

## Bird Species in Avian Collections - A Unique Source of Information

Roald L. POTAPOV

Zoological Museum and Zoological Institute, University of St. Petersburg, Russia

**Abstract.** Progress in the study of the functional significance of the wing's shape and size yields new possibilities for receiving information about the species' flight. This is important for species which are either very rare, inhabit remote areas, or are extinct, but still available in ornithological collections. Relative length of primaries and secondaries (the wing shape), the degree of wear of inner and outer webs of flight feathers, shape of its tops and other details allow understanding the main type of flight of the species and its role in its life. Another important source of information from collected specimens is the pattern of tarsus scalation. It has no functional significance and, as an ancient structure and independent from natural selection, gives an additional evidence of phylogenetic relationships between different taxa.

**Key words.** Avian collections, wing shape, scalation

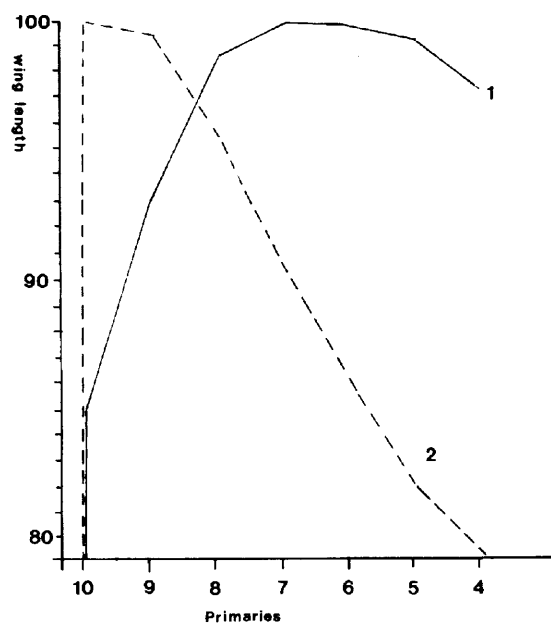
### 1. INTRODUCTION

With enthusiasm we should revive our interest towards museum bird collections. Ornithological collections represent the main source of a scientific ornithology, and they remain very important. In the present paper, we intend to attract attention to two features of the external morphology, which are well preserved in traditionally prepared specimens. These are the wing shape and scalation of the leg.

The wing shape contains information about the type of flight and its role in the life of a particular specimen representing a certain population or species. Wing shape is a clearly adaptive trait and may vary within a taxon in space and time. In contrast, the shape and position of the scales of the leg is a very stable character without clear adaptive traits and, simultaneously, is an old feature which birds inherited from their reptile ancestors.

### 2. WING SHAPE

It is well known that in all species which fly simply with up and down wing-strokes, the wing is composed of two functionally different parts – primaries fixed at the hand-bone and secondaries fixed at the forearm bone. Primary feathers, especially the external ones, execute the motion function, whereas the flat built secondary feathers execute the carrying function. To characterize interactions between these parts and peculiarities of the structure, the term „sharpness of the wing“ is applied. This reflects both the shape of the tip of the wing, built by external primaries, and width of the wing (more precisely: width of the supporting part of the wing, formed mainly by the secondaries) and the width-length ratio. Sharpness of the wing increases when the longest feather is close to the fore edge of the wing and when the wing is narrow (Fig. 1). Sometimes, sharpness of the wing



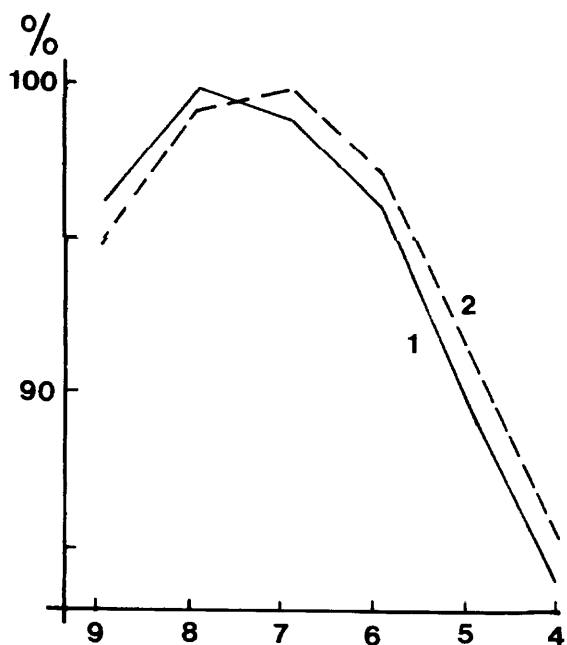
**Fig.1:** The shape of the tip of the wings:

