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Behavior of the Giant Nuthatch (*Sitta magna*)

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Abstract: This study describes the foraging and breeding behavior of the Giant Nuthatch (*Sitta magna*) in Northern Thailand. The study was done in 50×50 m plots where *S. magna* is usually found in the Chiang Dao Wildlife Sanctuary, Chiang Mai province. Observations were made once per month. The proportion of each direction of foraging and the proportion of tree species used for foraging were compared using binomial test. Breeding behavior was assessed using the focal-scan method on a trail from Den Ya Kad Check Point to San Pa Kiey sub office of Chaing Dao Wildlife Sanctuary, Chiang Mai Province. The tree species used in the test for foraging non-significant proportion of *Pinus Kesiya* was 0.7 and other species was 0.3 ($p = 0.487$, $\alpha = 0.05$), indicating that *S. magna* used more proportion of *Pinus kesiya* than other tree species for foraging. During January and February, about 5-8 *S. magna* foraged together for courtship and mating. Males followed and tried to fed females. Both males and females shared parental care tasks. *S. magna* used second cavity in *Pinus kesiya*, *Lithocarpus sootepensis* and unknown species dead trees for nests. Nestling left the nest at the average of 22.67 days old (from three nests). It is hoped that this study will be used for education policy making and in implementing action plans for the conservation of birds and biodiversity in this sanctuary.

Key words: Vegetation characteristic, foraging behavior, breeding behavior, giant nuthatch, bionominal test

INTRODUCTION

Chiang Dao Wildlife Sanctuary conserves 52,100 hectare for wildlife management and was established in 1978. This sanctuary was stipulated as an important area by the Important Birds Area Program in 1998 and supports Hume's Phaesent (*Syrrmaticus humae*) and Giant Nuthatch (*Sitta magna*) (Round *et al*., 2004).

Wildlife data, especially on birds, have been collected continuously under project such as Wildlife Observation in Chiang Dao Wildlife Sanctuary supported by DANIDA, Biodiversity Survey supported by the Department of National Parks Wildlife and Plant Conservation. These projects studied overall diversity and distribution of birds but did not concentrate on particular bird species. Data on rare wildlife species, such as giant nuthatch (*Sitta magna*) had no details of behavior, habitat and population ecology.

Giant Nuthatch (*Sitta magna*) is a small passerine bird in the order Passeriformes family Sittidae and genus *Sitta*. The Giant Nuthatch inhabits the coniferous forest and mixed coniferous and broadleaf forest at 1,000-2,000 m (BirdLife International, 2009). The coniferous forest and mixed coniferous in Chiang Dao Wildlife Sanctuary were composed of *Pinus kesiya*, *Phyllanthus emblica*, *Gluta usitata*, *Lithocarpus polystachyus* (Maxwell, 1998).

The species is distributed through out three countries, Southern China, Western Burma and Northern Thailand. Thailand records are from high mountains, including Doi Pha Hom Pok, Doi Ang Khang and Doi Chiang Dao and confusion between *S. magna* and *S. nagaensis* at Doi Suthep-Pui National Park and Doi Inthanon National Park, Chiang Mai Province (Birdlife International, 2009).

This study addresses two major components of the species' ecology i.e., foraging and breeding behavior.

Tree species preferred for foraging was also studied by counting the frequency with which each tree species was used for foraging. This study was to test the hypothesis that *S. magna* selected *Pinus kesiya* more than any other tree species for foraging. Observations of breeding behavior were carried out to determine the pattern and periods of mating, courtship, copulation, nest building, egg-laying, incubation, hatching and parental care.

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MATERIALS AND METHODS

Study area: The study area was approximately 7 km^2 in Chiang Dao Wildlife Sanctuary, northern Thailand (19°20'-19°23'N and 98°50'-98°52'E) with an altitudinal range of 1,200-1,600 m. The vegetation was characterized by Pine Forest and Hill Evergreen Forest where pine forest include *Pinus merkusii*, *Pinus kesiya*, *Quercus vestita* and *Quercus polanci*. Hill Evergreen Forest areas are such as *Betula alnoides*, *Cephalotarous griffithi* (Saidee, 2006).

Foraging behavior: Climbing direction for foraging observations were carried out in five point count sampling plots. The 50×50 m plot was laid, where *S. magna* is usually found. Observations were carried out from January 2005 till January 2006, one day per month from 08:00 am till 05:00 pm in a day. Manner of flight to attach itself to tree trunk and climbing up and down were observed at this time.

