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A PRELIMINARY LIFE HISTORY STUDY OF THE FLORIDA JAY, *CYANOCITTA C. COERULESCENS*

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INTRODUCTION

The present paper is based on field work conducted at the Archbold Biological Station, Lake Placid, Florida, during the period from March 27 to April 29, 1943. This thousand-acre station is operated in cooperation with the American Museum of Natural History. Mr. Richard Archbold made constant efforts to facilitate my work while I was a guest at the station. For assistance in preparing the manuscript I wish to thank Drs. Robert Cushman Murphy and Ernst Mayr and Mr. Frank A. Pitelka. Dr. A. L. Rand gave me valuable suggestions during the course of the field work. References to time in this paper refer to War Time, one hour ahead of Standard Time.

As the study covered a period of only five weeks and some of my time was otherwise occupied, the results are preliminary. My experience with this species is limited to the period spent at the Archbold Station, with the exception of a brief observation of a few individuals of the Great Basin race, *woodhousei*, in Arizona in 1938. Despite these limitations, so little has been recorded on the behavior of the Florida jay, and that of an incidental nature, that publication of the present rather fragmentary findings seems justified. The western races of this species of the group *californica* have also been somewhat neglected. The appearance of Bent's volume on the Corvidae, now in press, may be expected to contain much information on the Florida jay.

In a paper on the genera of Corvidae (1944, Amer. Mus. Novitates, no. 1251) I have presented reasons for considering the genus *Aphelocoma*, to which the Florida jay is currently referred, a synonym of *Cyanocitta*. The jays are apparently more primitive than the other principal groups of the Corvidae such as the nutcrackers, choughs, crows, and magpies. The conclusion from morphology that jays are the most primitive of the Corvidae is corroborated by the following (translated) statement of the Heinroths (1924–1926, p. 235) based on study of the European genera in captivity and in the field, "We incline to the viewpoint that the Jay [*Garrulus*] has the Corvid characteristics the least pronounced of any native species and in its behavior shows rather a certain similarity to bush-inhabiting song birds."

Regarding the specific limits of *C. coerulescens*, I agree with Coues, Hellmayr, and others that the western forms generally grouped under the name *californica* are best considered races of *coerulescens* despite the hiatus in occurrence from Florida to western Texas. The distribution recalls that of the Old World *Cyanopica cyanus*, which occurs in the Iberian Peninsula and in eastern Asia, but not in the intervening area.

As in most species of Corvidae, males of the Florida jay differ from females only by averaging slightly brighter in coloration and larger in size. The latter difference is reflected in the various measurements as given by Ridgway (1904, p. 323) and also in the following weights secured during the present work, though unfortunately the sex of a majority of the birds weighed was unknown, male: 76.4, 80.2; female: 70.4; sex unknown: 83.7, 79.0, 72.7, 70.4

grams. These sexual differences are usually but not invariably sufficient to permit the male and female of a pair to be distinguished when seen together.

HABITAT AND GENERAL BEHAVIOR

The Florida jay requires open ground for most of its feeding and thickets of brush and small trees in which to perch, nest, preen, escape enemies, and do some feeding. As a result it is concentrated along the edge between brushy and open areas. At present it occurs mostly (at least in the vicinity of Lake Placid) along the edges of man-made clearings such as roads, fire lanes, and lawns. The scrub jay, as it is locally called, is limited to the type of vegetation known as Florida scrub. On the Archbold Station this jay is common, especially along the roads and about the dwellings.

The general appearance and dominant plant species of the Florida scrub are given by R. M. Harper (1927, pp. 79–81). Because of the variegated topography of Highlands County, much of the scrub in the vicinity of the Archbold Station is not typical but contains a great amount of dwarf wax myrtle (*Myrica pumila*) and scattered trees of the slash pine (*Pinus caribaea*) together with the usual undergrowth of saw palmetto (*Serenoa serrulata*). In some places more typical scrub containing much spruce pine (*Pinus clausa*) and scrub oaks (*Quercus* sp.) occurs, but the jays, at least during the period of observation, preferred areas dominated by myrtle.

The Florida jay has the usual inquisitive, meddling, raucous habits of most jays, and is as fearless as the Canada jay (*Cractes* = "*Perisoreus*"). As several authors have noted, the Florida jay, if given the slightest encouragement, will perch on the head or shoulders of a human and take food from the fingers. It enters traps fearlessly and repeatedly. An interesting geographical variation in disposition exists in the races of *coerulescens* which can hardly be other than genetic. The Californian races are said to be quite tame when not persecuted, but the race *woodhousei* of the Great Basin is more furtive. Most writers on Arizona birds from the time of Merriam to the present have referred to it as shy and suspicious (see, for example, Swarth, 1904, p. 29).

Although the Florida jay spends much time on the ground, it never walks but hops with its sturdy legs rather widely spaced. I saw one hop rather than fly across a 75-foot paved court, giving a flip of its wings with each hop. When observing a person, they often go to the ground and look up. They also hop a great deal in the branches of bushes and trees, and, more often than not, reach their favorite lookout posts in the tops of bushes by hopping up through the branches. The flight of the Florida jay could hardly be described as weak, although they were observed among the higher branches of the tall pines scattered around the station grounds much less frequently than the blue jay. Yet occasionally the Florida jay takes flights of several hundred yards. One male sometimes flew from his nest to a perch about 40 feet high in a pine 30 feet from the nest. This resulted in an almost vertical flight, and sometimes he would fly against the trunk of the tree about halfway up and give a thrust with his legs which aided the remainder of the flight. *Cyanocitta coerulescens* has a relatively short wing as compared with *C. cristata*, or *sordida* (includes *sieberi*); this is doubtless correlated with its weaker flight.

FEEDING HABITS

Like other corvids, the Florida jay holds large pieces of food in its feet while breaking them with its bill. It also buries or otherwise conceals surplus food. When I put an abandoned jay nest containing one addled egg in the cage with a pair of captive jays, the male went to the nest immediately, seized the egg, carried it to the corner of the cage, and pushed it beneath the sand. Then with quick nervous movements he placed seven dead myrtle leaves over it. When the leaves were removed, a small portion of the egg shell could be seen above the sand; the egg was unbroken. In this case the food was evidently buried to keep another jay from getting it. This seems to support Rand's (1937, p. 41) suggestion that this instinct is an expression of "greed" and not of foresight. When burying a piece of bread or an egg a jay holds the object in its bill and seeks to push it beneath the sand without digging a hole or looking for an existing one. This is an awkward and inefficient process and usually part of the food remains visible. This is customarily concealed by covering with any convenient small objects. A different method of burying was once seen. A jay drove a kernel of corn beneath the sand with blows of its bill similar to those used in breaking food and then placed a leaf over the spot. Perhaps this method is used in burying acorns and other hard objects. More probably the jay intended to break the kernel and eat it, and the burying reaction followed when the kernel disappeared in the sand.

Jays were frequently observed searching for buried food (acorns) in fire lanes or other sandy areas. The head is swung from side to side with the bill pointed in the direction of movement. Spurts of sand are thrown first to one side and then to the other. This method of digging suffices in the sandy habitat of this species but would be "neck-breaking" in firm soil. Dr. A. L. Rand suggested to me that the jays may dig wherever there is a leaf which might mark a cache. The one bird which I briefly observed after this possibility was realized did seem to favor such places, but this was inconclusive. (See Strauss, 1939a, and Rand, 1937, for experimental studies of food burying by Corvidae.) Jays were observed digging in a lane which had just been harrowed, thus obliterating all small marks. The jays were frequently seen to eat acorns; presumably these had been buried the preceding fall.

Florida jays require a solid object upon which to hold acorns while breaking them with the bill. Pieces of wood projecting a foot or less above the soil in an open place are preferred. I found the opened shells of over 125 of the small acorns of the scrub oak beside one such "anvil," in this case a projecting root. They often carry an acorn as much as 50 feet to a favorite perch. As frequently, the food is taken to any convenient branch in a nearby bush. Rather large objects may be swallowed without subdividing. I offered a large disabled horsefly, *Tabanus imitans*, at least an inch long to a captive male jay, which swallowed it entire.

Blows of the bill similar to those used in pulverizing food are used as a substitute activity (Rand, 1943, p. 170), chiefly when an intruder is at the nest. I held a shrike egg in my hand near a male captive jay. He was eager to have the egg, but did not dare come closer than 3 or 4 feet. In frustration, he yanked the leaves from a twig near his feet and dropped them one by one, then bit off the twig bit by bit and finally struck savagely at the branch upon which he was perched. Grimes (1940, pp. 435, 436) speaks of a male Florida jay almost pounding its nest to pieces when an intruder was near. His photograph illustrating this shows the bird with bill widely opened, but of course it is normally closed when striking an object. Similar behavior is known in the blue jay, magpie (*Pica*), and other corvids.

