CHAPTER IV

RESULTS AND DISCUSSION

1. Environmental factors

1.1 Temperature of Bangkok

Temperature of Bangkok from three air monitoring stations during March 2003 to February 2004 ranged from 26.1 °C to 32.4 °C. In all stations, the means of highest and lowest temperature presented in April 2003 and December 2003, respectively (Figure 4-1 - Figure 4-3).

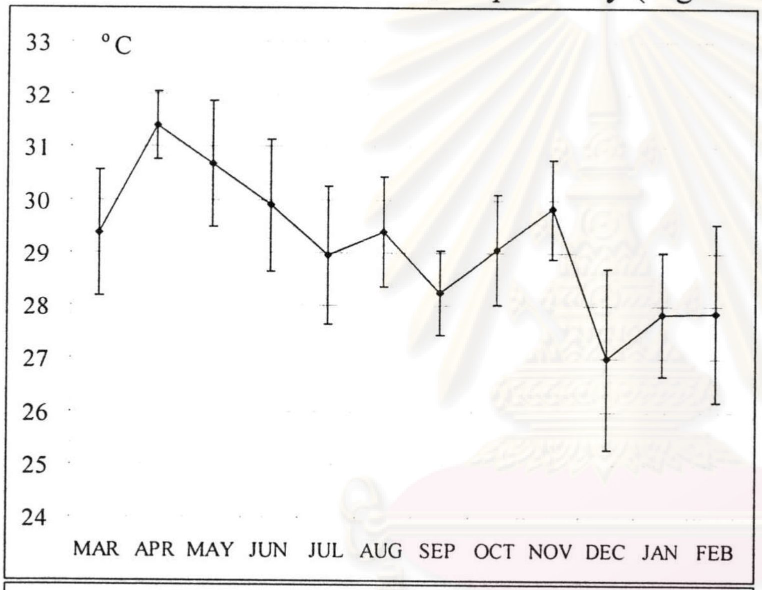


Figure 4-1: The mean ± SD of air temperature from Bangkok Metropolis air monitoring station during March 2003 to February 2004

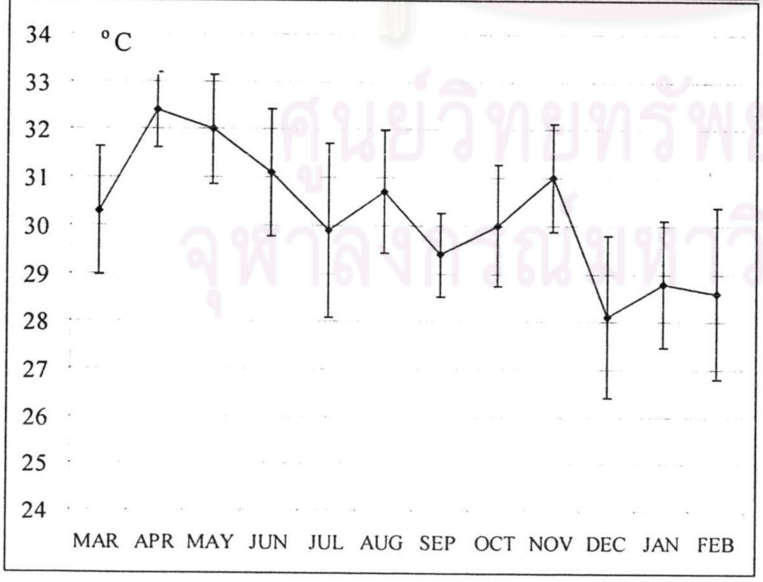


Figure 4-2: The mean ± SD of air temperature from Bangkok Port air monitoring station during March 2003 to February 2004

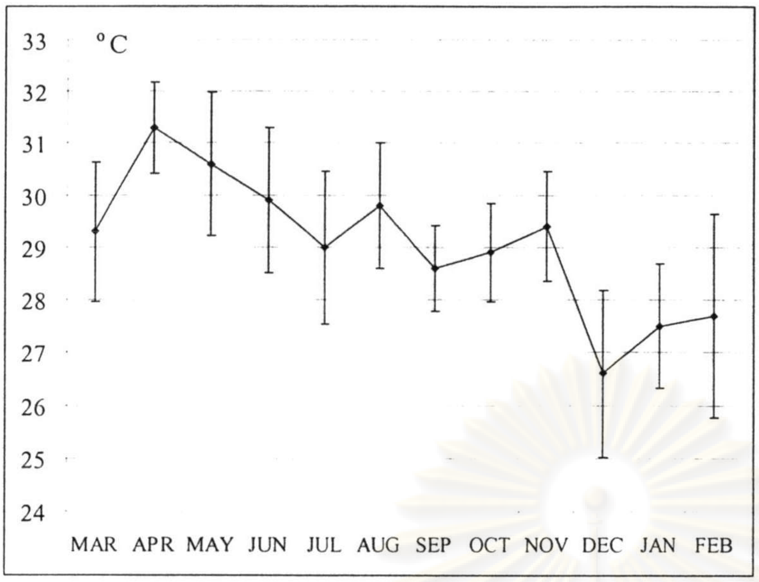


Figure 4-3: The mean ± SD of air temperature from Don Muang Airport air monitoring station during March 2003 to February 2004

