รายงานฉบับสมบูรณ์

การกินอาหารของไก่ฟ้า นิเวศวิทยาการสืบพันธุ์และการแก่งแย่ง
การใช้ทรัพยากรระหว่างไก่ฟ้าต่างชนิด ณ แปลงศึกษาความ
หลากหลายทางชีวภาพระยะยาวมอสิงโต อุทยานแห่งชาติเขาใหญ่:
เพื่อศึกษานัยของการผสมพันธ์ในไก่ฟ้าระหว่างต่างสายพันธุ์

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SUMMARY

One of the observed consequences of global climate change on wildlife is that lowland species are likely to shift to higher elevations, but the specific habitat and behavioral reasons for such shifts have been poorly documented. The aim of this study was to investigate habitat use and behavior in Siamese Fireback (*Lophura diardi*), a lowland species, which has recently expanded its range into sub-montane habitat where it now occurs in sympatry with the resident species Silver Pheasant (*L. nycthemera*) in Khao Yai National Park, northeastern Thailand, as a possible consequence of climate change. The results, on radio-collared birds, show that Siamese Fireback population groups tended to use topographically flat areas, similar to the topography found in the lowlands, with the exception of nest site locations, which were found on steeper slopes. The birds also selected areas with greater under-story cover during the mating season and moved to areas with higher ground vegetation density while rearing young chicks. The results also indicate differences in topography use between two pheasant species, with Siamese Fireback in areas of gentle topography while Silver Pheasant were found mainly on steeper slopes. As a possible consequence of non homogeneous topography on sub-montane habitat, Siamese Fireback found at higher elevation show larger home range sizes than has been reported for similar lowland *Lophura* species. Nevertheless, it remains largely unclear is which specific aspects of either the sub-montane habitats and/or the lowland habitats are being altered by climate change.

INTRODUCTION

Pheasants, subfamily Phasianinae, order Galliformes, include 52 species, of which more than 30 are listed in the red data book for threatened birds of Asia (BirdLife International 2009). Habitat disturbance and hunting pressure are the main cause to their declining populations (McGowan and Garson, 1995; Keane et al., 2005). Conservation actions have been variously proposed to help mitigate the threats to their survival (McGowan and Garson, 1995; McGowan et al., 1999) although, baseline information on their biology and ecology of most of the species is still lacking. Evaluation of their status of distribution and abundance is a prior need for implementing their conservation action plan.

Alarmingly, a recent status assessment (McGowan et al., 1998) shows a decline in 56% of galliformes species when compared with data available from 1970. In Thailand, pheasants consist of 10 species of which 6 are in the Red data book for threatened birds of Asia (BirdLife International, 2009). As for other country their major threat is the disturbance of their suitable habitat mainly in lowland species as lowland forest has almost all been converted to agriculture land while montane forest is disturbed by clearing for shifting agriculture (Round, 1988). The conservation action in Thailand has supported pheasant populations by limit them within several protected areas. At the current stage basic information on their biology and ecology, including distribution and abundance, are need to design and implement suitable management. A likely recent impact that has been reported is global climate change which may be affecting the pheasant community through enabling range shift of lowland species into sub-montane habitat (Round and Gale, 2008). At the moment still little is known on the effect of this community change.

Siamese Fireback (*Lophura diardi*) is classified as a near threatened species (BirdLife International, 2009) with an overall population estimate of 10,000 individuals distributed from eastern Myanmar through northeastern and southeastern Thailand and Laos, Cambodia, and central and southern Vietnam (Madge and McGowan, 2002). In Thailand their population is estimated at 5,000 individuals (Madge and McGowan, 2002; BirdLife International 2009), mainly found in lowland forest up to 800 m in elevation (Lekagul and Round, 1991; Robson, 2002). Habitat loss is a major threat in Thailand (Round, 1988). In this study Siamese Fireback is found sympatrically with Silver Pheasant (*L. nycthemera jonesi*), which range in north, northeastern and southeastern Thailand, southwestern China, eastern Myanmar, southern Vietnam, southwestern Cambodia, northern Laos and Island of Hainan (Johnsgard, 1999; Madge and McGowan, 2002). It is a highly variable species with 15 subspecies, which 2 occur in Thailand; *L. n. jonesi* (Figure 1.2) and *L. n. lewisi* (Lekagul and Round, 1991; Johnsgard, 1999; Robson, 2008). In Thailand, *L. n. jonesi* occur in evergreen forests from 700 to 2,000 m (Lekagul and Round, 1991). Due to their different use in elevation, the two species has only been reported sympatrically in the past 20 years when an increase in detection of Siamese Fireback was reported in the sub-montane forest area around the Mo Singto Long Term Biodiversity Plot at Khao Yai National Park (Round and Gale, 2008). Global climatic change was suggested as the cause of range shift for Siamese Fireback which lowland habitat condition has changed enabling this lowland species to move at higher elevation in order to find suitable habitat, however, the affect of this occurring sympatric still uninvestigated.

OBJECTIVES

The objective of this study is focused on the shift to higher elevation of the lowland Siamese Fireback leading to sympatry with another *Lophura* species on sub-montane forest of Khao Yai National Park, Thailand.

In this project we will investigate two major aspects:

1. Define the use of topography between the two *Lophura* species in order to define potential species overlaps.

2. Investigate the micro-habitat structure used by the lowland Siamese Fireback once moved to sub-montane habitat.

For this we will hypothesize:

H1. Topography is influencing habitat use by different pheasant species.

