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The First Observations of the Breeding Biology of the Elegant Tit *Parus elegans* in the Philippines.[1]

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Introduction

The Elegant Tit is widely distributed throughout the Philippines, and is represented by nine subspecies, all of which are endemic to the Philippines. The nominate race *elegans* ranges from Catanduanes and Luzon to Mindoro and Panay (see Harrap & Quinn (1996) for full descriptions). There are two other *Parus* species occurring in the Philippines, both of which are endemic and have more restricted ranges than the Elegant

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Tit; the Palawan Tit *Parus amabilis*, endemic to Palawan, and the White-fronted Tit *Parus semilarvatus* of Luzon and Mindanao. The Elegant Tit is thought to be most closely related to the Palawan Tit and the Yellow-bellied Tit *Parus venustulus* of mainland China and together they are placed in the subgenus *Paraliparus*; all three species are thought to be derived from the Coal Tit *Parus ater* (HARRAP & QUINN 1996). Found in all forest types, including pine, forest edge and secondary forest, at all elevations, the Elegant Tit usually travels in pairs, small family units and mixed species flocks with the Philippine Bulbul *Hypsipetes philippinus*, Velvet-fronted Nuthatch *Sitta frontalis*, *Phylloscopus* warblers and where present, *Rhipidura* fantail flycatchers (KENNEDY *et al.* 2001). Although, one of the more common birds in the Philippines, the breeding biology of the Elegant Tit, in comparison to the Palaearctic tit species, is virtually unknown. Breeding is thought to occur during the 'dry' season of January-June (KENNEDY *et al.* 2001), and HARRAP & QUINN (1996) record that nesting is in hollow trees, including moss as a nesting material.

Study Area and Methods

The study was conducted around Sibaliw (11°49N, 121°58E), Municipality of Buruanga, Province of Aklan, Philippines. This area is located on the Northwest Panay Peninsula mountain range at an average elevation of 450 m a.s.l., and consists largely of virgin lowland forest partly intersected by secondary growth. The climate on the Peninsula is perhumid (DICKINSON et al. 1991) (Figure 1).

Two nests were observed. The third and fourth nests were both similar in structure to the two nests described in this paper. The first nest was monitored infrequently between 26 May and 19 June 2002, allowing only qualitative, descriptive data to be collected. The second nest was monitored more intensively between 27 March and 11 April 2003, allowing quantitative data on feeding rates and food items to be collected. A total of 14 days of observation data were collected before the study was ended prematurely due to predation of the female. In total 102 hours of observations were made. Both nest holes were situated in the ground on slopes, the first in secondary forest and the second in primary forest. The second nest was monitored on alternate days during incubation, and then every day from hatching. It was monitored for half a day, alternating between 05:00 h-12:00 h in the morning and 12:00 h-18:00 h in the afternoon on consecutive days, so that the first and the last visits of both parents in the nest were recorded. Observations were made from a blind located 5 m away from the nest hole, using a spotting scope, and 10 x 42 binoculars. Observations of the nest, eggs and hatchlings were made using a Pentax fibrescope. Photographs of the nest hole and an egg were taken, and the egg measured using callipers. The egg was removed from the nest hole using a scoop and a fibrescope and replaced immediately after measuring. Dimensions of the nest hole were measured using a ruler. During incubation the time spent inside

