TOP: BARN OWL
MIDDLE: Cooper's Hawk (HY-M) and a Sharp-shinned Hawk (HY-F)

(photos by William S. Clark)

WHY ARE BIRDS' LEGS AS LONG AS THEY ARE?

By Stephen Fretwell, William Pursley, Grover Icenogle and Robert Tueling

In the process of banding birds, several measurements can be easily taken. Among these are generally included wing, tail, bill and tarsus lengths, along with notes on behavior, plumage, weight and fat. But the reasons for such measurements are sometimes not understood. In a previous paper on wing length, we argued that we can determine much of a bird's ecology by learning to understand the meanings of variations of such measurements. We began to pursue this possibility by studying variation in wing length between species of differing size, (Fretwell et al., 1973). We are continuing this analysis by studying the length of birds' legs.

It is easy to understand that birds that feed by wading through water would require longer legs than those feeding on the ground. Also, we can expect differences between birds which use their legs in catching prey in comparison with those which scratch for seeds on the ground or those which feed in trees. However, by looking at a slight difference in tarsus length we might also be able to detect fine differences in feeding behavior between species. For example, we might be able to learn where different sparrows perch. While most sparrows perch in weeds, presumably some perch higher than others or some perch in larger trees, smaller trees, or bushes. We can learn to understand such differences and to interpret it correctly by using information from leg length data, thus the collection and analysis of such data is important.

Leg length is most frequently determined by measuring the tarsus length. In this paper, we undertake an investigation of the variations in leg length. We will begin the process by first relating size (weight) to leg length. We will treat tarsus measurements as we previously treated wing measurements and will try to quantify or to be precise about the common sense idea that bigger birds will have longer legs. The question now is how much longer are the legs of bigger birds? How does a gram increase in average species body weight increase the average species leg length? In a later paper we will try to understand the variation away from this average increase, to determine the ecological adaptations of different species.

We need this analysis of tarsus length so that we can test our ideas about wing length. Obviously, many features of the ecology of a species that affect the evolution of wing length will also affect tarsus length. By obtaining a precise understanding of both, we can check out our findings on the above.

As was the case for our paper on wing length, we could approach this problem by looking at the loads put on the legs, and evaluate different possible stress factors as they relate to weight and structure. We will not approach leg length in this way; instead we will start by testing the simple assumption that overall shape of the birds does not change with size. We will model the relationship between the average tarsus length of a bird species to its average weight under the assumption of constant shape. Then we shall present some typical data to test the consequences of this model.

The Model

The model will be approached as before. We assume that the density of the birds stays the same, so that a big bird has just as much volume per gram of weight as a small one, and so that any change in one will likewise affect the other. Because of the difficulty in measuring the volume of a bird, we shall again imagine the bird laying within a box just big enough to achieve a snug fit. We assume that all birds will achieve an equally snug fit

Because we are assuming that all sized birds have equal shapes, it is reasonable to suppose that all the boxes holding different sized birds will have equal shapes. Thus the length and width of each box is some constant fraction of the height. The volume of the box is found by multiplying the length, the width, and the height. Since the width and length are constant fractions of the height, then the volume could be found by cubing the height and multiplying this number times these fractions. In short the volume of the box would be directly proportional to the height cubed, which we express in the equation below:

1) Volume of box = constant x $(\text{height})^3$

The birds are all taking up some other constant fraction of the boxes' volume. So the bird's volume is proportional to the boxes' volume. Writing this in a formula, we have:

2) Volume of bird = constant x (volume of box)

Substituting equation 1 in equation 2 we get:

3) Volume of bird = constant x $(\text{height})^3$

The constant in 3 is the fraction the volume of the bird is of the volume in the box times the fraction the boxes' width is of the height, times the fraction the boxes' height is of the length. Also, recall that the height of the box is equal to the tarsus length of the birds. Also, the volume of the bird is directly proportional to the weight of the bird. So we write:

4) Weight of bird = constant x $(\text{tarsus length})^3$

The new constant is the constant of 3 multiplied by the number of grams per cubic millimeter of bird, when squashed up in the box.

