

THE DOUBLE-SCRATCH AS A TAXONOMIC CHARACTER IN THE HOLARCTIC EMBERIZINAE

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THE Holarctic buntings of the sub-family Emberizinae are a relatively uniform group of species, mainly birds of scrub or open plains, with a bill adapted for seed-eating, mostly with a streaked brown plumage and bright specific colouring which is often confined to the head and breast. Morphologically they show little differentiation and it is therefore of interest that they appear to be divisible into two groups by a behavioural character, the presence or absence of which does not appear to be determined by, or correlated with, their immediate needs or surroundings. This is the use of the double-scratch in feeding, shown by many of the North and Central American species.

The double-scratch is a rapid backward kick performed simultaneously with both feet which are scraped along the surface of the ground, scratching back the superficial layer and exposing what is beneath. If the movement is watched closely in a relatively long-legged species it will be seen that at the commencement the bird is standing with bill pointing down, apparently looking for food on the ground immediately below the head. Without moving from the spot it then gives a small hop in which both feet are brought forward, apparently almost to the spot that it was previously looking at. This movement also tilts the body axis upwards so that the head is raised a little. Immediately after the first hop brings the feet forward a second hop occurs in which the feet are hardly raised but are brought smartly back to their former position, the claws scratching the surface and throwing back some of the superficial material. This restores the body axis to its original position so that at the end of the movement the bill is pointing down at the place where the scratching occurred. This will presumably enable the bird to observe immediately anything which has been exposed.

If no edible items are exposed the movement may be repeated in a rapid series, the bird remaining in the one place. If the substrate is not too hard or compressed the bird may rapidly excavate a sizable hollow. This behaviour is of obvious advantage to a species feeding in the fallen litter under trees or shrubs or on bare ground, particularly in the winter months when relatively little plant or animal food may be visible at the surface.

Among the Emberizinae this scratching movement appears to be confined to American species. It was observed in the Song Sparrow (*Melospiza melodia*), Swamp Sparrow (*M. georgiana*), Tree Sparrow (*Spizella arborea*), Fox Sparrow (*Passerella iliaca*), Rufous-naped Sparrow (*Zonotrichia capensis*), juncos (*Junco* spp.), and towhees (*Pipilo* spp.). Records of scratching

in literature are rather sparse and appear more often as casual comments in popular accounts, but it is also recorded in the following species, Black-throated Sparrow (*Amphispiza bilineata*), Olive Sparrow (*Arremonops rufivirgata*), and Green-tailed Towhee (*Chlorura chlorura*), (Wetmore et al., 1964) and for the White-throated Sparrow (*Zonotrichia albicollis*) (Peters and Burleigh, 1951). The scratching habits are so marked in this group of species that Vaurie (*in* Thomson, 1964) refers to "large feet for scratching" as a typical character of the Emberizinae.

This ability to scratch in feeding appears to offer an isolating character for a group of species within the Emberizinae which roughly comprises those species sometimes referred to as New World sparrows. In addition to the double-scratch the general characters of the group are a streaked brown plumage with relatively subdued specific signal characters, usually consisting of stripes or patches of varying colour on head and breast; sexual monomorphism; no eclipse nonbreeding plumage; hopping locomotion; and song usually a repetitive phrase delivered from a perch. It certainly includes the following genera—*Spizella*, *Melospiza*, *Passerella*, *Zonotrichia*, *Amphispiza*, and *Arremonops*—and is expected to include *Passerculus*, *Ammodramus*, *Passerherbulus*, *Ammospiza*, *Pooecetes*, *Chondestes*, and *Aimophila*. Related but slightly divergent genera are *Junco*, with more uniform and sober coloured plumage; and *Pipilo* and *Chlorura*, consisting of larger birds, mostly with more uniform colouring, though with conspicuously coloured markings in some species.

