11. Seasonal abundance of doves in Nebraska as determined by roadside counts is compared with that reported by Siegler and Newman in Texas.

12. In Nebraska, the doves showed an increase each year. Dove flocking and movements were correlated with harvesting of grain and with land use. A greater number was found in irrigated valleys than in dry uplands.

13. A method of determining dove population indices by use of the number of nests counted in sample areas is discussed. Factors showing the ratio of active nests to the season's total nest production proved to be similar for Iowa and Nebraska.

14. Throughout the report, data from Iowa and Nebraska are compared and contrasted.

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Ord
Nebraska

ADRENAL AND THYROID WEIGHTS IN BIRDS

BY FRANK A. HARTMAN

MANY studies have been made of the weights of certain endocrines in mammals, but relatively little has been reported on birds, especially wild birds. Crile and Quiring have published weights from more than fifty species of birds, most of them being from one or two individuals.

Our report deals with 143 species in 38 families, many of which are represented by a sufficient number of individuals to make statistical comparison of the various data. These data have been obtained in the course of collecting material for histological study. Most of the water birds, and some land birds, were obtained on or near Grand Isle, Louisiana. The remainder came from two regions, Kezar Lake in Maine, and central Ohio.

Although the gonads were weighed, in addition to the adrenals and thyroids, they are not included, since we found no relation between their weight and that of the adrenal and thyroid.

METHODS

The larger birds were weighed on a platform balance, the medium-sized birds on an Ohaus balance with a capacity of 2400 g. and a sensitivity of 0.1 g., while the small birds were weighed on a Torsion balance of 120 g. capacity and 2 mgm. sensitivity. The glands were weighed on one of three balances: two Roller-Smith Torsions of 30 (0.005 mgm. sensitivity) and 600 mgm. (0.2 mgm. sensitivity) capacity respectively and the Torsion balance of 120 g. capacity. The most sensitive balance, which had the capacity for the tissue, was employed in each instance. Birds were dissected within two or three hours of killing, many within an hour. Small birds were dissected, in much of this work, in a small box saturated with water vapor. The size and construction of the box was much like that used in tissue culture work. The vapor was produced by distilling water from a flask heated by an alcohol lamp. Later, this was found unnecessary, since the organs could be kept moist by contact with surrounding tissue while being removed, and trimming away of extraneous tissue required so little time. Each gland was carefully freed from fat or other tissue with the aid of a binocular loupe. Since the time after removal from the body is most important in the small birds, rapid weighing was desirable. This was accomplished on a Roller-Smith Torsion balance in a few seconds.

In order to ascertain the weight loss from exposure to air, we made observations on the adrenals and thyroids of two English Sparrows. These glands were hung on the Roller-Smith balance exposed to the warm, dry atmosphere of the laboratory in the winter. Weighings made every minute showed that the loss was 2% per minute. Therefore, it is not necessary to weigh the glands in a vial when the Roller-Smith Torsion is employed.

Although the time of day does make a difference in the weight of the individual (Baldwin and Kendeigh), this factor is not so great as the variation from one individual to another and is, therefore, ignored in this report. Immature birds are not included since the adrenals and thyroids are relatively different in young and in mature specimens (Latimer). Only birds that appeared healthy and well nourished were included in our regular list. Individuals containing internal parasites were not included unless their adrenal and

thyroid weights were obviously not different from those of uninfected members of the same species.

RESULTS

Lists have been made of the mean values of the body, adrenal and thyroid weights and of the percentage body weights of adrenals and thyroids in all individuals which appeared to be in normal health. Tables have been made of those species that contained a considerable number of individuals. Where a family contained no species with a large number of individuals, one species representing that family was included in the tables. Species including six or more variates have been treated statistically. The tables show the number of individuals in each species as well as the standard deviations. Additional data on species in which the number of individuals is too small are listed in the text. In species with less than six variates, the lowest and highest variates are shown. All are arranged according to the Check-List of the American Ornithologists' Union.

INDIVIDUAL VARIATION

In a study of the adrenal and thyroid gland weights, the individual variation within a species must be considered first. Inspection shows that a great range of individual variation within a species is not unusual. In some species, this may be due to the great dispersion of one or two variates. The standard deviation shows the dispersion of the variates about the mean.

In the following 45 species, the highest value of the variate for both adrenals and thyroids was at least double their lowest value: Great Blue Heron, American Egret, Herring Gull, Forster's Tern, Flicker, Red-bellied Woodpecker, Hairy Woodpecker, Downy Woodpecker, Kingbird, Crested Flycatcher, Phoebe, Black-capped Chickadee, Carolina Chickadee, White-breasted Nuthatch, Red-breasted Nuthatch, Brown Creeper, Prairie Marsh Wren, Mockingbird, Catbird, Brown Thrasher, Robin, Veery, Bluebird, Golden-crowned Kinglet, Cedar Waxwing, Loggerhead Shrike, Red-eyed Vireo, Yellow Warbler, Magnolia Warbler, Myrtle Warbler, Black-throated Green Warbler, Pine Warbler, Northern Yellow-throat, Redstart, English Sparrow, Red-wing, Purple Grackle, Scarlet Tanager, Cardinal, Goldfinch, Junco, Tree Sparrow, Chipping Sparrow, Swamp Sparrow, Song Sparrow. In addition, this great range of variates was shown for the adrenal in the following 19 species: Louisiana Heron, Coot, Red-backed Sandpiper, Barn Owl, Ruby-throated Hummingbird, Belted Kingfisher, Yellow-bellied Sapsucker, Tree Swallow, Barn Swallow, Tufted Titmouse, House Wren, White-eyed Vireo, Blue-headed Vireo,

Prothonotary Warbler, Bay-breasted Warbler, Meadowlark, Seaside Sparrow, Field Sparrow and White-throated Sparrow. It was also shown in the thyroid for nine species: Red-shouldered Hawk, Bobwhite, Purple Martin, Blue Jay, Black and White Warbler, Blackburnian Warbler, Black-poll Warbler, Northern Water-Thrush and Red-eyed Towhee.

The least standard deviation for both adrenals and thyroids occurred in the Flicker, Hairy Woodpecker, Downy Woodpecker and Emden Goose. The least standard deviation for adrenals alone occurred in the Brown Pelican, and for thyroids alone in the Parula Warbler and Chestnut-sided Warbler.

It is interesting to note that a Snow Bunting, which had been caught in December and kept in a cage in the laboratory until May, possessed extremely small adrenals (0.0045% of body weight) and thyroids (0.0015% of body weight), as compared with the same glands (adrenals—0.0113%; thyroids—0.0061%, of body weight) from the same flock of buntings killed in December. This bird was a female in good condition at the time of sacrifice. There were two platyhelminthes in the abdominal cavity.

