Chapter 4

Results

Measurements of various part of *S.magna* were made in three location captive in Chiang Dao Wildlife Sanctuary on 21 March 2005, 23 March 2005 and 20 March 2007 respectively. The capture on 21 March 2005 and 23 March 2005 could not measure on various part of tarsus. Data were present in Table 4.1.

Table 4.1 Measurement of various parts of captive *Sitta magna* at three locations.

Subject	Captive location in			Average
	Co-ordinate Latitude 214220 Longitude 48290 (reservoir)	Co-ordinate Latitude 214220 Longitude 48290 (reservoir)	Co-ordinate Latitude 214160 Longitude 48280 (forest fire line)	
Record Date	21-Mar-05	23-Mar-05	20-Mar-07	
Weight (gm)	37.03	41.55	44	40.86
Total length (cm)	17.08	20.05	22.05	19.73
Wing length (cm)	14.85	11.58	16.60	14.34
Expand the wings length (cm)	330	29	35.70	32.57
Body thickness (cm)	3.50	5.84	6.20	5.18
Bill (mm) - length	26.25	27.5	24.1	25.95
- thick	-	-	5.70	
Tarsus length (mm)	-	-	2.20	
Finger length (mm) - thumb	-	-	11.34	
- index	-	-	10.80	
- middle	-	-	13.30	
- little	-	-	6.70	
Fingernail length (mm)-thumb	-	-	11.54	

1. General behavior

1.1 Descriptions of observed comfort behavior: Comfort behavior includes preening, scratching, shaking and stretching.

These behaviors were not frequent, because *S. magna* spent most time foraging. Comfort behavior occurred between foraging, such as the first stretching, preening, scratching and shaking respectively or scratching at first and preening, stretching and shaking respectively.

1.1.1 Preening removed foreign matter and ectoparasites and maintained the integrity of feather surfaces. Oiling the feathers helped to waterproof feathers; a fatty substance is extracted by the mandibles from the uropygial gland at the base of the tail, and then spread over feathers with the mandibles.

Preening included nibbling with the bill-tips. Drawing the feather from base to tip through the mandibles aligned the barbs and fastened together the barbules of adjacent barbs. Nuthatches preened at breast, upper wing and under wing cover (Figure 7). Nuthatch usually perched on branches when preening but sometimes they attached themselves to a tree trunk with their bodies horizontal to the ground (two legs standing vertical to the ground) (Figure 8). Average frequency of preening was 2-4 times per day, for 1-3 minutes per time.

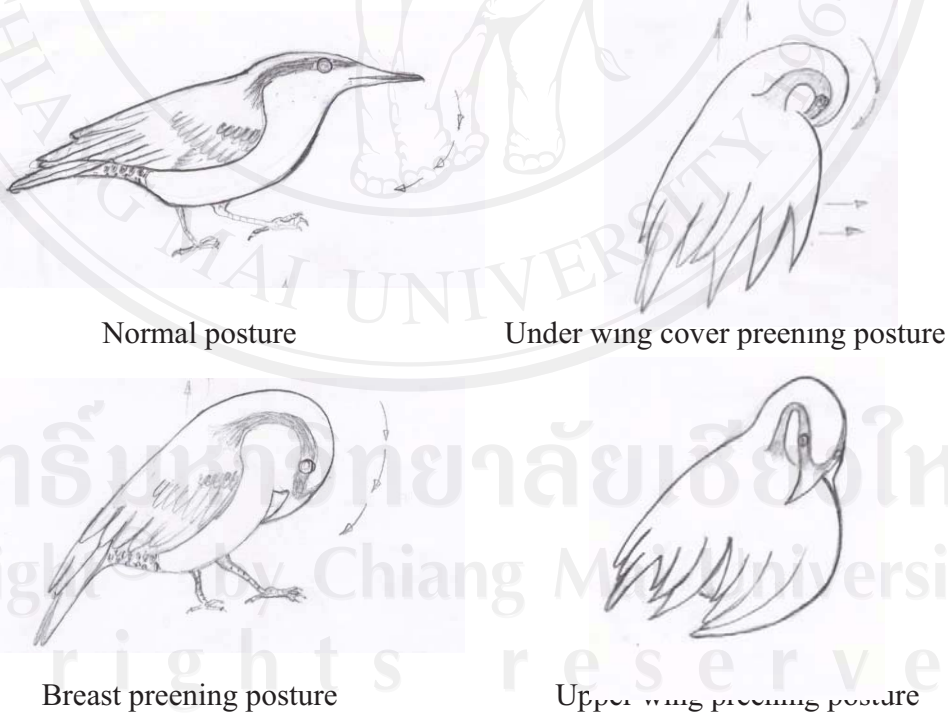
1.1.2 Scratching had the same objectives as preening and replaced preening, where the bill could not reach.

Scratching included scratching with legs and the bill. The birds scratched their head by extending their legs under or alongside the body, to reach the lowered head

(under wing scratching), or they lowered the wing and extended the leg above it towards the head, so that the tarsal joint was lateral to the wing (over wing scratching). Scratching with the bill was similar to preening, but preening was a higher level activity.

1.1.3 Shaking restored the integrity of the plumage surface, as opposed of preening, which restored individual feather integrity, and removed foreign matter and ectoparasite of the feather surface.

Shaking included head shakes and body shakes (Figure 9). Head shakes usually involved raising the head so that the axis of the bill in nearly in line with the backbone, and then vigorously rotating the head back and forth about the axis. Body shakes involved a similar rotary motion around the vertebral axis, often accompany by wing shuffling.

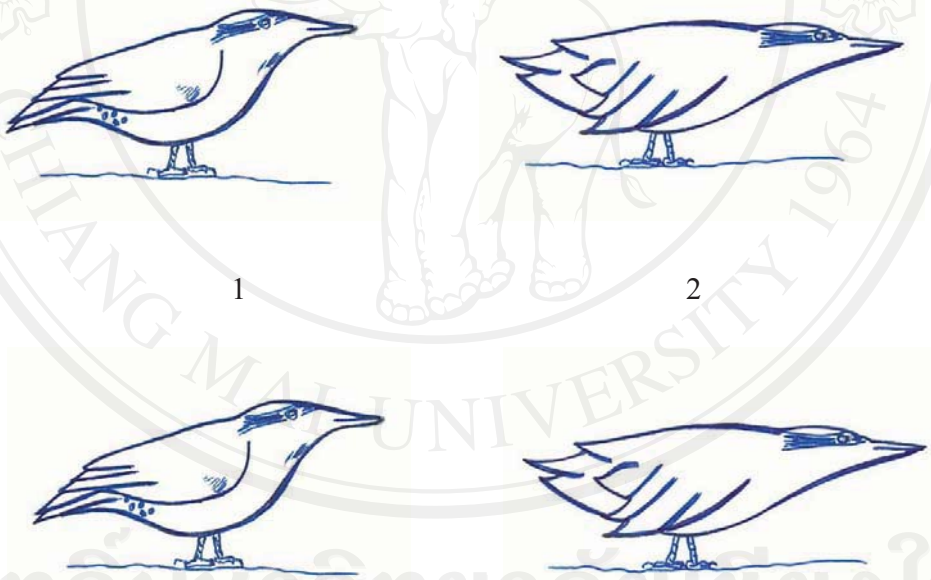


Normal posture Under wing cover preening posture

Breast preening posture Upper wing preening posture

Figure 7 Nuthatch perched on branch and acted preening behavior in three positions.

Figure 8 Nuthatch preening posture while attract tree trunk.



1 2

3 4

Figure 9 Head shaking (1, 2) and body shaking (3, 4)

1.1.4 Stretching was to maintain muscle tone for movement and included two patterns. Firstly wing-leg stretched in which the wing was extended on one side along with the leg on the same side and secondly bill-stretching (Figure 10).

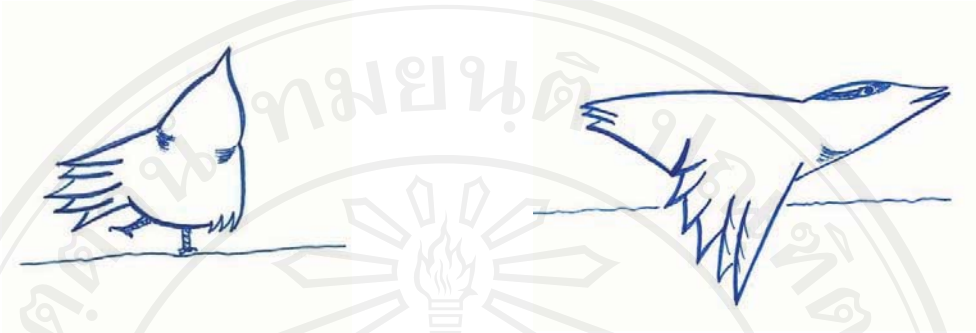


Figure 10 Wing-leg stretching (1) and bill-stretching (2)

1.1.5 The number of observed comfort behavior:

The number of comfort acted in the morning and in afternoon was compared using t- test. The hypothesis was tested whether *S. magna* acted comfort behavior leas in the morning than in afternoon, and found that *S.magna* was not significant difference for acted comfort behavior in the morning and in the afternoon ($\alpha = 0.05$) (Table 4.1.1).

Table 4.1.1 The number of exhibit comfort behavior in the morning and in afternoon for 12 days at each sampling plot.

Period	Sampling Plot					Total	X	SD
	1	2	3	4	5			
Morning	14	3	15	12	12	56	11.20a	4.76
Afternoon	26	7	23	18	16	90	18a	7.31

1.1.6 Nuthatches showed preferences in their position in the tree to exhibit comfort behavior, which occurred equally on branches, perches and on tree trunks

(α=.05) (Table 4.1.2), but exhibit comfort behavior which occurred differently in each sample plot (α=.05).

Table 4.1.2 The number of nuthatch acted comfort behavior in each tree position and each sampling plot.

Tree position	Sampling Plot					Total	$\overline{x}$ Tree position
	1	2	3	4	5		
Trunk	12	3	8	8	3	34	6.80a
Branch	14	7	14	9	7	51	10.20a
Perch	14	-	15	17	8	54	10.80a
Total	40	10	37	34	18	139	
$\overline{x}$ plots	13.33b	3.33a	12.33b	11.33b	6 ab		

1.2. Foraging behavior

The study of *S. magna* foraging behavior investigated foraging direction and tree species preferences.

1.2.1 Foraging patterns: The *S. magna* foraged by climbing along tree trunks and branches, they probed into tree crevices and searched for insects.

S. magna flew up and down [Figure 11 (1)] with *S.magna* wing- flicks 2-4 times to fly up and then they kept their wing to swoop down quickly. They flew up and down repeatedly until attached themselves to tree trunk.

They attached themselves to a tree trunk by slanting their body vertical with tree

trunk but two legs parallel with tree trunk[Figure11 (2)].

After attachment to a tree trunk, if they climb up, they slanted their body up with two legs unchanged and climbed up along tree trunk (Figure 12).

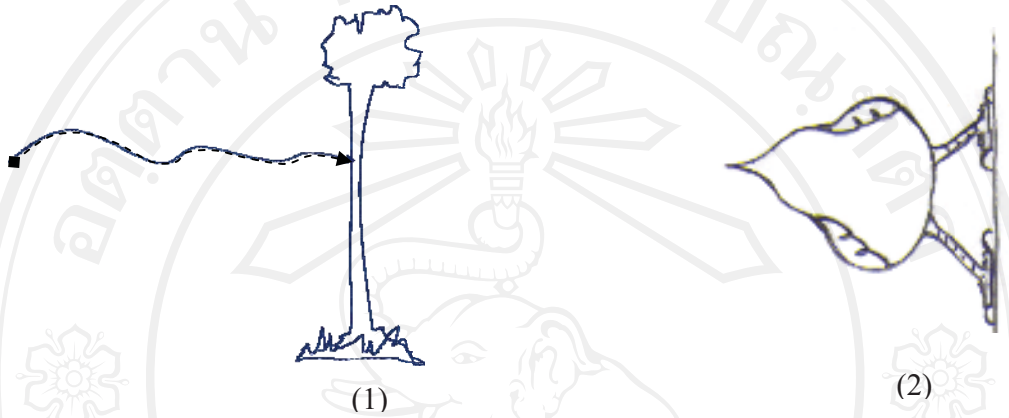


Figure 11 (1) The flight line pattern of *S. magna* (dash- line). (2) Posture landing on tree trunk before climbing up or down.

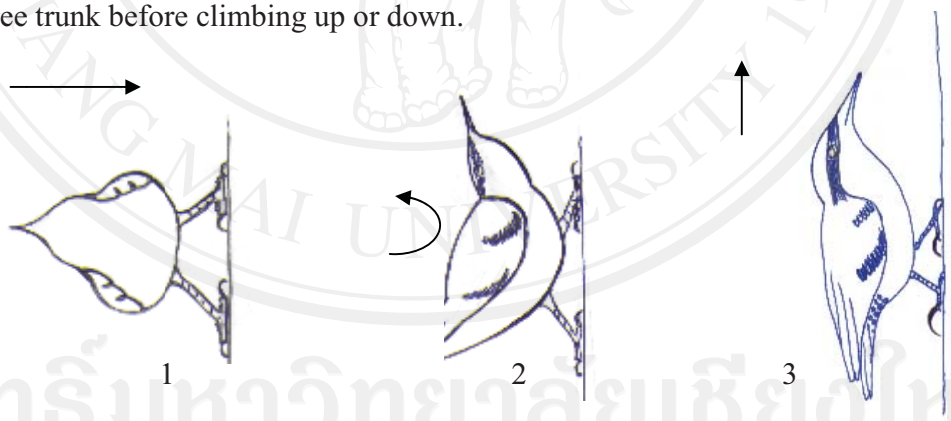
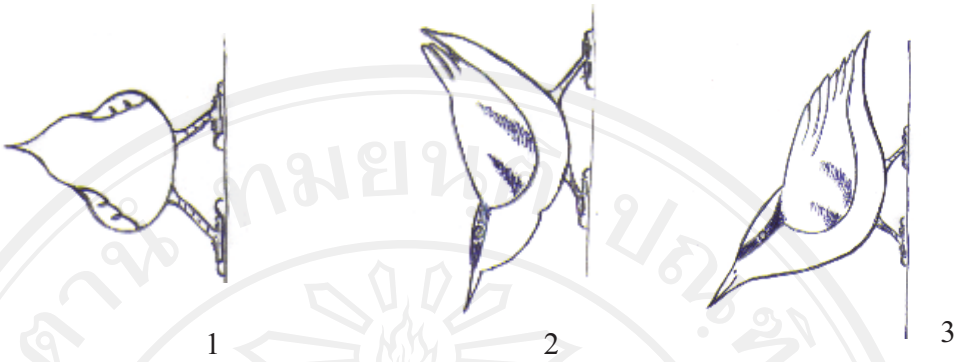


Figure 12 Posture attachment of body to tree trunk (1), turning up its body parallel with tree trunk (2), climbing up along tree trunk (3).

For climbing down, after attaching its body to tree trunk, it turned down its body, parallel with tree trunk, with two legs unchanged (Figure 13).



