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OBSERVATIONS ON THE PURPLE-THROATED FRUIT-CROW IN GUYANA

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The Purple-throated Fruit-crow (*Querula purpurata*) belongs to one of the many monotypic and isolated genera included in the diverse family Cotingidae. About the size of a jay, it has short legs and long, broad wings which, when folded, reach nearly to the end of the tail. A steel-gray beak, widest at the base and hooked at the tip, gives the broad head an almost trogon-like appearance. The plumage is entirely black, except that the male has a triangular throat-patch of glossy crimson feathers of modified structure (Strong, 1952). The throat-patch is spread and fanned out laterally by the male in display, and the same feathers, though black and less conspicuous, are spread by the female also.

Although this species is widely distributed and, in some places, quite common from Costa Rica south through the tropical forest areas of South America, no detailed observations appear to have been made. Most observers have noted that it goes about in small flocks: Slud (1964) refers to groups usually of from three to several individuals in Costa Rica; Chapman (1929) reported parties of from six to eight birds in Panama; and Olivares (1958) mentions bands of from four to six birds in Colombia. The records also show that its food consists of fruits and large insects, typically plucked or picked from the vegetation in flight.

Two ornithologists have found nests. Ellis (1952) reported a male and female cooperating in building a nest about 75 feet up in a tree at the edge of a clearing on Barro Colorado Island, Panama. Later he saw the female incubating, but could obtain no further details. Haverschmidt (1968) found a bird sitting on a nest 65 feet up in a leafless tree on the edge of a forest in Surinam, and, on another occasion, watched a male building. The nests as described by both Ellis and Haverschmidt were insubstantial, open cups.

I had opportunity to study fruit-crows from 16 January to 6 April 1970 when I camped in a forest clearing in the foothills of the Kanuku Mountains in southern Guyana. We had one fruit-crow nest that was built less than 100 yards from our camp and was successful and another about half a mile away. I devoted 85 hours to watching the first nest, five hours to the second, and made daily observations on the birds themselves that frequented the camp clearing. I also made incidental observations on other fruit-crows, all within two miles of camp.

Social Organization

Parties of fruit-crows are not simply feeding flocks or loose associations, as might have been supposed from earlier reports. They are closely integrated social groups which not only feed, rest, preen, and almost certainly roost together, but also jointly attend a single nest. F. Gary Stiles (pers. comm.) found a group of Purple-throated Fruit-crows in Costa Rica roosting side by side in close contact with one another.

The group that attended the nest near our camp consisted of four birds: two adult males, a female, and another bird in female plumage except for two red feathers on one side of its throat. The other group, nesting about half a mile away, consisted of a male and two birds in all black plumage, of which one, and probably both, were females. A third group, which we saw only occasionally, consisted of two males and a female and, possibly, a second female which may have been out of sight on a nest. We watched other groups of three or four birds farther afield; but it was usually difficult or impossible in such cases to be sure that we had seen all the birds because we found the groups in the tops of trees in high forest without clearings. About half a mile seemed to be the average distance between groups. On a two and a half mile walk, that I made several times between camp and a cock-of-the-rock display ground up the valley, I regularly passed within sight or sound of four or five groups of fruit-crows.

The social bonds between the individuals in a group are extremely close, and there is almost no aggression between them. At least this condition prevailed in the group near the camp and seemed to be true of other groups that we watched less thoroughly. In the camp group, the two males maintained a stronger social bond with each other than with the nesting female. The two males often perched side by side, sometimes almost touching, and occasionally preened each other. During the second half of the study, Male B lost a central tail feather and so was distinguishable from Male A.

Male A was the dominant bird, or more appropriately, because we saw no aggression, the "leader" of the group. When the group moved from place to place, Male A initiated the move. He associated with Female A more closely than did the other male, and he attended the nest more assiduously. The fourth bird — I refer to it as Female B although I never definitely ascertained the sex — was the most detached of the group. She nearly always trailed behind the others when the group moved, and she tended to perch a little apart from the others. Her unobtrusive behavior may have been partly due to the fact that she was in wing molt during nearly the whole of the period of observation.

The members of the group maintained contact with one another by frequent, and at times almost continuous, calling which normally ceased when all members of the group perched together, resting. The group near camp ranged over an area about 250 yards long, mainly along the stream that flowed past their nest tree and our camp. They did not, it seemed, range far up the slopes on either side of the valley, where the forest was drier and poorer; or if they did, they could not have spent much time there because we found them so regularly along the valley bottom. The neighboring group occupied a stretch of valley at least 350 yards long, but we did not determine the limits of their area. We never saw any interactions between the two groups at their mutual border. Most of the time they stayed well apart from each other.

Food

Purple-throated Fruit-crows usually feed in a manner typical of many cotingids — by seizing their food, both fruits and insects, in flight; but they regularly perched to pluck the fruits of *Didymopanax morototoni* and *Guarea trichilioides*, both of which bear their fruits in large bunches on strong stalks that afford a foothold.