P1.1 Silver Pheasant, a montane species, will mostly occupy slopes.

P1.2 Siamese Fireback, a lowland species, will mostly occupy flat patches.

H2. Forest structure influence patterns of habitat use by Siamese Fireback.

P2.1 Lowland forest species will mostly occupy topographically flat areas with understorey habitat characteristics similar to that of lowland forest habitat (e.g. Deignan, 1945; Vy *et al.*, 1998).

METHODS

Study area

This study was conducted at the area about 1 km^2 where including Mo Singto Long-term Biodiversity Research Plot, Khao Yai National Park (Brockelman et al., 2002), Thailand (2,168 km^2; 101°22' E, 14°26' N; ~ 130 km NE of Bangkok). In a hilly terrain 730 - 890 m elevation (Figure 2), and is dominated by seasonally wet evergreen forest (Kerby et al., 2000; Kitamura et al., 2004) (Figure 1). Average annual precipitation is 2,696 mm (range 2,976 to 2,297 mm) with a dry season from November to April and a wet season from May to October. Average daily temperatures vary between 18.7°C and 28.3°C, and mean humidity ranges from 64.6 percent during the dry season to 77.1 percent during the wet season (Savini et al., 2008).

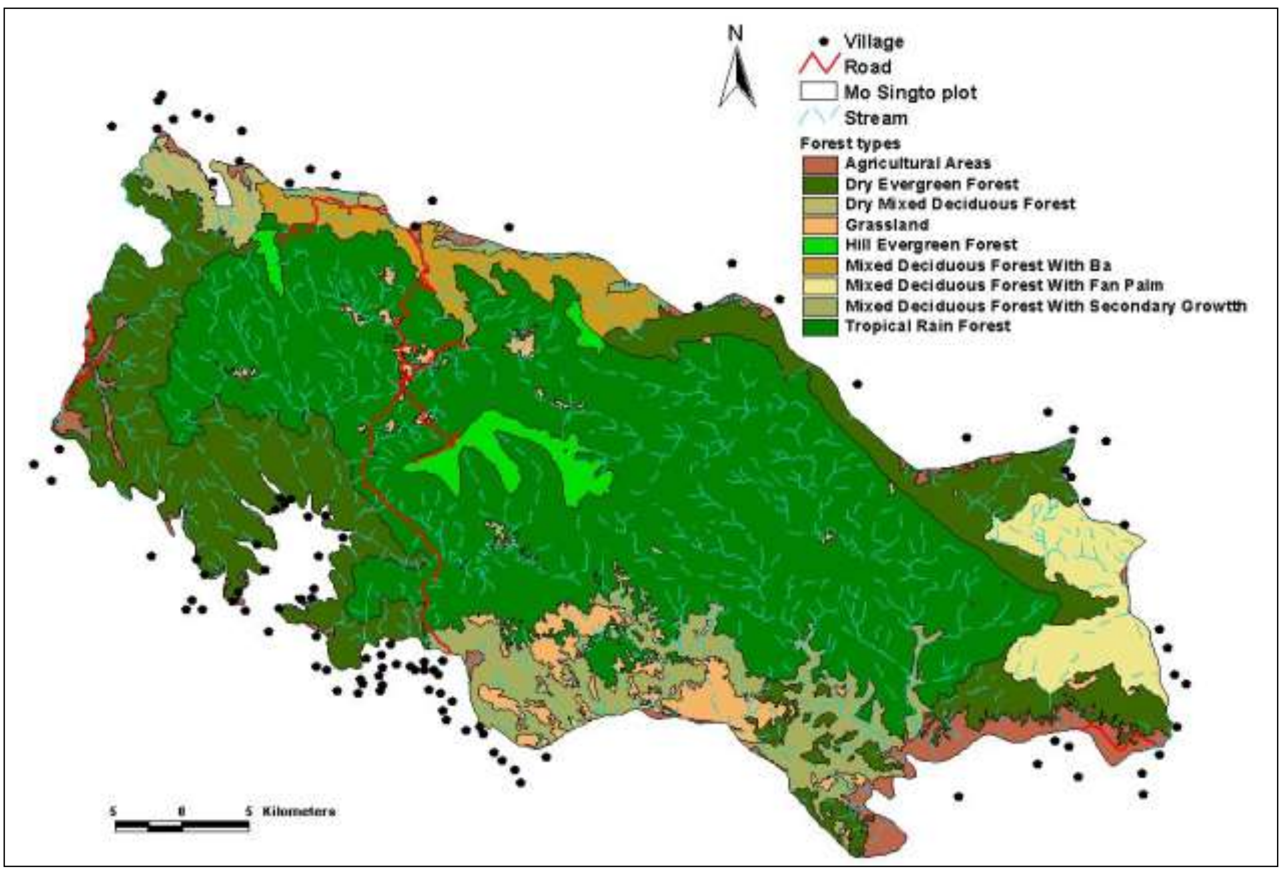

Figure 1 The area of Khao Yai National Park is dominated by seasonally wet evergreen forest.

