Bird-Banding

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WEIGHTS AND TEMPERATURES OF SOME MICHIGAN BIRDS[1]

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COMPARATIVELY little is known about the weights and temperatures of birds as they exist in the wild state. In view of the lack of such data, the following work was begun in the fall of 1931. An exceptional opportunity for collecting data was made available through the bird banding station operated under the direction of Professor J. W. Stack at Michigan State College.

This station was inaugurated in 1923 by Professor Stack and has been active throughout each year with the exception of the summer session, from the last of June until the opening of college in the fall term, which is generally the last week in September.

Owing to the fact that the station has been in operation over such a long period of time, large numbers of birds tend to be attracted to this area by the constantly available food. Due to the elimination of many shrubs, trees, and wild cover about the campus, the annual catch has decreased during the last few years.

Trammel bird nets and various types of traps are used to capture the birds, at this station.

REVIEW OF LITERATURE ON BIRD TEMPERATURES

The late S. Prentiss Baldwin, in his book "Physiology of the Temperature of Birds", states that Pembery (1898) summarized most of the work on mammalian and human temperature observed at that time, including also work on the physiology of bird temperature. Alexander Wetmore (1921) published his work, "A Study of the Body Temperature of Birds", covering 327 species of birds totaling 1,558 records. He also summarized the work of Eydoux and Souleyet (1838), Brown Sequard (1858), Martins (1858), Milne Edwards (1863), Sutherland (1899), Simpson and Galbraith (1905–1912), Hilden and Stenback (1916), Bergtold (1917), and Weber (1918) covering 89 species.

The work on bird temperatures up to 1921 was done more for the purpose of securing temperatures on a large number of families rather than on large numbers of any particular species.

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Wetmore (1921) includes the conclusions of the following observers in his study: Simpson and Galbraith (1905–1912) from records of gulls, starlings, sparrow-hawks, a kestrel, thrushes, owls of several species, domestic fowls, ducks and pigeons. They found that birds normally active during the day showed a diurnal rhythm with a gradual rise in temperature reaching a maximum in the late afternoon and then gradually decreasing, reaching a minimum in the early morning. In nocturnal species the tendency was reversed, the bird reaching a maximum late at night with the minimum temperature during the day.

Hilden and Stenback (1916) by means of confining diurnal birds in a dark room and using artificial lights caused them to reverse their temperature rhythm, having the maximum at midnight and a minimum in the afternoon. When the birds were again allowed normal conditions they changed to their normal rhythm.

Wetmore concludes that large birds show a smaller daily range of variation in temperature than small birds. He based his conclusion on the work of Simpson and Galbraith (1905–1912), which gave the following ranges from maximum to minimum:

Thrush	7.5 degrees F.
Starlings	7.2 degrees F.
Domestic Fowl	1.9 degrees F.
Domestic Duck	1.8 degrees F.

Wetmore believes that birds have a higher temperature in the summer than in the winter due to the longer day in summer, which provides a longer period of activity.

Martins (1858) noted a higher temperature in the female than in the male of the domestic duck. Simpson and Galbraith (1905–1912) also obtained similar results on birds of other species. Hilden and Stenback (1916), basing their conclusions on a few records of other species of birds, found that the males had a higher temperature than the females. Wetmore agreed with the conclusions of Simpson and Galbraith by observing that females had a higher temperature than males, although he noted some exceptions.

Wetmore found that the females of the species studied had a slightly higher temperature than the males, but in some species the males showed a decidedly higher temperature reading than the females. In some species the temperatures of the two sexes were approximately the same. Wetmore believed that the sex showing the higher temperature was also the one that incubated the eggs. His data bear out this conclusion. He discovered that in passerine birds sharing these duties, the temperatures of both sexes were approximately the same. In shore birds Wetmore found that the male had a slightly higher temperature when both sexes incubate.

Leon Gardner (1926) secured the temperature of 24 species of nestling birds and found that under uniform conditions younger birds showed a lower temperature than those more fully developed. He also discovered that absence of the incubating parent, if prolonged, fatigue, hunger, illness or removal from the nest causes a decrease in the body temperature of the young bird.

S. Prentiss Baldwin (1932) by the use of a thermocouple arrangement was able to secure very extensive records on the temperature of the Eastern House Wren. His observations led to the following conclusions.

1. The normal body temperature of the Eastern House Wren and other passeriform species is characterized by great variableness.
2. Excitement, through its effect on activity and other functions, tends indirectly to increase the body temperature.
3. Under experimental conditions, the body temperature of adult birds is normally unaffected by fluctuations in air temperature so long as these fluctuations are not extreme and do not occur too rapidly.
4. Birds are more quickly and seriously affected by a rise in body temperature than by a lowering.
5. Variations in the rate of respiratory movements of adult birds are probably of significance in temperature regulation.
6. The skin temperature of passeriform birds is lower than that of the internal body temperature, varies in different regions and is not in all cases the same in the two sexes.
7. There is a decided and rather abrupt daily rhythm of body temperature in passeriform birds.
8. Young Eastern House Wrens are distinctly poikilothermic in their temperature reactions.

