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Post-hatching Growth and Development of the Asian Paradise Flycatcher (*Terpsiphone paradisi*)

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Abstract: Parental care in birds may be provided by one sex or both depending on the maturity of the chicks at hatching and is provided especially to altricial nestlings. These often need both mother and father to provide food for them during their stay in nest. The amount of care the parents provide to the young affects their growth and development between hatching and fledgling and increases the chances of the nestlings surviving. Growth and development of the Asian Paradise Flycatcher were studied during the breeding season from 2005-2009 at Chiang Dao Wildlife Research Station, Chiang Mai Province and Khao Pra-Bang Khram Wildlife Sanctuary, Krabi and Trang Province. About 29 nestlings were measured (length of bill, unflattened wing and tarsus and body-weight) and their plumage development scored. All the measurements were highly correlated with the age of nestlings during their period in the nest except that body weight in the day before fledgling fell slightly. The body sizes of nestlings of Rufous-plumaged males with long central tail feathers (RL) and Rufous-plumaged males with short tails (RS) were also compared. The growth curves of nestlings of RL and RS males were nearly identical and there were no significant differences between them. The plumage developed gradually and was divided into 4 stages. The nestlings opened their eyes fully on day 7-8 and left the nest on day 10-11 before they were able fly properly. The nestlings made a begging call with their neck stretched out to try to reach the parent's bill and their gape opened so that their yellow palate was visible. A successful breeding cycle lasted 24-30 days including 2-4 days of egg-laying, 12-15 days of incubation and 10-11 days of parental care of nestlings in the nest. Fledgling success was 44.4%.

Key words: *Terpsiphone paradisi*, growth curve, body size, altricial, bill length, tarsus length

INTRODUCTION

More than 90% of bird species are altricial (Maier, 1998) with young that are rather undeveloped and helpless at hatching in contrast to precocial species. Altricial young require more parental care, moreover and have no chance of survival without such care during their period in a nest (Maier, 1998; Pough *et al*., 1999; Slater, 1999). With these characteristics, altricial species are most likely to be monogamous with the sexes forming stable mated pairs in which both sexes participate in rearing the nestlings (Immelmann, 1983; Maier, 1998; Slater, 1999). This benefits them both as it increases the survival of their young and so the contribution of each bird's genes to the next generation (Immelmann, 1983). In line with this, the Asian Paradise Flycatcher (*Terpsiphone paradisi*) is monogamous and both males and females take part in nest-building, incubation, brooding and feeding of the nestlings (Khobkhet, 2004). Males are distinguished by their conspicuously broad blue eye-rings and greatly elongated central pair of tail feathers extending up to 25 cm beyond the rest of the tail. Males have two colour morphs, rufous and white but some rufous morph males lack long central tail streamers. Females have only one morph, dull rufous-brown with grey eye-rings and a short tail (Sibley and Monroe, 1990; Lekagul and Round, 1991; King *et al*., 1995; Mizuta, 1998; Mizuta and Yamagishi, 1998; Khobkhet, 2004; Robson, 2004). The rufous morph predominates and is a common resident in both northern and southern Thailand, while the white morph occurs more in southern than in northern areas. The aim of this study was to report on the post-hatching growth and development of the Asian Paradise Flycatcher. The information provided covers the breeding period before fledging and may be a useful contribution in helping to assess breeding success in this species.

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MATERIALS AND METHODS

Study area: Fieldwork was partly carried out at Chiang Dao Wildlife Research Station (19°21'N, 98°55'E) Chiang Mai Province, Northern Thailand from 2005-2006 and 2008. The main vegetation types there are bamboo + deciduous, hardwood seasonal forest, which has many woody climbers and abundant seedlings and saplings of both evergreen and deciduous tree species as well as several species of bamboos (Maxwell, 1992).

