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| Author(s)        | YAMASHINA, Yoshimaro  |
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## Notes on *Emberiza jankowskii* Taczanowski with Special Reference to its Speciation

By  
**Yoshimaro Yamashina**

(Yamashina Ornithological Laboratory, Tokyo)

(With 1 Text-figures)

*Emberiza jankowskii* is an eastern Asiatic Bunting notable for its rarity and its very limited distribution. Its habitat is restricted to the small area of south Ussuriland, northeast Korea, and east Manchuria (see map). A few details of the life history of this bird were reported by Shulpin (1928), who studied it in Possiet Bay, region of south Ussuriland, but he failed to discover its nest and eggs. In 1936 I asked Mr. Miyuki Yamagata, who was in the service of a coal-mining company in the Tonning district of east Manchuria to collect eggs, young, and living birds of this rare species for me. As these have hitherto been undescribed, the successful results of this efforts are worth recording.

### Distribution

The first specimen was discovered on 9 March, 1886 by Jankowski at Sidemi, between the Possiet Bay and the Korean frontier. He forwarded this specimen to Taczanowski, who described it as new in 1888. This discovery astonished the contemporary ornithological world, for it was then deemed impossible for a new bird to be discovered in the temperate Eurasia. Tscherski collected 10 specimens in the same region, in 1913, about 30 years after the discovery. In 1927 Shulpin discovered the species' actual centre of distribution to be north of Possiet Bay. He collected about 50 specimens between the spring and autumn, chiefly in the region between Nagoruaga and Nowakiewsk, where the species breeds very commonly. He also ascertained that this bird is not found in the Nowgored Peninsula, north east of the Cladkaja River.

In east Manchuria Jankowski's bunting breeds in the Tonning district, just inside the Ussurian frontier. Mr. Yamagata was successful in procuring for me six adults (including three live ones), five young, and two nests with eggs. According to his three years observations, *Emberiza jankowskii* is never found there during winter. The birds arrive every year in early May, and start to nest toward the end of that month. All other records of this bird in Manchuria are in the non-breeding season between October and April, as follows: Echo (20 Feb. 1923)<sup>1)</sup>, Lake Tsingbou (10 Oct. 1931)<sup>2)</sup>, Ashiche (1 Nov. 1927)<sup>3)</sup>, Maoershan (20-22 Feb.)<sup>4)</sup>, Mutanko (16 Oct. 1943)<sup>5)</sup>, Dujcynshan (21 April 1920)<sup>6)</sup> (see

1) Loukashkin, 2) Loukashkin, 3) Meise, 4) Meise, 5) Fushihara, 6) Musilek.

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map in Fig. 1). Meise (1934) thought the species probably bred at Dujcynshan near Harbin, but Mr. Yamagata's observations in Toning show the species does not breed until late May. Therefore the Manchurian records in spirit indicate it is more likely part of the winter or migration range.