Such behavior as that just described is much more pronounced in the male, which in the Florida jay is more aggressive than the female. The male of my captive pair would dash after any morsel of food tossed into the pen, intimidating his female cagemate by screaming and aggressiveness. Once I tossed a desiccated spadefoot toad to the male to distract him and then gave

an addled shrike egg to the female. She took the egg in her bill but then put it on the sand again as though uncertain what to do with it. The male dashed in screaming, seized the egg and ate it.

In the spring the Florida jays feed mostly upon animal matter; acorns were the only exception noted. Jays hop along looking for insects or other small animals and when necessary make spirited chases after them. Richardson's (1938) description of a California jay chasing house flies on a lawn applies well to the actions of the Florida subspecies when catching insects: "A jay would hop around with head held high until a suitable fly was seen. Then ensued a short dash, usually of two feet or less but sometimes as long as four, with the head held low and extended forward. This dash, which consisted of a series of quick hops, usually ended with a final long hop, the abrupt raising of the tail, and the coincident successful capture of the fly. As nearly as could be seen the flies usually were deftly snatched before they flew, but occasionally they were caught in the air." In the Florida jay such pursuits are often continued for 10 feet or more and the bird makes extremely abrupt turns, aided by the wings. Sometimes they pursue an insect into the air for 3 or 4 feet, often almost turning a loop while doing so. California jays have been observed to pursue and catch large scarab beetles (*Pleocoma behrensi*) in the air (von Bloeker, 1935), but purely aerial sallies for food were not noted in the Florida jay. The latter sometimes drops down from a favorite perch on a telephone pole or bush to seize an insect but does not habitually feed in this shrike-like manner. Once a jay fluttered to a post ahead of me with its bill full of grass, which it then held under its foot while extracting a moth therefrom.

Jays were observed pulling energetically on large insects or other small animals crushed in the road by cars. Usually they will allow even the noisiest truck to pass at a distance of 6 or 8 feet. As a rule they are too self-possessed to blunder in front of cars but we have a museum specimen killed in that manner. A jay which found a hairy caterpillar about $1^1/_2$ inches long took it to a bare sandy place and rubbed it vigorously back and forth in the sand for several seconds. He then fed it to his mate, who swallowed it after some hesitation. Another jay was seen to kill a small snake 3 or 4 inches long; the snake was tossed this way and that, then carried 30 feet, and the process repeated. Finally it was taken into some bushes, where presumably the coup de grâce was administered. Two or three minutes later this jay appeared in a pine tree in the top of which his mate was perched and hopped up through the branches. The female begged and reached down as he offered her the snake. One end of the snake must have been lodged in the male's throat, as the female was pulled bodily from her perch and after considerable fluttering settled on a twig beside the male below. During my absence two jays were observed by a group of workmen to attack a foot-long "blacksnake" crossing a pavement. The snake coiled and struck, but the other jay pecked at him from behind; more jays were attracted by the excitement, and the snake was overwhelmed and killed. A California jay has even been seen to seize a kitten of the domestic cat and carry it some distance, though not, it was thought, with the intention of eating it (Mailliard, 1904).

During the last days of April the myrtle (*Myrica* [*Carothamnus*] *cerifera*) and other bushes were in blossom, and many insects were attracted. The jays at this time did much of their feeding in the bushes, hopping slowly about among the terminal twigs. Once I noticed one swinging below a twig like a chickadee, while picking insects from the leaves. Although the Florida jay spends much of its time in the dense scrub, its ground feeding is done for the most part in open areas rather than beneath the bushes, probably the better to enable it to avoid predators.

Surface water is rather scarce in the sandy, bushy country frequented by the Florida jay, and possibly this species can do without it during the summer when insect food is plentiful. On the Archbold Station the jays have learned to drink from leaking faucets in the extensive sprinkling

system. The faucets are about a foot from the ground; sometimes the jays jump into the air to snatch drops of water forming from the faucet. One jay stood with bill directed upwards and caught drops of water as they fell. One hot afternoon I saw seven jays disporting on a lawn in the mist from a sprinkler.

CALLS AND SONG

The usual call of the Florida jay is a harsh, grating *kă* repeated several times. This apparently corresponds to the familiar scream of the blue jay. It is given in a variety of situations: (1) when scolding; (2) perhaps to draw attention to itself (by birds that came to the vicinity of dwellings to be fed); or (3) merely to express excitement. When the jay is greatly excited, this note becomes more of a screech: *kē* or *kwē*. Birds in a trap sometimes gave this note as I approached, and sometimes it is directed at an intruder at the nest, rather than the more usual *kă*. Jays frequently screech (*kē*) every time they dash after a morsel of food thrown to them. At times notes similar to those described above but with an *r* sound are given; such calls are less harsh: *krȧ* or *krēr*. Such notes seem to be directed towards other members of the species rather than towards external objects, and are commonly uttered more rapidly. In the noisy squabbles which occur so frequently, a rapidly repeated *krē* or *krȧ* is the commonest note. This is evidently the note that other writers have called a *churr*. Sometimes between series of such notes a chirp is given, which reminded me a little of that of the robin (*Turdus migratorius*). A female jay which I removed from a pen at night after blinding her with a light, gave a loud "squalling" as she was carried, somewhat like the usual alarm notes, but with an element of terror added.

The Florida jay expresses alarm or excitement by bobbing its head and flitting its tail, as well as by alarm notes. Sometimes notes like those described above are given in a very subdued manner. When feeding or at the nest together, a pair of jays often converse in low notes which sound like *kä* or *kwä* or *kwe* and are audible for only 50 feet or so. Sometimes a jay which is curious or puzzled, e.g., by coming upon a quietly seated human, will give such low notes, followed perhaps by louder scolding notes. What appeared to be nonbreeding birds will often give a querulous soft *kwē* when separated from their companions; under such circumstances they usually beg from any (male?) jay which happens to come near them. The calls thus far described are essentially variations of a single type of note.

A female which I lifted from her eggs, in order to mark her, gave a low note which I recorded as a *cluck* when released on the ground beneath her nest. The begging calls of young in the nest are of the chipping type common in many passerines. During courtship feeding the adult female gives begging notes that are similar to those of the young. The adult male was never heard to give such notes.

Like many other corvids, the Florida jay has a warbling song which seems always to be given in a whispered or subdued manner. Wetmore (*in* Howell, 1932, p. 339) described this song as, "a mixture of sweet low-toned calls, high in pitch, mingled with others that were variously slurred or trilled in utterance." To me this whisper song somewhat suggested the usual song of a catbird (*Dumetella*), but it is much softer. Leach (1927, p. 234) described the song of the California jay as "... some of the sweetest and softest warblings of bird music. It was never given in vibrant tones, but in low soft notes, scarcely audible beyond a hundred feet or less, as if the birds were indulging in private rehearsal." The whisper song has also been compared with that of a canary and a thrasher.

One afternoon a very tame jay appeared and perched on my arm and then on my head. Soon it hopped to a sunny perch in a nearby bush, fluffed its feathers, opened its bill as though yawning (Strauss, 1939a, p. 160, found that jackdaws, *Corvus monedula*, yawn), and then gave a whisper song. The European jay (*Garrulus*) is said to give its

whisper song under such circumstances (Voigt, 1920, p. 149). On two other occasions, as I was quietly observing, a lone jay appeared and gave subdued alarm notes followed by a whisper song. Both the male and female of a caged pair sang from the back of a thick bush as I worked in the large cage. They were undoubtedly mildly alarmed by my presence. After bringing them to New York the male was once heard to sing briefly following alarm incidental to removing the other bird from her cage. The whisper song thus seems at times to express mild alarm or perplexity. At other times, as when given by a bird sunning itself, it might express physical well being. In any event the whisper song seems to have no relation to reproductive behavior. Some of the birds giving it were, I thought, first-year.