Some of the factors which might influence the endocrine weights have been considered. These are sex, sexual activity, season, and infection.

Sexual differences.—We have compared the adrenal and thyroid weights in males and females in all species where both are represented. There were differences between the sexes but these were no greater than the variation found within one or the other sex, except in those instances to be mentioned. In a few species we had a sufficiently large number of each sex to make a valid comparison. This was true for the Downy Woodpecker, Carolina Chickadee, Tufted Titmouse, White-breasted Nuthatch, Red-eyed Vireo, Myrtle Warbler, English Sparrow, Red-wing, and Cardinal. In none of these did there appear to be a significant difference between sexes in the adrenal. The difference in the thyroids between the male and female Red-wing looked significant but $t = 2.0$, which is not significant for the number of variates involved.[1] Therefore, a separation of the sexes has been made only in those forms where there appeared to be a difference.

All gonads were weighed but, since there was no relation between

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[1] $$t = \frac{M_1 - M_2}{\sqrt{(SEm_1)^2 + (SEm_2)^2}}$$

Values of t for various degrees of freedom are shown in Table 3, 8, Snedecor.

their weights and the variation of adrenal and thyroid weights, they have not been included in this study. Because of the observations of Riddle (1923) on the relation of adrenal hypertrophy to ovulation, we have noted especially the weight of the adrenals in the few birds which were collected with an egg in the oviduct ready to be laid. The values obtained were within the range of those from other individuals of the species. These observations were made on: a Woodcock, a hummingbird, a Flicker, a Black-capped Chickadee, a Robin, a Hermit Thrush, a Bluebird, and a Yellow-throat.

Seasonal differences.—Most of the collecting was done in the spring and fall, a small amount in the summer and little in the winter. In one species, the Myrtle Warbler, which was well represented in both spring and fall, there was no difference between either the adrenals or the thyroids at these seasons.

Infection.—The effect of infection on the adrenals and thyroids was observed in a gull and in some captive hawks. We have found few infected birds in the wild state, probably because they do not survive long in nature. A Herring Gull which appeared under-sized was collected on Lake Erie and found to have a large pus pocket in one shoulder. The adrenals and thyroids were twice normal size, being 0.030% and 0.016%, respectively, of the body weight. Two Cooper's Hawks and two Red-shouldered Hawks died of infections after several months in the laboratory. The adrenals of the Cooper's Hawks were twice normal size, being 0.022 and 0.0156% of the body weight, while the thyroids were somewhat smaller than normal, being 0.0036 and 0.0049% of the body weight. The adrenals of the Red-shouldered Hawks were two to three times normal size, being 0.032 and 0.048% of the body weight; while the thyroids were three to six times normal size, being 0.049 and 0.091% of the body weight.

Internal parasites.—We were interested in parasites as an influence on the size of the adrenal and thyroid. Each bird was examined for the presence of parasites. If they were found, the adrenal and thyroid weights were compared with the weights of these glands in birds of the same species, free from parasites. Frequently, there was no difference. The amount of infection varied widely. Undoubtedly we missed some of the parasites, but the following examples will illustrate the possible effect on the size of the glands.

All but one of the pelicans contained many nematodes, and sometimes cestodes, in the alimentary canal. The adrenals and thyroids of this one were within the range of the others. One cormorant contained nematodes in the stomach. Its adrenals were heavier,

while its thyroids were lighter, than other individuals of the species, being respectively 0.0268 and 0.0114% of the body weight. Nematodes were found in the abdomen of the sole Upland Plover which we collected. This bird had adrenals of 0.011% and thyroids of 0.0119% of the body weight. A Herring Gull with adrenals of normal size, 0.0162%, and thyroids above normal, 0.0128% of the body weight, contained nematodes. The intestine and abdominal cavity of a Barn Owl were infected with nematodes. Its adrenals (0.0125%) and thyroids (0.0062%) were little different from those of other Barn Owls. Two Barred Owls contained several tapeworms each. These are included in the tables, since they were the only specimens collected and they appeared normal. A Belted Kingfisher with many nematodes possessed adrenals and thyroids within the normal range. Two Flickers with several cestodes each contained adrenals of normal size, and thyroids which were low (0.0056 and 0.0044% of the body weight). A Downy Woodpecker containing a few cestodes had adrenals of normal size but thyroids which were smaller than usual (0.0065%). A House Wren with nematodes possessed normal-sized adrenals and thyroids. A Mockingbird with cestodes had very small adrenals (0.0036%) and undersized thyroids (0.006%). Two Robins with cestodes had abnormally small adrenals (0.0062 and 0.0072%) and subnormal thyroids (0.0088 and 0.0065%). A Bluebird with a cestode had glands of normal size. A Magnolia Warbler with cestodes in the abdominal cavity possessed glands of normal size. The only Yellow-breasted Chat which was collected contained adrenals of 0.013% and thyroids of 0.010% of the body weight. This bird contained one cestode. Five Red-wings infected with cestodes or nematodes, or both, possessed glands of normal size.

Thus one cannot predict from the amount of parasitic infection the influence it may have on adrenal and thyroid weights.

COMPARISON OF SPECIES

Are there significant differences between the adrenals and between the thyroids among the various species of the birds studied?

Inspection of the data shows differences in the percentage of body weight of the adrenals and thyroids among certain species. But, when there is considerable variation within the species, a comparison of the significance of differences (t) must be made. This has been done between species which appeared to be different.

Adrenals.—The adrenal of the Brown Pelican (Table 1), which appears the largest of any species studied, has been compared for

significance with the moderate-sized adrenal of the Emden Goose and one of the largest, that of the Prairie Marsh Wren. The value of t (Snedecor) for the pelican and goose is 7.5 and of the pelican and wren is 4.4. Therefore, the difference is certainly significant. The difference between the adrenals in the Marsh Wren and the Carolina Chickadee is probably significant, since $t = 2.4$. The difference between the adrenals in the Downy Woodpecker and Phoebe is probably not significant, since $t = 2.2$. The differences between the adrenals of the Mockingbird and Catbird and between the English Sparrow and Magnolia Warbler appear to be significant but are not, statistically, since $t = 1.0$ and 1.7, respectively, in each comparison.

The birds with the smallest adrenals are: the woodpeckers, Cooper's Hawk, Western Sandpiper, Barn Owl, Barred Owl, Blue Jay, Carolina Chickadee, Mockingbird, English Sparrow, and Red-wing.