1 2 3

Figure 13 Posture attachment of body to tree trunk (1), turning down its body parallel with tree trunk (2), climbing down along the tree trunk (3).

1.2.2 Climbing direction for foraging: The majority of nuthatches flew to attach themselves to the upper tree trunk and foraged downwards or they climbed down the tree trunk to one meter above the ground, and then climbed up. If the birds were not satisfied, they restarted this process or moved to another tree. A minority of nuthatches attached themselves to the base of tree trunks and foraged upwards. The foraging directions were compared using t-test. This was significant equal for foraged by moving down tree trunk and moving up tree trunk (α=0.05) (Table 4.2.1).

Table 4.2.1 The number of moving down tree trunk and moving up tree trunk for foraging in each sample plot.

Foraging direction	Sampling Plot					Total	X	SD
	1	2	3	4	5			
Moving down	30	8	31	26	24	119	23.80a	9.28
Moving up	25	7	22	22	19	95	19a	7.03

The hypothesis was tested whether *S.magna* forage more on tree trunks than on tree branches using t- test, which *S.magna* preferred significantly to foraged on trunks more than on branches (α =0.05) (Table 4.2.2).

Table 4.2.2 The number of moving along tree trunks and along tree branches for foraging in each sample plot.

Foraging position	Sampling Plot					Total	$\overline{X}$	SD
	1	2	3	4	5			
Tree trunks	55	15	53	48	43	214	42.80a	16.22
Tree branches	34	10	33	29	24	130	26b	9.77

1.2.3 Tree species preferred for foraging: *S. magna* habitat (Sample plot No.1-5) was composed of *Pinus kesiya* and other species; the number of *Pinus kesiya* and other species was compared using t-test, and found that the number of *Pinus kesiya* was significant less than other tree species (α = 0.05) (Table4.2.3).

Table 4.2.3 The number of *Pinus kesiya* and other species in each sample plot.

Tree species	Sampling Plot(number)					Total	$\overline{X}$	SD
	1	2	3	4	5			
Pinus kesiya	13	0	45	3	14	75	15a	17.84
Other	34	120	70	50	48	322	64.40b	33.62

The frequency with which each tree species were used for foraging was tested by t- test, which *S.magna* used significantly *Pinus kesiya* more than other species for foraging (α=0.05). So *S. magna* preferred *Pinus kesiya* more than other species for foraging. (Table 4.2.4)

Table 4.2.4 The number of each tree species were used for foraging in each sample plot.

Tree species used	Sampling Plot					Total	$\overline{X}$	SD
	1	2	3	4	5			
Pinus kesiya	65	0	70	48	48	231	46.20a	27.66
Other species	17	21	11	16	13	78	15.60b	3.84

Tree species did not affect foraging direction, because the main tree species used was *Pinus kesiya* while the number of *Pinus kesiya* least than other species.

1.3 Breeding behavior:

1.3.1 Mating and Courtship

S. magna coordinate foraged with their groups (3-4 birds), sometimes one *S. magna* separated to forage alone or participated in another group in a nearby territory. One month after *S. magna* (nestlings) left the nest (March or Aril), the nestlings kept on foraging together. Subsequently, each *S. magna* separated to establish a territory and mostly foraged alone (May - November). In November, the courtship behavior started with two birds and increased to 3-4 and 5 in a group by the end of November. They

contact called and flew together in a group. Until February, they could mate. Once an *S. magna* pair mated, the pair separated from the group to build their nest.

The courtship ritual consisted of call responses, the male following the female and then the male tried feeding the female (pattern of courtship feeding behavior). If the female rejected the male she left. If the female accepted, she received the food and separated from the group and began nest building. This process took about 10 days.

1.3.2 Nest building

1.3.2.1 Nest building

Nests were used for egg-laying, incubation, hatching, parental care and predator avoidance. *S. magna* couldn't build a new cavity. They preferred to use natural cavities for nests or the recycled nests. Nest designation behavior was performed at the same time as copulation. The male introduced the female to the nest cavity, by holding nest material in its mouth and hopping in and out of the nest cavity 2-3 times. If the female accepted, she entered the nest cavity. If she rejected the nest, the male found another cavity and the process started with the same again. During this study, one nest was found in 2006 and two in 2007. *S. magna* performed nest designation behavior about 9 days.

Males and females built cavity nests together. They co-operated, bringing nest materials to the nest. Nest materials included lichens, feathers and paper. In the morning period birds foraged first and then they took nest materials to the cavity with increasing frequency until midday, when they stopped building, and again in afternoon. The highest visiting frequency was 4.3 times (per hour) between 13.00-14.00 pm and diminished until 17.00 pm, when they stopped nest building (Figure 14).

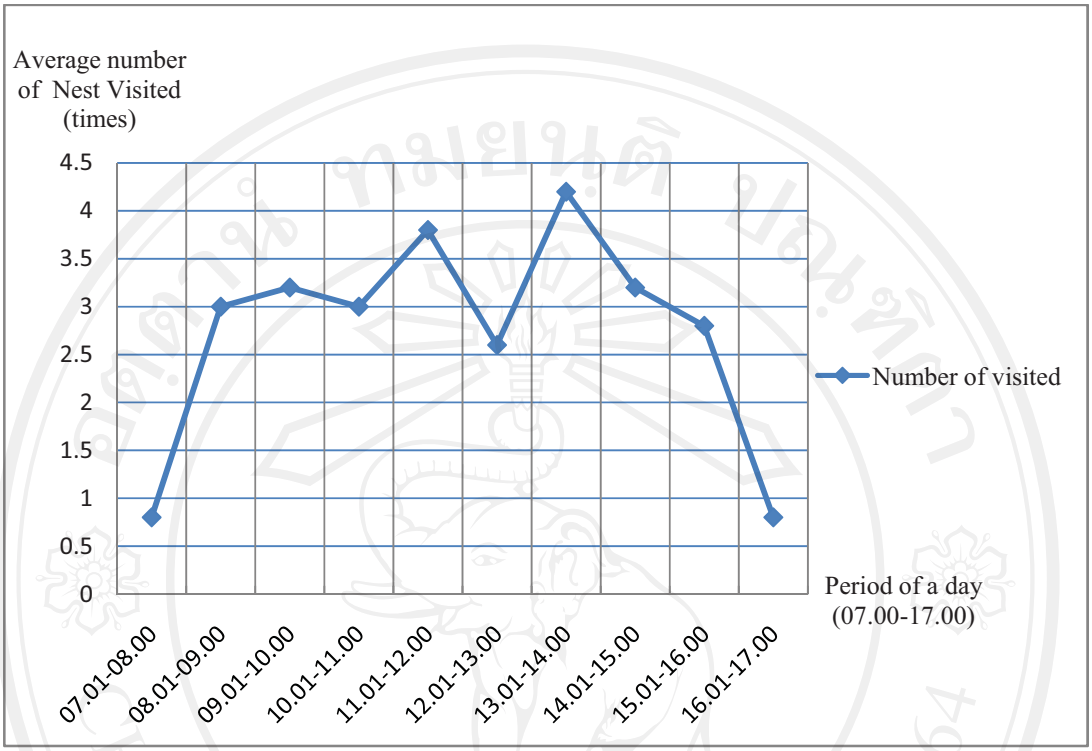


Figure 14 The average frequency of nest visited for nest building in each period in a day (for 5 day).

1.3.2.2 Nest tree characteristics

Nest tree: Tree species used for nest cavity included *Pinus kessiya* (Nest No 1), a dead tree (unidentified species) (Nest No 2) and *Lithocapus sootepensis* (Nest No 3) at different heights, of 25, 10 and 15 meters respectively.

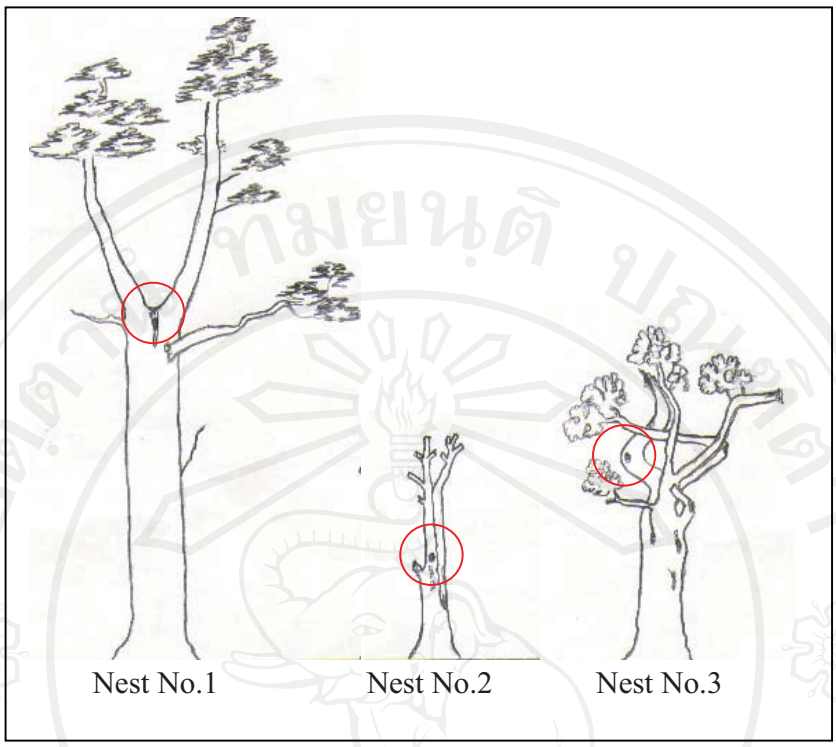


Figure 15 All three nests in difference trees.

1.3.2.3 Vegetative structure of nest site:

Nest No.1. In sampling plot No.1, the forest type was Pine forest at 1,300 meters from sea level. The dominant species was *Pinus kesiya*, with most number of trees and highest IVI (77.224), which composed of 11 species and 47 trees. The diversity index was 0.819 (Table 4.4.1). The cavity nest was on 25 meters high in *Pinus kesiya*.

Nest No. 2. In sampling plot No.2, the forest types were Pine forest and hill evergreen forest at 1,250 meter from sea level. The important species was *Castanopsis diversifolia*, but most number was *Lithocarpus elegans* (23 tree) and highest IVI index was *Castanopsis diversifolia* (33.582), which composed of 18 species and 120 trees. The diversity index was 1.127. Cavity nest was on 5 meters high in dead tree (unidentified species) (Table 4.4.3).

Nest No.3. In sampling plot No.4, the forest types were Pine forest and hill evergreen forest at 1,200 meter from sea level. The dominant species was *Lithocarpus sootepensis* with the highest number (27 trees) and highest IVI index (74.167), which composed of 12 species and 53 trees. The diversity index was 0.887. Cavity nest was on 10 meters height in *Lithocarpus sootepensis* (Table 4.4.7).

1.3.2.4 Nest cavity characteristics:

Nest cavity No.1 was a natural crack at tree fork in a living *Pinus kessiya* tree. Hole entrance was oval shape, facing the south. The entrance cavity dimension and cavity depth was unknown. The nest was 15 m above the ground (Table 4.3.4). *S. magna* entered cavity by leaning their body along nest length. This cavity nest was the highest nest. *S. magna* did not seal the nest entrance.

Nest cavity No.2 was a natural hole in dead tree (unidentified species). The nest was 5 m above the ground in the tree trunk. Hole entrance direction to the west in vertical oval shape, 7x15cm hole entrance dimension, this was so big because *S. magna* enters the hole by irrespectively posture. The nest was 30 cm deep and had two ventilation holes (2x2 cm dimension) below the entrance (Table 4.3.4). Birds perched on the top and climb down to nest entrance, sometime birds flew to perch at the nest entrance and entrance the cavity.

Nest cavity No.3 was a natural hole in living tree of *Lithocapus sootepensis*, nest was judged to be former squirrel hole by the shape of entrance was round or nearly round (7x12cm dimension). The nest was in a curve trunk, 10 m above the ground and was 38 cm deep (Table 4.3.4). There was one tree branch and one shallow above their hole which

served as a rest area for chopping some food before entry. This nest was protected by many tree branches covering the hole. The nest entrance faced east.

Table 4.3.1 Nest characteristic

General characteristics	**Nest**		
	1	2	3
Nest habitat			
Forest type	Pine and Hill evergreen forest	Pine and Hill evergreen forest	Pine and Hill evergreen forest
Elevation from sea level (m)	1,300	1,250	1,200
Nest tree characteristics			
Tree species	*Pinus kesiya*	Unknown Species	*Lithocapous sootepensis*
Tree height (m)	25	10	15
Tree characteristic	Live tree	Dead tree	Live tree
Nest cavity characteristic			
Hole entry (cm)	-	7x15	7x12
Cavity depth (cm)	-	30	38
Cavity height from ground (m)	15	5	10
Nestling number	2	4	4
Fledged age (days)	25	18	25
Nest materials	-	Feathers, lichens and paper	Feathers, lichens and paper

1.3.2.5 Nest materials

Nest materials were laid only on the cavity floors. Nest entrances were not sealed. Floor laying material included feathers, lichens, and paper. Birds took small paper from ground; almost all paper was clean so the birds' objective was to soften. Birds took nest materials to nest entrance or rest area near the entrance before took in cavity.

1.3.3 Copulation

Sexual union followed pairing. A preliminary period of courtship, during which selection of mates was determined, was followed by more rituals after the pairs were formed before actual copulation took place. The female *S. magna* slowly reduced aggressive behavior until the male could successfully feed her bill to bill, or the male could touch her, bill to bill successfully (Figure 16). Next, the male mounted the female and began copulation. After about 1 second the male dismounted the female and waited for a reduction in female aggression, in order to keep the pair-bond for about 5 seconds. After this the female shook her vent to reduce irritation and followed the male for foraging. Copulation was performed on horizontal tree branch and near nest site.

1.3.4 Egg laying, and incubation

The nest No.3 was observed and found that male and female shared nest building was successful on 13 February 2006. The female was fat, which indicated that she may be pregnant. The female always lived in the nest (13-15 February 2006) with the male feeding her at the inner nest cavity, so presumed that this period was egg laying.

Figure 16 Male touch female by bill to bill before male mount female to copulate.

Subsequent the female left the nest for foraging about 2-3 times a day; each time for 2-3 minutes. While she left she was replaced by the male. The female mostly lived in the nest and was continually fed by the male. The incubation period was about 9 days.

At the end of incubation period and successful hatching, the female left the nest and displayed slow activity near the nest entrance such as bill grinding, head shaking and climbing. She seemed to be exhausted. After about 5 minutes she resumed normal speed activity. The female remained in the cavity nest for warming the young. On inspection of the nest, four nestlings were found. No damaged eggs or nestling carcasses, so were found the eggs hatched successfully. Nestlings were naked and helpless at birth and were cared for in the nest. The nestlings were not taken out of nest for measurements because males and females may have deserted the nest.

1.3.5 Parental care

After hatching successfully, both males and females shared in caring for the

young. They fed the young in the inner nest cavity, because, at first nestlings were feeble and lived on the nest floor can't climbed to nest entrance which is 34 cm cavity deep in average (Nest No.2, 3). Males and females took out the fecal sacs from the nest after feeding the young in the inner cavity. Nestlings usually defecated after having been fed because their stomach development was not complete. The fecal sac included undigested food was wrap pod in a white sac.