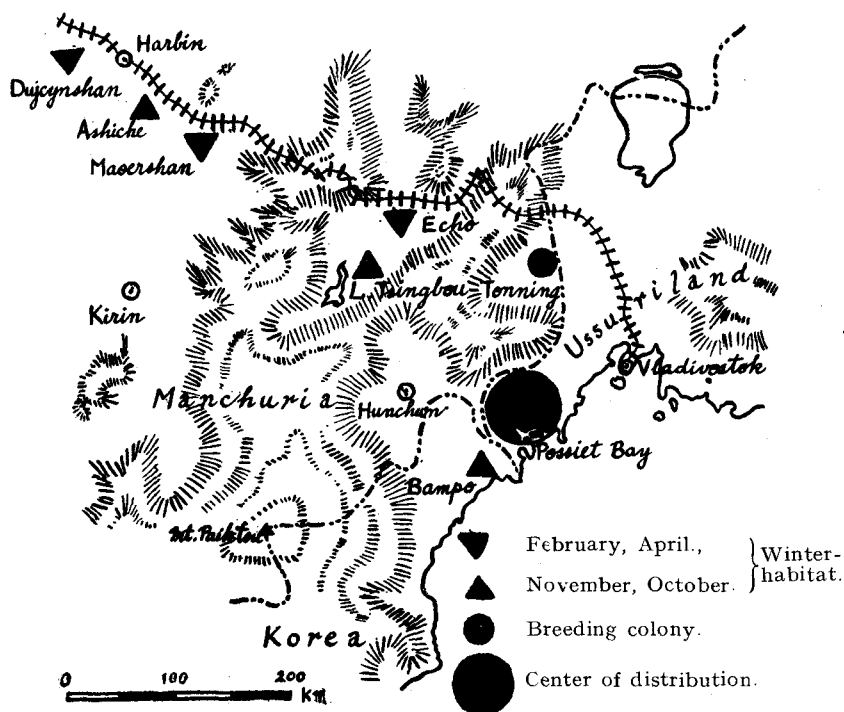


Fig. 1. Distributional map of *Emberiza jankowskii*.

In Korea Mr. Orii, my collector, collected 6 specimens on 25 October 1929 at Bampo, near the Ussurian frontier.

As an exceptional record there is the Summer Palace, a few miles outside of the west wall of Peking, from where Morrison (1948) reported two specimens of this bunting.

The collection data for the known specimens suggest that there is a single thickly populated breeding colony in the Toning region. From Shulpin's observations separate breeding colonies may be discovered in the future along the Manchuria-Ussurian frontier. Outside this row of breeding colonies is the winter range, where the birds wander sporadically during the non-breeding season. The winter range is at present known to be only the region along the East Chinese

Railways. This is perhaps because collecting is easy along the railways. But it is likely that *Emberiza jankowskii* may be recorded in the future in the Kirin and Hunchun plains (see map in Fig. 1).

### Habits

The breeding ground of *Emberiza jankowskii* in the Toning district of eastern Manchuria, where Mr. Yamagata discovered the nests, is an upland meadowland covered with low trees about 300 meters above sea level. As Shulpin (1928, p. 220) reported from south Ussuriland, *Emberiza jankowskii* and *Emberiza cioides weigoldi* breed there side by side. A few *Emberiza spodocephala extremi-orientis* and *Emberiza aureola* also nest there, but no *Emberiza leucocephalos*, which breeds only in Saghalin and the region north of the Amur river.

According to Mr. Yamagata, the general habits of *Emberiza jankowskii* are very much like those of *Emberiza cioides weigoldi*. However, these two species are easily distinguished by their clearly different plumages and by their different songs. The male *jankowskii* sometimes sings while perching on low trees, but seems to spend more of its time on the ground than *Emberiza cioides weigoldi*. Both sexes, especially the female, are fairly tame. Mr. Yamagata told me that he was able often to watch the nesting female from about one meter away without any blind.

Mr. Yamagata sent me three livebirds (2 MM, 1F) of this rare species captured in May, 1939. One male died that summer, but the others lived until September 1941. They were fed on ordinary Japanese-type soft food for buntings. This is made of 23% dried fish powder and 77% grain powder, mixed with roasted rice-bran and rice powder, and moistened with water. To this some ground green vegetable is added, and the diet is occasionally supplemented with meal-worms and millet. The birds remained quite healthy on this diet and proved to be charming cage-birds.

The male song is similar to that of *Emberiza cioides ciopsis*, but comparatively simpler, and may be syllabized as "bee bee zit zou". The call-note is quite the same as that of *cioides*, a two-syllabled "zi-zin".

In confinement *jankowskii* tends to develop white feathers, especially in the quills, during moult, resembling *Emberiza variabilis* in this point.

### Nesting

The first nest was discovered on 31 May, 1939 in a meadowland near Butsu-yakou, Toning. The nest was placed on the ground at the base of small apricot tree, and made of oak leaves and grasses lined with hair. The inside diameter of the nest measures 7 cm. Five young about five days old were found in this nest, which were collected as alcoholics. They are incubated by the female alone. The down plumage is grayish and traceable in the occipital-, ulnar-, femoral-, spinal-, humeral-, crural-, and ventral tracts, though somewhat are obscured by abrasion.