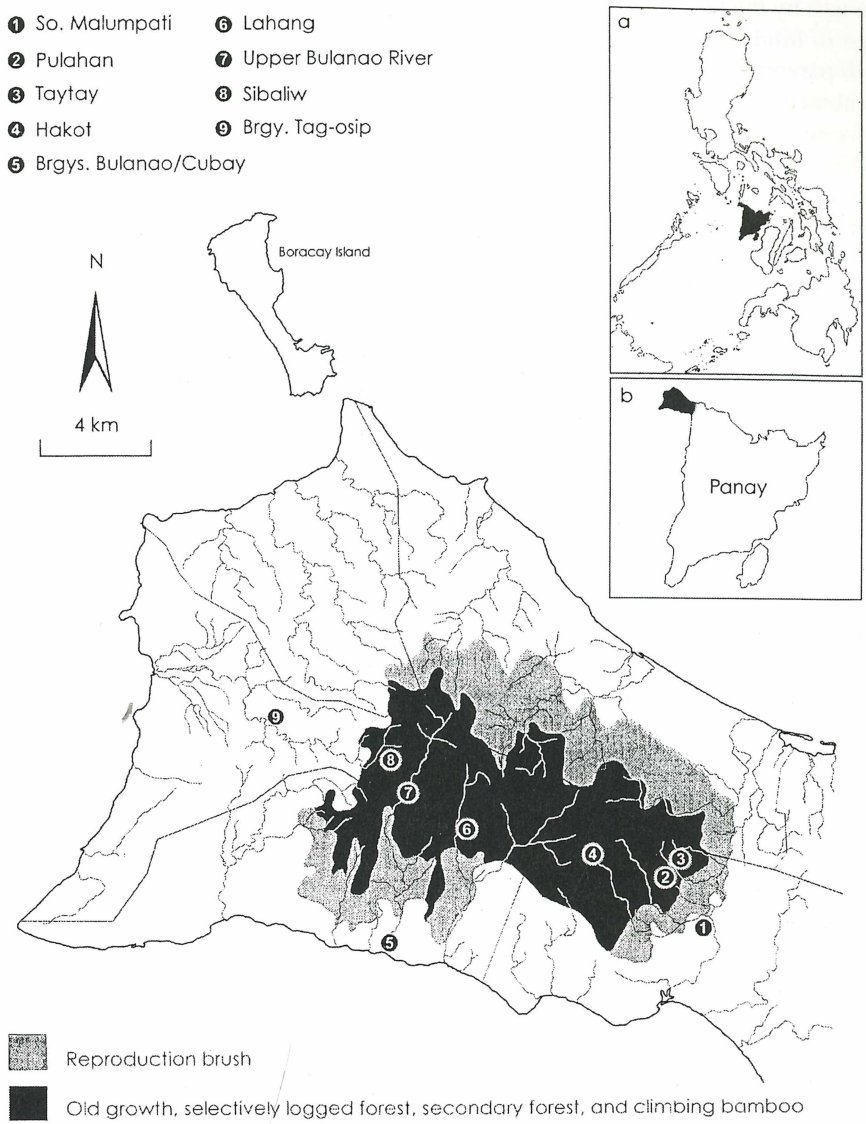

Fig. 1. Location of the Northwest Panay Peninsula, showing the study site (number 8, Sibaliw), nearest settlements, municipal boundaries and forest cover.

the nest by the female was recorded. In the nestling period, the time of feeding visits, type of food items and behaviour were also recorded. To analyse rates of feeding of both parents to the nest in a day, the two half days of two consecutive days have been combined to create one full day.
Fifty nest boxes (entrance hole type) were provided around the study area from June 2002. The boxes were designed following specifications used for the slightly larger European Great Tit. They were constructed from marine plywood. The front of the box measured 15 cm, and the back 17 cm, by 17 cm wide. The entrance to the boxes was predator-proof; with a fake roof which swings down in a vertical motion if a predator climbs on top thereby covering the entrance (after H. Mohr). The diameter of the hole was made in two sizes; 32mm, and 45mm. Great Tits prefer to occupy boxes with 32mm holes (LÖHRL 1970). All boxes were painted with environmentally-friendly, non-toxic paint. The boxes were mounted 1-5 m above ground in both primary and secondary forest and are monitored regularly throughout the year; once a month during the non-breeding season (July-December) and every two weeks during the breeding season (January-June).

Results

The Nest
All four nests were situated in the ground under a rock which created an overhang to the entrance. The diameter of the entrance hole varied from 40 mm to 50 mm and depths of 5 cm and 40 cm were recorded, with the nest constructed at the rear of the hole. How these holes were made is still unknown, but they may have been excavated by rodents, as small rodent droppings were found at the entrance to the second hole when it was first discovered at the beginning of nest building. The nest was predominantly made up of fine palm fibre (Palmae) and lined with wind dispersed arils of a vine called 'kagopkop' (local Kinaray-a name) and moss. Moss was used as a foundation during nest building. The palm fibre was compressed to form a cup-shaped depression into which the eggs were laid. Nest building by the female was also observed during incubation.