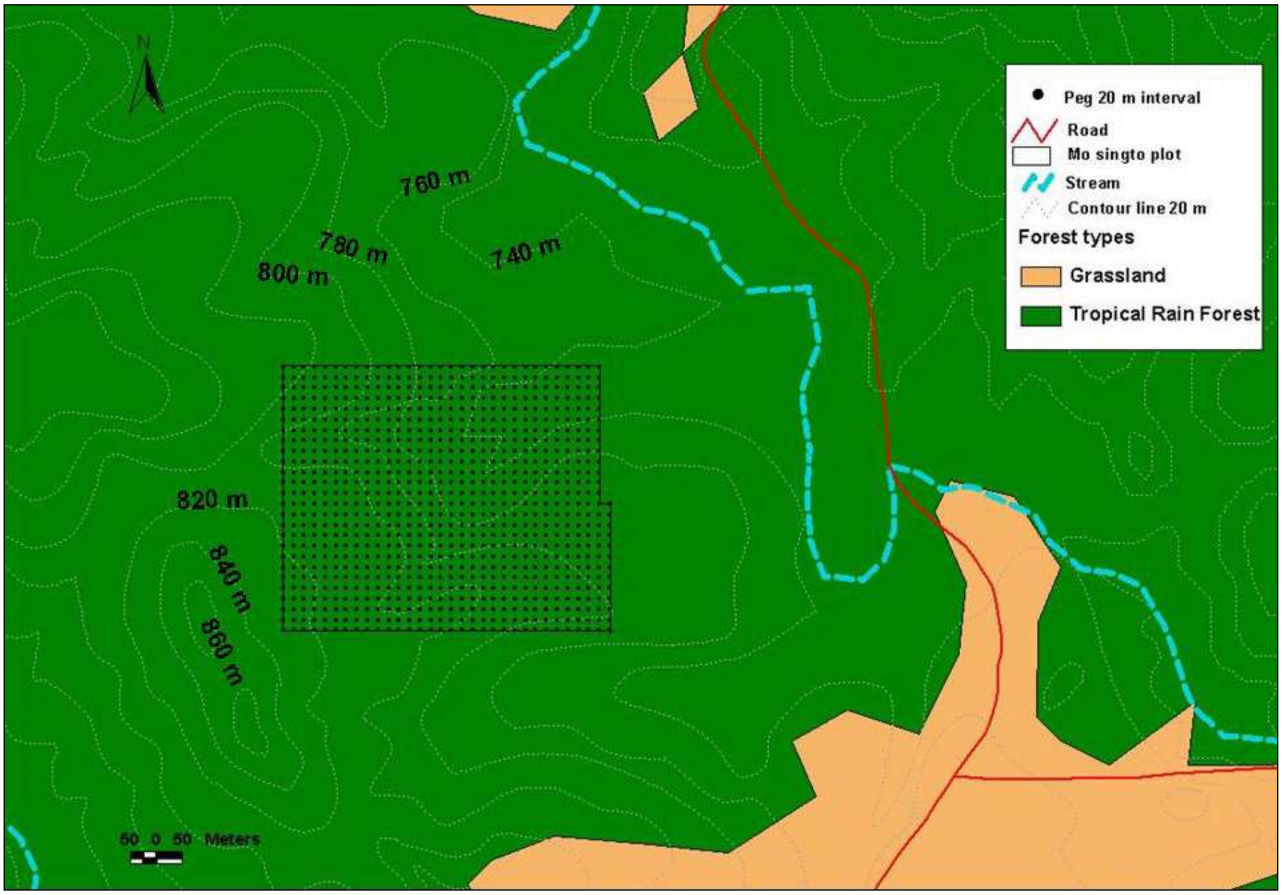

Figure 2 The area of Mo Singto Long-term Biodiversity Research Plot (30 ha in size) in a hilly terrain 730 - 890 m elevation, the plot is outlined by the box.

Animal capture and marking

All data were collected between February 2007 and September 2008. Individual pheasants were caught using mist-nests (Keyes and Grue, 1982) and modified traditional leg-snare traps made from bamboo and soft polyester string (Figure 3). Mist nets (3x12 m with 15 cm mesh) were set at ground level across pheasant pathways surrounded by leg-snare traps. All pheasants caught were ringed with size 11A (11.0 mm. of internal diameter) Thai Royal Forest Department (RFD) metal rings, and color-ringed with two-color combinations on the left leg and one color-ring and the metal ring on the right leg (Figure 4), so that they could be individually identified in the field. The pheasants were also fitted with a 15 g radio-collar model RI-2B made by Holohil Systems Ltd with a life span of 24 months. The RI-2B is designed as a necklace-mounted transmitter. The transmitter rests on the bird's breast while the antenna loops around the neck and emerges behind the head. The collar is made of flexible elastic attached to the transmitter in two points.

Figure 3 Pheasant capture used 12 meters with 3 shelves mist-net (left) and noose trap (right).

Figure 4 All pheasants caught were ringed with size 11A (11.0 mm. of internal diameter) Thai Royal Forest Department (RFD) metal rings and color-ringed.

Animal locations

Each individual pheasant was located by homing several times per day, with at least a two-hour interval between radio fixes for each individual. This time gap was considered sufficient to eliminate any potential disturbance generated from the previous observation (Savini and Sukumal, 2009). Once detected, individuals were followed for 15 min after which the individual and any associated group members were left alone to reduce excessive disturbance, before another collared individual was located. During each 15 min period and for each individual, we recorded their behavior and its proximity to members of the group. We also recorded its location, elevation, and slope at the point each individual was located. Triangulation was used to estimate a birds' position if the individual pheasant could not be seen due to dense ground vegetation.

Reproductive data

Data for each female caught were divided into four periods according to the chronology of the reproductive cycle: (1) in the group (mating period), (2) incubating, (3) alone with chicks, i.e., the initial period after hatching when females travel alone with their brood (between one and three months) and, (4) back in her group together with her chicks and the other group members (adult males, adult females and their brood), up to ten individuals.

