Breeding the Flame-fronted Barbet

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[Note: This article has been submitted as part of the nomination procedure for a U.S. First Breeding Award. Anyone having good evidence of a successful breeding of this species prior to the dates noted in this article, please notify the AFA Business Office in Phoenix, Arizona.]

Introduction

The Flame-fronted Barbet *Megalaima armillaris* (Silbey & Monroe, 1993), also known as the Blue-crowned or Orange-fronted Barbet, inhabits the forests and lowland hills of Java and Bali (Silbey & Monroe, 1990). It is a common resident of primary forest and the forest edge. This species occurs from sea level up to 2500 m (8200 ft.), but is more common above 900 m (2952 ft.). It is probably Java's most common barbet (MacKinnon & Phillips,1993).

Delacour (1947) described this species as a medium-sized (20 cm — 7.8 in.) barbet with a comparatively short black bill and a soft green color. It has an orange-yellow forehead and collar, black lores and a blue hindcrown. Another identifying characteristic of this species is the bird's blue-gray colored legs and feet. As is the case with most barbet species, not much is known about this bird's habits in the wild.

In captivity, the Flame-fronted Barbet is uncommon. ISIS (International Species Information System) historical information lists only three importations of *Megalaima armillaris* from 1951-1995. A reported total of 10 individuals have been brought into captivity during that time. The San Diego Zoo received two of these birds in 1961. Both died within one year. In 1966 three birds were captured from the wild and transferred to Kebun Binatong Surabaya (Wonokromo, Surabaya - Indonesia). The following year, these birds were also sent to San Diego. One of the three died in 1968, and the remaining two in 1971. None of these birds were known to reproduce. In 1992, five birds were imported for a private collection. These birds were purchased by the Cleveland Metroparks Zoo in September of 1993. In the spring of 1995, what is believed to be the first captive breeding of the Flame-fronted Barbet took place at the Cleveland Metroparks Zoo.

Housing

In September 1993 The Cleveland Metroparks Zoo received 2.3 (2 male, 3 female) Flame-fronted Barbets. The birds arrived as two pairs and a single female. The latter died during the quarantine period. The two remaining pairs were each placed into individual exhibits with harp wire fronts. The exhibits measured approximately 8 ft. square. In late 1993 the first pair was released into a large (13 x 11.6 x 9.5 m — 42.6 x 38 x 31 ft.) well-planted, walk through aviary with a waterfall flowing into a system of three pools and "open air" skylights. They shared the aviary with approximately 50 other birds of 21 species, including laughing thrushes, turacos, a Channel-billed Toucan and a variety of pigeons, starlings and other small softbills.

Diet

All birds living in the aviary, are offered a variety of foods each day. The inhouse insectivorous mixture contains boiled ground horsemeat, gamebird crumbles, shredded raw carrot, ground hard-boiled eggs in the shell, cooked brown rice and ZooVite. Also offered are chopped greens, boiled ground horsemeat, small chunks of raw horsemeat, chopped apple, orange, banana and grapes. Other fruits and vegetables are occasionally added as they become available. Finch mix, dove mix and waterfowl and herbivore pellets are also available for other species in the aviary and the barbets have been seen to take these on occasion. Mealworms (*Tenebrio*) are given a few times each week. When barbet chicks are suspected in the nest, neonate mice (*Mus*), waxworms (*Galleria*), crickets (*Acheta*) and soaked mynah pellets are added to the diet. Insects and mice are alternated and the mynah pellets are available every day.

Nesting and breeding

In February 1994 a number of nest boxes and a partially excavated nest log (# 0), were put into the aviary. The log was placed on a rock ledge

The male began to spend time clinging to the wire mesh near the ceiling and chipping the plaster and cement off of the ceiling beams.

Photo courtesy of Kym Parr

A young Flame-fronted Barbet. This species bred at the Cleveland Metroparks Zoo, possibly for the first time anywhere.

approximately 4 m (13.12 ft.) from the floor of the exhibit. As the spring progressed, the pair became very vocal and active, often dueting, chasing and displacing each other. The male was seen to feed the female preferred food items (usually grapes) on a number of occasions. Both birds ignored the log and nest boxes. The male began to spend time clinging to the wire mesh near the ceiling and chipping the plaster and cement off of the ceiling beams.