Thyroids.—In the thyroids, a comparison has been made between certain species which appear to be different, but prove not to be significant statistically:

Flicker with Phoebe, $t = 1.6$

White-breasted Nuthatch with Red-breasted Nuthatch, $t = 1.5$

Golden-crowned Kinglet with Red-eyed Vireo, $t = 1.1$

Therefore, there is no significant difference between the thyroids of different species in all of the forms studied.

DISCUSSION

The great range in relative weights of the adrenals and thyroids among the individuals of many species of wild birds is noteworthy. Data on the adrenals in mammals, even domestic forms, also show considerable range. Brown, Pearce and Van Allen found that the adrenals were $0.02082 \pm 0.00795\%$ of the body weight in 644 normal male rabbits, while Sato obtained $0.014 \pm 0.0039\%$ for 77 female dogs and $0.0104 \pm 0.0031\%$ for 122 male dogs.

The least standard deviation for both adrenals and thyroids occurs in the Flicker, Hairy Woodpecker, Downy Woodpecker and Emden Goose. The least standard deviation for adrenals alone occurs in the Brown Pelican, and for thyroids alone in the Parula Warbler and the Chestnut-sided Warbler. Riddle (1927) has described "thyroid" races in Ring Doves, some characterized by large thyroids, others by small thyroids. It is probable that birds of the same strain, such as can be obtained in domesticated forms (*e.g.* the Emden Goose), show less variation in adrenal and thyroid weights than do wild birds.

The limited evidence at our disposal indicates that the difference

in adrenals and thyroids, between sexes, is no greater than that to be expected from individual variation. More data might show significant differences. According to Sauer and Latimer, the female fowl has approximately 30% more adrenal cortex, in proportion to the body weight, than the male.

Our data have not enabled us to investigate the effect of sexual activity very thoroughly, since many of the specimens were collected at seasons when this was at a minimum. We have seen no indications in either sex that a change in adrenal or thyroid size occurs at the time of great gonadal activity.

Riddle found that there was a mean size increase of 40% in the adrenals of pigeons and doves at the time of ovulation. In the few wild birds which we have collected at the time of ovulation, we were unable to detect a significant change in the size of the adrenal. This is easily understood since Riddle was using birds of one strain under controlled conditions, while we collected birds at random from their wild environment. Moreover, the variation within the species might be so great that a change produced by ovulation would be masked.

The limited amount of seasonal data which we have been able to collect in the same species indicates that the normal variation is greater than that due to possible seasonal change. The small adrenals and thyroids in the captive Snow Bunting might be explained in part as due to seasonal and temperature change. J. W. Blunt, Jr., stated that the adrenals of both sexes of the Herring Gull decline in size through July, then swing upward again in August. No data were given. Riddle (1927) has shown that the thyroids of pigeons are largest in the autumn and winter, decreasing in the spring and becoming smallest in the summer. Podhradsky also found that the weight of the thyroid in poultry varied with the season, weighing most in the fall and winter and least in the summer. But the relative weight curve of the bird ran parallel.

Riddle has shown that doves and pigeons with macroscopic evidence of disease (parasites, tubercles, enlarged spleen or enlarged liver) possess adrenals nearly twice as large as those of healthy birds. He found only 60 out of 241 birds free from evidence of disease. His birds were in the protected conditions of domestication and thus might survive longer if diseased than birds probably do in the wild state. Hawks which died from infection after being in our laboratory several months usually possessed enlarged adrenals but often small thyroids. A Herring Gull that was infected possessed both enlarged adrenals and thyroids. One might suspect that the large adrenal of

the Pelican was caused by parasitic infection, except that the adrenals of an individual free from parasites were just as large. Moreover, there was no congestion or other evidence of a reaction in the adrenals of the infected birds. We have also pointed out that many species that were infected did not appear to have abnormally large adrenals. In this connection, the observations of Brown *et al.* are pertinent. They found that, so long as rabbits remained in apparently good health, the values obtained for organ weights (including adrenals) of animals with lesions did not differ materially from those of animals that were entirely free from lesions.

Stresses are, undoubtedly, factors in the size of adrenals and thyroids. Thus the same species transferred from the wild state to a life of limited activity may show a reduction in the size of these organs, as did the Snow Bunting mentioned above. This has been shown in mammals for the adrenal. Hatai (2) found that the adrenals of the Norway rat were nearly twice as heavy as those of the albino rat. Moreover, Donaldson and King observed that captive Norway rats possessed lighter adrenals than the wild strain, but heavier than the albinos. Relative absence of stress may have been a factor in the small range encountered in the Emden Goose.

Before we leave the consideration of individual variation within species, we wish to point out discrepancies between some of the values obtained by Crile and Quiring (1940) and those obtained by us. They determined the adrenal and thyroid weights in a few of the same species included in our report. We have calculated their values in percentage of the body weight so that they might be compared with ours. The adrenal weights (0.030%) in their Brown Pelicans (two specimens) were less than ours. Some of their adrenal values for the Order Passeriformes were considerably higher than ours. In the following list we give first their values and then ours—Phoebe: 0.028–0.031%; 0.0146 ± 0.0044%. Barn Swallow: 0.032–0.040%; 0.013–0.026%. Robin: 0.030%; 0.0117 ± 0.0046%. Bluebird: 0.045–0.065%; 0.0063–0.0143%. English Sparrow: 0.027–0.030%; 0.0097 ± 0.0027%. Likewise, certain of their thyroid values were higher, *viz.*—Phoebe: 0.0143–0.033%; 0.0122 ± 0.0047%. Barn Swallow: 0.0279–0.0395%; 0.008–0.014%. Bluebird: 0.0176–0.032%; 0.0055–0.0123%. English Sparrow: 0.0178%; 0.0099 ± 0.0021%. Cowbird (female): 0.0212%; 0.0058–0.0073%. Song Sparrow: 0.069%; 0.0107 ± 0.0039%.

The discrepancies are so great that we are at a loss to explain them. No statement was made regarding the manner in which they prepared their tissues.

The great range found between species in our studies extends, for the adrenal, from the Brown Pelican of 0.040% body weight to the female Red-wing of 0.0077% body weight, or some of the woodpeckers which go as low as 0.0044% body weight. The thyroid range is from 0.021% body weight in cormorants to 0.004% body weight in the male Red-wing and in the male Boat-tailed Grackle. Individuals are even lower. Variations in the blood contained in the glands, due to congestion or to water content due to other factors, may occur but they could not account for the great differences observed. Therefore, these differences must be due in considerable measure to variations in the amount of tissue present.

If the assumption is justified that size of an endocrine gland in a healthy bird is an indication of its ability to produce hormones, there must be a great difference in this ability among different individuals and between different species. With reservations, that minor differences may be due to water or blood, the assumption seems valid.