We will use the same data we used before when we examined wing length. We shall now multiply the tarsus length of each bird times itself three times, and then plot on graph paper the weight versus the tarsus length cubed. We expect a straight line, that when extrapolated back will go through zero weight and zero tarsus length. The slope will be the constant in equation 4.

We could also transform our raw data to logarithms, and then plot the data directly. We should again get a straight line, which has a slope of 3 (or 1/3), depending on whether we plot log weight versus log tarsus length, or log tarsus length versus log weight.

The data was collected by Bob Teulings on the outer banks of North Carolina in Operating Recovery, September through October, 1966. Using both methods in figure 1 and 2, the reader can see for himself that the model predicts the observed trends. In figure 1, we have plotted the cube of the tarsus length against the volumetric measurement weight. In figure 1 each point is a different individual. The species are grouped and circled. In figure 2, the mean tarsus length and body weight have been computed and then transformed into logarithms. The slope of the regression line is .316, very close to .33 the predicted value.

As was true in the wing length paper, in both graphs the points are quite scattered. This is cause for pleasure, because we hope to use the variation in tarsus length and wing length to explain the ecology of different species. It now is possible to study the variation taking body size into account to correlate the wing length and leg length in order to achieve a better understanding of the ecology of birds.

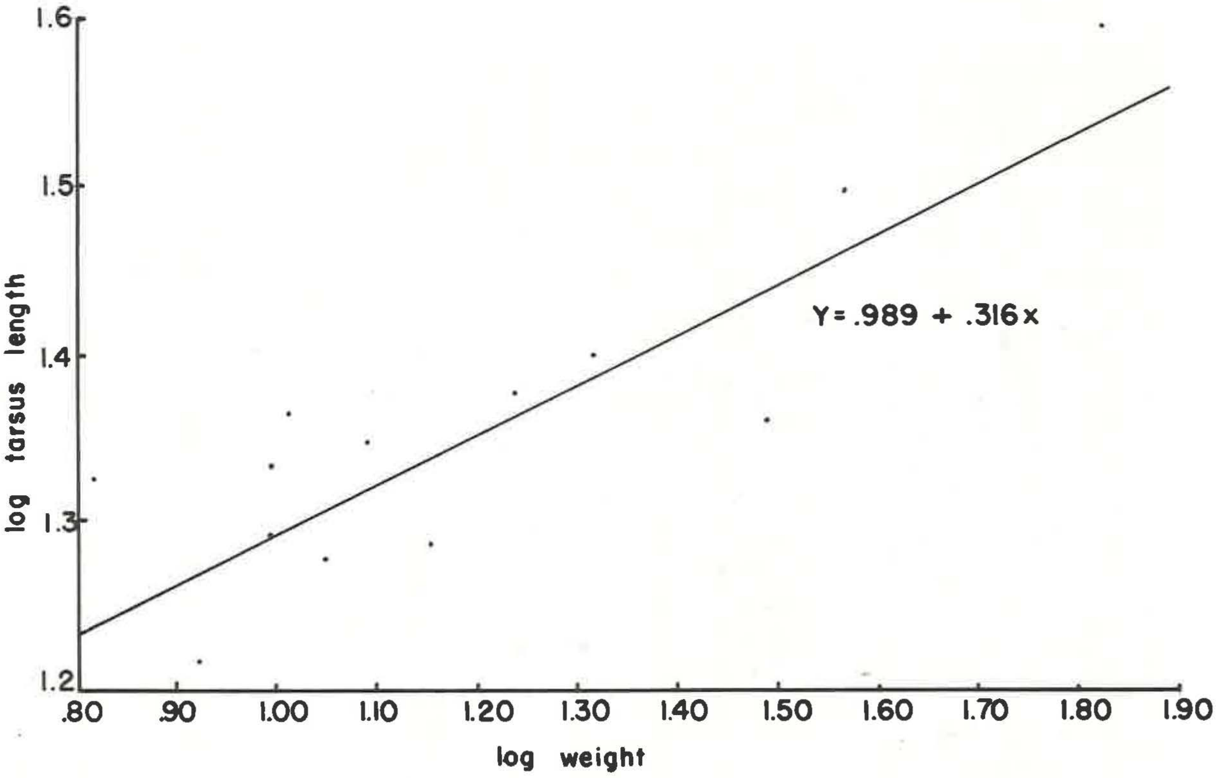
1.6
1.5
1.4
1.3
1.2
log tarsus length
Y = .989 + .316x
.80
.90
1.00
1.10
1.20
1.30
1.40
1.50
1.60
1.70
1.80
1.90
log weight

