Seiurus aurocapillus aurocapillus (Linnaeus), OVEN-BIRD.—Not common. A male was collected in the Pine Growth on April 4, 1944.

Seiurus noveboracensis noveboracensis (Gmelin), NORTHERN WATER-THRUSH.—The only bird of this species that I observed on the island was a male collected on March 24, 1944, in the Pine Growth east of Sardinera Beach, while it was feeding around an abandoned water hole under the casuarinas.

Seiurus motacilla (Vieillot), LOUISIANA WATER-THRUSH.—Recorded by Dr. Wetmore from specimens collected by Bowdish on August 18, 1901.

Setophaga ruticilla (Linnaeus), REDSTART.—A rather common winter migrant through the Pine Growth and the coastal plain. A female was collected at Uvero Beach on April 4, 1944.

Agelaius xanthomus monensis Barnés, MONA ISLAND BLACKBIRD.—Moderately common and restricted to the limestone plateau where it feeds in the cactus association and gathers in small flocks of ten to twelve birds. It has never been recorded from the Pine Growth or from the coastal plain.

The breeding season is in July and August. I have recorded seven nests, built on tall cacti (*Selenicerus* sp.). Two nests found on July 9, 1944, contained sets of four eggs each in an advanced stage of incubation. Five nests found later on July 27, contained four eggs each. The nest is a global structure, somewhat elongated, built of dry grass, small twigs, and other vegetable matter. Both parent birds remain close to the nest during the breeding period and are not easily alarmed. After the young leave the nests they gather in small parties.

One male and one female with testes and ovaries enlarged were collected on March 23, 1944, on the northwestern side of the plateau; two males were taken at Cueva del Gato, on the plateau, April 5, 1944; two males at Las Caobas, on the plateau, April 6, 1944; one male and one female at Cueva del Capitán, on the plateau, April 7, 1944; two males, one female, and one (?) at the north end of the plateau, October 6, 1944.

Piranga olivacea (Gmelin), SCARLET TANAGER.—A rare winter migrant. One male was collected at Palmar de Cogollo, northeast of Uvero Beach, May 3, 1944. This is the first record of the species.

Division of Fisheries and Wildlife
Department of Agriculture and Commerce
Mayaguez, Puerto Rico

LIFE HISTORY OF THE COSTA RICAN TITYRA

BY ALEXANDER F. SKUTCH

THE Costa Rican Tityra (*Tityra semifasciata costaricensis*) is a member of the Cotingidae, a large and heterogeneous family of arboreal birds, related to the Tyrannidae or American flycatchers, and confined to the warmer parts of the Western Hemisphere, including the Antilles. Very few species extend beyond the Tropics; only one, Xantus's Becard, reaches the southern boundary of the United States. Of very small to medium size (for passerine birds), the cotingas are for the most part clad in browns and grays, but some

are of most unusual and striking coloration. A number of species are predominantly white in plumage; a few almost wholly of this color, so rare among forest birds. Others are of the most brilliant and intense blue, with patches of rich purple on the under parts; still others are largely black. Long fleshy wattles, areas of brightly colored bare skin, and crests of curving plumes—ornaments so rare among the passerine birds of the Americas—are not uncommon in this wonderful family, to which belong the bell-birds, the umbrella-birds and the fruit crows.

In the high rain-forests where the majority of cotingas are found, these birds of the tree-tops are a standing—and largely unanswered—challenge to the bird-watcher. Their calls, now sharp and shrill, now sweetly soft, now of a most un-birdlike, mechanical quality, are among the characteristic sounds of the woodland. But one may hear these cries day after day for months and months before he succeeds in tracing them to their source amid the clouds of verdure so high overhead. Finding the nests, and learning something of the breeding habits, of these denizens of a world above and largely out of reach of our own, is the ornithologist's despair. In the forests over which I look as I write, *Lathria unirufa* is an abundant bird. One can hardly make a sudden loud noise of any kind without eliciting the sharp whistles of this bright brown, thrush-like citizen of the tree-tops; yet during eight nesting seasons I have looked in vain for its nest. On the other hand, the great globular nests of the becards (genera *Pachyramphus* and *Platypsaris*), built of vegetable materials in the tops of the scattered trees of the clearings and more open country where many species of this group of cotingas dwell, are often not difficult to find, although nearly always impossible to reach. Of the breeding habits of becards we have several more or less complete accounts (Gosse, 1847; Bent, 1942). Chapman (1929) studied the nesting of Natterer's Cotinga. But for the most part we have only scattered, fragmentary notes on the habits of the cotingas—isolated islets and reefs lost in the vast sea of our ignorance of this family which is in many respects the most remarkable and interesting group of exclusively neotropical birds.

APPEARANCE AND HABITS

In plumage, in voice, in mannerisms, the Costa Rican Tityra is one of the most distinctive of Central American birds—an original avian character. At the first glimpse of a male tityra winging overhead, one exclaims: "The little white bird!" Predominantly white plumage, so common among waterfowl and birds of Arctic regions,

is rare among forest birds and in itself a mark of distinction. Closer scrutiny of the tityra reveals that his plumage is not so white as it appears when he flies overhead; a formal description of the bird fails to convey an adequate conception of his whiteness when viewed when the bird is in flight or resting in the tree-top. His upper plumage is pale bluish-gray, becoming almost white on the back of the head; his under plumage approaches still more closely to white. His wings are largely black; his tail pale gray with a broad black band covering the terminal third and a narrow whitish border across the end. His dark eyes are surrounded by a broad area of bright red bare skin, covering the lores; and this is margined all around by black feathers, which form a narrow fringe across the chin and a broad band on the forehead. His short, stout bill is red over the basal half, black on the end. The upper mandible is terminated by a short, down-curved hook. The tityra is about the size of a Rose-breasted Grosbeak, but even stockier in build, with a shorter tail.[1]

The female tityra is far less white than the male, for her plumage is distinctly brownish-gray above, and light gray below. The bare skin of her cheeks is a paler red than that of the male. The two sexes are nearly equal in size.

The voice of the tityra is like that of no other feathered creature that I know, and is distinctly un-birdlike. To call it a very low grunt conveys only an approximate notion of its quality. It has been compared to the grunting of a pig, but the pig's notes are deeper, fuller and usually louder. At other times the tityra's notes incline more toward a dry, insect-like character. To appreciate their odd quality, one must hear them; and then there is little likelihood that the bird-lover will ever confuse the calls of the tityra with those of any other bird. It has an extremely limited vocabulary, and if it possesses any softer or more melodious notes, during a dozen years in its haunts, I have failed to overhear them.

One is not likely to confuse the Costa Rican Tityra with any other bird of Central America. The Snowy Cotingas (*Carpodectes*) are tree-top birds of about the same size and the same general aspect, but they are even whiter, lacking the black trimmings on head, wings and tail, and the bare red cheeks. Fraser's Tityra (*T. inquisitor fraserii*) bears a still closer resemblance to the subject of this study, but is readily distinguished by the absence of bare red cheeks. In flight, the wing of Fraser's Tityra shows a small white area, like a 'window,' in the midst of the black, which is lacking on the Costa

[1] A colored portrait of another race of *Tityra semifasciata*, by George Miksch Sutton, was published as the frontispiece of Volume 59 of The Auk, January, 1942.

Rican Tityra. This bird's notes are somewhat similar to those of the Costa Rican Tityra, but are drier and less 'grunty,' readily distinguished after they have been heard.

The tityras are at home among the tops of the big forest trees, where earth-bound man hears far more often than he sees them. But they often make excursions, in pairs or small flocks, through clearings and plantations with scattered tall trees, and they commonly nest in dead trees standing isolated near the edge of the forest. Almost always they prefer to fly and forage at a good height above the ground. They are restless, wandering birds, except while bound to a nest appearing seldom to remain long in one locality. Like other cotingas, while perching quietly they turn their heads from side to side, scrutinizing the surrounding foliage until they espy an edible insect, then make a sudden dart to snatch it from the foliage. The first tityra I ever saw held a fleet-winged dragonfly in its bill, but I do not know whether this was captured while flying or at rest. They eat also berries and other small fruits of trees.

The tityras appear to remain mated through the year, for I have a number of times seen them in pairs even during the autumn. Yet at all seasons, even during the nesting period, one occasionally meets small, wandering flocks composed largely of males, which seem to be considerably more numerous than the females. After pairing, the male tityra is ever a faithful companion of his mate, and seems to subject himself to her will. Late one cloudy afternoon in early March, I found a pair of these birds resting among the dead trees of a clearing at the edge of the woods, where they were preparing to nest. The male seemed to be in a hurry to go to their roosting place in the neighboring forest, and twice flew across the clearing to a tree at its border, where he called in his queer grunty voice and waited for his mate to follow. Since she was not yet ready to depart, he returned each time to await her pleasure. Soon, however, she yielded to his entreaties, and the pair winged away over the forest together.

Tityra semifasciata ranges over a vast territory, from southern Brazil to México, and several geographic races have been recognized. Over much of this area, it is one of the first members of the cotinga family that the visiting naturalist is likely to meet. Tolerant of varied ecological conditions, it is at home not only in the most humid rainforests but also in semi-arid areas with scattered trees. In Central America it is widespread over the lowlands of both coasts, and ranges far up into the mountains. On the Pacific side of the Cordillera de Talamanca, in late February, I found it nearly 7,000 feet above sea-

level, but am not sure whether it nests so high. I found it nesting at 5,500 feet at Vara Blanca on the northern side of the Cordillera Central of Costa Rica. But in this extremely wet region I failed to see the bird during the period from August to late February, which suggests that it might perform a slight altitudinal migration, dropping down to lower levels after the close of the nesting season, ascending the mountains again as the time for nest-building nears.