Tree species were preferred for foraging behavior as assessment of tree species preferred for foraging was conducted at the same site and time. The number with which each tree species was used was recorded. The data were compared by using the binomial test.

The vegetation characteristic in five sampling plots were collected for all trees with dbh >30 cm. Tree species, the number of tree and the position of each tree were recorded. Trees were divided into four layers according to height. First, the emergent or super canopy layer trees were defined as those which were 26-35 m in height. Top canopy or upper layer trees were defined as those which were 16-25 m high. Middle layer trees were defined as those which were 6-15 m high and lower layer trees which were defined as those which were <6 m high. The 10×50 m plots were laid in each sampling plot to produce the map of the vertical profile and crown cover of the plant.

Breeding behavior: The breeding behavior was studied along the trail from Den Ya Kad Check Point to San Pa Kiew sub station of Chiang Dao Wlidlife Sanctuary, where the *S. magna* is usually found and at nesting sites from 08:00 am till 05:00 pm every day from January to April in 2006 and 2007. Data were collected using the focal-scan method. The behavior of the male and females at nest were observed. The nestling age was identify by the female which began out off the nest after continuously living in nest for hatching. That the parent took out the nestling's fecal sac with this period may be a successful hatching and a start of nestling age. The relationship between nestling age and number of visitations for feeding were analyzed by linear regression.

RESULTS

Foraging behavior: Climbing direction for foraging Giant Nuthatches foraged along tree trunks and branches. The bird attaches itself to tree trunks with its body paralleled to the ground and two legs vertical to the ground. It moves up and down the tree trunk with its body vertical to the ground, while two legs remain vertical to the ground position.

Tree species were preferred for foraging behavior: *S. magna* habitat (Sample plot No. 1-5) was composed of 75 *Pinus kesiya* and 322 other species. This was non-significant more proportion of the number of other tree species than the proportion of the number of *Pinus kesiya* ($p = 0.312$, $\alpha = 0.05$).

Tree species were preferred for foraging found that *S.magna* used 231 *Pinus kesiya* and 78 others species. This was non-significantly more proportion of *Pinus kesiya* than proportion of others species ($p = 0.487$, $\alpha = 0.05$). So, *S.magna* preferred *Pinus kesiya* more than other species for foraging.

The vegetation characteristic in sampling plots (nest site): Sampling plot No. 1 (Nest No. 1) was composed of 11 species of 47 trees. The highest number of tree was 13 trees in *Pinus kesiya*. The emergent layer (26-35 m tall) was composed of *Pinus kesiya*, *Erythrima subumbrans*, *Syzygium albiflorum*. The top canopy layer (16-25 m tall) was composed of *Schima wallichii*. The middle canopy layer (6-15 m tall) was composed of *Syzygium albiflorum* and *Butea monosperma* (Fig. 1 and Table 1).

Sampling plot No. 2 (Nest No. 2) was composed of 18 species of 120 trees. The highest number of trees was 23 *Lithocarpus elegans*. The top canopy layer (16-25 m tall) was composed of *Xylia xylocarpa*, *Lithocarpus elegans*, *Castanopsis diversifolia* and *Schima wallichii*. The middle canopy (6-15 m tall) was composed of *Quercus vestita*, *Castanopsis diversifolia*, *Lithocarpus elegans*, *Schima wallichii*, *Castanopsis calathiformis* and *Gluta obovata* (Fig. 2 and Table 2).

Sampling plot No. 4 (Nest No. 3) was composed of 12 species of 53 trees. The highest number of tree species was 27 *Lithocarpus sootepensis*. The top canopy layer (16-25 m) was composed of *Lithocarpus sootepensis*. The middle canopy layer (6-15 m) was composed of *Quercus vestita*, *Butea monosperma*, *Castanopsis acuminatissima*, *Dipterocarpus obtusifolius*, *Lithocarpus sootepensis*, *Phyllanthus emblica*. The lower canopy layer (<6 m tall) was composed of *Phyllanthus emblica* (Fig. 3 and Table 3).

