

VOCALIZATIONS OF THE WHITE-BREASTED NUTHATCH

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The White-breasted Nuthatch (*Sitta carolinensis*) is the most widespread nuthatch in North America and has been the subject of several studies (Tyler 1916; Kilham 1968, 1972, 1981; Long 1982). Each study has included descriptions of, and proposed functions for, some of this nuthatch's vocalizations. However, none of these works featured a description of the complete vocal repertoire.

Herein I describe and analyze all known vocalizations of the White-breasted Nuthatch. A description of the behavioral context of these vocalizations is presented, and possible functions are suggested.

METHODS AND MATERIALS

I studied a population of White-breasted Nuthatches near Elysian, Le Sueur Co., Minnesota, an area of rolling terrain where the dominant trees included hackberry (*Celtis occidentalis*) and sugar maple (*Acer saccharum*). Data on vocalizations and associated behavior were collected from 1 October 1973-1 May 1975.

Vocalizations were recorded with either a Nagra IV or Uher 4000 Report-L tape recorder at a tape speed of 19 cm/sec, using an Electro-voice 634A microphone mounted on a 48-cm parabolic reflector. Nest cavity recordings were made using an Electro-voice 644 Sound-Spot microphone mounted near a nest hole. Audiospectrograms were made with a Kay Electric 6061B Sona-Graph. Frequency measurements were made from spectrograms produced with the narrow-band filter and time measurements were made from spectrograms produced with the wide-band filter. The acoustical terminology is that of Mulligan (1963:276).

RESULTS

Adult Vocalizations

Hit and tuck calls.—These calls consisted of single notes with the mean duration of *hits* being 0.028 ± 0.006 sec ($N = 53$) and of *tucks* 0.055 ± 0.010 sec ($N = 30$). *Hits* and *tucks* were easily categorized because (1) no calls of intermediate duration were noted, and (2) *hits* down-slurred while *tucks* exhibited a slight upslur (Fig. 1a). Both calls were given at a frequency of ca. 2 kHz.

These calls, the most commonly heard vocalizations of the White-breasted Nuthatch, were given year round but most frequently in autumn and winter. *Hits* and *tucks* were given by both sexes and were exchanged by paired nuthatches numerous times daily in winter months. Paired nuthatches are frequently out of sight of each other as they forage and these notes may serve to keep individuals informed as to the location of their

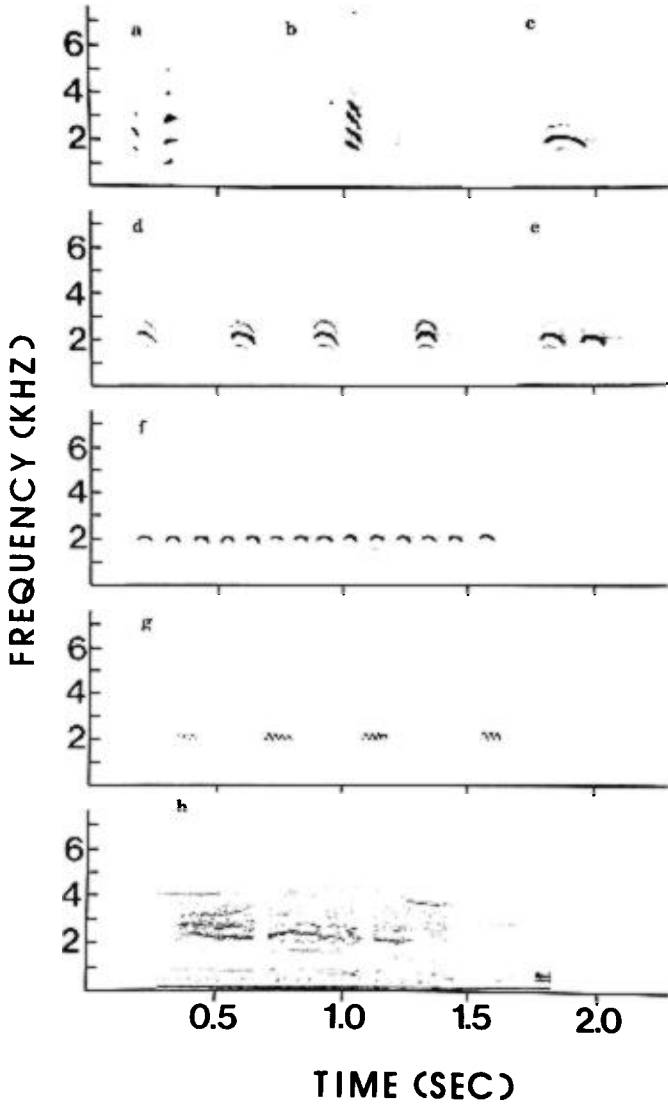


FIG. 1. Spectrograms of various White-breasted Nuthatch vocalizations: (a) *hit-tuck*; (b) *tchup*; (c) *quank*; (d) "discontinuous" *quank*; (e) *quank quank*; (f) "rapid" *quank*; (g) "rough" *quank*; (h) *chrr*.