1 *Cryptoplectron manipurensis* (Phasianidae) – a species with strongly sedentary mode of life;

2 *Coturnix coturnix coturnix* (Phasianidae) – migrant.

causes abrupt decrease of the length of the outermost (10th) primary (AVERILL 1925; STEGMANN 1961). The sharper the wing, the more rapid is the flight, the longer is its migration route and the more complicated is the wind in the area where food is taken. It has been well known for some time that migrating populations differ from sedentary ones by a sharper wing shape („Sibome's Rule“). One should take into account that in migrating birds, wing shape represents a compromise between requirements of flight during migration and that of everyday life (POTAPOV 1974). „Sibome's

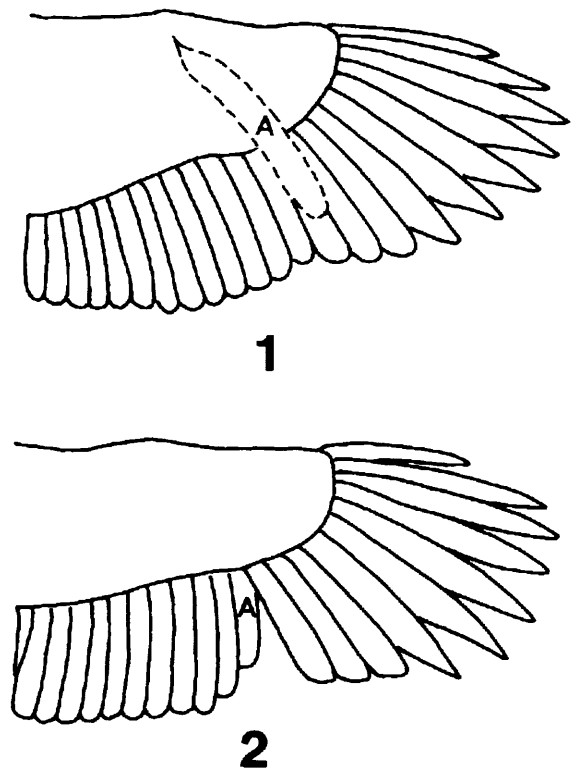
Rule“ was not accepted by all authors (RENSCH 1934; TUGARINOV 1946) and a correlation between wing sharpness and geographic latitude in conspecific populations was often applied instead: in northern populations the wing is sharper than in southern ones. A detailed analysis of all facts was performed to test both hypothesis. The results did not support the correlation with latitude, whereas there were no contradictions to Sibome’s Rule (POTAPOV 1967). The rare case of *Passer domesticus* where northern populations are sedentary and the southern subspecies migrates (POTAPOV 1967) is mentioned in this connection: the migratory subspecies has sharper wings, although it lives much farther to the south than the northern one (Fig. 2).



**Fig.2:** The shape of the tip of the wings in two populations of the House Sparrow (from POTAPOV 1967):

- 1 - sedentary population in Central Europe;  
2 - migrant population (*Passer domesticus bactrianus*) in Southern Tadjikistan.

All necessary variables for the estimation of wing sharpness can easily be taken from typical collection specimens where the wings are fixed in the naturally closed state. In this position, the wing is easier to measure than when it is dried in the open state. The reason is that drying of the open wing causes uneven desiccation of tissues, and feathers lose their natural position, whereas in normally folded wings this is not the case. For instance, in dried open wings of galliform birds the first (shortened) secondary forms the



**Fig. 3:** The shape of the opened wing and position of the first (shortened) secondary (A):

- 1 - in fresh specimen of *Tetrao urogallus* (male);  
2 - in dried specimen of *Centrocercus urophasianus* (from: DROVETSKI 1996).

hind edge of the wing (Fig.3,2). Therefore in dried open wings of Galliformes, a notch exists at the junction of primaries and secondaries. DROVETSKY (1994) devoted a technically complicated study to this notch, which in reality is an artefact appearing when a wing is dried. In living birds this shortened first secondary lies below the first primary, obviously strengthening the position of the latter (Fig. 3,1). The rear border of the wing of living Galliformes is smooth, without any notch where the primaries pass over to the secondaries.

In collected specimens with folded wings the longest primary forms the tip and the distance between the primaries can easily be measured. These distances, expressed in percent of the wing length and plotted on a graph, provide a clear picture of the shape of the wing and its sharpness. Wing breadth is measured as the distance from hand joint to the tip of the first secondary, which has a normal length (usually the 2<sup>nd</sup> or 3<sup>rd</sup>) and is expressed in percent of the wing length.