Table 1: Sampling plot No. 1 was composed of 11 species of 47 tree

Scientific name plot 1	No. of trees
Pinus kesiya	13
Syzygium albiflorum	12
Schima wallichii	4
Suregada multiflorum	1
Erythrima subumbrans	6
Antidesma sootepense	3
Stereospermum fimbriatum	4
Butea monosperma	1
Dalbergia oliveri	1
Ficus ribes Reinw.	1
Gluta obovata	1
Total	47

Table 2: Sampling plot No. 2 was composed of 18 species of 120 tree

Scientific name plot 2	No. of tree
Schima wallichii	7
Dalbergia oliveri	1
Gluta obovata	5
Castanopsis diversifolia	22
Castanopsis calathiformis	4
Castanopsis acuminatissima	12
Lithocarpus elegans	23
Quercus vestita	5
Xylia xylocarpa	1
Phyllanthus emblica	2
Symplocos macrophylla	17
Albizia lebbekoides	1
Engelhardtia spicata	1
Canarium subulatum	2
Picrasma javanica	12
Ternstroemia gymnanthera	2
Mammea siamensis	2
Diospyros glandulosa	1
Total	120

Table 3: Sampling plot No. 4 was composed of 12 species of 53 tree

Scientific name plot 4	No. of trees
Pinus kesiya	3
Butea monosperma	2
Gluta obovata	1
Castanopsis calathiformis	1
Castanopsis acuminatissima	7
Lithocarpus elegans	1
Quercus vestita	3
Lithocarpus sootepensis	27
Phyllanthus emblica	4
Symplocos macrophylla	2
Depterocarpus obtusifolius	1
Vaccinium exaristatum	1
Total	53

Breeding behavior: In this courtship behavior is as in December the courtship behavior started with about 5-8 *S. magna.* They foraged together in a group after foraged alone (May-November). The courtship ritual consisted of the male following the female and then the male tried feeding the female. If the female accepted, she received the food and then this pair mated separately from their group and began nest building.

Nest selection: *S. magna* cannot excavated cavity by their self, they used second cavity for their nest. The male

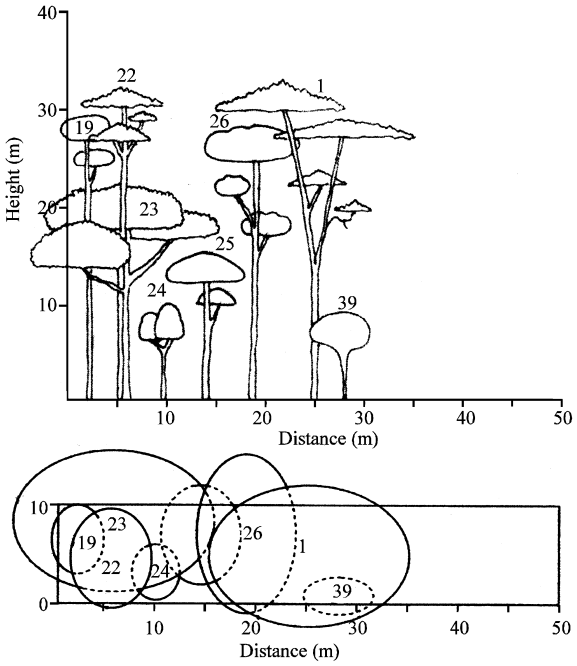

Fig. 1: Profile diagram of the sampling plot No. 1. The emergent layer (26-35 m tall) was composed of *Pinus kesiya* (22, 1), *Erythrima subumbrans* (19), *Syzygium albiflorum* (26). The top canopy layer (16-25 m tall) was composed of *Schima wallichii* (23). The middle canopy layer (6-15 m tall) was composed of *Syzygium albiflorum* (24, 25), *Butea monosperma* (39)

introduced the female to the cavity by holding a nest material in its mouth and hopping in and out of the cavity 2-3 times. If the female accepted, she entered the cavity. If she rejected the nest, the male found another cavity and the process started again. Nests characteristic were presented in Table 4.

Egg laying, incubation and hatching: Once the male and the female shared nest building was successful, one was fat, which indicated the female and pregnancy. The female almost always remained in the nest, with the male feeding her at the inner cavity nest. These behaviors may include egg laying. Until the male and female reciprocally foraged, by which one lived in cavity and another foraged alone. This period may be known as incubation behavior.