NEST-SITE

The Costa Rican Tityra nearly always nests in cavities in dead or, more rarely, living trees, usually between 40 and 100 feet above the ground. One female was seen carrying material into a hole only 20 feet up, in a slender stub standing in a clearing; but this exceptionally low nest was apparently never used. Either cavities resulting from decay or those made by woodpeckers are acceptable to the tityras, but the latter seem to be preferred, especially the chambers carved by species of *Centurus, Tripsurus* and others of the smaller woodpeckers, whose doorways are barely wide enough for the tityra to pass through. They not infrequently capture holes still used by the woodpeckers for sleeping, or even those newly completed for the accommodation of the woodpeckers' eggs and family, dispossessing the hole-carvers by persistence rather than by violence, in a manner which we shall consider later. I have not known them to oust the woodpeckers from holes that actually contained eggs or nestlings. The tityra's nest high in a rotting trunk of uncertain strength is best left unvisited by a man with even a moderate regard for the integrity of his bones. Once, when enthusiasm overruled judgment, I did look into a tityra's nest; but I should not repeat that climb, nor advise anyone else, not a member of a suicide club, to attempt it.

In 1939, I was surprised to find tityras nesting in the crowns of three palms (*Attalea* or some feather palm of very similar aspect) standing not far apart in a cleared valley, with forest near by. The three nests were placed in deep crannies between the crowded, massive, fiber-swathed bases of the great leaf-stalks, at heights ranging from 40 to 75 feet above the ground. Two were among the living fronds in the spreading crowns of the stately palm trees, the third among the stumps of fallen fronds at the base of the crown. That this sort of nest-site was not unwelcome to the tityras was indicated by the fact that each of the three palm trees—the only ones of the kind in sight—sheltered a nest. Each palm tree seemed to offer potential sites for a large number of nests, but the tityras' territorial habits prevented their fuller utilization. Except in this one spot in

the upper Térraba Valley of Costa Rica, I have never found the tityras nesting elsewhere than in cavities in trees. All of the nests that I have seen were in clearings near the forest.

NEST-BUILDING

Long before the approach of the breeding season, the tityras, as they roam in pairs through the forest and adjacent clearings, begin to examine woodpeckers' holes and other cavities in trees which might later serve them as nest-sites. I have watched them pursue these investigations as early as November; indeed, at all times of the year, they manifest a curiosity in the holes in trees that they encounter on their wanderings. The female goes to the doorway of the hole and looks in, while her mate, who follows her like a shadow, clings to some neighboring part of the trunk, with black-and-white wings prettily half-spread. Often he goes to the doorway, too, after his mate has completed her inspection. It is usually not until a later date that the birds actually enter the holes.

At times it appears that the examination of possible nest-sites may be made before the pair has been formed, or at least before the rivals of the successful male have become discouraged and given up their suit. On February 20, 1938, I saw tityras at Vara Blanca, Costa Rica, for the first time in half a year. The following morning, I found several of these birds in the vicinity of a dead trunk, standing in a narrow clearing amidst the forest on the mountain-side at 5,300 feet above sea-level, where a pair had nested the preceding July. When their voices first called my attention to their presence, I saw one female followed by three males. The female flew around from one to another of the dead trunks standing in the pasture, looking into the many old woodpecker holes that they contained; and the males followed her, sometimes peering into the cavities, too. They uttered their little thick notes, flitted their black-and-white tails fanwise, and sometimes one flew toward another; but the bird that was approached always promptly retreated; and there was no fighting, nor any suggestion thereof. After the female had made the rounds of the decaying trunks, she flew down the mountain again, followed by her three ardent swains.

This observation suggests that the tityra's method of mating and establishing a breeding territory is very different from that of finches and other song-birds, among which the male settles in an area, advertises his presence by singing, and awaits the arrival of a mate. The female tityra appeared to select the territory while the males followed her about, awaiting her decision. I should have given much

to learn how she made her choice between the three rivals; but since it was quite impossible for an earth-bound bird-watcher to follow the birds over the tree-tops, the courtship was performed largely beyond my ken. As late as March 6, there were three tityras in this clearing; but by the following day another of the males had been eliminated. The female's choice of a mate seemed to have been definitely made. But she was not seen building until April 3.

At lower altitudes in Costa Rica (2,000–3,000 feet), I have known the tityra to begin nest-building as early as the end of February, at the height of the dry season. March and April are the months of greatest activity in nest-building in Costa Rica. Tityras may often be seen taking material into holes in May, but this is probably in preparation for second broods, or to replace first nests that had been destroyed.

Like many other birds, the tityras, especially the female, may gather material some time before they actually begin to build, carry it in their bills a while, then drop it to the ground. In 1937, a pair of tityras was much interested in the still-occupied dormitory of a pair of Golden-naped Woodpeckers (*Tripsurus chrysauchen*) in a clearing at the edge of the forest. I first saw the female with material in her bill on February 20, but it was March 2 before I witnessed her actually take anything into the hole that she had chosen for her nest. Yet two days later I found her resting on top of the stub that contained the hole, with dead leaves in her bill. After I had watched her perch motionless here for twelve minutes, she suddenly let them all drop to the ground. During the period while the female tityra was gradually working herself up to the point of beginning to build, her mate seemed most eager to have her proceed with the work. Often, while she paused irresolutely in a neighboring tree, holding a twiglet or a dead leaf in her bill, he would go to the woodpeckers' hole and cling to the doorway, at times flying off a little way and then returning, as though to encourage her to take the stuff inside. Even when she was not in sight, he might go to look into the prospective nest-cavity, at times during the warmest hours of the afternoon.

For the Costa Rican Tityra, nest-building is a simple matter, consisting merely in filling up the bottom of the chosen cavity with a loose litter of small dead leaves, or pieces an inch or two across torn from bigger ones, fine dry inflorescences of trees, fine twiglets, and rarely a small green leaf. This work is done chiefly or wholly by the female, while her mate, as a rule, follows her faithfully back and

forth, and often goes to look into the cavity. The material for the nest is plucked from the tree-tops rather than gathered up from the ground—I have never seen a tityra on the ground or even very near it. She, as a rule, works in a desultory fashion, taking a few billfuls into the hole, then going off and remaining out of sight until the watcher wearies of waiting for her return. The male frequently carries material in his bill, often takes it to the doorway of the cavity; but rarely does any of the stuff he so assiduously carries find its way into the nest.

The male tityra's efforts to be helpful while his mate builds are most amusing to watch. One morning a male brought a piece of dead leaf to the woodpecker hole in which his mate was building, clung to the doorway, looked around for his absent partner, then flew up to the top of the trunk and waited, still holding the bit of leaf. After a few minutes he dropped down to the doorway, looked about him while he lingered there, and again flew up to the top of the trunk with the leaf still in his bill. Four times he took the piece of leaf to the doorway, and four times he carried it away again. The last time, he flew to a neighboring tree and dropped it. All this while his mate remained out of sight. I saw another male take material to the nest-tree on three separate occasions. The first time, he came alone, and when he saw that his mate had not followed, flew off in search of her still bearing the twiglet. The second time, he followed her to the nest-tree, clung to the top while she entered, then when she left flew away with her, still carrying what he had brought in his bill. The third time, he also came with his mate, again with a small twig in his bill, while she brought a number of pieces of dead leaves. While she was within, he came to cling at the entrance with his slight burden, as though to pass it in to her, but carelessly allowed it to drop to the ground. A boy who was cleaning the pasture near this nest told me that he saw the male give his mate what he had brought, outside the cavity, and she took it inside. I have never, myself, witnessed such a transfer of material among tityras; but it certainly is not impossible. The lad was not a trained observer, but since other things he reported to me proved his careful attention, I think this observation worth recording here.

Long acquaintance with the male tityra has convinced me that he is a courteous and peace-loving gentleman, a good father and a most devoted husband. He tries on all occasions to be helpful to his wife; but the goodness of his heart is frequently frustrated by the dullness of his wits.

The male Fraser's Tityra has a similar habit of bearing pieces of

material back and forth from the nest without taking them inside. I have seen him carry the same dead leaf to and from the nest ten times, following his mate as she filled the nest-cavity. Only exceptionally, almost accidentally, does he ever actually push anything through the doorway. The male Boat-billed Flycatcher (*Megarhynchus pitangua*) has the same habit of carrying material back and forth as he follows his building mate, but I have never seen him make an actual contribution to the nest. The male Rose-throated Becard (*Platypsaris aglaiae*) takes a large share in building the great, globular, pendent nest; but at a nest of the Cinnamon Becard (*Pachyramphus cinnamomeus*) and at several nests of the Slate-bellied Becard (*P. polychopterus similis*), the males, although attentive to their mates, made no contribution to the construction.