The most unusual sound produced by the Florida jay I called in the field the *klok* note, but following Sutton and Gilbert's (1942) description of what may be a corresponding performance in the Mexican brown jay, *Psilorhinus morio*, I am calling it the "hiccup." The hiccup of the Florida jay has a hollow mechanical sound, like rattling two sticks together, or like tapping on a heavy block of wood with a mallet. Once I momentarily mistook the tapping of a red-bellied woodpecker (*Centurus carolinus*) on the bottom of its nest cavity in a telephone pole for the hiccup of the jay. When heard at close range the hiccup has a double effect similar to that produced by snapping in and out the bottom of an oil can. The hiccup of the Florida jay is customarily given in an agitated manner. The bird directs its head and bill upwards, and a series of hiccups is then given as the head is thrust upwards in spasmodic, piston-like thrusts. The bill is opened each time the sound is emitted. The tail is slightly spread and, if the bird is perched on the ground, it is pressed against the ground as a result of the upward thrust of the head and neck. Usually about six to twelve hiccups are given in a series, sometimes so rapidly as to sound almost like a roll. I once saw a bird hiccup without thrusting the bill upwards, and the notes were then given at irregular intervals. This was unusual, although the degree of physical agitation accompanying this curious act varies.

In the brown jay, as described by Sutton and Gilbert, the hiccuping is produced by the inflation or deflation of a furcular pouch, which is a diverticulum of the clavicular air sac. In the Florida jay such a sac is evidently not present, as it has never been described and I have been unable to see any indications of one externally. Nevertheless, in view of my strong conviction in the field that the hiccuping of the Florida jay must somehow be produced mechanically rather than vocally, it seems likely that this sound is produced in a homologous manner in the two genera, although accompanied by little, if any, morphological modification in the more primitive Florida jay. Eventual anatomical examination of the birds now in captivity will settle this point. If the hiccuping does prove to be homologous in the two, it will then be quite certain that acquisition of this unusual method of producing sound preceded and presumably aided in the development of the furcular sac as it now exists in *Psilorhinus*.[1]

In the Florida jay the hiccup is given usually, and I believe exclusively, by the female. On all the many occasions when a bird whose sex was known hiccuped it was always a female. When a female was giving this sound, I have seen her mate thrust his bill upwards in excitement, but no audible sound resulted. The male did not thrust his bill upwards in the spasmodic manner of the female. The hiccup note was recorded in the Florida jay under the following circumstances: 1. In any situation involving sexual antagonism to jays other than her mate, the female hiccups. I twice saw the hiccup given in a very agitated manner by a female attacking a stuffed (male) jay. After a period of excitement a female would sometimes hiccup every time her mate flew. 2. In a pair engaged in what was apparently pre-nesting courtship

[1] Since the manuscript was completed, Dr. E. Mayr has kindly dissected a female Florida jay for me and we found no indication of a furcular pouch like that of *Psilorhinus*. I am still inclined to think that the hiccuping of the Florida jay is non-vocal, although it is uncertain how it is produced.

the female hiccuped after the male had been away for several minutes and he returned and fed her. 3. From a female in an outside cage when another jay flew near the cage. 4. Once from a bird that came to the porch to be fed. 5. Once in a subdued manner from a lone bird that seemed to be curious about me.

To summarize, in the nesting season, the hiccup of the female Florida jay is normally given as a threat to other Florida jays. When her mate is present it perhaps has the function of "backing him up" in a squabble; when he is absent it may serve to call him. It was heard on only two or three occasions (of 100 at least) when it seemed to be directed at objects other than members of the species, but even then the bird may have been calling her mate. When an intruder other than another Florida jay (such as a human or an owl) approaches a nest, vocal alarm notes are used, not the hiccup. A longer study extending through the non-breeding season will be required for a complete interpretation of the significance of this sound. In the brown jay the hiccup is said to be "a signal for quiet, for stealthy approach, for close attention to some not quite solved problem" (Sutton and Gilbert, 1942, p. 164). This suggests that its function in *Psilorhinus* is not the same as in the Florida jay.

NOTES ON COURTSHIP

The following observations were made on unmarked birds which may already have had nests. As with most corvids, courtship feeding of the female by the male is prominent. Only food which does not require further breaking with the bill seems to be offered in such feeding. Grimes (1940) has published a photograph of a male feeding a female on the nest.

On March 30 at 8:45 A.M. a (female) jay was observed to beg and be fed by a second bird, presumably her mate. This was repeated every three or four minutes. The male usually carried the food to the female as she perched on a fence post. Sometimes he brought food as far as 60 feet, even though the female was not begging. At times the female fed by herself on the ground. On one occasion, just after the female fluttered to the ground, the male began to hop around her in small circles with his head held high and his tail widely spread and dragging on the ground. The female obviously resented this courtship display and warded the male off by rotating her head so as always to direct her half-opened bill at him in a threatening manner. The male made at least ten circles around her.

A passing truck frightened the birds across the road behind a fence. I went over and found four or five jays. Two of them began to fight, but a third dashed in and interrupted them. After a few minutes the pair separated from the other jays and resumed courtship feeding. Later the female flew into some bushes and preened for ten minutes, during which time the male disappeared. Suddenly the female became alert and gave a low *kä* and then hiccuped. Her mate at once appeared from some bushes across the road and fed her. They fed along the road together and at 10:15 drank from a leaking faucet. It was now quite hot and they were less active. I left at 10:30, just after the male had fed his mate for the first time in 15 minutes. They had not moved more than 200 feet from the place where they were first observed, but on the following day could not be found in the vicinity.

On April 2 at 10:00 A.M. I briefly observed a male on a road displaying around a female in the manner described. A third jay seemed to resent the display and flew towards the pair. There was some excitement followed by a chase, and the intruder was driven off. The male then fed the female three or four times at short intervals. Once he carried a large object to a root and began to break it with his bill. The female fluttered down beside him begging loudly and was fed.

Swarth (1904, p. 30) observed a display of the related Arizona jay (*C. sordida arizonae*) before a rattlesnake which was much like the courtship display of the Florida jay: "Some of the boldest lit a

short distance from the snake and strutted before it in a most curious fashion, head and body held bolt upright, and the tail pressed down on the ground until about a third of it was dragging. A bird we had in captivity for some time strutted about in the same comical fashion whenever it was angered and wished to show fight."

Mr. F. A. Pitelka has pointed out to me that this similarity in the anger display and snake display of *C. sordida* to the courtship display of *C. coerulescens* tends to confirm the view he has expressed in recent papers (1942, 1943) that so-called courtship displays of birds are basically intimidation displays.

On April 20 I saw a female jay on a telephone wire beg very loudly and actually flip her wings over her back, rather than merely flutter them. She dropped down beside a male in the nearby fire lane and he fed her several times. Once he hopped about a foot into the air, seized a black beetle from a blossom and took it to the female, who was not begging at the moment. She swallowed it after hesitation. The female crossed the road to drink and then both flew up the road, where there were other jays. After a few minutes, one (evidently the male) began to hop down the fire lane followed by the begging female. The male hopped very rapidly for at least 100 feet, using his wings somewhat as though to avoid the female. The female followed for the entire distance with wings flapping, and begging loudly. They perched in a bush where there was a third jay; the female begged querulously for a time and then preened. (See also notes given above on courtship feeding in discussion of feeding habits.)

Copulation was never observed.

REFERENCE LIST OF NESTS

Nest 1 was 4 feet high in a myrtle. It contained two eggs when found on March 27; this proved to be the complete clutch. On April 11 one egg was missing and the other pipped; it hatched the following day. This indicates an incubation period of at least 17 days. The young was in the nest on April 19, but the next morning the nest was empty.

Nest 2 was 5 feet high in a myrtle. It contained one egg on March 27 but was deserted because of tampering, as explained elsewhere.

Nest 3 was 9 feet high in a myrtle. It contained one egg on March 27; two more were laid. Incubation was in progress on April 6, but on the morning of the eighth the eggs were gone and the parents absent.

Nest 3A was a repeat nest of the preceding pair, at least the marked female was the same bird. The nest was 8 feet high in a myrtle and about 100 feet from nest 3. It is interesting that the two nests of this pair were the only ones of about a dozen examined (including old nests) which were over $5\frac{1}{2}$ feet from the ground. Nest 3A was found April 10; probably it was begun the preceding day; the first egg was laid on April 16; the clutch was four; incubation was still in progress on April 29 when I left. The female of this pair was marked.

Nest 4 was 4 feet high in a dwarf holly. It was found on April 9 when the female was incubating three eggs. These must have been on the point of hatching, but it was mistakenly assumed that they were fresh, as a fruitless search for nests in this vicinity had been made in late March. On April 19 I was surprised to find young in the nest, larger than the young in nest 1 which hatched April 12. Probably the eggs in nest 4 hatched on April 9 or 10. The young were quite well feathered by April 29, but probably did not leave the nest for another week.

Nest 5 was 4 feet high in jessamine vines on a fence. It was found on April 21 when it contained three young about the size of that in nest 1 and one addled egg which was on the backs of the young. It was not visited after April 22. This nest and one old nest in rose vines were the only jay nests seen in the miles of vine-covered fences on the station.