What use is such examination of the wing shape? It provides an opportunity

- to estimate the relative length of migration route in different populations of the same migratory species;
- to estimate the relative length of migration route in several migratory congeneric species (KIPP 1958, 1959);
- to estimate the degree of flying potential in rare or extinct species in comparison with their better studied close relatives;
- to get an idea about the differences in life mode in representatives of conspecific populations of species with wide range, covering areas with quite different life conditions, and
- to provide another possibility, in samples collected during migrations or winterings, to differentiate local birds from migrating or wintering ones (PAVLOVA 1988; TSVELYKH 1993; TSVELYKH & MALANDZIA 1994).

The following examples illustrate the first three points.

**Rufous Warbler** – *Cercotrichas galactotes* L. Collected specimens of two subspecies have been studied, one of them living in the Transcaucasus, another

in Central Asia. Wintering sites of both populations lie in the same area in Near East, but differences in the migration route reach ca. 1,000 km. It is not difficult to see that the wing of birds from the Central Asia is sharper (Fig. 4a, Table 1).

**Brambling** – *Fringilla montifringilla* L. Wing is sharper compared with its closest relative, the Chaffinch (*F. coelebs*). The wintering sites of both species are the same, but the breeding area of the Brambling lies farther north than that of the Chaffinch. Wings of specimens from north-eastern Europe are compared (Table 2).

**Himalayan Quail** – *Ophryzia superciliaris* L. – an extinct species with almost unknown biology. The species inhabited steep grassland foothills of the Himalayas and had an extremely narrow range. The last specimen was collected in 1876. It is a close relative to Himalayan forest partridges of the genera *Arborophila* and *Bambusicola*. Wing shape is almost identical to that of the strictly sedentary species, *Arborophila mandelli*, which does not migrate even on a seasonal basis (Fig. 4b). The examination of wing shape in the extinct species allows us to suppose

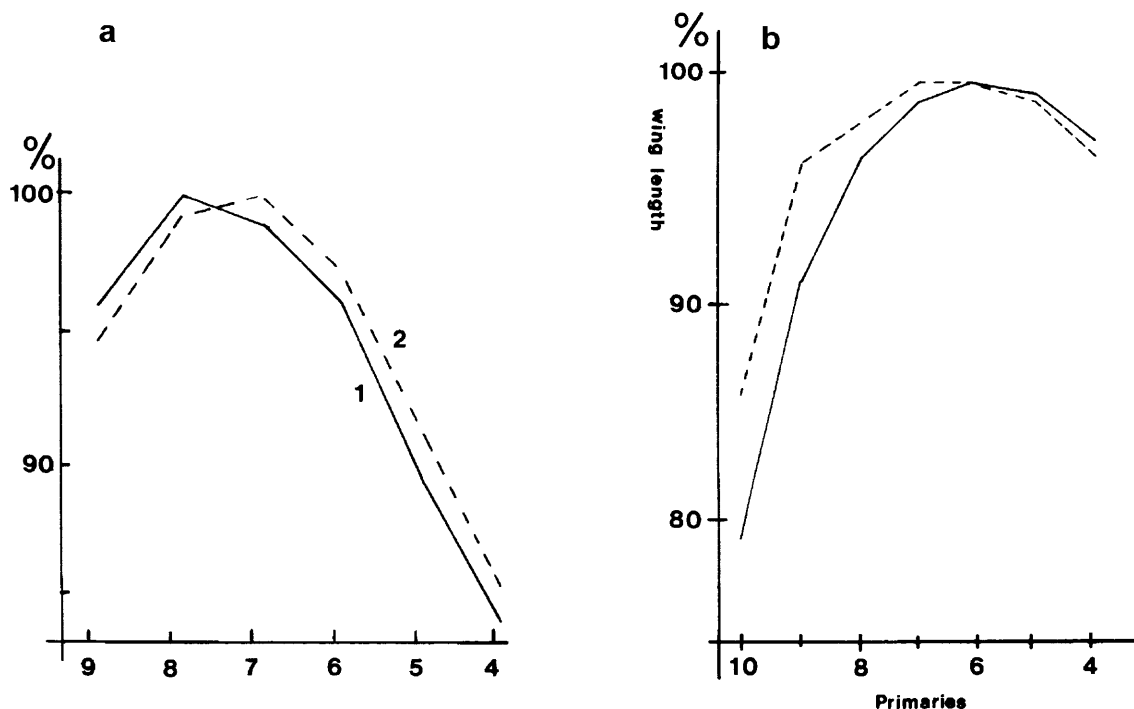


Fig. 4: The shape of the tip of the wings:

**a:** in two populations of *Agrobates galactotes*, Turdidae (from POTAPOV 1967): 1 - Transcaucasian population with short distance of migration (not exceeding 1000 km) 2 - Eastern Middle Asian population with long distance of migration (more than 1600 km). Wing length - in %; 1, 2..- numbers of primaries.

