THE RELATIVE VALUE OF BIRD MEASUREMENTS

By W. H. BERGTOLD

AN ORNITHOLOGIST who has at hand a large skin collection experiences little or no difficulty in making a subspecific diagnosis of a given specimen. It is quite different with one who has but a small and incomplete collection, because present-day minute differences on which subspecies are based make the diagnosis of them at times extremely difficult in the absence of a large series of skins for comparison. This is all the more true if he be called upon to identify a bird from one or two of its fragments only. Every ornithologist is called upon from time to time to determine the species or subspecies under such circumstances. In many cases this presents no real difficulties because some of the fragments may be so characteristic as to preclude the possibility of a mistake; thus the wing of a mockingbird, of a Townsend solitaire, or of a western tanager cannot be mistaken for that of any other bird. This, however, cannot be said of most of the juncos, many sparrows, crows, and snow geese, for example. With species or subspecies having quite similar plumages a diagnosis from fragments alone may be impossible without a large sized skin collection. Thus in such situations the wing measurement might throw the specimen into one subspecies and the tarsal length into another. This actually occurred to me while studying Colorado crows, at which time a cursory search was made in bird literature to ascertain if anyone had tried to discover in, or to give to, the usual bird measurements definite or relative values, which could be used as quantitative aids in diagnosis; but my search uncovered nothing.

It was thereupon decided to attempt to find such valuations, if it were possible with the available data. The method of investigation was substantially as follows: Tables of the minimum, maximum and average of the four mensural characters of a bird were selected for investigation, namely, length of wing, of tail, of tarsus, and of bill. The total length (tip of bill to tip of tail) was not included, as the available data covering this character are taken from skins, data relatively unreliable since the artifacts in the skins due to methods of preparation, etc., give this character an introduced variability. Tables of the minimum, maximum and average of the aforesaid measurements of various species of a single group, such as owls and shore-birds, were compiled. The average as given by Ridgway in his Birds of North and Middle America was taken as the normal or 100. This seems a fairly safe procedure since this average is struck from all the measurements of any series measured, and is not the mean. The percent departures of the minimum and the maximum from the average were then computed and tabulated. The measurements of males only, were utilized because males preponderate in the data recorded by Ridgway, this preponderance giving larger series from which to draw conclusions. Measurement variations in females were studied in a superficial way, through which it became patent that variations of a mensural nature in males were closely paralleled by those in females; hence it was deemed unnecessary to include females in a separate study.

I was unable to study measurement variations in ducks, hawks, and geese, because Ridgway's work has not yet included these groups. I was able, however, through the kind offices of Dr. A. K. Fisher and Dr. Alexander Wetmore, to give some attention to certain terrestrial birds, such as quails and sage-hens, which groups agree substantially with the conclusions reached with the other twenty groups.

TABLE No. 1

Species	Wing length			Tail length			Bill length			Tarsus length		
Spurred	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.
Towhee	83.57	86.11	92.71	90.17	100.33	111.51	12.19	13.46	14.73	26.42	27.69	29.21
Variation (greatest)												
Below average			2.9%			9.1%			9.4%			4.6%
Above average			7.7%			11.1%			9.4%			5.5%

Ridgway measured fifty male Spurred Towhees; the *average* wing length of this series was 86.11 millimeters, the shortest wing length was 83.57, and the longest 92.71. From these data it appears that the minimum wing length of these fifty specimens was 2.57 millimeters less than the average, and that the longest wing exceeded the average by 6.60 millimeters, whence one can deduce the fact that the shortest wing departed 2.9% and the longest 7.7% from the average. Table no. 1 illustrates this statement. The measurements of the bill, wing, tarsus and tail as given by Ridgway for two hundred different species of North and Middle American birds were treated in this manner, after which the percent departures were utilized to construct graphs displaying the curves of departures above and below the average. It is not possible, because of the cost, to publish copies of these graphs, nor yet of the tables of departures. A summary of the results can be, and is hereby, given.