Nest 6 was $4\frac{1}{2}$ feet high in a myrtle. It was found on April 23, the day it was begun; it was finished on April 27. No

eggs had been laid by the twenty-ninth. The male of this pair was marked.

In the text nest 1 is referred to as N1, the female of this pair as F1 and the male as M1, and the other nests are referred to in corresponding manner.

NEST-BUILDING PERIOD

The building of two nests, N6 and N3A, was observed, the former from the first and the latter from the second day of building, judging from their appearance when found. Data on attentive and inattentive periods and on the number of trips made are given in tables 1 and 2. Nest 6 was essentially completed on the morning of April 27, but no eggs had been laid by the afternoon of the twenty-ninth. It was unknown whether this was a first nesting for the season by this pair. Nest 3A was a

after the particular period of observation, a plus sign is added in the tables. The only two complete (observed from beginning to end) periods of attentiveness (with the exception of a momentary visit to the nest during a long period of inattentiveness on April 12) were of 30 and 31 minutes' duration, respectively, but incomplete periods of as much as 158 minutes were recorded. Inattentive periods usually ranged from about 25 to 60 minutes, but one of 113 and another of over 70 minutes occurred.

April	Period of observation	Attentive (building) and inattentive (not building) periods; latter in parentheses. Time in minutes		Total number visits to nest (♂ or ♀) for each attentive period or part thereof	Male fed female at
23	10:45–11:10 A.M.	25+	—	4+	—
"	1:25– 3:45 P.M.	56+(23)61+	[84%]	15+, 26+	—
24	8:55–11:07 A.M.	20+(35)77+	[73%]	11, 19	10:30
"	1:43– 2:00 P.M.	17+	—	(Disturbed)	—
"	2:30– 3:04 P.M.	34+	—	8	—
25	9:50 A.M.–12:20 P.M.	(40)30(19)61+	[61%]	2±, 6+	10:45; 11:05
"	3:15– 4:03 P.M.	48+	—	13	—
26	8:50–10:30 A.M.	(70+)31+	[31%]	5±	9:14; 10:28
"	3:30– 5:30 P.M.	(113)7+	[6%]	2±	3 times or more
27	9:00–11:00 A.M.	?*	—	6±	1 time
"	2:30– 3:00 P.M.	(30+)	—	—	1 time
"	7:30– 8:10 P.M.	(40+)	—	—	2 times

TABLE 1. Data on building of nest 6 which was begun on April 23 and almost completed by the twenty-sixth, although a little work was done on it on the twenty-seventh. For each period of observation of over 60 minutes, the percentage of time spent in nest building (attentive periods) is given. (See text.)

* Pair near nest throughout this period and made occasional visits to nest, once with material; exact time of these visits not recorded.

re-nesting of the pair whose eggs disappeared from N3 a few days before. The marked female was the same. Since this second nest was started so promptly, it is probable that the male was the same bird also. The two nests were on opposite sides of the road and about 100 feet apart; material for the second nest was not taken from the first.

During inattentive periods the birds usually left the vicinity of the nest. In doubtful instances, only absences from the nest of both birds for 15 minutes or longer have been recorded as inattentive periods. When a period began before or finished

The tabulated data give a general idea of the nest-building activities, but such rhythms are extremely variable and affected by a host of extraneous factors such as individual variation, weather, stage of the nest, activities of nearby jays, time of day, whether nest is first for year, etc. To judge from these two nests, about three-fourths of the time is occupied by nest-building and one-fourth is spent otherwise during the active phase of nest building. Of course the jays do not work constantly even during the attentive periods. At N6, evidently a first nest, at which an interval of undetermined length occurred between

completion of the nest and the laying of the first egg, the nest building tapered off more or less gradually. At the repeat nest 3A the female continued to spend most of her time at the nest even after the latter was almost completed, and nest building gave way to broody behavior gradually.

Material for the nest was secured at any distance up to at least 100 feet. If available, twigs were sometimes taken from the nest bush itself. Twigs were secured either on or off the ground. The jays spent much time in futile pulling on live twigs and tendrils of vines. Sometimes, with one twig in their mouths, they attempted to seize additional ones and finally dropped all of them. (Precisely the same behavior occurs when they are presented with an abundance of large pieces of food, especially if more than one jay is present.) I saw a jay with one foot on the ground and the other braced at right angles against a stem pull so hard that its body was thrust sidewise against the ground.

M6 contributed almost as much to the construction of the nest as the female, making as many trips, getting into the nest to work as did the female, and perhaps bringing even larger twigs as a rule. During the later stages of nest building, however, he rarely stayed at the nest long enough to do much, and if his mate was there at his arrival, he often merely deposited whatever he had brought and left immediately. At N3A, on the other hand, the female did most of the work. During the early stages M3 was quite active, but he usually stood on the rim or to one side of the nest and worked with his bill. His mate customarily hopped into the nest and worked vigorously, shaping it with her breast, wings, and feet, as well as working with the bill. Sometimes she would hop out and inspect the nest and then resume work, occasionally working constantly for as much as ten minutes, though one to four minutes was usual.

The birds do not bring material on every trip to the nest. Especially when they have been away for some time, they frequently go directly to the nest, and the female then often works for an unusually long time. At N6, after an absence, the pair often dashed to the nest bush screaming loudly (male only?) in excitement. During some inattentive periods, at least in the later stages of nest building, the birds may remain near the nest without working on it. Thus, pair 6 was near the nest from 9:00 until 11:00 on April 27, but went to the nest only three times. Only once did I see them carry material; the nest appeared finished at this time. However, this pair spent most of the time away from the nest after finishing it. On the last two days of field work, April 28 and 29, I visited this nest both morning and afternoon without seeing the birds. There was

April	Period of observation	Attentive (building) and inattentive (not building) periods; latter in parentheses. Time in minutes		Total number visits to nest (♂ or ♀) for each attentive period or part thereof	Male fed female at
10	9:15–11:46 A.M.	27+(51)73+	[67%]	3, 21	—
"	1:37– 5:30 P.M.	158+(19)31(25+)	[81%]	35, 8	—
11	9:30–11:20 A.M.	60+(29)21+	[74%]	17, 6	—
"	3:12– 5:24 P.M.	52+(43)37+	[67%]	6, 11	—
12	8:43–10:01 A.M.	42+(24)12+	[70%]	11, 5	—
"	4:40– 5:35 P.M.	(13+)1–(27)15+	[29%]	1, 1	—
13	7:30– 7:45 A.M.	(15+)	—	—	—
"	9:37–11:16 A.M.	44+(26)29+	[74%]	10, 5	10:26, 10:27, 10:47
"	5:00– 5:15 P.M.	15+	—	2	—
14	9:15–10:47 A.M.	(92+)	—	—	—
"	1:10– 1:40 P.M.	30+	—	2*	1:15, 1:28
15	9:06– 9:36 A.M.	30+	—	2*	9:12, 9:36
"	3:20– 3:33 P.M.	13+	—	0*	—

TABLE 2. Data on building of nest 3A, a second nest, which was probably begun on April 9 and essentially completed by the fourteenth, after which the female brooded most of the time. The first egg was laid on April 16. (See table 1 and also text for explanation of figures in brackets.)

* Female on nest throughout period; male brought food to nest at times indicated.

no reason to believe the nest deserted, although no egg had been laid. After marking M6 on April 24, something could be learned about their activities during inattentive periods. These they usually spent from one-fourth to one-half mile from the nest, often along the public road which offered opportunities for feeding and drinking. They usually spent the time away from the nest in feeding, preening, or, occasionally, in squabbles with other jays. The female spent more time in preening or quietly perching than did the male. Often one or two other birds, probably immatures, were feeding near them. At this time the new leaves and blossoms on the myrtle and other bushes harbored many insects, and the jays fed largely in these bushes. In this dense cover it would have been impossible to follow any species less tame and conspicuous. The pair stayed quite close together when away from the nest (within 30 feet of each other usually), and if in dense brush used low notes (*kä*), apparently as location notes. When leaving the nest vicinity or starting to return to it, either male or female might make the first flight.

On April 26 I saw a remarkable conflict of drives at N6. The male, after much tugging, secured a large mouthful of palmetto fibers. Just then F6, who had been perched nearby, flew about 100 feet from the nest. The male, instead of going to the nest, flew to a post near his mate. After a second or two he flew all the way back to a post 8 feet from the nest. He again changed directions and returned near F6 who had moved on and was now about 300 feet from the nest. I thought they would not return to the nest and followed them, but M6 came flying back, still carrying the nest lining, this time followed by F6. He stopped on a post halfway to the nest, and then went on to the nest where the material was finally deposited. They remained near the nest until I left 15 minutes later.