The other study area was the Khao Pra-Bang Khram Wildlife Sanctuary (7°55'N, 99°15'E), Krabi and Trang Province, Southern Thailand. There are nature trails at Thung Tiao, the vegetation in this area mainly consists of a small remnant patch of lowland rain forest (Mizuta, 1998). The ground flora are dense and diverse with *Salacca*, *Dracaena* and bamboos as well as many creepers and vines. The studies in Khao Pra-Bang Khram Wildlife Sanctuary were conducted from natural trails in Thung Tiao, the Roi Chan Pan Wang Forest Protection Unit and the Thung Sai Thong Forest Protection Unit from 2008-2009. The main vegetation at Roi Chan Pan Wang and Thung Sai Thong is similar to that at Thung Tiao.

Data collected: The data were collected during the four breeding seasons from March-July 2005-2006 and 2008-2009.

Male characteristics: In this study, there were males with three types of characteristics which were identical to those noted by Mizuta (1998) and Mizuta and Yamagishi (1998). These were Rufous-plumaged males with a long central pair of tail feathers (referred to as RL), Rufous-plumaged males with short tails (RS) and White-plumaged males with a long central pair of tail feathers (WL).

Nestling measurements: The measurements of nestlings were taken soon after hatching at about the same hour for each brood. Measures taken were lengths of bill, unflattened wing and tarsus as well as body-weight. The length of the bill, unflattened wing and tarsus were measured to the second decimal place using dial calipers. Body weight was measured using digital and spring balances (PESOLA). The nestlings were measured almost every day until the date of fledging. Plumage development, eye opening, colour of skin and of bill were also described with a system adapted from Ngoenjun (2001) and Sciborska (2004).

Sound recording: Sounds of the nestlings or begging calls were recorded on a HHP Portradisc MDP 500 (Mini Disc) recorder attached to a Telinga PRO 4B dynamic microphone. The sounds were produced, analyzed and presented as sonograms using the Avisoft-SAS Lab Program sound analysis computer program.

RESULTS

General breeding information: About 36 nests of the Asian Paradise Flycatcher were found at two study sites: 25 at the Chiang Dao Wildlife Research Station and 11 in the Khao Pra-Bang Khram Wildlife Sanctuary (7 in Krabi and 4 in Trang). The nests were found at different stages and also varied according to the type of characters of the male attending them (Table 1). Nests found were open, deep, bowl-shaped and 0.75-2.5 m above the ground. The birds started breeding in early March and stopped in July. The most common clutch was 3 eggs (15/20 nests) but clutch-sizes ranged from 2-4 eggs. Average egg size was 20.3±1.0 × 15.1±0.4 mm (n = 53) and their average weight was 2.4±0.1 g (n = 22). Successful breeding cycles lasted 24-30 days: 2-4 days of egg-laying, 12-15 days of incubation and 10-11 days of nestling care. The fledging success was 44.4%: 13 nests of RL males, 2 nests of RS and one nest of WL.

Growth of nestlings: About 29 nestlings from 11 nests were measured in all but the numbers measured varied between days. Bill, wing and tarsus lengths together with body weights of nestlings are shown in Fig. 1. All the measurements were highly correlated with the age of the nestlings during the period of their stay in the nest except that body weight in the last day before fledging was slightly lower. Mean bill, wing and tarsus lengths at 10 days were 10.4, 48.2 and 21.5 mm, respectively and the body weight was 14.7 g. The body sizes of nestlings of RL and RS males were also compared during the nestlings first 10 days of life. The growth curves of nestlings of RL and RS males were nearly identical (Fig. 2) and there were no significant differences in body sizes between the

Table 1: Number of nests of each type of male in the two study areas together with the stages of breeding at which they were discovered

	Chiang Dao Wildlife Research Station		Khao Pra-Bang Khram Wildlife Sanctuary		
Nest stage at which found	RL	RS	RL	WL	Total
Nest building	6	2	1		9
Egg laying	5	1		2	8
Incubation	6	1	2	4	13
Nestling	4		1	1	6
Total	21	4	4	7	36

