Study of variability of beak in Reed Bunting (*Emberiza schoeniclus* L.) using superimposition of contours (Aves: Emberizidae)

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Emberiza schoeniclus ukrainae (Zarudny, 1917), *E. s. tschusii* Reiser & Almasy, 1898 and *E. s. volgae* Stresemann, 1919 can be distinguished using superimposition of contours of the beak.

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Verbal characteristics have been usually used in taxonomic studies to describe the shapes of different objects (e.g. "cubiform shell', "violently arch convex incurvature of culmen", etc.). Such characteristics are quite subjective and often are not sufficient to determine fine differences between similar species or subspecies. Therefore, corresponding geometric or trigonometric characteristics sometimes are calculated for comparative studies of structural features, as they objectively reflect details of configurations. In certain cases, the differences between the shapes of objects can be detected without such labour-consuming calculations by using superimposition of exact contour projections made on transparent films with the help of a drawing apparatus (Logvinenko & Starobogatov, 1971; Skarlato et al., 1990, etc.).

One of the important diagnostic characteristics of birds is the beak shape. For example, the variability of the beak shape in Reed Bunting (*Emberiza schoeniclus* L.) clearly reflects interspecies differentiation. According to Portenko (1928, 1960), the beaks of some subspecies of this bird may have similar measurements of length, height and width but can significantly differ in curvature grade of upper mandible, which is traditionally described by qualitative characteristics. The rare attempts to express the curvature of the beak by corresponding numerical values were quite unsuccessful. The mode of calculation of the Reed Bunting beak curvature proposed by Matouš ek (1968) was based on determining the height of epitheca segment displayed in the line connecting the nostril opening with the upper mandible tip. This approach did not consider the fact that the nostril openings may be located in various parts of the proximal epitheca in different individuals.

I examined birds of three subspecies distributed in the south of the European part of Russia: *E. schoeniclus ukrainae* (Zarudny, 1917), *E. s. tschusii* Reiser & Almasy, 1898 and *E. s. volgae* Stresemann, 1919 (Bakhtadze, 2001). The series examined, partly collected by myself, included adult males obtained during nesting period in different areas of the named territory: *E. s. ukrainae* from the basin of the middle Don in the northern part of Rostov Prov. and neighbouring areas of Voronezh Prov. (6 specimens, deposited at Zoological Institute, St. Petersburg, further ZIN); *E. s. tschusii* from the Don delta (20 specimens, deposited at ZIN and Kiev National University); *E. s. volgae* from the western part of Caspian Lowland (17 specimens; deposited at ZIN). In addition, the beak conformation was studied in 10 specimens of *E. s. pyrrhuloides* Pallas, 1811 from the territory around the Sea of Aral and from SW Kazakhstan (ZIN collection).

The lateral profile of upper mandible was drawn for every individual. To do this, the stuffed bird was fixed in certain position (porous plates and entomological pins were used) and placed on the sample table of stereomicroscope (MBS-9) equipped with a drawing apparatus. A scale was positioned on the same level with the upper mandible for subsequent scaling. The 6–10× magnification was used to perform the drawings; 1 cm scale was marked on each picture. The drawings were equally scaled by using epidiascope and transferred to transparent films. It became obvious that the nostril openings occupy various posi-

Fig. 1. Transformation of images of the upper mandible from the birds of *E. s. volgae* collected in Caspian Lowland: **A,** contours of projections of 17 individuals; **B**, area of epitheca variation.

tions in different individuals. Therefore, the nostril opening location was not used further for analysis of the drawings. Two subjectively chosen points in the distal part of the lower (cutting) mandible edge were used to align the images: the tip of the upper mandible and a point on its lower edge at a distance of 3.3 mm from the tip. Superimposition of the drawings from different individuals resulted in corresponding images presented by multilinear profiles (Fig. 1A). Further processing of these images revealed the variation area of beak epitheca shape (Fig. 1B), which forms a space between peripheric lines. The final step of evaluation consisted in superimposition of images prepared for different processed series.

