

# REPRODUCTIVE BEHAVIOR OF THE RED-BREASTED NUTHATCH I. COURTSHIP

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DISPLAYS associated with the courtship of Red-breasted Nuthatches (*Sitta canadensis*) bear resemblances to those of the larger White-breasted Nuthatch (*S. carolinensis*), but the two species carry on their courtship in different surroundings. While *S. carolinensis* courts in trees bare of foliage in winter and early spring (Kilham 1968, 1972a), *S. canadensis* usually does so among branches and tops of coniferous trees where the birds are hard to follow. Hence observations on hand-raised nuthatches that bred successfully in an aviary were of particular value to present studies.

I made field studies of 17 pairs of Red-breasted Nuthatches in Tamworth and in Lyme, New Hampshire, between 1958 and 1972. While previous writers (Tyler 1948, de Kiriline 1952, 1954) have described some phases of Red-breasted Nuthatch courtship, I have encountered no detailed descriptions of other phases and no full account of their reproductive behavior in this literature. Löhrl (1960, 1961), who studied *S. canadensis* through one spring and hand-raised a single individual, made interesting behavioral comparisons between this species and the Corsican Nuthatch (*S. whiteheadi*).

## AVIARY NUTHATCHES

The aviary was a walled-in porch measuring  $2.5 \times 3 \times 4$  m. I filled the bottom to a depth of 20 cm with forest soil, together with moss, rotting logs, and ferns, as well as transplanting a few small balsams (*Abies balsamæ*). A number of bird houses, attached to stubs, provided a choice of nest sites. The hand-raised nuthatches lived largely on raw peanuts, sunflower seeds, suet, and raw hamburger in winter, but as spring progressed I added mealworms (*Tenebrio sp.*). With warmer weather I occasionally liberated a handful of insects caught in a light trap at night. The aviary lights were turned on at 05:00 each morning for convenience of observation. Days, therefore were not of natural length although the nestings in late May and June were synchronous with those in the wild.

As will be detailed in a following report on the nesting habits of *S. canadensis*, the aviary birds raised and fledged a brood of young when a year old, then brought a second clutch to the point of hatching in the summer of the same year. In a second year, 1966, they again incubated a set of eggs, but only a few hatched and none survived.

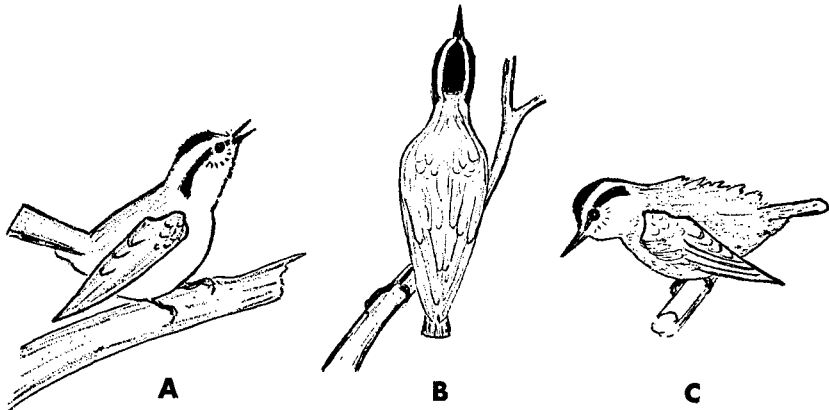


Figure 1. Displays of Red-breasted Nuthatch, observable in breeding season. A, aggressive courtship; B, precopulatory; C, combat threat pose.

#### VOCALIZATIONS

Avian vocalizations sound differently to different observers, and I have referred to renditions of others when possible. For the most part I have used the same terms as in descriptions of White-breasted Nuthatches (Kilham 1972a) to emphasize similarities in courtship occurring between the two species.