The second nest was discovered on the 19th of May 1940 also on the ground and under a small oak tree. The first egg was laid on 24th, the fourth egg was on the 27th. Thus an egg was laid daily until the clutch was completed. When Mr. Yamagata discovered the second nest wired me from Toning to Tokyo to ask how he should treat the eggs. I told

him to collect one egg but to leave the others in the nest so that the species breeding habits could be observed. Mr. Yamagata did as I told him, but unfortunately all the eggs disappeared from the nest on the 29th, most probably taken by mischievous native children. The measurement of single egg collected was  $20 \times 15$  mm. The ground color of the shell is grayish white, in which faint purplish shell marks are visible. The overlaying irregular spots and short lines of dark brown are evenly distributed and do not form a cap around the larger end. Speaking in general, it resembles the eggs of *Emberiza sulphurata* and that of *Emberiza citrinella*.

A third nest containing five eggs was found on the 30th of May, 1941 in the same meadow. Mr. Yamagata collected one egg (No. 5) at once, and left all other eggs in the nest after having measured their size and weight. These eggs also disappeared from the nest on 10 June. The colour of egg (No. 5) is similar to that of the first already described. Measurements and weight of these eggs in Mr. Yamagata's note are as follows: No. 1-  $18.5 \times 13.5$  mm., 1.95 gr, No. 2-  $18.3 \times 13.5$  mm., 1.95 gr., No. 3-  $18.5 \times 14.0$  mm., 2.00 gr.; No. 4-  $18.0 \times 14.0$  mm., No. 5-  $17.5 \times 13.5$  mm.<sup>1)</sup>, 1.90 gr.

### Origin of the species

*Emberiza jankowskii* has a very limited distribution, the radius of its main breeding range is about 50 km. Even in the winter it does not seem to move more than 500 km from the centre of its breeding area. However, it has marked specific characteristics in colour of plumage, structure of tail feathers, colour of eggs and type of song. It breeds separately alongside its nearest relative, *Emberiza cioides weigoldi*. Therefore, it is clearly a distinct species, independent of all other species of *Emberiza*.

The nearest relative of *Emberiza jankowskii* is most likely *Emberiza cioides* as previous investigators have suggested (Hartert 1910, Shulpin 1928, Meise 1934). The similarity of color patterns in the head, and the general color of the body, especially in the immatures, (Shulpin 1928) support this conjecture, and the resemblance of the two-syllable call notes and its nonmigratory nature which is rarely found in *Emberiza*, also strengthen it. However, the rather narrow and pointed tail feathers and the paler body color suggest relationship to *Emberiza leucocephalos*, which is perhaps why Sztolcman (1925) considered *jankowskii* to be a hybrid between *Emberiza cioides* and *Emberiza leucocephalos*. This theory is disproved by the study of its life history, but is possible hybrid origin is worthy of consideration.

Species formation by hybridization postulates the successful pure breeding of hybrid offspring, as I have previously discussed in the study of *Anas oustaleti* (Yamashina 1948). Thus the stock's parent of the original species must have lived together. If these original stocks were to hybridize, through repeated back-crosses, the original species should finally be eliminated because there is no condition to allow the pure breeding of the hybrid.

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1) The author's measurements.

*Emberiza jankowskii*, however, has developed in distinct, restricted part of the continent. Therefore, its origin must be considered from a totally different standpoint.

According to recent investigations of evolutionary genetics, there are three mechanisms by which living organisms may evolve. One is gene mutation of phenotype (Yamashina 1949). If this phenomenon alone appears in the chromosomes of individuals belonging to one group of animals, and if the number of such individuals increase in that group until it predominates in that group of animals, a new "race" may be produced, which is called either a "geographical race" or "domestic race", according to the kind of isolation mechanisms. Examples of such cases exist in many groups of animals.

