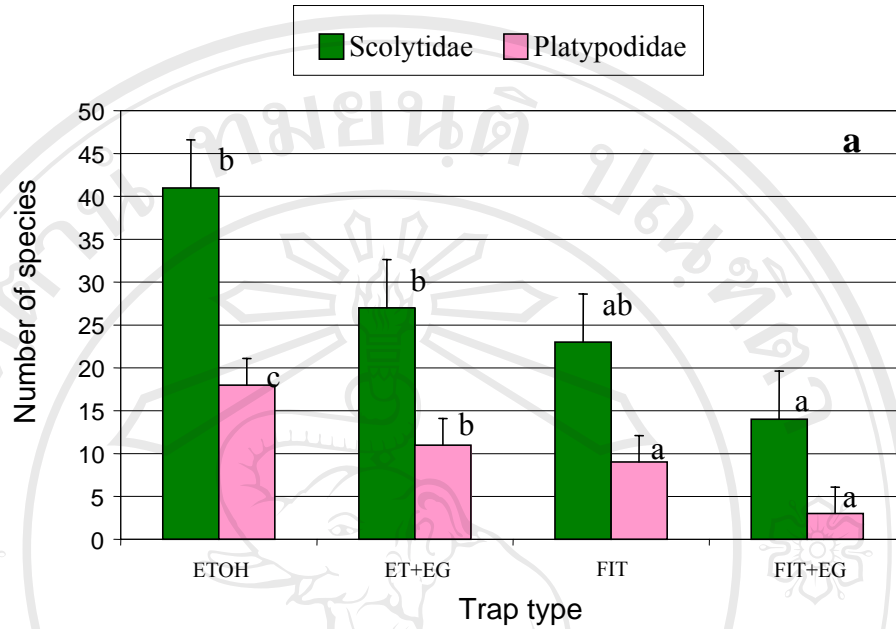


Figure 33 Number of species of Scolytidae and Platypodidae collected from four trapping types in mixed evergreen (a) and deciduous dipterocarp forests (b)