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USE OF BILATERAL SCRATCHING BEHAVIOR BY EMBERIZINES AND ICTERIDS

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The bilateral-scratch (or double-scratch) is an unusual foraging behavior employed by some emberizine finches and a few other kinds of birds in displacing litter, loose soil, or snow. Because of its potential taxonomic significance in Emberizinae, this behavior has received considerable recent attention (Harrison 1967, Gobeil 1968, Clark 1970, 1971, 1972, Enders 1970, Taylor 1970, Hailman 1973, 1974).

Except for the comparative treatments of bilateral scratching in two species of *Pipilo* (Davis 1957) and in two members of the *Zonotrichia—Junco* complex (Hailman 1974), little information is available on variation in the use of this behavior by emberizines. Since knowledge of variation in bilateral scratching is important for behavioral, evolutionary, and taxonomic reasons, I here undertake to consolidate information from my own observations and from the literature on this subject. Most of my own data are qualitative and concern bilateral scratching in certain northeastern American emberizines. I also collected quantitative data in 1967 and 1968 on seasonal change in the frequency of use of bilateral scratching by the Rufous-sided Towhee (*Pipilo erythrophthalmus*) in two New Jersey populations. Statements unaccompanied by a citation in the following text are based on my field notes.

This paper also documents the occurrence of bilateral scratching in the family Icteridae and discusses its use by two species of North American icterids.

BILATERAL SCRATCHING IN THE EMBERIZINAE

General characteristics. The basic patterns of movement shared by all emberizines in bilateral scratching are a) simultaneous or nearly simultaneous use of both legs, and b) a double hop that results in a short displacement of the bird forward then backward to its original position. The forward hop is a preparatory action that provides momentum to the scratching bird and permits it to shift both feet forward under its body during the displacement to grasp the loose soil or litter near its head. The preparatory hop continues without pause into the rearward or power hop. During this latter phase, the bird recoils backward, pushing itself against the resistance of the substrate, simultaneously dislodging the soil or debris under its feet and thrusting it out behind as the legs are returned to a support position.

Davis (1957:134) reported that the Rufous-sided Towhee (western race, *P. e. megalonyx*) initiates its scratch with "a sharp backward thrust of both feet simultaneously" that displaces the bird rearward. This displacement is then corrected by a recovery or return hop. I have been unable to confirm this mode (backward then forward) of bilateral scratching in any emberizine that I have observed performing the behavior, including the towhee (eastern races, *erythrophthalmus* and *rileyi*).

Variation in bilateral scratching. The basic patterns of movement and the manner of use (e.g., stance, frequency of use) of bilateral scratching vary both within and among species. The nature of the substrate, gait, and alternate food supplies seem to be the most important factors influencing variation in this behavior.

Much new information is needed to understand the magnitude and nature of this variation.

The bilateral synchronization of both legs during scratching enables the hind limbs to share equally in displacing litter or loose soil. However, I have occasionally seen the feet used asynchronously in the Savannah Sparrow (*Passerculus sandwichensis*). Apparently in these cases one foot lagged slightly behind the other as scratching began, with the result that the first foot moved over a greater distance than the second and probably contributed most of the force in moving the debris. Hailman (1973) also reported a case of asynchrony in scratching by the Song Sparrow (*Melospiza melodia*). It probably occurs in other species as well, especially in those that often walk or run on the ground.

The vigor of scratching differs among species. Species such as the Fox Sparrow (*Passerella iliaca*), White-throated Sparrow (*Zonotrichia albicollis*), and Rufous-sided Towhee tend to scratch forcefully with relatively long preparatory and power hops that produce conspicuous forward and rearward displacements of the bird. The head is raised upward (if previously lowered) during the preparatory hop, with the bill reaching the horizontal or pointing slightly downward. The power hop lowers the bill near the freshly disturbed substrate. The position of the head at the end of the scratch probably permits the bird to immediately assess its effectiveness in displacing debris or uncovering food. Other species such as the Savannah Sparrow, Vesper Sparrow (*Pooecetes gramineus*), and Brown Towhee (*Pipilo fuscus*) (Davis 1957:136) tend to perform relatively short, weak scratches. Body displacement in some of these species may at times be nearly absent; the primary scratching motions in such cases are shifting of the feet forwards and backwards under the body and a slight raising and lowering of the forebody.