They search for insects by perching quietly and scanning the vegetation around them, often bending low, twisting the neck, and turning the head. In 81 observations of fruit-crows taking food, the fruit-eating records were two and a half times as numerous as the insect-eating; but as soon as we knew the main fruit trees near the camp, the fruit-eating was much easier to see and record. Thus our data are undoubtedly biased. It is clear at least that both fruit and insects are of comparable importance in the diet. They took the fruits most often around the middle of the day, perhaps because they needed liquid at this time. The food taken to the young in the nest, which I shall discuss later, consisted almost entirely of insects.

We listed eight different kinds of fruits eaten by fruit-crows between 17 January and 3 April. Certainly, these eight were the main ones taken in the immediate area of camp, since all but three of the seeds collected in a tray slung beneath the nest were from trees at which we saw the birds feeding. The four main fruits, which comprised 90 per cent of the fruit-eating records, were:

<i>Didymopanax morototoni</i> (Araliaceae)	17 January–8 March
<i>Guarea trichilioides</i> (Meliaceae)	17 January–18 March
<i>Hirtella</i> sp. (Chrysobalanaceae)	21 February–8 March
Lauraceae sp.	12 March–3 April

In addition, the fruit-crows fed on the fruit of *Cecropia* sp. (Moraceae) during the latter part of our study period. They also took another species of Lauraceae early in the period, and a few times they ate two kinds of unidentified fruits. The largest fruits were lauraceous, the early fruiting species measuring about 27 × 15 millimeters.

Voice and Displays

The usual call, uttered repeatedly whenever the birds are active, is a mellow, disyllabic *oo-waa*, delivered with the beak closed and the throat feathers more or less fanned. This is the call that gives the bird its local names—“ter-wo” in the Kanuku Mountains and “cuaba” in western Colombia (Olivares, 1958). When uttering this call, the bird typically leans forward nearly horizontally and shivers its partly fanned tail in a curious side-to-side movement which, as Chapman (1929) remarked, gives the impression that the bird is shaking water out of its tail feathers. It frequently intersperses the disyllabic call with a monosyllabic, more drawn out *wooo* with an upward inflection.

The fruit-crow also utters a variety of harsher calls with the beak open. Frequently, when the birds are feeding or moving about together, one of the group gives a sharp *wak* or *wak-wak*. This call seems to be a mild signal alerting the birds, but its function and motivation are not obvious. Sometimes, one gives a low, harsh form of the *wak* call, usually in a monosyllable, and again, in social contexts that are not clear.

When truly alarmed, fruit-crows call with a considerably louder and more arresting version of the harsh *wak-wak*, usually of several syllables. They gave this alarm when flying predators appeared and also when one of our party climbed the nest tree and attempted to look into the nest. Later, I shall describe their mobbing behavior, a most important part of their nesting strategy.

If we allow for the subjective element in transcribing bird calls, it seems clear from the accounts of Chapman (1929) and Slud (1964) that the calls are essentially the same in Central America as in Guyana.

We saw one of the courtship displays of the fruit-crows when Male A began to try to entice Female A away from the nest which she was building, to a new nest site which he had chosen. He followed her persistently in short flights among the treetops, calling repeatedly, spreading his throat-fan widely, and shivering his tail. Later when showing the female the new site that he had chosen, he behaved in the same way. The only copulation we saw occurred on a different occasion, almost certainly involved other birds, and was preceded by no special ceremony.

Breeding

The Nest and Nest-building

The first nest, found by my wife near camp on 19 January, was 35 feet up, very near the top of a slender tree beside a forest trail. The main structure was complete but the lining was unfinished. The nest, a rather loose cup, consisted partly of twigs and partly of dry panicles of a vine (*Sparattanthelium wono-toboense*) which hung down in sprays from the top of a neighboring tree. These had been incorporated into the nest in such a way that the seed-heads themselves hung down in a fringe around the bottom of the nest. The fork, from which several fine branches grew obliquely upward, afforded good support for the apparently rather weak nest structure.

On 19 January, I saw Female A take a fine twig to the nest, place it in the cup, and then sit in the nest, shaping it with feet and breast and pulling in odd strands of material that were projecting from the nest rim. One of the males was perched about 18 inches away and, when the female left the nest he, too, went onto it and stayed for about 30 seconds, performing nest-shaping movements.

Nest-building continued intermittently for 26 days. Only the female brought material, but one male, almost certainly Male A, was seen to sit on the nest and shape it several times between 20 and 28 January as he had on 19 January. One time he stayed for four minutes. I never saw him bring material to the nest, but once he picked a twig from a tree near the nest and dropped it. Once Male B also picked and dropped a piece of the fruiting vine that was such a conspicuous part of the nest structure. I never saw Male B on the nest, but he often perched near it, and I never saw Female B do any building, but once she pecked at the material hanging below the nest and then perched just above the nest, looking down into it while Female A, which had just returned with nest material, waited on a perch nearby. I saw no aggression between any of the members of the group at the nest; on every occasion, if one was there first, the other simply waited quietly not far away.