The Eggs
The eggs were much like those of other *Parus* species, in that they were white or whitish, with little gloss, and speckled with red-brown spots which were usually denser at the blunt end. The clutch sizes were 4 and 5 eggs. Measurements were taken to the nearest mm on a single egg, which measured 17 mm in length and 13 mm in width (photo: E. S.), which is within the range of the other similarly sized tit species of Southeast Asia (HARRAP & QUINN 1996; ROBSON 2002). Unlike the Great Tit (PERRINS 1979), the female did not cover the eggs while away from the nest during the laying period.

Incubation

As with most other *Parus* species incubation was solely undertaken by the female (PERRINS 1979; HARRAP & QUINN 1996). A total of 1311 minutes (21.85 hrs) of observations took place at the second nest (excluding the incubation which takes place while the female is at roost). The date of the onset of incubation was unknown as all eggs had been laid when the nest was discovered. However, incubation was estimated to last approximately 11-15 days, depending on whether incubation began when the first egg was laid or after the laying of the last egg. In the Coal Tit incubation does not begin until completion of the clutch (DEADMAN 1973). Therefore, the shorter of the two time periods is the more likely.

The male did not feed the female inside or next to the nest hole. Therefore, the female left the nest at regular intervals to feed. On average the female spent 4 hours per day outside the nest. Usually she was away from the nest for periods of 20-25 min, before returning to sit on the nest for 50-55 min. A long period off the nest was usually followed by a longer period back on the nest. Feeding of the female by the male may have occurred around the vicinity of the nest when the female was outside searching for food, although this was never observed, and the male was rarely seen in the 20 m visible around the nest hole.

Hatching and Feeding of Young

Hatchlings were tiny, naked and blind. The hatching of the first egg took place in the afternoon, at about 15:00 h. After hatching of the first egg, the male started to visit the nest. Both parents were seen to offer food to the hatchlings, and the female immediately increased the frequency of visits from the nest to bring back food. Egg-shell was not observed being carried out of the nest, but may have been eaten, as in the Marsh Tit *Parus palustris* (STEINFATT 1938).

The number of visits by both parents, and therefore the amount of food brought to the second nest, increased on successive days, presumably as the number of chicks to feed increased (Table 1). The number of visits increased by 4-9 visits for each half day observed, with an average increase of 5.4 visits per half day observed. Of the total 230 feeding visits by both parents, the female did most of the feeding, with 139 visits (60%) compared to the male with only 91 (39%) feeding visits (Table 1). The sex of the parent was unidentified in only 1% of visits.

The distribution of feeding visits between both parents was fairly constant throughout the day, with an average of 6.4 feeding visits between both parents per hour. There was a peak between 12:00 h-14:00 h and then perhaps another smaller peak during the last feeding hours between 16:00 h-18:00 h (Figure 2). This equates to roughly one feeding visit per chick per hour, increasing to 1.5 visits per chick per hour during the peaks. In total this means around 77 visits or food items per day, or 15 visits per chick.

Tab. 1. The proportionate workload of the female.

Age of oldest nestling in days	1	2	3	4	5	6
Total visits observed by both parents	25	29	34	43	47	52
% visits by female	40%	52%	61%	72%	62%	63%

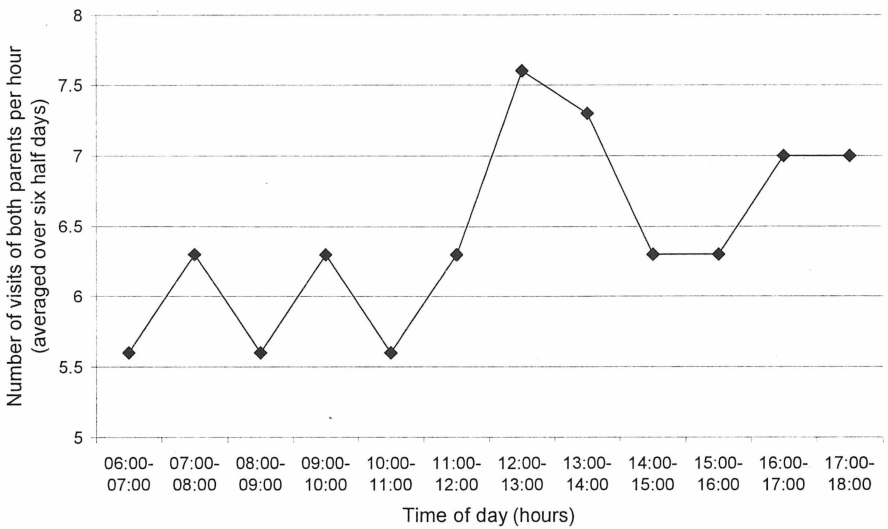

Fig. 2. The distribution of feeding visits by both parents during the course of the day (six separate half days [see Methods] have been combined to make three full days and visits are averages taken over these days).