On April 27 they were not at the nest at 7:30 P.M., and again I found them along the public road. During the following half hour they fed in the bushes or perched quietly; the male fed the female once. When it was becoming quite dark, they took a long flight in the opposite direction from the nest. There is little doubt that they roosted at a distance from the nest, for I remained near the nest until dark without seeing them.

On one occasion a bird not his mate was observed to beg when M6 came near it with food. He ignored it and took the food to his mate. Courtship feeding with pair 6 was at long intervals, as a rule, and the female was usually undemonstrative and took the food without begging.

Nest 3A was found at 9:15 A.M. on April 10, when it consisted of a platform of about 25 or 30 twigs. Presumably it was started the preceding day. Although the female was the marked bird of N3, unfortunately this was not realized until the fourteenth. This was because the nest was in a thick bush which hindered observation, and perhaps undue caution was employed to prevent disturbance, for at the time it appeared likely that this would be the only nest found before completion. This nest was virtually completed on April 13. F3, unlike F6, spent an increasing amount of time at the nest as it neared completion. Possibly this was because N3A was a second nest, and N6 was (probably) not. On the fourteenth I found F3 on the nest at 1:10 P.M. She remained there until I left at 1:40, spending most of this time quietly sitting in the nest or on its rim, occasionally poking a bit with her bill, and more rarely laboring diligently for a few moments. At 1:32 she preened in the nest. On the fifteenth she was on the nest from before my arrival at 9:06 to 9:36, sitting quietly and from time to time working a bit. At 9:36 she left the nest but returned and hopped into it when I walked over. She did the same when I returned at 3:20. I lifted her up and felt in the nest; it was empty. She remained on the nest until I left at 3:33. She worked a little at shaping the nest. The following day the nest contained one egg.

With F3 broody behavior may be said to have commenced on the fourteenth, two days before the first egg was laid. Concomitantly the male began to feed her on the nest. All the courtship feedings ob-

served were at the nest except the first two on April 13. In pair 6, on the other hand, none of the courtship feedings were at the nest. This was probably correlated with the fact that F6 had exhibited no broody behavior up to the time observation ceased.

EGG-LAYING PERIOD

The only observations were made at the two nests of pair 3. F3 would always permit herself to be lifted from the nest by hand, even before it contained eggs. If she was not on the nest as I approached, she would invariably fly rapidly to the nest and jump into it as though to protect it. At both of her nests incubation seemed to start with the first egg, and at the second nest, as noted above, she brooded much of the time in the days preceding the laying of the first egg on April 16. On that day the nest was observed from 1:25 to 3:15 P.M. F3 did not leave the nest during this time. I lifted her up and found one egg in the nest. She spent most of this time brooding, but from time to time hopped to the edge of the nest, inspected its interior, and worked a bit with her bill. Her mate fed her on the nest at 1:46, 2:03, 2:17, 2:26, 2:30, 2:44, 2:49, and 3:15. I visited the nest at 5:15 and 7:30 P.M. the same day; F3 was on the nest on both occasions. On April 19 there were four eggs in the nest.

In addition to F3, two other females, F4 and F5, permitted themselves to be handled while on the nest, which in the latter two cases contained young. When this was done they would fluff out their plumage and half open the bill, but without making any serious attempt to strike the intruder. This was in marked contrast to trapped jays which bite viciously. The presence of the nest in some way increases the docility of the brooding female; the same was noticed in a shrike (*Lanius ludovicianus*). M6 was trapped below the nest for marking. He was very quiet and did not bite but held a kernel of corn in his bill which he ate after I released him. Whether this meekness was correlated with the proximity of his nest is doubtful. In nonbreeding jays, which sometimes aid in feeding the young in the nest, the courtship begging and feeding, which presumably precedes and induces this behavior, may serve to mollify the natural predatory nest-robbing inclinations.

INCUBATION PERIOD

Incubation is by the female alone. The male feeds the female at the nest during incubation, although this was noted only once at N1. The female, nevertheless, leaves the nest to eat and drink. Observations on the time spent on and off the nest are tabulated in table 3.[1] The data are further summarized in table 4.

This evidence suggests that periods off the nest during incubation are of short duration. Periods on the nest are also rather short, as a rule, perhaps because it is usually very hot in the sandy scrub inhabited by the Florida jay. Incubating females often are restless. At N1 the female was apt to leave the nest shortly after being fed by the male. So far as I could see, the male did not "call off" the incubating female nor did he perch on a nearby post or bush while the female was away from the nest more frequently than while she was incubating. I never recorded courtship feeding while the incubating female was off the nest, but it probably occurs.

Sometimes the pair does not keep together when the incubating female is away from the nest, and this may be the

[1] Pitelka (1941) has suggested methods of tabulating such data. I differ with him only in believing that when the available data are rather scanty (as in the examples given by Pitelka, and in the present instance) it is better to publish them *in toto*. This is in general agreement with the recent trend towards the more complete recording of quantitative data in biological studies, and is especially important when working with such extremely variable units as attentive and inattentive periods. Here extremes and mean will often not be of great significance. When the data are so extensive that they must be condensed (e.g., Baldwin and Kendeigh's mechanically recorded data on the house wren), it will usually prove desirable to publish other statistics such as the coefficient of variation, standard deviation, etc., in addition to the extremes, mean, and mode as suggested by Pitelka.

rule. On the afternoon of April 5, F1 was not on the nest; M1 was on a nearby telephone pole and came down and scolded as I looked in the nest. F1 was apparently out of hearing, as she did not return until two minutes later.

I watched F3 while she was off the nest for three minutes on the afternoon of March 31. She flew to the fire lane, found an acorn, and ate it. Then she flew across the road and drank from a leaking faucet. She recrossed the road at a point 150 feet from the nest and ate another acorn, then returned to the nest, stopping for a few moments on a post near the halfway mark. The male was not in sight, but after another inattentive period I saw him fly back with the female as far as the base of the nest bush.

If the two incubating females observed by me were representative, about 80 or 90 per cent of the time is spent on the nest during this phase. I kept no extended records of the activities of the male during incubation, but some mention of their behavior has been made in discussing other points. The males divide their time between conspicuous perches near the nest and more or less prolonged absences. During the latter they often go considerable distances from the nest, just as both birds do during inattentive periods in the nest-building phase. At N3 the male's return to the vicinity of the nest often coincided with his feeding of his mate on the nest. At N1 such feeding was observed only once. The male frequently drops down from one of his lookouts near the nest to feed on the ground nearby.

Bird	Date	Attentive periods (incubating). Time in minutes in parentheses	Inattentive periods (not incubating). Time in minutes in parentheses	Female fed on nest by male at	Number days incubation
F3	March 31	Before 3:30–3:40 P.M. (10+)	3:40– 3:44 P.M. (4)	3:39	2 or 3
"	" "	3:44–5:30 P.M. (106)	5:30– 5:40 P.M.(10)	4:06, 5:07	"
"	April 5	Before 9:00–9:25 A.M. (25+)	9:25– 9:27 A.M.(2)	9:23	7 or 8
"	" "	9:27– 9:38 A.M.(11)	9:38– 9:40 A.M.(2)	Not fed	"
"	" "	9:40– 9:52 A.M.(12)	9:52– 9:55 A.M.(3)	" "	"
"	" "	9:55–10:28 A.M.(33)	10:28–10:31 A.M.(3)	10:27	"
"	" "	10:31–10:51 A.M.(20)	10:51–10:53 A.M.(2)	10:51	"
"	" "	10:52–after 11:25 A.M. (32+)	—	Not fed	"
F1	" 6	Before 9:45–10:00 A.M. (15+)	10:00–10:02 A.M.(2)	Not fed	10?
"	" "	10:02–10:57 A.M.(55)	10:57–11:00 A.M.(3)	" "	"
"	" "	11:00–11:01 A.M.(1−)	11:01–11:03 A.M.(2)	" "	"
"	" "	11:03–after 11:15 A.M. (12+)	—	" "	"
"	" 7	Before 9:40–9:44 A.M. (4+)	9:44– 9:52 A.M.(8)	" "	"
"	" 7	9:52–10:05 A.M.(13)	10:05–10:13 A.M.(8)	" "	"
"	" 7	10:13–10:40 A.M.	10:40–10:52 A.M.(12)	" "	"

TABLE 3. Data on incubation (see text and table 4).