FIG 2

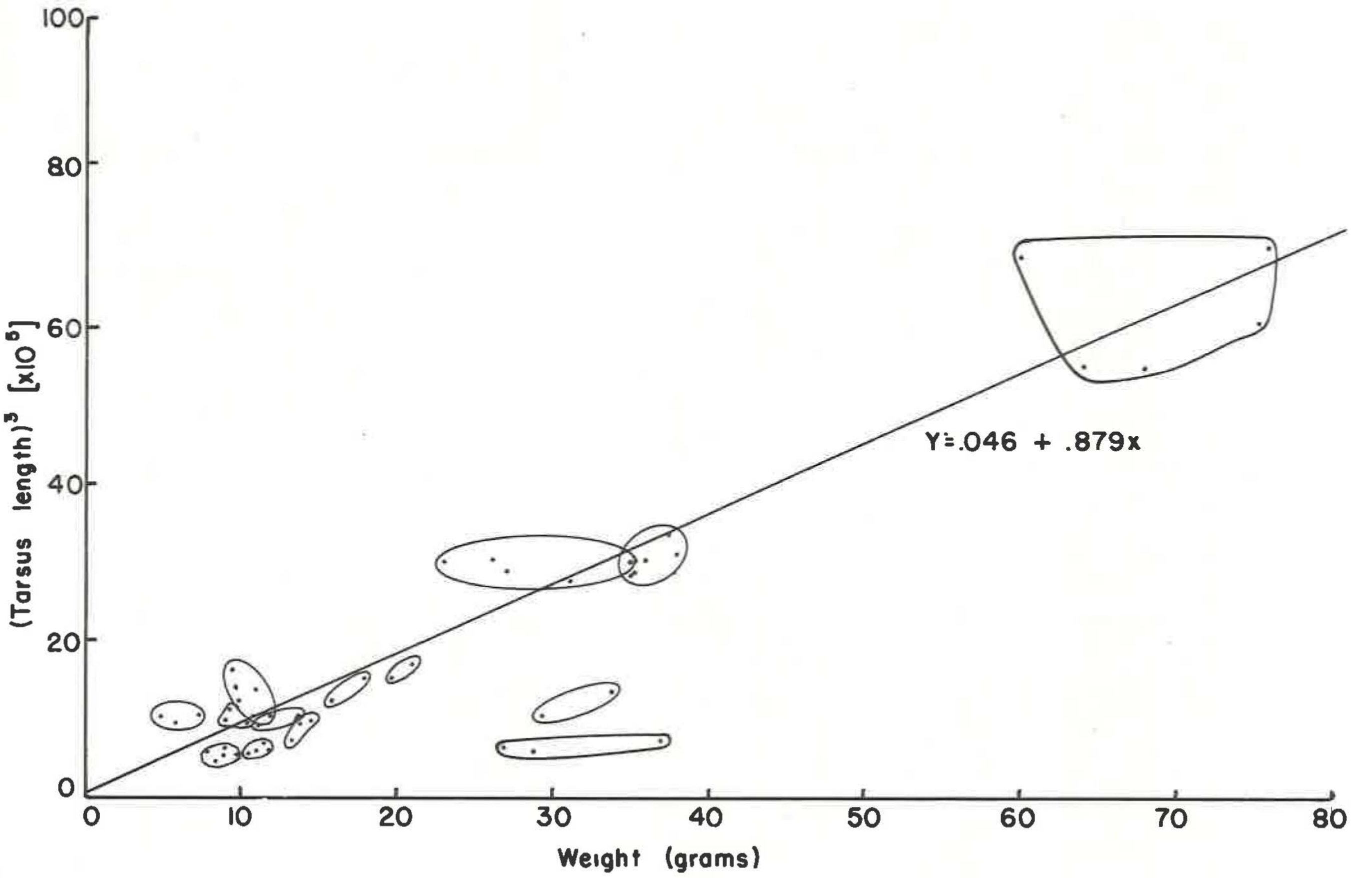
100
80
60
40
20
0
(Tarsus length)³ [x10⁵]
Y=.046 + .879x
0
10
20
30
40
50
60
70
80
Weight (grams)