In the Great Tit and Coal Tit, before visiting the nest or while the female is brooding, the male usually sings or calls outside, and looks into the hole from an adjacent branch, presumably to see whether or not the female is inside (HINDE 1952; DEADMAN 1973). This behaviour was also observed in the Elegant Tit from the first day of hatching for the duration of the observation period. After several calls, the female would emerge out of the hole and fly straight out; the male would then enter the hole to feed the brood. A few cases of ritualised begging displays (fluttering of the wings) by the female were observed outside the nest. This usually occurred when the male appeared from the nest hole having just fed the brood and the female was waiting to enter with food in her beak. However, the parents never exchanged food between themselves: the

female performed the begging display, but then entered the nest to give the food to the young.

The young were predominantly fed with caterpillars and spiders (Table 2), and food items were delivered one at time. Thirty-eight percent of the food delivered by both parents was caterpillars. The unidentified food items comprised nearly 36% of observations due to decapitation of the animal by the adults, and because often the parents would fly straight inside the nest without perching nearby first, thereby rendering it impossible to identify the food. After caterpillars, spiders were the next most common food item delivered (Table 2). Interestingly, as the nestlings matured the amount of caterpillars fed decreased with a corresponding increase in spiders, and crickets and grasshoppers, so that on the 5th and 6th day of the nestling period spiders made up 24% and caterpillars 23% of food items delivered. Larger food items with hard exoskeletons, such as crickets, grasshoppers and preying mantises were fed only as the nestlings matured, starting around the 4th or 5th day of the nestling period.

Tab. 2. Food items fed to the young in the nest

Food Item	Age of Oldest Nestling in Days						Total	% of Total Diet
	1	2	3	4	5	6		
Caterpillar	7	11	17	29	15	8	87	37.7
Unidentified	17	15	11	3	18	19	83	35.6
Spider	-	1	4	7	10	14	36	15.8
Cricket	-	-	1	1	-	7	9	3.9
Unidentified white larva	1	1	-	1	1	1	5	2.6
Grasshopper	-	-	-	-	2	1	3	1.3
Stick insect	-	-	-	2	-	-	2	0.8
Beetle larva	-	1	1	-	-	-	2	0.8
Sac of spider eggs	-	-	-	-	-	2	2	0.8
Preying mantis	-	-	-	-	1		1	0.4

Fledging and Death

The first nest successfully fledged all four young on the 17th June, approximately 17 days after the first egg hatched. Unfortunately, the second nest failed when the female was predated by an *Accipiter* hawk near to the nest hole, late in the afternoon, six days into brooding. The male did not return to the nest hole as it was already nearly dusk. He was observed at the nest hole the following morning, calling and carrying food in

his beak. However, when the nest was checked all the chicks had died. The male remained in the vicinity of the nest hole during the afternoon, and was frequently seen with food in his beak. Neither nest hole was re-occupied in the next (2004) breeding season.

Response to Predators

The main predators of the Elegant Tit are thought to be raptors, snakes, monitor lizards, and cats (Malay Civet and Leopard Cat), with rodents and woodpeckers also included as possible predators of nestlings. During the observation period most of these predators or their signs were seen around the nest hole. During the early stages of incubation rodent droppings were noticed at the entrance to the hole, but the nest was undisturbed. On one occasion a Rough-necked Water Monitor *Varanus salvator nuchalis* passed directly by the nest hole and was observed scanning the ground near the nest thoroughly. The monitor lizard could easily excavate the nest and eat the eggs inside. The response of the female, who was perched above the nest higher up in a tree, was simply to remain silent and motionless, delaying her feeding visit, until the lizard had moved away from the nest. On another occasion a Serpent Eagle *Spilornis cheela* was observed perching and flying a short distance behind the nest. On both occasions there was no mobbing action or noise to drive the predator away from the nest. When humans approached the nest, both parents were observed to stay some distance away from the nest, and remained silent and motionless, watching intently. Occasionally, they would fly short distances between adjacent trees to follow the movements of the human intruder. Moreover, during the course of our observations, there were no audible calls emitted by young during approach and/or feeding visits by the parents. Likewise, when the fiberscope was inserted into the hole the nestlings made no noise, although often they would raise their heads and beg. Faecal sacs were often seen being removed by both parents from the nest. As documented for other tit species this is to help avoid detection of the nest (HINDE 1952).