These observations differ slightly from the reports of Ellis (1952) and Haverschmidt (1968). At the nest watched by Ellis the male brought material and the female did the building. Ellis did not describe the details of this

cooperation. Haverschmidt briefly mentioned a male building a nest, without giving further details. All the observations agree, however, in showing that the male is actively concerned in the building of the nest and that he also plays an active part in the selection of the nest site. The exact role played by the male in the construction of the nest may well be variable. Also, since we did not see the construction of the main structure, it may be that, in the group we observed, the male built or helped build it, leaving the female to do the lining.

Most of the material brought to the nest for the lining consisted of fine terminal twigs of an abundant understory tree (*Rinorea brevipes*), the very fine twigs of another abundant small tree (Myrtaceae sp.), and once the fruiting panicles of the vine *Sparattanthelium wonotoboense*, already mentioned. The twigs of the myrtaceous tree were the main material used in the nest lining. They are very fine, tough, and springy, and branch obliquely at short intervals. They were also used in the lining of the second nest.

Between 19 and 28 January, I saw the female spend eight periods, of up to six minutes each, sitting on the nest, at times performing shaping movements but for much of the time sitting quietly. Then, on 29 January, she sat on the nest for 45 minutes during midmorning. On 30 January, she was on the nest in the morning for only nine minutes in a period of two hours and 40 minutes, and in the afternoon was not seen on the nest at all. On 31 January, she failed to appear at the nest in the early part of the day, but at 16:00 I saw her leave the nest and by 17:55 she reappeared and remained on the nest all night. On the following morning at 06:40 she left to join the three other birds as they flew, calling, to the nest from up the hill where they apparently roosted. I was surprised to find, on inspection, that the nest contained no egg.

From 31 January until 4 February, the female seemed to show little interest in the nest. From 4 to 9 February, she spent long periods visiting other possible nest sites, concentrating, from 5 February, on a high branch of a huge Mora tree (*Mora excelsa*) in the camp clearing. One of the males — probably Male A, although I could not distinguish the two at this time — always took the initiative, flying to the Mora branch and calling from there. The female followed, alighting on one particular fork where she sat, calling and making settling movements. It appeared that the male was “dissatisfied” with the original nest site; but none of the Mora forks looked as substantial to us as the fork already containing the nest. Possibly the Mora site, about 75 feet up, was nearer the height preferred by fruit-crows for their nests. Our second nest, and the two reported by Ellis and Haverschmidt, were all between 65 and 75 feet.

The female continued, however, to visit her nest occasionally during the period when she inspected the Mora site. After 9 February, we did not see her again at the Mora site. On 6, 8, and 9 February, I saw the female spend four periods, each of about two minutes, on the nest. On 9 February, she began taking nest material to it again after an interval of 11 days, and she continued to do so until 14 February. On 16 February, after spending little time at the nest for two days, I found her sitting in it in the late afternoon, and she remained on it for the night. I inspected the nest when she left at 07:00 the following morning and found an egg. It was visible through the bottom of the nest cup, which, after four weeks of desultory lining, still let through chinks of light.

Throughout the nest-building period all four birds regularly came and went from the nest as a group. Typically, Female A led, followed closely by

Males A and B, with Female B straggling in the rear. They swooped in, Female A and Male A and often Male B landing in the nest tree while Female B perched in a tree nearby. Female A first went to the nest, and after she had finished building and had flown to a perch in an adjacent tree, Male A often went and perched on the nest edge, looking down into the cup for a few seconds. Sometimes, during the early days of observation, he sat in it and carried out nest-shaping movements. When they all flew off, Male A was in the lead.

The fruit-crows made no attempt to conceal the position of the nest, which in any case was fairly conspicuous as the tree had very thin foliage. Both male and female called when perched at the nest with normal loudness, vibrating the tail conspicuously. At times, three fruit-crows perched within a few feet of the nest. Observation was unusually easy for us, apart from the fact that the nest itself was inaccessible, as at no stage in the nesting cycle did the birds pay the slightest attention to a person standing just below the nest, only about 30 feet away.

Our observations at the second nest were far less complete. This nest we found by following the group when they were building. We had seen two females collecting twigs from a tree — the same myrtaceous species which was used for the lining of the first nest — about 100 yards from their nest site. We saw only one female, however, go to the nest with material, and it seemed probable that the other was picking material and dropping it, just as Male B and Female B did at the first nest. The male regularly went onto the nest and on one occasion sat for two minutes while the female waited on a perch just below.