1.2 Relative Humidity of Bangkok

The means of relative humidity of Bangkok during March 2003 to February ranged from 58 % to 85 %. The means of highest and lowest relative humidity, from Bangkok Metropolis station and Bangkok Port station, presented in September 2003 and December 2003, respectively (Figure 4-4 - Figure 4-5). Moreover, from Don Muang Airport station, the means of highest and lowest relative humidity presented in July 2003 and December 2003, respectively (Figure 4-6).

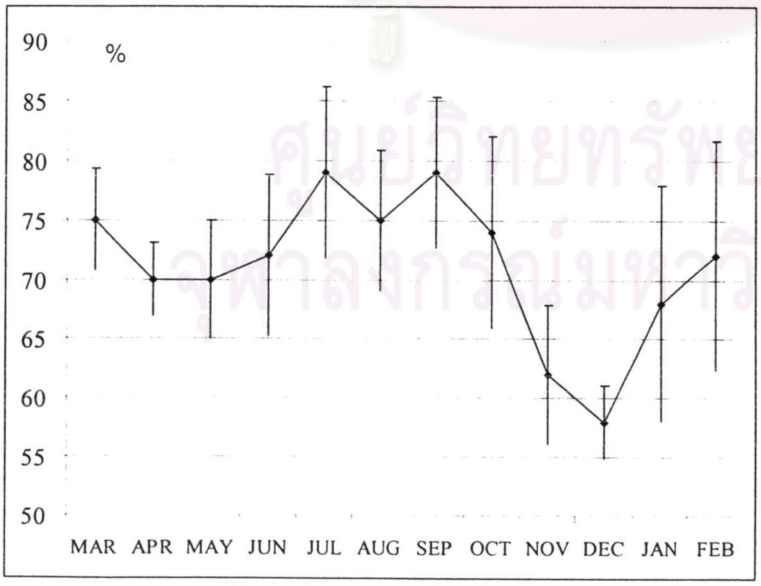


Figure 4-4: The mean ± SD of relative humidity from Bangkok Metropolis air monitoring station during March 2003 to February 2004

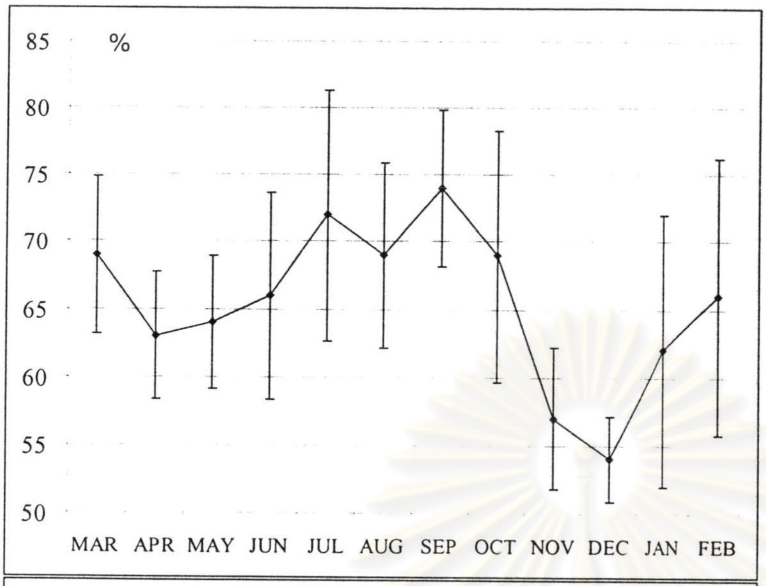


Figure 4-5: The mean ± SD of relative humidity from Bangkok Port air monitoring station during March 2003 to February 2004

