J. Raptor Res. 38(3):263–269

BREEDING BIOLOGY OF THE GREY-FACED BUZZARD (*BUTASTUR INDICUS*) IN NORTHEASTERN CHINA

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ABSTRACT.—We studied the breeding biology of the Grey-faced Buzzard (*Butastur indicus*) in Zuojia Nature Reserve, Jinlin province, China from 1996–98. Grey-faced Buzzards are summer residents in northeastern China. Nesting sites were occupied in March and annual reoccupancy was 60%. Grey-faced Buzzards built new or repaired old nests in late March and laid eggs in early April. Laying peaked in late April and spanned 32 d (N = 15 clutches). Clutches consisted of 3–4 eggs, incubated for 33 ± 1 d predominantly by the female, to whom the male brought prey. After young hatched, the female also began hunting. The mean brood-rearing period was 38 ± 2 d and nestling females attained larger asymptotic mass than males, but the latter grew faster. Males fledged at a mean age of 35 d and females at 39 d. Young were slightly heavier than adults at fledging, but the wing chord and tail lengths were shorter than those of adults. A total of 50 eggs was laid in 15 nests ($\bar{x}$ clutch size = 3.3), of which 80% hatched and 90% of the nestlings fledged. A mean of 2.4 young fledged per breeding attempt. Overall nest success was 80%. Causes of nest failure were addled eggs and predation on eggs or nestlings by small mammals (e.g., Siberian weasel [*Mustela siberica*]).

KEY WORDS: *Grey-faced Buzzard;* Butastur indicus; *breeding biology; clutch size; nestlings; fledglings; development; reproductive success.*

BIOLOGÍA REPRODUCTIVA DE *BUTASTUR INDICUS* EN EL NORESTE DE CHINA

RESUMEN.—Estudiamos la biología reproductiva de *Butastur indicus* en la reserva Natural de la Providencia de Jinlin en China desde 1996–98. *B. indicus* es un residente de verano en el noreste de China. Los sitios de anidacion fueron ocupados en Marzo y la reocupación anual de los nidos fue el 60%. *B. indicus* construyo o repararo los nidos viejos a finales de Marzo y puso huevos a principios de Abril. El pico de la postura ocurrió en Abril y abarco 32 días (N = 15 nidadas). Las nidadas fueron de 3–4 huevos incubados 33 ± 1 dias, los cuales fueron incubados predominantemente por la hembra, a la cual el macho traia presas. La media del periodo de crecimiento fue de 38 ± 2 días, las hembras obtuvieron una mayor masa corporal que los machos, pero estos crecieron mas rápidamente. Los machos emplumaron en un promedio de 35 días y las hembras a los 39 días. Los juveniles al emplumar fueron levemente mas pesados que los adultos. Una media de 50 huevos fue obtenida en 15 nidos (tamaño de la nidada = 3.3), de los cuales un 80% eclosionaron y un 90% de los pichones emplumaron una media de 2.4 pichones emplumados por intento reproductivo. El éxito general de anidacion fue de 80%. Las causas del fracaso de anidacion fueron atribuibles a huevos podridos y ala depredacion de pichones por pequeños mamíferos (*Mustela siberica*).

[Traducción de César Márquez]

Among subtropical birds, raptors are one of the least-studied groups, and relatively little is known about their breeding biology, particularly in China. Since 1995, several surveys have been conducted to document the distribution and population status of Grey-faced Buzzards (*Butastur indicus*) during

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Figure 1. The distribution of the Grey-faced Buzzard. Dark shading indicates breeding range; grey shading indicates winter ranges. The white square indicates the study area.

their breeding season in Zuojia Nature Reserve, northeastern China. Because of these survey efforts, the species is known from more localities than ever before in China (Deng et al. 1997). Feng et al. (1991) estimated the population at a maximum of 30 breeding pairs in Zuojia Nature Reserve and 1000 breeding pairs in northeastern China. The species occurs either in conifer forests, broad-leaf forests, or mixed forests. Grey-faced Buzzards are summer residents in this area. A variety of reports suggest that most Grey-faced Buzzards that breed in northeastern China migrate to Okinawa, Taiwan, the Philippines, Indonesia, and Malaysia for wintering (Ching et al. 1989, Severinghaus 1991, Deng et al. 2003).

