

HEART WEIGHTS OF NORTH AMERICAN CROWS AND RAVENS

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IN recent years when so much attention has been focussed on human cardiovascular problems and their amelioration, the study of cardiophysiology in mammals has contributed much toward our understanding of these problems, but basic research in other vertebrates has lagged far behind in this respect. Feral birds, for example, have scarcely been examined since the pioneer investigations on heart rate by Odum (1941). Some revival of interest in this field is indicated by the recent reports of Hartman (1954) and others whose studies have centered on anatomical relationships between avian heart weight and such variables as body weight and altitude. From a perusal of these papers, it is evident that many more data are needed from feral birds before the physiological questions can be answered. Nonetheless, it has been known for many years that the largest birds (in terms of body weight) have the smallest or lightest hearts, relative to body weight, and vice versa. In the Passeriformes, the Common Raven (*Corvus corax*) is evidently the largest living representative, not only in terms of body weight but also in linear measurements. Presumably, ravens and their close relatives, the crows, should have relatively small hearts or heart/body weight ratios.

The present report was undertaken to demonstrate the heart/body ratios of these large passerines. Included in our study are data for 13 ravens, 9 Fish Crows (*Corvus ossifragus*), and 43 Common Crows (*C. brachyrhynchos*).

METHODS

The 65 specimens discussed in this paper were taken in late spring or summer, thus representing local breeding populations. Wintering, migrating, or molting individuals have been excluded; our data for birds in these conditions may be used for later considerations. All were collected between 1955 and 1959 at or near sea level. The Fish Crows came from southern Georgia, principally along the coast. Common Crow specimens were taken in the Macon, Georgia, area, and in Washington, west of the Cascade Range from localities ranging from the San Juan Islands south to the Olympia area and the Olympic Peninsula. The ravens were collected at Anchorage, Alaska, except for two individuals from the Olympic Peninsula of Washington. Taxonomically, according to the A. O. U. Check-list (1957:377-379), the Common Crows of Georgia represent the subspecies *paulus*, and the Washington birds belong to a separate species *caurinus*. The ravens from Alaska represent the subspecies *principalis* and those from western Washington, *sinuatus*. Evidence has been amassed by Johnston (in press), however, to show that *C. b. paulus* is synony-

mous with *C. b. brachyrhynchos*, and that *C. caurinus* is simply a well-marked subspecies of *C. brachyrhynchos*.

Weights were obtained in essentially the same method utilized by Norris and Williamson (1955). Birds fresh from the field were weighed on a double-beam balance to the nearest 0.1 gram, and the heart was preserved in 10 per cent formalin. At a later time each heart was thoroughly dried on filter paper, the major vessels were trimmed off close to the organ, and clotted blood was carefully removed before the heart was weighed on a triple-beam balance to the nearest 0.01 gram. Even though Hartman (1954, 1955) weighed only fresh hearts, in our study weights of the formalin-preserved hearts were considered to be as accurate as fresh weights might be, especially since Norris and Williamson (1955:79) demonstrated an insignificant weight difference between the same heart weighed fresh as compared with a later weight taken after formalin-preservation.

RESULTS

Complete data on body and heart weights are given in Table 1 because there are so few extant reliable weights of these birds. Many collectors, preparators, and taxonomists have failed to recognize the two distinctive age groups (first-year and adult) of these and some other corvids, so that many specimens labelled "adult" are in fact first-year birds, and vice versa. It is essential that these differences be recognized so that data obtained from individual specimens might be treated according to the proper age group; otherwise, questionable or erroneous conclusions might be reached. Hartman (1955:231), for example, did not distinguish age groups for the various corvids utilized for his heart ratios, and one would suspect that the data presented there are not precisely accurate. For this reason, plus the fact that he combined data for the two sexes, his data might not be strictly comparable to those given in Table 1. Nonetheless, his figure of 1.20 (heart weight/body weight) for a male of *brachyrhynchos* from Ohio is in general agreement with the average of 1.23 for eight adult males from Georgia. The average of 10 specimens from Florida (0.98) given by Hartman suggests that Common Crows of that region are large birds with relatively small hearts.

Hartman (1955:223 *et seq.*) did not find any significant sex differences in heart ratios for the many species given in his compilation, but his samples were usually less than 10. Whether or not our data presented for the two sexes can be considered as "significantly different" is a debatable point because these are also small samples. In the largest comparable sample (*brachyrhynchos* from Washington), average weights do indicate some degree of sex difference in the heart ratios (1.12 for males and 1.07 for females), but these differences are not significant at the 5 per cent level. Norris and Williamson,

