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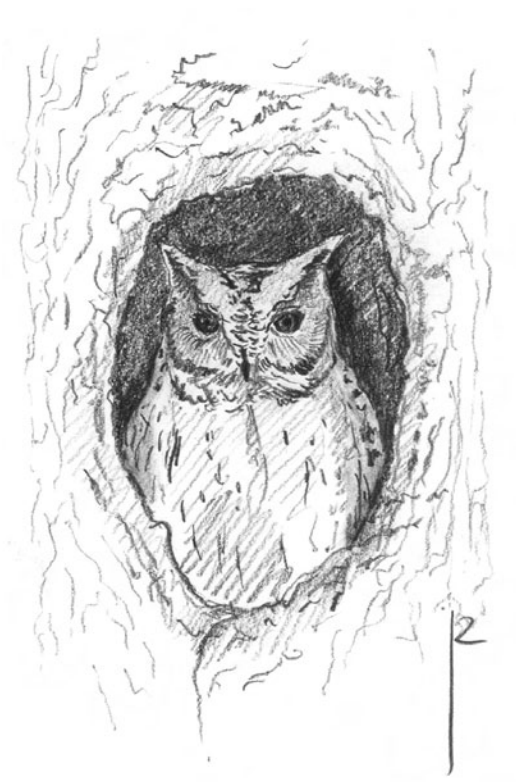
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Nesting ecology of the Collared Scops Owl *Otus lettia* in Thailand

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Information on the Collared Scops Owl *Otus lettia* in Thailand is extremely limited and this study examined its nesting ecology. From August 2006 – September 2007, 23 nests were found and observed in Chanthaburi Province. The breeding season for the Collared Scops Owl started in early January and continued until the end of April. The majority of nest sites were a tree cavity with the opening facing skyward. The average nest height was 3.4 m (SD 1.7) from the ground; average size of the nest entrance was 16 (SD 6.1) cm x 28 (SD 17.4) cm; cavity dimensions were 17 (SD 6.1) cm wide, 24 (SD 8.9) cm long, and depth was 24 (SD 28.5) cm. The average crown cover in the nest area was 43%. The majority of the land used around the nest site was agricultural land. The number of eggs laid per nest was 1–4, with a majority of the nests containing three eggs, and the hatching rate was 60%. The average weight of hatched chicks was 13 (SD 1.6) g and the fledgling weight was 88 (SD 7.6) g. The nesting success was 52% (12 of 23 nests), the survival rate (to fledging) was 65% and mortality rate was inversely related to chick age.

Key words: Collared Scops Owl, *Otus lettia*, nest, eggs, nesting season, chick survival, fledging success, Thailand

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INTRODUCTION

The Collared Scops Owl *Otus lettia* is a very common resident in Thailand (Lekagul & Round 1991), but information on its ecology is extremely limited. It is a small owl (19–25 cm), distributed in East Asia (India, China and Nepal) and southeast Asia (Albania, Ceylon, Malaysia, Indonesia, Hainan, Taiwan, Great Sunda Islands, Philippines and Thailand) (Howard & Moore 1980, Hekstra 1984, Khobkhet 1999). The Collared Scops Owl is a nocturnal bird that is seldom observed in daytime. Its diet is mainly insects and other small animals, such as beetles, grasshoppers, lizards, earthworms, mice, bats, small birds and frogs. Their preferred habitats are dry evergreen forest, evergreen forest, hill evergreen forest, grassland and fruit orchard. The breeding season is between February and April. Typically, three to five eggs are laid in natural hollows or woodpecker holes in a tree trunk or dead stump and most nesting sites are 2–5 m in height. Incubation starts with the first egg laid, and chicks in the same nest always show disparity in size (Khobkhet 1999). The young are semi-altricial at hatching, with their eyes closed and their bodies covered with natal down (Loahajinda 1985). This study describes the nesting behaviour and other basic information of this owl.

METHODS

Study area

Chanthaburi Province was our study area as this area is covered in a variety of land use types, such as fruit orchards, Para rubber plantation and patches of forest. Chanthaburi Province is 6338 km^2 in size and is located in the eastern part of Thailand (Fig. 1), c. 245 km from Bangkok. It has a tropical climate influenced by the southwest monsoon. The amount of rainfall in 2005

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Figure 1. Location of Chanthaburi Province in Thailand.

was 2870 mm, the rainy season runs from May to September, and rainfall decreases from October to April (Meteorological Department 2006). The primary land-use in Chanthaburi Province is agriculture, followed by forests, water sources, urbanization and housing. Orchard farming is the most common agricultural activity in the province (Land Development Department 2004: OAE, 1995–2002).