Habitat measurements

Features of the habitat were recorded using 5-m radius circular plots (Martin et al., 1997). We established plots by centering them on the sites where individual pheasants were first located after homing. In addition, we also established control plots centered on randomly selected locations within 30 ha of Mo Singto Long-term Biodiversity Research Plot (for details on the plot see Brockelman et al., 2002). The plot contains hilly terrain between 730-890 m in elevation, and is covered primarily by seasonally wet evergreen forest. In each plot, habitat features were recorded following Martin et al. (1997). For each plot we counted all understory stems with DBH ≤ 10 cm and trees with DBH >10 cm which were then categorized into three classes based on their height: 0.5-3 m, >3-5 m and >5 m. We also estimated the percentage vegetation cover of each height category for each plot.

Home range size analysis

Home range size was estimated for each of the reproductive cycle periods using 95% minimum convex polygons (MCP) as well as kernel home ranges based on 50% and 95% probability of use which is less prone to the effects of outliers (Boitani and Fuller, 2000). The analyses were conducted in Arcview GIS version 3.2a with the Animal Movement Extension (Hooge and Eichenlaub, 2000).

Patterns of habitat use analysis

All statistical analyses were conducted using SPSS version 15.0 (Kinnear and Gray, 2000; Garson, 2009) and R version 2.7 software (Crawley, 2007). Data were examined for normality using Kolmogorov-Smirnov tests. To investigate potential differences in their use of topography and elevation, locational data were compared among groups of Siamese Firebacks and between the two pheasant species using non-parametric procedures (Kruskal-Wallis *H*-test and Mann-Whitney *U*-test respectively).

We used non-parametric Kruskal-Wallis tests to compare habitat variables between sites selected by females during four periods of the reproductive cycle and randomly selected areas. Non-parametric Kruskal-Wallis tests were also used to compare topography (slope) between sites selected by females during four periods of the reproductive cycle and randomly selected areas. We used forward stepwise multinomial logistic regression with the presence/absence of females during three reproductive periods (1, 3, and 4, see above) as the dependent variable to identify which habitat features significantly influenced habitat use. Since stepwise regression procedures involve multiple testing, increasing the risk of type 1 errors (Mac Nally, 2000; Whittingham et al., 2006), we set our significance level α <0.01. The order of entry of independent variables into any stepwise regression model and the total number of variables can all effect the final model selection (Whittingham et al., 2006). For the forward selection procedure, we began with a constant-only model and added habitat variables one at a time based upon their relative correlations with the dependent variable, until the step at which all habitat variables not included in the model had a significance of > 0.1. Goodness of fit was determined using the likelihood ratio test of the overall model (the model chi-square test). Final model selection was determined using Akaike Information Criterion (AIC) whereby the step with the lowest AIC value was judged to be the 'final model'. We then compared the habitat variables identified as having a significant influence on habitat use by females between the three periods and the randomly chosen areas using Kruskal-Wallis *H*-tests.

For the nesting/incubation period (Period 2), we used a forward stepwise binary logistic regression to identify which features of the habitat influenced nest site selection. The presence/absence of females in each reproductive phase was entered as the dependent variable. We used the same criteria for forward selection procedure as the multinomial stepwise regression model (see above). Similarly, goodness of fit was determined using the model chi-square test and final model selection was determined using AIC. We compared topography (degree of slope) between nest site selected by females and those of randomly selected areas using Mann-Whitney *U*-tests.

RESULTS

Year cycle of female Siamese Firebacks

Two Siamese Fireback females were fitted with radio collars and observed for 19 months between February 2007 to September 2008 (Female 1) and for eight months between February and September 2008 (Female 2). The female year cycle consists of: (1) associating in a group of other adults during the mating period (mean period± SD: 30.3 ± 18.9 days), (2) incubation (mean period± SD: 23.5 ± 0.71 days), (3) alone with chicks (mean period± SD: 69 ± 41.0 days) and (4) associating again in a group of adults along with her chicks (mean period± SD: 227 ± 77.8 days).

Home range size patterns

We compared home range size between the two observed female Siamese Firebacks during each period of the year cycle. The 95% MCP analysis indicated a difference in the home range size during the different phases of the year cycle (Figure 5a). Home range size decreased when females left the group after the mating season and started to range alone with their young chicks, but increased again when females rejoined the group with their grown chicks (Table 1). Both females showed the same pattern in home range size variation between the different years phases (Figure 5b). A similar pattern was observed using a 95% kernel for the overall home range and a 50% kernel for the core area (Table 1).