*Courtship song*.—This consists of repeated series of plaintive, nasal “waa-aa-ns.” There may be 2 to 6 notes in a series with 12 to 16 series sung per minute. Tyler (1948) has aptly stated that “this note varies greatly in length, sometimes being drawn out into a long whine: it may be repeated in a very rapid series, or delivered in a slow deliberate measure. Often written *yna*, although *kng* suggests the nasal quality better, it corresponds evidently to the sharply pronounced *kank* of the whitebreast.” The “waa-aa-n” notes when sung at high intensity are accompanied by the courtship pose.

*Agonistic song*.—The song expressing anger or annoyance is a rapid, somewhat harsh series of “hn-hn-hn” notes that, at high intensity, can be prolonged like an electric buzzer. This is one of the most readily heard vocalizations of male Red-breasted Nuthatches in the breeding season. The “hn-hn” song is usually accompanied by the aggressive courtship pose (Figure 1A). In actual conflicts, both male and female nuthatches make a hard “grr” or “chirr” note.

*Vibratory song*.—While this is probably derived from the “hn-hn-hn” song, the separate notes come so fast as to be indistinguishable. The result is a vibratory sound that de Kiriline refers to in one place (1964) as a “trilled note” and in another (1952) as a “thiiiiirrrrrr.” I have heard it,

as did de Kiriline, at the peak of the breeding cycle, close to the time of copulation, when the female is either doing the last of the excavating or is bringing in nest material. The song expresses a high pitch of emotion in the male.

It is of interest in summary of the courtship, agonistic, and vibratory songs that Löhrl (1961) has designated them as *Quaklaute*, *Schimpflaute*, and *Stimmfuhlungslaute* in presenting a series of sonograms. He finds that one is derived from the other. The "hn-hn" and vibratory songs represent increasing frequency accompanied by an increased shortening of the basic "waan" note. Löhrl also notes that emotional intensity increases as a male goes from one of these types of song to the next.

*Musical songs.*—These are given so rapidly and with so much variation as to be difficult to describe. It is curious that Tyler (1948) and de Kiriline (1952) speak of having heard them only once, for I have heard them hundreds of times, both when watching at a nest and when Red-breasted Nuthatches came close in the woods. De Kiriline describes the song she heard as "composed of a string of soft, clear, utterly musical notes" and as "an astonishing and never-before heard performance." To one accustomed to the more prosaic vocalizations of *S. carolinensis*, the vocalizations seem most un-nuthatchlike. Distinguishable varieties of these songs are as follows:

(1) Red-breasted Nuthatches of both sexes use low twitterings and medleys of notes in the nonbreeding season as social, keep-in-touch songs, expressive of mild excitement. I have heard these snatches of song in the fall and even once on 20 December in snow-laden pine woods. The musical notes were common among the hand-raised nuthatches when they were 3 to 5 months of age. On 9 December, for example, when I brought in fresh boughs of a balsam, all four nuthatches broke into excited medleys as they explored the first balsam they had ever seen.

(2) The male sings similar songs but at greater intensity from late April on when feeding his mate, either when she is taking a respite from incubating and brooding or when he comes to the nest. The male also sings when feeding the young. Females may sing, as noted by de Kiriline (1952) in her single case, but far less frequently than the male.

(3) Although the musical songs are all low, the loudest come from males at times of high emotional intensity as, for example, at the end of a pursuit flight or in a lull in a conflict with a rival male. Among variants of such songs heard were a quavering, soft "tee-you-you-you," and on another occasion, a "wee-wur-tee-tee-too-too-wee-rr," heard at close range in the aviary.

*Phews.*—These notes may be given singly or as a short series. They are almost identical with the "phee-oo" note of *S. carolinensis* and are

given under the same conditions of emotional intensity, such as pursuit flights. Unlike the White-breasted, the male Red-breasted Nuthatch may string the "phews" into a song. One heard in the aviary was a pleasant, thrushlike "pew, pew, pew—pew—, pew."

#### DISPLAYS

*Courtship.*—A male singing his courtship song at full intensity, as he is apt to do at the very beginning of the day, extends head, neck, and body upward while swaying from side to side with his back to his mate.