The relative size of the adrenals and thyroids in different species bears no relation to their activity. Let us consider the adrenal first. Many birds with relatively much smaller adrenals are more active than the Brown Pelican. Birds which, like the Ruby-throated Hummingbird and the Purple Martin, are very active, have adrenals of moderate size. The relative size of the adrenals in different mammalian species also is not related to their activity. Likewise, there is no evident relationship between the habits and relative size of the thyroids. There is nothing unusual in the cormorant to distinguish it from many other birds with relatively much smaller thyroids. Size has nothing to do with the relative amount of iodine available in the region where the bird was taken, since there was no distinction between the relative weight of thyroids of birds of the same species taken in central Ohio and along the Gulf Coast (*e. g.* the Red-winged Blackbird).

Comparison of the relative adrenal size in birds with that in other vertebrates is interesting. Among the fishes, the weight of the interrenals, which are homologous to the adrenal cortex, has been determined (Hartman, Shelden and Green). In birds, this constitutes 65% of the adrenal (Miller and Riddle). The values for Elasmobranch interrenals range between 0.0092% body weight for some of the dogfishes and 0.0002% body weight for the blue shark. In the few reptiles studied, the range for the adrenals is from 0.05 to 0.01% of the body weight (Naccarati; Valle and Souza). In the

mammal, the guinea pig's adrenal is highest, attaining 0.05% (Bessessen and Carlson) to 0.07% (Kosaka) of the body weight; while that of the cow (Swett, Miller, *et al.;* Swett, Graves, *et al.*) is one of the lowest, ranging from 0.0034 to 0.0088%, according to our calculations. Thus we see that the relative weights of the adrenals in the birds studied do not go so high as those found in mammals but, otherwise, the range is similar.

CONCLUSIONS

The range of individual variation in the relative weights of the adrenals and thyroids may be so great in wild birds that few species show significant differences with each other. Basing our judgment on the habits of each species, we conclude from our study that the relative weights of the adrenals and thyroids of birds are unrelated to their activity.

SPECIES NOT SHOWN IN THE TABLES

(The values for body, adrenal and thyroid weights are given in this order: arithmetic mean and range.)

ARDEIDAE

2 *Casmerodius albus egretta* (American Egret): body, 975 g. (952–997); adrenals, 0.0179% (0.0138–0.0219); thyroids, 0.0050% (0.0029–0.0071). 1 *Leucophoyx thula* (Snowy Egret): body, 345 g.; adrenals, 0.0318%; thyroids, 0.0065%. 1 *Florida c. caerulea* (Little Blue Heron): body, 317 g.; adrenals, 0.0170%; thyroids, 0.010%. 1 *Butorides v. virescens* (Eastern Green Heron): body, 204 g.; adrenals, 0.0174%; thyroids, 0.0069%.

ANATIDAE

1 *Aythya collaris* (Ring-necked Duck): body, 665 g.; adrenals, 0.0158%; thyroids, 0.0071%. 1 *Lophodytes cucullatus* (Hooded Merganser): body, 585 g.; adrenals, 0.0207%; thyroids, 0.0085%. 1 *Mergus serrator* (Red-breasted Merganser): body, 917 g.; adrenals, 0.0137%; thyroids, 0.0076%.

ACCIPITRIDAE

1 *Buteo borealis* (Red-tailed Hawk): body, 1285 g.; adrenals, 0.0121%; thyroids, 0.003%. 2 *Buteo l. lineatus* (Northern Red-shouldered Hawk): body, 737.5 g. (700–775); adrenals, 0.0139 (0.0134–0.0143) %; thyroids, 0.011 (0.0073–0.0147) %. 1 *Aquila chrysaëtos canadensis* (Golden Eagle): body, 4410 g.; adrenals, 0.0073%; thyroids, 0.0054%.

RALLIDAE

1 *Rallus e. elegans* (King Rail): body, 333 g.; adrenals, 0.0138%; thyroids, 0.0045%.

CHARADRIIDAE

1 *Charadrius v. vociferus* (Killdeer): body, 79 g.; adrenals, 0.0109%; thyroids, 0.0074 %. 2 *Squatarola squatarola* (Black-bellied Plover): body, 198 g. (183–213); adrenals, 0.0127 (0.0093–0.0161) %; thyroids, 0.0068 (0.0063–0.0072) %.

SCOLOPACIDAE

1 *Philohela minor* (American Woodcock): body, 2539 g.; adrenals, 0.0088%; thyroids, 0.0059%. 1 *Bartramia longicauda* (Upland Plover): body, 97 g.; adrenals, 0.011%; thyroids, 0.012%. 2 *Tringa solitaria* (Solitary Sandpiper): body, 60.3 (54.5–66) g.; adrenals, 0.0152 (0.0145–0.0158) %; thyroids, 0.09%. 4 *Totanus melanoleucus* (Greater Yellow-legs): body, 178.9 (136–207) g.; adrenals, 0.0125 (0.009–0.0164) %; thyroids, 0.0072 (0.0063–0.0084). 4 *Erolia alpina sakhalina* (Red-backed Sandpiper); body, 51.6 (41–58) g.; adrenals, 0.0113 (0.0081–0.0178) %; thyroids, 0.0090 (0.0072–0.0123) %. 1 *Crocethia alba* (Sanderling): body, 63.7 (54.4–73) g.; adrenals, 0.0129 (0.0123–0.0134) %; thyroids, 0.0109 (0.0101–0.0116) %.

LARIDAE

1 *Larus delawarensis* (Ring-billed Gull): body, 947 g.; adrenals, 0.0412%; thyroids, 0.0333%. 1 *Larus atricilla* (Laughing Gull): body, 247 g.; adrenals, 0.0347%; thyroids, 0.0084%. 1 *Larus philadelphia* (Bonaparte's Gull): body, 221 g.; adrenals, 0.0191%; thyroids, 0.0109%. 3 *Sterna forsteri* (Forster's Tern): body, 123.7 (120–128) g.; adrenals, 0.0186 (0.0113–0.0279) %; thyroids, 0.0072 (0.0057–0.0084). 1 *Sterna h. hirundo* (Common Tern): body, 96 g.; adrenals, 0.0176%; thyroids, 0.010%. 2 *Sterna d. dougalli* (Roseate Tern): body, 110.5 (108–113) g.; adrenals, 0.0161 (0.0149–0.0172) %; thyroids, 0.0111 (0.0106–0.0115) %. 1 *Thalasseus m. maximus* (Royal Tern): body, 497 g.; adrenals, 0.0183%; thyroids, 0.008%. 3 *Hydroprogne caspia* (Caspian Tern): body, 548 (538–562) g.; adrenals, 0.0272 (0.0221–0.0316) %; thyroids, 0.0087 (0.0077–0.0092) %.