Bird	Number days incubation	Attentive periods (incubating)	Inattentive periods (not incubating)
F3	2 or 3	106 minutes (88.3%)	4, 10 minutes (11.7%)
F3	7 or 8	11, 12, 20, 33 (also 25+, 33+) " (91.8%)	2, 2, 2, 3, 3 " (8.2%)
F1	About 10 or 11	1−, 13, 27, 55 (also 4+, 12+, 15+) " (78.4%)	2, 2, 3, 8, 8, 12 " (21.6%)

TABLE 4. Summary of attentive and inattentive periods during incubation.

CARE OF NESTLINGS

Information on feeding of the young and brooding of them was obtained chiefly at N1 and N4 and is summarized in table 5. The data are hardly extensive enough to warrant extended analysis. It is evident that the frequency of feeding the young increases as they become older. Young were fed two or three times an hour in the days immediately following hatching. This had increased to from five to twelve times an hour by the time they were over a week old. The amount of time spent in brooding decreases somewhat as the young become older, but they are shielded from the sun much of the time even when quite large. The single period of observation at N5 indicated that the young in this nest were brooded more and fed less frequently than the others observed. The oldest young studied were estimated to be about fifteen days old; I thought they would leave the nest in about another week. Rand (1937, p. 30) estimated that blue jays leave the nest at about 20 days of age. A total of 26 trips to the nest with food by males and 18 by females was recorded. The excess by the males is apparently to be attributed to the fact that the female does virtually all the brooding. When not brooding, females feed at least as frequently as males.

In the rook (*Corvus frugilegus*) Yeates (1934, p. 59) found that the female broods almost constantly during about the first nine days after the young hatch. The male brings all the food during this period. The female begs for food but eats all that the male gives her and does not pass on any of it to the young. The male feeds both the young and the female during this time.

This is not true of the Florida jay. The brooding female normally begs for food when the male brings it; but she customarily gives this food to the young. Usually the male retains part of the food and both parents join in feeding the young. Sometimes the male gives the female all the food and departs, leaving his mate to feed the young. By the fifteenth when the young in N1 was three days old, the female was definitely seen to bring food to the nest. Possibly for the first day or two the male brought all the food. From the very first the female seemed to give to the young part at least of the food brought by the male, though she may have eaten some of it.

Lack (1940) in his paper on courtship feeding did not mention the extension of this behavior into the post-hatching stage. Yet this occurs in the rook, in the Florida jay, and probably in other corvids. The brooding F4 on April 27, when her young were about 17 days old and quite well feathered, still begged audibly and fluttered her wings when her mate brought food. She was more demonstrative than F6 when the latter was nest building, but this may have been individual variation. Once I saw F4 when brooding take food from M4, hop to the bottom of the bush and then up to the nest as though she were bringing food herself and feeding the young. At this same nest on the afternoon of April 25, F4, who had been brooding, hopped to a twig a foot above the nest. M4 came with food and, since the young were uncovered, he fed them himself, although F4 begged with fluttering wings.

Brooding is regularly by the female. On April 19, M4 came while the female was away and fed the young; he then hopped onto the nest in brooding position, but at once jumped off again as though he had made a mistake, and flew. The young were brooded much of the time even when quite large. The observations were made mostly in the middle of the day when it was very hot and the brooding was presumably to protect the young from the sun. The female is apt to terminate a period of brooding at the time the male brings food to the nest. F4 often left just before her mate, after helping him distribute food which he had brought.

At N1 the female once hopped 3 feet through the nest bush, preparatory to leaving the nest after brooding. Just then M1 came to the nest, and F1 returned to it to help him feed the young. On another occasion F1 returned to the nest, and M1 immediately flew up to the nest from the ground nearby; quite possibly he had delayed taking food to the nest until she returned. On April 18, F1 on three consecu-

April	Nest no.	Age of young	Period of observation	Food brought to nest	Young brooded
12	1	Hatching 11:00 A.M.	1:24– 2:34 P.M.	? 1:41 by ♂ 2:06 by ♂ 2:12 by ♂ (2+)	1:41– 1:45 1:57–after 2:34 (59%)
13	1	1 day	1:35– 2:30 P.M.	1:36 by ♂ 2:30 by ♂ (2+)	Before 1:35–after 2:30 (sprinkling) (100%)
14	1	2 days	8:42– 9:42 A.M.	? 9:20 by ♀ ? 9:37 by ♂ ? 9:42 by ♀ (2–3)	8:48– 9:15 9:20– 9:37 9:42–? (73%)
15	1	3 days	1:40– 2:37 P.M.	2:06 by ♂ 2:25 by ♀ (2+)	Before 1:40–2:23 2:37–? (75%)
16	1	4 days	10:38–11:30 A.M.	10:48 by ♂ (1+)	10:48–11:20 11:30–? (62%)
"	1	4 days	1:30– 2:33 P.M.	? 1:31 by ♀ ? 1:44 by ♀ 2:13 by ♂ (3?)	1:31– 1:37 1:44– 1:58 2:05–after 2:23 (60%)
18	1	6 days	10:05 A.M.–12:02 P.M.	10:27 by ♂ ? 10:35 by ♀ 10:45 by ♂ 10:52 by ♀ 11:06 by ♂ 11:23 by ♂ 11:48 by ♀ 12:02 by ♂ (4+)	Before 10:05–10:17 10:26–10:34 10:52–11:02 11:06–11:24 11:48–after 12:02 (53%)
19	4	About 9 days	1:50– 3:41 P.M.	2:09 by ♂ 2:23 by ♀ 2:26 by ♂ 2:37 by ♀ 2:44 by ♂ 2:52 by ? 3:06 by ? 3:08 by ♀ 3:31 by ♀ 3:32 by ♂ (5.4)	Before 1:50–2:09 2:23– 2:26 2:44 moment by ♂! 3:08– 3:28 3:31–after 3:41 (47%)
22	4	About 12 days	10:40–11:27 A.M.	10:40 by ♂ 10:48 by ♀ 10:57 by ♂ ? 10:58 by ♂ 11:05 by ? 11:11 by ? 11:17 by ? 11:21 by ? 11:27 by ♀ (11.5)	10:48–10:57 11:27–? (19%)
24	4	About 14 days	4:30– 5:15 P.M.	4:31 by ? 4:32 by ? 5:03 by ? 5:04 by ? (5.3)	— (0%)
25	4	About 15 days	2:00– 2:38 P.M.	2:00 by ♀ 2:01 by ♂ 2:15 by ♂ 2:20 by ♂ 2:35 by ? 2:38 by ♀ (9.5)	2:00– 2:20 2:38–? (53%)
26	4	About 16 days	9:00 P.M. (dark)	—	Brooding
22	5	About 10 days	1:35– 3:52 P.M.	1:44 by ♂ 1:49 by ♂ ? 2:30 by ♀ 3:51 by ♀ (1.8)	Before 1:35–2:05 2:30– 3:50 (80%)

TABLE 5. Data on feeding and brooding at three nests. A question mark before a time of feeding means that the bird came to the nest at that time, but it was uncertain whether it brought food. Figures in parentheses are numbers of feedings per hour and percentage of time spent in brooding during each period of observation (see text).

tive occasions during the course of the afternoon left the nest and flew directly across the road to a leaking faucet to drink.

Only a little was learned about nest sanitation. In the days immediately following the hatching of the single young in N1, the parents would spend much time sitting on the nest rim, working in the nest with their bill. At N4, when the young were older, the parents frequently would peer into the nest after feeding the young. The fecal sacs were usually eaten at the nest, it seemed, but sometimes carried off. The parents at N4 would usually fly from the nest to a certain pine limb 75 feet away and wipe the bill vigorously after eating a fecal sac. The female after brooding was also apt to stretch, preen, shake herself, and scratch her head. F4 during the last days of incubation usually left the nest when I was 5 or 6 feet away. During the last days of field work, she would permit herself to be handled when brooding, fluffing up her plumage, and opening the bill. She was not too perturbed to accept pieces of bread from my fingers.

RELATIONS OF THE NESTING PAIR TO OTHER BIRDS

The Florida jay does not nest in colonies or groups, although in places where suitable habitat is restricted, conditions might simulate colonial nesting. All the nests were at least one-third of a mile apart except the repeat nest of pair 3. Some data on the relation of nesting pairs to other jays have been given incidentally in the preceding discussion, but observations bearing directly upon this question are summarized here.

As already noted, in the two instances in which a male was observed to display before a female, rivalry seemed to be incited in nearby (male?) jays. These incidents probably occurred before the pairs in question had begun nesting.