THE NEST EXAMINED: THE EGGS

The only tityra's nest that I have ever plucked up courage to reach was situated in the top of a massive dead trunk, standing in the cove in front of the laboratory clearing on Barro Colorado Island in Gatún Lake, Canal Zone. The trunk, a remnant of the forest that was inundated and killed when Gatún Dam was closed to impound the waters of the Río Chagres in 1914, rose about 35 feet above the water and was a hundred yards from the nearest shore. It was only the reflection that, if the trunk fell, the water would receive me more gently than solid ground, that nerved me to attempt the ascent; actually it was an exceedingly foolhardy thing to do. From a cayuco carved from a solid trunk, we threw a cord over the broad top of the thick stub. With this we pulled over a stouter rope, and with the rope we drew up a rope-ladder. The top of the stub was badly decayed, and the rope cut deeply into the rotten wood, making it stick, so that we experienced much difficulty in hauling up the heavy ladder. Our tugging dislodged chunks and fragments of the punky wood, which fell all about us in the dugout canoe. At length, however, we hoisted the ladder to the top, and made it fast by tying the thick rope to the base of a neighboring smaller stump, also projecting above the water. Since all of these trees had been dead about twenty years, one can imagine their state of decay—also the enduring qualities of some of the more resistant of tropical timbers.

By the time everything was in readiness for the ascent, the sight of so much rotten wood caused my resolution to waver; but my helper urged me on and I was ashamed to turn back. As I neared the top of the rope-ladder, I found the trunk in such an advanced stage of decay that I was fearful lest the whole upper portion should crumble

and drop me and all the birds' nests it contained into the water. On the way up I passed a large cavity, entered through an old woodpeckers' hole that sheltered two nestlings of the Blue-headed Parrot (*Pionus menstruus*), well grown but still naked and ugly. A pair of Noble Flycatchers (*Myiodynastes maculatus nobilis*) were feeding nestlings in a lower cavity; and a Black-winged Palm Tanager (*Thraupis palmarum atripennis*) had newly hatched nestlings in a well-made nest in a cranny at the very top, close to the tityra's nest. The supporting rope had passed over the top of the stub quite near the nest of the tityra. If it had chanced to rest a foot farther to the right, it would have broken through into the nest-cavity and destroyed it. This was in a most unusual situation, quite different from that of any other tityra's nest I have ever seen. In the upper side of the short stub of an obliquely ascending thick branch was an irregular hollow, apparently made by decay, a foot deep and wide enough readily to admit my hand. Although the opening was at the top, the cavity descended slantingly into the wood, and so gave the bird protection from the sun and at least the direct fall of rain. A loose litter of fragments, an inch or two across, torn from dead leaves, with a few pieces of leaf still green, filled the bottom of the hollow. Upon first peering in, I could see no eggs; but feeling amongst the litter of leaves, my fingers encountered two.

These eggs were dark buff or, better, the color of coffee with milk, heavily marbled, especially on the thicker end, with brown. A few small, scattered, black spots completed their decoration. They measured 30.2 by 20.6 and 29.8 by 21.4 millimeters. These are the only authentic eggs of the tityra of which I can find a record. Pure white eggs taken from an unlined cavity and ascribed to the tityra, beyond doubt belonged to some other bird, probably to the woodpeckers whose hole the tityras were investigating when shot by the collector.

INCUBATION

The female tityra alone incubates the eggs. Information on this point is available for a number of nests in Costa Rica and Panamá, and is corroborated by extended observations on one or more nests of Fraser's Tityra, the Slate-bellied Becard, the Cinnamon Becard, and the Rose-throated Becard. In none of these cotingas does the male share the labor of incubation, although he does feed the nestlings.

Before she begins to incubate, the female tityra may sometimes be seen resting in her high doorway, looking out upon the world. At times she will dart out as though to fly away, but within a few inches of the entrance turn in the air and go in again at once. Her mate

may remain perching in a neighboring tree, from time to time going to cling in front of the doorway and look in at her. As the day ends, the female, often in company with her mate, lingers near the nest cavity, guarding it; but in the waning light both fly off together to sleep in the neighboring forest. At a slightly later period, the male will depart first, leaving his mate perching alone near the nest. As the twilight deepens she may fly toward the doorway, only to turn back when in front of it, often repeating this move a number of times, but in the end losing courage or changing her mind, and winging away through the dusk in search of her mate. Such vacillating behavior is especially likely to occur if, as often happens, a family of great-billed araçari toucans sleep in a neighboring hole—but we shall have more to say of this in the section which treats of the relations of the tityra with other birds. At daybreak, male and female tityra often fly together from the adjoining forest to perch for a while near the nest, before the woodpeckers, which also sleep in a near-by cavity, have left their dormitory.

Apparently the filling of the nest-hole with loose litter may be practically completed for a considerable period before the eggs are laid, but during the intervening days the female tityra brings an occasional billful of dry leaves to the nest. The inaccessibility of tityras' nests makes it difficult to determine when the set of eggs is completed, and how soon after this incubation begins. But observations on the vacillating conduct at nightfall of female tityras that are on the point of beginning to incubate, make it appear likely that there is a certain amount of individual variation in the time, in relation to the deposition of the last egg, when they begin to sleep in the nest.

My most extended record of the behavior of an incubating female tityra was made at the nest in the rotting stub in Gatún Lake, from an open cayuco tied to a neighboring lower stub. Although I sat in plain view of the nest, the tityras appeared to take no notice of my presence. I watched this nest from 6:00 to 11:23 A. M. on May 29, 1935, and from 2:00 to 6:45 P. M. on the following day. During the ten hours, the female's sessions on the eggs ranged from 24 to 49 minutes, with an average, for eight sessions, of 37.1 minutes. Her recesses varied from 13 to 29 minutes, with an average, for nine absences, of 19.6 minutes. She spent 65.4 per cent of the time in the nest—a poor record of assiduity for so large a bird, but matched by that of a Fraser's Tityra which during six hours spent only 63.1 per cent of the time on her eggs. Becards in their bulky nests, which

must be hot and stuffy inside, sit even less constantly. During 20 hours, a Rose-throated Becard incubated only 56.3 per cent of the time. A short record of three hours for the Cinnamon Becard showed that she incubated only 47.6 per cent of the period.

Upon leaving her eggs, the tityra would emerge from the cavity and hop along the broad top of the stump to its highest point, where she would usually stand for several minutes, preening her feathers, stretching her wings, or only idly looking around, before she took flight for the wooded shore. Once she emerged from the cavity and spent six minutes resting and preening here, then returned to her eggs without going ashore. (In making the foregoing calculations, I did not count this brief intermission as a recess.) Upon returning from her outing, she would alight upon the same point and linger here for a minute or two before hopping down into the cavity.

It was remarkable how often the male tityra, watching from the neighboring forest, saw his mate before she reached the shore. Sometimes he flew out a short distance over the water to meet her. Then, together, they vanished above the tree-tops. On five of her ten returns to the nest, the female was escorted by her mate to the decaying stub standing in the water. He would rest for a minute or more atop the trunk near the doorway, before winging back to the shore. Once as she was returning alone to the nest, the female tityra was attacked above the water by one of the Noble Flycatchers which were feeding nestlings in the same trunk. The flycatcher plucked at her feathers, causing her to cry out in alarm or pain. But as soon as she alighted on the stub, the Noble Flycatcher ceased this ignoble conduct and left her in peace. She promptly returned to the shore, as though for the consolation of her mate, which a minute later saw her safely back to the nest. On another occasion, one of the flycatchers darted at the male tityra as he rested on top of the stub near his own nest, causing him to retreat to the shore. But aside from these two incidents, the tityras, the Noble Flycatchers and the Palm Tanagers nesting in the stub got along very well together. As to the Blue-headed Parrots, as long as I watched they remained in the distant forest, quite neglecting their two nestlings.

This male tityra was typical of his kind. As a rule they are most attentive to their incubating partners, watching from a neighboring elevated perch for their emergence from the nest, and now and again going to the doorway to peer in.

From time to time the female tityra, returning to her eggs, would bring a billful of leaves to the nest. I have seen this also at other

nests of the tityra, sometimes even after the eggs had hatched. The becards, which construct great bulky nests, and numerous other birds whose nests are very big or elaborate, or mere loose piles of litter like that of the tityra, continue to bring more or less material to them during the period of incubation.

Since upon my first venturesome climb to the tityra's nest I suffered no mishap, I went up twice more, and each time found the eggs completely buried and covered over in the leaf-litter. It would be interesting to know how this was accomplished. Possibly the female sat so deeply embedded in the leaves that when she rose to leave the nest they merely fell into the depression she had occupied, and so were buried with no effort on her part. Possibly, too, she was more actively responsible for covering them. This is a question which it was quite impossible to settle by direct observation. In the only other accessible nest of any member of the cotinga family that I have ever found, one belonging to a Slate-bellied Becard, the eggs were also more or less covered with loose leaves during the absences of the female. The habit of concealing the eggs beneath loose material upon the departure of the parents from the nest is far less frequent among passerine birds than one would suppose it might be because of its protective value. Aside from the dendrocinclas (*Dendrocolaptidae*), I know no other passerines that habitually do this; but among grebes, ducks, geese, partridges, sand-grouse, and a few other non-passerines, it is a not uncommon practice. The protectively colored eggs of the tityra, buried in the deep litter that covers the bottom of the dark nest cavity, must often escape toucans and other predators that come in search of them—or have these egg-eaters caught on to the trick?

In the middle of the afternoon, while the female tityra stood atop the trunk beside the nest, preening her feathers, her mate flew across the water with a big green caterpillar in his bill, and alighted close beside her. Without offering the food to her, he hopped to the rim of the nest-cavity and looked down into it. Evidently he had brought the caterpillar in expectation of finding nestlings to which he could give it, for upon seeing that the eggs were still unhatched, he swallowed it himself. The male tityra not infrequently brings food to the nest in this anticipatory fashion, finds that there are still no young mouths to receive it, then eats it himself or carries it off again. At a nest near Vara Blanca in the Costa Rican highlands, I saw the male do so twice. Since the male tityra has never been known to pass food to his mate, not even while they are attending nestlings,

these morsels were obviously not intended for her. Similar anticipatory food-bringing has been witnessed at nests of numerous other passerine birds, especially wood warblers and tanagers. It serves to form in the male parent, when he does not incubate, the habit of bringing food to the nest in advance of the hatching of the nestlings, with the result that after these escape the shells he will promptly find and attend them.