mate. Kilham (1972) suggested that *hits* and *tucks* also serve to maintain pair bonds.

Tchup call.—The *tchup* call (Fig. 1b) consisted of a single note averaging 0.056 ± 0.009 sec ($N = 31$) in duration. This call down-slurred from an average high frequency of 2.12 ± 0.19 kHz ($N = 25$) to an average low of 1.60 ± 0.15 kHz ($N = 25$). The call was uttered by individuals of both sexes.

The *tchup* call apparently was used to announce the arrival of an adult outside of the nest hole. After the *tchup* call was given by an adult arriving at the nest hole, young nuthatches always responded with begging calls. Also, during incubation, adult females often responded with *chrr* calls when males gave *tchup* calls outside the nest hole. Kilham (1972, 1981) suggested that *tchup* calls may also be used to express mild excitement.

Quank calls.—These vocalizations of the White-breasted Nuthatch have been phonetically rendered as *kun*, *ka-un*, *kaan*, or *quank*. Previous authors noted that these calls “are employed when the bird is excited” (Tyler 1916:24) or that they “expressed excitement, the degree depending on whether the notes are single or given in a rapid series and whether loud or soft” (Kilham 1972:117). Five variations of the *quank* call were found in the present study and these are described below.

(1) *Quank call.* This call consisted of a single note averaging 0.135 ± 0.035 sec ($N = 38$) in duration. The entire note had a frequency of about 2 kHz (Fig. 1c). Both sexes gave the call throughout the study period.

Single *quanks* appear to express mild excitement (pers. obs.; Kilham 1972, 1981). These calls were nearly always given when nuthatches were approached by observers while foraging in trees or on a bird feeder.

(2) “Discontinuous” *quank call.* The “discontinuous” *quank* call consisted of a series of notes repeated at varying intervals. The individual notes averaged 0.103 ± 0.020 sec ($N = 18$) in duration and had an average frequency of about 2 kHz (Fig. 1d). Both sexes gave the call throughout the study period.

This call appeared to indicate a somewhat higher level of excitement than the single *quank* call. For example, the discontinuous *quanks* were given when nuthatches sighted a Great Horned Owl (*Bubo virginianus*) or a Barred Owl (*Strix varia*). During the nesting season nuthatches also gave this call when an intruder, generally a gray squirrel (*Sciurus carolinensis*) or human, approached the nest hole.

(3) *Quank, quank call.* This vocalization consisted of two *quank* calls given in rapid succession. The first *quank* averaged 0.091 ± 0.003 sec ($N = 24$) in duration and the second 0.087 ± 0.005 sec ($N = 24$). The average, between-note duration was 0.068 ± 0.005 sec ($N = 24$). The call

had a frequency of ca. 2 kHz (Fig. 1e). Both sexes uttered this call throughout the study period.

The *quank, quank* call was given in a variety of circumstances, all of which indicated a rather high level of excitement. For example, when nuthatches were scolding Great Horned or Barred owls this call was given in conjunction with discontinuous *quanks*. In these cases the *quank, quank* call was often given shortly after the nuthatches apparently noticed the owls. Then, after a few minutes, the *quank, quank* calls diminished into discontinuous *quanks* suggesting a reduction in the level of excitement (i.e., habituation).

Long (1982:218) noted that male White-breasted Nuthatches sometimes uttered a call with "paired syllables" (*quank, quank*) while performing displays near the nest induced by the presence of live or mounted predators. In the present study, a male nuthatch gave the *quank, quank* call after being chased by a Sharp-shinned Hawk (*Accipiter striatus*).

(4) "Rapid" *quank* call.—This vocalization consisted of a rapid series of 4–18 *quank* calls, with 4–8 being the most common. A greater number of notes was given in contexts which might be expected to be characterized by a higher level of excitement. The mean duration of the individual *quank* notes was 0.066 ± 0.014 sec ($N = 44$) and the mean internote interval was 0.051 ± 0.004 sec ($N = 37$). The call was given at an average frequency of 2 kHz (Fig. 1f). The notes were generally given at a rate of 9.1 ± 1.0 per sec.