In this case it is well known that the speed of the race formation depends on the following factors:

- (1) The frequency of gene-mutations, (2) The size of the group of animals, (3) The length of one generation, (4) The selection, and (5) The isolation from the neighbouring groups.

Through the accumulation of gene mutation, the superficial characteristics of one group may be diverge ever so much from those of the original group, but the species is never formed by this way. For instance, the superficial differentiation between many races of the domestic fowl or the domestic pigeon which are derived by this way far surpass those between some species or even genera of other birds, but they do not differ specifically from each other.

On the other hand, in some wild birds the superficial difference between species is far less than that between races of other species. For instance, the morphological differences between *Parus palustris* and *Parus atricapillus* throughout Eurasia are far less than between the races of *Parus varius* in the Riukiu Islands. These facts show that the phenotypical difference between two species are not essential ones. An essential difference between two species must be in chromosome constitution, proved in the dipteran insects (Sturtevant & Dobzhansky 1936, Metz 1941, etc.). The dissimilarity of chromosome constitution is derived from chromosome aberration and gene mutation of conjugability (Yamashina 1942). Thus these two mechanisms appearing in the chromosomes are basic factors of the species formation. If these phenomena have occurred in the chromosomes of some individuals to produce several homozygotes in the new chromosome constitution, and if all the new individuals have complete vitality and breeding ability a new species is formed.

Now, conjecture that once upon a time a chromosome aberration may have occurred in some individuals of *Emberiza cioides weigoldi* living around the Posiet Bay of south Ussuriland. In the next step, some homozygotes bearing the new chromosome complex may have been produced. These homozygotes with the new chromosome constitution could have been the original stock of *Emberiza jankowskii*. These homozygotes, the newly born *Emberiza jankowskii* found a suitable environment in south Ussuriland, and therefore, they propagated and expanded their distribution to its present state.

In this explanation, we must consider that *Emberiza jankowskii* as a young

species not far from its prototype. Its distributional pattern is comparable with those of other young species now expanding their distribution rather than with those of old species falling into extinction. A good example of the former case is the *Sturnus vulgaris* stock released in New York in 1890-1. According to Cook's investigation (1928), a centre of distribution was at first formed by these starlings, where they were thickly populated. In the next step, as overpopulation developed there, the individuals spread, especially in winter. In the beginning, these individuals spreading from the centre of distribution returned to their homes perhaps due to their homing instinct. But individuals finally colonized somewhere outside of the centre. The increase of such colonies resulted in the expansion of their distribution.

If the distributional pattern of *Emberiza jankowskii* (see map in Fig. 1) be compared with that of *Sturnus vulgaris* made by Cook (1928), we see a remarkable similarity between them. Namely, both species have a centre of distribution where the species are thickly populated. Outside but not far from this centre, we find a line of colonies. And in winter the species spreads beyond this limit.

The distributional pattern of old species falling into extinction is quite different. For instance, *Dryocopus javensis richardsi*, a magnificent Woodpecker now almost extinct is found very sporadically in central and southern Korea as well as in Tsushima Island. There is no centre of distribution where the species is actively propagating. In every part of its distribution the species is being exterminated like the tide pools in the beach fade away in turn. There is no resemblance between the distributional pattern of this Woodpecker and that of *Emberiza jankowskii*. Thus *Emberiza jankowskii* is considered from the distributional point of view to be a young species not far from its formation, rather than an old relic species, though the distribution is very limited.

### Discussion and conclusion

Two valuable papers on speciation in Passerine birds have been published recently, Miller's (1941) and Lack's (1947). Miller (1941) emphasized geographic isolation as most essential to the process of segregation in speciation in the Genus *Junco*. Lack (1947) concluded that adaptation performed the greatest role in speciation in *Geospiza*. These two mechanisms are, of course, very important in the phenotypical divergence of species, but phenotypical differences derived by these ways are not essentially characteristic of any species. No one can apply the species concept to *Gallus gallus* when including its various domestic races from the morphological point of view alone, as the species *Gallus gallus* really exists as "a group of individuals which can produce totally fertile  $F_1$  offspring" (Yamashina 1945, 1949). The essential characteristics of any species are in its physiological characteristics, not in its morphological ones.