**b:** in two sedentary species of Himalayan partridges:

1 - *Ophryzia superciliaris*

2 - *Arborophila mandelli*

that this species was also non-migratory and flew exclusively between the slopes to avoid threats. HUME & MARSHALL (1879) supposed that the species was a wintering guest at its collection sites, being a migrating species from unknown breeding places. But the shape of the wings tells us that the flight was of an explosive, vertical type with sequences of short wing beats interrupted by gliding. The wing of *Ophrysia* was broader than in *A. mandelli* – 83.6% and 79.2% of the wing length of the latter.

Applications of the proposed method may be much wider, in particular for the study of the ontogenetic development of flight characteristics of different species or to discover intersexual differences in life style etc. In comparative analyses one should use specimens with the same degree of abrasion of feathers and in comparisons between populations one should take into account that differences in the wing shape will be stronger in more isolated populations. In recent years, special formulae have been developed which can help to calculate the degree of sharpness (TSVELYKH 1983). When someone uses such formulae he should take into consideration that such a formula neglects many peculiarities of wing shape, and this may lead to loss of important information.

### 3. SCALATION OF THE LEG

GADOW (1891-93) was the first to stress the high taxonomic importance of leg scalation in birds, but later

this character was not regularly examined, so that phylogenetic studies only rarely mentioned this feature (for instance, for the reconstruction of phylogenetic relations of the family Tetraonidae (POTAPOV 1965)).

The variability of foot scalation, in particular within the ancient order Galliformes forced us to examine the diversity of this trait for different taxa. This work is still far from completion, but some conclusions can already be ruled out. The scalation of the leg proved indeed to be very stable within a species or within a genus (provided that monophyly of a genus is evident). A complete absence of variation in leg scalation was shown within the genera *Alectoris*, *Arborophila*, *Tetraogallus*, *Perdix*, as well as for the entire family of Tetraonidae and, with one or two exceptions, in the families Numididae and Odontophoridae. On the other hand, within the largest genus of Galliformes, *Francolinus*, we discovered several types of scalation (Fig. 5), which is already published (POTAPOV 1999). This fact supports the polyphyletic origin of the genus (CROVE et al. 1992). Currently, we are preparing a special publication on this subject.

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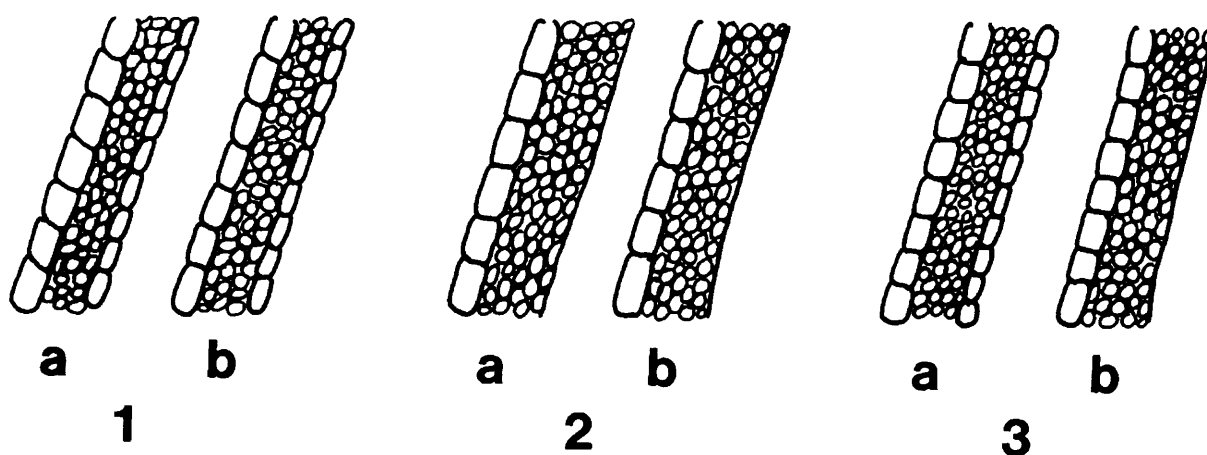


Fig. 5: Three main types of tarsi scalation in *Francolinus*:

a - in outer side,  
b - in inner side.

Type 1 (most of the species) - with two back rows of scales, larger than in nearest, but smaller than the scales in two frontal rows.

Type 2 - without back rows of larger scales than on the sides of the tarsus. The spurs are not shown.

Type 3 - with only one back row.

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Roald POTAPOV, Department of Ornithology, Zoological Museum and Zoological Institute, University of St. Petersburg, grouse@RP4401.spb.edu