The incubation period of the tityra is unknown. The only cotinga whose incubation period I have been able to determine is the Slate-bellied Becard (*Pachyramphus polychopterus similis*). The eggs of this smaller bird hatch in 18 or 19 days, and the incubation period of the tityra is probably no less than this.

CARE OF THE NESTLINGS

Since my sojourn on Barro Colorado Island came to an end before the eggs hatched in the decaying trunk standing in the water, I have never seen unfeathered nestlings of the tityra. Possibly they are quite naked and devoid of natal down, like those of the Slate-bellied Becard. Both parents join in feeding them; and since the male brings food to the nest even before they hatch, it is probable that he does not delay long in attending to their wants. Their mother alone broods them. If their father arrives with food while she is in the nest, he does not, like so many male birds, give it to his mate to be passed by her to the little ones beneath her, but alights on a near-by perch and continues patiently holding it, until at her own good time she departs and leaves the nestlings free to receive the morsel he has brought. I have seen him wait for a quarter of an hour, from time to time going to the doorway to look into the nest, or voicing a slight grunt to preclaim his presence, until at last his brooding mate flew away and he could deliver his offering to the little ones. At one nest the male tityra somehow lost all of his tail, but despite this handicap continued faithfully to bring food to the nestlings.

The food of the nestlings consists largely of insects of various kinds, caterpillars and spiders. Once I saw a male tityra bring a small lizard to the nest. The tityras do not often forage in the clearings where they nest, but among the tree-tops in the neighboring forest, where it is seldom possible to watch them as they hunt. When they arrive at the nest, the food, carried in the bill, has been well mashed and is difficult of recognition. The frequently green color and massive bodies of the insects brought for older nestlings suggest that they were captured among the foliage rather than in the air. My observations on the care of the nestlings have been oft-repeated at a number

of nests rather than long-continued, and I have always found the male doing his full share of the work. At one nest in southern Costa Rica I watched for three hours, during which the male brought food nine times, the female ten. This lofty hole contained at least two nestlings that no longer required brooding during the day, but their exact age was unknown. Both parents attend to the sanitation of the nest.

I have, at several nests, attempted to learn the approximate age at which the young depart, not by direct inspection of the contents, but by watching from the ground to determine the length of the period during which the parents take food into the cavity. At a nest in southern Costa Rica, the tityras began to feed nestlings on April 20, 1936. It was May 10 before I glimpsed a nestling's head in the high doorway. Now the parents merely clung in front of the entrance to pass in food to their offspring, which evidently climbed up the inner wall of the old woodpecker hole to receive it. Three days later, the nest was empty, and there was a large gap in the side wall, apparently made by some predatory animal. I thought that the young tityras were old enough to have made their escape if threatened, and looked for them in the neighborhood, but in vain. The parents were present, and seemed to enjoy more leisure than they should if they had fledglings to feed; so I fear that the young met a premature and unhappy end. They had remained in the nest at least 21 days. From another nest, the young made a successful exit 19 days after I first saw the parents take food into the hole, but apparently the nestlings were then already several days old. The nestling period of the Costa Rican Tityra is at least three weeks, and probably several days longer. The nestling period of Fraser's Tityra, a bird of the same size and very similar habits, is at least 25 days.

Upon leaving the nest, the fledgling tityras are led into the neighboring forest, where it is almost impossible to keep track of them. Their plumage is brownish, closely resembling that of the adult female. Two young birds reared in a hundred-foot-high hole in a forest clearing sometimes followed their parents back into the clearing as these made ready for a second brood in the same hole. Eighteen days after quitting the nest, when their mother had begun to incubate again, these young tityras would sometimes accompany their father into the clearing; but usually when he came to escort his mate back to the nest, they remained behind. After a few more days, they were no longer seen in the neighborhood. They appeared to remain dependent upon their parents, at least in part, for about three weeks after flying from the nest, or until about six weeks of age.

While attending nestlings, both male and female occasionally bring pieces of leaf to the nest. At one nest, I saw both parents do this repeatedly. Sometimes the birds drop these bits of leaf while resting near the nest, sometimes while clinging in front of the doorway, when the fragments flutter down in a manner that leaves no doubt as to their identity. Again, the leaves may be taken inside, and not improbably placed in the expectant mouth of a nestling! The tityras appear to bring this material from old habit or pure absent-mindedness; it evidently plays no rôle in their domestic economy at this stage of the nesting. The female tityra whose three-week-old nestlings seemed just to have been lost, as already related, was seen to gather a billful of dead leaves in the top of a neighboring tree, then let them fall to earth. Thus tityras at all stages of the nesting may, at times, perform acts which seem more properly to belong to an earlier or a later stage, such as bringing food before the eggs hatch (by the male, at least), bringing nest material while incubating or even while feeding nestlings. They are birds of wavering determination, finding it difficult to make up their minds as to what they will do next, often changing their decisions, and not infrequently absent-mindedly doing things that bear no relation to the matter in hand.

THE SECOND BROOD

In Costa Rica, the tityras frequently, if not regularly, attempt a second brood when they have been successful in bringing out their first at an early date. A female whose nestlings had departed on or shortly before April 29, 1936, was seen to enter and rest in the doorway of the nest-hole on May 9, while still feeding two full-grown young birds. On May 11, she went into the hole in the evening to pass the night. By May 17, she was certainly incubating again in the nest where her first brood had been reared, leaving her mate to attend the young birds, which seemed to be becoming rapidly self-supporting. By June 5, both parents were feeding the nestlings of the second brood, the older offspring having meanwhile gone their own way. By June 25 the nest was empty; and although the fledglings were not seen, the aggressive behavior of the usually so mild parents suggested that their little ones were hiding near by.

In late May of the following year, I found two pairs building nests, most probably for second broods. Soon after arriving at Vara Blanca, I found a pair of tityras feeding nestlings at an altitude of 5,300 feet, as late as July 16, 1937. In late May and June, 1939, two pairs of tityras engaged in a long-continued dispute for the possession of a nest-site, most probably for a second brood.

In 1943, I again found very definite evidence of a second brood. The nestlings of the first brood had departed from the old woodpecker hole on or about May 21. By June 26, their mother appeared to be incubating again in the same hole. On the evening of July 11, this bird behaved most queerly. As the day waned, she stood in her high doorway, looking out, then flew forth, only to turn in mid-air after she had gone only a few inches, and return to the doorway. She repeated this several times, then flew out and away in the fading light. Possibly my presence below the nest disturbed her, but it had not done so on past evenings. After that, the nest was abandoned. This observation suggested the desertion of well-incubated eggs through the waning of the reproductive urge late in the season. But the incompleteness of the evidence renders it inconclusive. Possibly the nest had been robbed during the day; possibly the eggs were infertile. The position of the lofty hole discouraged the investigation of this point.

TERRITORIAL RELATIONS

The Costa Rican Tityra is most decidedly a 'territorial' bird. Indeed, it is one of the relatively few tropical birds, especially among those of the tree-tops, which I have seen engage in disputes over territorial jurisdiction, although these have never assumed the violent form so often described for northern birds. A clearing at the edge of the forest, several acres in area, may contain a number of fire-killed trees, each of which has one or more holes that would be suitable nest-sites for the tityras; yet I have never known more than a single pair to breed in such a clearing. The only tityras' nests that I have seen at all close together were those in the three palm trees already mentioned. Unfortunately, I failed to measure and record the distance that separated these trees, but all stood not far apart in the same small pasture. Each palm seemed to offer sites for many nests, but the birds' intolerance of close neighbors of their own kind prevented their becoming tityra apartment-houses. Possibly the fact that the wide-spreading fronds of the palms to a certain extent screened the tityras from each other made it possible for these three pairs to nest here closer together than one would find them in the usual dead and naked trunks, where they are visible from afar.

I have numerous observations bearing upon the defense of territory by tityras, only a few of which can be given here. On March 27, 1936, while I watched a nest of the Golden-naped Woodpeckers situated in a clearing at the edge of the forest, a pair of tityras flew out from among the trees. The male tityra alighted on top of the wood-

peckers' tall trunk, while his mate went to examine the hole in which these birds had, until recently, slept. She also investigated lower portions of the decorticated trunk, clinging to its smooth surface. Presently she went back into the forest, soon to reappear with a fragment of dead leaf, which she took toward the woodpecker hole. At this point another pair of tityras, which had, a short while before, begun to nest in the tall, dead trunk in the center of the clearing, discovered the trespassers, flew at them, and drove them unresistingly away. The trunk where the established pair of tityras nested was about a hundred yards distant from that which the new arrivals examined.

Two days later, this or another pair of tityras visited a more distant dead tree where another pair of Golden-naped Woodpeckers had their nest. The female tityra tried to force herself into a hole half-way up the trunk that was far too small to admit her. Once she looked into the woodpeckers' nest, but finding one of them incubating within, left it at once. The male tityra was chiefly an interested onlooker, but both he and his mate went to look into some small excavations made by the woodpeckers, too shallow to serve for nesting. The pair returned several times to repeat their investigation of this trunk; and the female, ever hopeful, each time tried to squeeze herself into the narrow holes.