Individuals of both sexes gave this call throughout the study period in a variety of circumstances and it appeared to indicate a rather high level of excitement. For example, during the breeding season this call was given when gray or red (*Tamiasciurus hudsonicus*) squirrels approached a nuthatch nest hole. Long (1982:218) reported that male nuthatches sometimes uttered rapid *quanks* ("wawaawaawa") when performing nest-site displays to live or stuffed predators.

The rapid *quank* call was often directed toward other nuthatches. On three occasions males with adjacent territories were observed near their boundaries addressing rapid *quanks* toward their rivals. This call was also given by males when nuthatch songs were played back within their territories. Kilham (1981) referred to the "rapid" *quank* call as the agonistic song and indicated that it was given when he approached a nest and, on another occasion, when a male nuthatch approached a Barred Owl.

(5) "Rough" *quank* call.—Another variant of the *quank* call was the rough *quank*. The word "rough" is used to describe the effect that rapid modulation in frequency has upon the quality of the sound produced. This call consisted of a series of notes repeated at varying intervals. The in-

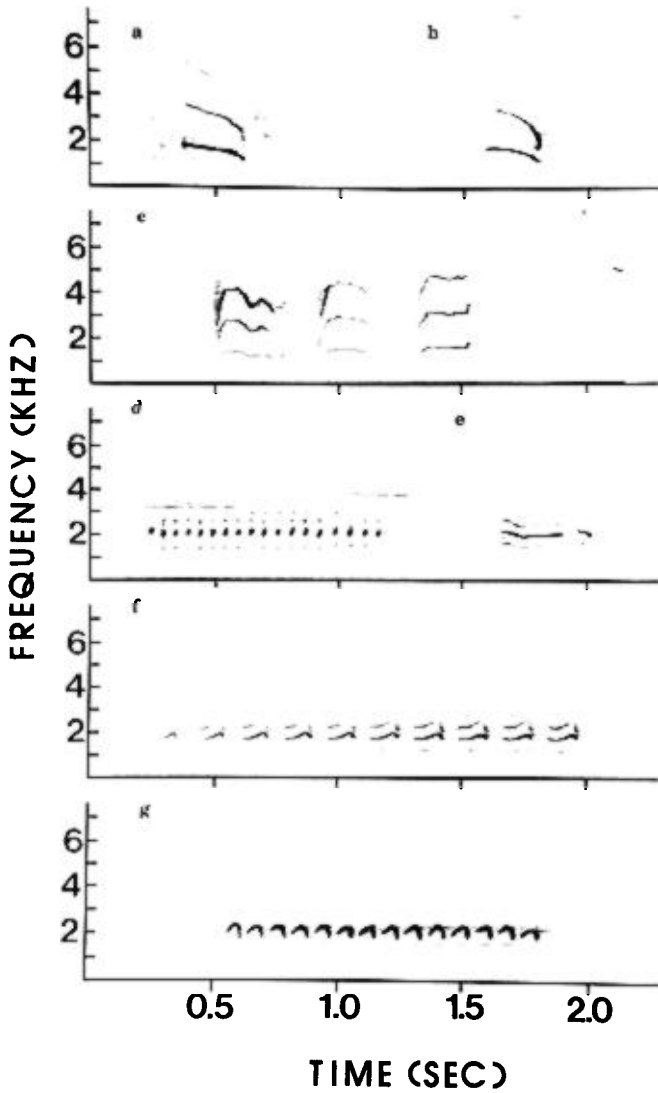


FIG. 2. Spectrograms of various White-breasted Nuthatch vocalizations: (a) and (b) *phoo*; (c) "squeal"; (d) *brr-a*; (e) "whine"; (f) slow song; (g) fast song.

dividual notes averaged 0.109 ± 0.005 sec ($N = 16$) in duration and had an average frequency of ca. 2.3 kHz (Fig. 1g). This call was very similar to the discontinuous *quank* except for the frequency modulation.

The rough *quank* call appeared to express the highest level of excitement of any of the *quank* calls. It was given by individuals of both sexes and was only recorded prior to the nesting period. This call was given along with rapid *quanks* on the three occasions when males with adjacent territories were observed near the boundaries. Kilham (1981:273) also reported that nuthatches give this call when they come together. He noted that "the vocalizations of 3 or 4 nuthatches in conflict . . . include . . . quavering *qua-rr* . . ." The harsh nature of the call (Morton 1977) and the situations in which it occurred suggest that it functions as an agonistic call.