Distinct differences between the processed series of *E. s. ukrainae*, *E. s. tschusii* and *E. s. volgae* are revealed (Fig. 2). Each subspecies demonstrates a particular type of the upper mandible configuration against a background of a rather wide individual variability of epitheca expressed on the image as corresponding cross-hatched areas. These data confirm the real existence of different Reed Bunting subspecies in South Russia. The processed representatives of *E. s. ukrainae* differ from other investigated birds in the thinnest and slightly curved upper mandible. Vaurie (1959) classified this subspecies to the group of thin-beaked Read Bunting (“*schoeniclus*”). The results of this study are entirely in agreement with observations made by Vaurie (1959) and Portenko (1960) who noticed that *E. s. ukrainae* has a particular type of beak “transitional” to that of southern Reed Bunting subspecies. Such “southern Reed Buntings” represented by a series of *E. s. tschusii* from the Don delta have a thicker beak with significantly curved culmen, which suggests these birds to be members of the “medium-beaked” group of Reed Buntings (“*intermedia*”). Among a number of *E. schoeniclus* subspecies spread in the south of European Russia, individuals of *E. s. tschusii* also occupy a “medium” position. They were distinct from the rather thin-beaked *E. s. ukrainae* as well as from the thick-beaked *E. s. volgae* (Fig. 2). A massive beak with strong arch curvature of the upper mandible typical of Reed Bunting from the western part of Caspian Lowland has been often associated with the beak of the Middle Asian subspecies *E. s. pyrrhuloides* (Stepanyan, 2003; Vaurie, 1959). This circumstance became one of the reasons to deny the taxonomic status of *E. s. volgae*. However, comparison of the upper mandible profiles of birds collected in the north-western part of Caspian Lowland and in Middle Asia (Fig. 3) revealed significant differences between them quite comparable with those of other Reed Bunting subspecies (e.g. *E. s. ukrainae* and *E. s. tschusii*). These differences justify the separation of a “thick-beaked” subspecies of Reed Bunting, *E. s. volgae* (subspecies group “*pyrrhuloides*”), inhabiting the north-west of the Caspian Lowland.

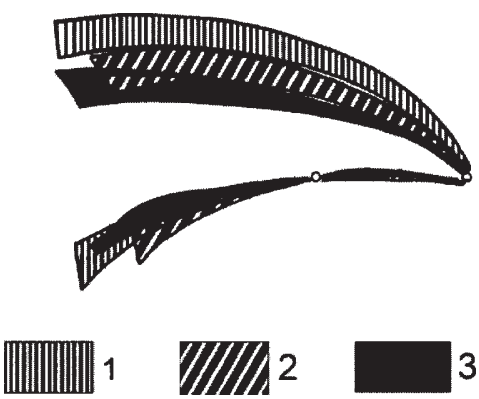

Fig. 2. Superimposition of the upper mandible projections in *E. s. ukrainae* (1), *E. s. tschusii* (2), and *E. s. volgae* (3).

The results obtained completely agree with the notion of a wide range of individual and geograph-

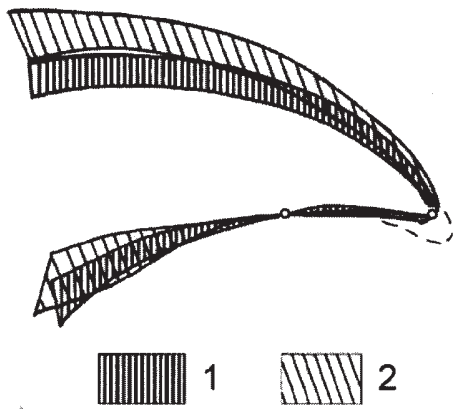

Fig. 3. Superimposition of the upper mandible projections in *E. s. volgae* (1) and *E. s. pyrrhuloides* (2). The dotted line shows the position of anomalous elongated and curved tine on the upper mandible in an individual of *E. s. pyrrhuloides*.

ical variability of the Reed Bunting's beak shape. The differences in the beak shape and size in subspecies of this species could be due to unequal adaptation for getting of food (Stegmann, 1948).

Superimposition of contours can become a promising method for studying the variability of structural features in other species of birds.

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