The following year there was again a single pair of tityras nesting in the clearing, now in the hole which the first pair of Golden-naped Woodpeckers had made the preceding year. On February 27, when this pair of tityras were on the point of beginning to fill up the bottom of the hole they had already chosen, their long and tranquil occupancy of the clearing was threatened by a sudden invasion. During the last hour of the day, four others of their kind flew out of the neighboring forest, and there was much excitement all around. All six rested not far apart among the boughs of the same small tree, called in their thick, grunty voices, and twitched, fanwise, their short, black-and-white tails. Presently one would dart at another, which would quickly change his position to avoid a collision; and this might cause a general shifting about of the whole group. Then one would start to fly across the clearing, and some or all of the others would follow closely. They might all settle together in another tree in the clearing or about its edges, or else fly out of sight over the neighboring forest. But soon they would return, and grunt and dart at each other, and fly about together just as before. They continued to fly over the clearing until the daylight began to wane, then vanished into the forest.

Early next morning, the flock of tityras returned to the clearing and behaved as on the preceding afternoon. Later in the morning there were seven individuals in the group, which was now made up of five miles and two females, including the resident pair. The stranger males were evidently trying to win the resident female from her mate, each for himself. The proceedings would have been more interesting to watch had I been able to distinguish the accepted male from his rivals. The birds were long in coming to the point; all seemed to lack resolution; and the discussions promised to be long drawn out. The tityras are mild-tempered birds and do not like to make violent scenes.

By the morning of March 1, the invading army of tityras had dwindled away, and only two males followed the female as she flew across the clearing. Next morning, I again saw two males flying after her as she winged over the clearing; but later she returned with a single one. I would have given much to know with certainty whether he was the same that had been with her from the first, and had successfully routed the whole crew of upstart pretenders to his mate's affections. His familiarity with the clearing and its potential nest-holes seemed to indicate that he was indeed the old-established master thereof. After tranquility had been restored to the clearing, the female tityra gathered a billful of dead leaves from a neighboring tree-top, and, after some delay, took them into the woodpecker hole—the first material that she actually carried inside in my presence (see p. 349).

From time to time, during the next two months, strange tityras wandered into this clearing; but I saw no other attempt to disrupt the domestic harmony of the mated pair until April 20, when they were feeding nestlings. On this date, as the female tityra returned to the nest with food in her bill, she was followed by two intruding males, which came to rest in the top of a neighboring tree. Paying little heed to them, after a short delay she flew into the hole to deliver the food. Then one of the intruders flew to the top of the trunk that contained the nest, where he clung for a few moments. Soon he flew back and perched a foot away from the other; both called and flirted their tails. When the father of the family soon after returned and saw these trespassers, he darted at them twice, and they tamely withdrew into the forest. The head of the family did not even deem it necessary to empty his bill before beginning to negotiate with the strangers, and as soon as they were out of sight, he went to the nest to deliver what he had brought for his nestlings.

It seems that it is the custom for unattached male tityras to go a-wooing by twos or in small flocks. On page 332 we have given another example of this.

Close beside a little-used roadway in the Valley of El General stood a tall dead tree, barkless but with numerous branches, that in May and June, 1939, claimed my attention by virtue of the many birds that found shelter in it. The gaunt arboreal skeleton rose above a low, densely entangled thicket; but two hundred yards away began the forest, and the tree was not too far distant to attract some of the forest birds. Here a pair of Golden-naped Woodpeckers reared their family of three; a pair of Thin-billed Wood-hewers (*Lepidocolaptes souleyetii compressus*) fed their nestlings in a natural cavity eighty feet above the ground; two Frantzius's Araçaris (*Pteroglossus frantzii*) slept in an old hole made by one of the larger woodpeckers. In addition to these occupied cavities—all of which were deserted by early June—the tree contained several other holes carved out by the big Pileated Woodpecker (*Ceophloeus lineatus*), or possibly by the Guatemalan Ivory-bill (*Phloeoceastes guatemalensis*). From May 24 to June 17, if not for a longer period, one of these empty holes was the cause of an interminable dispute between two pairs of tityras, both of which wanted it for a nest-site, probably for a second brood. The tree contained enough unoccupied cavities to accommodate both pairs; but each pair insisted upon having the whole tree and the surrounding territory for themselves alone.

On June 8, when these lengthy discussions between the two pairs were at their height, I wrote in my journal: "With characteristic mildness of temper, patience and persistence, the two pairs have now protracted their dispute for over a fortnight. All four birds will rest among the dead branches, quite close together at times, apparently in perfect amity. Of a sudden, one will dart at a member of the other pair, causing it hastily to shift to another perch. Then they will flit about confusedly for a few moments, apparently greatly excited, voicing their grunty notes and twitching their tails as they rest between movements, but rarely if ever striking each other; for the individual who sees itself the object of another's attack invariably retreats. The flare-up over without any bird having suffered the slightest injury, all rest from their nervous exertions quietly side by side as before. Soon becoming hungry, all four wing away in company to the forest, where doubtless they forage in unruffled fellowship. After a brief absence, all four return together to the dead tree, to resume the interrupted argument in the same intermittent fashion as before.

"I noticed a few days ago that one of the female tityras had lost most of her tail feathers, but whether by the agency of her rival or otherwise, I have no means of knowing. If one tityra succeeded in depriving another of a portion of her tail, it must have been a great surprise to both the parties concerned. Yesterday evening and this morning the mate of the whole-tailed female failed to appear. I do not know what can have befallen him; possibly he fell victim to the White-throated Falcon (*Falco albigularis*) or some other bird of prey; but I feel sure that his mild adversaries of his own kind are not the cause of his absence, whether it be temporary or for all time. The three survivors carried on the dispute this morning in just the same fashion as the four formerly did, going off to forage together between sessions in the big dead tree. The argument seems to have become a habit with them, and they would feel lost if they were to discontinue it. It is the female with the undamaged tail who most frequently enters the coveted cavity, but she never stays long within. Sometimes the other pair dart at her as she goes into it."

But by June 15, the other pair of tityras appeared to be in the ascendancy. The whole-tailed female had found her old mate, or a new one, as the record made on this date shows: "This morning a single pair of tityras, that of which the female lost most of her tail, had undisputed possession, so far as their own kind was concerned, of the big dead tree. They loitered much among its upper branches, sometimes went to peer into its cavities, and once the female entered the hole which was in dispute between the two pairs. Yet they did not appear to be preparing to breed. Late in the afternoon, while I watched the Golden-naped Woodpeckers retire, the second pair of tityras arrived in the tree, and the dispute between the two pairs was resumed in the fashion I have already described. Several times both pairs flew off together to the forest, then returned in company to the dead tree. Finally, as night approached, all four tityras winged away to the forest together, probably to roost in the same place."

On the morning of June 17, five tityras, three males and two females, flew into the dead trees together, and engaged in the same sort of harmless altercation as on so many past mornings. After a while, all five flew away together; and I have no further record of tityras at this tree. On my last visit to it, on June 25, neither pair had begun to nest there; and in view of the lateness of the season, it is highly improbable that they did so that year.

Thus the net result of this long-drawn-out dispute was that neither of the two pairs reared a brood—at least, not a second brood. But

when we consider the many evils attendant upon over-population, was not this a most happy result? If the tityras were already so numerous in this region that all could not find isolated nest-trees—and they were indeed very abundant locally, so that every suitable dead tree seemed to shelter a nesting pair—they would only have created a more difficult situation for themselves in the following year, if they further increased their population. Had they been more fierce or more determined birds, one pair might have killed or disabled the other, and so quickly have reached a decision; but then the two offspring they might have reared—if their enemies of many kinds had not broken up the nest—would merely have sufficed to refill the gaps they themselves had caused in the population. This is the way that fiercer creatures would have settled the difficulty; but the tityras' way seems better: they preserved the breeding population intact for the exigencies of future years; and they appeared to enjoy their earnest if inconclusive conversations. We marvel at the manner in which birds, particularly in the Tropics, preserve their numbers at a fairly constant level from year to year, never seeming to undergo such extreme fluctuations in population as have been observed among many mammals and birds of the far North. This episode of the tityras shows us one of the ways in which the regulation of numbers may be accomplished.

While the Costa Rican Tityras argued over the nest-hole, a pair of Fraser's Tityras built their nest in another hole in the same tree, undisturbed by them. Although so similar in coloration, the Fraser's Tityras do not arouse the territorial jealousy of the Costa Rican Tityras, as others of their own species do. The former may perch undisturbed close by a nest of the latter, and both may breed in the same clearing. I have, however, seen a male Fraser's Tityra drive Costa Rican Tityras from the trunk that sheltered his nestlings; but this was probably a manifestation of parental zeal rather than of territorial jealousy.

RELATIONS WITH OTHER SPECIES

As with so many other hole-nesting birds unable to carve out cavities for themselves, the tityras' manner of nesting brings them into competition not only with wood-carving species, but with other hole-users in the same plight as themselves. In the first category are the woodpeckers whose holes they covet, often before the makers have finished with them; in the second class are araçari toucans which nest and sleep in holes made by the bigger woodpeckers, swallows, House Wrens, Fraser's Tityras, and numerous other birds.