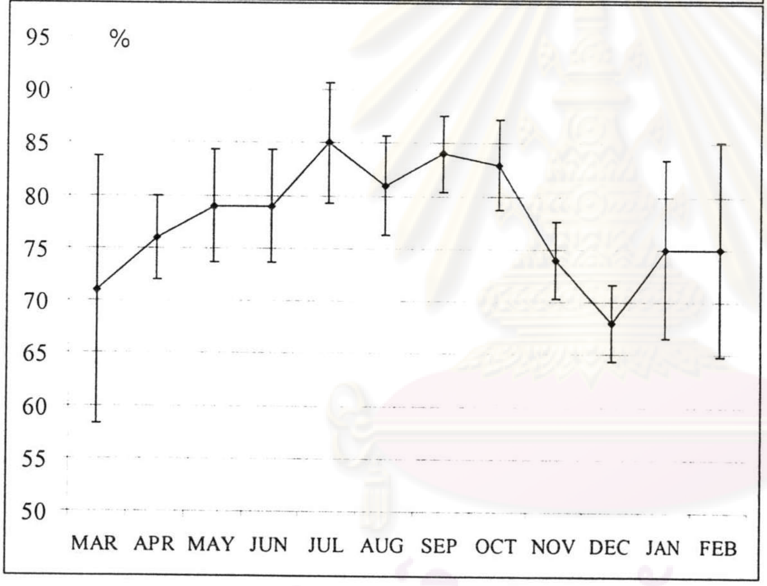


Figure 4-6: The mean ± SD of relative humidity from Don Muang Airport air monitoring station during March 2003 to February 2004

1.3 Rainfall of Bangkok

The rainfall of Bangkok during March 2003 to February 2004 was highest in August 2003 and the lowest was in November and December 2003 in the data from Bangkok Metropolis and Bangkok Port stations (Figure 4-7 - Figure 4-8). From Don Muang Airport station, the rainfall was highest in July 2003 and the lowest was in November and December 2003 (Figure 4.9). From this data, the ant data collections were divided into 2 seasons; wet season (during May to October 2003) and dry season (during March to April 2003 and during November 2003 to February 2004).

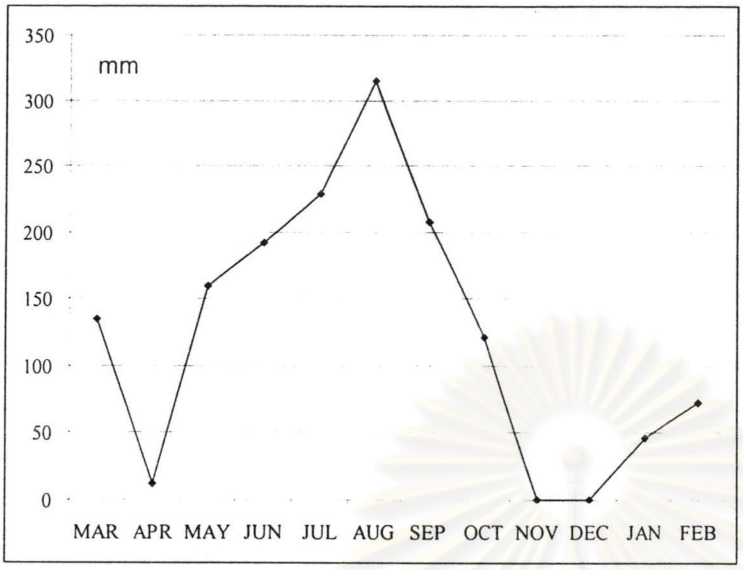


Figure 4-7: The rainfall from Bangkok Metropolis air monitoring station during March 2003 to February 2004

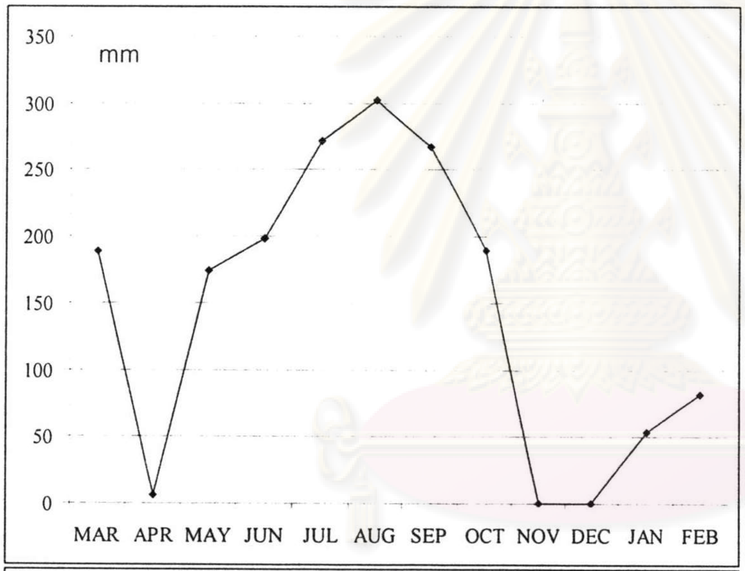


Figure 4-8: The rainfall from Bangkok Port air monitoring station during March 2003 to February 2004