*Precopulatory.*—The male stretches upward as in the courtship pose (Figure 1B), but his upward-pointing bill and body are more nearly vertical as he towers above his crouching mate and moves around in a tottering, swaying fashion while trying to keep his back to her. The performance is an exaggerated version of the courtship pose.

*Aggressive courtship.*—When roused in the course of courtship a male Red-breasted Nuthatch lowers his wings, cocks up his tail, holds head high with crest feathers raised, and puffs out the feathers of lower back and rump (Figure 1A). He may sing the "hn-hn" song at the same time, swaying from side to side as he does so.

*Combat threat.*—When about to engage in conflict, a nuthatch lowers its head, points its bill downward, and sometimes fluffs its back feathers (Figure 1C).

*Begging and wing quiver.*—When in a full begging pose a female crouches with bill up; her wings have a fine quiver as she makes a repeated whistlelike "purp." When about to be fed, she may give "we-we-we" notes. A harsher "chirr" or "whirr" may also accompany begging. Males may quiver their wings occasionally, for wing quivers also indicate an emotional response to the approach of a mate and are not necessarily associated with begging.

*Courtship flights.*—Exaggerated types of flight, whether a slow wing beat flutter or a floating glide on outstretched wings, are expressive of high emotional intensity. They are most apt to occur in flights to or from the nest hole at times of excavation and nest building.

*Crest-raising.*—This often accompanies other displays or may occur alone where a nuthatch is excited for any reason.

#### DEVELOPMENT OF COURTSHIP

*Pairs in winter.*—Red-breasted Nuthatches may remain as pairs on their breeding grounds if the cone crop has been good or, alternately, if close to a feeding station. A pair watched through the winter of 1971-72 in a small woodland swamp, for example, nested there in the spring. These nuthatches, as I have found with other pairs, made mixtures of low inti-

mate notes throughout the winter. I heard no clear answering back and forth between the sexes as with *S. carolinensis*. The notes usually sped up when a Red-breasted Nuthatch of either sex flew from one tree to another. They may thus serve to some extent as location notes as well as maintaining the pair bond. I have seen no other signs of courtship in winter. While a male might give a few "wa-aans" in midwinter, these were never prolonged into a full territorial or breeding song until late March.

*Singing of unmated male.*—At 07:25 on 22 March 1970, an unmated male sang at the top of a maple, taller than surrounding trees. His series of plaintive "waa-aa-ns" came at a rate of 12 per minute and with each series his head shot upward. After 15 minutes he began a circuit of tree tops, singing for various lengths of time on each until I lost him at 08:30. This male apparently found a mate sometime in April. In May the two nested more or less in the center of the circuit the male followed on 22 March, suggesting that the "waa-aa-n" song has territorial as well as courtship functions.

I had two hand-raised males. When I deprived one of them of his mate, he sang courtship songs day after day, whereas he had been relatively silent before that time. The mated male in the aviary sang the courtship song most vigorously at dawn when I turned on the lights. At this time he was something of a lone male, for he was the first to leave his roosting place. When his mate appeared from her balsam bough, he sang with back to her in courtship display.

*Courtship feeding.*—The aviary male fed his mate items as varied as suet, hamburger, bits of peanut, and orange, but insects were preferred. He first prepared these, whether moths divested of wings or mealworms, by puncturing them with his bill until they were limp. The female might then take the food without display. At times when she crouched with wings quivering the male maneuvered to face her directly so that the two met with bills in line, touching billtip to billtip. As with *S. carolinensis*, such maneuverings may have value as practice for feeding small nestlings later. When tiny insects are plentiful, a male in the wild may feed his mate as often as three times a minute. When such feeding takes place at the nest hole, it is often so rapid that it is difficult to tell exactly what is happening.

The courtship feeding of *S. canadensis* serves varied functions. Among these are a strengthening of the pair bond and the development by practice of a male's innate urge to feed his mate, and later the young, on the nest. A third function is that the begging pose of the female is similar to her copulatory pose, and hence the male feeding her becomes accustomed to close physical contact well ahead of actual copulation.