Nest Boxes

There has been no record of Elegant Tits or other hole breeders utilising the nest boxes.

Discussion

The Nest

The breeding biology of the Elegant Tit and other *Parus* species occurring in the Philippines is poorly known. As for the Elegant Tit there is no record of the nesting behaviour of the Palawan tit, however, for the White-fronted Tit there is one record of a nest in a round hole in a dead stump 5 m from the ground in forest (KENNEDY *et al.* 2001). The discovery of four ground nests, while as yet no nests in tree-holes have

been found, leads to the tentative suggestion that this may be the norm for the Elegant Tit. While ground nesting is relatively uncommon amongst many tit species, it is fairly common in both the Yellow-bellied Tit and Coal Tit. The Yellow-bellied Tit has been found nesting in tree cavities, rock crevices and maybe also earth banks, while the Coal Tit also nests in tree holes, abandoned rodent holes, rock crevices, walls, under stones or among tree roots, and will also use nest boxes (HARRAP & QUINN 1996). TINBERGEN (1946) suggested that ground nesting in the Coal Tit may be because this species is usually found in coniferous woods, where natural holes in trees are comparatively scarce. However, it is thought that tree holes in the forest around Sibaliw should be relatively common, and the forest is presumed to be similar to that in which the White-fronted Tit was found nesting. There are certainly many other recorded hole breeders in the area (e.g. woodpeckers, Visayan Tarictic Hornbill *Penelopides panini panini*, Coleto *Sarcops calvus*, Blue-crowned Racquet-tail *Prioniturus discurus*) (DICKINSON *et al.* 1991). The discovery of the nests in the ground may have been chance coincidence; the area has not been extensively surveyed for natural tree holes, and the small holes which could be used by the tits are harder to see than those utilised by the bigger species. Interestingly, the nests of almost all the small hole breeders (e.g. Velvet-fronted Nuthatch, *Rhabdornis* spp. (except *R. inornatus*), Colasisi *Loriculus philippensis*) have not been recorded (KENNEDY *et al.* 2001).

However, none of the nest boxes provided were occupied during either of the two breeding seasons. Moreover, the nest under observation was just 60 m away from two nearby nest boxes, which may suggest that this species nests under ground as their habit. However, there are other possible reasons why the nest boxes were not occupied; perhaps there was no shortage of natural nest holes (tree or ground), or the dimensions of the boxes may be unsuitable for this species (see VAN BALEN (1984)).

In both cases the nests were situated in the ground under a rock which created an overhang to the entrance; such sites are perhaps chosen as this stops water from getting inside the nest. The nest of a cup of moss, lined with soft fibres is typical of most tit species. It is highly unlikely that the nests where being occupied by the same female as the four nests were spaced between 500 m-1.5 km apart. Interestingly, the two nests described in this paper were not re-occupied the following breeding season, although in the case of the second nest this is not surprising as the female was predated and the nest failed. In the Great Tit the majority of birds re-occupy their previous territory, and the median distances moved are between 50 m and 143 m, with further distances being moved if the brood was preyed upon (HARVEY, GREENWOOD & PERRINS 1979).