FIG. 1

Acknowledgments

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Literature Cited

Fretwell, Stephen, W. Pursley, G. Icenogle, R. Tueling. 1973. Why are birds' wings as long as they are? EBBA News 36(4)

IDENTIFICATION OF WINTERING ORIOLES IN THE NORTHEAST

By John P. Hubbard
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Small numbers of orioles (*Icterus* app.) occur annually in the northestern United States from late autumn through early spring. The vast majority of these birds are Baltimore Orioles (*I. galbula*), but at times occasional occurrences of Bullock's Oriole (*I. bullockii*) or Orchard Oriole (*I. spurius*) might be expected.

Adult males of all three species are readily identifiable, as their plumages are the same as summer birds except for having some brown or gray feather tips. Orchard Orioles can be recognized in other plumages by their greenish and yellow coloration and small size (in the hand the wing chord is 85 mm or less). On the other hand, certain plumages of Baltimore and Bullock's Orioles may be very similar, particularly among immature birds -- which are the most frequently recorded as wintering birds. The purpose of this paper is to discuss identification of these difficult orioles, based on a study of specimens and the literature.

At the outset it should be stated that the field identification of confusing orioles of the Baltimore/Bullock's complex is not an easy matter, nor one that invites a casual approach. The two species are closely related and interbreed in the Great Plains, and similarities in plumage are a reflection of their close relationship. In the Northeast the chances of finding a true Bullock's Oriole are far, far less than that of finding a Baltimore Oriole, although this does not mean that the possibility is nonexistent. A healthy attitude might be to regard all orioles as Baltimore until proven otherwise, with Bullock's being identified only when distinctive

plumages and the best of circumstances are involved. As a word of caution, to my knowledge none of the immature orioles collected in winter in the Northeast has turned out to be an unequivocal Bullock's Oriole.

Besides similarities in plumages, a contributing source of confusion and error in the identification of Baltimore and Bullock's Orioles is their treatment in field guides. Observers should realize that field guides can cover only a limited amount of the individual variation that exists within species, and often various extremes are not covered. In addition, at times the wrong characters are emphasized as means of identification, and there may even be errors in this regard.

For example, female and nonadult male Bullock's Orioles are often said to be characterized by their pale abdomen (= "belly"), the color of the area being given as whitish to pale gray. The fact is that some (many?) immature Baltimores also have the abdomen whitish or otherwise pale in color, while some Bullock's have the area buff to pale orange. While the character is of some value in corroborating an identification, the color of the abdomen is obviously not a firm basis for calling a bird a Bullock's Oriole. One field guide errs in showing the whitish of the abdomen extending back to include the undertail coverts in Bullock's Oriole, but actually that area is buff to yellow or pale orange.

The characters that can be used to identify confusing orioles of the two species can be traced back to Robert Ridgway's classical treatment of the birds, and in most field guides these characters are shown even if not emphasized. The important characters involve the coloration of the head and the upper parts, particularly the back. The characters of the head reflect the colors and patterns on adult males of the two species of orioles.

In adult male Baltimore Orioles, the head is black throughout, whereas in Bullock's the black is relieved by orange, especially on the forehead, in the superciliary area (= "eyeline") and in the auricular (= "cheek") region. In female and nonadult male Baltimore Orioles the auriculars and often the forehead and superciliary area tend to be gray to brown, although at times there is a minor suffusion of yellowish or orangish in them. In Bullock's Orioles the three areas are usually yellowish to orangish and sometimes the entire crown is suffused with that coloration. A general impression is that in Bullock's Orioles the auricular region, in particular, is