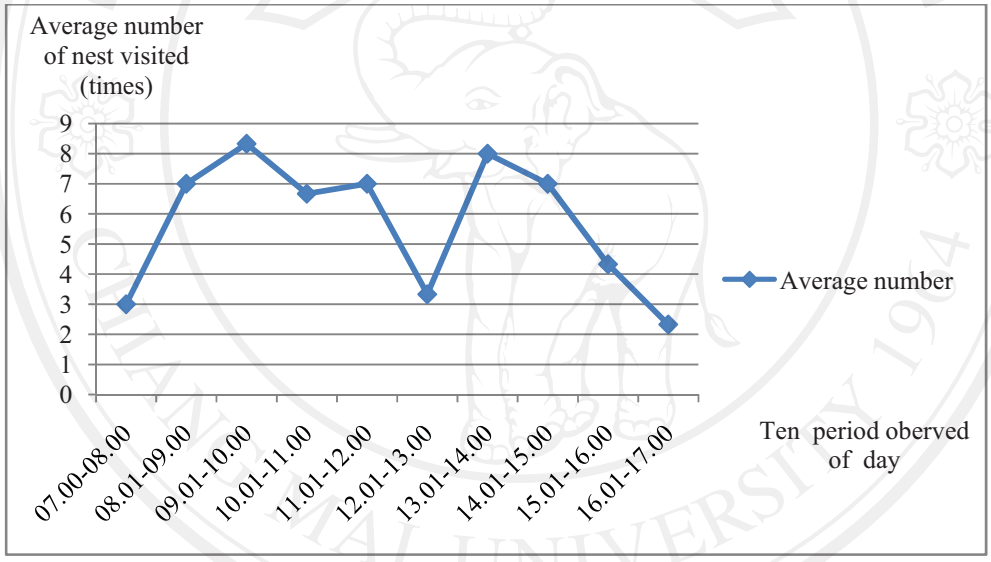


Figure 17 Average number of male visits to the nest for feeding female in cavity nest(eggs laying period) between 13-15 February 2006, in the morning period peak of feeding rate and slump at 12.01-13.00 pm and peak in afternoon again, finally slump in evening.

When nestlings were about 20 days old (Nest No.3), they could climb up to the nest entrance and were fed by the parents there. The frequency of male and female feeding gradually increase as the young grew. So the relationship between nestling age

and number of visitations for feeding was analysed by Simple linear regression.

There was a strong correlation between nestling age and number of feeding bouts (P=0.004, α=0.05) (figure 18). The accurate predict was 41 percent (r2=0.411, $\hat{Y}$=40.28+1.48x), and frequency of feeding was not only determined by nestling age, but included surrounding factors such as fluctuating weather.

In the morning period, feeding occurred more frequently than in the afternoon. In the morning period 6.57 times per hour on average and in afternoon was 5.08 times per hour (Figure 19). These frequency different from eggs laying and incubation period higher (8.5 times per hour in the morning and 8 times per hour in afternoon), though only the male foraged. This show that in eggs laying and incubation period was needed feed than parental care.

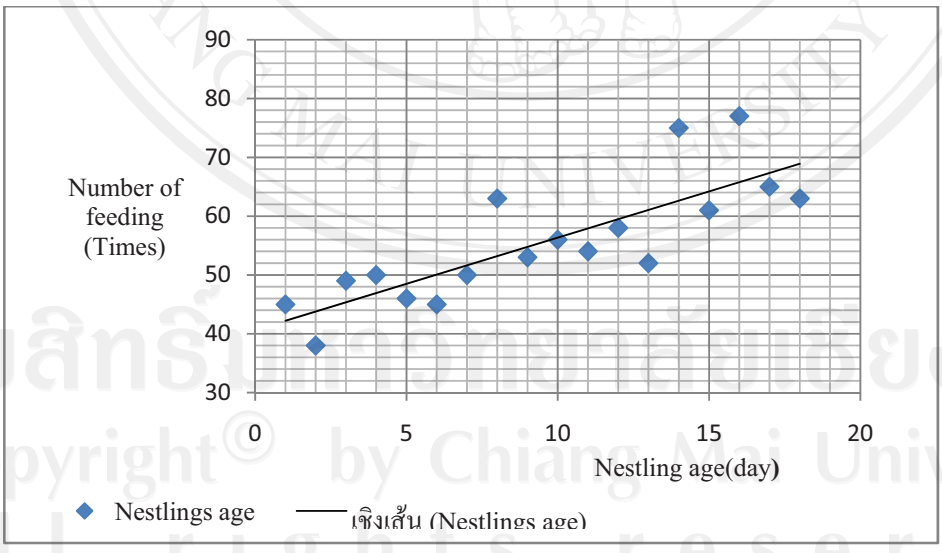


Figure 18 The relationship between nestling age and the number of feeding bouts. The regression ling is plotted as a solid line (r^2=0.411, $\hat{Y}$=40.28+1.48x).

1.3.6 Fledging or nest leaving

At two days old, feathers began to grow, and they still lived in cavity till average 20 days old. Nestlings could climb to nest entrance and showed their bill at about 20-21 days old, nestling could emerge their head out of cavity, and full covering of feathers. At this time the nestling call was the same as that of adults.

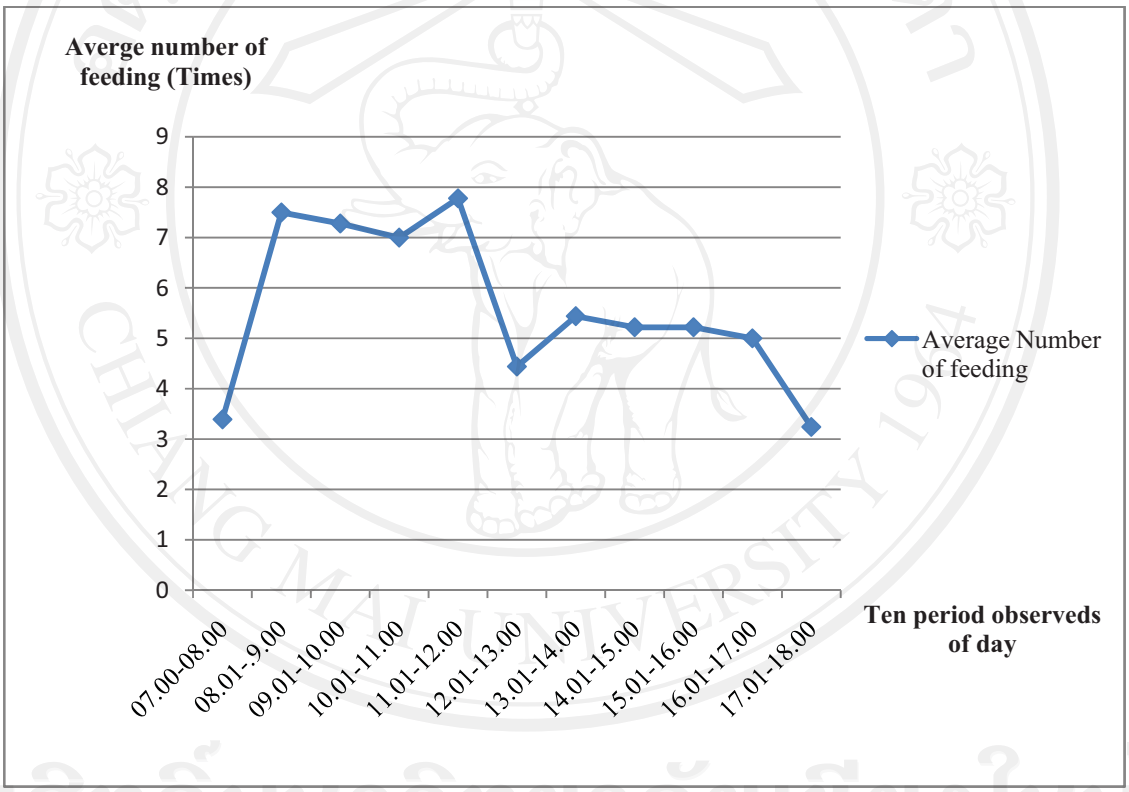


Figure 19 The average feeding rate of male and female *S. magna* over 18 days. Note morning peak of feeding and slump in afternoon.

Some nestlings could climb out of the nest cavity but could not climb along tree trunk, so they returned to the cavity and try leaving again until they were successful.

Nestlings lived in the cavity nest until 18-25 days old, on average.

The parents watched over the young until they fledged. At nest No.1 (in *Pinus kesiya* tree) the young fledged successfully at 25 day of age, nest No.2 (in dead tree) young fledged successfully at 18 day of age and nest No.3(in *Lithocarpus sootepensis*) young fledged successfully at 25 day of age.

Table 4.3.2 Duration of breeding behavior in three cavity nest

Behaviors	Nest 1	Nest2	Nest3	Average
Nest building, and copulation	13 days (20 Feb-3Mar 2007)	7 days (7-13 Mar 2007)	20 days (25 Jan-13 Feb 2006)	13.33 day
Eggs laying	3 days (3-5 Mar 2007)	3day (13-15 Mar2007)	3 days (13-15Feb 2006)	9 day
Incubation	9 days (5-13 Mar 2007)	8 days (15-22 Mar 2007)	9 days (15-23Feb 2006)	8.66 day
Hatching	13 Mar 2007	22 Mar 2007	23 Feb 2006	
Parental care	25 days (13Mar-6 Apr2007)	18 days (22Mar-8Apr2007)	25 days (23 Feb-19 Mar 2006)	22.66 day
Fledging age	25 days	18 days	25 days	22.66 day

Nest No.3 was observed by watching the parent activity surrounding nest. The period of the male feeding the female in the cavity nest defined the period of the female living in the cavity for incubation after egg lying, until the male and female left nest. This period presumed that their hatching successfully (Table 4.3.6)

Table 4.3.3 Activity for observation in each behavior change

Behaviors	Change activity for observation
Nest building	Male and female separate from group and male introduces female to cavity and build together by bring nest material in cavity.
Eggs laying	Change from held nest material to hold the feed in cavity by male only, expected female lived in cavity.
Incubation	Male and female reciprocally foraged, by one lived in cavity and another foraged alone.
Hatching	Both male and female foraged and fed to nestling in cavity and out cavity immediately.
Fledging	Nestling emerged and out off hole to climb along tree trunk by precariously climbed for five minute, eventually culminate in departure from the nest.

2 *Sitta magna* habitats

2.1 Sampling plot No.1

This plot was the nesting no1 site, and was composed of 11 species 7 families of 47 trees. *Pinus kesiya* was represented by the highest number of trees (13) and had the highest IVI index (Important value index) (77.2). This species dominated with highest relative density (RD) value, and relative dominance (RDo) value, follow by *Syzygium albiflorum*, (12 trees) with an IVI index of 16.8. *Schima wallichii* had an IVI of 25.5) and was represented by only 4 trees (Table 4.4.1). The vegetation structure were compiled to map of the vertical profile and crown cover (Figure 20)

Table 4.4.1 The main characteristics of sampling plot No.1 or nest No1 site [tree species, number of tree, relative frequency(RF), relative density(RD), relative dominance(RDo) and Important value index(IVI)].

NO.	Scientific name In sample plot No. 1	Number of trees	RF	RD	Rdo (%)	IVI
1	*Pinus kesiya*	13	6.061	19.182	51.981	77.224
2	*Schima wallichii*	4	6.061	4.348	15.119	25.528
3	*Syzygium albiflorum*	12	3.030	3.325	10.426	16.781
4	*Erythrima subumbrans*	6	1.515	1.535	10.663	13.714
5	*Gluta obovata*	1	7.576	2.813	1.483	11.872
6	*Dalbergia oliveri*	1	6.061	3.836	0.953	10.850
7	*Stereospermum fimbriatum*	4	3.030	1.279	5.451	9.761
8	*Butea monosperma*	1	4.545	1.535	0.429	6.059
9	*Ficus ribes*	1	1.515	0.256	2.029	3.800
10	*Antidesma sootepense*	3	1.515	0.767	0.682	2.964
11	*Suregada multiflorum*	1	1.515	0.256	0.782	2.554
		47				

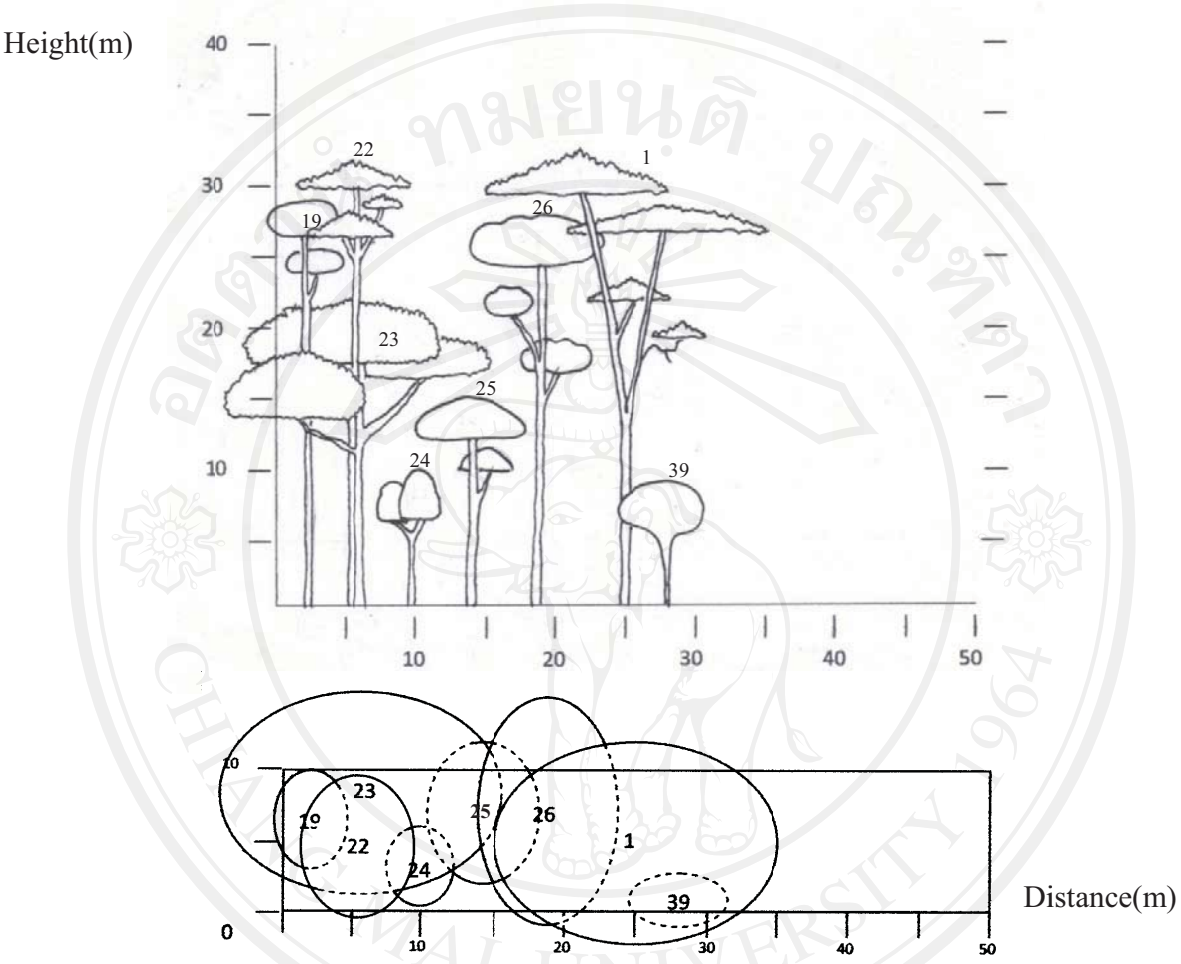


Figure 20 Profile diagram of the site around *Sitta magna* nest No.1. The upper emergent layer was composed of *Pinus kesiya* (1, 22). The emergent layer was composed of *Erythrima subumbrans*, *Syzygium albiflorum* (19,26). The upper top canopy layer was composed of *Schima wallichii* (23). The upper middle canopy layer was composed of *Syzygium albiflorum* (25). The middle canopy layer was composed of *Syzygium albiflorum* and *Butea monosperma* (24, 39)

Most trees were in the upper middle canopy layers from11-15m tall. Fourteen trees or 29.79 %, were *Syzygium albiflorum, Suregada multifloram, Gluta obovata* and *Dalbergia oliveri.* The next highest number of trees was in top canopy layer from 16-20 m tall (11 trees or 23.40 %). This layer was composed of *Schima wallichii, Erythrima subumbrans* followed by emergent layer and upper emergent layer, from 26-30 m tall and 31-35m tall consecutively (were 7 trees or 14.89% in each layer) which were composed of *Pinus kesiya, Syzygium algiflorum*, and *Erythima subumbrans*, followed by middle canopy layer from 6-10 m tall (5 trees or 10.63 %), composed of *Antidesma sootepense, Ficus ribes* and *Butea monosperma*. The lowest number of trees was in the upper top canopy layer, from 21-25 m tall, (3 trees or 6.38 %) represented by *Schima wallichii* (Figure 21). BRP (Basal area proportion) values are shown in table 4.4.2.