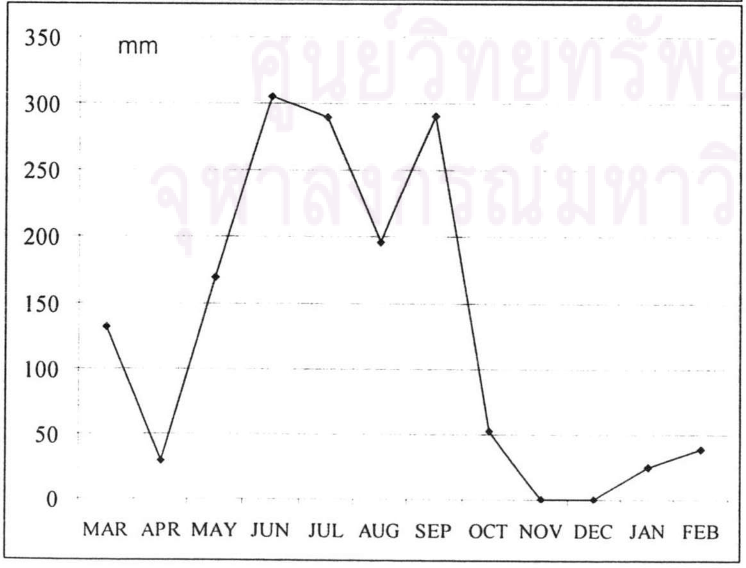


Figure 4-9: The rainfall from Don Muang Airport air monitoring station during March 2003 to February 2004

2. Ecological Values of ants in public parks of Bangkok

2.1 Species richness

The species richness of ants in public parks of Bangkok was divided into 6 subfamilies, 23 genera and 43 species (Table 4-1).

Table 4-1: Species number in each genus and subfamily of ants in public parks of Bangkok during March 2003 to February 2004

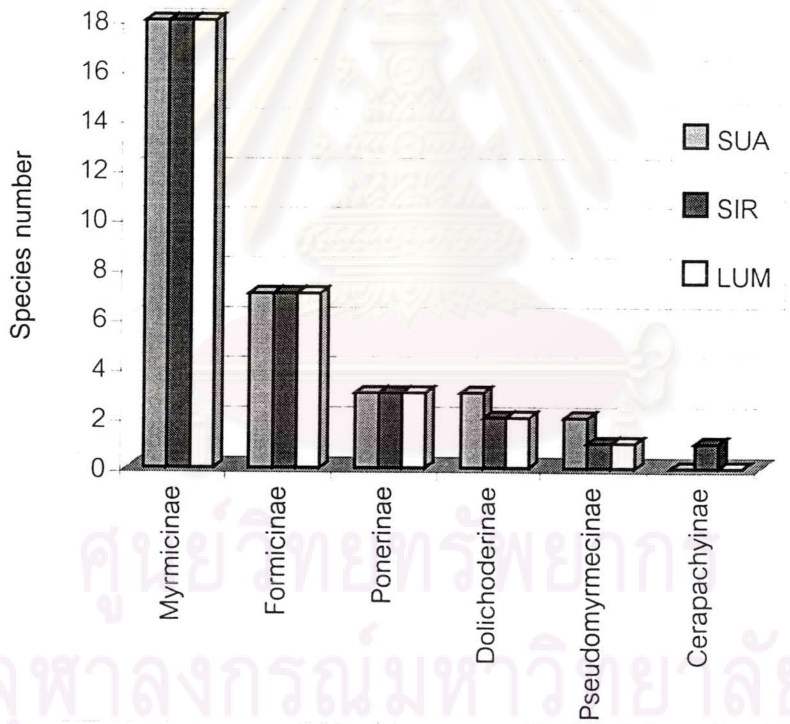
Subfamily / Genus		Species number	Subfamily / Genus		Species number
Subfamily	**Myrmicinae**	**24**	Subfamily	**Formicinae**	**9**
Genus	*Cardiocondyla*	2	Genus	*Anoplolepis*	1
	Catulacus	1		*Camponotus*	1
	Crematogaster	4		*Oecophylla*	1
	Meranoplus	1		*Paratrechina*	4
	Monomorium	6		*Polyrhachis*	2
	Pheidole	1			
	Pheidologeton	1	Subfamily	**Dolichoderinae**	**3**
	Smithistruma	1	Genus	*Iridomyrmex*	1
	Solenopsis	1		*Tapinoma*	2
	Strumigenys	1			
	Tetramorium	5	Subfamily	**Pseudomyrmecinae**	**2**
			Genus	*Tetraponera*	2
Subfamily	**Ponerinae**	**4**			
Genus	*Anochetus*	1	Subfamily	**Cerapachyinae**	**1**
	Diacamma	2	Genus	*Cerapachys*	1
	Odontomachus	1			

The greatest subfamily was Myrmicinae that contained 11 genera, 24 species, compared with Formicinae (5 genera, 9 species), Ponerinae (3 genera, 4 species), Dolichoderinae (2 genera, 3 species), Pseudomyrmecinae (1 genus, 2 species), and Cerapachyinae (1 genus, 1 species), respectively.