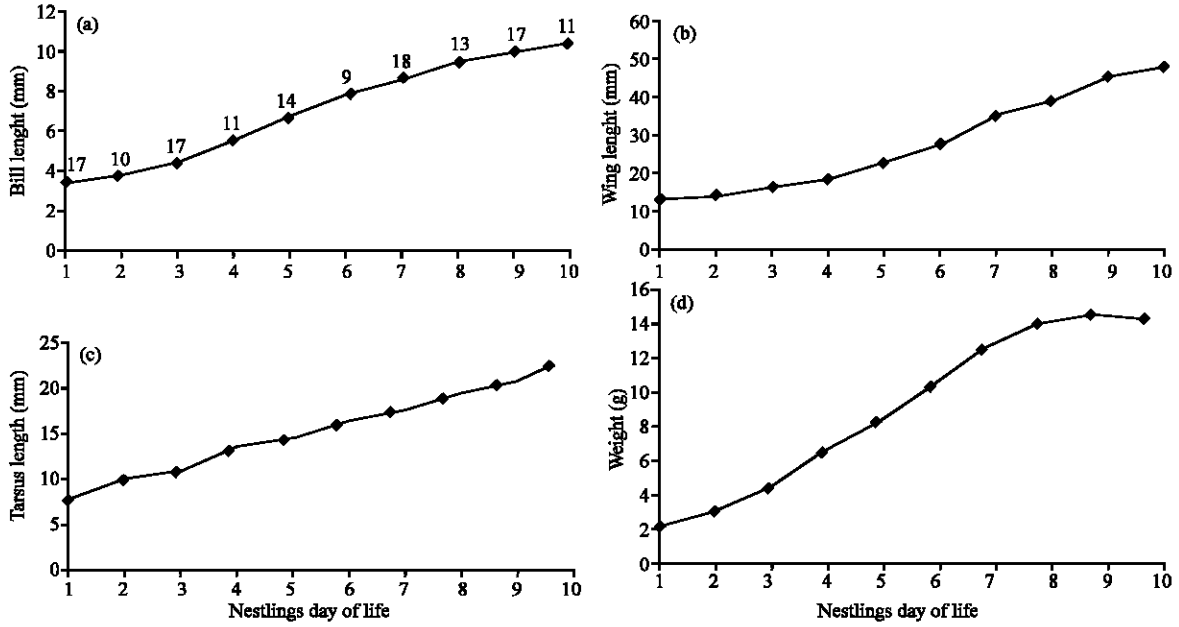

Fig. 1: Growth curve of nestlings: a) bill length; b) wing length; c) tarsus length; d) weight. Labels show the number of nestlings