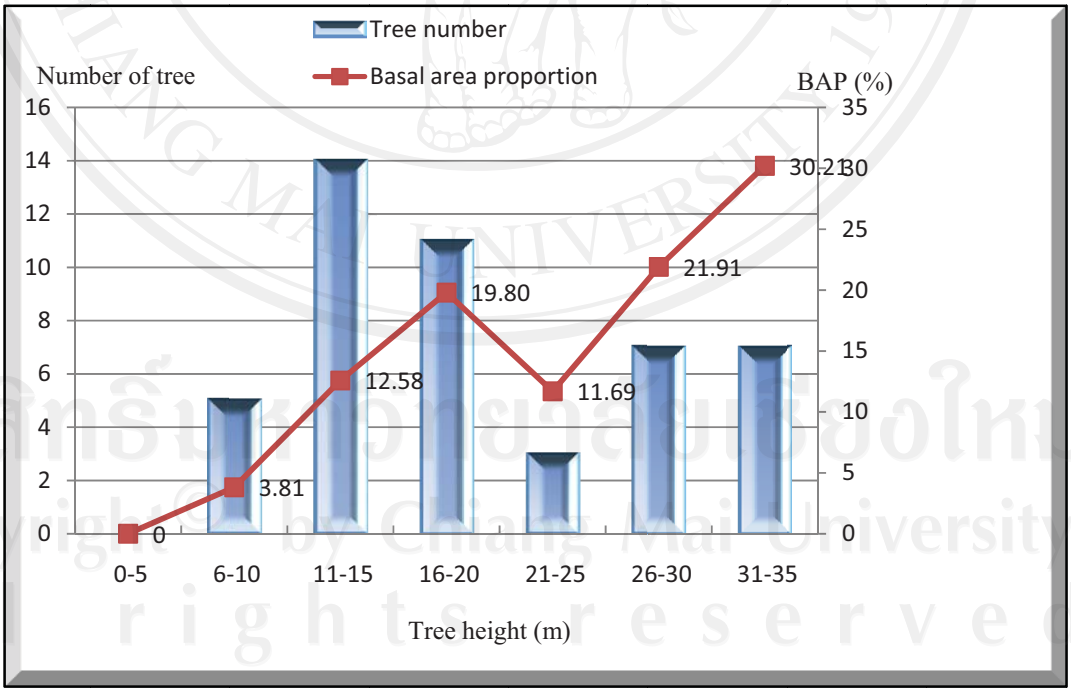


Figure 21 Basal area and number of trees in each height layer

Table 4.4.2 The comparison of characteristic in sampling plot No.1 or nest No.1 site with tree height layer, number of tree, percentage of number of tree, basal area and basal area proportion.

Height (m)	Number of tree Plot 1	Percent	Basal area (m^2)	Basal area proportion (%)
0-5	0	0	0	0
6-10	5	10.64	0.22	3.81
11-15	14	29.79	0.726	12.58
16-20	11	23.40	1.143	19.80
21-25	3	6.38	0.675	11.69
26-30	7	14.89	1.265	21.91
31-35	7	14.89	1.744	30.21
Total	47	100	5.773	100

2.2 Sampling plot No.2

The forest community was composed of 18 species 10 families and 120 trees. The highest number of trees were 23 *Lithocarpus elegans*. The highest IVI index was 33.5 for *Castanopsis diversifolia,* the number of trees was 22, which was less than *Lithocarpus elegans* (23 tree) but the RDo value was higher than for *Lithocarpus elegans*. (Table 4.4.3). The vegetation structure were compiled to map of the vertical profile and crown cover (Figure 22)

Table 4.4.3 Comparison of characteristics of nest No.2 site with tree species, number of tree, relative frequency(RF), relative density(RD), relative dominance(RDo) and Important value index(IVI).

No	Scientific name Plot 2	Number of tree	RF	RD	Rdo (%)	IVI
1	*Castanopsis diversifolia*	22	1.515	5.371	26.696	33.582
2	*Lithocarpus elegans*	23	3.030	6.138	17.726	26.894
3	*Castanopsis acuminatissima*	12	6.061	10.230	9.661	25.952
4	*Schima wallichii*	7	6.061	4.348	12.237	22.646
5	*Symplocos macrophylla*	17	4.545	7.673	6.246	18.464
6	*Picrasma javanica*	12	3.030	3.836	10.800	17.666
7	*Gluta obovata*	5	7.576	2.813	1.594	11.983
8	*Dalbergia oliveri*	1	6.061	3.836	0.574	10.471
9	*Quercus vestita*	5	3.030	2.046	4.298	9.374
10	*Mammea siamensis*	2	4.545	2.046	1.656	8.247
11	*Castanopsis calathiformis*	4	3.030	1.279	2.332	6.641
12	*Phyllanthus emblica*	2	4.545	1.535	0.497	6.559
13	*Engelhardtia spicata*	1	3.030	0.521	1.151	4.693
14	*Xylia xylocarpa*	1	1.515	0.256	1.413	3.148
15	*Canarium subulatum*	2	1.515	0.521	1.086	3.113
16	*Albizia lebbekoides*	1	1.515	0.256	1.063	2.834
17	*Ternstroemia gymnanthera*	2	1.515	0.512	0.590	2.617
18	*Diospyros glandulosa*	1	1.515	0.256	0.398	2.169
		120				

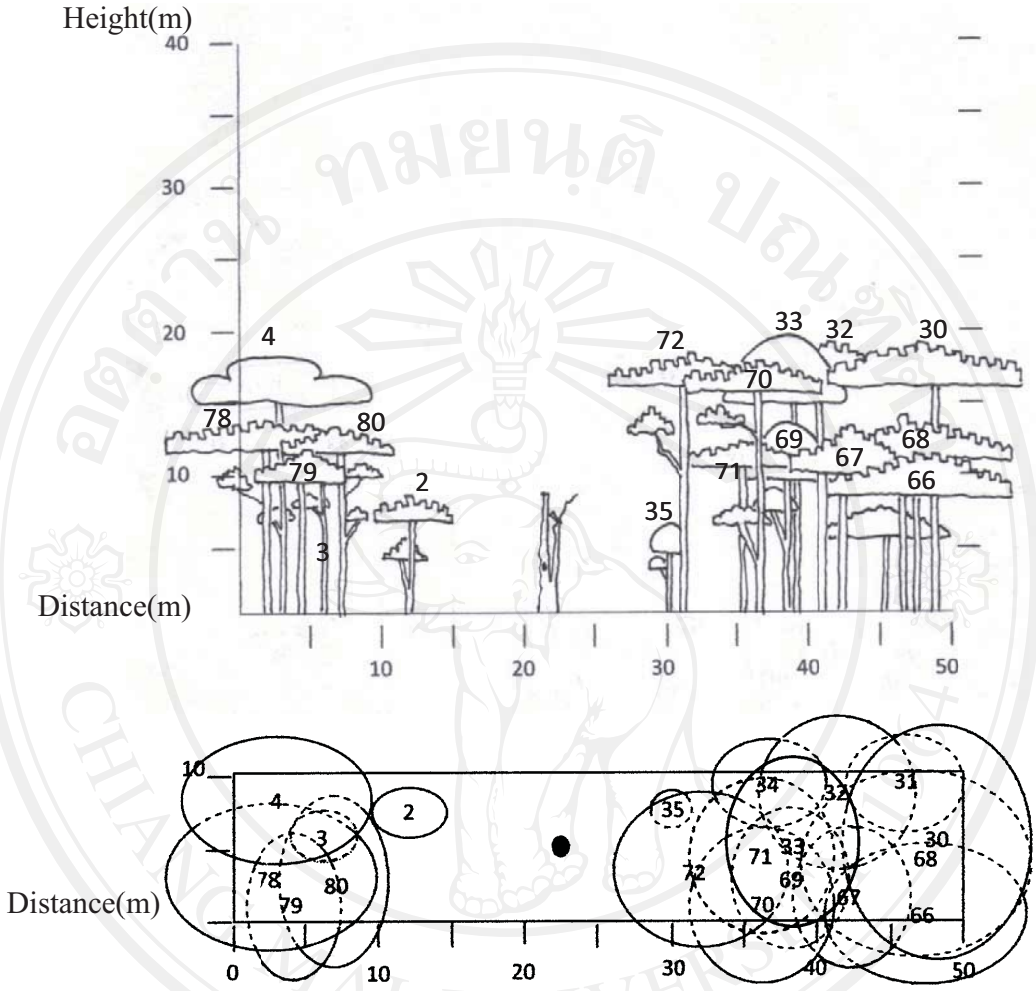


Figure 22 Profile diagram of the site around *Sitta magna* nest No.2. The top canopy layer was composed of *Castanopsis diversifolia* (30,32,70) *Schima wallichii* (33) *Lithocarpus elegans* (72) and *Xylia xylocarpa* (4). The upper middle canopy was composed of *Quercus vestita* (66,79) *Castanopsis diversifolia* (67,68,80,78,34) *Lithocarpus elegans* (31,71) *Schima wallichii* (69) and *Castanopsis calathiformis* (3). The middle canopy layer was composed of *Gluta obovata* (35) *Castanopsis diversifolia* (2).

Most trees were in the upper middle layers from 11-15m tall was 62 trees or 51.67%, such as *Lithocarpus elegans, Castanopsis acuminatissima,Castanopsis calathiformis, Engelhardtia spicata, Canarium subulatum,Mammea siamensis,Diospyros glandulosa,*and *Dalbergia oliveri*. Follow by middle layer from 6-10m tall was 31 tree or 25.83%, such as *Symplocos macrophylla, Phylllanthus emblica* and *Gluta obovata* follow by top canopy layer from16-20m tall, was 26 tree or 21.67%, such as *Castanopsis diversifolia*, *Xylia xylocarpa,Schima wallichii,Albizia lebbekoides, and Ternstroemia gymnanthera.* This plot was not taller than top canopy layer (Figure 23 and Table 4.4.4). BAP (Basal area proportion) values are show in table 4.4.4.

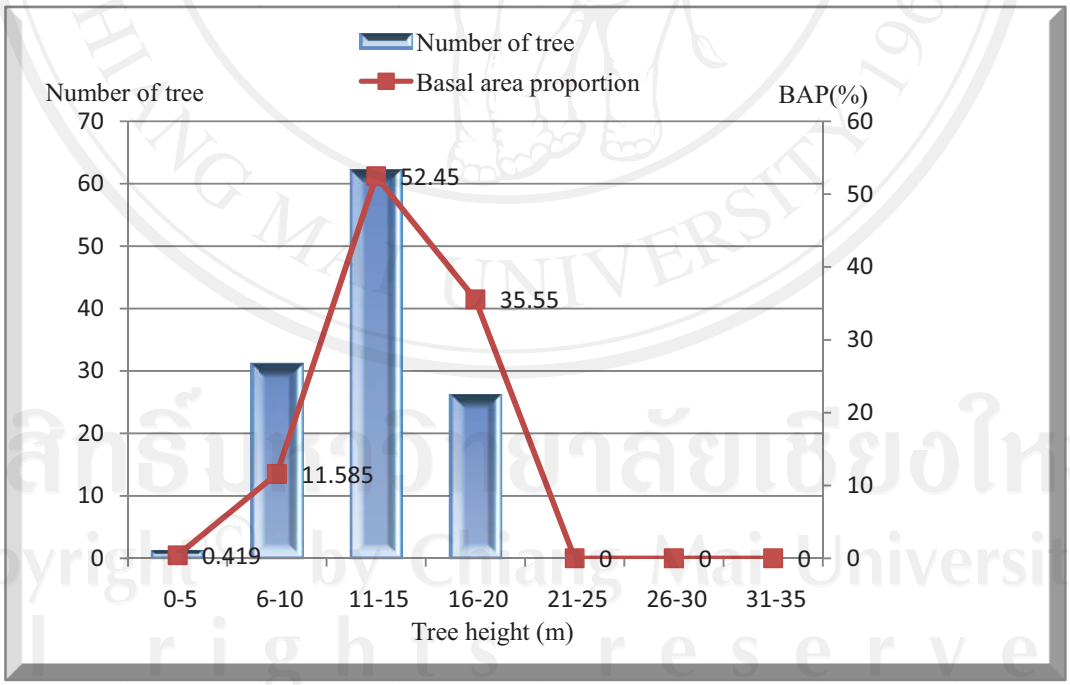


Figure 23 Compare basal area proportion and number of tree in each layer.

Table 4.4.4 The comparison of characteristic in sampling plot No.2 or nest No.2 site with tree height layer, number of trees, number of trees in percentage, basal area and basal area proportion.