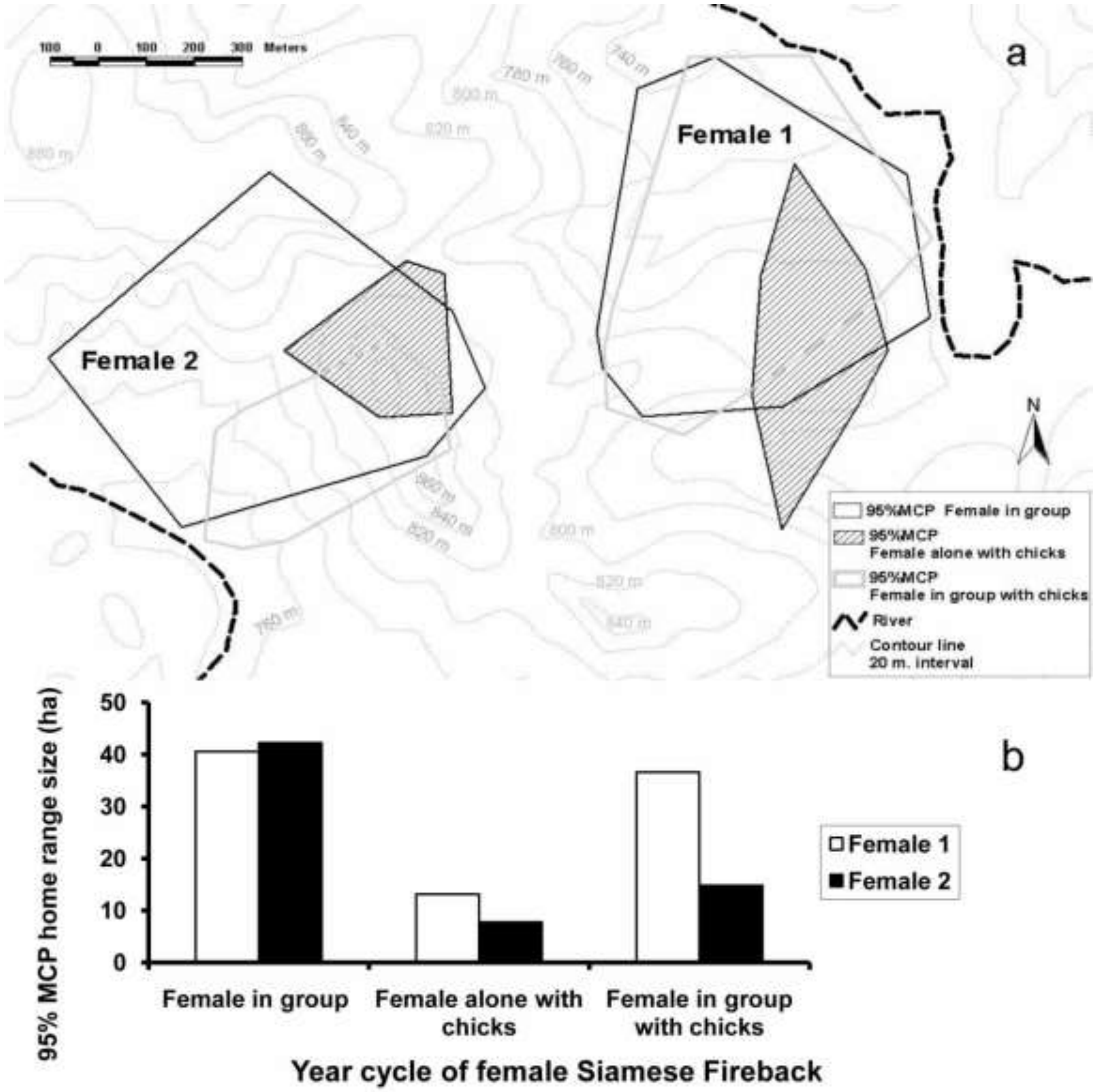

Figure 5 a) Ranging size during different periods of the year cycle of Siamese fireback, Female 1 and Female 2, estimated using 95% minimum convex polygon (MCP) b) 95 % MCP home range size compared in different phases of the year cycle between the two female Siamese firebacks.

Table 1 Home range sizes of two female Siamese Fireback pheasants during different periods of the 12-months reproductive cycle. The duration of each period (months) of the cycle is rounded for clarity.

	Year cycle			
	Period 1 In group Mating	Period 2 Alone Incubating	Period 3 Alone with chicks	Period 4 In group with chicks
Months	February-April	April-June	May-August	August-February
No. of observations				
Female 1	46	C.[a]	36	64
Female 2	33	C.[a]	107	56
95% MCP (ha)				
Female 1	40.6	Inc.[b]	13.2	36.6
Female 2	42.3	Inc.[b]	7.8	14.8
95% Kernel (ha)				
Female 1	62.4	Inc.[b]	19.8	54.3
Female 2	50.9	Inc.[b]	6.7	22.9
50% Kernel (ha)				
Female 1	8.9	Inc.[b]	3.4	9.5
Female 2	3.4	Inc.[b]	1.3	3.7

[a]C.=Data obtained from video cameras (K. Probprasert, unpubl. data).
[b]Inc.= 87 % of time sitting on the nest.

Habitat characteristic between sites selected by females and randomly selected areas

The forest habitat selected by female Siamese Fireback during all periods of the reproductive cycle was dominated by tall trees (height > 5 m; mean ± SD 8 ± 3.1 trees), dense understory trees (height > 3-5 m; 13 ± 6.9 stems) and dense understory saplings (height 0.5-3 m; 299 ± 170.6 stems). Randomly selected areas were dominated by trees (taller > 5 m; 7 ± 4.1 trees), dense understory trees (> 3-5 m tall; 11 ± 6.0 stems) and dense understory saplings (0.5-3 m in height; 187 ± 110.5 stems). There was a significant difference between areas selected by females and random areas (Tree height >5 m: Kruskal-Wallis *H*-

test, $\chi^2 = 8.4$, df = 1, $p<0.05$; understory tree height >3-5 m: Kruskal-Wallis *H*-test, $\chi^2 = 3.9$, df = 1, $p<0.05$; tree height 0.5-3 m: Kruskal-Wallis *H*-test, $\chi^2 = 30.1$, df = 1, $p<0.05$).