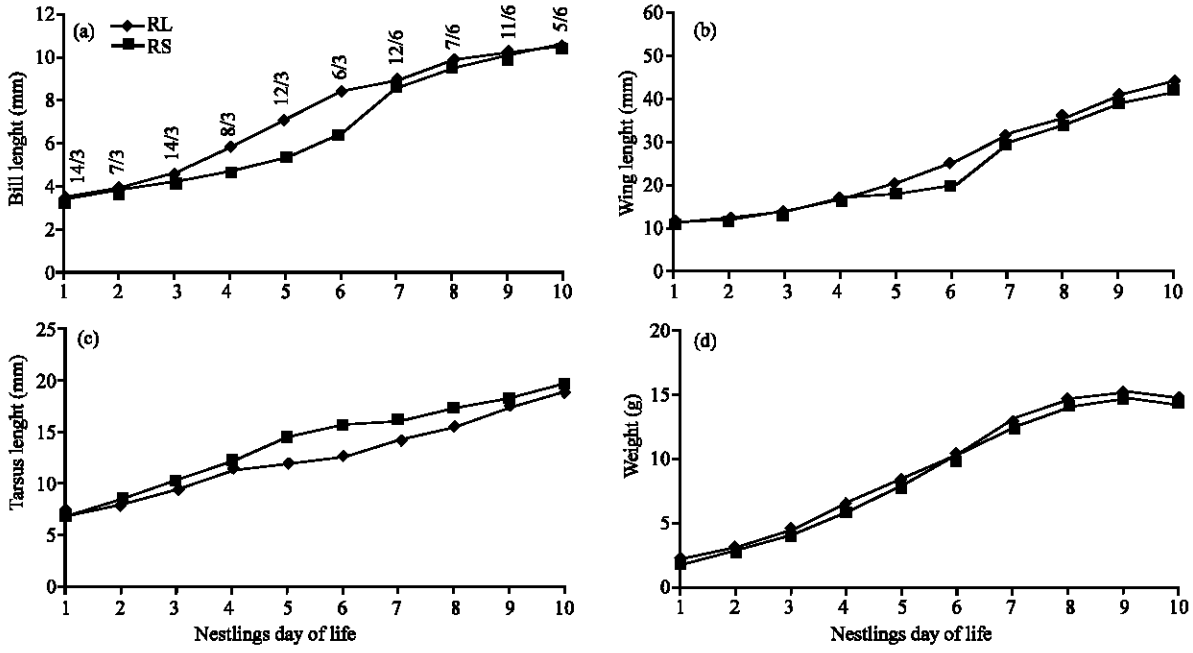

Fig. 2: Growth curves of nestlings: a) bill length; b) wing length; c) tarsus length; d) weight. Labels show the number of nestlings from nests of RL/RS males

nestlings from RL and RS males (t-test, $p>0.05$). However, the sample sizes of nestlings were too small to make a definite conclusion. The nestlings at hatching were almost naked, sparsely covered with natal down; their eyes were closed for some time after hatching and they were incapable of locomotion. They had pinkish and transparent skin through which entrails and yolk-sac were visible and flesh-coloured legs. The bill had a dark tip and soft pale yellow edge and the palate was yellow inside the gape.