Of the remaining Holarctic species there are two groups. One is the longspurs of the genera *Calcarius* and *Rhynchophanes*. These are birds of open country or tundra. They are terrestrial and normally walk or run, but may hop occasionally. The long hind claw is associated with terrestrialism and a walking gait. As far as is known they do not double-scratch. They show marked sexual dimorphism, the males being boldly patterned and coloured on the head and breast, the females dull in colour with a brown-streaked plumage. The male has a winter eclipse plumage like that of the female. Song is usually delivered in flight. There are four Nearctic species, one of which, the Lapland Longspur (*Calcarius lapponicus*) also occurs in the Palearctic.

The Snow Bunting (*Plectrophenax nivalis*) an arctic species with a Holarctic distribution, may be a specialised offshoot of this longspur group. It is sexually dimorphic, the female being browner and more streaked, the male having a striking black and white breeding plumage and an eclipse-type nonbreeding plumage. It is terrestrial, usually running or walking, and does not use the double-scratch. Its relative lack of heavy pigmentation

and denser plumage would appear to be the result of adaptation to arctic conditions.

Another odd species that might belong in this group, or else shows similar but parallel divergence, is the Lark Bunting (*Calamospiza melanocorys*), which shows marked sexual dimorphism, the breeding male being black with a white wing patch while the female is brown-streaked. The male has a non-breeding eclipse plumage. Like the longspurs it is a mainly terrestrial species of open country but would appear to be much more prone to perch than these. There appears to be no useful information on gait and double-scratching.

The other main group of species is that of the typical Old World buntings of the genus *Emberiza*. These species share with the longspurs the sexual dimorphism, with a brightly patterned head and breast in the male, and an inconspicuous brown-streaked plumage in the female. The male has an eclipse nonbreeding plumage. As a group they differ in being much more arboreal, occupying a similar range of habitats to those occupied by the New World sparrows. They do not use the double-scratch in feeding. Witherby et al. (1938) state that the normal locomotion of these birds is a hop, but a subsequent series of observations (Woods, 1946; Alexander, 1946, 1947, 1948; Ellis, Rayner, and Williams, 1948; Macpherson, 1949; Wallace, 1957) showed that in at least eight of these species walking or running occurred as well as hopping when the birds were on bare ground. The song is a repetitive phrase delivered from a perch or rock.

There is also a monotypic genus in Asia. The Crested Bunting (*Melophus lathamii*) differs from species of the genus *Emberiza* in that the male has a distinct crest (although an incipient crest is present in the Rustic Bunting (*E. rustica*), and a black plumage with brown wings. It is much more terrestrial in its behaviour and the very inadequate comments in literature appear to infer that it normally walks. It mounts to a low perch to sing. It would appear to be a specialised offshoot of *Emberiza*, and in some respects forms a parallel to the Lark Bunting of North America.

DISCUSSION

It is customary to regard the Emberizinae as a group originating within the complex radiation of nine-primaried oscines in the New World. The longspurs must therefore be considered as a specialised group derived from these, while the Old World genera are usually regarded as forms arising from an invasion of New World forms.

In view of the probable phylogeny of these groups it is difficult to understand the distribution of the double-scratch as a character of behaviour in these species. As a form of feeding behaviour it is obviously of value to a ground-feeding species and might be expected to be of greatest use to a

terrestrial bird. It is, however, apparently absent in the more terrestrial species and present in more arboreal birds. In addition it is present in one large group of species on one continent and absent from a related group apparently occupying similar niches on another. We cannot therefore dismiss the pattern of presence and absence of this character as evidence of adaptation to environment. Since the character is common to a large group of closely related species, the New World sparrows, which show ecological and morphological diversity to a limited degree only, it can be suggested that it may be inherited through a common ancestor. It is, however, absent from the related longspurs and Old World buntings which might have been expected to have also arisen from this ancestral stock. It seems improbable that it should be lost in derived groups which would have equal need of it, and that its present distribution is purely accidental.

Another possible explanation would involve reversing the general view on evolutionary spread and suggesting that the New World forms might represent an adaptive radiation from an invasion of Old World bunting stock, and that the ability to use the double-scratch represented a new and further evolutionary development lacking in an earlier group.