Until now only two cases of breeding by Grey-faced Buzzards have been reported in China (Feng et al. 1991, Zheng and Wang 1998), and these only included brief descriptions. The nests and eggs have been described (Cheng 1987, Xu 1995), and breeding territory and roost characteristics have been reported (Kojima 1982, Deng et al. 1997, 2003). Here, we describe breeding biology of Grey-faced Buzzards based on 3 yr of observations in Zuojia Nature Reserve in northeastern China.

STUDY AREA

The study area, ca. 184 km^2 in size, was located in Zuojia Nature Reserve and included the Tumengling Mountains and Zhujia Mountains ranging from the eastern Changbai Mountains to the western plain (126°1′–127°2′N, 44°6′–45°5′E; Fig. 1). Elevation at the site ranged from 200–500 m above sea level. The climate is east monsoon, characterized by hot, dry summers and cold, snowy winters. Mean monthly temperatures ranged from −20.5°C in January to 23.6°C in August during study period. The vegetation within the study area was quite diverse, although the forest type was secondary forest. The seven tree species mainly present on the study area were Mongolian oak (*Quercus mongolica*), Dahurian birch (*Betula davurica*), Manchurian linden (*Tilia mandschurica*), Japanese elm (*Ulmus japonica*), Scotch pine (*Pinus sylvestris*), Korean larch (*Pinus koraiensis*), and Masson pine (*Pinus massoniana*; Deng et al. 1997). In the study area, Dahurian rose (*Rosa dahurica*), Korean rose (*Rosa doreana*), willowleaf spiraea (*Spiraea salicifolia*), ural false-spiraea (*Sorbaria sorbifolia*), and Sakhalin honeysuckle (*Lonicera maximowiczii*) dominated the shrub layer.

METHODS

Breeding areas were surveyed by foot periodically throughout the breeding season to find mated pairs. We defined nesting sites as an area where aerial displaying, mating, nest-building, incubating, brooding, and repeated prey-carrying occurred. An area with a mated pair was considered an occupied nesting site. Observations of Grey-faced Buzzards in their breeding areas were made from above canopy lookouts and ground blinds with the aid of 8–12× binoculars and a spotting scope. We distinguished mature males, females, and immatures by their body size and plumage color (Deng 1998). The body size of males was smaller than that of females. Also, the plumage color of adults was darker than that of immatures. We classified display flight as territorial only if followed by an encounter between the resident and an intruder (Delannoy and Cruz 1988), otherwise interactions between pair members were considered courtship. We estimated above-ground heights of flying birds in courtship relative to known above-ground heights of hills and other topographic features. Nest measurements were taken at accessible nests. Nest height was measured in plumb-line distance from the nest to ground level. Shortest diameter, longest nest diameter, nest depth exterior, and nest depth interior were measured using a ruler.

We measured egg dimensions (breadth and length to the nearest 0.1 mm) with vernier calipers, and determined egg mass and body mass of nestlings (nearest 0.1 g) with a spring scale (Pesola, Barr, Swizerland). Individual young were marked with colored leg bands soon after hatching. Ricklefs' (1967) method of fitting equations to growth curves was used to compare growth patterns of male and female nestlings. Nestlings were weighed, and the length of their wing chord, tail length, culmen, and tarsal length were measured at 3-d intervals. After fledging, mist nets were used to capture fledglings and adults, which were measured (tarsal length, wing chord, culmen, and tail length) and weighed. Tarsal length was measured from the intertarsal joint to the bend of the foot. The tail length (mm) was measured from the base to the tip of the center rectrix. Reproductive output was the total number of fledglings produced over a nestling season. Reproductive success was a general term that included several measures and components, expressed on per pair, per breeding attempt, or per egg basis. All statistical procedures followed Zar (1999).

RESULTS

Courtship and Territoriality. We observed the movements and behavior of fledglings for 118 hr

Table 1. Grey-faced Buzzard nest-site characteristics in northeastern China.