I have repeatedly observed the Song Sparrow and Dark-eyed Junco (*Junco hyemalis*), and less often the White-throated Sparrow, modifying the forcefulness of their scratching on different substrates. They tend to perform relatively long, powerful scratches in heavy leaf litter and shorter, weaker ones in light grass litter or on loose soil. Thus, it is likely that differences in the foraging sites searched by various species account for part of the interspecific differences in vigor of scratching and in other scratching parameters as well (Hailman 1974).

Strength of scratching seems to be at least partly dependent on the stance of the bird during scratching. Moreover, some of the interspecific differences in vigor of scratching and in stance probably reflect differences in adaptive modifications of the hind limbs related to habitat or gait (Davis 1957:156–163).

Hailman (1973) investigated the problem of gait variation in some emberizines known to scratch bilaterally. In my experience, scratchers that usually or often hop, e.g., the Rufous-sided Towhee, Fox Sparrow, White-throated Sparrow, and Swamp Sparrow (*Melospiza georgiana*), generally initiate their bilateral-scratch from an erect standing posture with head held high. But scratchers that often walk or run on the ground, e.g., Savannah Sparrow, Vesper Sparrow, and Brown Towhee (Davis 1957), tend to perform the bilateral-scratch in a decided crouch with the back at a low oblique angle to the substrate or horizontal and with the legs moderately splayed. The head may be held partly above the back or level with the back with the bill pointing downwards.

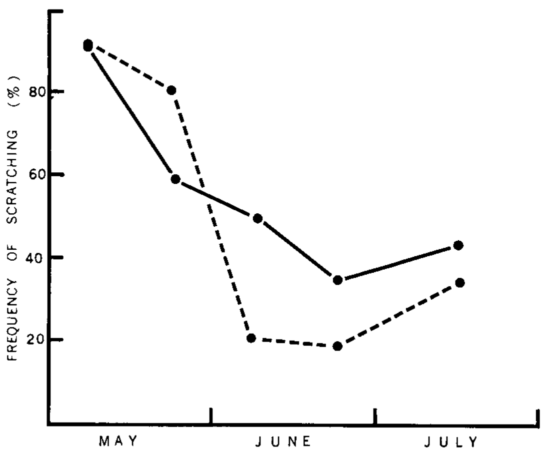

FIGURE 1. Percent frequency of all timed bouts (3 or more minutes) of continuous foraging on the ground during which towhees in two New Jersey populations scratched at least once in the litter. The solid line summarizes information on towhees in a xeric oak-pine woodland and the dashed line represents data on towhees in a mesic oak woodland. Sample size for the respective times and localities varies between 14 and 48 bouts.

The Song Sparrow often hops or walks (occasionally runs) on the ground depending on substrate or social context (Hailman 1973, pers. obs.). Its scratching posture varies from erect with bill horizontal to a semi-crouch with head lowered and bill angled downwards.

The frequency of bilateral-scratching during a period of foraging, and the tendency to employ multiple scratches in a single bout of scratching can also vary within and among species. The type of substrate may influence variation of these parameters as well. Few comparative data are available but my observations suggest that the Rufous-sided Towhee and the Fox Sparrow tend to employ scratching behavior on a given substrate more often than the Dark-eyed Junco, Savannah Sparrow, or Vesper Sparrow. The Rufous-collared Sparrow (*Zonotrichia capensis*) uses this behavior infrequently although some individuals may employ it persistently at times (Miller and Miller 1968). The Seaside Sparrow (*Ammospiza maritima*) apparently uses it only very rarely (Enders 1970).

I found that Rufous-sided Towhees in two New Jersey habitats used the bilateral-scratch on leaf litter much more frequently (chi-square, $P < 0.05$) during early spring than during late spring and early summer (fig. 1). This seasonal change seemed to be correlated with changes in the food supplies available to towhees. During the early stages of foliage development in late April and early May when the towhees arrived, there was little food on the litter surface or above the ground. Towhees spent nearly all their foraging time during this period scratching for food in the litter. With warmer weather and the advance of foliage development, other kinds of arthropods became available on the litter surface and on foliage above the ground. At this time, towhees commonly used other foraging techniques besides scratching as they sought food in the new feeding zones. The apparent small increase in frequency of scratching in July may have resulted from the presence of broods of dependent young.

I have observed Savannah Sparrows and Vesper Sparrows perform only single scratches in a bout of scratching. Each scratch is followed by a pause. Other species often scratch several times in quick succession before pausing. Hailman (1974) showed that the number of scratches in a bout follows a geometric decay function in the Dark-eyed Junco and the White-throated Sparrow. He suggested that the probability of a second or third scratch following in quick succession in a single bout depends on the apparent (to the bird) success of the preceding scratch. I have noted that during a bout of rapid scratching, some birds may turn 10 to 30 degrees between successive scratches.