WITH THE GOLDEN-NAPED WOODPECKER (*Tripsurus chrysauchen*).—This small woodpecker is numerous among the forests at lower elevations on the Pacific side of southern Costa Rica, where tityras are abundant. Its holes are a favored nest-site of the tityras. They are deep and spacious, usually placed high, and carved into fairly sound wood; their narrow doorway keeps out the Frantzius's Araçaris (*Pteroglossus frantzii*), which easily enter the holes of the bigger Pileated Woodpecker and the Guatemalan Ivory-bill. The clearing where for two years I watched the activities of a pair of tityras was also the home of a pair of Golden-naped Woodpeckers and a pair of Wagler's Woodpeckers (*Centurus rubricapillus wagleri*). The hole of the latter also has a narrow doorway; and the male Wagler's Woodpecker carved far more holes during the course of the year than did the pair of Golden-napes; but they were always in such soft wood that by the time he and his mate had abandoned them as dormitories, they were in a more or less ruinous condition. The tityras took little interest in the holes of the Wagler's Woodpeckers, but in both years nested in cavities formerly occupied by Golden-napes.

Family bonds are strong among Golden-naped Woodpeckers (*see* Skutch, 1943). After the young birds begin to fly about, they return at nightfall to sleep with their parents in the hole where they were hatched and reared. This chamber may continue to serve as their family bedroom until the young birds disperse as the subsequent breeding season draws nigh, in March of the year after they hatched. At this time, the parents begin actively to enlarge a new hole for the reception of their eggs, often in the same trunk where they nested the preceding year.

In February, 1937, a pair of tityras began to take an interest in the lofty chamber where the pair of Golden-naped Woodpeckers had nested in 1936, and where they still slept with one full-grown son. On March 2, I for the first time saw the female tityra take material into this cavity; but it is not impossible that she carried in a few pieces in a desultory manner at an earlier date. About this time, the Golden-napes temporarily abandoned this hole for others near by, apparently because of molestation by the tityras. But they did not find their new quarters satisfactory, and by March 6 the three were again sleeping in their former dormitory. On the evening of March 11, I saw one of the male woodpeckers throw out a rather long stick and many pieces of dead leaf which the tityra had taken into his bedroom, thereby undoing most or all of her day's work. Father and son slept in this hole, while the mother retired that night to

rest alone in the new hole which the pair were now rapidly enlarging lower in the trunk, but which was still too small to accommodate all three of the Golden-napes.

Next day the female tityra resumed the work of filling up the woodpecker's dormitory. That night all three woodpeckers slept in it, without throwing out more litter as they retired. This was the last time the entire woodpecker family slept in the hole that had sheltered them for nearly a year. On the evening of March 14, a male—probably the father—slept alone in it. About this time the young male vanished, doubtless having gone off to set up housekeeping for himself. A few days later, the parent woodpeckers established themselves in a new hole they had very rapidly carved far down in the trunk, and here the female soon afterward laid her eggs. They had deserted their nearly completed new hole close below that claimed by the tityras, and another newly begun somewhat lower still; but whether because of the tityras' presence or from some other cause, I do not know. It was March 29 before I found the female tityra sleeping in the Golden-napes' former dormitory, where apparently she now had eggs.

The change in ownership of this hole was effected, so far as I saw, without any actual fighting between the tityras and the woodpeckers. If the woodpeckers happened to be working at their new hole lower in the trunk when the tityras arrived, they appeared uneasy and sometimes flew away. Rarely a tityra would actually fly toward a woodpecker as it carved at the tree-trunk, causing its prompt retreat. But the tityras also appeared to be slightly afraid of the woodpeckers, and accordingly encounters were studiously avoided by both parties. I have seen Golden-naped Woodpeckers relinquish their dormitory to Fraser's Tityra in an equally pacific fashion, and at a season when they would not, as the pair we first considered, have moved into a new hole anyway in the usual course of events. There was never any use of force between the two kinds of birds; but the woodpeckers seemed to grow tired of throwing out the trash that the cotinga so persistently carried into their bedroom, and at length concluded that it would be easier to carve a new chamber in a neighboring part of the same dead tree.

Although tityras are usually even-tempered, peace-loving birds, now and then one finds an individual with a fiery disposition. In late June, 1943, a female was preparing to rear a second brood in a dead tree standing in a pasture. In another hole in the same trunk slept a family of Golden-naped Woodpeckers, parents with two sons a few

months old. In May, the tityras had reared their first brood at the same time that the woodpeckers reared their only brood; and during this period I saw no indications of enmity between them. But now, on the evening of June 24, the female tityra suddenly developed an antipathy to her neighbors. She stood atop the highest fork of the old trunk, and as the woodpeckers approached their bedroom door below her, darted angrily down at them, coming very close, making an audible *snap* with her bill when nearest them, throwing them into great excitement, and causing them to retreat to a neighboring dead tree. One finally fled to a grove a hundred yards away. From her lofty lookout at the top, the tityra swooped angrily down at the woodpeckers whenever they returned to the trunk, and so kept these early roosters in the open until past their usual hour of going to rest. Then three Frantzius's Araçaris arrived to enter their dormitory lower in the same trunk, and hold both tityra and woodpeckers at a distance until they had entered their roomy chamber, the work of one of the larger woodpeckers. When they had settled down for the night, the tityra resumed her perch at the very top of the trunk, and now quietly watched the Golden-napes as they cautiously slipped through their bedroom door. Finally, in the fast-failing light, she winged away toward the river.

Next morning, I twice saw this tityra dart toward one of the Golden-napes as it rested innocently in a tree-top at the edge of the forest, fifty yards from her nest, putting it to flight. But the following evening she remained quietly in her nest-hole while the woodpeckers retired, and did not molest them.

WITH PUCHERAN'S WOODPECKER (*Centurus pucherani*).—With this wide-ranging woodpecker, the tityra comes into contact over a far greater area than with the Golden-naped Woodpecker. So far as I have seen, the habits of Pucheran's Woodpecker are quite similar to those of its congener; and the holes carved by both are equally desirable shelters for the tityra's nest. In April, 1941, I found a pair of these woodpeckers sleeping in a hole that appeared to have been freshly carved, forty feet up in a barkless trunk standing in a maize field in the Pejivalle Valley, in eastern Costa Rica. They also spent considerable time in this cavity by day, and seemed to be preparing to incubate there, but since they still removed loose chips from the bottom, the female woodpecker had probably not yet begun to lay. On April 27, a female tityra was carrying dead leaves into this hole. The woodpeckers promptly began to work at a new hole lower in the same trunk, where, as soon as it was big enough, they slept, and

later nested. Here, as with the Golden-naped Woodpeckers, the tityra acquired possession of the coveted hole without my having witnessed any fighting between the two kinds of birds, although I spent a good deal of time in view of the trunk. For some reason or other, she did not rear a family in this hole.

WITH THE COSTA RICAN WOODPECKER (*Piculus rubiginosus uropygialis*).—In the Costa Rican highlands, a pair of tityras claimed an old woodpecker's hole in the dead top of a living tree standing in a pasture, and began to fill it with the usual dry leaves and trash. During their absence, a male Costa Rican Woodpecker arrived and began to throw the material out of the doorway. For at least two days he continued to clean out the hole, at times becoming quite excited and repeating over and over his loud, rolled call. But no fighting was witnessed between the woodpecker and the tityras; and when the former looked through the doorway and found the female tityra within, he promptly flew away as though in alarm. The woodpecker was not nesting in this hole, nor did he use it as a dormitory. Possibly this was his nest-chamber of the preceding year, and he still retained a proprietary interest in it. The tityra apparently never laid in this cavity.

Sutton and Pettingill (1942) writing of tityras of the Mexican race (*T. s. personata*) state: "April 4 to 8, a pair at the Rancho sparred fiercely with a pair of Golden-fronted Woodpeckers [*Centurus aurifrons*], who were doing their best to finish a nest for their own use." This observation shows a very different temper, not only of the tityras but also of the woodpecker, from that which I have found usual of the Costa Rican Tityra and the woodpeckers with which it comes in contact.

WITH FRANTZIUS'S ARAÇARI (*Pteroglossus frantzii*).—With these brilliant, red-billed toucans, the tityras' relations are somewhat more complex than with the woodpeckers; for not only do the two species at times compete for the possession of one of the big holes abandoned by the early-nesting *Scapaneus* or *Ceophloeus*, but the tityras fear these great-billed, nest-robbing birds for the injury they may inflict upon themselves or their offspring.

On April 19, 1939, I found a pair of tityras carrying material into an old hole of one of the bigger woodpeckers, in the top of a tall dead tree standing in a narrow, bush-choked clearing between two strips of forest. This cavity was the dormitory of three araçaris. Probably, when they began to prepare a nest in the hole, the tityras were unaware of the other birds' prior claim, for the araçaris were

absent all day; but they soon discovered that they would not remain in undisputed possession. In the evening, before the araçaris flew out of the forest to go to rest, the tityras would arrive and perch in commanding positions near their chosen hole. Then when their great-billed antagonists winged toward the doorway of the dormitory, they would give chase, and dart close by them as they clung before the entrance looking in, as they did every evening before slipping inside, to make sure that no creature that could harm them had hidden away in the cavity during the day. The zeal which the tityras displayed in worrying the araçaris varied from evening to evening. Sometimes they would dart back and forth above their heads while they perched, and pursue them hotly as they flew. Again, their demonstrations were far milder. Often they expended all their store of anger on the first araçari that approached, and allowed the others to go to roost in comparative peace. But if they ever actually touched the araçaris, it was a very slight, ineffectual contact; their display was almost wholly bluff; and the araçaris paid scarcely any attention to it.