A new log (#1) was suspended from the ceiling of the aviary in the area where the male had been "excavating" the beams and walls. It was hung inside a corner where one wall of the exhibit and a ceiling beam came together. The next day the male was seen chipping at the entrance hole of the log. Both the male and the female continued to excavate the log over the next few weeks. They worked independently and almost continuously until the cavity was completed. Two weeks after beginning excavation, the cavity was large enough for a bird to go into the log, turn around and come out head first. As the cavity reached completion, one of the birds would often sit in the entrance hole with its head protruding slightly—just enough to be able to look around. This behavior was also seen later, particularly when eggs or chicks were present in the nest. The pair continued to do some courtship feeding and defended their nest by chasing away other birds that came too close.

In late April 1994 the second female (F2) escaped through the harp wire front of the exhibit she shared with her "mate" (M2) and found her way into the aviary. Since capturing her was not possible in that area, the male (M2) was released into the aviary later that day. The arrival of the second pair of birds appeared to disrupt the pre-nesting behavior of the first pair and not much nesting activity was seen for the remainder of the season. The log (#1) that the original pair had excavated caved in on the top and the birds totally abandoned the log after that. In November 1994 the female (F1) was found dead in the exhibit. The necropsy results showed liver abnormalities.

In spring 1995 the male (M1) returned to making holes in the beams and walls. Two new nest logs (#2) and (#3) were suspended from the ceiling of the aviary, in slightly more "open" locations. Within two days M1 and F2 were seen working on log #2. As the month progressed, they switched to log #3, and within weeks they had completely excavated both logs. Once excavation was complete, however, neither bird was seen to show any further interest in either log. It was also noted that, after the new logs were installed, there was a noticeable increase in vocalization and activity from all three birds. Some fighting was also seen. On March 26 M2 was found dead.

Necropsy results showed trauma to the head and neck and suggested that this individual was killed, probably by another bird. Interestingly, it was also discovered during the necropsy that this bird was actually a female. The death of M2 left only M1 and F2 as the breeding pair.

In April 1995 two new nesting opportunities were presented. Log #4 was added to the exhibit, and a second hole was punched in log #1 approximately 18 cm (7 in.) below the original hole (which was excavated the previous spring). The following day both birds were seen working on log #1. Within five days the cavity appeared to be complete.

Approximately two weeks later, both birds were seen alternately sitting in the hole and inside the cavity. It was estimated that eggs had been laid (28 April) and that the pair was taking turns incubating. Near the end of incubation, the birds spent more time in the cavity. On 14 May both parents were seen taking food to the nest and their behavior suggested that they may have been brooding chicks.

On the morning of 18 May, the male was noticeably active outside the nest; flying around, vocalizing, and tapping on the walls. Since none of these behaviors were seen during nest building, incubation or rearing, their presence suggested that there may be a problem in the nest. A barbet chick was found dead on the floor at the opposite end of the aviary. The chick's skull had been crushed and the body had been eviscerated. It was suspected that the chick had been ejected from the nest and probably carried away by another bird in the aviary. A number of the species living in the exhibit could be classified as opportunistic nestling predators. It was not known whether the chick had died in the nest, was

killed by the barbets, or if another bird killed it after it was thrown out. After this first chick was found, neither barbet was seen near the nest. The nest was inspected and there was no sign of any other chick(s). Other institutions have reported similar problems with their breeding barbets throwing chicks out of the nest, and have pulled successive clutches of eggs for artificial incubation and hand-rearing.

The pair quickly reverted to pre-nesting behavior until the beginning of June, when they were seen going in and out of the nest. On 12 June it was suspected that a second clutch of eggs was present in the nest. The female was seen sitting in the hole and chasing the male away from favored foods. Pre-nesting wall excavation, vocalization and courtship feeding had ceased. By noting the same changes in behavior that were seen with the first clutch, the eggs were estimated to have hatched on 26 June. Over the next couple of weeks, the parents were seen switching duty at the nest entrance (one bird would land near the hole and tap on the log for the other to come out). Again, both birds fed and brooded the chicks. The female was acting much more aggressively toward the male since the chicks had hatched. She would chase and displace him often when they were away from the nest.