The measurement data given by Ridgway and utilized in this study show variations in individuals only in so far as they record the minimum and the maximum, of the characters as they occur in some particular individual of the group; the data do not show if the variations in a given specimen follow similar curves in all four characters. That is to say, it cannot be determined whether or not the variations in measurements of tail, bill or tarsus necessarily follow the curve of the variation in the wing. It might be that a wing varies plus and the other members minus. However, in a manner I was able to answer this question from Ridgway's data concerning Spurred Towhees, for he gives tables of measurements of this species in groups, one including fifteen males, a second ten males, and the third fourteen males. The average wing length of the individuals of these three groups (plus eleven more) taken together (fifty) is 86.11 millimeters, while that of the group of fifteen is 4% longer than the average, .3% longer in the group of ten, and 1.4% longer in the group of fourteen. In the group of fifteen alone the wing is, as said, 4% longer than the average, but the tail is only 3.7% longer than the average, and both bill and tarsus have negligible departure from the average. In the group of fourteen the relations are quite different; the wing, tail and tarsus exhibit departures above the average of 4, 2, and 1% respectively, while the bill is shorter than the average by 2.7%. Also, I have been able to answer this question so far as it applies to some quail, sage-hens, prairie chickens and Bohemian waxwings, and can say that variations in one mensural character are seldom correlated with, or run parallel with, the variations of the other measurable characters.

If it be assumed that the evidence evoked by this method of examination is valid and correct one can say from a casual examination of the data that the wing shows the narrowest range of variation, and the bill and tail the widest.

If one arbitrarily takes ten per cent as the normal limit of variation below and above the average, and tabulates the number of times this limit is exceeded either way, some interesting facts are uncovered. By such a tabulation (table no. 2) we learn that in the two hundred species under review, the wing is but four times above and four times below the limit of variation assumed, yet the bill is fifty-seven times above and fifty-seven times below, and so on. If one adds together the times the measurements go outside this zone (above or below the 10%), with all the species in

the four principal mensural characters, and compares each with each, it is found that the wing is nine and one-half times more valuable than the tail, three and one-half times more valuable than the tarsus and eleven and three-quarters times more valuable than the bill in the use of these characters in deciding closely related subspecies, as well as with more or less similar species.

TABLE No. 2

Number of departures more than 10% from the average

Groups of species, 20 in each	Number of individuals	Wing	Tail	Bill	Tarsus
Wrens, Titmice, Nuthatches, etc.	395	0	2	13	3
Skimmers, Gulls, Terns, etc.	210	0	18	12	3
Crows, Jays, Blackbirds, etc.	419	2	13	11	3
Goatsuckers, Swallows, etc.	418	2	6	25	4
Woodpeckers, Toucans, etc.	432	1	7	12	2
Finches	743	0	8	14	6
Shore-birds	231	1	8	4	2
Owls	216	1	4	5	*
Tanagers, Wood Warblers	378	1	4	8	3
Thrushes, Thrashers, etc.	395	0	6	10	2
Total	3,837	8	76	114	28

* Data not available.

If we take one hundred as the number of points of value to be given to all four characters taken together, and then divide them proportionately according to the above valuation, it can be said that the wing's usefulness is sixty-eight, the tarsus' twenty, the tail's seven, and the bill's only five. Hence I now feel that if I had two crows to identify as to subspecies I would give these values to their measurements, to help me allocate the crows as to subspecies. These valuations make it look as if the wing would decide the question in all cases, as its value is greater than the three others combined; if, however, one other measurement substantiated that of the wing the case would be thereby all the stronger.

It seems to me that the results of this brief study are in line with what one, *a priori*, would assume to exist. It is a common experience to find a bird with a distorted bill, or tarsus, or a missing tarsus, and it is a matter of common observation that a bird may do pretty well without the tail, and despite any or all of these abnormalities may be vigorous and able to maintain its own. But a bird with a broken or disabled wing or a markedly abnormal wing does not survive long.

SUMMARY: 1. It is possible that the present method of investigation is not the correct way to solve the problem under consideration; furthermore, it is equally possible that there is no ultimate solution to it. 2. On the assumption that the method employed in this study is correct, the following values may be given to bird measurements: The wing, 68 points; the tarsus, 20 points; the tail, 7 points; and the bill, 5 points.

Denver, Colorado, December 15, 1924.