COLUMBIDAE

1 *Zenaidura macroura carolinensis* (Eastern Mourning Dove): body, 148 g.; adrenals, 0.0066%; thyroids, 0.0065%.

CUCULIDAE

1 *Coccyzus a. americanus* (Yellow-billed Cuckoo): body, 63 g.; adrenals, 0.0188%; thyroids, 0.0086%. 1 *Coccyzus erythrophthalmus* (Black-billed Cuckoo): body, 38 g.; adrenals, 0.0139%; thyroids, 0.0067%.

PICIDAE

1 *Ceophloeus pileatus abieticola* (Northern Pileated Woodpecker): body, 239 g.; adrenals, 0.0044%; thyroids, 0.0058%. 4 *Centurus carolinus* (Red-bellied Woodpecker): body, 75.1 (65–85.5) g.; adrenals, 0.0091 (0.0065–0.0134) %; thyroids, 0.0116 (0.0059–0.019) %. 1 *Melanerpes erythrocephalus* (Red-headed Woodpecker): body, 75.8 g.; adrenals, 0.0043%; thyroids, 0.0102%.

TYRANNIDAE

4 *Tyrannus tyrannus* (Eastern Kingbird): body, 43.4 (40.8–46.8) g.; adrenals, 0.0171 (0.0129–0.0218) %; thyroids, 0.0277 (0.0152–0.0549) %. 5 *Myiarchus crinitus boreus* (Northern Crested Flycatcher): body, 34.5 (30–39.2) g.; adrenals, 0.0123 (0.0072–0.0167) %; thyroids, 0.010 (0.0056–0.0153) %. 3 *Empidonax minimus* (Least Flycatcher): body, 9.4 (8.6–10) g.; adrenals, 0.0111 (0.008–0.0133) %; thyroids, 0.0151 (0.0105–0.0180) %. 2 *Myiochanes virens* (Eastern Wood Pewee): body, 14.5 (14.1–15.0) g.; adrenals, 0.0131 (0.0117–0.0145) %; thyroids, 0.0135 (0.0135–0.0135) %. 1 *Nuttallornis borealis* (Olive-sided Flycatcher): body, 14.8 g.; adrenals, 0.0084%; thyroids, 0.0114%.

HIRUNDINIDAE

3 *Iridoprocne bicolor* (Tree Swallow): body, 21.9 (21.0–22.7) g.; adrenals, 0.0106 (0.0066–0.0157) %; thyroids, 0.0105 (0.0081–0.0125) %. 1 *Riparia r. riparia* (Bank Swallow): body, 19 g.; adrenals, 0.0118%; thyroids, 0.0172%. 2 *Hirundo rustica erythrogaster* (Barn Swallow): body, 17.8 (16.7–18.9) g.; adrenals, 0.0194 (0.0132–0.0256) %; thyroids, 0.0112 (0.0082–0.0142) %. 1 *Petrochelidon pyrrhonota* (Cliff Swallow): body, 21.0 g.; adrenals, 0.0119%; thyroids, 0.0086%.

TROGLODYTIDAE

4 *Troglodytes aedon* (House Wren): body, 11.2 (10–12.9) g.; adrenals, 0.0111 (0.0083–0.0167) %; thyroids, 0.0094 (0.0068–0.0129) %. 3 *Troglodytes troglodytes hiemalis* (Eastern Winter Wren): body, 9.8 (8.9–12.0) g.; adrenals, 0.0199 (0.0175–0.0237) %; thyroids, 0.0130 (0.0114–0.0128) %. 1 *Thryothorus l. ludovicianus* (Carolina Wren): body, 23 g.; adrenals, 0.0093%; thyroids, 0.0109%.

MIMIDAE

3 *Toxostoma r. rufum* (Brown Thrasher): body, 73.4 (71.3–74.5) g.; adrenals, 0.0108 (0.0070–0.0166) %; thyroids, 0.0082 (0.0050–0.0099) %.

TURDIDAE

3 *Hylocichla guttata faxoni* (Eastern Hermit Thrush): body, 32 (30.4–35.7) g.; adrenals, 0.0141 (0.0116–0.0184) %; thyroids, 0.0080%. 1 *Hylocichla ustulata swainsoni* (Olive-backed Thrush): body, 31.7 g.; adrenals, 0.0114%; thyroids, 0.0110%.

SYLVIIDAE

1 *Polioptila c. caerulea* (Blue-gray Gnatcatcher): body, 5.9 g.; adrenals, 0.0178%; thyroids, 0.0083%. 3 *Regulus calendula* (Ruby-crowned Kinglet): body, 7.2 (6.8–7.9) g.; adrenals, 0.0101 (0.0079–0.0129) %; thyroids, 0.0074 (0.0074–0.0114) %.

STURNIDAE

2 *Sturnus v. vulgaris* (Starling): body, 78.7 (75–82.4) g.; adrenals, 0.0134 (0.0150–0.0177) %; thyroids, 0.0079 (0.0077–0.0081) %.

VIREONIDAE

2 *Vireo g. griseus* (White-eyed Vireo): body, 11.4 (10.4–12.4) g.; adrenals, 0.0193 (0.0149–0.0236) %; thyroids 0.0147%. 1 *Vireo flavifrons* (Yellow-throated Vireo): body, 17.5 g.; adrenals, 0.0106%; thyroids, 0.0171%. 5 *Vireo s. solitarius* (Blue-headed Vireo): body, 17.0 (15.7–18.3) g.; adrenals, 0.0141 (0.0102–0.0194) %; thyroids, 0.0097 (0.0078–0.0107) %. 1 *Vireo philadelphicus* (Philadelphia Vireo): body, 11.7 g.; adrenals, 0.0118%; thyroids. 0.0099%.