But if the tityras' threats made little impression upon the araçaris, and quite failed to keep them out of their customary bedroom, they knew another and more effective way of evicting the bigger birds. By day the tityras, chiefly the female, labored to fill up the cavity with dry leaves and inflorescence stalks that they plucked from neighboring trees. Soon the araçaris found their quarters becoming cramped. On the evening of April 24, the tityras did not come to defend their nest in their usual fashion; but what they had accomplished during the day disturbed the great-billed birds far more than their own presence might have done. The three araçaris arrived at their customary late hour, and one entered the hole. A second tried to follow, but seemed to experience unwonted difficulty in passing through the doorway, for several times it stuck in its head only to draw it out again. At last it gave up the attempt to enter and flew back to the edge of the forest, followed by the third araçari, which had been watching from the top of the lofty stub. Then the one that had gone in emerged and also flew back to the forest. Next, the araçari which had found it so difficult to enter came again to the doorway, stuck in its head, pulled out a bunch of material in the end of its long, red bill, and flew off to a neighboring tree, where it dropped the load. Finally two of the araçaris returned and managed to enter together, the third going elsewhere to sleep. Araçaris usually have a number of lodges available for just such emergencies.

The next evening the tityras were again on hand to receive the

araçaris. When two of the toucans arrived to enter their dormitory, the tityras pursued them with far less spirit than on past evenings. This time the second araçari went in without much difficulty. Then the tityras perched side by side on the truncated end of the branch that contained the hole, often leaning over the edge to peer down, as though they tried to see what their enemies were doing there. Finally, as it was fast growing dark, the male tityra flew off to the east, leaving his mate alone on the end of the stub. While she stood there in the dusk, a third araçari arrived very late, and tried to join the other two in the hole. Finding it difficult to squeeze head-first into the scant remaining space, it turned about and inserted itself forcibly rump-first, with its tail doubled forward over its back. This was the first time that I ever saw a toucan enter a cavity in this retrograde manner. As it slowly pushed itself in, the female tityra fluttered toward it in a faint-hearted manner. Then, after delaying longer on the end of the stub, she dropped down and hovered a moment before the doorway of the nest-cavity, as though she desired to enter, but feared to have the araçaris as bedfellows. After another rest atop the stub in the gathering dusk, she winged away to the forest.

I believe that the female tityra had reached that stage in her preparations for rearing a family where she would have slept in the hole had it not been for the araçaris. Next morning, at seven o'clock, she arrived with a billful of dead leaves, and four or five times flew up in front of the doorway as though to go in but, without actually touching it, dropped down to cling to a lower portion of the tree. Apparently she was not sure that all the araçaris had departed. Finally, after ten minutes of this vacillating behavior, she screwed up her courage to the sticking point, clung to the doorway, peered cautiously in, then entered with her pieces of leaf. She lingered within for about twenty minutes, and I suspect that she laid an egg.

That evening four araçaris arrived at the dead tree, and were pursued by the tityras in their usual fashion. The big birds were rather unsettled; for after two had entered the hole one on the outside called sharply, bringing them out again; and all flew back into the forest. Two and then a third returned; and although the second experienced considerable trouble in pushing itself inside, the third, folding its long tail forward and turning about, managed to struggle backward into the top of the chamber. If the tityra had indeed laid an egg in the morning, I fear that it was smashed by the three toucans sleeping above it.

Next evening, April 27, the araçaris again entered the hole despite

the half-hearted demonstrations of the tityras. These lingered atop the stub in the failing light, occasionally peering down over the edge. As it grew darker, the male flew off, leaving his mate alone on the stub. She fluttered many times before the doorway of the cavity, and once almost touched it; but in the end her fear of the araçaris—or her common sense—prevailed, and she flew off through the dusk in the direction her mate had taken.

On the evening of April 28, the tityras were not present. Two araçaris arrived, examined the cavity from the outside, then flew off. I thought that perhaps the female tityra had stolen a march upon them and entered before they or I arrived, but the vigil which I began at dawn of the following day proved conclusively that neither tityra nor araçaris had slept in the hole. The tityras arrived from the forest at daybreak and rested a while on the end of the stub; but soon the male flew off, and after a brief delay the female followed.

During the next few nights, either one or two araçaris slept in the hole, sometimes pushing in backward. But after May 2, they no longer used this cavity for roosting. If the tityras were at all responsible for their change of residence, they had achieved this result, as appeared likely, by filling up the cavity and making it uncomfortable for the toucans, rather than by their harmless threats of attack as the original tenants retired in the evening. But after the tityras gained possession of the coveted hole, they were slow in making use of it. This was probably because the egg or eggs which the female had apparently laid there about April 27 had been broken by the araçaris; her strong desire to enter the hole at nightfall at this period was almost certain proof that she had laid. The tityras now usually spent the last half-hour of the day resting in or near the dead tree that contained the cavity, but as the light grew dim both flew off to the forest. By May 16, nearly a month after I found her building a nest here, the female had at last begun to incubate in this hole. Mild-mannered though they be, the tityras often come off victorious, even in conflicts with far bigger and more powerful birds, by virtue of their great persistence. Perhaps the tityras' need to adopt a Fabian policy, in disputes with more powerful rivals, accounts for the dilatory, indecisive character that is so evident to anyone who watches them closely.

I regret that I can not record a happy ending for this nesting; but before the young were fledged the hole was abandoned by the tityras. On an evening in early June, five araçaris arrived at the dead tree. One went to look into the hole where the tityras had attempted to

rear a brood, but did not enter. Then all flew back into the forest. The high chamber was abandoned by both of the parties that had so long contended for its possession.

In an earlier year, a pair of tityras nested in the same tall dead tree where from two to five araçaris often lodged for the night, and were often made uneasy by their huge-billed, piratical neighbors. The tityras occupied a hole a hundred feet above the ground, where earlier a Golden-naped Woodpecker had slept; while the araçaris used a slightly lower and much more capacious cavity, from which a brood of Pileated Woodpeckers had recently departed. At the beginning of March, 1936, when the tityras were ready to occupy their nest, one or both members of the pair would come each evening to rest upon high, exposed perches near by and await the arrival of the araçaris. They would closely pursue the bigger birds as they flew up to the dormitory, and dart above their heads as they clung before the doorway before crawling through. Yet I never saw them actually strike the araçaris; and the big-billed birds seemed to take slight notice of these menaces. Sometimes, as they flew at their enemies, the tityras, especially the male, uttered a queer little grunt.

During the day, the female tityra had been spending considerable time in her nest, where at intervals her mate came to look in through the doorway, but by March 9 she had apparently not yet begun to incubate. That evening, after her ineffectual feints against the araçaris, she alighted upon the topmost point of a very tall and slender, naked trunk standing close beside the one in which the toucans slept and she had her nest. Here she rested motionless, a very lonely little figure silhouetted darkly against the fading sky above the western ridge, while all the bird world sank into drowsy silence. What a struggle must have been taking place in her small breast as she stood, outwardly so reposeful, against the great, darkening, cloud-veiled sky! The hole in which she had built her nest and possibly also laid an egg or two, in which she sat every morning to prove her possession, was unattended; and the hour had come when growing parental impulses prompted her to sleep in it. But just below were two larger, more powerful birds which she feared; and she hardly dared to pass the night so close to them, although several feet of solid wood separated their chamber from her own.

Finally, when even the late-retiring motmots and woodhewers had settled down for the night, and the bats had begun to flit through the dusk, the lonesome little bird made a move toward the round entrance of the hole, now scarcely visible in the darkening trunk.

But in front of it she lost courage, fluttered on beating wings, and rose to rest upon the top of the trunk. After a brief interval of outward immobility, she dropped down again to the hole. Again she lost courage at the critical moment, fluttered, and this time flew to a more distant tree to rest and gather courage for another attempt. Five or six times in all she started to enter the hole, and as many times she veered aside without actually touching the doorway. After her final attempt, instead of going again to some near-by perch, she turned her course toward the woods to the south, whither she and her mate had gone on former evenings, and vanished amid the dark woodland leafage. It was by this time so dark that I felt sure that she would not return that night. She had not been quite brave enough, and sought the company of her mate instead of occupying the dark cavity in the tree alone.

The next evening, the male tityra lingered with his mate after the two had pursued and threatened the two araçaris that retired into the Pileated Woodpecker's hole. In his presence she found greater courage, and after a little hesitation entered the hole so near that in which the dreaded toucans had stowed themselves away. But she was not entirely confident, for she leaned far out of the entrance, and once flew or fell out, only to turn about before she had gone many inches and return to the interior. In a very short time she flew out and away to join her white mate, which watched from a neighboring perch. But his roosting-time had come, and now he flew off to the forest on the south, leaving her once more to face her inner conflict alone. After some delay, the female tityra returned to her nest for the second time that evening. But she was too ill at ease there, and in a few minutes abandoned it again to perch on a high stub of the next dead tree. As she stood there motionless in the failing light, a third araçari joined the other two in the Pileated Woodpecker's hole, and she darted past it as it went in. As on the preceding evening, she started several times toward her hole, only to flutter before it and return to a lofty perch. In the end her courage again failed, and she winged off through the dusk to seek her mate.