Influence of topography on habitat use

Habitat use by both female Siamese Firebacks for the majority of their reproductive cycle was significantly influenced by topography. Both females selected topographically flatter areas (shallower slopes) during mating (Period 1), when they were alone with chicks (Period 3) and when they were in groups with their chicks (Period 4) than that available in the randomly located areas (Female 1: Kruskal-Wallis *H*-test, $\chi^2 = 45.3$, df = 3, $p<0.0001$; Female 2: Kruskal-Wallis *H*-test, $\chi^2 = 44.7$,df = 3, $p<0.0001$), but not during nesting/incubation (Period 2).

Patterns of habitat use during reproductive periods

There was a noticeable difference in the way understory vegetational characteristics influenced habitat use by both female Siamese Firebacks during different periods of the reproductive cycle (Table 2). During the mating period (Period 1) the habitat used by Female 1 was not influenced by understory vegetation, whereas Female 2 had densely distributed trees of 0.5-3 m in height and denser coverage of trees > 5 m in height. There was difference in which vegetation characteristics influenced habitat use by both females during Periods 3 and 4. When both females were alone with chicks (Period 3), habitat selection was significantly influenced by both tree density 0.5-3 m, and tree coverage >3-5 m. In addition, both females selected a habitat with tree density 0.5-3 m. However, the vegetation was not observed an influence when both females were in groups with their chicks (Period 4).

Table 2 Results of forward stepwise multinomial logistic regression showing the influence of understory vegetation characteristics on habitat use by female Siamese Fireback during different periods of the reproductive cycle. Significant results (α<0.01) are highlighted in bold.

Variables in three phases of year cycle	Female 1				Female 2			
	Mean	Coefficient	df	*p-value*	Mean	Coefficient	df	*p-value*
Female with group (mating) n=30								
Tree density: height 0.5-3 m	135 stems	-0.007	1	0.023	335 stems	0.015	1	**<0.0001**
Tree density: height >3-5 m	-	-	-	-	15 stems	0.021	1	0.814
Tree coverage: height >3-5 m	35.70%	-0.009	1	0.436	55.70%	0.043	1	0.127
Tree coverage: height >5 m	68.30%	0.023	1	0.04	76.10%	0.059	1	**0.002**
Female alone with chicks n=30								
Tree density: height 0.5-3 m	508 stems	0.015	1	**<0.0001**	394 stems	0.02	1	**<0.0001**
Tree density: height >3-5 m	-	-	-	-	11 stems	0.495	1	**<0.0001**
Tree coverage: height >3-5 m	52.10%	0.047	1	**0.007**	19.60%	-0.253	1	**<0.0001**
Tree coverage: height >5 m	51.50%	-0.037	1	0.027	49.70%	-0.006	1	0.766
Female in group with chicks n=30								
Tree density: height 0.5-3 m	239 stems	0.004	1	0.041	181 stems	<0.0001	1	0.918
Tree density: height >3-5 m	-	-	-	-	14 stems	0.51	1	0.417
Tree coverage: height >3-5 m	41.90%	0.007	1	0.548	46.70%	0.009	1	0.649
Tree coverage: height >5 m	64.10%	0.012	1	0.286	68.70%	0.023	1	0.05
Goodness of fit test			504	0.962			504	1
AIC values	AIC=357.797				AIC=282.922			

- = The variable is not selected into the model

Nest site selection by female Siamese Fireback

A total of 11 nests of five different females were observed during the study period. Nine nests were located in the buttresses of large trees (in genera *Aphananthe, Ficus, Balakata, Nephelium, Mastisia and Cleistocalyx*), one nest was located in a clump of *Rattan* sp. and another nest was located on the ground covered by rattan leaves. The average clutch size was 8 ± 3 (maximum = 14 eggs, minimum = five eggs) (Figure 6). All eggs from five of the eleven nests (45%) hatched. Females appeared to prefer to place nests on steeper slopes in the study area although the differences were not statistically significant (Mann-Whitney *U*-test, z = -1.852, p=0.064). Forward stepwise binary logistic regression analysis indicated that there were significant differences in under-story vegetational characteristics between nest sites and randomly selected areas, and that females mostly avoided locating their nests in areas with a higher percent coverage of trees >3-5 meters in height (Coefficient = -0.094, Wald=5.968, df = 1 p<0.05).

Figure 6 The maximum clutch size of Siamese Fireback found 14 eggs.

Altitudinal differences between Siamese Fireback and Silver Pheasant

Four groups of Siamese Firebacks and one group of Silver Pheasants were observed during the sixteen month study. The topography of the habitats used by all four groups of Siamese Fireback (SMF) did not differ significantly from that available across the study site (Kruskal-Wallis *H*-test, χ^2 =4.8, $n_{SMF\ group1}$ =107, $n_{SMF\ group2}$ =118, $n_{SMF\ group3}$ =120, $n_{SMF\ group4}$ =114, p=0.185). There was however a significant difference in the gradient of habitats used by Siamese Fireback compared to the gradient of habitats used by Silver Pheasant (SPH) (Mann-Whitney *U*-test, z = -9.3, n_{SMF} =459, n_{SPH} = 50, p<0.0001) with Silver Pheasant found mainly on slopes and Siamese Fireback found mostly on flat areas (Figure 7).