COMPSOTHLYPIDAE

4 *Protonotaria citrea* (Prothonotary Warbler): body, 13.3 (11.3–14.5) g.; adrenals, 0.0129 (0.0086–0.0206) %; thyroids, 0.0108 (0.0083–0.0135) %. 1 *Vermivora peregrina* (Tennessee Warbler): body, 13.0 g.; adrenals, 0.0149%; thyroids, 0.0059%. 1 *Vermivora r. ruficapilla* (Nashville Warbler): body, 8.3 g.; adrenals, 0.0157%; thyroids, 0.0060%. 2 *Dendroica c. caerulescens* (Black-throated Blue Warbler): body, 9 g.; adrenals, 0.0184 (0.0175–0.0192) %; thyroids, 0.0079 (0.0066–0.0092) %. 5 *D. fusca* (Blackburnian Warbler): body, 9.5 (8.5–10.9) g.; adrenals, 0.0145 (0.0156–

0.0194) %; thyroids, 0.0102 (0.0065–0.0180) %. 5 *D. castanea* (Bay-breasted Warbler): body, 14.6 (14–15.3) g.; adrenals, 0.0094 (0.0075–0.0143) %; thyroids, 0.0101 (0.0071–0.0130) %. 5 *D. striata* (Black-poll Warbler): body, 8.5 (6.5–10) g.; adrenals, 0.020 (0.0166–0.022) %; thyroids, 0.0127 (0.0079–0.0211) %. 3 *D. p. pinus* (Pine Warbler): body, 10.8 (7.7–13) g.; adrenals, 0.0194 (0.0115–0.0250) %; thyroids, 0.0120 (0.0073–0.0187) %. 1 *Seiurus aurocapillus* (Oven-bird): body, 17.5 g.; adrenals, 0.0183%; thyroids, 0.0091%. 4 *Seiurus n. noveboracensis* (Northern Water-Thrush): body, 17.7 (14.5–21.4) g.; adrenals, 0.0197 (0.0157–0.0266) %; thyroids, 0.0109 (0.0059–0.0213) %. 1 *Oporornis agilis* (Connecticut Warbler): body, 19.4 g.; adrenals, 0.0078%; thyroids, 0.0131%. 1 *Icteria virens* (Yellow-breasted Chat): body, 25.1 g.; adrenals, 0.0103%; thyroids, 0.0101%. 5 *Wilsonia canadensis* (Canada Warbler): body, 9.6 (9.3–10.0); adrenals, 0.0141 (0.0105–0.0172); thyroids, 0.0085 (0.0071–0.0097) %.

ICTERIDAE

1 *Dolichonyx oryzivorus* (Bobolink): body, 35.1 g.; adrenals, 0.0118%; thyroids, 0.0124%. *Sturnella magna* (Meadowlark) 5 males: body, 112.1 (98–112) g.; adrenals, 0.0066 (0.0034–0.0079) %; thyroids, 0.0058 (0.0048–0.0077) %; 4 females: body, 83.9 (78–95.3) g.; adrenals, 0.0106 (0.0069–0.0151) %; thyroids, 0.0065 (0.0055–0.0083) %. 1 *Icterus galbula* (Baltimore Oriole): body, 35.3 g.; adrenals, 0.0135%; thyroids, 0.0105%. 2 *Euphagus carolinus* (Rusty Blackbird): body, 60.5 (55–66) g.; adrenals, 0.0095 (0.0069–0.0121) %; thyroids, 0.0064 (0.0049–0.0079) %. *Quiscalus q. quiscula* (Purple Grackle) 4 males: body, 121.5 (118.4–126.3) g.; adrenals, 0.0104 (0.0064–0.0192) %; thyroids, 0.0117 (0.0041–0.0155) %; 3 females: body, 100.0 (95.4–105.6) g.; adrenals, 0.0077 (0.0058–0.0107) %; thyroids, 0.0082 (0.0037–0.0153) %. *Molothrus ater* (Cowbird) 4 males: body, 51.5 (48.0–54.9) g.; adrenals, 0.0093 (0.0079–0.0117) %; thyroids, 0.0061 (0.0046–0.0081) %; 4 females: body, 38.9 (35.2–42.5) g.; adrenals, 0.0121 (0.0075–0.0146) %; thyroids, 0.0067 (0.0058–0.0073) %.

FRINGILLIDAE

3 *Hedymeles ludovicianus* (Rose-breasted Grosbeak): body, 42.7 (41–44.3) g.; adrenals, 0.0129 (0.0113–0.0146) %; thyroids, 0.0128%. 2 *Carpodacus purpureus* (Purple Finch): body, 20.7 (18.5–23) g.; adrenals, 0.0279 (0.0191–0.0368) %; thyroids, 0.0140 (0.0130–0.0149) %. 4 *Ammospiza maritima fisheri* (Louisiana Seaside Sparrow): body, 17.8 (15.5–20) g.; adrenals, 0.0064 (0.0036–0.0076) %; thyroids, 0.0068 (0.0049–0.0083) %. 3 *Spizella pusilla* (Field Sparrow): body, 13.8 (12.2–14.8) g.; adrenals, 0.0104 (0.0091–0.0121) %; thyroids, 0.0084 (0.0057–0.0112) %. 1 *Passerella iliaca* (Fox Sparrow): body, 43.6 g.; adrenals, 0.0021%; thyroids, 0.0063%. 1 *Melospiza lincolnii* (Lincoln's Sparrow): body, 16 g.; adrenals, 0.0150%; thyroids, 0.0150%. 2 *Plectrophenax nivalis* (Snow Bunting): body, 36.9 (34.7–39) g.; adrenals, 0.0113 (0.0112–0.0115) %; thyroids, 0.0061 (0.0059–0.0063) %.

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TABLE I

ARITHMETIC MEAN BODY WEIGHTS, ADRENAL WEIGHTS AND THYROID WEIGHTS WITH STANDARD DEVIATIONS
(Arranged according to the Check-List of the American Ornithologists' Union)

Family and species	*Number*	*Body weight arithmetic mean (grams)*	*Adrenal*		*Thyroid*	
			Arithmetic mean (grams)	*Weight per cent body wt.*	*Arithmetic mean (grams)*	*Weight per cent body wt.*
COLYMBIDAE						
Podilymbus podiceps (Pied-billed Grebe)	1	312	0.0600	0.0192	0.0283	0.0091
PELECANIDAE						
Pelecanus occidentalis (Brown Pelican)	6	3422±344	1.387	0.0405±0.0056	0.257	0.0075±0.0013
PHALACROCORACIDAE						
Phalacrocorax auritus (Double-crested Cormorant)	2	1858 (1787–1929)*	0.337	0.0182 (0.0177–0.0187)*	0.389	0.0211 (0.0176–0.0246)*
ARDEIDAE						
Ardea herodias (Great Blue Heron)	5	1951 (1476–2269)	0.234	0.0120 (0.0067–0.0237)	0.116	0.0061 (0.0044–0.0081)
Hydranassa tricolor ruficollis (Louisiana Heron)	3	467 (418–513)	0.0654	0.014 (0.0096–0.022)	0.0266	0.0057 (0.0055–0.0060)
ANATIDAE						
Anser anser (Emden Goose)	10	5707±878	0.6286	0.0114±0.0016	0.5185	0.0089±0.0018
ACCIPITRIDAE						
Accipiter cooperii (Cooper's Hawk)	3	569 (543–593)	0.0496	0.0084 (0.0081–0.0084)	0.0336	0.0059 (0.0052–0.0068)

*Range.