Height (m)	Number of tree Plot 2	Percent	Basal area (m^2)	Basal area proportion (%)
0-5	1	0.83	0.03	0.419
6-10	31	25.83	0.829	11.585
11-15	62	51.67	3.753	52.45
16-20	26	21.67	2.544	35.55
21-25	0	0	0	0
26-30	0	0	0	0
31-35	0	0	0	0
Total	**120**	**100**	**7.156**	**100**

2.3 Sampling plot No.3

Sample plot No 3 was where *S. magna* was usually found foraging. The forest community was composed of 17 species, 14 families and 115 trees. Tree species represented by the highest number of trees were *Pinus kesiya* (45) followed by *Dalbergia oliveri* (12), *Lithocarpus sootepensis* (11) and *Symplocos macrophylla* (11), and other minor species (Table 4.4.5)

The highest IVI index was 93.105 of *Pinus kasiya (*which is in agreement with highest number of trees (45) and highest Rdo (67.862%), followed by 27.176 of *Lithocarpus sootepensis* and Rdo was 7.030% which included 11 trees, follow by 20.879 of *Castanopsis acuminatissima*, Rdo was 4.589% and included 3 trees which less than 12 trees of *Dalbergia oliveri* but IVI index was 14.246 which less than *Castanopsis acuminatissima*, because these trees were small trees or less RDo value (Table 4.4.5).

The vegetation structure were compiled to map of the vertical profile and crown cover (Figure 24)

Table 4.4.5 Comparison of characteristics of sampling plot No.3 which *S. magna* usually foraging site [tree species, number of tree, relative frequency (RF), relation density (RD), relative dominance (RDo) and Important value index(IVI)].

No	Scientific name Plot 3	Number of trees	RF	RD	Rdo (%)	IVI
1	*Pinus kesiya*	45	6.061	19.182	67.862	93.105
2	*Lithocarpus sootepensis*	11	4.545	15.601	7.030	27.176
3	*Castanopsis acuminatissima*	3	6.061	10.230	4.589	20.879
4	*Symplocos macrophylla*	11	4.545	7.673	2.477	14.696
5	*Dalbergia oliveri*	12	6.061	3.836	4.349	14.246
6	*Schima wallichii*	5	6.061	4.348	3.003	13.412
7	*Gluta obovata*	3	7.576	2.813	0.878	11.267
8	*Mammea siamensis*	5	4.545	2.046	2.274	8.865
9	*Picrasma javanica*	3	3.030	3.836	1.087	7.953
10	*Depterocarpus obtusifolius*	6	3.030	1.279	2.786	7.096
11	*Syzygium albiflorum*	1	3.030	3.325	0.426	6.782
12	*Butea monosperma*	3	4.545	1.535	0.538	6.619
13	*Stereospermum fimbriatum*	1	3.030	1.279	0.221	4.531
14	*Engelhardtia spicata*	1	3.030	0.512	0.162	3.704
15	*Turpinia nepalensis*	3	1.515	0.767	1.338	3.620
16	*Protium serratum*	1	1.515	0.256	0.547	2.318
17	*Lithocarpus polystachyus*	1	1.515	0.256	0.426	2.197
		115				

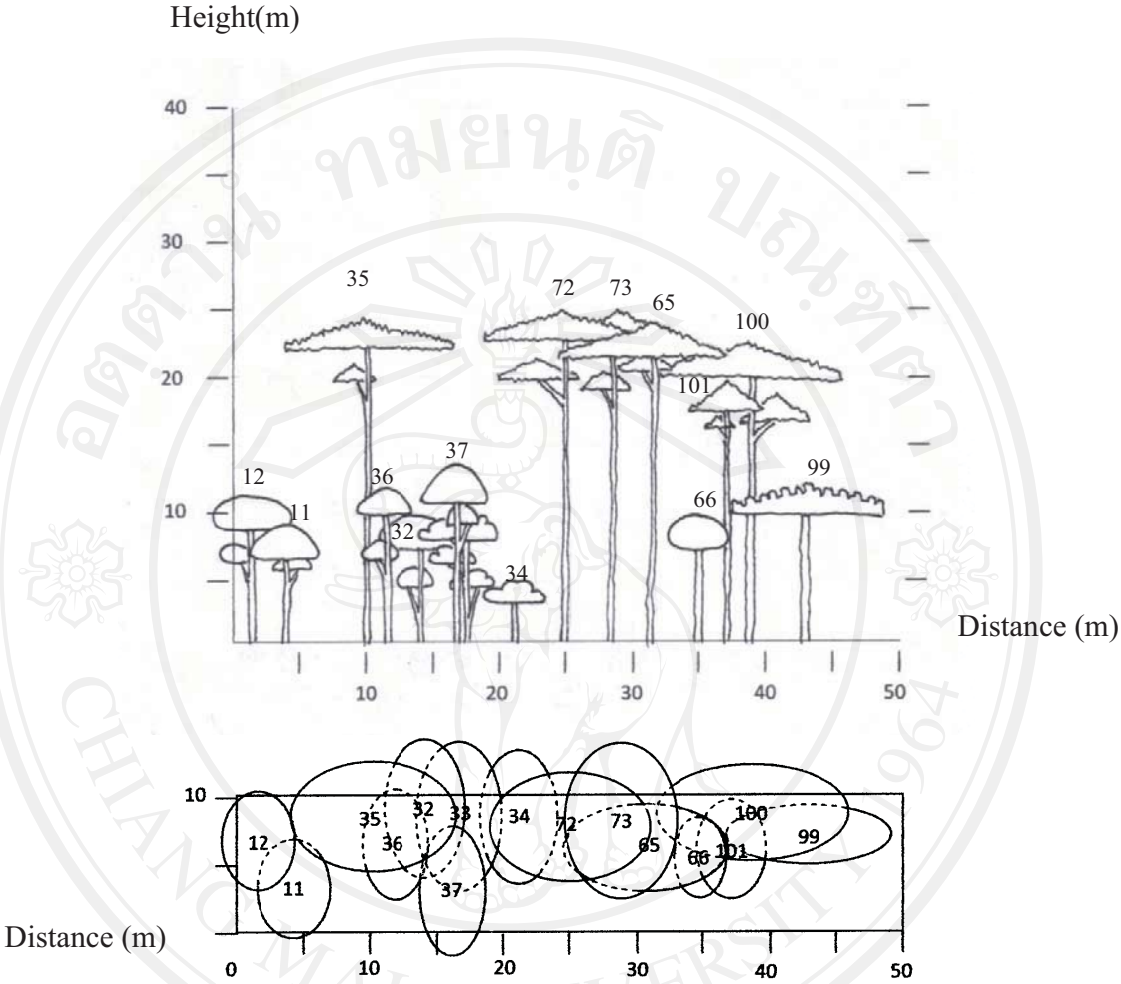


Figure 24 Profile diagram of the site around *Sitta magna* foraging area is sample plot No.3. The upper top canopy layer (21-25m tall) was composed of *Pinus kesiya* (100, 65, 73, 72, and 23). The top canopy layer (16-20m tall) was composed of *Pinus kesiya* (101). The upper middle canopy layer (11-15m tall) included *Lithocarpus sootepensis* (99), *Mammea siamensis* (37, 36) and *Dalbergia oliveri* (12) and *Symplocos macrophylla* (33). The middle canopy layer (6-10m tall) included *Dalbergia oliveri* (66, 32) and lower canopy layer (less than 6m tall) included *Symplocos macrophylla* (34).

Vegetation structure is defined in figure 25 and table 4.4.6. The highest number of trees was in the middle canopy layer from 6-10m tall was 35 tree or 30.43% and included *Symplocos macrophylla, Dipterocarpus obtusifolius, Gluta obovata, Butea monosperma, Turpinia nepalensis, Lithocarpus polystachyus, Schima wallichii*, and *Engelhardtia spicata.* BAP (Basal area proportion)value are show in table 4.4.6.

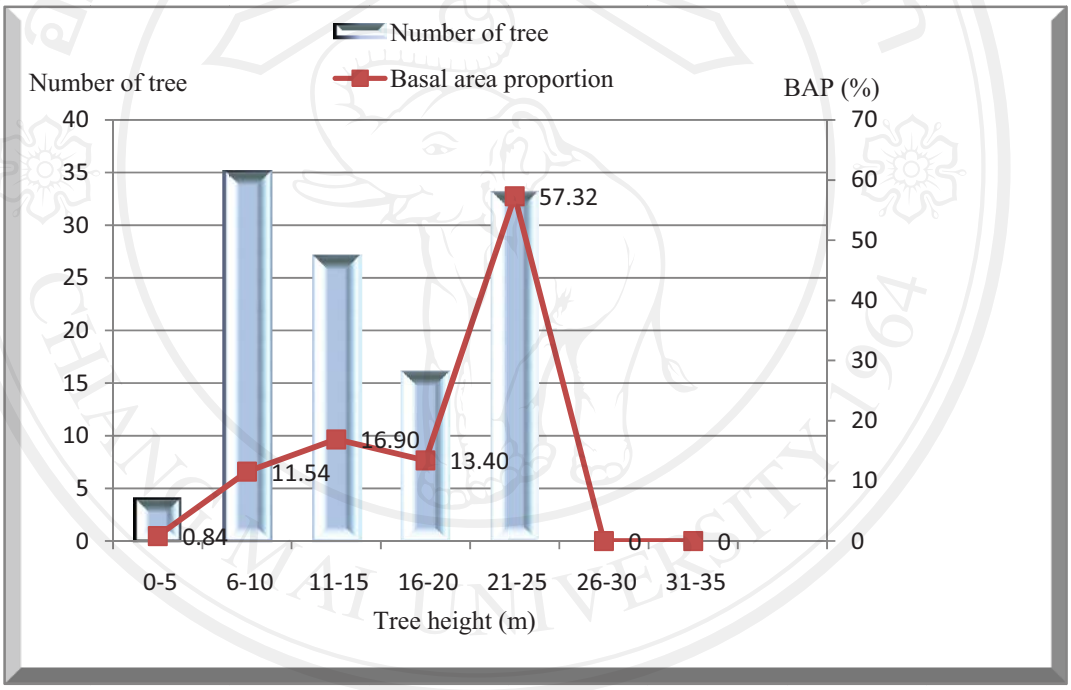


Figure 25 Basal area proportion and number of tree in each height layer.

Table 4.4.6 The comparison of characteristic in sampling plot No.3 with tree height layer, number of tree, number of tree in percentage, basal area and basal area proportion.

Height (m)	Tree number Plot 3	Percent	Basal area (m^2)	Basal area proportion (%)
0-5	4	3.48	0.07	0.84
6-10	35	30.43	0.966	11.54
11-15	27	23.48	1.415	16.90
16-20	16	13.91	1.122	13.40
21-25	33	28.70	4.798	57.32
26-30	0	0	0	0
31-35	0	0	0	0
Total	**115**	**100**	**8.371**	**100**

2.4 Sampling plot No.4

This plot was nest no.3 site and also a foraging site . The forest community was composed of 8 families 12 species and 53 trees. The highest number of tree species was 27 *Lithocarpus sootepensis* followed by 7 *Castanopsis acuminatissima.* The highest IVI index was 74.167 of *Lithocarpus sootepensis* which to be agreement with highest number of tree (27 trees) and highest Rdo value (54.021%), follow by 38.997 of *Pinus kesiya* but the number of tree was merely 3 trees, but the value of RF,RD were higher than other species (Table 4.4.7). The vegetation structure were compiled to map of the vertical profile and crown cover (Figure 26)

Table 4.4.7 Comparison of characteristics of nest No.3 site and *S.magna* usually foraging site with tree species, number of tree, relative frequency(RF), relation density(RD), relative dominance(RDo) and Important value index(IVI).

No	Scientific name Plot 4	Number of trees	RF	RD	Rdo (%)	IVI
1	*Lithocarpus sootepensis*	27	4.545	15.601	54.021	74.167
2	*Pinus kesiya*	3	6.061	19.182	13.754	38.997
3	*Castanopsis acuminatissima*	7	6.061	10.230	19.314	35.605
4	*Symplocos macrophylla*	2	4.545	7.673	0.630	12.848
5	*Gluta obovata*	1	7.576	2.813	0.854	11.243
6	*Lithocarpus elegans*	1	3.030	6.138	0.954	10.122
7	*Quercus vestita*	3	3.030	2.046	3.270	8.346
8	*Phyllanthus emblica*	4	4.545	1.535	2.216	8.296
9	*Butea monosperma*	2	4.545	1.535	0.828	7.004
10	*Depterocarpus obtusifolius*	1	3.030	1.279	1.539	5.848
11	*Castanopsis calathiformis*	1	3.030	1.279	1.143	5.452
12	*Vaccinium exaristatum*	1	1.515	0.256	1.380	3.151
		53				

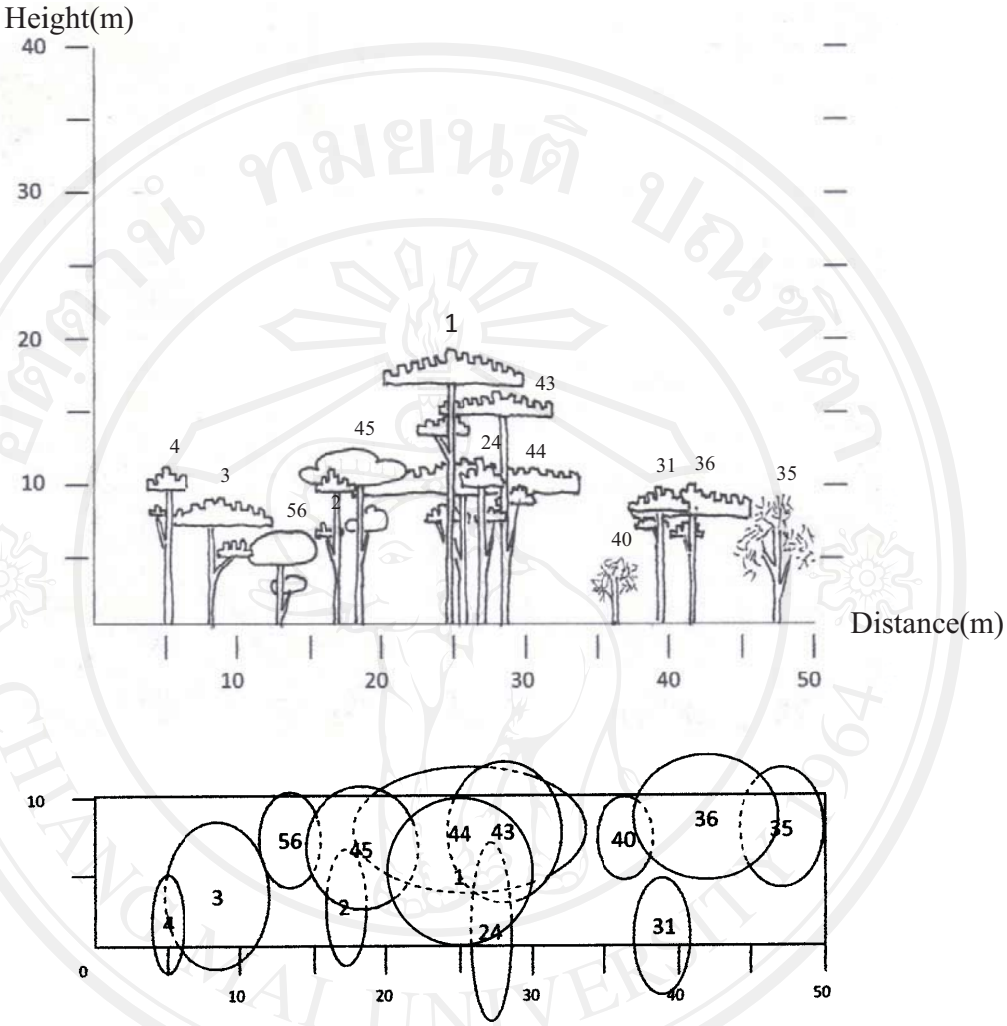


Figure 26 Profile diagram of the site around nest No.3 and usually foraging.