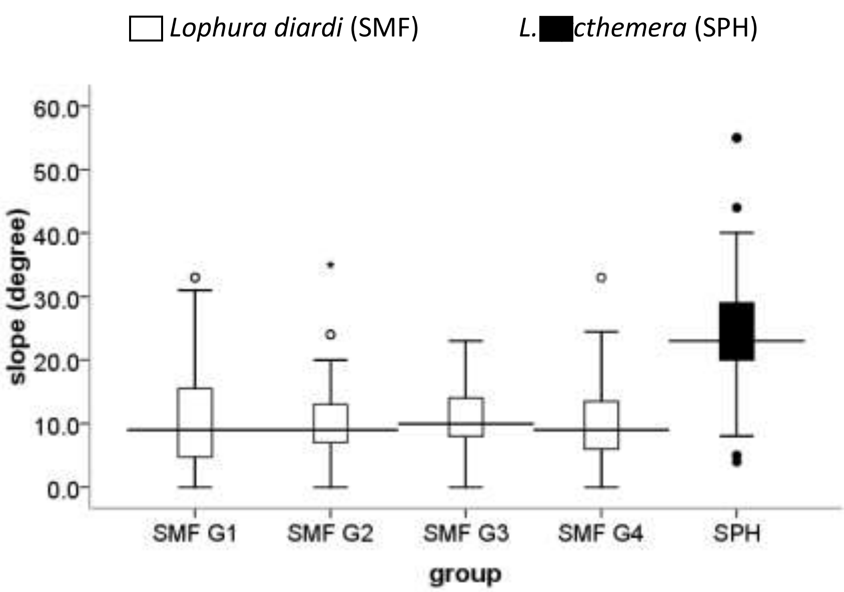

Figure 7 The slope comparison between four Siamese Fireback groups and Silver Pheasant.

The elevation use between the four Siamese Fireback groups was significantly different (Kruskal-Wallis *H*-test, χ^2 =250.4, $n_{SMF\ group1}$ =114, $n_{SMF\ group2}$ =118, $n_{SMF\ group3}$ =143, $n_{SMF\ group4}$ =115, p<0.0001). Moreover, there was also a significant difference between the two *Lophura* species (Kruskal-Wallis *H*-test, χ^2 =262.2, $n_{SMF\ group1}$ =114, $n_{SMF\ group2}$ =118, $n_{SMF\ group3}$ =143, $n_{SMF\ group4}$ =115, n_{SPH} = 79, p<0.0001). Silver Pheasant was found at higher elevations only when compared to Siamese Fireback group 1, but used lower elevations when compared with Siamese Fireback group 2, 3 and 4 (Figure 8).

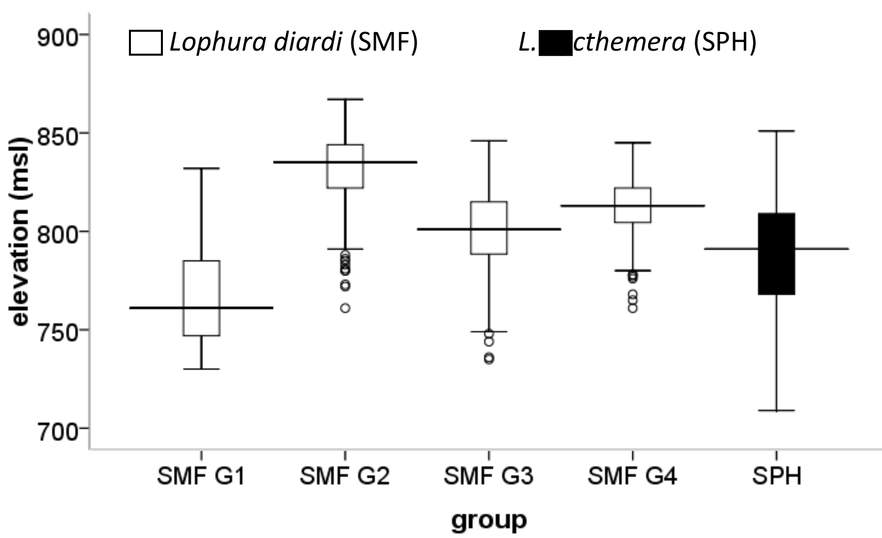

Figure 8 Elevation comparisons between four Siamese Fireback groups and Silver Pheasant.

The nests from Siamese Fireback were on terrain with a gradient higher than 15 degrees while one nest of Silver Pheasant also found on steep slope (Table 3).

Table 3 The topography of nest site of two pheasant species.

Species	Slope (degree)
Siamese Fireback	35
Siamese Fireback	18
Siamese Fireback	27
Siamese Fireback	25
Siamese Fireback	24
Siamese Fireback	26
Siamese Fireback	19
Siamese Fireback	18
Silver Pheasant	55

Reticulated Python (*Python reticulatus*) predation on Silver Pheasant

Reports of predation by reptile on pheasants are rare (Lind and Welsh, 1990; Bezy and Enderson, 2003) and generally they were considered vulnerable mainly to mammalian and avian predators (Gates, 1972). This note report on the predation of a Silver Pheasant by a Reticulated Python (*Python reticulatus*) at Khao Yai National Park (14°26' N 101°22' E), Thailand, at about 850 m above sea level in an area of seasonally wet, evergreen forest.

A Silver Pheasant female (weight 950 g) was radio-tagged on 16 April 2007; it was flushed into a large mesh mist-net set on the ground during the last week of incubation (Dzus and Clark, 1996). After chicks hatched, the bird was relocated on average every day for collecting data on ranging, habitat use, behavior and development of the chicks. The female was last located on 12 August 2007 when she was observed together with a group of Siamese Fireback sympatric in the area (Round and Gale, 2008). The pheasant was relocated again in the morning of 24 August 2007 which the radio signal was detected in the area with highly density of liannas (Figure 7) at an elevation of 736 m and at a distance of about 496 m from the area of the last observation. The signal was detected near a fallen tree under which we observed a Reticulated Python about 2 m in length (Figure 8). The python coiled on the ground without alarm and the pheasant shape was not observed on the python body. We marked the location, but left the snake undisturbed.