The reports of unusual variants of the bilateral-scratch in certain western races of the Rufous-sided Towhee (Dawson and Bowles 1909, Woodbury 1933) have not been confirmed. The wing and tail movements that were interpreted as counterbalancing movements may have been pre-flight signals that towhees often use if disturbed while foraging (Greenlaw unpubl. data).

BILATERAL SCRATCHING IN THE ICTERIDAE

Use of the bilateral-scratch by icterids. I have often observed bilateral scratching by Brown-headed Cowbirds (*Molothrus ater*) in Maine, New Jersey, and Long Island, and by Redwinged Blackbirds (*Agelaius phoeniceus*) on Long Island. In both species, I have had clear views at close range of their feet and legs as they scratched. Several times I was able to directly compare bilateral scratching of the icterids with that of a Song Sparrow foraging nearby on the same substrate.

George A. Clark, Jr. has called my attention to a reference to bilateral scratching in the Shiny Cowbird (*Molothrus bonariensis*) (Wetmore 1926:384). My observations confirm and extend Wetmore's report of its occurrence in the Icteridae.

The bilateral-scratch of the Brown-headed Cowbird and the Redwinged Blackbird involves the two basic patterns of movement that typify this behavior in emberizines. The legs usually are brought forward simultaneously or nearly simultaneously and perform the power thrust together. But the scratch is short and weak so that displacement of the bird during scratching is small. The birds usually perform the bilateral-scratch in a hunched, crouched stance with the head at or below shoulder level, with the bill directed downwards and its tip near the substrate, and with the legs moderately splayed. The tail is held in line with the dorsum, which is usually horizontal, or is drooped slightly in undisturbed feeding. In social feeding contexts, the two species may cock the tail and droop the wings as they forage. This behavior serves a signal function and is not directly related to scratching or to other foraging methods.

Although I have watched carefully, I have never observed the Common Grackle (*Quiscalus quiscula*) using the bilateral-scratch. Unlike the blackbird and cowbird, the grackle often bill-sweeps in litter (Clark 1971).

Variation in bilateral scratching. I have detected intra- and interspecific variation in the use of bilateral scratching by the cowbird and blackbird. In both species, the legs are often employed synchronously. But sometimes, especially in the blackbird, there is a tendency to move the legs asynchronously, resulting in a forward "step-hop" followed by unequal division of labor of the legs in the scratch.

Also in both icterids, the power thrust has a pronounced lateral component that often leaves the legs spread wide after a scratch. But although their scratching motions are short and weak, the bilteral-scratch of the cowbird tends to be a little stronger than that of the blackbird. Yet on a few occasions, I have observed small pieces of debris fly out well behind both scratchers.

Their scratching stance also differs somewhat. Cowbirds generally scratch in a somewhat more erect posture than blackbirds, but the difference is small. The head is seldom if ever held above the level of the back during scratching in either species.

Substrate. The use of bilateral scratching by the blackbird and the cowbird depends on the substrate. They generally employ this behavior in displacing light, fibrous grass-forb litter in relatively open spots with thin or patchy standing vegetation. They seldom use it on exposed mineral soil without litter, although Wetmore (1926) noted that Shiny Cowbirds scratched in sandy areas for seeds. I have never seen the Brown-headed Cowbird or the Redwinged Blackbird scratch in leaves, but they do scratch in beds of small wood chips.

The Brown-headed Cowbird, and occasionally the Redwinged Blackbird, also scratch bilaterally in short, standing, live grass after food is first located by visual inspection or by probing with their bills (the blackbird may also gape). Their movements and stance during scratching in this substrate are as described above. The bilateral-scratch in short grass permits the scratcher to draw several grass stems rearward and laterally, thereby exposing their bases. The stems are held under the feet as the bird gleans at the ground. I have never seen any emberizine use the bilateral-scratch in this manner.

Comparison with emberizines. Bilateral scratching of the blackbird and the cowbird seems to differ from that of emberizines in few important respects. The use of this behavior in short grass by the icterids is the chief difference in scratching between the two groups. The two icterids tend to scratch in a deeper crouch with the bill closer to the substrate. But in general their scratching movements and their manner of using the bilateral-scratch resemble the behavior observed in the Savannah Sparrow, Vesper Sparrow, and Brown Towhee. Their posture during scratching seems most similar to that described for the Brown Towhee by Davis (1957). Most differences are only quantitative and are probably associated with the extreme dependence of the icterids on a walking gait during terrestrial locomotion.