NEST-SITE CHARACTERISTICS	MEAN	SD	RANGE	N
Nest height (m)	13.3	3.5	8.8–16.6	15
Nest-tree height (m)	17.5	3.3	13.5–22.9	15
Nest tree DBH (cm)	30.8	9.3	22.1–44.2	15
Shortest nest diameter (cm)	30.3	6.2	25.5–38.6	13
Longest nest diameter (cm)	35.1	7.6	28.9–40.3	13
Nest depth exterior (cm)	42.6	11.5	33.7–55.6	13
Nest depth interior (cm)	17.3	8.1	9.8–29.5	13
Nest support branch diameter (cm)	8.6	3.7	5–18	10

at two nests. Grey-faced Buzzards are summer residents that establish nesting territories only during the breeding season in northeastern China. Reoccupancy of nesting sites occurs in early March. Annual reoccupancy was 60% (N = 15). Six nests were reoccupied at least twice. Most Grey-faced Buzzard activity during March and early April involved courtship and territorial display flights. A typical courtship flight began when the male circled above the nest site and the female followed shortly afterwards. Both male and female soared and actively flew giving intermittent vocalizations. Males used flapping more frequently than females and circled in the sky higher than the females. Buzzards reached estimated above-ground heights of 30–150 m ($\bar{x}$ = 80 m, N = 12). Display bouts lasted 5–20 min ($\bar{x}$ = 14 min, N = 12). Most courtship flights (75%, N = 12) ended with a steep dive into the forests. We observed 11 territorial display flights in the study area in 1998. Resident males initiated territorial behavior from a perch (N = 7) or while in flight (N = 4). When intruders entered air space near the nesting site, resident males flew straight at them and evicted intruders. Buzzards only chased raptors and relatively large birds such as corvids.

Nest Building and Nest Characteristics. Grey-faced Buzzards started nest building shortly after occupying their nesting areas in late March or early April. Both adults took part in nest construction. In 1997, during 80 hr of observation at three nests, we observed deliveries of 72 dry sticks; males contributed 43 (60%) and females 29 (40%). Most nest building activity occurred between 0600–0730 H. Nests were built in trees on forked branches. Buzzards gathered dry sticks from the ground or nearby trees within 50 m of the nest trees. Several nests contained dried or green needles of *Pinus* spp. in the nest platform. Near nest completion, the pair created a bowl by compacting a layer of finer twigs with their talons and breast. The earliest nest-building activity in a season was observed on 21 March 1998. The earliest copulation was observed on 29 March 1997, ca. 4 wk before laying. Copulation usually occurred after a courtship display.

More than half (N = 8) of nests were located in Korean larches. Nests typically were placed in the upper half ($\bar{x}$ height = 13.3 m) of relatively tall trees ($\bar{x}$ height = 17.5 m; Table 1).

Egg Laying, Incubation, and Hatching. By late April, females remained near the nest site and were mostly inactive. Males provided food at this stage and during the following months. Earliest recorded laying dates were 20 April 1996, 17 April 1997, and 19 April 1998. Laying of first clutches spanned 37 d (17 April–24 May). First clutches were on average completed on 12 April ± 9 d (mean ± SD, N = 15 clutches) for 3 yr. Mean clutch size was 2.9 ± 0.8 (N = 15). Mean egg dimensions were 53.7 × 43.3 mm (N = 47). The mean egg mass was 51.5 g (49.8–53.5 g, N = 47), 9.9% of the female's body mass ($\bar{x}$ female body mass = 490 g, N = 6) and 38.2% of her mass for a clutch of four eggs.

Females incubated while males provided food. In 1997, we recorded incubation patterns of a female during 12-hr periods (0600–1800 H) for 5 consecutive days. The female incubated 22% of the first day (1 egg), 29% of the second day (2 eggs), 38% of the third day (3 eggs), 39% of the fourth day (3 eggs), and 43% of the fifth day (4 eggs). Most hatching occurred during late May, except when pairs renested. Hatching was asynchronous, spanning 1–3 d. Hatching for all years peaked on 25 May ± 4 d and spanned 12 d (20 May–2 June, N = 10). The incubation period from laying to hatching of the last egg averaged 33.5 ± 1.6 d (N = 9).