2.2 Species richness of ants in Suan Luang Rama IX, Queen Sirikit Park, and Lumpini Park

Suan Luang Rama IX showed the highest species richness of 33 species. Queen Sirikit Park and Lumpini Park showed the same species richness of 31 species. In all parks, the greatest to lowest subfamily was Myrmicinae, Formicinae, Ponerinae, Dolichoderinae, and Pseudomyrmecinae, respectively. Subfamily Cerapachyinae was found only in Queen Sirikit Park (Figure 4-10).

Figure 4-10: Species number of ants in each subfamily in Suan Luang Rama IX, Queen Sirikit Park, and Lumpini Park during March 2003 to February 2004



Note: SUA = Suan Luang Rama IX, SIR = Queen Sirikit Park, LUM = Lumpini Park

Discussion

From the results, the proportion of subfamily and species of ants was similar to the study of Ogata et al. (1998) which found that the ant diversity at two parks of Fukuoka City, Japan, had a total of 4 subfamilies 21 genera and 31 species. The largest proportion in genus and species was Myrmicinae, followed by Formicinae, Ponerinae, and Dolichderinae respectively. As same as the study of Wiwatwitaya and Rojanawongse (2001), Prasityousil (2001), Phoonjumpa (2002), Noon-anant (2003), and Senthong (2003), Myrmicinae and Pseudomyrmecinae were the largest and the least proportion in genus and species, respectively.

The ants in subfamily Myrmicinae is the most common, based on both genus number and species number (Hölldobler and Wilson, 1990; Bolton, 1994). This subfamily has the largest number of genera (156 genera in 1998), and is most diverse in morphology and biology in the Formicidae. That is the reason why the greatest subfamily of ants found in this study was Myrmicinae. On the other hand, the ants in subfamily Cerapachyinae was found less than in other subfamilies in this study, it may be due to the ants in this group are small size and hunting singly.

Table 4-2: Species number of ants in each sampling method in the public parks of Bangkok during March 2003 to February 2004

Study sites / Sampling methods	**Species number**			
	Pitfall Trapping (Grass field)	**Honey Baiting (Building)**	**Time Unit Method (Standing-tree area)**	**Total**
Suan Luang Rama IX	9	19	28	33
Queen Sirikit Park	22	16	21	31
Lumpini Park	15	18	26	31
Total species number	**29**	**25**	**40**	**43**

Table 4-2 showed the difference in species richness of ants among the public parks. By pitfall trapping, Queen Sirikit Park showed the greatest in species richness member of 22 species. Suan Luang Rama IX showed the lowest in species richness member of 9 species. By honey baiting, Suan Luang Rama IX showed the greatest in species richness and Queen Sirikit Park showed the lowest in species richness. Moreover, by Time Unit Method, the greatest species richness was Suan Luang Rama IX and the lowest species richness was Queen Sirikit Park.

Discussion

The difference in species richness among the sampling methods showed that the ants collected by Time Unit Method in standing-tree sites were the highest in species richness, combining of 40 species from total 43 species. It may assume that most of ants in the public parks have habitats or food sites in standing-tree area. In addition, for the highest of species richness, Time Unit method is suitable to use for collecting ants in public parks because the method is simple, low cost, and high efficiency.

From table 4-2, It indicates the effect of site selection for pitfall trapping. Most of ants in public parks have habitats or food sites on standing-tree areas, so the distance from standing-tree site has an effect on species richness. The grass field that used to sampling ants in Suan Luang Rama IX was farthest from standing-tree area when compared with the others. In contrast, the grass field in Queen Sirikit Park was nearest so the species richness from pitfall trapping was highest.

2.3 Occurrence

Twenty-three species of ants in public parks, such as *Pheidole bugi, Solenopsis geminata, Oecophylla smaragdina,* and *Paratrechina longicornis*, were 100% of occurrence, whereas *Crematogaster* sp.3 of AMK, *Polyrhachis dives*, *Tetraponera allaborans*, *Smithistruma* sp., and *Tetramorium* sp.6 of AMK were the least proportion of occurrence at 16.67% (Table 4-3).