The phenotypical characteristics peculiar to the species are classified in two kinds:

(1) *The phenotypical characteristics bearing on speciation*: Some genes at a part of the chromosome, where it is torn off or attached on the occasion of chro-

mosome aberration, may lead to mutation. The phenotypes governed by such mutant genes have a bearing on speciation. The genes transferred at the time of chromosome aberration may change the phenotype from "position effect". Phenotype governed by such genes have also a bearing on speciation.

(2) *Phenotypical characteristics not bearing on speciation*: All groups of individuals have natural racial divergences caused by the spreading of mutant genes. Thus, the species as a group of individuals, which is isolated from other individuals may yield other "races" from the original one. Such race formation can occur either before or after that group had formed a species. If the species is formed on an island when isolation is complete, phenotypical characteristics of this kind are frequently greater than in other cases. Such phenotypical characteristics have no bearing on essential speciation.

Current investigators fail to distinguish between these two kinds of phenotypical characteristics involved species formation. Geographical isolation and adaptation, as proposed by Miller and Lack as the chief factors of speciation, are merely factors which promote "race formation" of species as "a group of individuals", as indicated in (2). Phenotypical characteristics essential to species formation as indicated in (1) must be acquired at the occasion of chromosome aberration, and maintained by that species, so far as they are suitable to the environment in which the species is going to establish itself. The number of individuals having such characteristics may increase as the number of individuals of the species increases.

The chief phenotypical characteristics of *Emberiza jankowskii* are considered to belong to the first kind mentioned in (1), because, first, the age of the species is considered to be too short to have allowed race-formation by adaptation. Second, the species is considered to have developed among its probable parent species without any isolation, and third, the species is quite homogenous in its superficial characters, showing none of the variation considered to be indispensable during race-formation. These facts suggest conversely that *Emberiza jankowskii* has developed non-adaptively. The tailfeathers, which resemble those of *Emberiza leucocephalos* may be attributed to parallel mutation, which appeared at the time of chromosome aberration. The fact that a character of one species found in other species is proved by Miller (1941) in the Genus *Junco*. The chestnut patch on the abdomen of *Emberiza jankowskii* recalls the pattern of the hooded rat investigated by Castle (1916). The gene influencing the patch of *Emberiza jankowskii* may be a different one which is more stable than that of the hooded rat, but it is conceivable that such a plumage pattern as in *Emberiza jankowskii* may be due to several gene mutations occurring at the time when the chromosome aberrations appeared in the ancestral stock of *Emberiza jankowskii*.

Species formation without adaptation and isolation (geographical) seems to have been reported rarely by previous workers, but it seems to be rather common among birds. Species having strong vitality but very limited distributions which overlap with those of closely related species, are often found among the buntings,



thrushes, and other passerines, *Emberiza chrysophrys*, *Turdus hortulorum*, *Bombicilla japonica* are good examples of this type of species. According to the present studies on *Emberiza jankowskii*, such species may be considered to be young species not far from their first formation. Further, the origin of many species belonging to the various vigorous genera such as *Emberiza* and *Turdus* may be explained by the same way. We often see two similar species, clearly distinguishable in coloration, breeding side by side in the same environment. For instance, we often see the nests of *Turdus cardis* and *Turdus chrysolaus* built in the same forest, only a few meters apart. From the view-point of the natural selection theory, it is unaccountable, but if we consider that the species is formed essentially by non-selective evolution as mentioned above, it is remarkable. The presence of very similar species and that of very different conspecific races may be explained only in this way. *Emberiza jankowskii* is, I think, one of the most interesting and important examples for the study of avian speciation. Recent study of Udagawa (1954) reported that karyotype of *Emberiza fucata* differs from those of *E. elegans* and *E. spodocephala*.

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