Because of the loss of the first chick, it was decided that this second clutch should be removed for hand-rearing. On 10 July the nest log was removed and cut open to find two barbet chicks. These chicks were estimated to be approximately two weeks old.

After the removal of the second and third chick (and nest), it didn't take long for the male to start excavating the walls again. In less than a month it was necessary to install another log (#5) in place of the one which had been removed. Log #1 was eventually repaired, and the cavity filled with mulch. It was rehung in the exhibit near its original location. Both of these logs were ignored by the birds.

In mid August the birds were seen working on log #4. Starting from "scratch," the pair excavated a complete cavity in this dried deciduous log in less than a month. Nesting behaviors were seen as before and suggested that a third clutch of eggs was laid the first week of October. The eggs were estimated to have hatched on 22 October. The only significant difference in the behavior of the pair with this clutch was the increased aggression of the female toward the male. At one point, during the first week after hatching, the male was found in the hallway outside the aviary. It was suspected that he had been chased out by the female. As she became more aggressive toward him, there was some concern that the harassment would affect the pairs' rearing ability/success.

Because of the increased aggression, and to prevent the chicks from fledging into the aviary, the log (with fourth and fifth chick inside) was removed on 13 November. These chicks were approximately three weeks old when they were removed from the nest. They were hand fed until fledging.

Hand-rearing protocol

The diet items used for the hand-feeding of all four chicks were: white mealworms (head removed), waxworms, cricket abdomens, chopped neonate mice (head, feet and tail removed), Bird of Prey diet (bone chips, tendon and grain removed), moistened softbilled bird fare, soaked mynah pellets, diced/mashed apple, papaya, grape, apricot, and plum (a wider variety of fruits was used as the chicks grew). At each feeding one piece of food was dipped in ZooVite and Osteoform. All food was prepared with Pedialyte electrolyte solution (later distilled water). At two weeks the diet fed at each feeding was approximately 50% protein and 50% fruit. As the chicks got older, the percent of fruit in the diet was increased and the percent of protein was decreased, the diet was also prepared with less liquid. The chicks feeding response, droppings, flight feather tips and posture were monitored to indicate the adequacy of the diet.

The two week old chicks were fed on a 12-hour cycle with feedings approximately every three hours. The number of feedings was gradually decreased as the chicks got older. Feeding through the night was attempted for the first few days, but proved to be unsuccessful (and unnecessary). The chicks were weighed before and after each feeding. To prevent over feeding, they were fed no more than 10% of their first morning weight at each feeding.

The chicks (at two weeks) were kept in a brooder at 32°C and approximately 30% humidity. The temperature was lowered as their feathering, and the outside temperature increased. They were contained in a small bowl lined with a towel, both to aid them in keeping their legs under their bodies, and to help simulate the support of the walls of a nest cavity. When removed from the dish their legs would appear slightly splayed. This posture appeared to be normal however, as adult barbets standing on a flat surface have a similar posture. All healthy chicks showed this same characteristic and all developed normally.

Chick development

As previously noted, the second and third chicks were pulled from the nest at approximately two weeks of age. On both chicks the upper mandible was shorter than the lower mandible. There was also an area of rough, thickened skin or papilla on the area below the tarsometatarsal joints. These "heel pads" are commonly seen on chicks of cavity nesting species that do not line their nest cavities. Although both chicks shared characteristics typical of young barbets, there was a dramatic difference in the size and appearance of these two chicks.

The third chick was much smaller (17g), weaker and less developed than the second chick. It had no visible feather growth under the skin and its eyes were tightly closed. It had a very flattened posture and seemed unable to hold its legs under its body or its head erect. This chick showed only a very weak feeding response, and died three days after removal from the nest. The second chick was considerably larger (44g), stronger and more developed than the third chick. All its developing feathers were visible under the

skin. The chicks posture and strength were good. It was a very active feeder, and it was able to open its eyes halfway.