Hatching behavior began when both male and female foraged together, by none of them lived in cavity nest. On the inspection of the two nests (Nest No. 1 and 3), four nestlings were found in each nest with no damaged eggs or nestling carcasses. So, it was found that the eggs hatched successfully. Nestlings were naked and helpless

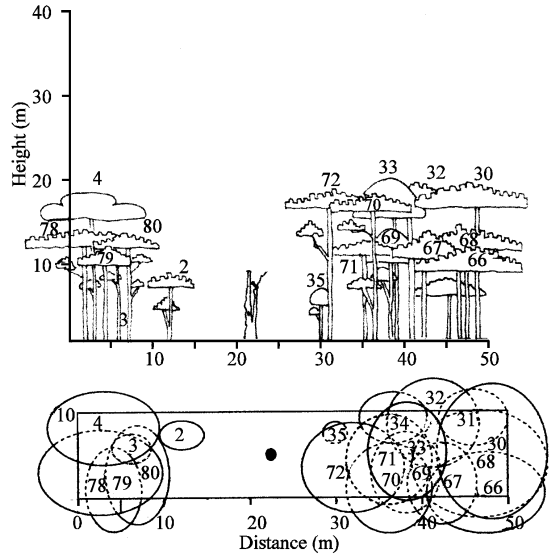

Fig. 2: Profile diagram of the sampling plot No. 2. The top canopy layer (16-25 m tall) was composed of *Xylia xylocarpa* (4), *Lithocarpus elegans* (72), *Castanopsis diversifolia* (30, 32, 70) and *Schima wallichii* (33). The middle canopy (6-15 m tall) was composed of *Quercus vestita* (67, 96) *Castanopsis diversifolia* (78, 80, 2, 34, 67, 68), *Lithocarpus legans* (71, 31,) *Schima wallichii* (69), *Castanopsis calathiformis* (3) and *Gluta obvata* (35)

Table 4: Nest characteristics

	Nest		
General characteristics	No. 1	No. 2	No. 3
Nest habitat			
Forest type	Pine forest	Pine forest	Pine forest
Elevation from sea level (m)	1,200	1,300	1,250
Nest tree characteristics			
Tree species	*Lithocapous sootepensis*	*Pinus kesiya*	Unknown species
Tree height (m)	15	25	10
Tree characteristic	Live tree	Live tree	Dead tree
Nest cavity characteristic			
Hole entry (cm)	7×12	-	7×15
Cavity depth (cm)	38	-	30
Cavity height from ground (m)	10	15	5
Egg number	-	-	-
Nestling number	4	2	4
Fledged age (days)	25	18	25
Nest materials	Feathers Lichens Paper from tourist	-	Feathers Lichens Paper from tourist

at birth and were cared for in the nest. The male and the female fed to nestling in cavity and took out nestling's fecal sac immediately (Nestlings usually defecated after having been fed because their stomach development was not complete. The fecal sac included undigested food which was a wrapped pod in a white sac).

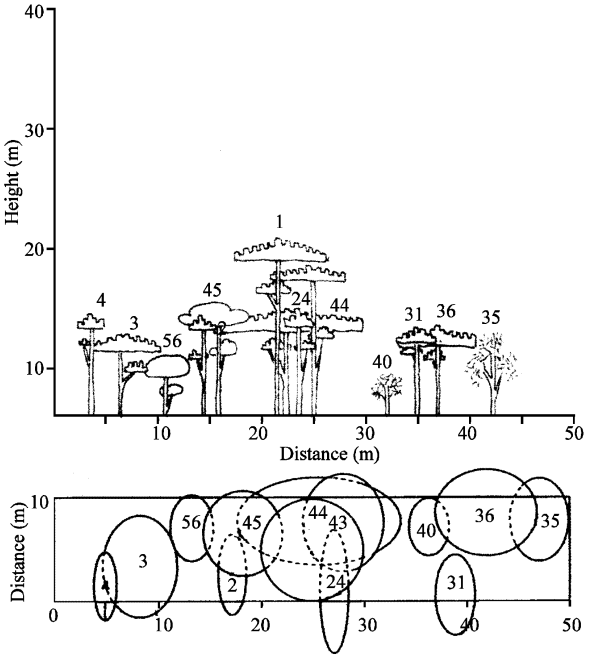

Fig. 3: Profile diagram of sampling No. 4. The top canopy layer (16-25 m) was composed of *Lithocarpus sootepensis* (1, 43). The middle canopy layer (6-15 m) was composed of *Quercus vestita* (4, 3), *Butea monosperma* (56), *Castanopsis acuminatissima* (2) *Dipterocarpus obtusifolius* (45), *Lithocarpus sootepensis* (24, 44, 31, 36), *Phyllanthus emblica* (35). The lower canopy layer (<6 m tall) was composed of *Phyllanthus emblica* (40)