The second nest was about 70 feet up in a tree about 100 feet high, on sloping ground in forest where there was no closed canopy but a rather open growth of large, but mainly slender, trees. Although similar to the first nest, it appeared a little more twiggy, perhaps because it lacked the fragments of fruiting vine that hung down from the other nest. It was placed in the same kind of fork and was clearly visible from below, but not with comfort, since a thick understory of vegetation hid it except from one position almost directly below.

The fruit-crows at the second nest behaved very like those in the first group. All three flew to the nest tree together, calling, and making no attempt to make themselves or the nest inconspicuous.

Defense of the Nest

Neither the location of the nests, nor the behavior of the nesting adults at either of the nests, suggested that in this species it can be at all important for the safety of the nest that it should be inconspicuous, as are so many nests in tropical forest; but it is certainly significant that both nest trees, along the entire length, were growing clear of other trees. Once a group of Capuchin monkeys (*Cebus capucinus*) passed close to the camp nest, and once a troupe of squirrel monkeys (*Saimiri sciureus*) passed through trees adjacent to the other nest. In neither case did the monkeys climb the nest tree, which they could not have reached without first descending to the ground. The choice of nest trees that are clear of the surrounding vegetation may be an important adaptation in tropical forest, as suggested also for the Bearded Bellbird (*Procnias averano*) by Snow (1970).

It soon became clear that the fruit-crows' method of ensuring the safety of the nest against avian predators is to establish a zone around it in which

they are dominant and from which they persistently chase most other birds. The fruit-crows regularly mobbed intruders near the nest during nest-building and on through the breeding cycle until our observations ceased, shortly before the one young flew. On some days, mobbing took up a considerable part of their time.

Slud (1964) recorded that he had seen fruit-crows make passes at a perched hawk and mentions that they are also apt to worry a large toucan; but he commented that the fruit-crow's "limited powers of flight might make it an easy prey for a raptorial bird." Actually, fruit-crows are extremely agile on the wing, and it seems likely that this agility may be related primarily to its mobbing of nest predators rather than to its methods of feeding, because birds with far weaker powers of flight, such as trogons, feed in essentially the same way as the fruit-crows. Similarly, the black plumage may result from the positive selection for a conspicuous, "aggressive" color. The black of such aggressive birds as drongos (*Dicruridae*) may have the same explanation.

Fruit-crows occasionally mobbed toucans at distances up to 200 yards from the nest, but mostly they mobbed birds that came within about 50 yards of the nest. The members of the camp group spent much of their time within 100 yards of the nest. They returned to its vicinity at intervals after they had fed farther afield, resting and preening usually on high perches within sight of the nest. Thus, it is improbable that a potential predator would usually have been able to approach the nest without being detected. However, there were periods, of not more than a few minutes, when all the birds were well away from the nest, and its safety seemed to be left to chance.

When mobbing an intruder, fruit-crows utter the *oo-waa* call repeatedly, occasionally varying it with the drawn-out, upwardly inflected *oooo*. They face the intruder, lower the head, and while calling fan out the throat-ruff and shiver the tail. Sometimes they snap the beak several times in quick succession. If the intruder is in an accessible position, they dive at it repeatedly, one after the other, coming to within a few inches of it and then swerving away at great speed. At the closest point, they utter a curious rasping call never heard on other occasions.

An intruding bird may enjoy a degree of immunity if it perches quietly in thick cover where the fruit-crows cannot dive at it. As soon as it flies, however, they are after it at once, often in a close pack, pursuing it closely and harrying it until it is well away from the nest area. Once, what appeared to be a tail feather fluttered from a jay that the fruit-crows were pursuing in this way. If there are several intruders, the fruit-crows may split their forces, paying most attention to the birds closest to the nest.

A few observations showed that instead of mobbing flying predators, and perhaps particularly dangerous climbing predators, fruit-crows utter alarm calls and get out of the way. On two occasions when a hawk — probably a *Micrastur* sp. — flew over a nest, the fruit-crows uttered a sharp *wak-wak-wak* and dived down to lower perches; and once they called in the same way when a Turkey Vulture (*Cathartes aura*) flew overhead. When our Indian helper attempted to climb to the camp nest with a mirror mounted on a rod, the birds gave the same call, and they repeated it later when I approached the nest. Some birds other than fruit-crows may interpret this call as a warning. On more than one occasion, when the fruit-crows uttered it near a Capuchinbird (*Perissocephalus tricolor*) display ground, the Capuchinbirds at once dived down from their display perches into lower cover.