This second chick did well and remained healthy, and by day 17, the tips of its flight feathers and some breast and side feather shafts had broken through the skin. On day 19, the brooder was turned off (air temperature 29° C), the lore and crissum feathers were showing, and some bristles had already formed around the top mandible. By day 22 the chick's appetite began to diminish slightly. Flight feathers were protruding from their sheaths and showing on the back of the wings, and the neck and face feathers were coming in. The chick was usually perching on the edge of its nest bowl or a rolled up towel rather than sitting in the bowl. It slept fluffed up in a ball in an adult posture, with head tucked behind wing, and its eyes were fully open. On day 26 the percent of protein in the diet was decreased in response to the chicks feeding preferences and a very slight upturning of the tips of the flight feathers. The chick was accepting water droplets from the tip of a plastic syringe. It was becoming much more active and exploratory, and vocalizing often. By day 32 the chick was showing selection in food choice by refusing to accept or grabbing and tossing non favored food items. It showed more adult behaviors such as holding and crushing food items in its bill before throwing them back to swallow, standing on one foot and scratching, wiping its bill vigorously on a stick to remove food particles, and perching on a stick. On day 37 the chick took its first flight, and was moved to a wire cage with perching and water and food dishes. Its appearance was that of a somewhat small, drab adult. By day 40 the chick was eating and drinking on its own. Its weight was 62g at fledging.

The third and fourth chicks (hatched 22 October) followed basically the same developmental stages as the previous chick. They however, were pulled from the nest at approximately three weeks of age, with eyes fully open and bodies almost fully feathered. There was some concern about these older chicks accepting handfeeding. This concern proved to be unfounded as the chicks, after some apprehension, took food from forceps within 24 hours. The larger of the two chicks weighed 64g at 23 days and the smaller one was 55g. Both chicks were healthy, alert and vocal. These chicks seemed to have developed much more rapidly than the earlier chick who was pulled at 16 days. They both took their first flight and were eating on their own by 25 days old, rather than 37-40 days. The nestling period for wild barbets is 20-35 days (Perrins, 1990). Their weights at fledging were 52g, and 58g.

Discussion

As many institutions and individuals who have tried to breed barbets have

discovered, there are a number of factors which can make successful housing and breeding of these birds very challenging.

The pugnacious temperament of most barbets makes them unsuitable for housing with other small softbills or often even birds their own size and/or own species. As we discovered, keeping more than a pair, even in a large, complex aviary, eventually led to aggression between the birds and the probable death of one individual. Surprisingly, we never witnessed a problem between the barbets and the other birds in the aviary, which ranged in size and temperament from tiny bishops to large laughing thrushes and a Channel-billed Toucan. Perhaps because of their relatively small size (although field guides suggest a measurement of 20cm [7.8in.], none of our birds were larger than 15cm [5.9in.]), or the large size and/or complexity of the aviary, we never saw the barbets bother any of the other birds. Neither were the barbets intimidated by birds much larger than themselves. MacKinnon & Phillips (1993) mention that this species mixes with other birds at fruit trees in the wild. Perhaps this species is slightly more tolerant than most other barbet species.

The early behavior of our barbet pairs gave little indication of their compatibility. As other institutions have noted, some barbets seem to bond easily, even with different mates. Our breeding male (M1) quickly re-paired with a second female after his original mate died. We witnessed only a few instances of courtship feeding by the male. In most cases there is very little formal courtship apart from some chasing of the female by the male (Harrison, 1978). In our situation the chasing was done by both sexes, more often the female. A word of warning; the chasing and displacing we witnessed by the female became much more serious when the pair had chicks in the nest. With successive clutches, and as brooding progressed, the harassment of the male by the female became more severe. Other institutions have noted that this aggression escalated to the point that they found it necessary to remove the male until after the chicks had fledged.

Perhaps the most interesting aspect of barbet breeding behavior is nest choice and excavation. Our breeding male would attempt to excavate the plaster on the aviary walls. He was quite industrious and would often spend a good part of the day chipping away at the walls and ceiling. A number of other institutions that house barbets have noted similar behaviors, and have reported that their birds have drilled holes in beams, ceilings and walls of exhibits.

Nest logs were hung in various locations in the aviary. Both birds were always very quick to show interest in new logs, but would quickly resort to the walls if a suitable log was not available. The birds totally ignored nest boxes or logs that had already been excavated by other birds (or humans). This disinterest in nest boxes has been reported by other institutions, who noted that their birds would sometimes roost in boxes or pre-excavated cavities, but would not use them for nesting.