Chrr call.—This call was given only by adult females during the period prior to nesting. It covered a wide range of frequencies (0.5–6.0 kHz; Fig. 1h) and averaged 0.591 ± 0.212 sec ($N = 11$) in duration.

The *chrr* call of the adult female was similar in structure to the begging calls of older nestlings (Fig. 3d,e) and appeared to serve the same function, i.e., to elicit feeding. Kilham (1972:121) suggested that in this manner the female "teaches her mate, or more exactly awakens his latent parental instincts, by playing the role of a nestling. . . ."

Phee-oo call.—The *phee-oo* call (Fig. 2a,b) consisted of a single note with an average duration of 0.235 ± 0.050 sec ($N = 31$). The call exhibited a gradual downslur from an average high frequency of 3.45 ± 0.08 kHz ($N = 16$) to an average low frequency of 1.89 ± 0.24 kHz ($N = 16$). These calls were not loud, being audible to a distance of 20 m, and were heard only during the mating and nesting period.

The *phee-oo* call appeared to serve two functions, one of which was the expression of sexual excitement (Kilham 1972). During the present study male nuthatches gave the *phee-oo* call prior to and during sexual pursuit flights and females gave the call immediately before and after coition. The *phee-oo* call also appeared to express anxiety. For example, on one occasion a male nuthatch uttered several *phee-oo*s when closely approaching a nuthatch model for the first time (as songs were being played back). Also, females often gave this call when I approached a nest-hole to put up or take down a microphone.

Squeal call.—This call (Fig. 2c) was given by four of nine female White-breasted Nuthatches as they were being held or removed from a trap or mist net. None of the 18 males captured during the study uttered this call. The mean duration of the call was 0.247 ± 0.043 sec ($N = 14$). Other investigators have also noted that females may utter such calls more frequently than males (Rohwer et al. 1976, Balph 1977).

Brr-a call.—This call (Fig. 2d) was a trill composed of 2–21 notes of equal pitch (1.8–2.2 kHz). There seemingly was a positive relationship between the number of notes and the level of agonistic behavior. The mean duration of the call was 0.339 ± 0.065 sec ($N = 17$) with the individual notes averaging 0.014 ± 0.001 sec ($N = 27$) and the internote interval averaging 0.029 ± 0.006 sec ($N = 25$).

The *brr-a* call was directed at both nuthatches and other species. Interspecifically, it was given when another bird, usually a Black-capped Chickadee (*Parus atricapillus*), approached a nuthatch on a feeder and, conspecifically, when a nuthatch model was placed within 1 m of a speaker during playback of nuthatch songs. On the four occasions when playback was used, males approached to within a few cm of a study skin, assumed the aggressive threat posture described by Kilham (1981), and gave the *brr-a* call. Many other species of birds have been found to utter low, harsh sounds in an aggressive context (Morton 1977).

“Whine” call.—This call (Fig. 2e) consisted of a single note averaging 0.204 ± 0.022 sec ($N = 7$) in duration. It exhibited a gradual downslur from an average high frequency of 2.09–0.15 kHz ($N = 7$) to an average low frequency of 1.84 ± 0.19 kHz ($N = 7$). Males uttered the call more frequently than females (six of seven observations).

The “whine” call frequently preceded the *brr-a* call and was given in situations similar to those in which the *brr-a* call was given, e.g., when another bird approached a nuthatch on a bird feeder or when playback of song was used with a model. Unlike the *brr-a* call, the aggressive threat posture did not accompany the “whine” call.

Song.—The song of male White-breasted Nuthatches has been described as “a regular series of about six to eight notes, sometimes more sharply accented, striking the same pitch, each with a slight rising inflection” (Bent 1948:8) and has been variously rendered into syllables such as *hah-hah-hah* and *what-what-what* (Allen 1912). Kilham (1972) described the song as a rapid series of 8–11 *what* notes or musical *wurps*. These descriptions generally correspond to what I have termed the slow song. Other authors (Tyler 1916, Bent 1948) have also described a variation of the song (which I have designated the fast song) in which 20–30 notes are crowded into the same amount of time as the 8–11 occupy in the slow song.