Altogether, we saw the fruit-crows at the camp nest mob 13 species of birds. Toucans (*Ramphastos vitellinus* and *R. tucanus*) and Cayenne Jays (*Cyanocorax cayanus*) were the species most frequently mobbed, accounting respectively, for nine and eight of the 33 mobbings recorded. Fruit-crows also mobbed the Green Toucan (*Pteroglossus viridis*); three hawks—a species of *Buteogallus*, Black-faced Hawk (*Leucopternis melanops*), and one unidentified; three icterids—Crested Oropendola (*Ostinops decumanus*), Yellow-rumped Cacique (*Cacicus cela*), and Red-rumped Cacique (*C. haemorrhous*); the White-tailed Trogon (*Trogon viridis*); the Black-tailed Tityra (*Tityra cayana*); the Guianan Cock-of-the-Rock (*Rupicola rupicola*); and a small flycatcher; and once a troupe of monkeys. Those birds that were not potential nest predators were mobbed rather half-heartedly or even ignored, unless they happened to come very close to the nest, in which case they were driven away vigorously.

Mobbing nearly always succeeded in causing the intruder to leave the nest area, except in the case of the Black-faced Hawk. This bird, certainly the same individual on the four occasions recorded, stolidly perched in a tree near the nest, taking little notice of the succession of diving fruit-crows that passed within inches of its head and only occasionally raising a foot to ward them off. Twice this hawk distracted the fruit-crows for so long during my watches at the nest that I eventually drove it off myself. Whether it actually had designs on the nest, I never knew.

At the camp nest, intruders became less frequent as the nesting cycle continued, presumably because they learned to avoid the constant harrying to which they were subjected in the area. I recorded 12 mobbing incidents in 19 hours and 20 minutes of observation during the nest-building period; 10 in 37 hours and 20 minutes during the incubation period; and only five in 28 hours and 20 minutes during the nestling period—a decline from one incident about every 40 minutes to one about every six hours.

Incubation

Female A in the group at the camp nest laid the only egg in the clutch early on the morning of 17 February. She left the nest at 07:00 hours in response to the calling of the others near by. Fifteen minutes later, they all returned to the nest. The two males perched near the nest and both looked down into it; twice one of them moved closer and the other displaced it. Female B, meanwhile, was on a higher perch in a neighboring tree, well above the level of the nest, and must have been able to see its contents. At 07:16, Female A went to the nest and settled down on it. Thus, within a short time of the laying of the egg, all members of the group had almost certainly seen it.

The routine of incubation remained much the same throughout the period. Only Female A incubated. Between the times when she first left the nest in the morning (between 06:50 and 07:12 for seven records) and the time she finally returned to it and stayed for the night (once at 16:35, and from 17:18 to 17:47 on five other occasions) she sat for about two-thirds of the time. Thus, in one complete day's watch she sat on the nest 67 per cent of the time; in the six shorter watches, totaling 14 hours, she sat 62 per cent of the time.

The female's absences from the nest were much less variable in length of time than her sessions on the nest; exactly half of the 50 recorded absences were from 12 to 17 minutes. Only two absences were longer than 23 minutes, 26 and 31, and only one was less than six minutes—a four-minute absence

caused by the female leaving the nest prematurely on an alarm and soon returning. By contrast, her sessions on the nest varied from half a minute to one hour and 15 minutes, with the majority toward the lower end of this range. I recorded only four sessions on the nest of more than 50 minutes, but there was some bias against the longer sessions because we could record them only during long watches.

Early in the incubation period, the female's departures from the nest were usually stimulated by the other fruit-crows in the group. After a period of perching quietly near the nest, they grew restless, began to call, and then flew off to feed, whereupon Female A left the nest and joined them. Later, her departures seemed more often spontaneous in that she left when the others were silent or out of sight. Several times she left the nest to join the others in mobbing an intruder. Such instances account for several of the very short sessions that we recorded.

Just as during nest-building, all four fruit-crows normally returned to the nest together with Male A leading. Often Male A flew into the nest tree accompanied by the female and sometimes by Male B too. Much more rarely, Female B joined them in the nest tree. Male A sometimes went to the nest and perched at it for a short time while Female A waited on a lower perch; he then flew to a lower perch or out of the tree altogether and Female A at once went onto the nest. Sometimes the female alone flew into the nest tree and all the others landed in a tree near by; and rarely, the female returned to the nest alone, although on such occasions the other birds were not far away.

Throughout the incubation period, we could see the egg against the sky through the bottom of the nest cup. Attempts to view the egg directly from above by climbing adjacent trees, or by holding up a mirror fixed to a long pole, were unsuccessful; the tree was too slender to be climbed. From 8 March, when the egg had been incubated for 19 days, I checked it regularly from below.

The first sign of hatching occurred on the afternoon of 11 March, when the female appeared very restless. She left the nest and returned to it at short intervals, and at times stood looking down into it and turning her head sideways. Later events suggested that the female was probably beginning to hear the chick call inside the shell. On 12 and 13 March, the female was more settled and the egg was still visible in the nest. Then on 14 March, after 25 days of incubation, I found half of the eggshell beneath the nest. It was exceedingly dark with a deep olive ground color rather thickly covered with blackish-brown markings.