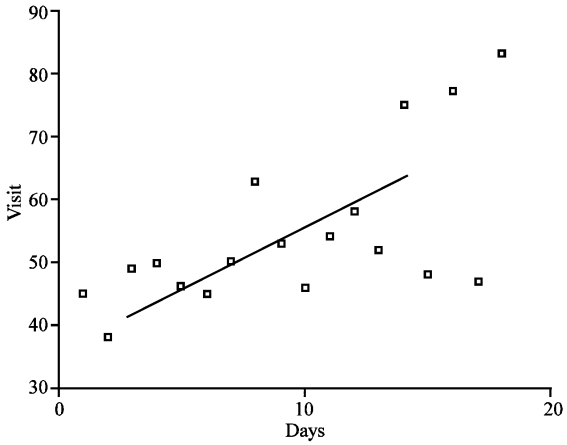

Fig. 4: The relationship between nestling age and the number of feeding. The regression line is plotted as a solid line

Parental care: Both the male and the female helped in caring for the young. They fed the young in the inner nest

cavity and took out fecal sacs. When nestlings were about 20 days old (Nest No. 1), they could climb up to the nest entrance and were fed by the parents there. The parents also flung some food by holding food in their mouths and flinging with tree trunk until the food was smaller and bring it to the young.

The nestlings protruded their bill only, next they could protruded their head and were fed by their parents at the nest entrance. They were covered with feathers like the adults which had obvious broader black head-bands. They also have liked the rough calls adult and beggar calls at appearance of their parents.

About 25 days old (Nest No. 1), nestlings were fledged by the climbing out of the cavity and the perching near the nest entrance. Subsequently, they climbed up the tree trunk and flew away alone without the parental care. Some nestlings climbed out of the nest but could not climb up the tree trunk or fly, so they returned to the nest cavity and tried again until they were successful (about two times).

The young in the first nest fledged at about 25 days old, the second nest fledged at about 25 days old and the third nest fledged at about 18 days old.

The frequency of feeding gradually increased as the young were grewing. Feeding was most frequent in the early morning and in the afternoon and slackening off in the evening. There was a strong correlation between nestling age and the number of feeding ($p = 0.004$, $\alpha = 0.05$). Nestling age could predict the numbers of feeding ($r^2 = 0.411$, $Y = 40.281 + 1.485X$) (Fig. 4).

DISCUSSION

S. magna foraged along tree trunks. Their diet consists mostly of insects, ant and other arthropods, which live and hatch in the bark of tree trunks. Dickson *et al.* (1979) examined the bark characteristics and food diversity. He found that trees with deeper bark support greater insect diversity.

The habitat of *S. magna* is mostly the pine forest or conifer mixed with broadleaf tree species but it strongly prefers foraging in *Pinus kesiya*. This is also confirmed by the research of Gabbe *et al.* (2002), who examined tree species use by observing the foraging behavior for thirteen species of foliage gleaning birds.

Twelve of the bird species foraged selectively with respect to tree species. Less common bird species tended to be more selective foragers than the more abundant bird species. Almost all the brood will survive. The cavity nester such as hornbills breeds more successfully than open nester, this study showed that the Yellow-throated Marten and the Binturong are both important natural predators of both breeding females and chicks.

However, in Khao Yai National Park, she found that between 1981 and 1991 only two Brown Hornbill chicks and one Great Hornbill were killed by Martens (Poonswad, 1998). The cavity nest of *S.magna* was an exposed-nest, so the birds may be killed by natural predators.

CONCLUSION

The Chiang Dao Wildlife Sanctuary is an area for conservation and protection of wildlife and animals. It is well known as a place, where birdwatchers can see many bird species and especially those known for being relatively rare and threatened species (*Syrmaticus humiae* and *Sitta magna*).

Information on these species, such as foraging behavior, breeding behavior etc. was used by officials to zone ecotourism, to conduct research, to concentrate protection and to provide information to bird watchers. Although, the numbers of these species are less in the past, it is difficult to say exactly the numbers that are now present in the Sanctuary.

In conclusion, there is a need for further research to surveys distribution of *S. magna* along coniferous forest in this sanctuary for accurate and current species distribution data.

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