A poster program was utilized to help us communicate with local citizens to find nests and roosts of Collared Scops Owls. The posters were distributed to communities, schools, local administrators and displayed at community stores between January and June 2007. All nests found were located by GPS and mapped. After we found a nest, the nest tree species, nest height and nest dimensions (width, length, and depth) were recorded. Plant composition and structure in a circular vegetation plot of 10-m radius around the nest was also determined. The crown cover of trees (diameter at breast height: DBH > 4.5 cm) in each plot was estimated using the formula for an ellipse: area = $0.25\pi \times d1 \times d2$, where d1 is the largest crown diameter and d2 is the diameter perpendicular to d1.We characterized land use around nests sites, using plot radii of 200 m, 305 m, and 1000 m. The first two plot sizes were based on the extent of the core area and home range of the Eurasian Scops Owls *Otus scops* in altered and semi-arid landscapes, respectively (Martinez *et al.* 2007). The 1000-m radius plot was based on 50% of the home range of the Spotted Owl *Strix occidentalis* in the southern Oregon Coast Ranges (Carey *et al.* 1990). Land use within these three plots was evaluated using the Arc GIS program, based upon the land-use map from the Land Development Department (2004).

Adult, nesting owls were trapped, weighed and measurements taken of the tarsus, bill and wingspan. Adults and chicks were banded with unique combinations of coloured plastic rings. Egg dimensions were measured and the chicks were marked when hatched on their talon. After hatching, each chick was measured (tarsus, bill and wingspan) and weighed every 2–3 days. After the chicks fledged, they were identified by their rings. Measurements are given as mean ± SD unless otherwise noted.

Point Biserial Correlations (Pearson correlation coefficients) between crown cover, land-use type and nest characteristics was used to assess nesting success. Regression analysis and stepwise regression were calculated to derive the equations necessary to predict chick age.

RESULTS

Nest site characteristics

Twenty-three owl nests were found between early February and the end of April 2007, in agricultural areas. Eighteen of the nests were in trees and five were on the ground (Table 1). Nest dimensions are given in Table 2. Most owl nests (74%) opened on top (skyward).

Table 1. The location and characteristics of 23 Collared Scops Owl nests in Chanthaburi Province, Thailand.

Nest Location	Nest characteristics		Number of nests
In trees	In dead tree stumps		2
	In live trees	In the tree trunk	8
		On epiphytic ferns	4
		On dead branches	3
		In the tree fork	1
On the ground	In dead stumps		2
	In cement tubes		2
	Under tree fork		1

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The average crown cover at the nest location was 136.1 ± 40.1 m^2 or 43% of the total 10-m radius area around the owl's nests, while the average crown cover above the nest was 132.0 ± 40.3 m^2 or 42% of total area. The average nest tree's crown cover was 29.7 ± 17.6 m^2, or 9% of total area. No correlation was found between the percentage of crown cover and nest success ($P > 0.05$).

Within a 200-m radius of the owl's nest, 93.9% of the area consisted of agricultural land, 3.4% of water sources and 2.8% of urbanization and housing (Table 3). Proportional land use was similar at distances of 305 m and 1000 m. There was no correlation between the percentage of each type of land use (agricultural area, the water sources, urbanization and housing area and forested area) and nest success ($P > 0.05$).

Eggs and breeding biology

The average dimensions of the eggs were 28.85 ± 1.10 x 33.65 ± 1.39 mm ($n = 41$). Clutch sizes ranged from 1–4 eggs, with the majority of nests having 3 eggs (63%, $n = 23$). The hatching rate was 60% (27 of 45 eggs). The incubation period was 22–29 days ($n = 3$) and the nestling period was 18–26 days ($n = 6$). The interval time between the first attempt that failed with chicks (at 7–8 days old) and the next attempt was 15 days ($n = 1$). Breeding pairs left their chicks alone during the daytime after they were 16.0 ± 4.1 days old. The average body weight, and bill, tarsus and wingspan length of 12 adults (sex unknown) were 141.3 ± 17.8 g, 15.0 ± 1.8 mm, 32.5 ± 2.1 mm and 55.8 ± 2.4 cm, respectively.