Nestling Period. Young emerged from eggs with eyes closed. The eyes began to open after 0.5 d. By the fourth day after hatching, the young could stand up and showed improved coordination in pecking at food held above them by the female. Nestlings could be sexed accurately in the nest after they were 8 d old by examining the feather tips (the primary feather tips of males emerged from the sheaths at ca. 8 d, N = 14; females at 9–10 d, N = 12) and extent of black in wing (males had more black than females). The first tail feathers appeared at approximately 12.5 d in males (N = 14) and 12 d in females (N = 12). Young began to replace the natal quill-coverts down 20 d after hatching.

During the nestling period, males hunted more frequently than females. However, only females dismembered and fed prey to young. Late in the third week and early in the fourth week after hatching (19–26 d), females spent less time brooding. In one nest, the female brooded four 18-d-old young more than half of the time (N = 8 hr), but decreased brooding to 8% (N = 8 hr) when the young were 26 d old. From 25–31 d after hatching, the young squabbled over prey and were able to dismember most soft parts. At 26–28 d, the young flapped their wings regularly and began to roost overnight in branches near the nests. The nestling period ended when the young flew short distances from the nest and roosted in trees 10–20 m away. Nine males fledged at a mean of 35 d of age (range = 33–38, SD = 1.2), and 10 females at 39 d (range = 37–41, SD = 1.1), with a combined mean fledging age of 37 d (range = 31–41, SD = 2).

Growth Rate. Increase in tarsi length, mass, wing and tail length followed Gompertz or logistic growth patterns (Fig. 2). Male and female nestlings showed differences in mass growth patterns. Females attained a higher asymptotic mass than males ($\bar{x}$ female = 559 g, N = 10; $\bar{x}$ male = 462 g, N = 9). It took males 12.6 d to grow half their asymptotic mass, but 15.1 d for females. The time interval of growth from 10–90% of the asymptote (t_{10}–t_{90}) was shorter in males than in females ($\bar{x}$ male = 25 d, N = 9; $\bar{x}$ female = 27 d, N = 10). Males generally fledged earlier (36–38 d) than females (37–41 d). Both males and females at fledging were slightly heavier than adults (adult mass: $\bar{x}$ male = 396 ± 11 g, N = 9; $\bar{x}$ female = 519 ± 13 g, N = 10).

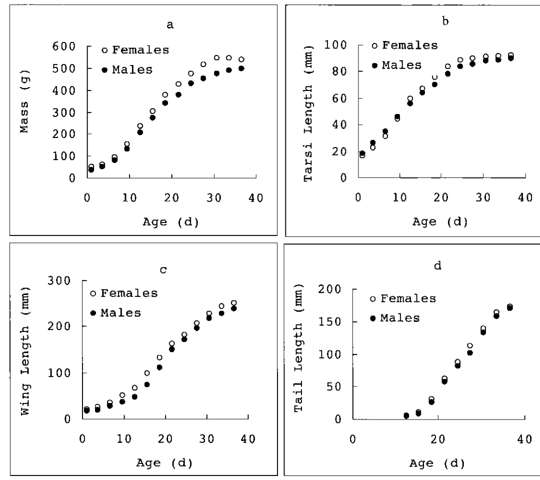

Figure 2. Changes of mass (a) tarsus length (b) wing chord length (c) and tail length (d) of males (N = 9) and females (N = 10) of Grey-faced Buzzard nestlings in northeastern China.

Fledgling and Post-fledgling Periods. Fledging spanned nearly 7 wk, from mid-June–late July. After fledging, young remained in the nest area and returned to the nest frequently. By 42–48 d after hatching, the young had dispersed 50–100 m from the nest. Adult females still fed young at this time. The young were capable of handling and carrying prey to a perch away from the nest and their siblings. Young constantly solicited food and mobbed adults when the adults entered the nest area.

At two nest sites, we monitored movements of five young. One young did not spend time in the nest area away from the nest, but dispersed abruptly. Four spent 2 d away before their dispersal. The ages of young at one nest site averaged 76 d (N = 3) and in another 80 d (N = 2) when they dispersed. Adults and young did not stay together after the latter dispersed.