Courtship feeding involves the transfer of a considerable amount of food. The female Red-breasted Nuthatch not only builds the nest, but also lays a comparatively large number of eggs and incubates them alone, which greatly reduces the time she needs to feed herself. The added nutrient her mate brings in courtship feeding may thus be necessary to her well-being, as appears to be the case also in *S. carolinensis*.

#### DISPLAYS OF MALE BY UNFINISHED NEST HOLE

Pairs of Red-breasted Nuthatches may try out three or four stubs while searching for a suitable one for nesting, the female making the final choice as well as doing the initial excavating. Her mate meanwhile stays close by. While doing little actual work, he does carry on displays that may serve three functions, namely strengthen the pair bond, synchronize sexual drives, and tie these in with attachment to the nest site. His activities may also incite his mate to make a choice instead of abandoning one stub after another in search for a better one. This tendency of the female affects the display behavior of the male considerably, as shown in the following examples:

(1) Female accepting nest and excavating: A male may be quiet and relatively inactive as long as his mate is present at the nest excavation. If she is absent even for 10 minutes or less he begins to display. Thus at 09:45 on 26 May 1963, when his mate was temporarily absent, Male A perched on limbs 30 cm from the nest hole or clung just above it with wings quivering for minutes at a time. He drove away chickadees (*Parus atricapillus*) and on each of three occasions floated back to the hole on outstretched wings. When Female A finally returned, MA began a courtship song, then popped into the hole just ahead of her. Both were inside the nest momentarily. MA then left, leaving her to continue her excavating. This "pop-into-the-nest-ahead-of-mate" ceremony may be repeated many times daily at this stage, as I have noted at four nests. Löhrl (1961) describes the same phenomenon briefly in *S. whiteheadi*.

(2) Long absence of female: FA did much excavating as well as bringing in nest material on 25 May but remained longer than usual away from the nest in the late afternoon. MA appeared much disturbed by her absence. He hovered at the entrance of the nest hole, entered, quickly came out, preened vigorously in what appeared to be displacement activity, and finally, behaving like a lone male, began singing plaintive "waa-aans" at the rate of 140 per minute, with 10 seconds on and 10 seconds off. Then he suddenly became calm and silent. FA returned to a tree nearby where MA now joined her and the two left, apparently to feed together.

(3) Female not coming to hole for several days: On 29 and 30 April 1968 Female B stayed away from an excavation in a yellow birch stub,

but her mate remained close to the hole. In a curious mixture of displays MB sang "waa-aa-ns" at a rate of 14 to 16 series a minute, while holding an aggressive courtship pose and flicking his wings. If FB, who fed in trees nearby, came at all close, he stopped to quiver his wings. If she came still nearer, he popped into the hole. She appeared to have lost interest in the excavation for she did not actually come to it, in spite of his displays.

(4) Extreme display: The members of Pair C were in an apparent state of harmony early in the morning of 20 June 1970 when FC was bringing nest material to the hole. The stub was a rotten one and FC later began to investigate a second hole communicating, by chance, with the nest hole. She appeared disturbed and finally stopped coming to the stub altogether. Her mate then started a series of exaggerated displays, seemingly in an effort to persuade her to return. For the first 10 minutes he sang "waa-aa-ns" with body nearly vertical. From this performance he switched to a combat threat pose and sang rapid "hn-hn" notes until FC came somewhat nearer, when he entered the hole, but she came no closer. MC then emerged from the hole in a most peculiar type of flight. With body feathers fluffed out and tail widely spread, he flew while still retaining a combat threat pose (Figure 1C), looking from the ground more like a large fluttering bumblebee than a bird. It seemed from this as well as other observations that male Red-breasted Nuthatches can, on occasion, exhibit much versatility in displays, especially when in mixed emotional states.

#### PURSUIT FLIGHTS

Pursuit flights take place primarily at the time of nest building. Such flights may begin simply. Thus Female D was excavating early on the morning of 6 May 1966 when MD poked in at her several times with his bill. She then emerged and he chased her at high speed in, out, and around nearby trees. On 10 May at another nest the female had stopped excavating and was feeding not far away when her mate assumed an aggressive courtship pose, sang "hn-hn" notes, then flew at her. The two then whirled away in a fast chase in which the male, for the 3 to 4 seconds it lasted, kept close behind the female.