TABLE I—*Continued*

FALCONIDAE *Falco sparverius* (Sparrow Hawk)	2	104.5 (104–105)	0.0166	0.0159 (0.0153–0.0165)	0.0115	0.0110 (0.0085–0.0135)
PHASIANIDAE *Colinus virginianus* (Bobwhite)	6	194.6±20.8	0.02145	0.0110±0.0019	0.01775	0.0093±0.0042
RALLIDAE *Fulica americana* (Coot)	4	505 (481–543)	0.0751	0.015 (0.0092–0.0229)	0.045	0.0089 (0.0073–0.0106)
SCOLOPACIDAE *Ereunetes mauri* (Western Sandpiper)	5	25.2 (22.5–26.7)	0.0025	0.0106 (0.0074–0.0129	0.0033	0.0131 (0.0111–0.0157)
LARIDAE *Larus argentatus smithsonianus* (Herring Gull)	8	1012.1±194	0.155	0.0153±0.0062	0.085	0.0084±0.0024
TYTONIDAE *Tyto alba pratincola* (Barn Owl)	2	524.5	0.0456	0.0087 (0.0053–0.0121)	0.0409	0.0078 (0.0065–0.0090)
STRIGIDAE *Strix varia* (Barred Owl)	2	706.5	0.0672	0.0094 (0.0092–0.0095)	0.0389	0.0055 (0.0052–0.0059)
TROCHILIDAE *Archilochus colubris* (Ruby-throated Hummingbird)	4	3.36 (3.0–3.63)	0.000427	0.0127 (0.0095–0.0193)	0.000467	0.0139 (0.0132–0.0146)
ALCEDINIDAE *Megaceryle alcyon* (Belted Kingfisher)	5	150.6 (137–166)	0.0191	0.0127 (0.0060–0.0188)	0.0139	0.0092 (0.0081–0.0107)

TABLE 1—*Continued*

Family and species	*Number*	*Body weight arithmetic mean (grams)*	*Adrenal*		*Thyroid*	
			Arithmetic mean (grams)	*Weight per cent body wt.*	*Arithmetic mean (grams)*	*Weight per cent body wt.*
PICIDAE						
Colaptes auratus luteus (Northern Flicker)	16	134.3±8.9	0.0128	0.0095±0.0003	0.00873	0.0065±0.0003
Sphyrapicus varius (Yellow-bellied Sapsucker)	8	46.8±4.2	0.00435	0.0093±0.0024	0.00352	0.0076±0.0019
Dryobates villosus (Hairy Woodpecker)	9	67.6±7.6	0.00561	0.0083±0.0003	0.00426	0.0063±0.0003
Dryobates pubescens medianus (Northern Downy Woodpecker)	30	26.9±1.9	0.00229	0.0085±0.0003	0.00191	0.0071±0.0003
TYRANNIDAE						
Sayornis phoebe (Eastern Phoebe)	10	19.4±1.4	0.00283	0.0146±0.0044	0.00237	0.0122±0.0047
HIRUNDINIDAE						
Progne subis (Purple Martin)	7	47.8±3.4	0.00636	0.0133±0.0021	0.00410	0.0086±0.0033
CORVIDAE						
Cyanocitta cristata (Blue Jay)	18	88.9±5.47	0.00854	0.0095±0.0025	0.00693	0.00779±0.0026
PARIDAE						
Parus atricapillus (Black-capped Chickadee)	18	11.5±0.87	0.00139	0.0121±0.0043	0.00120	0.0104±0.0036
Parus c. carolinensis (Carolina Chickadee)	21	10.0±0.8	0.00100	0.0100±0.0036	0.00125	0.0125±0.0049
Parus bicolor (Tufted Titmouse)	14	21.4±1.5	0.00241	0.01126±0.0047	0.00211	0.00987±0.0036
SITTIDAE						
Sitta c. carolinensis (White-breasted Nuthatch)	14	21.0±1.5	0.00265	0.0126±0.0047	0.00194	0.00924±0.0046
Sitta canadensis (Red-breasted Nuthatch)	13	10.2±1.0	0.00166	0.0163±0.0074	0.00166	0.0163±0.0053

TABLE 1—*Continued*

CERTHIIDAE						
Certhia familiaris americana (Brown Creeper)	9	8.8±0.47	0.00125	0.0142±0.0061	0.00092	0.0105±0.0038
TROGLODYTIDAE						
Telmatodytes palustris dissaëptus (Prairie Marsh Wren)	7	12.5±1.1	0.00225	0.0184±0.0051	0.00124	0.0099±0.0031
MIMIDAE						
Mimus polyglottos (Mockingbird)	10	54.5±4.1	0.0054	0.0099±0.0041	0.00463	0.0085±0.0024
Dumetella carolinensis (Catbird)	10	37.9±3.8	0.00576	0.0152±0.0084	0.00455	0.0120±0.0038
TURDIDAE						
Turdus migratorius (Robin)	14	79.7±9.1	0.00932	0.0117±0.0046	0.0082	0.0103±0.0033
Hylocichla fuscescens (Veery)	10	30.0±4.7	0.00453	0.0151±0.0047	0.00378	0.0126±0.0029
Sialia sialis (Bluebird)	6	32.06±2.66	0.00342	0.0106±0.0026	0.00316	0.0098±0.0024
SYLVIIDAE						
Regulus satrapa (Golden-crowned Kinglet)	14	6.3±0.62	0.00085	0.0135±0.0045	0.000552	0.0088±0.0044
BOMBYCILLIDAE						
Bombycilla cedrorum (Cedar Waxwing)	9	33.8±3.0	0.00524	0.0155±0.0040	0.00341	0.0101±0.0041
LANIIDAE						
Lanius ludovicianus (Loggerhead Shrike)	7	48.5±1.27	0.00582	0.0120±0.0049	0.0049	0.0101±0.0044
VIREONIDAE						
Vireo olivaceus (Red-eyed Vireo)	15	17.9±2.9	0.00293	0.0164±0.0057	0.00247	0.0138±0.0050