There is a third explanation which would fit both the present view on the evolution of these groups and at the same time explain the distribution of the double-scratch as a behaviour character. Double-scratch is absent from the longspurs although these are a mainly North American group obviously related to the New World sparrows. The major behavioural difference between these two groups, and the one which appears relevant, is that of locomotion. The sparrows usually hop and the longspurs usually walk or run.

There appears to be a direct correlation between hopping and the use of double-scratch in feeding. The description of this scratching already given shows clearly that it is directly derived from hopping. It seems possible that this is true of the scratching methods of feeding when these occur in any of the Passeriformes. Double-scratching occurs in the wydahs (Viduinæ), in some of the thrushes (Turdinæ), and babblers (Timaliidae), and probably in other groups. In each case it is associated with species in which hopping is the usual mode of locomotion. There is no evidence of this type of scratching in species which normally walk such as the larks (Alaudidae), wagtails (Motacillidae), starlings (Sturnidae), and crows (*Corvus* spp.). There is not an absolute correlation. The Blackbird (*Turdus merula*) is a species which both hops and runs. Gibbs and Hartley (1957) refer to one digging first with one foot then the other. One may, however, assume that there is a direct morphological adaptation enabling a bird that hops to scratch in this fashion, and that a change from hopping to walking as the normal mode of progress involves structural changes that result in the loss of the ability to

use the double-scratch in feeding. It can therefore be supposed that the evolution of the longspur group in bare open country involved the development of walking and loss of hopping as the normal mode of locomotion and this in turn involved the loss of the double-scratch associated with hopping.

The Old World buntings are similar to the New World sparrows but they also show very close links with the longspurs in plumage. Their dual mode of locomotion, which might be inferred to indicate partial adaptation by an arboreal group to terrestrialism, could also be interpreted as indicating the relics of terrestrialism in a group which has secondarily evolved a more arboreal mode of life. It can therefore be proposed as a hypothesis that the Old World buntings in their evolution from the New World sparrow stock have passed through a phase similar to that shown by the longspurs, or share a common ancestry with them; and that during this phase they have lost the ability to use the double-scratch in feeding and have not re-evolved it.

Such a derivation would be a reasonable conclusion since the spread of Nearctic Emberizidae into Eurasia would be most likely to have occurred via a northern land-bridge or short sea crossing and would have occurred most easily if the invading stock was adapted to tundra-like conditions and able to exist near the ice-cap. The notion of a common ancestry of longspurs and Old World buntings could be further argued with reference to the close similarity between the Lapland Longspur as the present Eurasian longspur, and the buntings of the Little Bunting (*E. pusilla*)—Reed Bunting (*E. schoeniclus*)—Rustic Bunting (*E. rustica*) subgroup.

SUMMARY

The Holarctic buntings of the subfamily Emberizinae can be divided into two groups by the presence or absence of a behavioural character, the use of the double-scratch in feeding. The double-scratch is a rapid backward kick of both feet by which the superficial layer of the substrate is scraped back. It may be repeated in one place until a hollow is made. Within this group this scratching movement is confined to New World sparrows, juncos, and towhees, being known for nine genera and suspected for another seven. These species also show certain common characters of morphology and behaviour as do those of the other groups subsequently mentioned. There are two main groups within the remaining species. The terrestrial Longspurs, with a Holarctic distribution, have a walking locomotion and lack the double-scratch. The Snow Bunting may be related to these, and the Lark Bunting shows similar characters. The other main group is that of the Eurasian Old World buntings, and the monotypic Crested Bunting. These birds usually hop but may walk, and do not use the double-scratch in feeding although occupying similar niches to the New World sparrows. The Old World species are usually regarded as derivatives of New World stock. It is suggested that the double-scratch is associated with hopping locomotion and may be lost by birds that walk; and that the Old World buntings have evolved via a terrestrial walking form similar to the longspurs, and in the process have lost, and failed to re-evolve, the double-scratch mode of feeding.

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