I witnessed many pursuit flights in the aviary, usually after turning on the lights in the morning. The male might tower above his mate in a pre-copulatory pose, bumping her with his breast or pecking at her bill to make her fly. At other times he would assume an aggressive pose, then fly at her. The two would fly about the aviary at high speed, often circling close to my head and sometimes making harsh "grrr" notes as they flew.

Such flights represent a high state of sexual emotion in the male and an outlet for excess sexual and aggressive energy. In spite of the aggressive

poses I never saw a male attack his mate. If he chanced to see a fly at the end a pursuit flight, he might catch and feed it to her.

#### COPULATORY BEHAVIOR

Of four copulations witnessed in the aviary, three were by the pair that bred successfully. The most striking occurred at 05:30 on 10 May when the male, in a precopulatory pose, bumped his mate into a fast chase. When the two came to rest, he assumed a combat threat pose and mounted, pecking lightly down at her head as he did so. As with other copulations, this one lasted possibly 2 seconds. On the following morning there were two pursuit flights in succession. The male then copulated at a time when his mate, with all body feathers ruffed out, appeared exhausted.

I observed one copulation in the wild. This was at 14:00 on 11 May 1969 when a male alighted with wings quivering on a nearly horizontal limb about 50 cm from where his mate was excavating a nest hole. After some moments he assumed a precopulatory pose, making "phew, phew" and warble notes the while. His mate then flew to him and lit 10 cm away. He fluttered on her back and the pair copulated.

So far as I can determine, no accounts of copulation in *S. canadensis* have been published previously. Löhl (1960, 1961) states that he did not witness copulations of either *S. whiteheadi* or *S. canadensis*, but does give a quotation from de Kiriline. This latter appears to be erroneous; the female display de Kiriline mentioned occurred in winter and she does not refer to it as being copulatory in nature (pers. comm.). Mrs. (de Kiriline) Lawrence has kindly sent me the following unpublished notes on Red-breasted Nuthatch copulations she made in 1951:

"The first time I described it (21 April) as a very energetic affair. Swift pursuit, the male pursuing the female, ended on spruce branch with a hissing note, apparently uttered by the female. The male gave a longdrawn soft vibrating note 'thiiiiirrrr.' Before and during the approach, during mounting and after, both birds quivered their wings vigorously.

"The second time (30 April) copulation took place twice in quick succession on top of a small cupboard at the feeding station. The female solicited with head, bill stretched forward, body horizontal, wings drooped and quivering, tail lifted. The male gave his vibrating note, mounted, vocalizing and quivering his wings at a very fast rate. Both times coitus occurred so quickly that it seemed almost an impossibility that anything could have taken place in so short an instant."

These observations bring out, as I had also noted, that circumstances attending copulations in *S. canadensis* can vary considerably.

#### RELATION OF COURTSHIP TO AGGRESSIVE BEHAVIOR

The foregoing accounts suggest that at high intensity a male Red-breasted Nuthatch may switch rapidly from courtship to aggressive be-



havior, as if the two states became close and even reinforced each other at peaks of emotion. This apparent relationship was brought out further in an inadvertent experiment. In the spring of 1965 the aviary still contained all the nuthatches, comprising two pairs, hand-raised the year before. Conflicts between the two males became frequent in April, one male becoming dominant over the other. On 3 May I removed both the subordinate male and his mate. The dominant male bred successfully in May and June and by July his mate was incubating a second brood. I had at the time still a third male. Toward the end of June I liberated him in the yard, where he remained tame, keeping close to the house and coming regularly to the aviary screen to feed on suet. Here he was soon acting as a rival, precipitating conflicts with the aviary nuthatches on nearly every visit.