Figure 7 The habitat where the predation was observed.

Figure 8 Reticulated Python (~2.0 m) coiled under a fallen tree.

During the afternoon of 26 August 2007 the python was relocated, using the radio signal of the ingested radio collar, at about 10 m from the point of the first observation under a pile of dead vine. The python was still coiled at the same place when relocated on 28 August 2007. During the morning 31 August 2007 while relocating the python we found only its dung with the color band, metal ring and radio collar inside (Figure 9). The python dung was collected and still functioning radiotag was retrieved.

Figure 9 The python dung with the color band, metal ring and radio collar inside.

DISCUSSIONS AND CONCLUSIONS

Although suggestions have been made (Round and Gale, 2008), it still remains largely unclear what is the driving force for Siamese Fireback in Khao Yai National Park to expand their range into higher elevation forests. Independently from the cause generating the observed shift our study tried to examine habitat use by a lowland forest bird species which is now found ranging into sub-montane forest, Across habitat and elevational gradients some bird species appear physiologically highly tolerant to both micro-climate and micro-habitat changes (Martin, 2001). If populations of Siamese Fireback at Mo Singto are tolerant to similar abiotic and biotic factors across the elevational gradient, then there may be two main/principal reasons as to why this lowland species is expanding ‘upward’either : (1) as a direct response to lowland habitat degradation, or (2) the ‘amount’ of available optimal habitat at higher sub-montane elevations has significantly increased providing the species with an alternative to lowland habitat saturation. However, few long-term data exist regarding the relative abundance of the lowland Siamese Fireback populations or changes in forest micro-habitat structure (e.g. over the past 20 yr) to test either hypothesis.

Overall, the results shown here indicate how a lowland pheasant, Siamese Fireback (*Lophura diardi*), can adapt and survive after expanding their range to sub-montane habitat by reducing competition and risk of interbreeding with the resident montane pheasant species, Silver Pheasant (*L. nycthemera*). Topography is a predominant factor in influencing habitat use between *Lophura* pheasants, Silver Pheasant occupy predominantly steep slope while Siamese Fireback occupied mainly flat and gently sloping habitat patches. The micro-habitat structure in sub-montane forest also influenced patterns of habitat use by female Simaese Fireback during different periods of the reproductive cycle. They mostly occupied topographically flat areas with high understory plant, as observed in a lowland population (Deignan, 1945; Vy et al., 1998), during the mating season and when females were alone with young chicks, confirming their adaptation and survival in a new environment where predation pressure remain high. However, this study also highlight the general lack of detailed information on ecology and biology of Siamese Fireback a near threatened species for who still little is known. The gap appears even larger when the entire group of Southeast Asian Galliformes is considered.

In order to be fully reliable the information obtained with this study still needs to be compared with a more quantitative work conducted on Siamese Fireback inhabiting their original lowland habitat. This will fill the gap of knowledge of this threatened pheasant species (McGowan and Garson, 1995; Madge and McGowan, 2002). The habitat key variable for maintaining a Siamese Fireback population is a topographical flat area covered by with dense understory plants. This information could be referable information for other places where the management for this species is needed, for example in Vietnam and Laos where the lost of suitable habitat is high (McGowan and Garson, 1995).

Concerning the impact of habitat modification generated by global climate change, this study provides information on how a lowland species can get benefit from expanding their range to higher altitudinal habitat. Range expansion to higher elevation for species which are normally restricted to lowland habitat has been predicted the effects to the resident species on those higher habitats by reducing their population size as consequence of direct competition increase (Shoo et al., 2005). However, a previous work by Round and Gale (2008) showed that the detection rate of the montane Silver Pheasant remained unchanged while a significant increase for the lowland Siamese Fireback in the area was recorded. In this regard the results here presented show a clear topographical separation between the two species that might limit direct interaction between them. Moreover a slight difference in their mating behaviour has also been reported (Savini and Sukumal, 2009). However, with the current knowledge, I cannot exclude a potential risk of hybridization between the two resident species on a longer term. Hybridization is also considered as a potential threat when closely related species are that usually separated geographically, come into contact. Although no inbreeding has been so far documented, mixed-species groups have been reported and explained (Savini and Sukumal, 2009). The interbreeding of pheasant in the wild within similarity genera have been reported before between Silver Pheasant (*L. n. occidentalis*) and Kalij Pheasant (*L. leucomelana lathami*) in northwestern Yunnan and northeastern Burma where they overlap in habitat use (Johnsgard, 1999). Famous is also the case of the Imperial Pheasant (*L. imperialis*) long being considered a very rare species and now known to a hybrid between Edwards's (*L. edwardsi*) or Vietnamese Pheasant (*L. hatinbensis*) and Silver Pheasant as their habitat overlap in Vietnam (Hennache et al., 2003).

We conclude that the Siamese Fireback population including others bird species within the Khao Yai National Park is a suitable candidate for such long-term research. If the factors that provide the driving force behind the elevational range expansion of birds' community across temporal scales can be identified, then these could enable ecologists to predict with greater accuracy the responses of other lowland species to changes in regional climate patterns, and to changes in agricultural/forestry land-use patterns, themselves often brought about by climate change.

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