Clutch Size and Incubation

The clutch sizes for the two nests were four and five eggs respectively. Thus, clutch size appears to be half that observed for Great Tits (ca. 10) in the UK (GOSLER 1993), but similar to that of the Yellow-bellied Tit (5-7 eggs) (HARRAP & QUINN 1996), and the subspecies of Coal Tit (4-10 eggs) and Great Tit (3-7 eggs) found in Southeast Asia

(ROBSON 2002). The size of the egg (17 x 13 mm) is similar to the Coal Tit (15 x 11.6 mm) and the Yellow-bellied Tit (16.4 x 12.5 mm), the Elegant Tit being the largest of the three species (HARRAP & QUINN 1996).
During incubation the female left the nest at regular intervals to feed, as unlike the Great Tit the male did not feed the female inside or next to the nest hole (KLUIJVER 1950). On average the female spent 4 hours per day outside the nest, usually she was away from the nest for periods of 20-25 min, before returning to sit on the nest for 50-55 min. The female Elegant Tit thus spent more time off the nest than has been recorded for the female Great Tit, which gets on average only 3 hours per day to feed, alternating periods of about 30 min on with 10 min off (GOSLER 1993). DEADMAN (1973) records periods of 30-40 min off the nest at the beginning of the day to 5-6 min at towards the end of the day. GOSLER (1993) states that the female maintains the egg-surface temperature close to 35.4 °C, and alters her period on and off the nest according to air temperature; incubation is also shorter if the egg temperature is maintained closer to 36 °C. Furthermore, a long period off will be followed by a longer period back on, which is what was observed in the Elegant Tit. It is suggested that the female Elegant Tit may be afforded more time away from the nest as the warmer temperature in the tropics will prevent the eggs cooling too fast and allow the eggs to be maintained at the optimum temperature for longer. Moreover, as the female spends more time and longer periods of time away from the nest, where she can feed herself this may explain why the Elegant Tit male was not observed feeding the female inside the nest during incubation, while in the Great Tit, the average male visits the nest 6.9 times per hour to provide food for the incubating female (KLUIJVER 1950), in addition to feeding her outside the nest (E. C., pers. obs.). The fact that the female did not cover the eggs while away from the nest may also be due to the warmer temperature in the tropics. It has been suggested that egg covering in the Coal Tit depends on temperature (DEADMAN, 1973). The incubation and nestling periods (11-15 days and 17 days) are very similar to those of the Great Tit (13 days and 15-21 days, depending on the subspecies (GOSLER 1993), the Yellow-bellied Tit (12 days and 16-17 days) and the Coal Tit (14-16 days and 16-22 days) (HARRAP & QUINN 1996).

Feeding of Young
The number of feeding visits to the nest (5.5-7.5 per hour) and the number of food items per day is much lower than has been observed for British Coal Tits, where the number of feeding visits is between 15-20 per hour and on average the number of food items per chick per day is between 50-69 (DEADMAN 1973; BARNES 1975).
The results suggest that in the Elegant Tit the female does most of the feeding; 60% of feeding visits were by the female compared with 39% by the male. KLUIJVER (1950), HINDE (1952) and BETTS (1955a) found that in general in the Great Tit, the male did most of the feeding until around the seventh day, with the proportion of feeding visits by the female about 28%, as the female was still brooding. After this time the female's

share increases steadily to 60-90%. In the Yellow-bellied Tit and Coal Tit both sexes feed the young, although the proportion of feeding by each parent is unknown. However, in the Coal Tit, the female spends the first few days after hatching in the nest keeping the brood warm, and the male does most of the feeding (DEADMAN 1973; HARRAP & QUINN 1996). The higher proportion of feeding visits by the female from the start of the nestling period, may be due to the temperature in the tropics meaning that less brooding is necessary (as with incubation, see above).

Usually, begging displays and 'courtship feeding' are seen early on in the breeding season and are thought to be essential in providing the female with extra food to produce eggs. However, the ritualised begging display was never observed in the vicinity of the nest during the laying and incubation period, but it was observed several times before the female entered the nest to feed the young. Thus, it was the female which had food in her beak, rather than the male. However, the parents never exchanged food between themselves; the female performed the begging display, but then entered the nest to give the food to the young. This wing-fluttering behaviour has been recorded outside Coal Tit nests, when both parents coincide during feeding visits, and is thought to be a 'recognition' display (DEADMAN 1973).

The diet composition of the nestlings was similar to that recorded for other tit species, with caterpillars forming the majority of the diet fed to the nestlings, especially in the first few days. Most studies record between 48-80% of the nestling diet as caterpillars (e.g. BETTS 1955B; DEADMAN 1973; EGUCHI 1980). The slightly lower amount of 37.7% recorded in this study is possibly due to the large number of unidentified items (35.6%) recorded because of difficulties in observing the birds at close range, and an unfamiliarity with the invertebrates of the region. Alternatively, caterpillars may form a smaller proportion of the Elegant Tit's diet or there may have been lower densities of caterpillars available to the birds observed.