The second nest apparently failed soon after the egg was laid. On 28 February, 11 days after we found the nest, the female was sitting on it. In the course of a three-hour watch in the morning, she sat for periods of 12, 31, and 65 minutes, and left for periods of 9, 8, and 11 minutes. When leaving and returning to the nest, she was accompanied by the other birds of the group. For the first 57 minutes of the watch, however, the nest was unattended and it seemed likely that she was just beginning incubation; indeed, she may have laid the egg that morning. On subsequent visits to this nest, on 3 March and several days later, I saw no birds either at it or near it. The nest appeared undamaged though it was far too high to be examined properly. This group of fruit-crows apparently began to build elsewhere; later, one of the females was seen collecting nest material, but the nest was not found.

The Nestling Period

The female was still on the nest at 06:45 on the morning the egg hatched, and half of the shell was lying on the ground below. At 07:07 she left the nest for 10 minutes, during which time the two males successively perched at the nest and looked in. One male seemed to be trying to feed the chick though nothing was visible in his beak. On this day, the female spent the greater part of the morning brooding the chick. Thus she was on for 95 per cent of a watch of just over two and one-half hours in the early morning, and for 88 per cent of one hour at the end of the morning; but she brooded the chick for only 38 per cent of an hour in the late afternoon.

On this day, one of the males, and perhaps the other, offered food to the chick three times during the four and one-half hours of observation; several times the female stood up in the nest and held her head low in the nest for a few seconds, apparently offering food. The food items were all small. Once a tiny insect was seen in the tip of the male's bill; on other occasions the bird moved his bill as though shifting food forward inside but nothing was visible.

Over the next three weeks, the female spent increasingly less time at the nest. Morning watches of two hours or more, when the chick was age 2, 6, 9, 12, 14, 17, and 21 days, gave the following percentages of time on the nest: 77, 60, 30, 18, 16, 9, 3. She regularly attended the nest less in the afternoon, but we watched less at that time. We never watched in the early afternoon during the only period that the nest was exposed to the hot sun. She may have shielded the nestling at that time; clearly she had felt the heat when incubating at that time of day. After the chick was a few days old, it was regularly left uncovered during light or moderate rain.

All four adults brought food to the nest, but in unequal amounts. During the first few days of the nestling period, it was difficult to be certain of the relative contributions of each bird; the two males were not distinguishable until the chick was six days old, when Male B lost his central tail feather; and when the female lowered her head in the nest, as she did at intervals when brooding, it was not possible to tell whether she was feeding the chick or tending it in some other way. By the third day, however, it became clear that the female was providing only a small part of the food. From 20 March, when the chick was six days old, until we left on 4 April, I recorded 78 visits with food by the two males and 16 by the female. I saw Female B go to the nest with food only once. In the course of the watches when a special effort was made to distinguish the males at all their visits to the nest, Male A made 36 visits and Male B 13 visits. Unfortunately, to distinguish between the two males, I had to stand directly below the nest in a position that was not always suitable for watching other activities.

During the nestling period, the adults usually maintained the following routine. Just as the male flew in with food, the female left the nest. Usually, he alighted on a perch just below the nest and, after a few seconds, flew up to the nest and perched on it. As during incubation, the three other birds of the group normally approached the nest together; the other male perched either in the nest tree or in an adjacent tree while Female B perched a little farther away. When the first male (usually Male A) left the nest, Male B, if he had food as he did on a small number of occasions, flew to the nest, delivered it, and then all four birds flew off together, Male A leading and Female B in the rear. One or both of the males sometimes returned again with food while the female was still on the nest. Then, after a few minutes, the female returned perhaps fed the young herself, and settled down to brood again.

Later, when the female was brooding less, her departures were more often spontaneous; but the group continued to approach and to leave the immediate area of the nest in a body.

The young bird was fed almost entirely on insects. I could not recognize the smaller items brought in the first few days; by the fourth day small katydids were being brought. From day 6 to 21, the food consisted of katydids, moths, cicadas, and mantids, together with many other adult, winged insects and small numbers of insect larvae. All the large insects were held with the head pointing forward and the wings, and sometimes the legs, sticking out to the sides. On day 12, an adult brought a fruit to the young, and over the next nine days I saw them bring three more fruits, one of which was probably from a Matchwood tree about 100 yards from the nest. Thus, of 76 feedings which were recognizable, only four consisted of fruit. The female fed regularly on fruits at this time, the seeds of which we collected in a sheet slung beneath the nest. Throughout the 21-day period of observation, the adults swallowed the fecal sacs which the chick produced immediately, but not every time, after feeding.

During morning watches of two hours or more, the adults fed the young at the rate of two to seven times each hour, and exactly four times an hour during the longest watch of six hours, from 06:30 to 12:30. Feedings tended to be clumped so that the shorter watches gave widely varying averages.