Chick growth and development

Newly hatched chicks were semi-altricial, their eyes were still closed with natal down, and the egg tooth was still apparent. Details of chick development are as follows: *Age 6–10 days*, the remiges and semi-plumes began to grow. The eyes opened on average at 6 ± 2.8 days and the eggs tooth disappeared on average by 8.5 ± 2.4 days. *Age 11–15 days*, the bristles around the bill began to grow and were obvious by 20 days old. *Age 16–20 days*, the rectrices began to grow, while the remings and semi-plumes had become fully developed. During this period some of the chicks fledged. *Age 21–25 days*, fully feathered and the chicks fledged from the nest.

The overall daily growth rate for body weight, bill, tarsus, wingspan was 3.0 g, 0.2 mm, 0.7 mm and 1.2 cm, respectively. The highest daily rate of increase in body weight, 4.5 g/d, was when the chick was 6–7 days old. The chick attained maximum body weight when 24–25 days old, but the body weight had decreased by 1–2 g at 1–2 day before fledging. The highest daily rate

Table 2. The dimensions of Collared Scops Owl nest trees and hollows in Chanthaburi Province, Thailand.

	Nest tree ($n = 18$)			Nest hollow ($n = 23$)				
				Entrance		Cavity		
	DBH[a] (cm)	Height (m)	Nest height (m)	Width (cm)	Length (cm)	Width (cm)	Length (cm)	Depth (cm)
Mean ± SD	41.9 ± 14.5	9.3 ± 5.3	3.4 ± 1.7	16.4 ± 6.1	28.3 ± 17.4	17.5 ± 6.1	23.7 ± 8.9	24.3 ± 28.5
Range	25.1–83.7	1.4–21.0	1.2–6.1	6.0–34.0	14.0–83.0	11.0–35.0	13.0–51.0	0–137.0

[a]Diameter at breast height.

Table 3. The percentage of the land use types within different areas around Collared Scops Owl nests in Chanthaburi Province, Thailand.

Area around nest (m)	Percentage of the land use types					
	Field or mixed field crop[b]	Forest	River, canal, reservoir, lake, pond[a]	Urbanization and housing area	Mixed orchard, Para rubber[b]	Transplanted paddy field[b]
200	6.66	0.00	3.36	2.77	87.21	0.00
305	8.52	0.00	2.93	2.56	85.99	0.00
1000	13.12	1.58	2.55	3.69	78.18	0.88

[a]Water sources. [b]Agricultural area.

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of increase in bill length was 0.4 mm/d when 3–6 days old. The highest daily rate of increase in tarsus length was 1.2 mm/d when 1–8 days old. The highest daily rate of increase in wingspan was 1.81 cm/d when 12–13 days old. All rate of increase, bill, tarsus and wingspan, declined in that order from hatching to fledging. Comparative data on the averages of body weight, and bill, tarsus and wingspan length among hatchlings, fledglings and their parents (adults) are shown in Table 4.

By using stepwise regression analysis we predicted the age of the owl chick between hatching and fledging using measurements, and we found that the wingspan was suitable for predicting the age of owl chicks in this period:

$$\text{Age (day)} = [0.635 \times \text{Wingspan (cm)}] - 2.490$$
$$(\text{Adjusted } R^2 = 0.989, P < 0.05)$$

Breeding success

Breeding success, where the outcome was known, is as follows: the hatching success was 60% (27 of 45 eggs); fledging rate was 65.2% (30 of 46 young). Overall nest success (at least one young surviving to fledging) was 52.2% (12 of 23 nesting attempts). A total of 30 chicks fledged from 12 nests (2.5 ± 0.9 fledgling per successful nest), with 54.5% of pairs rearing one or more young (12 of 23 owl nests, 22 pairs, one pair used a different nest after the first attempt failed). Chick mortality rate was inversely related to chick age: when chicks were 5 days old, mortality rate was 38% and declined to 31% at 6–10 days old, 25% at 11–15 days old, and 6% at 16–20 days old.

DISCUSSION

In Chantaburi Province, Collared Scops Owl laid their eggs in the dry season between January and early March. The chicks hatched from mid-February to late-March and fledged from mid-March to late-April, which was by the beginning of the wet season. The breeding season of Collared Scops Owl in this study (late-January to late-April) was similar to that of other Scops Owls in southeast Asia, starting in the late dry season and ending in the rainy season, such as Andaman Scops Owl *Otus bali* (mid-February – mid-April), Sunda Scops Owl *Otus lempiji* (February–April), and Philippine Scops Owl *Otus megalotis* (January–May) (König *et al.* 1999).