The top canopy layer was composed of *Lithocarpus sootepensis* (43, 1). The upper middle canopy layer was composed of *Lithocarpus sootepensis* (44, 24), *Dipterocarpus obtusifolius* (45), *Castanopsis acuminatissima* (2). The middle canopy was composed of *Phyllanthus emblica* (35), *Lithocarpus sootepensis* (36, 31), *Butea monosperma* (56), and *Quercus vestita* (3). The lower canopy layer was composed of *Phyllanthus emblica* (40).

Vegetation structure was defined in Figure 27 and Table 4.4.8. Most trees were in the upper middle canopy layer, from 11-15m tall (26 trees or 49.06%), such as *Lithocarpus sootepensis*, *Castanopsis acuminatissima, Lithocarpus elegans* and *Dipterocarpus alatus*,follow by middle canopy layer from 6-10m tall is 19 trees or35.85%, such as *Quercus vestita*, *Vacinium exaristatum*, *Gluta obovata, Phyllanthus emblica, Symplocos macrophylla* and *Butea monosperma*, follow by top canopy layer from 16-20m tall, was 6 trees or 11.32% such as *Lithocarpus sootepensis*, *Pinus kesiya*. The upper top canopy layer and lower canopy layer was composed of only one tree in each layer (Figure 26 and Table 4.4.8). BAP (basal area proportion) values are show in Table 4.4.8.

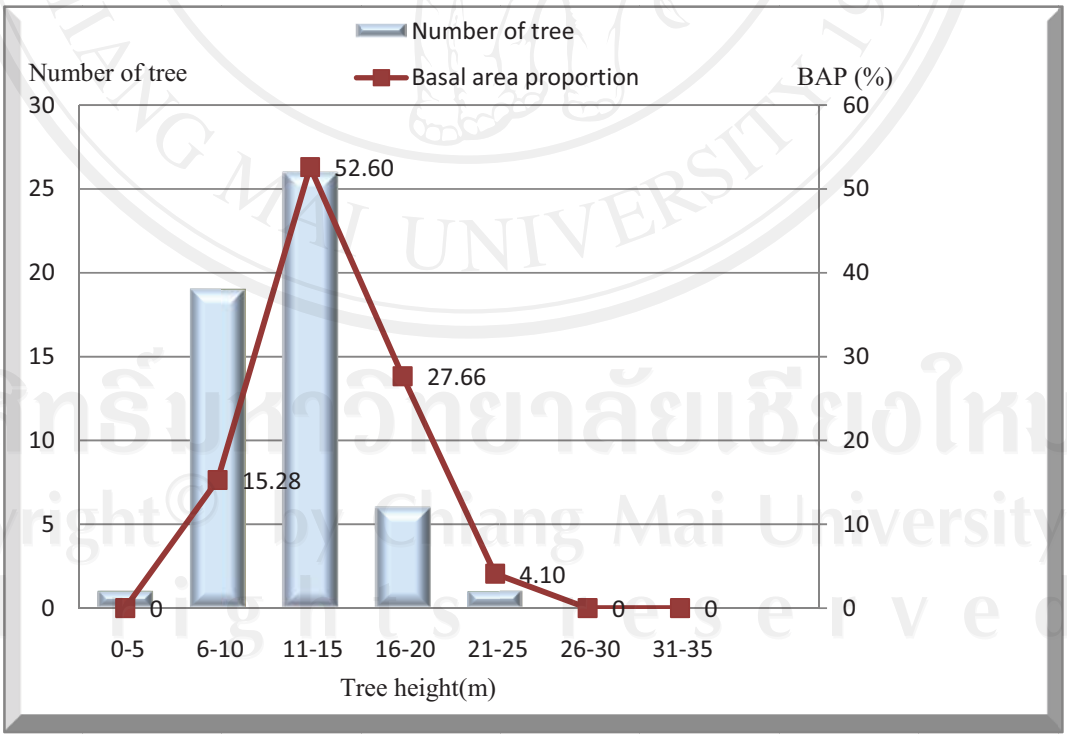


Figure 27 Basal area and number of tree in each height layer.

Table 4.4.8 The comparison of characteristic in sampling plot No.4 or nest No.3 site with tree height layer, number of tree, number of tree in percentage, basal area and basal area proportion.

Height (m)	Number of tree Plot 4	Percent	Basal area (m^2)	Basal area proportion (%)
0-5	1	1.89	.016	0.35
6-10	19	35.85	0.693	15.28
11-15	26	49.06	2.385	52.60
16-20	6	11.32	1.254	27.66
21-25	1	1.89	0.186	4.10
26-30	0	0	0	0
31-35	0	0	0	0
Total	53	100	4.534	100

2.5 Sampling plot No.5

This plot was where *S. magna* usually foraged. The forest community was composed of 7 families 8 species and 62 trees. The highest number of trees was 23 for *Lithocarpus sootepensis* followed by 19 *Castanopsis acuminatissima.* The highest IVI index was 61.384 of *Pinus kesiya* (Table 4.4.9), the number of *Pinus kesiya* was 14 trees which less than the number of *Lithocarpus sootepensis* (23 tree) but more IVI index, because *Pinus kesiya* was more RF, RD and Rdo value than *Lithocarpus sootepensis*. (Table 4.4.9). The vegetation structure were compiled to map of the vertical profile and crown cover (Figure 28)

Table 4.4.9 Comparison of characteristics of sampling plot No.5 which *S. magna* usually foraging site with tree species, number of tree, relative frequency (RF), relation density (RD),relative dominance (RDo) and Important value index(IVI).

No	Scientific name Plot 5	Number of trees	RF	RD	Rdo (%)	IVI
1	*Pinus kesiya*	14	6.061	19.182	36.141	61.384
2	*Lithocarpus sootepensis*	23	4.545	15.601	29.140	49.286
3	*Castanopsis acuminatissima*	19	6.061	10.230	24.183	40.474
4	*Gluta obovata*	1	7.576	2.813	5.699	16.088
5	*Schima wallichii*	2	6.061	4.348	2.934	13.343
6	*Dalbergia oliveri*	1	6.061	3.836	0.463	10.360
7	*Mammea siamensis*	1	4.545	2.046	1.135	7.265
8	*Phyllanthus emblica*	1	4.545	1.535	0.305	6.387
		62				

Vegetation structure is shown in Figure 29 and Table 4.4.10. The highest number of trees was in the upper middle canopy layer from 11-15m tall (25 tree or 40.32%), such as *Quercus brandidiana, Castanopsis acuminatissima*. Follow middle canopy layer from 6-10m tall was 22 trees or 35.48% such as *Phyllanthus emblica, Mammea siamensis, Dalbergia oliveri, Gluta obovata*, follow upper top canopy layer from 21-25m tall was 10 trees or 16.13% such as such as *Pinus kesiya*, follow by top canopy layer from 16-20m tall was 4 trees or 6.45% and tree height less than 6m tall was only 1 tree in *Castanopsis acuminatissima*. BAP (basal area proportion) values are show in Table 4.4.10.

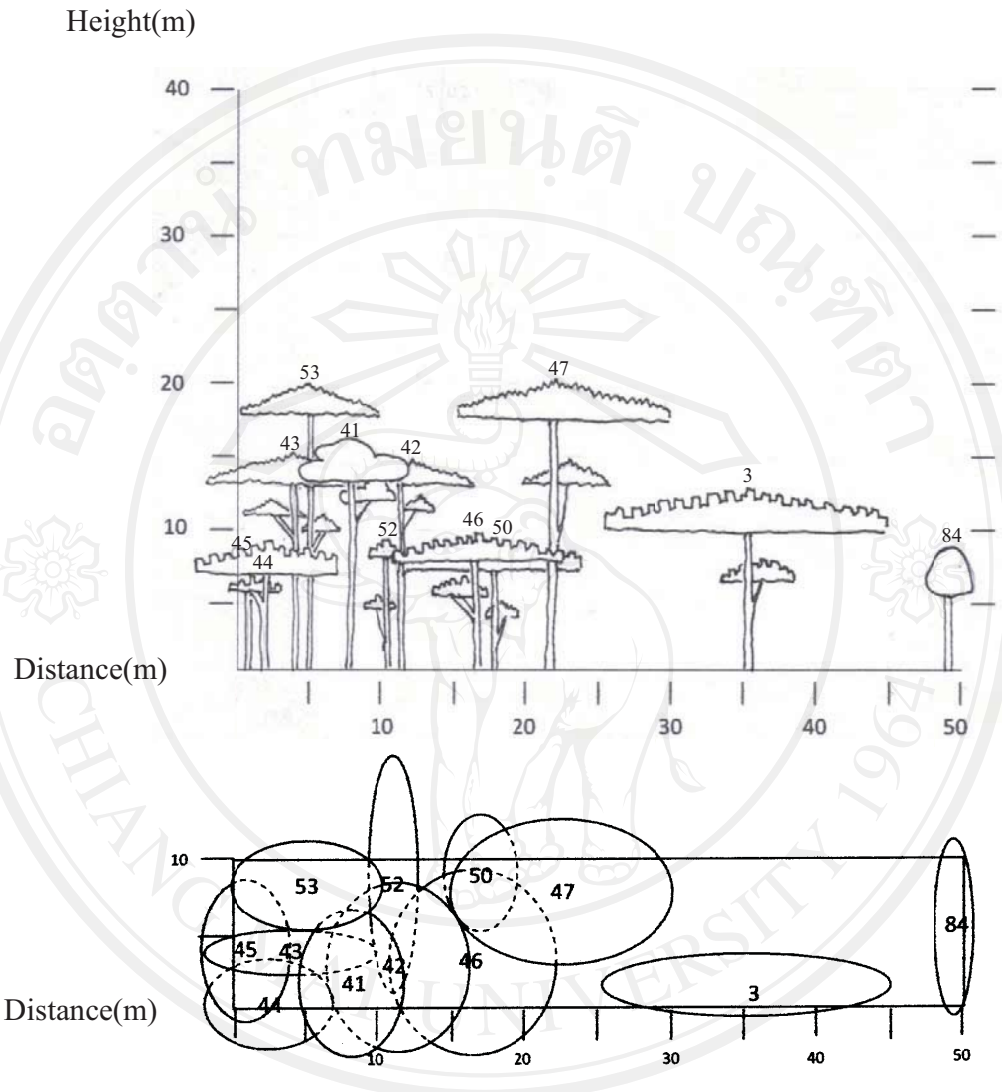


Figure 28 Profile diagram of the site around *S. magna* usually foraging.

Top canopy layer was composed of *Pinus kesiya* (47, 53), *Schima wallichii* (41). The upper middle canopy layer was composed of *Castanopsis acuminatissima* (3), *Pinus kesiya* (42, 43). The middle canopy layer was composed of *Gluta obovata* (84), *Lithocarpus sootepensis* (50), *Castanopsis acuminatissima* (46, 52, 44, 45).

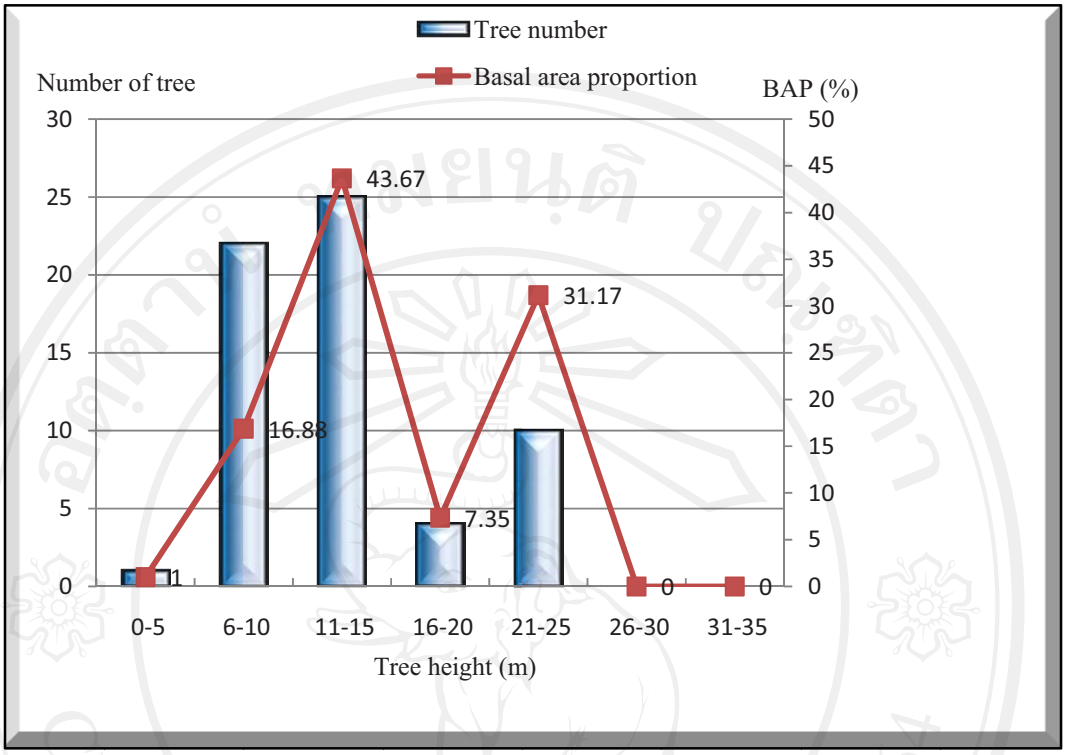


Figure 29 Basal area and number of tree in each height layer.

Table 4.4.10 The comparison of characteristic in sampling plot No.5 with tree height layer, number of tree, number of tree in percentage, basal area and basal area proportion.

Height (m)	Tree number Plot 5	Percent	Basal area (m^2)	Basal area proportion (%)
0-5	1	1.61	0.048	1
6-10	22	35.48	0.81	16.88
11-15	25	40.32	2.096	43.67
16-20	4	6.45	.353	7.35
21-25	10	16.13	1.496	31.17
26-30	0	0	0	0
31-35	0	0	0	0
Total	62	100	4.803	100

Species diversity index (H'): Species diversity index was calculated as a combination tree species richness and abundances, so high species diversity index indicates a high number of species and even distribution of the individuals among the species (Table 4.4.11). The H' index did not affected to nest selection (Cavity nest were plot no 1, 2 and 4).

Table 4.4.11 Species diversity index (H') of five sampling plots.

	Plot no 1	**Plot no 2**	**Plot no3**	**Plot no 4**	**Plot no5**
H	0.819	1.127	0.982	0.887	0.770

Five plots were small similarity value. Similarity indices were calculated for each pair of plots (Table 4.5.2).