REVIEW OF LITERATURE ON BIRD WEIGHTS

Sidney R. Esten (1931) reviewed the work of William VanGorder (1911–1923) who obtained records mainly on hawks and water birds, but he reported on some species which were also included in this paper. Mr. and Mrs. Charles L. Whittle (1925–1930) took records of bird weights at Cohasset, Massachusetts and at Peterboro, New Hampshire. Mr. Whittle concluded that individual variation is too great to determine correct weight averages from records of a small number of birds. However, he found that chickadees seemed to be an exception to the rule.

Dayton Stoner (1928) observed the weights of young Bank Swallows from birth until they left the nest and found that their weight increased up to the 11th to 13th day, when a decrease was noted. He thought this was primarily due to a re-absorption of fat, which develops but gradually diminishes as the time for leaving the nest approaches. At the time of the initial flight the birds weigh more than the average adult.

Maurice Broun (1932) took the weight and also the wing measure-

ment of several species of birds at Austin Ornithological Research Station in the fall of 1932. He states that the majority of the birds were weighed in the forenoon, when full crops might be expected. He states no conclusions on his work.

Mrs. Kenneth B. Weatherbee (1934) has taken records of weight, body length, wing, tail, tarsus and culmen of birds caught at Worcester, Massachusetts, and at Pomfret, Connecticut, from 1932–34. Her work was mainly on measurements of the different parts of the birds' bodies.

METHODS USED IN OBTAINING RECORDS OF BIRD WEIGHTS AND TEMPERATURES

The birds observed in these experiments were caught in the government type of sparrow trap or trammel bird net and then conveyed in carrying cages to the laboratory where they were weighed and their temperatures taken.

The time of capture of each bird was recorded in the data, but the length of its confinement in a cage at the laboratory varied, depending on the time when the writers were able to attend it. This confinement no doubt produced a physiological effect on weight and temperature.

The scales used in obtaining weights were secured from the W. M. Welch Scientific Company, Manitowoc, Wisconsin and were checked with a set of Standard Weights from the Bureau of Standards, Washington, D. C. by Professor Snow of the Physics Department of Michigan State College. The range of error was found to be .2 gram.

The first method used in obtaining weights was to put the bird into a cloth sack and fasten the sack onto the scales with a rubber band. This proved unsatisfactory, due to the accumulation of fecal deposit and the absorption of atmospheric moisture by the cloth sack. Metal cones proved most satisfactory as they prevented absorption, could be easily cleaned and prevented the bird from moving. In securing the net weight it was necessary to deduct the weight of the metal band on the bird's leg and the weight of the metal cone.

All weights were determined accurately to one-tenth of a gram. There was found to be a slight variation in the weight of the cones due to fluctuation in humidity and accumulation of dust. It was necessary to balance the scales and reweigh the cones frequently during the process of weighing.

A special bird-thermometer was made by the Will Corporation, Rochester, New York, and used throughout the period of this work.

Considerable individuality was shown by all species handled in

their reaction to having their weight and temperature taken. Birds caught the first time seemed excited and reluctant to open their bills for the insertion of the thermometer. However, repeats were generally docile, thereby facilitating the securing of their temperatures.

Wetmore and Baldwin found a variation of several degrees between the temperatures of the esophagus and the proventriculus, due perhaps to the poor peripheral circulation of the former. In the data in this paper the thermometer was inserted down to the region of the proventriculus. Since the instrument was so constructed that only a maximum temperature could be taken, the following data represent the maximum during the first three minutes following the insertion of the thermometer. It was found by taking the temperatures of birds over periods of from one to ten minutes that the reading reached a maximum during the first three minutes. Birds were held in such a way as to reduce body movement to a minimum. Since it was necessary to release the birds in order to study their migratory movements, no observations on pathological conditions or determination of sex could be made by means of post-mortem examinations.

S. Prentiss Baldwin and Alexander Wetmore have done the most extensive research on birds' temperatures. Wetmore obtained a few records on a large number of families, while Baldwin confined most of his work to the study of the Eastern House Wren.

The writers hoped by a study of large numbers of several species to obtain accurate averages on weights and temperatures and that some facts could be obtained on diurnal and seasonal variations of weights and temperatures. However, no accurate average could be determined on some species due to the limited number captured.

POSSIBLE FACTORS INVOLVED IN STUDYING BIRD WEIGHTS AND TEMPERATURES

Before taking up a discussion of the data collected, it would be feasible to consider some of the factors that may be involved in the study of weights and temperatures.