The following day I set forth on a long journey and was absent until March 22. Upon my return, I found that the female tityra had conquered her fears and now slept in the nest with her eggs. Her mate would linger in the clearing as the day waned, but flew off into the forest before the arrival of the single araçari which now remained in sole possession of the Pileated Woodpecker's hole. The big bird now retired late, and his impact against the trunk would

bring the female tityra out of her nest in time to dart at him, uttering a little scolding grunt, as he slipped inside. Soon she resolutely returned to her nest, making no false starts, to sleep within a few feet of the monster she dreaded. During the next two weeks, this sally from her nest, to dart at the araçari as it entered its dormitory, was the evening ritual of the female tityra.

The araçaris were now also nesting the same clearing, in a neighboring trunk. The member of the pair which did not incubate by night lodged alone in the trunk where the tityras had their nest; the two or three other araçaris that had taken shelter their earlier in the season had somehow been induced to leave the breeding pair alone in the clearing. Although the araçaris are undeniably fond of a meal of eggs or nestlings, for some reason they spared those of their neighbors, the tityras. Perhaps the narrowness of the doorway protected them; but I once saw an araçari remove an egg from another hole built by the same kind of woodpecker, and therefore, presumably, with a doorway of the same diameter. By the second week of April, the nestling tityras were reaching the age when they no longer required much brooding. Now their mother remained out later in the evening, and instead of being found in her nest when the araçari arrived, was waiting high up in some neighboring dead tree to give it chase. After the great-billed bird had gone into its bedroom, she wavered in her determination to enter the nest, just as she had done when beginning in incubate. She went to the doorway, clung hesitantly there, then flew up to the top of the trunk, where she lingered until the light had grown dim. I could hardly distinguish her when, after a long delay at the doorway, she entered for the night.

Ten days later, when the nestlings were evidently becoming well feathered, the female tityra still exhibited this vacillating behavior at nightfall; but now the balance of forces had tilted to the opposite side. All through the day, both parent tityras never lost an opportunity to chase their red-billed neighbors as they flew about the clearing performing the duties of their own nest; but the bigger birds suffered slight inconvenience from this unremitting though mild persecution. In the evening, after the young tityras' hunger had been satisfied, their parents would rest upon some neighboring perch to await the arrival of the araçaris. The male would nearly always grow impatient, or drowsy, before the araçari arrived in the gathering dusk to enter its dormitory. Sometimes he would make a start toward the forest, only to circle around and return to his mate when he saw that she did not follow, repeating this several times

before he actually flew into the woodland, leaving his mate to guard the nest alone in the twilight. After she had seen the araçari safely into its dormitory, she would alight on top of the high trunk and bend over the edge, peering down toward her nest. Then, after a further delay, she started off toward the forest, but described a long loop in the air which took her back to the top of the trunk where her nest was. She made a move to enter, but in the end took flight once more, in a long, wavering course which ended in the crown of a mighty tree growing in the forest to the south, possibly the same in which her mate had already gone to roost. Was her vacillating conduct caused by anxiety for her nestlings, her fear to leave them sleeping alone so near the dreaded araçari, even when they no longer required her warmth by night; or was it merely that she wavered between an old habit and a new one in process of formation?

Although she now no longer covered the nestlings during the night, when there was little to be feared from the sleeping araçaris, she and her mate would resume guard over the nest in the dim light of early dawn. The araçari would look out of its dormitory once or several times before it flew north; and at each appearance of the great red bill in the doorway, the tityras would start in its direction. When at length the araçari issued forth, both pursued it closely as far as the edge of the forest. And each evening the mother tityra would guard the nest until it was nearly dark.

Despite their fears of the araçaris—or was it because of the precautions these fears led them to take?—the tityras successfully reared their two nestlings, which made their debut into the world about April 21. The araçaris were less fortunate, for about this time someone cut down their nest-tree to take their young. While the tityras reared a second brood in the same hole as the first, the pair of araçaris, which did not attempt to raise a second brood, sometimes lodged in the Pileated Woodpecker's hole so close by, to the continued annoyance of their neighbors. Again the tityras' nesting was a success. As the irony of fate would have it, the following year, in this same clearing, a pair of tityras and a pair of araçaris—I believe the same two pairs—nested together in another trunk, the tityras near the top in a hole made by Golden-naped Woodpeckers, the araçaris in a low hole made by the Guatemalan Ivory-billed Woodpecker. The araçaris' nest was early despoiled; but the tityras almost succeeded in bringing forth their brood before their cavity was torn open, apparently by a mammal. Despite the araçaris' nest-robbing proclivities, I have rarely known them to pillage the homes of their

nearest neighbors, at least not of those that breed in cavities. In 1943, a pair of tityras and a pair of araçaris successfully reared families in the same trunk.

After the tityras' second brood had taken wing in late June of 1936, I found the parents guarding them among the trees at the edge of the clearing. When a long-tailed, brown Squirrel Cuckoo (*Piaya cayana*) passed heedlessly by, they darted at the big, harmless wayfarer and knocked several feathers from its wing, so aggressive had they become in defense of their offspring. The Squirrel Cuckoo was probably as surprised by this rude conduct as myself; for I cannot recall any other occasion when a tityra so mistreated another bird, of its own or of a different kind.

SUMMARY

1. The Costa Rican Tityra (*Tityra semifasciata costaricensis*) is found in pairs throughout the year; but even during the breeding season other individuals travel in small flocks, composed largely of males, which considerably outnumber the females. These unmated males may follow the female about by twos or threes while she seeks a nest-site, and at times invade the territory of a mated pair at the height of the breeding season.

2. The tityra nearly always nests in high cavities in dead or more rarely living trees, preferring those made by the smaller woodpeckers. Rarely it nests in crannies between the broad bases of the petioles of palm trees.

3. Potential nest-sites are examined by the mated pair many months in advance of the breeding season.

4. The nest-cavity is partially filled with a loose litter of dead leaves, fine twiglets and dry inflorescences, all gathered among the tree-tops. The female builds the nest with little or no help from the male, which often carries material to the doorway, but usually lets it drop to the ground or carries it away again.

5. The single nest which could be reached contained two eggs, which were covered by the litter of dead leaves whenever the female was absent.

6. The female alone incubates; but the male is most attentive to her, escorting her to the nest and often going to look in. He sometimes brings food in anticipation of the hatching of the nestlings, but does not give it to his mate.

7. The female brings billfuls of dry leaves to the nest from time to time during the course of incubation; and even after the eggs have

hatched, both parents occasionally bring such material, either dropping it or taking it into the hole.

8. The nestlings are fed by both parents, each of which delivers the food itself. If the male, coming with a morsel, finds his mate in the nest, he holds it patiently for many minutes until she leaves. The nestlings' fare consists largely of winged insects, caterpillars and spiders. They remain in the nest at least 21 days and probably a few days longer.

9. In Costa Rica, the breeding season extends from late February or early March to June or July. A second brood is frequently reared, at times in the same hole as the first. Incubation of the second set of eggs may begin about two weeks after the departure of the first brood.

10. The tityra defends a nesting territory, but probably not a feeding territory. Even when sufficient holes are available, one almost never finds two pairs nesting in the same small clearing, and intruders are gently but firmly repelled. For more than three weeks, two pairs disputed the possession of a woodpecker hole in a tree that had several available holes. Although they made many feints of attack, the threatened individuals always moved away in time to avoid contact. No fighting was ever seen between these or any other tityras.

11. Tityras sometimes capture holes used for sleeping, or newly completed and intended for nesting, by the woodpeckers *Tripsurus pucherani* and *T. chrysauchen*. They continue to fill up the holes with litter until the woodpeckers grow tired of cleaning them out and carve new holes close by. No actual fighting between tityras and woodpeckers has been witnessed, nor have the tityras been known to capture holes that contained the woodpeckers' eggs or young.

12. Tityras may dispossess *Pteroglossus frantzii* of old holes made by the bigger woodpeckers and used as dormitories by the toucans. They employ the same expedient of filling the cavities with nest material during the absence of the larger birds. It may be several weeks before the toucans relinquish their dormitory to the tityras.

13. When nesting near the toucans, tityras at all times keep close watch over the larger birds. The female tityra sometimes exhibits strange, vacillating behavior at nightfall as she begins to incubate near the toucans, and again when she ceases to brood the nestlings.

14. On three occasions, the tityras successfully reared broods in the same trees where nest-robbing *Pteroglossus* bred or slept in neighboring holes.

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San Isidro del General
Costa Rica

BIRDS OBSERVED ON ESPIRITU SANTO, NEW HEBRIDES

BY WALTER E. SCOTT, U. S. ARMY

ON September 24, 1944, the author landed on Espiritu Santo, the New Hebrides, possibly even a stranger land than the New Caledonia he had just left some several hundred miles closer to Australia. But the birds of the two localities were considerably alike, so the knowledge gained in New Caledonia in the previous five months was of great value.

In the New Hebrides archipelago, Espiritu Santo is the largest island, with 875 square miles. It lies at approximately 15 degrees South Latitude, has a broad flat coastal plain and level plateaus several hundred feet above sea level, and a mountainous range rising to 6,195 feet in the northwestern part. According to 'Pacific World': "The climate is hot and humid throughout the year, more moderate along the coast. The wettest season is from November to May." That book also states that the forest vegetation extends to the beaches, including tropical hardwoods, fig trees, palms and tree ferns. With these facts, especially the "hot and humid," the author thoroughly agrees.

Because this one-man scientific expedition was sponsored by the U. S. Army (although without their knowledge), observations of birds were entirely restricted to the southeastern portion of the island. Likewise, time was limited and although opportunities for study presented themselves at every moment, it seemed, much too often they were neglected because of more important duties. However, work in reconnaissance and trail mapping and training in newly-opened