Table 4.4.12 Matrix of similarity indices (SI) in percent for 5 plots

					Plot No.	
				-	5	
			-	4.48	4	
		-	2.275	3.794	3	SI
	-	1.88	2.412	4.005	2	
	-	2.55	2.382	3.007	4.806	1
Plot No.	1	2	3	4	5	
	Similarity indices (SI)					

3. Vocal communication

The calls of birds are described from element, phrase and sentence from sonogram. An element is words or syllables of the bird call. A phrase is composed of similar element of bird call and motif composed of different elements of bird calls. A sentence is composed of more than one of phrase of a bird call. The vertical axis of a sonogram shows the frequency of bird calls (kHz) and the horizontal axis shows duration (in seconds).

3.1 Vocal communication patterns

3.1.1 Individual recognition: Individuals of *S. magna* have specific calls with different patterns (sonogram) such as the number of words or different frequencies or durations of call.

The sonogram in Figure 30 shows the different call patterns of two *S. magna*. The left phrase was composed of 8 elements; the frequency was between 1.8-2.3 kHz, duration was 1.3 seconds. The right phrase was composed of 7 elements, the frequency was between 1.3-2.4 kHz and duration was 1.1 second.

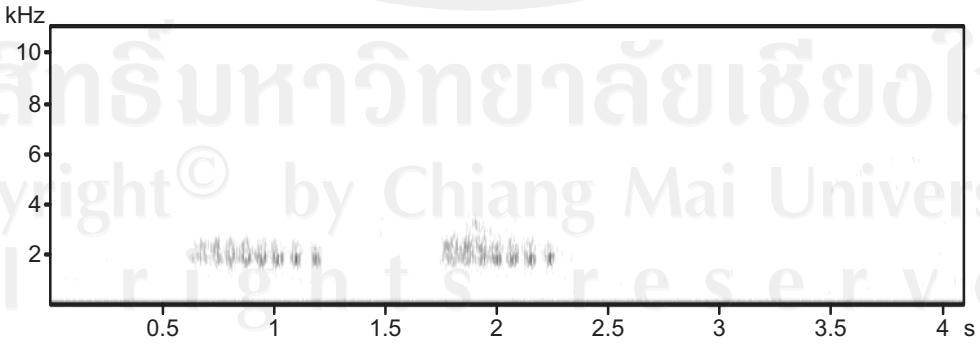


Figure 30 Different call patterns of two *S. magna*.

3.1.2 Begging call**:** The *S. magna* begging call is comprised 2 patterns : distant begging call and close begging call.

3.1.2.1 Distant begging call: A distant begging call is defined as the nestling call when their parents forage away from the nest. If the nestlings cannot see their parents, they usually make a begging call. The nestlings usually are hungry because they usually defecate after being fed. The patterns of begging calls were similar to adult calls. There was one element, sonorously and repeatedly, the frequency was between 1-3 kHz, word duration was 1.3 second (Figure 31). The nestlings call begging at the entrance of the nest cavity by emerging their heads out of the nest cavity.

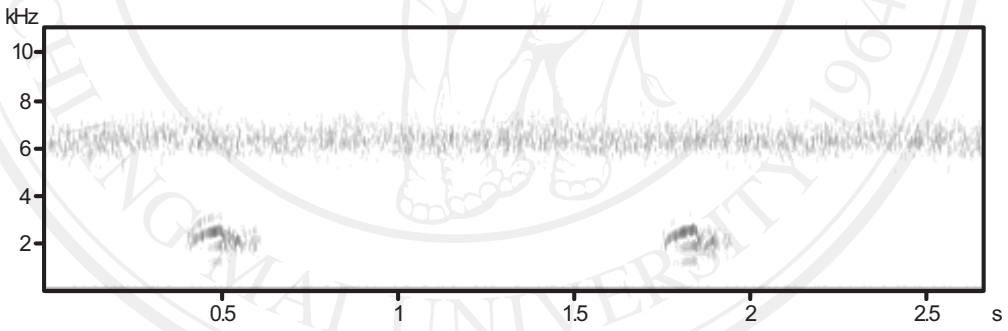


Figure 31 The patterns of distant begging calls of *S. magna* nestling showing two uttered rasping.

3.1.2.2 Close begging calls: Close begging calls were defined as the nestling call when the parents returned to the cavity nest with food. Close begging calls in *S. magna* nestling were was a frequent loud vibration, repeatedly and clearly. The frequency was between 1-3.5 kHz, but was not stable. Some phrases were comprised of 6 elements but some phrases were comprised of 4 elements (Figure 32).

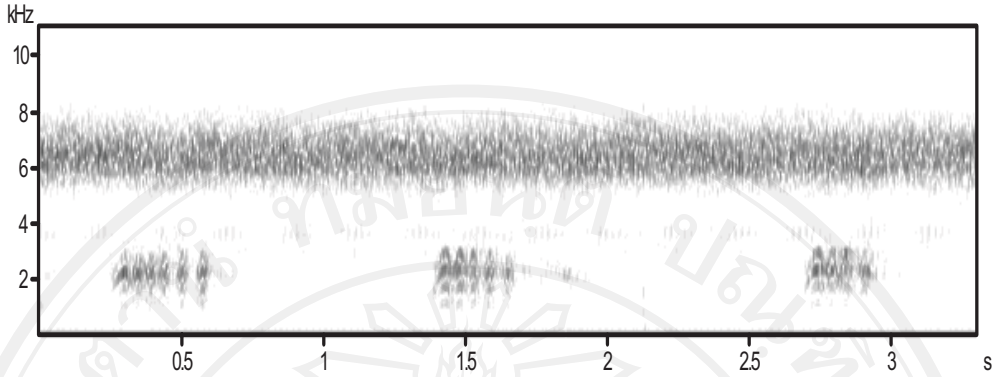


Figure 32 Sonogram of the close begging call of *S. magna* nestling showing three uttered repeatedly.

3.1.3 The development of nestling calls: *S. magna* nestlings live in a deep cavity nest (approximately 28-33cm deep). Birds calls were unclear until the nestlings climbed to the cavity entrance successfully (approximately 18 days of age) and they called almost completely or nearly as adult call, that is the number of word and word interval were inconstant until two days before fledging, they called completely when they fledged (approximately 24 days of age).

Figure 33 shows the sonogram of normal development of *S. magna* nestling. (A) Nestlings at 18 days of age could show their head at the nest entrance. After begging call or successful feeding, they called one element with a harsh and terminal flourish. The interval element was 1.7 seconds. It was probable that the nestlings heard the parent call nearby. (B) At 19 days of age, the terminal flourish in some words disappeared. The interval element was 2.2 seconds and was inconstant. (C) At 21 days of age, the terminal flourish disappears completely. The rhythm became almost constant and the interval

elements were 1.7 seconds. (D) At 23 days of age, the nestling call was complete. They call loudly and continuously. The interval element was constant at 2.2 seconds.

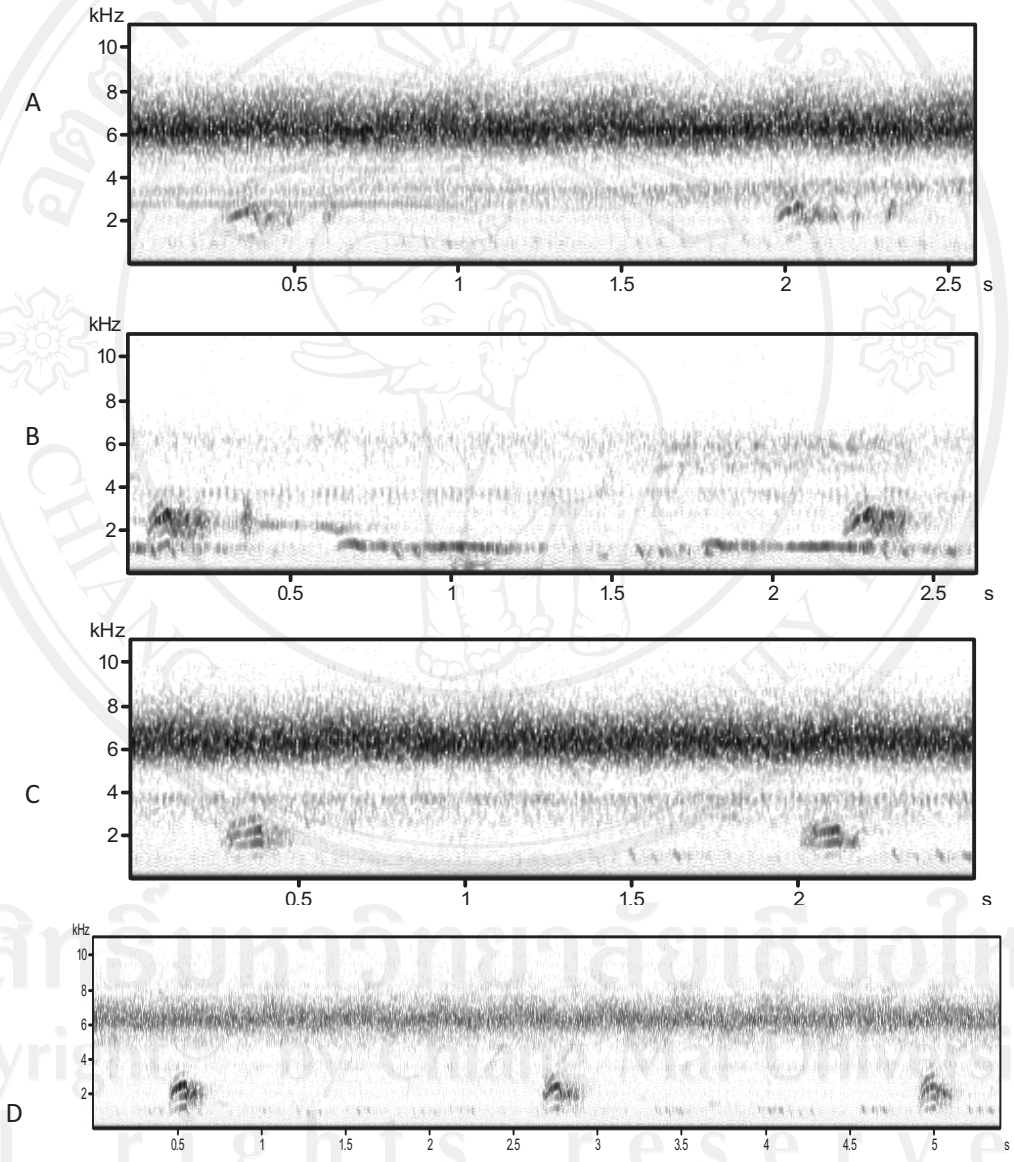


Figure 33 Sonogram of normal development of *S .magna* nestling (in red quadrilateral).

3.1.4 Feeding call: The parent call for signal to their young when back to the nest after foraging, this call was communication to the young. This call was smooth to whimper repeatedly in quick and long continuousness. The parents call feeding from throat like whimper sound while hold some food in their bill. Feeding call pattern was inconstant, unequal of the number of element in each phrase, inconstant of phrase interval. The frequency was between 1.8-2.2 kHz which lowers than other call of *S. magna* (Figure 34.)

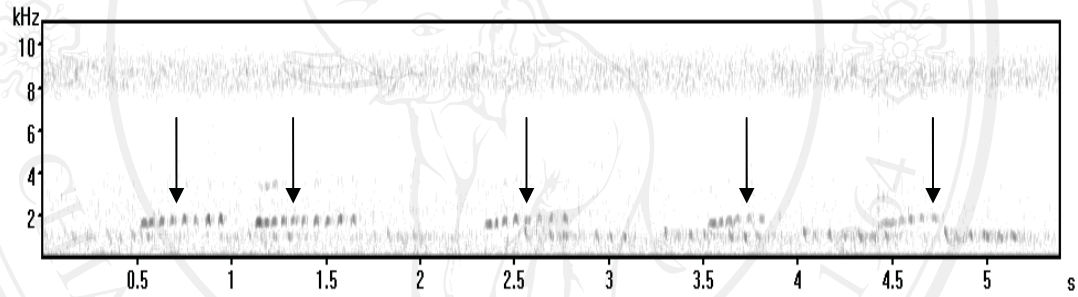


Figure 34 Sonogram of feeding call of *S. magna* parent.

3.1.5 Alarm call: After parent fed to their young, they usually perch near cavity entrance to be aware of predators and call alarm repeatedly.

Alarm call characteristic was rough repeatedly, loudly and hardened. A phrase of alarm call comprised of 5 elements approximately in similar element, like tongue teetering, phrase interval inconstant, frequency period was between 1-3 kHz (Figure 35).

3.1.6.Exciting call or exclaim call: This call by parent was exclaimed, for example, the parents hold insect in their mouth to the nest, but the insect escaped, so the parent call exciting and climbed quickly to caught the insect again.

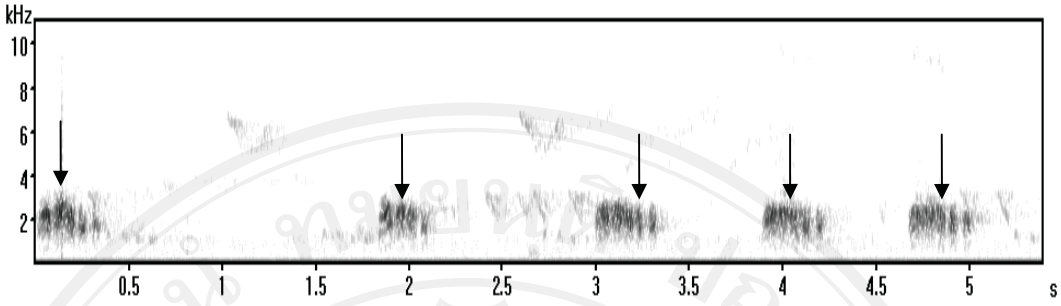


Figure 35 Sonogram of alarm call of *S. magna*

Exciting call shown in figure 36 was composed of two different motivs in a sentence. The first motiv was composed of 5 elements and the second was composed of 4 elements. These motivs had two similar elements at the end (element 4, 5 and 8, 9).

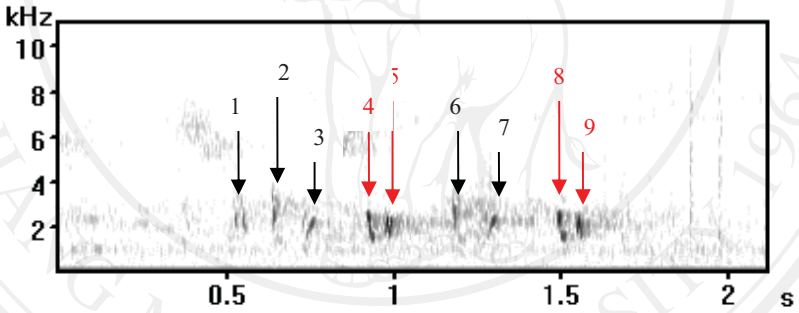


Figure 36 Sonogram of exciting call or exclaim call of *S. magna*.

The exciting call is an innate call with almost constant pattern because each motiv had two elements that was constant similarity. These calls were at a higher 3.5 kHz frequency than other calls, approximately. Each motiv began with a higher frequency and with lower at the end.

3.1.7. Territorial call: After foraging, male call territorial by perch head down invert near nest for protect our area from other male but invite female. Territory call composes of 4 patterns.