The physical characters of the bird are involved in this study. In the animal kingdom the bird is considered to have the most rapid rate of metabolism, its katabolism being very high as compared with anabolism. Birds are partially able to regulate the heat of their bodies by producing heat in the contraction of muscles and the retention of heat by the insulating effect of their feathers. The bird has no sweat glands, but is able to regulate a high internal body temperature by the evaporation of moisture from the internal surfaces of the lungs and air sacs.

All the data in this paper were obtained from studies of migratory species and migration may be considered to affect weight and temperature.

Birds are considered to have the highest temperatures of the animal kingdom. For the purpose of comparison, temperatures quoted in "Handbook of Physiology" by Halliburton and McDowell (1930) are listed here. Since the Fahrenheit scale is used entirely throughout this paper, these temperatures have been transposed from the Centigrade scale.

	Centigrade	*Fahrenheit*
Human	36.5–37.5 degrees	98–99 degrees
Horse, Donkey, Ox	37.5–38.0 degrees	99.5–100.4 degrees
Dog, Cat	38.5–39.0 degrees	101.3–102.2 degrees
Sheep, Rabbit	38.0–39.5 degrees	100.4–103.1 degrees
Mouse	37.5 degrees	99.5 degrees
Rat	37.9 degrees	100.2 degrees
Birds	42.0 degrees	107.6 degrees

TABLE I

INITIAL WEIGHTS OF SPECIES OBSERVED

Species	*No. Incl.*	*Average (grams)*	*Minimum (grams)*	*Maximum (grams)*
Virginia Rail	1	69.9	....	....
Eastern Bob-White	6	194.4	177.1	206.5
Eastern Mourning Dove	21	130.8 ± 1.6	103.6	146.9
Eastern Hairy Woodpecker	1	62.1	....	....
Northern Downy Woodpecker	5	27.1	26.2	28.9
Yellow-bellied Sapsucker	2	46.7	44.2	49.1
Red-headed Woodpecker	5	79.2	70.5	88.0
Northern Flicker	1	137.6	....	....
Eastern Phoebe	1	16.9	....	....
Eastern Wood Pewee	1	13.1	....	....
Yellow-bellied Flycatcher	2	11.9	11.8	12.0
Alder Flycatcher	1	8.8	....	....
Northern Blue Jay	30	84.0 ± .7	70.4	96.3
Eastern Cowbird	41	46.0 ± .5	34.3	53.9
Baltimore Oriole	4	32.7	28.9	38.1
Bronzed Grackle	143	105.2 ± .7	83.5	137.0
Eastern Goldfinch	11	12.8 ± .2	11.4	14.0
Northern Pine Siskin	1	13.6	....	....
White-crowned Sparrow	48	32.1 ± .3	22.9	38.7
Gambel's Sparrow	1	27.1	....	....
White-throated Sparrow	375	27.2 ± .1	19.1	34.5
Eastern Tree Sparrow	3	16.6	15.4	18.5
Eastern Chipping Sparrow	19	13.0 ± .3	10.3	19.7
Eastern Field Sparrow	1	12.1	....	....
Slate-colored Junco	597	19.5 ± .1	14.7	27.6
Mississippi Song Sparrow	77	20.6 ± .1	17.3	25.2
Lincoln's Sparrow	8	18.5	15.2	20.1
Swamp Sparrow	2	16.9	16.4	17.4
Eastern Fox Sparrow	5	39.5	30.4	45.5
Red-eyed Towhee	6	40.7	35.2	45.1
Eastern Cardinal	23	44.6 ± .6	34.6	53.2

TABLE I (continued)

Species	*No. Incl.*	*Average (grams)*	*Minimum (grams)*	*Maximum (grams)*
Rose-breasted Grosbeak	2	44.8	43.9	45.7
Bank Swallow	20	14.0 ± .1	12.7	17.5
Cedar Waxwing	3	35.7	34.6	36.8
Blue-headed Vireo	1	14.4	....	....
White-eyed Vireo	1	11.3	....	....
Black and White Warbler	2	9.7	9.5	9.9
Magnolia Warbler	3	10.6	9.0	11.7
Chestnut-sided Warbler	1	8.3	....	....
Oven-bird	5	18.9	16.8	22.7
Mourning Warbler	3	11.0	10.3	11.7
Canada Warbler	2	9.5	8.8	10.1
American Redstart	2	7.5	7.0	7.9
Catbird	10	35.1 ± .5	31.2	39.0
Brown Thrasher	16	71.8 ± .7	65.1	82.3
Eastern House Wren	2	9.8	9.3	10.2
Brown Creeper	3	8.7	8.0	9.2
White-breasted Nuthatch	12	21.3 ± .1	19.6	22.9
Red-breasted Nuthatch	1	8.7	....	....
Tufted Titmouse	4	21.7	19.3	23.9
Black-capped Chickadee	19	10.3 ± .1	9.2	11.8
Eastern Golden-crowned Kinglet	9	6.5	6.0	6.9
Eastern Ruby-crowned Kinglet	5	6.4	6.1	6.6
Wood Thrush	1	47.7	....	....
Veery	1	35.9	....	....
Olive-backed Thrush	23	32.0 ± .1	24.6	39.4
Eastern Hermit Thrush	44	29.0 ± .2	23.8	35.3
Eastern Robin	54	74.1 ± .5	62.3	90.6

Total number of species—58.