Table 4-3: Occurrence of ants in the public parks of Bangkok during March 2003 to February 2004

Subfamily	Species	Occurrence	Sites	Methods
Myrmicinae	*Cardiocondyla emeryi**	100.00	S,Q,L	T,P,H
	*Cardiocondyla nuda**	33.33	S,L	P,H
	Catulacus granulatus	66.67	S	T
	Crematogaster rogenhoferi	100.00	Q	T,P
	Crematogaster sp.3 of AMK	16.67	L	T
	Crematogaster sp.9 of AMK	33.33	S,Q,L	T,P
	Crematogaster (Orthocrema) sp.1 of AMK	50.00	S	T
	Meranoplus bicolor	100.00	S,Q,L	T,P,H
	Monomorium chinense	100.00	S,Q,L	T,P,H
	*Monomorium destructor**	100.00	Q,L	T,P,H

Table 4-3: (Continued)

Subfamily	Species	Occurrence	Sites	Methods
	Monomorium floricola	100.00	S,Q,L	T,P,H
	*Monomorium pharaonis**	33.33	S,Q,L	T,P,H
	Monomorium sechellense	100.00	S,Q,L	T,P
	Monomorium sp.	100.00	S,Q,L	T,P,H
	Pheidole bugi	100.00	S,Q,L	T,P,H
	Pheidologeton diversus	100.00	S,Q,L	T,P,H
	Smithistruma sp.	16.67	Q	P
	Solenopsis geminata	100.00	S,Q,L	T,P,H
	Strumigenys sp.	66.67	Q	P
	Tetramorium bicarinatum	50.00	S	T
	Tetramorium lanuginosum	50.00	S,Q,L	T,H
	Tetramorium simillimum	50.00	S,Q,L	T,P,H
	Tetramorium smithi	100.00	S,Q,L	T,P,H
	Tetramorium sp.6 of AMK	16.67	L	T
Ponerinae	*Anochetus graeffei*	100.00	Q.L	T,P
	Diacamma rugosum	100.00	S,Q	T,H
	Diacamma vagans	100.00	S,L	T,P,H
	Odontomachus simillimus	83.33	S,Q,L	T
Formicinae	*Anoplolepis gracillipes**	66.67	S,L	T,H
	Camponotus rufoglaucus	100.00	S,Q	T,P,H
	Oecophylla smaragdina	100.00	S,Q,L	T,H
	*Paratrechina longicornis**	100.00	S,Q,L	T,P,H
	Paratrechina sp. 5 of AMK	100.00	S,Q,L	T,P,H
	Paratrechina sp.8 of AMK	83.33	S,Q,L	T,H
	Paratrechina sp.9 of AMK	50.00	Q,L	T,P
	Polyrhachis laevissima	100.00	L	T
	Polyrhachis (Myrmhopla) dives	16.67	S	T
Dolichoderinae	*Iridomyrmex anceps*	100.00	S,L	T,P,H
	*Tapinoma melanocephalum**	100.00	S,Q,L	T,P,H
	Tapinoma sp.	50.00	S,Q	T,P
Pseudomyrmecinae	*Tetraponera ruflonigra*	100.00	S,Q,L	T,P,H
	Tetraponera allaborans	16.67	S	T
Cerapachyinae	*Cerapachys longitarsus*	33.33	Q	T,P

Note: S = Suan Luang Rama IX, Q = Queen Sirikit Park, L = Lumpini Park
T = Time Unit Method, P = Pitfall Trapping, H = Honey Baiting
* = Exotic species

Discussion

In this results, the ants that had high occurrence in the public parks such as *Solenopsis geminata, Pheidole bugi, Tapinoma melanocephalum, Paratrechina longicornis,* and *Paratrechina* sp.5 of AMK are eurychoric species, that having a wide geographic distribution. They can adapt to inhabit in vary habitats such as ground surface, trees and building (William,

1994) These ants can rapidly change nest sites and cover the areas. On the other hand, the ants that had low occurrence, it may be due to some species have limited range of food sources and habits as some species of *Crematogaster* and *Tetraponera* are limited to host plants (Schultz and McGlynn, 2000).

Compared with the study of Dalad Senthong (2003), many species found in the urban communities were also found in the public parks. It shows that the high-adaptive-ability ants can spread from the public parks to the urban communities or from the urban communities to the public parks.