Reproductive Success. From 1996–98, 18 nests were built and 15 nesting attempts were observed (eggs laid; Table 2). In 15 nesting attempts, two nest failures occurred during incubation and one during the nestling stage. According to our observations, the causes for nest failure (N = 5) were predation on eggs or nestlings by small mammals (such as the Siberian weasel [*Mustela siberica*]).

DISCUSSION

Our observation of Grey-faced Buzzard courtship and territorial behavior appears to differ from

Table 2. Annual reproductive success of Grey-faced Buzzards during breeding season (1996–98) at Zuojia Nature Reserve, northeastern China.

YEAR	NESTING ATTEMPTS[a]	EGGS LAID	MEAN CLUTCH SIZE	EGGS HATCHED (%)	YOUNG FLEDGED (%)	SUCCESSFUL NESTS N (%)	PRODUCTIVITY PER NEST ATTEMPT
1996	4	12	3.0	10 (83)	8 (80)	4 (100)	2.0
1997	6	22	3.7	15 (68)	14 (93)	4 (67)	2.3
1998	5	16	3.2	14 (87)	14 (100)	4 (80)	2.8
Total	15	50	3.3	40 (80)	36 (90)	12 (80)	2.4

[a] Number of nests with eggs.

other *Butastur* buzzards. White-eyed Buzzards (*B. teesa*) and Rufous-winged Buzzards (*B. liventer*) seldom circled above their nest site during the prenesting period (Smythies 1986, Cheng 1987, Xu 1995). Grasshopper Buzzards (*B. rufipennis*), which occurs in Africa, performed soaring displays above the nest site (Rasa 1987, Thiollay and Clobert 1990). The behavior of Grey-faced Buzzards circling above the nest site during the pairing period might serve both to attract potential mates and to give an assertive message to potential intruders. Grey-faced Buzzards showed strong territorial behavior when birds of similar size and shape entered the territory. We frequently observed chasing behaviors of the buzzards directed toward congeners, other raptors, waterfowl, and corvids.

The nesting period was ca. 105 d from nest building to dispersal of young from their natal areas. This is comparable to White-eyed and Rufous-winged buzzards, which have relatively short nesting periods (Smythies 1986, Cheng 1987, Xu 1995, Gao 2003). Also, the breeding period in Grey-faced Buzzards is shorter than that of their tropical counterparts of comparable size (Newton 1979, Mader 1981, Delannoy and Cruz 1988, Thorstrom and Quixchán 2000). The nesting cycle of songbirds also is longer in tropical than in temperate regions. Differences between tropical and temperate avian groups are due to differences in the length of time required to complete various stages of breeding (Newton and Marquiss 1982, Delannoy and Cruz 1988). The shorter breeding period of the Grey-faced Buzzards compared to that of the White-eyed and Rufous-winged buzzards (Smythies 1986, Cheng 1987, Xu 1995) resulted from shorter periods of nest building, courtship, egg laying, and brood rearing. White-eyed and Rufous-winged buzzards built their nests earlier than the Grey-faced Buzzards and they had a relatively longer brood-rearing period (Cheng 1987, Xu 1995).

It is possible that the breeding season, especially the laying and nestling period of the Grey-faced Buzzard, was restricted by food abundance. In northeastern China, the prey of the buzzards are mainly frogs, reptiles (snakes and lizards), rodents, and some small birds (Deng 1998). We suggest that the nestling and fledging periods in Grey-faced Buzzards were synchronized with the peak of prey abundance.

Grey-faced Buzzards preferred to build their nests in large Korean larches and Scotch pines with high canopy closure in wooded areas (Deng et al. 2003). This selection was different from that of White-eyed and Rufous-winged buzzards (Xu 1995, Deng et al. 2003). White-eyed Buzzards usually built their nests in broadleaf tree species in open country or cultivated areas (Cheng 1987). However, Rufous-winged Buzzards preferred to build their nests in conifer or broadleaf tree species near rivers and swamps in lowland plains (Smythies 1986, Lekagul and Round 1991).