Although three of the adults regularly fed the young bird, Male A alone contributed 60 per cent of all the food, and he evidently had no difficulty in increasing his rate. He regularly brought food to the nest at short intervals, especially in the early morning. On four occasions, he fed the chick three times in 13 minutes or less. Once he fed it three times in eight and one-half minutes and once, three times in nine minutes. On one occasion, in the late morning, he fed it four times in 16 minutes; and once, after feeding had been interrupted for about an hour while the adults mobbed a hawk near the nest, he brought food four times in 27 minutes. The adults regularly offered the nestling more than it could take. It refused the food offered on 10 out of 95 occasions on days 6 to 21; earlier, when it was two days old, it refused three of 11 offerings of food.

The nestling was covered in buff-colored down, which by day 12 appeared speckled with black from the feathers growing beneath it. When the nestling was 17 days old, it still appeared buffy with black patches, and the flight and tail feathers seemed to be about one-third grown. The long quills, terminating in the expanded black vanes, gave the wings and tail the appearance of a Chinese fan. At the age of 20 days, the head and the wing coverts appeared black with scattered buffy spots. My observations ceased when the nestling was 21 days old, but Mr. William Clements, our camp helper, visited the nest regularly until the young bird left when it was 32 or 33 days old.

Discussion

The Purple-throated Fruit-crow's breeding strategy seems to be founded on active defense of the nest; and this must have favored the evolution of communal groups with an extreme reduction of intraspecific aggression. None of the other cotingids, whose habits are known, has a comparable system. The Red-ruffed Fruit-crow (*Pyroderus scutatus*), also the single representative of its genus, is closest to *Querula* in general appearance though considerably larger; but the very incomplete accounts of its behavior suggest that the males

display communally (Olalla, 1943), and may also hold individual territories (Hamilton, 1871). They have a booming call, and the difference in size between the male and female is much greater than in the Purple-throated Fruit-crows. On the other hand, T. K. Salmon (quoted by Sclater and Salvin, 1879) reported that it defends its nest fiercely against hawks. A thorough investigation of the ecology and behavior of *Pyroderus* would be of the greatest interest.

I suggested earlier that the peculiarities of the fruit-crow's wings and tail, which for a cotingid are unusually ample and make the bird highly maneuverable in flight, are primarily adapted to its mobbing behavior rather than to its method of feeding, and that the black plumage may also be advantageous in that it is conspicuous and intimidating. The bird's behavior and nest site compensate for the lack of a cryptic plumage. These factors may also account for the absence of juvenal plumage. The Bare-necked Fruit-crow (*Gymnoderus foetidus*), another large, mainly black cotingid, has a highly cryptic nest (Bérait, 1970) and a very distinct vermiculated juvenal plumage.

If the history of a single nest kept under detailed observation is typical, the single-egg clutch is remarkable. In this case, it seems unlikely that the amount of food that the adults were able to supply could possibly have limited the clutch size to one. Four adults were available to feed the nestling and all brought food, but in fact one male did most of the feeding, and the chick was regularly offered more than it could eat. As pointed out by Snow (1970), all the larger cotingids that build open tree nests, as far as we know, lay only one egg. With *Querula* now added to the list, it seems that we must seek some more general explanation for the small size of the clutch, an explanation unconnected with the feeding ecology of any particular species.

The fruit-crow's incubation and fledging periods are, for its size, very long. Both are almost the same as those of the distinctly larger Bearded Bellbird, which has a notably slow development (Snow, 1970). As the young fruit-crow's diet consisted almost entirely of insects, we may have to reconsider the suggestion that the bellbird's long fledging period is adapted to a fruit diet, poor in protein. Lack (1968) gave few details for the Cotingidae, and a thorough discussion of the rates of development in this family must still await the accumulation of more field data.

Summary

This paper is based on a study of the Purple-throated Fruit-crow (*Querula purpurata*) from January to April 1970, in the foothills of the Kanuku Mountains in southern Guyana, where they live in small communal groups of from three to four birds, with strong social bonds and an almost complete absence of aggressiveness between members of the group.

The adults feed partly on insects and partly on tree fruits, both usually taken on the wing. The fruits of four trees (*Didymopanax morototoni*, *Hirtella* sp., *Guarea trichiliodes*, Lauraceae sp.) were especially important during the period of observation.

We found two nests, one of which was successful. Both nests consisted of open cups made of sticks and were situated in isolated trees. The birds made no attempt to conceal the nest, which they defended vigorously by mobbing intruders at all stages of the nesting cycle.

The clutch in the one successful nest consisted of a single egg. Only the female that laid the egg incubated it, but all four members of the group brought food to the young. The incubation period lasted 25 days.

The members of the group fed the nestling almost entirely on insects and regularly brought more food than it could eat. One male did 60 per cent of the feeding and he apparently had no difficulty in increasing his feeding rate as the occasion demanded. The young bird left the nest at the age of 32 or 33 days.