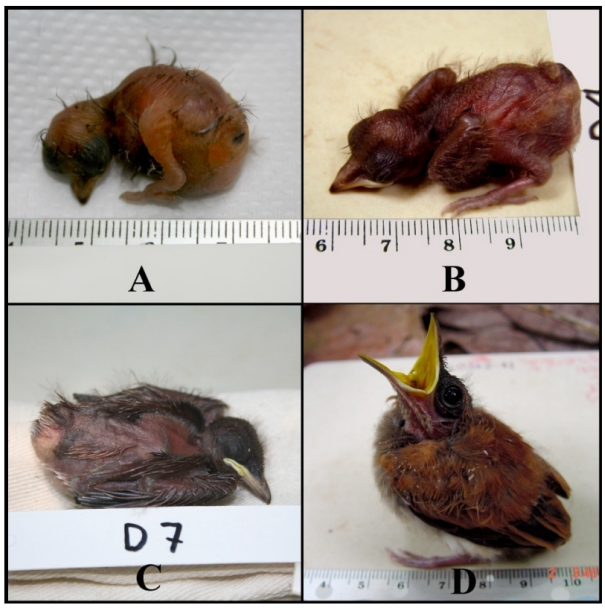

Fig. 3: The four stages of plumage development in nestlings

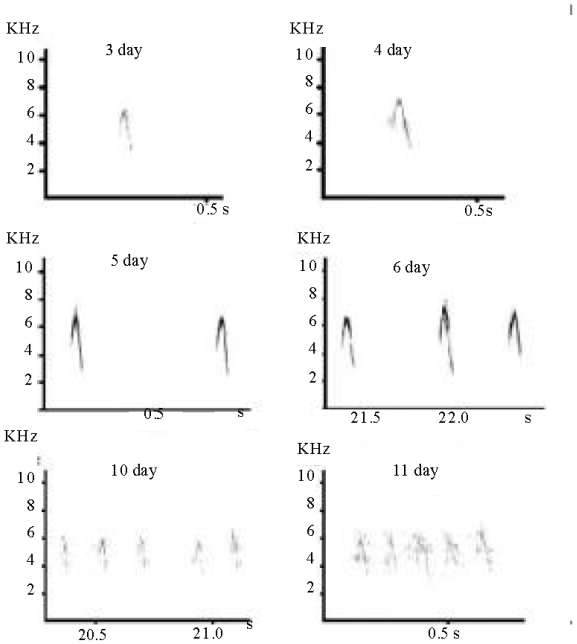

Fig. 4: Sonograms of begging calls emitted by nestlings at different ages

The plumage developed gradually and this was divided into 4 stages (Fig. 3). A-stage: the feather germs were not visible (day 1). B-stage: the feather germs appeared continuous under the skin in all the pterylae. The allula feathers and primaries pierced the skin (up to day 4). C-stage: the skin was punctured by dorsal contour feathers. At this stage, the dorsal contour feathers and primaries were pins with a rufous tip (up to day 7). D-stage: the nestlings were almost completely covered with rufous contour feathers. The rufous vanes of flight and dorsal feathers were more than half the total length of the feathers (from day 7 onwards). The nestlings left the nest on day 10-11 before they were able to fly well. The yolk-sac was visible after hatching and grew smaller until day 4. The nestlings opened their eyes on day 4-5 at first in the form of a thin slit with complete eye opening

following on day 7-8. The light pink body, bill and wings darkened from the first day. The nestlings first preened themselves on day 6-7.

Vocal communication: The nestlings made the begging call when their parents returned and perched at the nest but in some cases, the begging call also occurred when their nest was shaken whether parents were present or not. This only happened in the first few days after hatching. Nestlings making the begging call stretched their necks out to try to reach the parent's bill and opened their gapes until the yellow palate was visible. The begging calls were short and high-pitched vocalizations sounding like jeeap but rather soft before day 3-4. The sonograms showed each element of the begging call to be of high frequency and to rise and fall in the form of a chevron (Fig. 4) but they became of lower frequency in the few days before fledging.

DISCUSSION

The complete breeding cycle of the Asian Paradise Flycatchers in this study was almost a month long, similar to that reported by Mizuta (1998) and Mizuta and Yamagishi (1998), who studied the breeding biology of this species in Khao Pra-Bang Khram Wildlife Sanctuary, Krabi Province. The clutch sizes found varied from 2-4 eggs and the nestlings hatched near simultaneously. After the eggs hatch both parents invest in large amounts of parental care. As well as providing food they also protect their nestlings and this includes transmission of body heat to them until there are able to thermoregulate on their own (Saunders, 1954; Immelmann, 1983; Maier, 1998). This parental investment influences the growing process of the nestlings to yield an S-shaped growth curve (Fig. 1).

This is similar to that found by Sciborska (2004) who studied the growth of nestlings in the Citrine Wagtail (*Motacilla citreola*) and also reported that tarsus and wing length were highly correlated with the age of nestlings. In the broods observed here, the Asian Paradise Flycatcher nestlings fledged at 10 and 11th day old but were practically unable to fly and their body sizes at day 10 were less than those of adult birds except for tarsus length which approximated that of adults (the body sizes of adult birds are taken from Mizuta (1998), Mizuta and Yamagishi (1998) and Ngoenjun (2001). It seems that the growth of the tarsus to reach full development may be achieved by the date of leaving the nest (Sciborska, 2004). Early in the nestling period altricial chicks cannot stabilize their body temperature and must be provided with warmth from the parent (Maier, 1998).

In the Asian Paradise Flycatcher both male and female spent more time brooding the nestlings in the A-B than the C-D stage because the plumage developed only gradually during the A-B stage but rapidly in the C stage when the sheaths of contour feathers opened and the chick became almost covered. This result is similar to that reported by Carere and Alleva (1998) for the Common Swift (*Apus apus*): in this species the parent spent less time brooding when the nestlings were >6-9 days old.

Adults of some species of birds carry food to nestlings in their beaks. These nestlings respond to any disturbance that might signal the arrival of a parent at the nest by gaping widely and they often have brightly coloured mouth linings (Pough *et al*., 1999). It was found that nestling Asian Paradise Flycatchers usually responded when their nest was shaken whether parents were present or not by doing vigorous begging displays that include presenting the yellow markings inside their mouths, stretching, wing flapping and making the loud calls to stimulate the parents to provide food. The Pacific Swift (*Apus pacificus*) shows a similar response (Falls, 1982; Ngoenjun and Sitasuwan, 2001).