When I discovered N1, the parents scolded and two strange jays dashed up. F1 hiccuped. After flying at one of the intruders (probably the female) of the second pair, M1 hopped above the other strange jay, probably a male, and pecked at him, finally driving him to a bush 30 feet away where he was no longer resented. Similar behavior was often noted, but the aggressive behavior of the male was often so desultory that a strange jay stayed in the nest bush for many minutes.

On April 5 I had scattered a handful of scratch feed in the fire lane in front of N1 (8 or 10 feet away). At 9:57 A.M. the following day F1 was on the nest and M1 in the top of a bush above her. A third jay hopped from bushes by the nest and fed in front of the nest; M1 did nothing. Shortly F1 left the nest and fed with the stranger. Soon M1 came down and joined them. F1 flew across the road, leaving her mate and the third jay by the nest. She returned to the nest in two minutes. M1 left but returned in a minute and pecked at the strange jay, who ignored this threat. At 10:15, M1 returned after another absence and made a determined rush at the stranger but to no avail. There was a fourth jay about 50 feet away in the fire lane, giving a querulous note. M1 happened to fly past it, and she (?) begged but was ignored. The two strangers finally left the immediate vicinity of the nest after about half an hour. Two strange birds, probably these, were often in the vicinity of N1 but obviously took no interest in the nest either before or after hatching of the young. The efforts of M1 to chase them away were usually lackadaisical and often ineffective. He ignored strangers unless they were within 20 feet of the nest, with rare exceptions.

On March 30 I wired a stuffed jay on the fence 25 feet from N1. M1 on the telephone wires above ignored it. I wired the mount 6 feet from the nest. M1 attacked at once viciously and continued to strike the mount even after it was upside down. I returned the mount to the fence; it was again ignored. I removed the head of the mount and wired it 6 feet from the nest; the male attacked, knocked it to the ground, went down after it, and carried the head to bushes 15 feet away, where I rescued it. I put the mount, minus head and neck, 6 feet from the nest. The female returned to the nest, started to settle,

then eyed the mount and went over and knocked off one wing and some feathers from its back. I chased her away. M1 ignored the headless mount, though I am sure he saw it. He sallied after a jay in a tree 100 feet away and then drove another strange jay from a telephone pole near the nest, and a spirited chase followed. The next day I wired a stuffed male red-winged blackbird (*Agelaius phoeniceus*) 6 feet from the nest; it was ignored by both birds, as was a pale blue shirt tied later in the same place.

On March 30 I wired a poorly stuffed jay on a limb 10 or 12 feet from N3. M3 approached, eyed it closely from 2 feet away, but did not touch it. I put the mount 3 feet from the nest. M3 pecked it on the head three times, not very viciously, then flew off. On March 31 I put the stuffed blackbird in the fire lane below this nest. M3 went down and inspected it from close range, but quickly lost interest. On the afternoon of this day, as I was making notes on incubation, M3 appeared 50 feet from the nest chasing a brown thrasher (*Toxostoma rufum*), but the thrasher later flew past the nest without further molestation.

On the afternoon of April 1, I set a poor mount of a gray phase screech owl (*Otus asio*) in the fire lane below N3. F3 stood up in the nest and eyed the owl, then flew to the ground near it, and began to screech. Her mate and a third jay flew up. F3 *immediately went back on the nest.* A fourth jay came up. The strangers scolded from the nearby bushes. M3 went behind the owl, crouched, and paused as though to "get up nerve," and then with a flip of his wings hopped over the owl and struck it on the head. The third time he knocked over the owl. I went to rescue it and backed away with the owl behind me. M3 was very excited and allowed a close approach. He flew into the bushes and began to chase the two strange jays away. Forgetting this, he and one of the strange jays flew down to the spot where the owl had been, and M3 several times picked up and dropped feathers which had been knocked from the owl. M3 then flew off and left one stranger in the nest bush and the other in the fire lane nearby. I wondered if I had confused M3 with one of the strange jays, but, no, in three minutes he came back and fed his mate on the nest. He then hopped up through the nest bush and evicted the strange jay perched on top of it, pursued it to a bush 25 feet away, and chased it from there; the other stranger had by now disappeared also.

On April 1, as I was returning along the road carrying a mounted jay, I saw a male feed a female on the limb of a pine, the latter begging loudly. They then flew across the road and the female screamed and hiccuped, obviously much agitated. I supposed she was disturbed by me, but it was the stuffed jay, as I found when I inadvertently set it on the lawn and crossed the road to observe the pair. The female was very antagonistic to the mount (a male) and hopped around it in a curious sidling fashion so as to present her back when in front of it. She hopped up from behind the mount and nipped it on the legs several times, continuing to hiccup. She flew across the road and screamed at me, then returned and pounced on the mount from above. Her mate seemed unconcerned, though he once hopped within 2 or 3 feet of the mount. I rescued the mount and observed the birds, but soon lost sight of the female. Presumably she returned to incubate on N4 which was about 60 feet away (nest not found until later). I later learned that the pine where I first saw this pair was the favorite resting and preening perch of both M4 and F4. As noted below, when the same mount was later placed near N4, it was again ignored by the male and attacked by the female. It is curious that the female of this pair seemed unusually aggressive and the male unusually docile.

On April 22 the young in N4 were about twelve days old. I placed a mount of a male Florida jay in the fire lane 15 feet from the nest. F4 soon came and fed in the fire lane, ignoring the mount; soon she fed the young and then brooded. A few minutes later the male brought food to the nest; both parents helped in feeding the young and then flew to the fire lane. To my surprise the female, who had ignored

the mount five minutes before, now launched a savage attack on it; she hiccuped in a very agitated manner, once while perched on the back of the mount. The male seemed unconcerned, continued to gather food, and went to the nest to feed the young as I removed the mount. However, the presence of the male may have been necessary to release the female's attack.

At times jays which come near the nest are ignored by the owners. Sometimes the explanation may be that the intruders are non-breeding (? first-year) birds which do not constitute sexual rivals. On April 24, while I was seated about 20 feet from N4, a jay dashed up and alighted 2 or 3 feet from me and in a few seconds was feeding from my hand. M4 came to a bush above my head, and I thought that the tame jay must be his mate despite the sudden change in behavior. However, just at that time F4 was seen feeding the young. The following afternoon the same tame bird appeared. I tossed some corn in the fire lane, and both M4 and F4 as well as the strange jay fed peaceably within 2 or 3 feet of each other. This was almost the identical spot where F4 had attacked a mounted jay a few days before. *The strange jay begged every time M4 hopped near it,* but he did not feed it. I marked it to determine if it ever went to the nest to help in feeding the young, but this did not occur. I was already certain that only the parents were caring for these young. On two or three other occasions a strange jay was seen to beg from a mated male which happened to pass it, and some birds perhaps beg from every male (and female?) which happens to approach them.

Grimes (1940, pp. 433–434) found three Florida jays feeding the young in a single nest; he thought two of the three were males. Dr. A. L. Rand wrote me that he also had the impression that more than two birds were caring for the young in some nests of this species which he found. Skutch (1935, pp. 261–265) found as many as seven brown jays (*Psilorhinus mexicanus*) feeding the young in a single nest. Five of the seven were first-year, supposedly non-breeding birds, as shown by particolored bills. Swarth (1904, p. 31) found first-year "*Aphelocoma*" *sordida arizonae* to have light areas in the bill. Dickey and Van Rossem (1938, p. 409) mention the same in "*A.*" *unicolor griscomi* and also state that first-year birds are duller in color. Although no variation in bill color was noticed in the Florida jay, some birds did look rather dull and brownish, especially on the wing coverts.

From the above evidence it would be natural to assume that the Florida jay does not nest until it is two years old and that the individuals which engage in indiscriminate begging and in feeding of young not their own are first-year, non-breeding individuals. Although some large members of the family such as the raven (*Corvus corax*) do not breed until two years old, the smaller jackdaw (*Corvus monedula*) and European jay (*Garrulus*) do so when one year old (Niethammer, 1937, pp. 3, 18, 30). The smaller American jays may be expected to nest when one year old, and F. A. Pitelka informs me that it is known that the California jay may do so. Possibly some Florida jays do not nest when a year old, but show indications of breeding behavior by courtship feeding and sometimes by feeding young. Strauss (1939b, p. 165) found that jackdaws too young to nest form pairs which engage in courtship feeding. It is also known that year-old jackdaws nest later in the season than adults (Niethammer, 1937, p. 18). Possibly Florida jays observed begging from mated adults would themselves nest later in the season. If such were the case, egg dates for the species should indicate a protracted nesting season, but this does not seem to be true. Available records of nests containing eggs are distributed as follows: 4 in late March; 25 in April; 7 in May, and 2 in early June.