The proportion of the diet made up of spiders increased steadily after hatching. This is the same as has been recorded for the Great Tit. ROYAMA (1970) found that the proportion of the diet made up by spiders increased steadily after hatching, peaked at about day six or seven, and then declined. He also noticed that this occurred irrespective of habitat or time in the season, and that trends were also detectable in data on Great Tits collected by BETTS (1955*a*) and TINBERGEN (1960). GOSLER (1993) added that it is possible that this is related to the development of feathers, since both feather keratin and spider protein are rich in the sulphur-containing amino acid cystine, and feather development starts at around day five. Unfortunately, data after the sixth day of brooding are not available, due to death of the young when the female was predated. The large proportion of caterpillars and spiders in the early stage is also likely to be due to the softer exoskeleton and smaller size, compared to grasshoppers and crickets that were fed at later stages.

Response to Predators

The response of the Elegant Tit towards predators seems very different to responses observed in the Great Tit and other tit species. Great Tits have been recorded to have a wide variety of predator responses, including 'scolding' of humans, diving at a predator, mobbing of a perched predator and observed mobbing of snakes (CURIO 1993), and a variety of alarm calls (HINDE 1952). Coal Tits also defend their brood, sitting tight and hissing at intruders (GRAHAM 1998). However, neither the male nor female Elegant Tit was seen to make any noise or movement when a variety of predators approached the nest. Silent observation, with little movement at a long distance from the nest, has been observed in Great Tits when humans or cats have been on or near the nest box. This silence appears to be adaptive since conspicuous mobbing might betray the nest to these sophisticated adversaries (ZIMMERMANN & CURIO, 1988). By utilising the ground rather than tree holes, the Elegant Tit has managed to evade one potential tree-hole predator, woodpeckers. Woodpeckers frequently take the young of Great Tits from the hole, and elicit mobbing attacks from adult Great Tits when nearby (PERRINS 1979). Furthermore, there were no audible calls emitted by young during approach and/or feeding visits by the parents. This is in contrast to the Great Tit nestlings which emit audible begging calls, with larger broods making more noise, and suffering higher predation rates (PERRINS 1979). Several studies have documented the increased risk of predation with begging calls (REDONDO & CASTRO 1992; HASKELL 1994; HALUPKA 1996). An experiment by HASKELL (1994) concluded that begging was costly only for ground-nesting birds, and the cost was an increasing function of begging rate. A closed habitat, such as a tropical rainforest, is also more difficult for the parent birds to scan for predators, and so such habitats should select for silent broods, compared to more open temperate woodland habitats (see HALUPKA 1996).

Thus, there are at least two possible reasons why Elegant Tit nestlings remain silent while their Palaearctic relatives make noisy begging calls. One possibility is that the ground nests of the Elegant Tits are more vulnerable to predation than tree-hole nesting birds due to their vulnerability to ground predators, such as monitor lizards, carnivores, and rodents, which could dig up the nest. Secondly, the lower clutch size in the Elegant Tit may mean less need to compete for food, and therefore the costs of begging may be larger than the benefits. It is also possible that the presence of humans in the vicinity (despite the hide) rendered the brood silent. HALUPKA (1996) found that begging in meadow pipit nestlings was significantly reduced or stopped completely when a human was within 80 m of the nest.

The male did not tend the young after the female died, resulting in the death of all young in the second nest observed. In the Great Tit only the female can brood the young; the male can only take over after the end of the brooding period, i.e. after day nine (PERRINS 1979; E. C., pers. obs.). However, PERRINS (1979) noted that even then the male may give up after an initial period of feeding a motherless brood. However, female Great Tits which have lost their mates have been known to rear their whole brood (KLUIJVER 1950).