TABLE I
BODY AND HEART WEIGHTS OF CROWS AND RAVENS

	Number	Body Weight	Heart Weight	Ht. wt./body wt.
<i>Corvus ossifragus</i>				
adult male	1	310	2.70	1.15
first-year male	2	292.4* (268.5-316.3)	2.43 (2.36-2.50)	1.26 (1.07-1.34)
adult female	5	283.6 (268.6-294.0)	2.59 (2.17-3.00)	1.11 (0.96-1.34)
first-year female	1	300.5	2.24	1.34
<i>C. brachyrhynchos</i>				
Georgia				
adult male	8	447.8 (415.5-509.0)	3.68 (2.77-4.43)	1.23 (1.09-1.52)
adult female	6	403.3 (372.6-444.3)	3.27 (2.95-3.78)	1.24 (1.10-1.34)
first-year female	1	414.0	3.06	1.35
Washington				
adult male	19	415.2 (388.8-486.3)	3.74 (3.00-5.11)	1.12 (0.78-1.33)
adult female	8	367.9 (314.6-421.2)	3.46 (3.04-3.86)	1.07 (0.86-1.19)
first-year female	1	348.9	3.04	0.87
<i>C. corax</i>				
Alaska				
adult male	2	1593.3 (1540.6-1646.0)	14.29 (12.03-16.55)	0.90 (0.73-1.07)
first-year male	2	1355.1 (1305.0-1405.2)	13.91 (13.67-14.14)	1.03 (1.01-1.05)
adult female	1	1233.0	11.77	0.95
first-year female	6	1169.0 (1008.3-1294.0)	12.66 (11.03-15.69)	1.08 (0.98-1.29)
Washington				
adult male	1	1016.7	10.52	1.03
first-year female	1	969.3	11.18	1.15

* Mean weight in grams followed by extremes in parentheses.

however, reported (1955:81) that “. . . both *Cyanocitta stelleri* and certain fringillid species show higher heart ratios in males than in females. (This is likewise true of *Aphelocoma coerulescens*. . .” Since their samples included 24 *Cyanocitta* and 84 *Aphelocoma*, it is possible that larger samples of *Corvus* might reveal sex differences of a significant nature. For other passerines Williamson and Norris (1958:91) presented additional data indicating some sex differences in heart ratios.

The values of 0.78 (*brachyrhynchos* from Washington) and 0.73 (*corax* from Alaska) represent the smallest heart ratios known for any of the Corvidae. This particular raven was the heaviest (1646.0 grams) of all those examined here, and had the largest linear measurements (wing—441 mm., tail—242, tarsus—68.9, bill from nostril—53.9, depth of bill—28.4). On the other hand, the adult male raven from Washington (heart ratio = 1.03) had the following measurements: weight—1016.7 grams, wing—380 mm., tail—212, tarsus—65.2, bill from nostril—48.6, depth of bill—26.0. The differences in

these weights and linear measurements compare favorably with the averages given by Ridgway (1904:259–262) for the subspecies *principalis* and *sinuatus*, respectively. Body size, however, is obviously not the only factor to be considered, because in smaller corvids (*Cyanocitta*), heart ratios as small as 0.80 have been reported by Norris and Williamson (1955:81). There are undoubtedly some complicating variables, such as activity and basal metabolism which influence these ratios in addition to sex, age, climate, and altitude.

The data in Table 1 also suggest that first-year crows and ravens have larger hearts than do adults of the comparable sex. As a matter of fact, with the exception of one *brachyrhynchos* from Washington, in these three species, values for first-year birds are uniformly greater than those for adults of the same sex. These data are of further interest since Hartman (1955:224) reported either no differences between age groups or that young birds had smaller hearts than adults. In these corvids, however, it must be remembered that maturation is more protracted than that found in the usual passerine types, the latter attaining essentially “mature” or “adult” size, proportions, and coloration in a year or less. Our data for *Corvus* substantiate Hartman’s statement (1955:237) that “the age at which heart size attains adult magnitude appears to differ among species.”

Finally, a possible factor to be considered in heart weights is that of fat deposits. As yet, there is no clear evidence to indicate that this is a significant factor in birds of the size considered here, for major fat deposits in subcutaneous and abdominal areas are likely proportional to those around the heart. Although excessively “fat” birds were not examined in this study, light or moderate fat deposits were sometimes noted upon dissection of abdominal areas, but the same birds had some fatty deposits around the heart. Thus, it appeared grossly that additional weight of a heart attributed to fatty deposits would be proportional to additional body weight as the result of subcutaneous and abdominal deposits of fat. It might be argued that lean body and heart weights would be more accurate, but this is not necessarily true since *entirely* fat-free birds would be exceptional in nature anyhow. In fact, Odum and Perkinson (1951:220) showed that heart lipids in the White-throated Sparrow (*Zonotrichia albicollis*) increased in premigratory individuals along with total body lipids, though not proportionately.

SUMMARY

Body weights, heart weights, and heart weight/body weight ratios are given for 65 North American crows and ravens. The samples included two species of crows and two subspecies of ravens, the latter being the largest passerine birds. Data were presented for both adults and first-year birds of both sexes when available.

The adult Common Ravens from Alaska proved to be the largest birds examined, and had the smallest heart ratios (even among extant data for other corvids), averaging 0.90 for males and 0.95 for a single female. Adult Common Crows from Georgia had average heart ratios of 1.23 for males and 1.24 for females, whereas those from western Washington were 1.12 and 1.07, respectively. Adult Fish Crows tended to have heart ratios somewhat intermediate between those of the Common Ravens and Common Crows (1.15 for a male and 1.11, an average of five females).

In these three species males have heart ratios sometimes greater than, sometimes less than, those of females, but these differences do not appear to be significant.

Comparisons between heart ratios of adults and those of first-year birds of the same sex showed that adults of these three species have smaller hearts than the first-year birds. The reason for this difference is unknown at present.

Whether fat deposits are significant as variables in relative heart size seems to be purely speculative at the present time, but there was no conclusive evidence from these studies that even a moderately fat crow or raven had a significantly different heart ratio from that of a lean individual.

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