In 1966 the aviary contained the same male as in 1965, with a different female. She laid eggs, of which all but one appeared to have been infertile. In this year no rival males were present, either within the aviary or without, and I wondered whether the pair's failure to breed successfully and the absence of a rival may not have been in some way related. It is of interest in this regard that Lorenz (1963) has described the need of a rival pair for successful breeding of cichlid fishes. In the cases he discussed, the rival pair was needed chiefly as a target for the dominant male's excess aggressiveness, for if the rival pair was removed, the dominant male would attack and kill its own mate. The male Red-breasted Nuthatch, in contrast, never actually attacked his mate under any circumstances. It thus seems that the value of the rival to my aviary male was to key his emotional state to a pitch where it would build the full sexual drive needed for successful breeding.

In summary it seems that although agonistic and courtship behavior are related in many avian species, the relation is particularly notable in the Red-breasted as compared with the White-breasted Nuthatch. Possible explanations of this phenomenon are discussed below.

#### COMPARATIVE BEHAVIOR

Table 1 shows the differences in the reproductive behavior of *S. canadensis* and *S. carolinensis*. The members of pairs of White-breasted Nuthatches are the more stable in remaining on their breeding territories through winter months with active courtship usually beginning in January. Red-breasted Nuthatches, on the other hand, are more variable. When cone or other crops are favorable, pairs may remain near their breeding territories, but usually migrate under less favorable conditions. Active courtship does not begin in either situation until late March, but is then carried on at a high emotional level with a wide variety of displays. Red-

TABLE 1  
DIFFERENCES IN BREEDING BEHAVIOR OF RED- AND WHITE-BREASTED NUTHATCHES  
IN NEW HAMPSHIRE

Points of difference	<i>S. canadensis</i>	<i>S. carolinensis</i>
Winter activities and food supply	Winter pairs irregularly migratory. Food supplies variable year to year	Stable winter food supply. Pairs remain on breeding territories
Onset of breeding season	Late March	November to January
Courtship		
Variability	Rapid changes in displays. Emotional level high	Displays more fixed
Musical songs	A feature of courtship	No equivalent
Agonistic behavior	Marked association with courtship	Mildly associated with courtship
Resting motionless. Leisurely preening	Infrequent	Frequent at times of copulation and egg-laying
Nest hole		
Nature	Cavity excavated in well-rotted stub	Natural cavity with comparatively large opening
Displays	Male flies into hole just ahead of mate and uses a variety of other displays	No equivalent
Protection	Sticky pitch around entrance	Distraction display plus sweeping with insects, etc.

breasted Nuthatches are comparable in these respects to such migratory species as the Yellow-bellied Sapsucker (*Sphyrapicus varius*) (Kilham 1962a) and Yellow-shafted Flicker (*Colaptes auratus*) (Kilham 1959), both having displays that are more animated, colorful, and frequent than those of the resident Hairy (*Dendrocopos villosus*) (Kilham 1966) and Downy (*D. pubescens*) Woodpeckers (Kilham 1962b). A further parallel that might be drawn with these picine species is the close relation of agonistic to courtship behavior. Both flicker and sapsucker, for example, have courtship displays that are surprisingly similar to those prevailing between territorial rivals of the same sex, a situation also noted by Lanyon (1957) for Meadowlarks (*Sturnella*).

The rapid changes from courtship to agonistic behavior exhibited by *S. canadensis* can be confusing to the observer. Why should a male Red-breasted Nuthatch, for example, face his mate in combat threat pose one moment, then, with a musical song, feed her a few seconds later? Here it seems a question of time. With a shorter reproductive season in which to establish a territory, find a nest site, and build sexual drives to the level needed for copulation, a migratory or wandering species may have to operate at a high emotional level. This can be achieved more effectively by mixing courtship and agonistic behavior, apparently, than by courtship activities alone.