Conclusions

This study documents the first insights into the breeding biology and behaviour of the Elegant Tit. Existing information on this species and the two other endemic *Parus* species occurring in the Philippines are scarce. While information on closely related species is non-existent or limited, it appears that the Elegant Tit shows similarities in nesting behaviour to both the Yellow-bellied Tit of China and the widely ranging Coal Tit. While these two species also nest in tree holes, they also frequently use rock crevices or ground burrows. They are also very similar in clutch size, incubation and nestling periods, feeding behaviour. However, it is interesting to note that there do appear to be many differences between the breeding of this species and its European counterparts, such as the Great Tit. It is suggested that differences between the tropical Elegant and Yellow-bellied Tits and their Palaearctic relatives may be due to geographical variation, and that rather than being influenced by food supply, climate (temperature), and predation are the most important factors influencing the breeding biology of the Elegant Tit. For example, it is suggested that the female is able to leave the nest for feeding more often and for longer periods of time than has been found in the Great Tit, because of the higher temperatures in the tropics, meaning that the eggs cool less quickly. The results of smaller clutch size, large numbers of species of predators, low feeding rates and lack of audible begging calls are consistent with those found by EGUCHI (1980) in the Great Tit in Japanese evergreen forests, and more generally in tropical forests, where birds are thought not to raise as many nestlings as they could feed (SKUTCH 1967) because of the above constraints.

Summary

First observations of the breeding of the Elegant Tit suggest that it prefers ground nests to tree holes, and shows similarities in nesting behaviour to the closely related Yellow-bellied Tit and Coal Tit. The aim was to describe the unknown breeding biology and behaviour of one of the most common Philippine birds, the Elegant Tit (*Parus elegans*). Four nests of this species were found in low-elevation forest in the Northwest Panay Peninsula Natural Park and the first descriptions of the nest and eggs documented. One nest was monitored intensively, allowing quantitative data on feeding rates and food items to be collected. All nests were situated in the ground under a rock which created an overhang to the entrance. Fifty standard hole entrance type nest boxes were hung in the area, but were never used, despite the species being thought to use hollow trees (HARRAP & QUINN 1996). Incubation was done solely by the female, which was not fed by the male on the nest, and so left the nest regularly to feed. Feeding of the young was done by both parents, with the focal female contributing 60% of the food items delivered. Food items consisted predominately of caterpillars (38%) and spiders (16%). No mobbing of predators around the nest hole was observed.

This study documents the first insights into the breeding biology and behaviour of the Elegant Tit. The Elegant Tit shows similarities in nesting behaviour to the closely related Yellow-bellied Tit and Coal Tit. However, there appear to be many differences between the breeding of this species and its European counterparts, such as the Great Tit. It is suggested that these differences may be due to geographical variation, and that rather than being influenced by food supply, climate and predation are the most important factors influencing the breeding biology of the Elegant Tit.

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Zusammenfassung

Erste Beobachtungen zur Brutbiologie der Philippinenmeise *Parus elegans* auf den Philippinen. Obwohl die Philippinenmeise einer der auf den Philippinen häufigsten Vögel ist, besteht Unkenntnis über ihre Brutbiologie und ihr Verhalten. Vier Nester der Art wurden im Tieflandwald des Naturschutzgebietes der NW Panay-Halbinsel gefunden. Sie lagen sämtlich unter der Erde unter einem überhängenden Fels. Obwohl 50 Standardnisthöhlen für Kleinhöhlenbrüter im Gebiet hingen, hatte die Philippinenmeise sie oder Naturhöhlen in Bäumen nie bezogen. Nur das Weibchen brütet. Es wird nicht vom Männchen gefüttert und verlässt daher das Nest regelmäßig zur Futtersuche. Beide Eltern füttern die Jungen, ein näher beobachtetes Weibchen brachte 60 % aller verfütterten Beutetiere. Diese bestehen hauptsächlich aus Raupen (38 %) und Spinnen (16 %), der Anteil der Spinnen nimmt mit dem Brutalter zu. Die Eltern einer näher beobachteten Brut hassten auf keinen Feind in Nestnähe. Wir vergleichen das Verhalten der Philippinenmeise mit dem verwandter, intensiv bearbeiteter Arten wie *Parus ater* sowie der weniger bekannten *Parus venustulus* Chinas.

Viele der gefundenen Artunterschiede lassen sich auf das wärmere Klima der Tropen zurückführen, nicht auf Unterschiede der Nahrungsdichte oder –zusammensetzung..

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