We suggest that the fruit-crow's breeding strategy has been an important factor determining its body proportions and its social behavior. The one-egg clutch cannot be an adaptation to the number of young that the adults can feed. We need more information on other species of Cotingidae before we can discuss thoroughly the very long incubation and fledging periods of this and other members of the family.

Acknowledgments

I am very grateful to my wife for help with the observations. She first saw the nest near our camp and, while watching the display ground of Capuchinbirds, saw fruit-crows collecting nest material, which led to the discovery of the second nest. She also helped in the day-long watch at the camp nest. Mr. William Clements, our helper, continued to visit the camp nest after we left, and Mr. Carl Hopkins of Rockefeller University, who was in a camp nearby, very kindly supervised his visits. Dr. R. M. Harley of the Royal Botanic Gardens, Kew, kindly identified plant specimens.

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THE LIVING BIRD



Albert Earl Kilbert

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COVER PAINTING OF THE SOUTHERN HELMETED CURASSOW

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I made the cover painting of the Southern Helmeted Curassow (*Crax unicornis*) for the forthcoming book "Curassows and Related Birds" by Jean Delacour and Dean Amadon. While working on the color plates for this book I was fortunate enough to see all the genera and most of the species of the Curassow family in life, either in the wild or in captivity. Over the course of two expeditions, I came to know many of these somber toned, yet beautiful, birds as they lived in the volcanic mountain forests, steaming lowland jungles, or dry savannas. Throughout tropical America, they inhabit the fascinating worlds of bromeliads, orchids, lianas, and neblina — wild and remote places only now threatened by the intrusion of man.

The Southern Helmeted Curassow from the mountains of Bolivia eluded me. It is extremely rare, known only from scattered field observations and a very few museum specimens. However, my acquaintance with its close relative, the Northern Helmeted Curassow (*Crax pauxi*) in Venezuela, together with study specimens enabled me to paint a fairly accurate picture of this secretive bird. I have based many of the following remarks on the conclusions of Delacour and Amadon.

The turkey-sized curassows and the smaller guans and chachalacas comprise the family Cracidae, gallinaceous birds found mainly in the forested regions of neotropical America. The 13 curassows fall into four groups: (1) the perhaps primitive little Nocturnal or Russet Curassow (*Nothocrax urumutum*); (2) the Razor-billed Curassow (*Mitu mitu*) and two allied species in which the red bill is laterally compressed or otherwise modified; (3) the two Helmeted Curassows which have a large, hard casque; and (4) the seven "typical" curassows which often have soft, fleshy knobs or wattles and a recurved crest of stiffened feathers.

Some authorities regard the Northern Helmeted Curassow from Venezuela and Colombia and the Southern Helmeted Curassow from Bolivia as subspecies of the same species even though their ranges are separated by a gap of some 1,200 miles. Delacour and Amadon tentatively regard the two as distinct species having an interrupted, and in part relict, distribution down the Andes: ". . . though it is difficult to believe they would not interbreed freely, were their ranges to meet."

The two curassows are very similar in every respect except for the shape of the casque and the feathering of the head. Aside from the great gap in range, the principal character favoring specific separation is the feathering of the head. In the Northern Helmeted Curassow, the feathering is dense and plush with a matt appearance; in the Southern Helmeted Curassow, the crown feathers curl forward with a glossy appearance. The shape of the casque varies geographically in all forms, but the variation is not clinal. A rare rufous phase that occurs in the female *Crax pauxi* is as yet unknown in *Crax unicornis*.

In 1969, John S. Weske and John W. Terborgh (*Auk*, 88:233-238, 1971) discovered a new form of helmeted curassow in a locality in Peru, about 850 miles north of the type locality of *unicornis* in Bolivia and even more distant from the range of *pauxi* to the north. This was significant. Would the new form bridge the differences between the northern and southern forms and show them to be, indeed, subspecies? Evidently not. Weske and Terborgh concluded that the new form was a race of the Southern Helmeted Curassow and named it *Crax unicornis koepckeae*.

Both species inhabit the dense epiphytic vegetation in humid cloud forests where they are most difficult to observe. Charles Cordier found the Southern Helmeted Curassow in Bolivia between 1,500 and 3,600 feet, inhabiting forests of heavy rainfall in a rugged terrain cut by steep valleys (*Animal Kingdom*, 74 (2): 9-11, 1971). Though the bird no doubt eats tender leaves and buds, its favorite food is the nuts of the almond tree after they have fallen to the ground.

Probably, like other curassows, the Southern Helmeted Curassow travels in pairs or in small family groups and roosts in trees at night. It weighs about eight pounds; its nest, eggs, and downy young are unknown except perhaps by the Indians who, according to Cordier, fashion, among other things, cigarette lighters from its casque.

The distribution of the helmeted curassows along the Andean chain was almost certainly more continuous in the past. The reasons for this diminution are unknown. Hunting by natives, who in some regions valued the helmets as well as the flesh, is a possibility.