Since Florida jays defend their nest and its immediate vicinity from other jays, this area is a territory. Whether it is homologous with the usual breeding territories of song birds depends, perhaps, on whether intruding jays are repelled because they are potential sexual rivals or because they represent possible nest predators. In the latter case, the jay's motive in scolding or

chasing a human, an owl, or another jay in the vicinity of the nest would be the same. The fact that the female often uses the hiccup note when threatening other jays and rarely uses it in scolding other animals suggests that the jays are considered to be sexual rivals. This probability is further supported by the fact that breeding jays do not seem to resent the presence near the nest of some jays, presumably non-breeders, and have even been known to permit the latter to aid in feeding the young.

A puzzling feature of the behavior of the Florida jay is the presence of groups of jays engaged in excited screeching and chasing. Such flocks usually contain from four to twelve birds. The commonest notes then given are *krē* or *krà*, rapidly repeated. The females often hiccup in a very agitated manner. Frequently one jay in the group will be observed to pursue another persistently through the branches of the thick scrub, and sometimes longer pursuits in the open follow. Often such flocks remain at a high pitch of excitement for long periods of time, with occasional interludes of relative quiet. At first it seemed that this type of behavior might be associated with pairing activities, but as it continued throughout the period of field work this is impossible, unless the nesting season is much more protracted than seems to be the case.

N6 was found when I was attracted to such a flock of screaming jays. Two of them were carrying sticks; this proved to be pair 6. They soon revealed the nest, which was then scarcely started and contained only four or five sticks. Throughout the period of nest building a flock of excited jays was present near this nest much of the time. Pair 6 seemed to have only a secondary interest in this excitement, and the latter was certainly not initiated by any activity—territorial or otherwise—on their part. When the other jays made a particularly excited outburst of calling and dashing about, the pair would be infected by the excitement to some extent and would sometimes fly over and join the flock, M6 screaming and his mate hiccuping. Usually they would soon quietly resume nest building. Only when the other jays came within 40 feet or less of the nest, would pair 6 sometimes chase them. I noticed somewhat similar excited flocks among the blue jays which are common in some habitats on the Archbold Station, but this may have been pairing activity.

The social behavior just described cannot be interpreted until marked birds have been studied during the pre-nesting as well as nesting periods. Possibly it represents a conflict of social, gregarious drives and disruptive pairing or sexual drives. During inattentive periods the jays tend to gather in flocks, with unmated and non-breeding birds. The mated pairs react aggressively to other jays, resulting in constant turmoil. Such melees were observed several times a day. Sometimes birds were observed feeding quietly together, but rarely more than four or five at a time.

REACTIONS TO DISTURBANCES IN THE NESTING CYCLE

N3A was started only two or three days after the eggs had been stolen from N3 by an unknown predator. The eggs in N3 had been incubated for eight or nine days. The first egg of the repeat clutch was laid April 16. This clutch contained four eggs, the earlier one three. I added a fifth jay egg to the second clutch and it was accepted.

At N2 I experimented to find if this species is a determinate or indeterminate layer. This nest contained one egg on March 27; the next day there were two; I took one of them. On March 29 there was still one egg in the nest at 9:20 A.M., but evidently another was laid later in the day, as on the thirtieth there were two, one of which I took. No more eggs were laid, and the nest was deserted. The latter seemed to be done reluctantly. On April 1 both birds scolded as I looked in the nest; and even up to the fifth, one or both birds would appear and show mild concern at my daily inspections. On April 7 the nest was obviously deserted; the one egg was still in it. This suggests that the Florida

jay is a determinate layer and that it will not tolerate removal of eggs which keeps the total present at one (although two eggs are not infrequently a complete clutch in this race).

I went to N1 on April 20 at 9:30 A.M. to observe the feeding of the young, but the parents were behaving abnormally, sitting in the top of the nest bush for minutes at a time. The nest lining looked slightly pulled above the level of the nest. I went over and found the one young missing. Both jays scolded; one, apparently the male, went to the nest and spent three or four minutes poking in it with his bill. I went to N5 which contained young of about the same size and put one of them in N1 to replace the missing young. It was 10:30 by the time this was accomplished and the parents were no longer around the nest. I returned at 1:20 P.M. and was about to remove the young jay from the nest, when an adult dashed up to within 5 feet. The jay went to the nest and inspected the young closely. The adult gave a low *kà, kà,* and then flew to a nearby bush. When I left ten minutes later the jay had not visited the nest again. One would think that this must have been one of the parents, but the young jay was not accepted and was found dead the next morning. The dead nestling was placed in the pen containing a pair of captive jays and the male at once ate it.

SUMMARY

The Florida jay (*Cyanocitta c. coerulescens*) was studied from March 27 to April 29 near Lake Placid, Florida. Though a short-winged species it takes many short flights and more rarely longer ones. Most of its time is spent in hopping in open areas or among the twigs of bushes in search of food or in perching. Unlike most bush-inhabiting species it is bold and becomes very tame. It buries food usually by thrusting it beneath the sand without digging a hole, but was once observed to drive a hard piece of food beneath the sand with blows of its bill. Leaves or other small objects are placed over the spot where food is buried. In searching for buried food the jay swings its head from side to side throwing the sand to either side with the bill. Hard objects are held in the feet and broken with the bill; often certain projecting roots or similar objects are habitually used for this purpose. Frustration or rage is expressed by striking on the perch with the bill and by screeching. The male is much more aggressive. Acorns presumably buried the preceding autumn were being consumed in numbers, but the bulk of the food was animal matter. Insects are captured both in bushes and on the ground, sometimes after spirited pursuits. A variety of calls, chiefly harsh, are given and also a peculiar, evidently mechanically produced "hiccuping." The latter is given usually, if not exclusively, by the female and serves as a threat to other jays and probably in other ways. A whisper song is given by both sexes and seems to express either physical well being or mild perplexity.

Males in a courtship display were twice observed to hop, with head elevated and tail spread and dragging, around females. Both of these pairs practiced courtship feeding and presumably were in a pre-nest-building or at least pre-incubation period of the reproductive cycle. Courtship feeding is continued through incubation and to some extent after the young hatch. Both sexes participate in nest building, but there is a tendency for males to do less than females. One nest was completed in six days and another in four days, although a little was added to it on the fifth day. The former was a second nest, and the first egg was laid on the eighth day after it was begun. Nest-building attentive periods varied from 30 to over 158 minutes each and inattentive periods from 25 to 113 minutes. Inattentive periods were usually spent about one-third mile from the nest; the time was spent in feeding, resting, and preening, or squabbling with other jays; courtship feeding occurred at infrequent intervals. Nest-building periods comprised about three-fourths of the total (daylight) time.

Only the female incubates. At a repeat

nest the female spent most of the two-day period between the finishing of the nest and the laying of the first egg in perching or brooding on the nest. Incubation, or at least light brooding, starts with the first egg. The observed females spent about 80 or 90 per cent of their time incubating; attentive periods usually vary from 10 to 60 minutes but one of 106 was recorded; inattentive periods are usually of less than 5 minutes. One male usually fed his mate at the nest once or twice during each attentive period, but at another nest only one feeding was recorded. The male spends much time on a conspicuous perch near the nest, but is often absent from the nest vicinity; his behavior except when feeding his mate on the nest does not seem to be correlated with his mate's incubating rhythm to any great extent.

Both sexes share in feeding the young, but the female alone broods. Young are fed two or three times an hour during the first week, and this gradually is increased to five to twelve by the second week. Up to the termination of observation when the oldest young were about fifteen days old, they were brooded more than half of the time, partly, it seemed, to protect them from the sun. At one nest the female fluttered her wings and begged when the male brought food. She usually received part of it, and both shared in feeding the young. After feeding, the parents wait for the appearance of fecal sacs; these are eaten or carried away.

During all phases of the nesting cycle jays sometimes attack other jays which approach the vicinity of their nest. Stuffed jays and also a screech owl were attacked, but a stuffed blackbird was ignored. However, some jays are ignored near the nest; such birds were apparently non-breeding birds. The latter were sometimes observed to beg from mated males but were never fed. Others have observed such birds to aid in feeding the young in a nest, but this is probably unusual. Noisy groups of jays exhibiting much squabbling and antagonism were observed daily, but their significance is obscure.

A second nest was begun two or three days after the disappearance of the eggs (incubation about eight or nine days) from a first nest. One pair deserted after a normal clutch of three had been laid, when an egg was removed from the nest each day to keep the total at one.

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