CONCLUSION

In this study, Young birds reared in open nests frequently flap their wings vigorously in the wind for several days before flying. This flapping may help to develop muscles but it is unlikely that it helps the birds to learn to fly. A bird's flying abilities do improve with practice for a period after it leaves the nest (Pough *et al*., 1999). Flapping behaviour was found in this study and occurred when the nestlings were 9-11 days old.

The nestlings sat on the edge of nest cup or on a branch of the nest tree and flapped their wings several times before they fledged. The parents would swoop down near the nestlings making loud calls which appeared to stimulate the nestlings to fly out from nest. The nestlings then stayed with their parents for a period after they left the nest because their limited flying abilities at fledging meant they could not catch insects in the air.

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REFERENCES

Carere, C. and E. Alleva, 1998. Sex differences in parental care in the common swift (*Apus apus*): Effect of brood size and nestling age. Can. J. Zool., 76: 1382-1387.

Falls, J.B., 1982. Individual Recognition by Sound in Birds. In: Acoustic Communication in Birds, Kroodsma, D.H. and E.H. Miller (Eds.). Academic Press, New York, pp: 237-252.

Immelmann, K., 1983. Introduction to Ethology. 2nd Edn., Plenum Press, New York, ISBN: 0-306-40489-3, pp: 156-177.

Khobkhet, O., 2004. The Birds of Thailand. Vol. 4, Sarakadee Press, Bangkok, pp: 141-144.

King, B., M. Woodcoc and E.C. Dickinson, 1995. Birds of South-East Asia. Harper Collins, London, pp: 394-396.

Lekagul, B. and P.D. Round, 1991. A Guide to the Birds of Thailand. Darnsutha Press, Bangkok, pp: 394-396.

Maier, R., 1998. Comparative Animal Behaviour: An Evolutionary and Ecological Approach. Allyn and Bacon, USA., pp: 260–261.

Maxwell, J.F., 1992. Lowland vegetation (450–800 m) of doi chiang dao wildlife sanctuary, Chiang Mai Province, Thailand. Tigerpaper FAO., 19: 21-25.

Mizuta, T. and S. Yamagishi, 1998. The breeding biology of the Asian paradise flycatcher *Terpsiphone paradisi* in khao pra–bang khram wildlife sanctuary, Southern Thailand. Nat. Hist. Bull. Siam Soc., 46: 27-42.

Mizuta, T., 1998. Breeding biology of monogamous Asian paradise flycatcher *Terpsiphone paradisi* (Aves: Monarchinae): A special reference to colour dimorphism and exaggerated long tails in male. Raff. Bull. Zool., 46: 101-112.

Ngoenjun, P. and N. Sitasuwan, 2001. Breeding behavior and post-hatching development of *Apus pacificus*. J. Wildlife Thai., 9: 18-22.

Ngoenjun, P., 2001. Behavior of Pacific Swift (*Apus pacificus*) at Nam Lod Cave, Mae Hong Son Province. The Graduate School of Chiang Mai University, Chiang Mai, pp: 37-60.

Pough, F.H., C.M. Janis and J.B. Heiser, 1999. Vertebrate Life. 5th Edn., Prentice-Hall Inc, New Jersey, pp: 486-551.

Robson, C., 2004. A Field Guide to the Birds of Thailand. Asia Books, Bangkok, pp: 172-173.

Saunders, A.A., 1954. An Introduction to Bird Life for Bird Watchers. Dover Publications Inc., New York, pp: 75-82.

Sciborska, M., 2004. Breeding biology of the citrine wagtail (*Motacilla citreola*). J. Ornithol., 145: 41-47.

Sibley, C.G. and B.L. Monroe, 1990. Distribution and Taxonomy of Birds of the World. Yale University Press, London, pp: 491-492.

Slater, P.J.B., 1999. Essentials of Animal Behaviour. Cambridge University Press, Cambridge, pp: 157-219.