The slow variant consisted of a series of notes, generally 9–11, given at an average rate of 6.7 ± 1.0 notes per sec ($N = 38$). The individual notes, each with a slight rising inflection, averaged 0.095 ± 0.010 sec ($N = 77$) in duration and the internote interval averaged 0.065 ± 0.007 sec ($N = 70$) in duration. Slow songs were given at frequencies between 1.5 and 2.0 kHz (Fig. 2f).

The fast variant consisted of a longer series of notes, generally 16–26, given at an average rate of 11.5 ± 0.5 notes per sec ($N = 38$). The individual notes, each with a slight rising, then falling, inflection, averaged 0.053 ± 0.004 sec ($N = 42$) in duration and the internote interval averaged 0.036 ± 0.003 sec ($N = 38$) in duration. The dominant frequencies of the fast songs were between 1.9 and 2.5 kHz (Fig. 2g).

The two song variants of the White-breasted Nuthatch appeared to function in the same context. General observation suggested that, as with other nuthatch vocalizations, the speed of delivery was related to the level of excitement, i.e., an increased speed of delivery indicated a higher level of excitement.

The song of the White-breasted Nuthatch apparently serves the same functions as the songs of many other species, i.e., territorial defense and courtship. However, Kilham (1972:126) noted that while the song of the nuthatch may serve to advertise territory it “differs in a number of ways from those of more classically described species in being sung in most sustained fashion in mid-winter . . . and . . . in the male nuthatch addressing his song to his mate rather than to rival males.”

Vocalizations of the Young

“*Begging*” calls.—The “begging” call of young White-breasted Nuthatches exhibited gradual change throughout development. This call (Fig. 3a) first appeared within 24 h after hatching and was quite variable in both duration (0.09–0.16 sec) and frequency (4–6 kHz). Between 3–7 days post-hatching the call (Fig. 3b) lengthened ($\bar{x} = 0.183 \pm 0.009$ sec, $N = 9$) and covered a wider range of frequencies.

On about the eighth day post-hatching, the begging call developed a raspy component, i.e., part of the call covered a wide range of frequencies (Fig. 3c) and had a harsh sound. The terminal part of this call resembled the earlier begging call in its frequency (4.5–5.5 kHz) and absence of harmonics. This call was longer in duration (0.19–0.30 sec) than the above mentioned calls.

As the nestlings grew older the raspy component of the begging call became more apparent and harmonics appeared in the latter portion of the call (Fig. 3d). The call also continued to lengthen (0.35–0.43 sec). By the 14th day post-hatching the begging call was composed entirely of the raspy component and covered an extremely wide range of frequencies (0.5–6.0 kHz) with the fourth harmonic being dominant (Fig. 3e). At this time the juvenile begging call closely resembled the *chrr* call of the adult female (Fig. 1h) and was variable in duration.

“*Juvenile squeal*” call.—This call (Fig. 3f) consisted of a single note averaging 0.146 ± 0.023 sec ($N = 11$) in duration. The call showed a grad-