Wild barbets usually excavate their own nest holes in the trunks or branches of rotten trees, termite mounds, earth banks etc. The Pied Barbet *Tricholaema leucomelas* appears to be the only species known which, in the absence of suitable trees, will take over the deserted nests of other birds (Perrins & Middleton, 1985). Most barbets in the wild usually choose a nest site high above the ground. Both sexes work together at excavation of a cavity. The entrance hole is small, just large enough to admit the bird and the birds dig into the wood several inches before turning to make the nest cavity. Some species use the same hole year after year, digging it farther each season, and sometimes adding a second entrance (Austin, 1961).

Through trial and error we discovered that our captive birds shared most of these same nesting preferences and habits. The pair would excavate almost any usable log in the exhibit, but the birds were always most interested in logs very high up near the ceiling (especially those that were up against a wall rather than hanging in the open). The birds also showed a preference for logs with entrance holes just large enough for them to squeeze through. It appeared that the type of log was not as important as we initially thought. Our pair nested in both a dry deciduous log and a section of the pithy flowering stalk of a large agave. Palm logs have also been used by other institutions with success. Although the birds would excavate almost any log, they would sometimes totally abandon them after excavation. Apparently the location of the log, the size of the entrance hole, suitability for excavation, and the size and shape of the excavated chamber were all important factors in choosing a nest log.

Soon after the birds had excavated a suitable nest, the female would lay the eggs. Barbets lay 2-5 white eggs that rest in the bottom of the nest hole, no nesting material is used to line the cavity (Harrison, 1978). It appeared that our pair laid two eggs in each clutch and incubation lasted from 13-15 days. As was noted by other institutions, incubation and rearing was done by both parents and food was carried to the nest in the bill of the parents. Although our pair threw their first chick out of the nest, their success at rearing improved with successive clutches. The second clutch of two chicks was removed at approximately two weeks old for fear they would be thrown out by the parents. One of the two chicks died a few days after removal from the nest (possibly it was not fed as well or was being out competed by the older chick). The remaining chick was successfully hand-raised. The pair probably could have raised this remaining chick successfully to fledge. The third clutch of two chicks was removed at approximately three weeks of age. Although it was

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believed that the parents would rear both chicks successfully, the nest log was particularly small and narrow at the bottom. It was feared that the chicks, with their plump bodies and swollen abdomens, would not be able to successfully exit through the narrow chamber. It became necessary to brake open the log to remove them. Both chicks were found to be cramped, but healthy and would have certainly fledged successfully on their own if not for the unusually narrow cavity. In many barbet cavities, there is little actual nest-chamber...the young may be extremely cramped. Several instances have been recorded in captivity where parent birds have bored into the wood at nest-chamber level to allow the fledgling young to escape (Campbell & Lack, 1985).

It is interesting to note that the breeding pair always went back to nest relatively quickly after the chicks were removed from the nest, provided there was a suitable log available. In the season summarized here, the female laid three clutches (producing three healthy chicks) in seven months.

As mentioned above, the second, third, and later the fourth and fifth chicks produced by the pair were removed for hand-rearing. The rearing procedure was developed by gathering information from other institutions who had successfully reared Gaudy Barbets *Megalaima mystacophanos*, Crested Barbets *Trachyphonus vaillantii*, and Gold-whiskered Barbets *Megalaima chrysopogon*.

The behaviors, and developmental "events" we witnessed while rearing our chicks were similar to those reported by other institutions who had hand-reared Crested and Gold-whiskered Barbets. Because the size of adult Flame-fronted and Crested barbets are similar (20-22cm), weights of the hand-reared Crested Barbet were compared to the weights of the second Flame-fronted Barbet chick. Weights for hand-reared chicks of both species were also similar.

The small amount of information that we were able to gather from books, papers, surveys and personal communication from other institutions paralleled our experiences with these birds and aided us greatly in our efforts to breed and rear this species. It is hoped that the information gathered here will be helpful to others attempting to breed and raise barbets.