TABLE 1—*Continued*

Family and species	*Number*	*Body weight arithmetic mean (grams)*	*Adrenal*		*Thyroid*	
			Arithmetic mean (grams)	*Weight per cent body wt.*	*Arithmetic mean (grams)*	*Weight per cent body wt.*
COMPSOTHLYPIDAE						
Mniotilta varia (Black and White Warbler)	12	10.3±0.56	0.00141	0.0137±0.0025	0.000834	0.0081±0.0022
Compsothlypis americana pusilla (Parula Warbler)	9	7.6±0.83	0.00115	0.0151±0.0034	0.00078	0.0103±0.0022
Dendroica petechia (Yellow Warbler)	6	10.3±0.80	0.00171	0.0155±0.0046	0.00098	0.0096±0.0037
Dendroica magnolia (Magnolia Warbler)	17	8.3±0.61	0.00129	0.0156±0.0044	0.00110	0.0133±0.0054
Dendroica coronata (Myrtle Warbler)	25	12.6±1.10	0.00157	0.0125±0.0049	0.00150	0.0119±0.0041
Dendroica virens (Black-throated Green Warbler)	19	9.0±0.50	0.00151	0.0168±0.0061	0.00127	0.0141±0.0042
Dendroica pensylvanica (Chestnut-sided Warbler)	11	9.7±0.44	0.00146	0.0151±0.0034	0.00093	0.0096±0.0017
Geothlypis trichas brachidactyla (Northern Yellow-throat)	15	10.1±0.83	0.00155	0.0153±0.0058	0.00103	0.0102±0.0036
Setophaga ruticilla (Redstart)	9	8.3±0.65	0.00122	0.0147±0.0058	0.00098	0.0118±0.0050
PLOCEIDAE						
Passer domesticus (English Sparrow)	28	25.1±2.3	0.00243	0.0097±0.0027	0.00249	0.0099±0.0021
ICTERIDAE						
Agelaius phoeniceus littoralis (Red-winged Blackbird)						
male	15	54.0±3.4	0.00485	0.0089±0.0034	0.00243	0.0045±0.0020
female	8	34.0±1.48	0.0026	0.0077±0.0020	0.0026	0.0077±0.0012
Cassidix mexicanus major (Boat-tailed Grackle)	7	161.3±13.0	0.0189	0.0117±0.0030	0.0068	0.0042±0.0010

TABLE 1—*Continued*

THRAUPIDAE						
Piranga erythromelas (Scarlet Tanager)	8	28.5±1.1	0.00359	0.0126±0.0043	0.00273	0.0096±0.0026
FRINGILLIDAE						
Richmondena cardinalis (Cardinal)	21	44.6±3.1	0.00482	0.0108±0.0029	0.00446	0.0100±0.0034
Spinus tristis (Goldfinch)	6	13.5±0.95	0.00148	0.0097±0.0038	0.00193	0.0145±0.0032
Pipilo erythrophthalmus (Red-eyed Towhee)	8	41.5±2.9	0.00442	0.0108±0.0027	0.00317	0.0077±0.0021
Junco hyemalis (Slate-colored Junco)	6	20.9±1.41	0.00253	0.0115±0.0016	0.00187	0.0104±0.0034
Spizella arborea (Tree Sparrow)	7	17.6±0.96	0.00142	0.0081±0.0030	0.00191	0.00142±0.0045
Spizella passerina (Chipping Sparrow)	7	12.6±1.28	0.00157	0.0120±0.0043	0.00113	0.0086±0.0055
Zonotrichia albicollis (White-throated Sparrow)	10	27.9±3.26	0.00315	0.0113±0.0053	0.00335	0.0120±0.0026
Melospiza georgiana (Swamp Sparrow)	17	18.5±2.49	0.00235	0.0127±0.0050	0.00174	0.0094±0.0029
Melospiza melodia (Song Sparrow)	15	21.8±2.67	0.00283	0.0130±0.0049	0.00224	0.0107±0.0039

SUMMARY

1. Body weights, adrenal weights and thyroid weights were obtained for 143 species of birds distributed among 38 families, in order to compare the relative size of the adrenal and thyroid within each species, as well as between species.

2. The range of relative weights in adrenal and thyroid was great in 45 species, in adrenal alone for 19 species, and for thyroid alone in nine species. The standard deviation indicated that the spread of values was large in many species. The least standard deviation for both adrenals and thyroids occurred in the Flicker, Hairy Woodpecker, Downy Woodpecker, and Emden Goose. The least standard deviation for adrenals alone occurred in the Brown Pelican, and for thyroids alone in the Parula and Chestnut-sided Warblers.

3. A Snow Bunting, caught in December and kept in a cage in the laboratory until May, possessed extremely small adrenals and thyroids as compared with these glands from the same flock of buntings killed in December.

4. Among the few species in which the number of individuals was large enough for a valid comparison, none showed a significant difference in the adrenals and thyroids between sexes.

5. The relative weight of adrenals in birds collected with an egg in the oviduct was no greater than that found in other individuals of the species not ovulating.

6. In the one species well represented in both spring and fall, the Myrtle Warbler, there was no difference between either the adrenals or the thyroids at these seasons.

7. In the few infected birds which we collected the adrenals were often enlarged while the thyroids were sometimes enlarged.

8. Parasitic infection influenced the weights of the adrenals and thyroids in some instances but not in others.

9. Standard errors were calculated wherever the numbers were sufficient and a comparison of the significance of differences was made between certain species which suggested a difference on inspection.

10. The adrenal of the Brown Pelican was relatively the largest of any species studied. The Woodpeckers were among those birds which have the smallest adrenals. Others that might have equally small adrenals were: Cooper's Hawk, Western Sandpiper, Barn Owl, Barred Owl, Blue Jay, Carolina Chickadee, Mockingbird, English Sparrow, and Red-wing. The adrenals of the Marsh Wren are probably significantly larger than those of the Carolina Chickadee.

11. There was no significant difference between thyroids among the different species.

12. The relative size of the adrenals and thyroids in different species bears no relation to their activity.

13. Comparison of the relative weights of the adrenals in birds with those in mammals shows a similarity in range among individuals of a species and among different species of the class.

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Department of Physiology
Ohio State University
Columbus, Ohio

THE NUMBER OF SPECIES OF BIRDS

BY ERNST MAYR

"How many species of birds are known?" is a question the bird taxonomist is asked very frequently. The answer, up to now, has had to be a guess. It is for this reason that I decided to count the species, family by family, on the basis of the best available information.

In the tenth edition of the 'Systema Naturae' (1758), the first work in which the species concept is consistently applied, Linnaeus enumerates 564 species of birds, known to him from all parts of the world. In the subsequent 150 years a number of additional counts were published, each one to be quickly superseded by a newer one. The last of these counts is contained in the fifth and final volume of Sharpe's 'Handlist' (1909). The number admitted by Sharpe was 2,810 genera and 18,937 species. This figure, however, includes not only the fossil species, but also treats all subspecies as full species. It is, therefore, obvious that the actual number of species of birds must be considerably below Sharpe's figure, even though about 400 additional good species have been described since 1909. In 1935 I