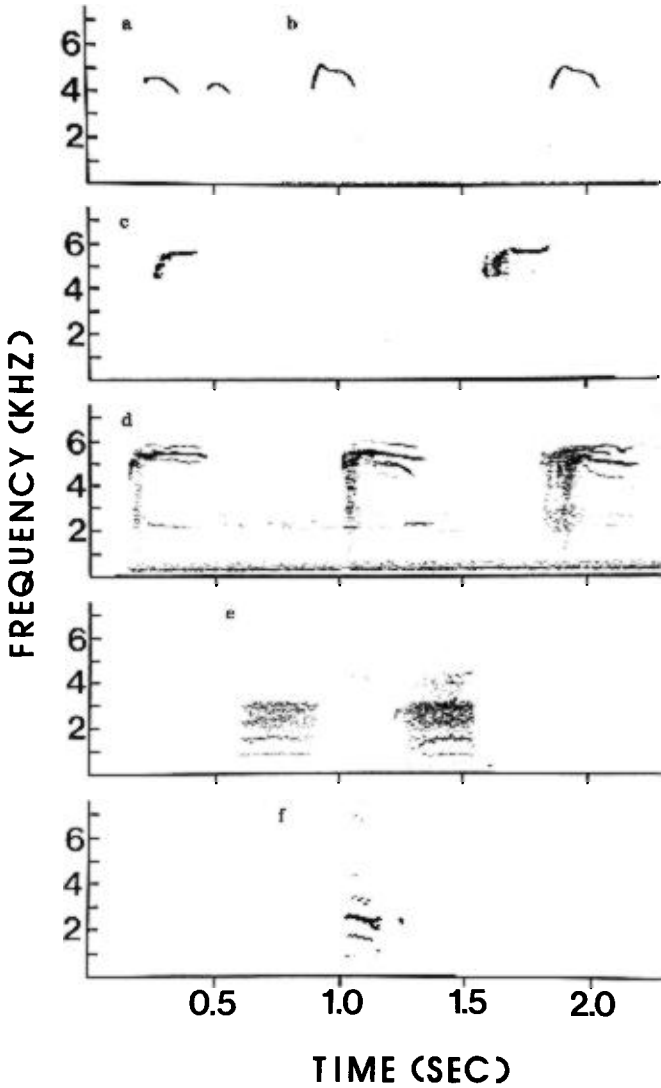


FIG. 3. Spectrograms of various White-breasted Nuthatch vocalizations: (a) "begging" call (24 h); (b) "begging" call (3-7 days); (c) "begging" call (8 days); (d) "begging" call (11 days); (e) "begging" call (14 days); (f) "squeal."

ual drop in frequency from an average high of 2.47 ± 0.16 kHz ($N = 11$) to an average low of 2.05 ± 0.05 kHz ($N = 11$).

This call was given by a 24-day-old female while being held. Although young nuthatches were handled on several occasions, this was the only time that the call was given. Whether this was due to the absence of the appropriate stimulus or to the fact that the call had not previously been a part of the nestling's repertoire is unknown; however, whereas adult nuthatches usually flew from the immediate area when nestlings were removed from the nest, on this occasion they remained nearby and gave rapid *quank* calls.

DISCUSSION

The vocal repertoire of the White-breasted Nuthatch was found to consist of 15 distinct types of calls and a song that was given at two different rates. Of these calls, adults gave 13 and the young two. When the similarities between the calls are considered, it appears the nuthatches may have only nine basic calls, with the remaining four calls comprising variations of some of these basic calls. The "discontinuous" *quank*, *quank*, *quank*, "rapid" *quank*, and "rough" *quank* appear to be variations of the basic *quank* call, with each variant being indicative of a different level of excitement. The two song variants may similarly reflect different excitement levels.

Most of the functional categories of calls found in other passerines were detected in the repertoire of the White-breasted Nuthatch (cf. Thorpe 1961:37). I did not note an alarm call specific to flying predators; however, nuthatches did appear to respond to the aerial warning call of the Black-capped Chickadee. On one occasion several chickadees gave the warning note described by Odum (1942) and Ficken et al. (1977) when a Sharpshinned Hawk flew over the area. The nuthatches, as well as the chickadees, remained motionless. Other investigators have reported that birds of one species may respond to the warning calls of another species (e.g., Thorpe 1961, Van Tyne and Berger 1976).

Various studies (e.g., Thorpe 1961, Armstrong 1963) have shown that vocalizations with similar functions have similar structures. For example, the scolding calls of most birds cover a wide range of frequencies, a characteristic that makes the calls easy to locate, whereas warning calls generally have a relatively narrow and high frequency range, a trait that makes the call difficult to locate. The structure of nuthatch vocalizations similarly is related to their function. In situations where it appears to be advantageous for the nuthatch to be easily located, calls cover a wide range of frequencies, e.g., the begging calls of newly-fledged young and the *brr-a* call. In situations where nuthatches may be vulnerable (nestlings), vocalizations cover a narrow range of frequencies.

Descriptions of the vocalizations of Red-breasted (*S. canadensis*) and European (*S. europaea*) nuthatches indicate close similarity between their vocal repertoires and the repertoire of the White-breasted Nuthatch. Kilham (1973:607) compared the vocalizations of White-breasted and Red-breasted nuthatches and found their repertoires to be surprisingly similar. In fact, he stated that "one might expect a greater divergence considering that they are both congeneric and sympatric." Lohrl's (1958) description suggests that the vocalizations of the European Nuthatch also bear a great similarity to those of the White-breasted Nuthatch. Verbal descriptions, however, have obvious limitations and spectrographic analysis will be necessary to make more definitive comparisons.

SUMMARY

Vocalizations of the White-breasted Nuthatches (*Sitta carolinensis*) were studied from 1 October 1973–1 May 1975 in Le Sueur County, Minnesota. The vocal repertoire of this nuthatch was found to consist of two juvenile and 13 adult calls plus a song that was given at two different rates. A description of the behavioral context of the vocalizations is presented, and possible functions are suggested.

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