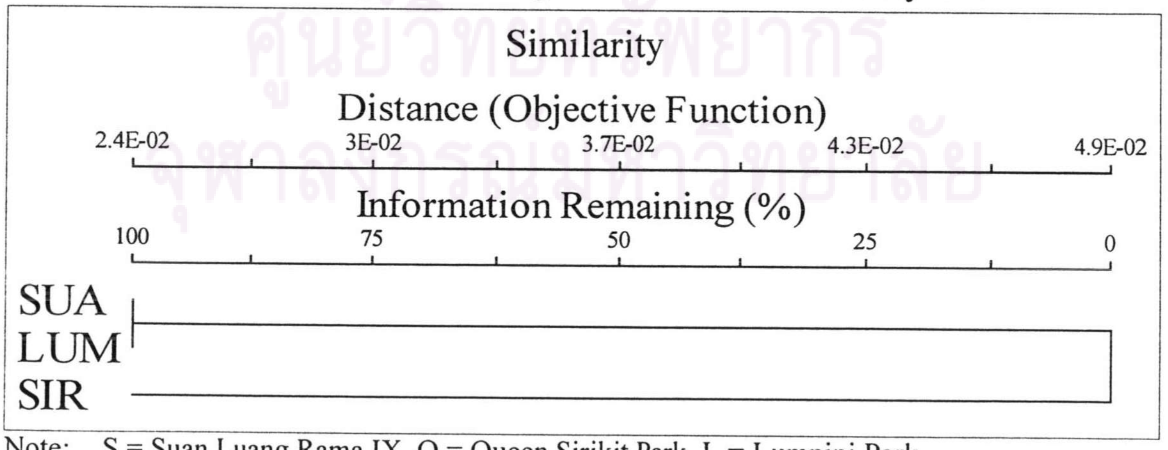
3. Similarity Index

From the species number of ants in public parks, they were conducted to calculate for similarity indices and compared between public parks by using Sorensen equation and the result was showed in Table 4-4.

Table 4-4: Sorensen similarity indices of ants in the public parks of Bangkok during March 2003 to February 2004

	Suan Luang Rama IX	Queen Sirikit Park	Lumpini Park
Suan Luang Rama IX	-	75.0	78.1
Queen Siritkit Park	-	-	77.4
Lumpini Park	-	-	-

Figure 4-11: Cluster dendrogram from cluster analysis of ant communities in the public parks of Bangkok, during March 2003 to February 2004



Note: S = Suan Luang Rama IX, Q = Queen Sirikit Park, L = Lumpini Park

It was found that Suan Luang Rama IX and Lumpini Park community had the highest similarity index (78%) while Suan Luang Rama IX and Queen Sirikit Park had the lowest similarity index (75%).

Discussion

Generally, resource and habitat condition necessary for some ants will appear with the succession of vegetation. For instance, *Crematogaster matsumurai, Vollenhovia emeryi, Camponotus quadrinotatus* and *C. keihitoi* nest under the bark and in rotting wood (The Myrmecological Society of Japan 1991,1992 cited in Yamaguchi, 2004). In the urban park the occurrence of these ants is dependent on the park age (Yamaguchi, 2004) because decayed nest materials are likely to appear in parks a long period after plantation. So the older park should have more species richness. But in these results, the species richness of ants in three public parks did not significantly different (33, 31, and 31 species), and the similarity of ants species between the public parks is high. It may be caused by the park management. The park management operations favor visitors and hinder the free growth of planted trees. Therefore, the habitats containing decayed nest materials might not increase with time in old parks.

5. Species diversity index

In this study, only the data from the pitfall traps was used to calculate species diversity indices and evenness indices.

Shannon diversity index was calculated based on the species and abundance of species in a community. The results showed that community, which had the highest value, was Queen Sirikit Park community followed by Lumpini Park and Suan Luang Rama IX, respectively (Table 4-5).

6. Evenness index

The values of evenness index were calculated and found that Queen Sirikit Park community had the highest of evenness followed by was Lumpini Park and Suan Luang Rama IX, respectively (Table 4-5).

Table 4-5: Species diversity index and Evenness index of ants in public parks of Bangkok

Community	Species diversity index	Evenness index
Suan Luang Rama IX	1.1581	0.37467
Queen Siritkit Park	1.8011	0.58269
Lumpini Park	1.2863	0.41613

<u>Discussion</u>

Species diversity indices and evenness indices were calculated based on species richness and abundance of ants collected by pitfall trapping, so Queen Sirikit Park ant community, which had the highest species richness, was shown the highest value. It was the effect of site selection for pitfall trapping that was discussed above. Therefore, Suan Luang Rama IX ant community which collected from the grass field that farthest from standing-tree areas was shown the lowest values of diversity and evenness indices.

7. Relationships between environmental factors and species richness, and abundance of ants

Environmental factors for this study consist of temperature, relative humidity and rainfall. The relationship results were analyzed by using Spearman correlation as shown in Table 4-6.