Nest logs available and used

Log#O **original log:** barbets excavated it in old exhibit- put on rock shelf in aviary-ignored--removed

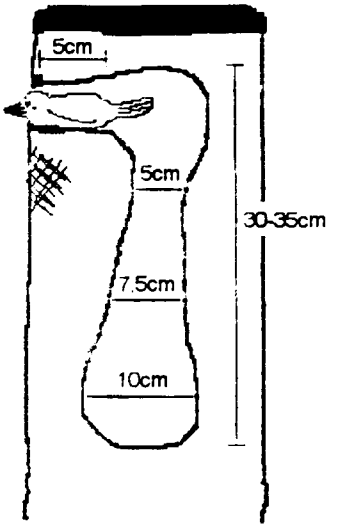
Log#1 **breeding log:** barbets(original pair) excavated top hole Spring 94-second hole (below) birds excavated a complete cavity used to hatch 3 chicks (from 2 clutches) Spring 95 and Summer 95**-cavity was filled with mulch and re hung in exhibit Fall 95

Log#2 **first new log:** barbets excavated--did not use

Log#3 **second new log:** barbets excavated--did not use

Log#4 **deciduous log:** birds ignored a natural cavity in log and small holes started by woodpeckers, they excavated into the solid wood -- they began some excavation in Spring 95, then excavated a complete cavity used to hatch 2 chicks in Fall 95**

Log#5 **old parakeet log:** already excavated by other birds -ignored—removed



Logs (except log #4) were 76-91 cm sections of a large flowering stalk from an agave (maguey) plant. The outer shell was hard and very fibrous and the inner core (particularly of the older stalks) was a solid foam-like pith which the birds could easily excavate. All logs (except numbers 5 & 4) were prepared for the birds in the same manner:

- a 5-6 cm hole was made near the top of the log, only penetrating the outer shell Sleaving the pulp intact
- caps made of cardboard or plastic sheeting were made to cover the top and bottom of the log (to discourage moisture, insects etc. from entering the cut ends of the log)
- a small square of heavy nylon mesh was stapled to the front of the log just below the hole to provide a landing area
- eye hooks were screwed into the sides of the log, near the top, and wire was used to hang the log from the ceiling or secure it to a ceiling beam

**The shape and dimensions of the cavity were very similar in both successful nests.

Table 1.
Weights of Crested and Flame-fronted Barbet chicks at various ages

Age (day)	Crested	Flame-fronted
14	40g	44g
15	44g	48g
16	48g	50g
17	48g	52g
19	57g	53g
21	66g	54g
23	64g	54g
25	61g	56g
27	61g	57g
29	60g	57g
31	57g	61g
33	52g	62g
fledge	64g	63g

References

Austin, O. L. BIRDS OF THE WORLD. New York, Golden Press, 1961.

Campbell, B.; Lack, E. A DICTIONARY OF BIRDS. Vermillion SD, Buteo Books,1985.

Delacour, J. BIRDS OF MALAYSIA. New York, The MacMillan Co., 1947.

Harrison, C.J.O. BIRD FAMILIES OF THE WORLD. New York, Harry N. Abrams Inc.,1978.

ISIS Studbook Report. INTERNATIONAL SPECIES INFORMATION SYSTEM, Apple Valley, MN, 1995.

Kowalczyk, E. Breeding the Gold-whiskered Barbet (Megalaima chrysopogon). AFA WATCHBIRD, Oct/Nov, 1990.

MacKinnon, J.; Phillips, K. FIELD GUIDE TO THE BIRDS OF BORNEO, SUMATRA, JAVA AND BALI. Oxford, Oxford University Press, 1993.

Mossbarger, S. LEVAILLANT'S / CRESTED BARBET (TRACHYPHONUS VAILLANTII): OBSERVATIONS ON DIET, REPRODUCTION AND VOCALIZATION AT THE DALLAS ZOO. M.S. Dissertation, University of Texas, Arlington, 1986.

Perrins, C. M.; Middleton, A.L.A. THE ENCYCLOPEDIA OF BIRDS. New York, Facts on File Publications, 1985.

Perrins, C. M. THE ILLUSTRATED ENCYCLOPEDIA OF BIRDS. New York, Prentice Hall Press, 1990.

Silbey, C. G.; Monroe, B. L. DISTRIBUTION AND TAXONOMY OF BIRDS OF THE WORLD. New Haven, Yale University Press, 1990.

Silbey, C. G.; Monroe, B. L. A SUPPLEMENT TO DISTRIBUTION AND TAXONOMY OF BIRDS OF THE WORLD. New Haven, Yale University Press, 1993.

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