Most raptors select habitat types with relatively open canopy for easier access to nests, and fewer connections between neighboring trees, which limits the movements of arboreal animals (e.g., Moore and Henny 1983, Cerasoli and Penteriani 1996, Malan and Robinson 2001, Malan and Shultz 2002). We did not find this selection pattern in our study. On the contrary, Grey-faced Buzzards selected their breeding habitat in dense conifer or mixed forests. Thorstrom and Quixchán (2000) suggested that dense forest habitat may limit raptor hunting behaviors. According to our observations, Grey-faced Buzzards seldom hunt in the forest near nest sites. Their foraging sites were often in open areas such as pastures, peat bogs, and paddy fields near the nest sites.

Female nestlings attained a higher asymptotic mass than males. However, males left the nests earlier than females. Sexual differences in growth rates have been found in other raptors (e.g., Schnell 1958, Moss 1979, Delannoy and Cruz 1988).

In this study, during the late nestling period, young were slightly heavier than adults, and the mass decreased slightly at least for females when the fledgling period began (Fig. 2). This pattern also was found in the Common Buzzard (*B. buteo*; Xu 1995) and the Upland Buzzard (*Buteo hemilasius*; Gao 2003). Grey-faced Buzzard young fledged (took their first flight from the nest tree) 31–41 d after hatching. This is comparable to the Rufous-winged Buzzard's relatively short brood-rearing period (Gao 2003).

Productivity seemed high during the study, with 2.4 young fledged per breeding attempt. High productivity was the result of a low nest predation rate and high nesting success (80%). In our study, causes of nest failure were addled eggs ($N = 9$) and predation on eggs or nestlings ($N = 8$) by mammals such as the Siberian weasel. The richness and density of animals that prey on Grey-faced Buzzards was low in the study area (Deng 1998). Few mortalities were observed in either adults or young. For example, two adult females banded in 1996 were still on their territories in 1998. Thus, if a pair of Grey-faced Buzzards was successful in laying eggs, they had a good chance of producing offspring successfully.

There are no data for productivity of other *Butastur* species. However, productivity and nesting success was higher for the Grey-faced Buzzard than for the Puerto Rican Sharp-shinned Hawk (*Accipiter striatus*; Delannoy and Cruz 1988), and the Bicolored Hawk (*Accipiter bicolor*; Thorstrom and Quixchán 2000). Sharp-shinned Hawks suffered a higher degree of nest failures from nestling mortality attributed to parasite infestation and clutch desertion. Bicolored Hawks laid addled eggs and suffered predation on eggs or nestlings. These patterns were consistent with the general trend that tropical birds have lower fecundity and reproductive success than their counterparts in temperate latitudes (Ricklefs 1969, Newton 1979).

ACKNOWLEDGMENTS

We thank Liu Yang, Yan-hui Li, Ren-kai Song, Lu-ye Tang, and Ya-mei Yu for help in the field. Wei-dong Luo and Bao-xue Zhang were very patient in helping with data collection. Earlier drafts of this manuscript were improved by comments from Zheng-wang Zhang and Yan-yun Zhang. The staff of Zuojia Natural Protection Area provided logistical support during the study period. We also thank the anonymous reviewers of The Journal of Raptor Research.

LITERATURE CITED

BORTOLOTTI, G.R. 1986. Evolution of growth rates in eagles: sibling competition vs. energy considerations. *Ecology* 67:182–194.

CERASOLI, M. AND V. PENTERIANI. 1996. Nest-site and aerial point selection by Common Buzzards (*Buteo buteo*) in central Italy. *J. Raptor Res.* 30:130–135.

CHENG, T. 1987. A synopsis of the avifauna of China. Science Press, Beijing, China.

CHING, H.C., S.T. YU, AND C.H. CHIANG. 1989. A survey of Grey-faced Buzzard Eagle hunting in ManChou Area. KenTing National Park, Taipei, China.

DELANNOY, C.A. AND A. CRUZ. 1988. Breeding biology of the Puerto Rican Sharp-shinned Hawk (*Accipiter striatus venator*). *Auk* 105:649–662.