Table 2, in contrast to Table 1, brings out the similarities underlying

TABLE 2  
COMPARISONS OF VOCALIZATIONS AND DISPLAYS OF RED- (RBN) AND WHITE-BREASTED (WBN) NUTHATCHES

Points compared	<i>S. canadensis</i>	<i>S. carolinensis</i>	Remarks
Vocalizations			
Intimate notes	"Hit-tu" etc. Wide variety	"Hit-tuck." Less varied. Antiphonal	Heard best in winter
Courtship song	"Waa-aa-n"	"Waan"	Similar in both species
Agonistic song	"Hn-hn-hn"	"Hn-hn-hn"	" " " "
Pursuit song or copulation song	"Phew"	"Phee-oo"	" " " "
Begging notes	"Purp, we-we-we." "Chrr, whirr"	"K-duck." "Chrr, whirr"	No similarity Similar in both species
Displays			
Courtship	Back to mate and swaying, no bowing	Bows forward, otherwise the same	Bowing of WBN displays rufous patch of vent region
Precopulatory	Exaggerated courtship pose	Same	Used more consistently by WBN
Aggressive courtship	Head and tail up, wing drooped, feathers of lower back fluffed out	Same, but rarely used. Spreads tail more widely than RBN	WBN has striking color pattern revealed by spreading tail

the courtship displays of the two *Sitta* species. One might expect a greater divergence considering that they are both congeneric and sympatric, but other factors may operate to prevent hybridization. A White-breasted Nuthatch mated to a Red-breasted might find it difficult, for example, to negotiate the sticky pitch surrounding the nest hole that can be lethal even for *S. canadensis* (Kilham 1972b) while a Red-breasted Nuthatch mated to the larger species might not accept as a nesting place a natural cavity large enough to admit squirrels and requiring a special type of defense against them (Kilham 1968). Different times of onset of the breeding season of the two species may serve to isolate them still further reproductively.

The American nuthatches, *S. canadensis* and *S. carolinensis*, bear some comparisons with European species. Thus, the White-breasted Nuthatch, while having points of similarity with the European nuthatch (*S. europaea*) described by Löhrl (1958) differs in having far larger territories. With less time devoted to conflicts than its European relative, it appears to devote more time to courtship. The Red-breasted Nuthatch, on the other hand, has been compared at length by Löhrl (1960, 1961) with the Corsican Nuthatch. Löhrl, among other observations, noted that his single, captive Red-breasted Nuthatch had a natural dominance. With its brighter, more contrasting colors, Löhrl assumed this a matter of giving

out stronger signals. It is curious in this respect that both American species are more brightly colored and appear to have a livelier courtship than their European counterparts. This, among other things, makes them particularly attractive birds.

#### SUMMARY

The courtship of the Red-breasted Nuthatch was studied in the field and in individuals hand-raised in an aviary. An aviary pair fledged one brood, then brought a second as far as hatching. Courtship among these aviary birds appeared the same as that noted in the wild. Main activities observed were the following:

A courtship song used to attract a mate, an agonistic song given at a faster rate, and a vibratory song that was a trill, the last two songs being basically derived from the first by increasing speed and heights of sexual emotion. Red-breasted Nuthatches sing a variety of musical medleys that, at times of emotional intensity, become moderately loud songs.

A male singing his courtship song extends head and body upward. The precopulatory pose of the male is an exaggerated form of the same display. Males frequently assume an aggressive courtship pose in relation to their mates, accompanied by the agonistic song. This association of aggressiveness and courtship is especially notable in *S. canadensis* as compared with *S. carolinensis*.

The female Red-breasted Nuthatch makes the final choice of the nest stub. If the pair start a nest hole and the female then rejects it to look for another one more suitable, the male may make a variety of displays, including flying into the hole ahead of her to induce her to return. Pursuit flights, in which the male may first nudge the female, occur toward the end of excavation. As with almost all other forms of courtship in *S. canadensis*, copulatory behavior is also subject to considerable variation.

Comparisons are made in the final section to the behavior of the White-breasted Nuthatch. Although the two species differ in regard to nesting, their vocalizations and displays have a basic similarity that is of interest in two species that are closely related as well as sympatric. In both species, courtship feeding appears to be of nutritional importance for the female at the critical time of egg-laying as well as during courtship.

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