Table 4-6: Spearman coefficient of environmental factors and species richness, and abundance of ants in the public parks of Bangkok during March 2003 to February 2004

Site		Temperature	Relative Humidity	Rainfall
SUA	**Species richness**			
	- Time Unit Method	-0.618	0.441	0.500
	- Pitfall trapping	0.754	-0.406	-0.174
	- Honey baiting	0.493	0.116	0.580
	Abundance			
	Paratrechina sp.5 of AMK	0.429	0.371	0.143
	Pheidole bugi	0.429	-0.086	0.029

Table 4-6: (Continued)

Site		Temperature	Relative Humidity	Rainfall
SIR	**Species richness**			
	- Time Unit Method	-0.368	-0.493	-0.841*
	- Pitfall trapping	-0.412	0.508	0.294
	- Honey baiting	-0.371	-0.174	0.314
	Abundance			
	Paratrechina sp.5 of AMK	0.086	0.143	0.029
	Pheidole bugi	0.314	-0.486	-0.714
	Solenopsis geminata	0.371	-0.543	-0.086
LUM	**Species richness**			
	- Time Unit Method	0.537	-0.618	-0.177
	- Pitfall trapping	0.264	0.105	0.316
	- Honey baiting	-0.678	0.577	-0.516
	Abundance			
	Paratrechina sp.5 of AMK	-0.100	0.500	0.100
	Pheidole bugi	0.638	-0.543	-0.257
	Solenopsis geminata	-0.087	0.771	0.371

Note: SUA = Suan Luang Rama IX, SIR = Queen Sirikit Park, LUM = Lumpini Park

From the results in Table 4-6, species richness and abundance of ant species that are common species and high abundance in Suan Luang Rama IX and Lumpini Park were not significantly correlation with temperature, relative humidity, and rainfall ($P>0.05$), while species richness of ants collected by Time Unit Method were negatively correlated with rainfall ($P <0.05$).

8. The effects of seasons on species richness

There were significant differences in the means of species richness between wet and dry season ($P<0.05$) (Table 4-7).

Table 4-7: The differences of the means of species richness of ants in the public parks of Bangkok between wet and dry season during March 2003 to February 2004

			Wet season - Dry season
Paired Differences	Mean		-2.4444
	Std. Deviation		2.83333
	Std. Error Mean		.94444
	95% Confidence Interval of the Difference	Lower	-4.6223
		Upper	-.2666
t			-2.588
df			8
Sig. (2-tailed)			.032*

Discussion

From the study of Höllderbler and Wilson (1990) and Andersen (2000), temperature, humidity, and rainfall are the environmental factors which affect on ant communities in ecosystem. Every ant species operates within ranges of temperature and humidity. For example, the study on ants in Australia, *Pheidole militicida* (Höllderbler and Moglish, 1980 cited in Hö-llderbler and Wilson, 1990), *Formica polyctena* (Rosengren, 1977 cited in Höllderbler and Wilson, 1990), and *Prenolepis imparis* (Talbot, 1943, 1946 cited in Höllderbler and Wilson, 1990) showed that the increase in foraging activity when humidity rises at high temperature. Another source of differential foraging in the face of varying humidity is simple physiological resistance to desiccation, a phenomenon that has been observed in *Tetramorium caespi*tum (Brain, 1965 cited in Höllderbler and Wilson, 1990), *Pogonomyrmex* (Hansen, 1978 cited in Höllderbler and Wilson, 1990), and diurnal ant species in Australia (Briese and McCauley, 1980 cited in Höllderbler and Wilson, 1990).

From the results, species richness and abundance of the ants in the public parks showed no correlation with temperature and relative humidity. It may be caused by many reasons. First, the change of temperature and relative humidity was too narrow, and this study used air temperature, relative humidity data that might not show the direct effect on the ant composition in the public parks. Second, many ant species found were reported as tramp species and invasive species that can use a variety of strategies to fit into widely variable habitat. So the change of temperature and relative humidity in narrow range may not effect on this species group. Finally, the sampling times may not be enough to show the correlation. It may need more samplings to clarify the results.

Rain halts most foraging in place where the drops pelt the ground and from small puddles and rivulets (Hodgson, 1955; Lewis et al., 1974; Skinner, 1980 cited in Höllderbler and Wilson, 1990). Every collector is familiar with this phenomenon, to his frequent frustration and especially during tropical wet season (Höllderbler and Wilson, 1990). That is one of the reasons why the species richness in Queen Sirikit Park were show negative correlation with rainfall. In addition, the rain makes the collectors spend more time to collect ant species in the wet study site. So the higher the rainfall, the less species will be collected in limited time. From these reasons, the correlation between species richness from Time Unit method and rainfall was negative. The effects of the rainfall to ant data collection was also shown on the species richness difference between wet and dry season (Table 4-7).