3.1.7.1 Rough or hoarse quivering, this call include 6-8 elements in a phrase (Figure 37).

3.1.7.2 Call one element of reverberation (Figure 38).

3.1.7.3 Call two element of hiccup (Figure 39).

3.1.7.4 Call one element of whistle (Figure 40).

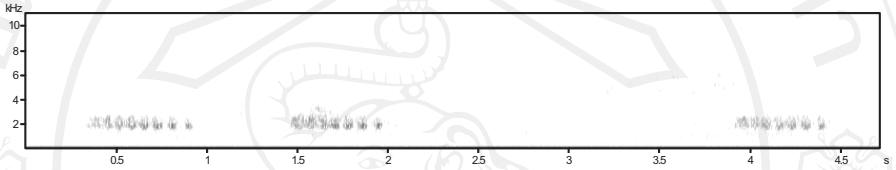


Figure 37 Sonogram of territorial call in rough or hoarse quivering of *S. magna*.

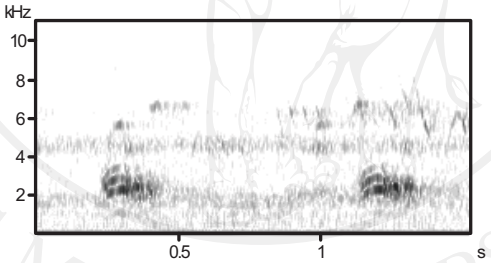


Figure 38 Sonogram of territorial call in one element of reverberation of *S. magna*.

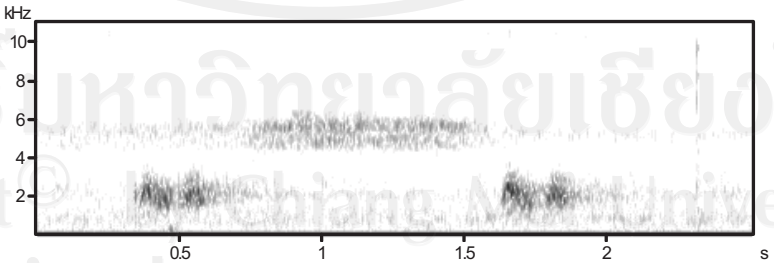


Figure 39 Sonogram of territorial call in two element of hiccup *S. magna*.

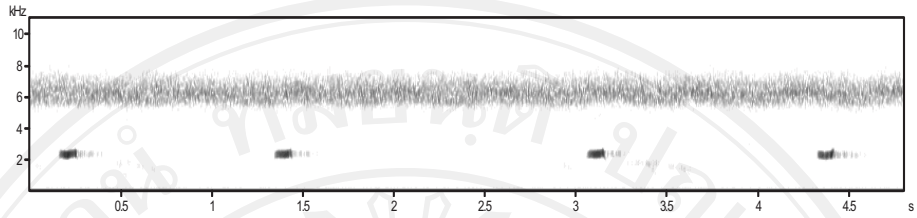


Figure 40 Sonogram of territorial call in one element of whistle *S .magna*. The duration of "whistle" call between 0.2-0.3 second.

3.1.8 Contact call or duet call: *S. magna* have calls contact or duet call for communication between individuals of the same species. They usually perch or attach stagnant along tree trunk when they call. The contact call was composed of 4 patterns of the observation.

3.1.8.1 Duet call: First *S. magna* call "quivering" and another *S. magna* respond by "whistle" call (Figure 41). Figure 41 shows the sonogram which was composed of two phrases of hoarse quivering" voice of the first *S. magna* ("Quivering" call at first) and two elements of" whistle" voice of another *S. magna* for respond ("whistle" call respond). The call at first was composed of 1-3 phrases. Likewise the responding call was composed of 1-3 phrases.

3.1.8.2 Duet call: First *S. magna* "hiccough" calls two times and responded by "whistling calls two times (Figure 42). They call duet for their territory. Figure 42 show sonograms for two phrases of "hiccough" call continuous of the first *S. magna* sometime was composed of five or more phrase continuous. Next, another *S. magna* "whistling" call continuous for respond. The duration of "whistle" call was

between 0.5-0.8 second. This duration was longer in duration than whistle of territory call.

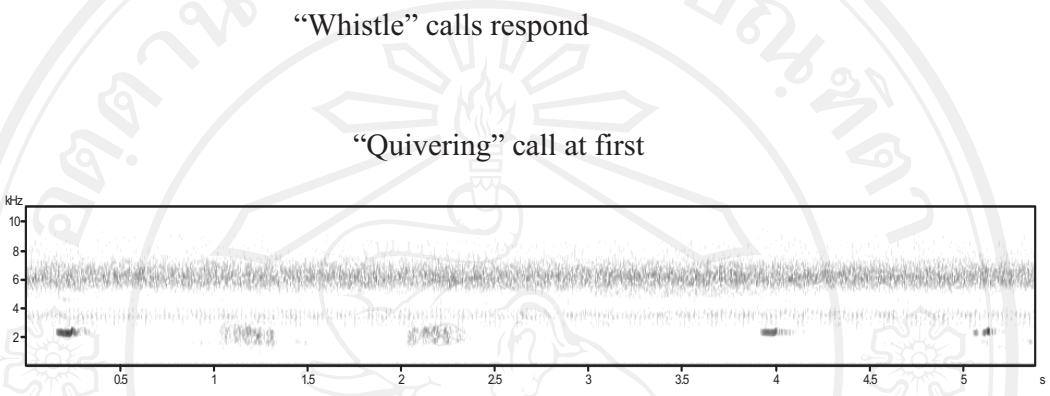


Figure 41 Sonogram of duet call by "quivering" call at first and responds by "whistle" call.

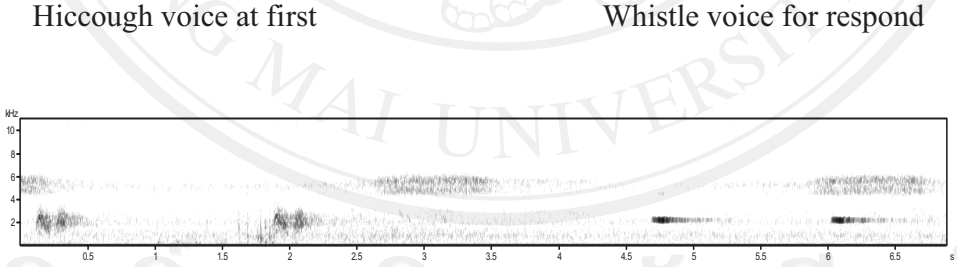


Figure 42 Sonogram of duet call by hiccough call at first and whistle call for respond.

3.1.8.3 The contact call was only one phrase of reverberation of stimulus call. The responds by call hoarse quivering(Figure 43). This contact call may not be communication between male and female because stimulus calls were interfered with responded call almost overlay. This call may be territories call.

3.1.8.4 Contact call by whistle stimulus and another bird responded by whistle. The bird call stimulus by high frequency of whistle continuously 2-4 element till another bird responded by whistle and may be more element that stimulus call.

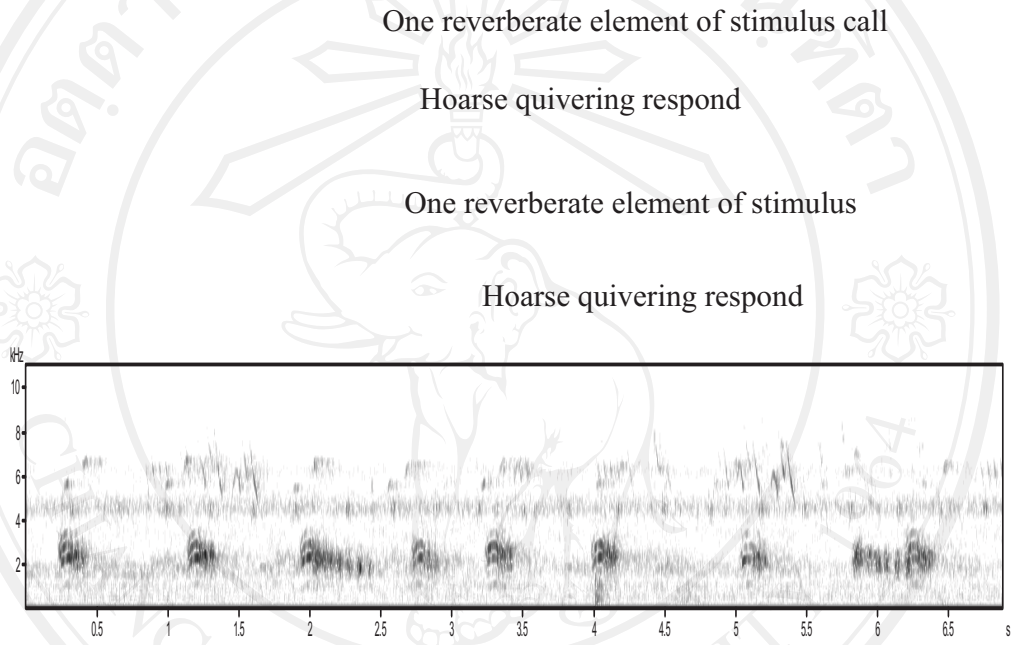


Figure 43. Sonogram of contact call by one element of reverberation calls and responds by hoarse quivering calls.

3.1.9 Aggressive call: Aggressive behavior may be interspecific or intra-specific. Interspecies aggression was protection and rivalry call. Most species of birds struggle for nest sites. Intra-species aggressive was behavior for struggle activity for female to meeting in breeding period. Aggressive calls of *S. magna* were composed of 2 patterns.

3.1.9.1 Call loudly, steady and constant for territorial. Figure 44 shows a sonogram of constant rhythm and steady vibrate three elements. Birds perched on the top of a perch near their territorial and called to protect their broadly territorial.

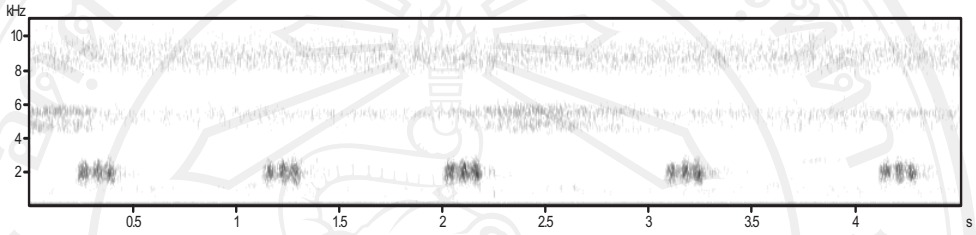


Figure 44 Sonogram of aggressive call by constant rhythm of *S. magna*.

3.1.9.2 Calls vibrate repeated in quick when were invaded by enemy or protected their nest, food source (Figure 45).

Normal call Aggressive call

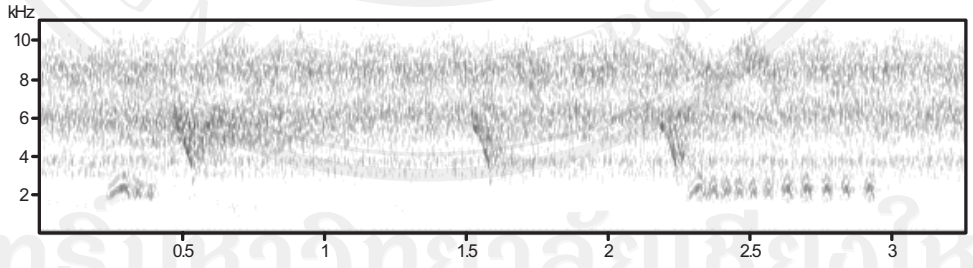


Figure 45 Sonogram of aggressive by call vibrate repeated in quickly when enemy approached.

Figure 45 shows sonogram of different normal calls and aggressive calls that normal call is one reverberant element, if the enemy approached they call hoarse quivering repeatedly (11 elements continuously); in normal situation they call 3-7

element repeatedly.

3.2. Responses to playback of local vs. distant contact calls in *S. magna*.

Responses to playback of local and distant contact calls in *S. magna* were trialed by recording the contact calls of *S. magna* at Angkang forest, Fang District, Chiang Mai province away from the sample plots about 70 km in January 2005, this was breeding period of *S. magna*. The calls were transferred to sonogram using Avisoft-SAS Lap Pro version 4.53. Respond calls were extracted leaving only the stimulus calls, which were played back to local *S. magna* at Den Ya Kad forest in five sample plots.

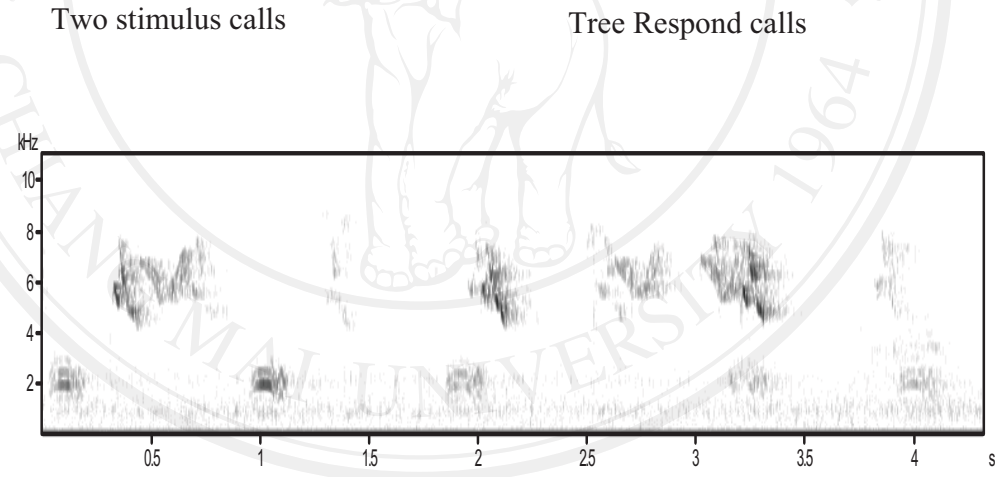


Figure 46 Structure of contact calls at Doi Ankang, two elements first is stimulus calls and three faded elements is respond calls.

Stimulus calls were played back 50 times to *S. magna* in the sample plots (10 stimulus in 1 plot), but only one respond call was heard.

S. magna at Den Ya Kad forests did not respond to calls of *S. magna* from a different location. This indicates that isolated *S. magna* populations develop distinctive dialects, unrecognizable by other populations.

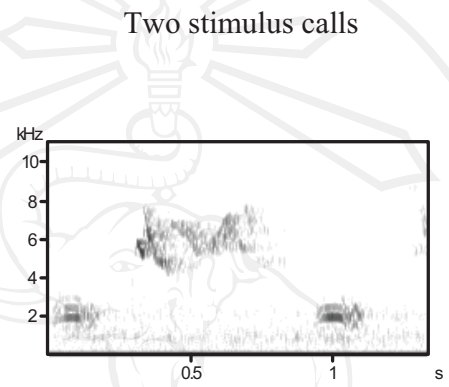


Figure 47 Two stimulus calls remain after extraction of "respond" calls.