SUMMARY

This paper documents the occurrence of bilateral scratching behavior in the Icteridae and characterizes variation in the use of this behavior by emberizines and icterids.

Bilateral scratching consists of synchronous use of both legs and a forward-rearward displacement of the bird resulting from preparatory and power hops. The degree of synchrony in use of the legs, strength of scratching, stance, frequency of use of scratching, and the performance of multiple scratches without pause vary within and among species. Strength of scratching and stance seem to be related to gait. The nature of the substrate and alternate food supplies also seem to influence aspects of bilateral scratching.

The scratching behavior of emberizines and icterids is generally similar in both groups with most differences probably related to the extreme dependence of

icterids on a walking gait on the ground. The icterids sometimes use the bilateral-scratch in short, erect, dense live grass while emberizines do not.

I am grateful to George A. Clark, Jr. and Jack P. Hailman for their thoughtful advice and criticism of a draft of this paper. Hailman also kindly provided a prepublication copy of his 1974 article on bilateral scratching in two emberizines. Clark called my attention to the important Wetmore reference and Hailman to the Miller and Miller reference.

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THE EFFECT OF LARGE SONG REPERTOIRES ON NEIGHBOR "RECOGNITION" IN MALE SONG SPARROWS

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The occurrence of different life history strategies within a taxon often perplexes the evolutionary biologist, for adaptive significances of alternative habits are not always clear. Such is the case with the diversity of singing behaviors among the Oscines. Individuals of some species possess only one song (e.g., many fringillids listed in Borror 1961), while individuals of other species may have a thousand different songs (e.g., Brown Thrasher, *Toxostoma rufum*; Kroodsma, unpubl. data). Congeners may sing similarly—*Zonotrichia* species usually have one song per individual (Marler and Tamura 1962, Nottebohm 1969, Borror and Gunn 1965); or their singing may be quite different—the *Aimophila* species (Borror 1971) and the *Spizella* species (pers. obs.) are good examples.

Epigamic selection is one rather important selective force in the evolution of elaborate plumages, complex display patterns, and large song repertoires (see Nottebohm 1972, Otte 1972), but vocal diversity may also be important in male-male interactions, playing a role in the establishment and maintenance of territories in some songbirds. In several species with small song repertoires (table 1), territorial males respond more aggressively to songs of non-neighbors than they do to those of neighbors. Such reduced aggression to a specific and relatively unvarying stimulus at a specific location is presumed to be a considerable energetic savings (Falls 1969, Peeke and Veno 1973). Unclear, however, is the effect which a greater diversity of stimuli, such as a larger song repertoire, will have on this process of "neighbor recognition," or habituation (Petrinovich and Peeke 1973). With larger repertoires, the amount of exposure to and probably the familiarity with each song type of neighboring males will decrease proportionately; regardless of the neural mechanisms involved, distinguishing songs of neighbors from those of strangers may then become more difficult.

I examined this phenomenon of "neighbor recognition" in the Song Sparrow (*Melospiza melodia*), a species with a somewhat larger repertoire than has been used previously. The classic study by Nice (1937) as well as studies by Borror (1965), Mulligan (1966), and Harris and Lemon (1972) provide excellent background on the behavior of the species. Repertoire size varies geographically; minimum estimates for southern Quebec and Maine are nine and eight song patterns per individual respectively (Harris and Lemon 1972, Borror 1965), while on my study area they averge about ten.

I conducted 60 playbacks to 15 territorial paired males during late May and June 1973 at the Rockefeller University Field Reserch Center near Millbrook, New York. The birds were uniquely color-banded, and territories for each were mapped before starting playback experiments.

I recorded songs with a Uher 4400 tape recorder and 60 cm parabolic reflector. "Neighbors" in all cases had territories adjacent to the experimental male, while "strangers" were at least two territories removed. Most strangers held territories between 100–200 m but never more than 800 m from the experimental male. Over similar distances Harris and Lemon (1972) found much sharing of syllable types among males. Songs of Song Sparrows do, however, change over distance; if playback songs are selected from greater distances, any increased response to novel songs of the "local" population could be offset by a decreased response to songs of different dialects (Harris and Lemon 1974).