According to the egg and clutch sizes in this study, the egg dimensions of the Collared Scops Owl were about the same size as eggs of the Sunda Scops Owl (28.8 x 33.5 mm) but bigger than those of the Indian Scops Owl (27.0 x 33.0 mm). The clutch size was similar to the Indian Scops Owl clutch (3–4 eggs), but larger than Sunda Scops Owl clutch (2 eggs, rarely 3; König *et al.* 1999). Regarding clutch size and breeding season of Collared Scops Owl, Hekstra (1984) indicated that clutch size varied from north to south across its range, laying four or five eggs in the north in the spring but only three or four eggs in the south where it breeds during the period of maximum rainfall.

Although most owl nests were located in agricultural areas (fruit orchards and Para rubber plantations), it should not be concluded that Collared Scops Owls actually prefer to nest in these areas. The methods of nest searching and nest location used public relations, and as most people were active around their own agricultural land, most nests were found in those areas. Future studies should emphasize nest searchers in forested areas, such as Community Forests, National Parks, Forest Parks and Wildlife Sanctuaries.

In Australia, suitable tree hollows occurred most often in the tree canopy and least often in the main trunk (Harper *et al.* 2004), and in dead wood more than in live wood. In another Australian study by Whitford (2002), owls preferred hollows in the tree trunk rather than nesting on branches. Interestingly, in our study, the Collared Scops Owl used epiphytes, the ground and cement tubes as nest cavities, which suggests that nest sites were in short supply and that the provision of nest boxes would likely improve conditions for the owl. Most of the nest sites in this study were

Table 4. Average body weight, and bill, tarsus and wingspan among Collared Scops Owl hatchlings, fledglings and adults (parents). Mean ± SD and sample size (in parentheses) are given.

Stage	Weight (g)	Bill (mm)	Tarsus (mm)	Wingspan (cm)
Hatchling	12.8 ± 1.6 (18)	6.3 ± 0.5 (14)	11.4 ± 0.9 (14)	7.7 ± 0.5 (14)
Fledgling	88.4 ± 7.6 (32)	12.2 ± 0.7 (32)	30.1 ± 2.2 (32)	38.8 ± 3.8 (32)
Adult	141.3 ± 17.8 (12)	15.0 ± 1.8 (10)	32.5 ± 2.1 (10)	55.8 ± 2.4 (10)

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open on top, allowing rainwater to easily flood the nest, with nest drainage likely a significant factor in chick survival. We also found that one nest cavity of Collared Scops Owl was used by Asian Barred Owlets *Glaucidium cuculoides* after the Collared Scops Owls had left, indicating that two species of owl can share the same nest and habitat but at different times.

Conservation-oriented research is of paramount importance in Thailand. Many people still think that the owl is an evil bird. Most Thai people believe that when they hear or see an owl it is a sign of bad news. Because of this belief, most people try to eradicate owls from their land by shooting, stealing eggs, using pesticide to kill owls, or trapping owls near the nest. In addition, changing land use is another significant threat, such as destruction of owl habitat by urbanization or deforestation.

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SAMENVATTING

In dit onderzoek in de provincie Chanthaburi, Thailand, werd informatie verzameld over de broedbiologie van de Gekraagde Dwergooruil *Otus lettia*. Tussen augustus 2006 en september 2007 werden 23 nesten van deze soort gevonden. De nesten lagen overwegend in landbouwgebieden. De bedekking door boomkruinen rond het nest was gemiddeld 43%. Het broedseizoen begon vroeg in januari en duurde tot eind april. De meeste nesten waren in een boomholte gemaakt met de opening naar boven gericht. De nesten waren op gemiddeld 3,4 m hoogte gebouwd. De nestopening was gemiddeld 16 × 28 cm groot, de nestholte gemiddeld 17 cm hoog en 24 cm breed en diep. De legselgrootte was 1–4 en de meeste nesten bevatten 3 eieren. Van de eieren kwam 60% uit. Bij het uitkomen wogen de jongen gemiddeld 13 g, bij het uitvliegen gemiddeld 88 g. Het nestsucces was 52%. De overleving van de jongen in de nestfase was gemiddeld 65%, waarbij de overlevingskans met de leeftijd toenam.

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