DENG, W.H. 1998. Breeding ecology and habitat characteristics of Grey-faced Buzzard. M.S. thesis, Northeast Normal Univ., Changchun, China.

———, W. GAO, AND G.M. ZHENG. 2003. Nest and roost habitat characteristics of the Grey-faced Buzzard in northeastern China. *J. Raptor Res.* 37:228–235.

———, X. WANG, AND W. GAO. 1997. Breeding habitat selection of the Grey-faced Buzzard Eagle. *J. Northeast Norm. Univ.* 9:57–61.

FENG, H.L, G.Q. XIANG, AND K.Q. ZHANG. 1991. Observation on breeding Grey-faced Buzzard Eagle. Chinese Science Publishing House, Beijing, China.

GAO, W. 2003. Ecology of falcon order in China. Chinese Science Press, Beijing, China.

KOJIMA, Y. 1982. Territory and territorial behavior of the Grey-faced Buzzard Eagle *Butastur indicus. Tori Bull Ornithol. Soc. Jpn.* 30:117–147.

LEKAGUL, B. AND P.D. ROUND. 1991. A guide to the birds of Thailand. Saha Barn Bhaet, Bangkok, Thailand.

MADER, W.J. 1981. Notes on nesting raptors in the llanos of Venezuela. *Condor* 83:48–51.

MALAN, G. AND E.R. ROBINSON. 2001. Nest-site selection by Black Sparrowhawks *Accipiter melanoleucus*: implications for managing exotic pulpwood and sawlog forests in South Africa. *Environ. Manage.* 28:195–205.

——— AND S. SHULTZ. 2002. Nest-site selection of the Crowned Hawk-Eagle in the forests of Kwazulu-natal, South Africa, and Taï, Ivory coast. *J. Raptor Res.* 36. 300–308.

MOORE, K.R. AND C.J. HENNY. 1983. Nest site characteristics of three coexisting accipiter hawks in northeast Oregon. *Raptor Res.* 17:65–76.

MOSS, D. 1979. Growth of nestling Eurasian Sparrowhawks, *Accipiter nisus. J. Zool.* 197:297–314.

NEWTON, I. 1979. Population ecology of raptors. Buteo Books, Vermillion, SD U.S.A.

——— AND M. MARQUISS. 1982. Fidelity to breeding area and mate in Eurasian Sparrowhawks, *Accipiter nisus*. *J. Anim. Ecol.* 5:327–341.

RASA, O.A.E. 1987. Patterns of intra-African small raptors spring migration in the Taru Desert, Kenya. *Afr. J. Ecol.* 25:165–171.

RICKLEFS, R.E. 1967. A graphical method of fitting equations to growth curves. *Ecology* 48:978–983.

———. 1969. The nesting cycle of songbirds in tropical and temperate regions. *Living Bird* 8:165–175.

SCHNELL, J.H. 1958. Nesting behavior and food habitats of goshawks in the Sierra Nevada of California. *Condor* 60:377–403.

SEVERINGHAUS, L.L. 1991. The status and conservation of Grey-faced Buzzard-Eagles and Brown Shrikes migrating through Taiwan. Pages 203–223 *in* T. Salathé [ED.], Conservation migratory birds. ICBP Technical Publication, Bros. Ltd, London, U.K.

SMYTHIES, B.E. 1986. The birds of Burma. Nimrod Press, Hants, U.K.

THIOLLAY, J.M. AND J. CLOBERT. 1990. Comparative foraging adaptations of small raptors in dense African savanna. *Ibis* 132:42–57.

THORSTROM, R. AND A. QUIXCHÁN. 2000. Breeding biology and nest site characteristics of the Bicolored Hawk in Guatemala. *Wilson Bull.* 112:195–202.

XU, W.S. 1995. Chinese raptors. Chinese Science Press, Beijing, China.

ZAR, J.H. 1999. Biostatistical analysis. Prentice-Hall, Englewood Cliffs, NJ U.S.A.

ZHENG, G.M. AND Q.S. WANG. 1998. China red data book of endangered animals. Chinese Science Press, Beijing, China.

Received 20 August 2003; accepted 15 May 2004
Associate Editor: Marco Restani