TABLE II

INITIAL TEMPERATURES OF SPECIES OBSERVED

Species	*No. Incl.*	*Average (degrees)*	*Minimum (degrees)*	*Maximum (degrees)*
Eastern Bob-White	6	107.9	107.3	108.5
Eastern Mourning Dove	18	107.6 ± .2	105.3	109.5
Eastern Hairy Woodpecker	1	106.6	....	....
Northern Downy Woodpecker	3	107.3	106.9	107.6
Yellow-bellied Sapsucker	2	108.5	107.6	109.3
Red-headed Woodpecker	4	108.4	107.0	109.2
Northern Flicker	1	104.7	....	....
Eastern Phoebe	1	107.9	....	....
Northern Blue Jay	26	109.6 ± .1	107.7	111.6
Eastern Cowbird	38	110.2 ± .1	107.9	111.4
Baltimore Oriole	3	107.1	103.4	109.4
Bronzed Grackle	128	110.4 ± .1	106.9	112.7
White-crowned Sparrow	39	109.0 ± .1	105.9	110.8
Gambel's Sparrow	1	109.5	....	....
White-throated Sparrow	245	109.7	106.2	112.7
Eastern Tree Sparrow	2	110.8	110.0	111.5
Eastern Chipping Sparrow	15	109.5 ± .2	106.8	110.8
Slate-colored Junco	368	109.2	104.0	113.6
Mississippi Song Sparrow	64	109.6 ± .1	102.0	112.0
Lincoln's Sparrow	4	108.3	104.5	110.1

TABLE II (continued)

Species	*No. Incl.*	*Average (degrees)*	*Minimum (degrees)*	*Maximum (degrees)*
Swamp Sparrow	2	110.2	108.9	111.5
Eastern Fox Sparrow	5	109.1	107.8	110.4
Red-eyed Towhee	3	109.7	109.0	110.0
Eastern Cardinal	14	109.7 ± .2	106.0	112.0
Rose-breasted Grosbeak	1	108.1	....	....
Bank Swallow	31	109.1 ± .2	104.5	111.1
Magnolia Warbler	2	109.1	108.4	109.7
Oven-bird	3	108.5	107.5	109.7
Catbird	7	109.0	107.8	110.0
Brown Thrasher	13	109.8 ± .2	108.2	111.3
White-breasted Nuthatch	7	108.7	106.8	110.0
Red-breasted Nuthatch	1	102.7	....	....
Tufted Titmouse	2	108.2	108.1	108.3
Black-capped Chickadee	11	108.1 ± .4	104.1	111.3
Olive-backed Thrush	18	109.8 ± .2	107.9	112.1
Eastern Hermit Thrush	28	109.2 ± .2	104.3	110.9
Eastern Robin	48	109.5 ± .1	105.2	115.8

Total number of species—37

Birds are considered to be homothermic by all authors used as reference in this paper. The late Mr. S. Prentiss Baldwin (1932) in his work on nestling House Wrens found that the young birds were distinctly poikilothermic, but their development of temperature control is quite complete when the bird is nine days old, after which time it reacts as a homothermic animal. There are various factors affecting the temperature of the bird which have been published by Baldwin (1932) and Rowan (1931).

CONSIDERATION OF INITIAL WEIGHTS AND TEMPERATURES

Initial readings are those taken the first time a bird is captured. It should be kept in mind that the data in this paper were not obtained under constant conditions, but from mature birds under natural conditions.

In Table I there is a list of the average, maximum and minimum weights of the 58 species observed. There is a fairly large range in the weight of some species due probably to individual differences and the fluctuating abundance in available food. Considering the ten species having the largest number of weights recorded, the following ranges were found.

Species	*Records*	*Range*
Slate-colored Junco	597	12.9 grams
White-throated Sparrow	375	15.4 grams
Mississippi Song Sparrow	77	7.9 grams
Bronzed Grackle	143	53.5 grams
Eastern Cowbird	41	19.6 grams
Northern Blue Jay	30	25.9 grams
White-crowned Sparrow	48	15.8 grams

Eastern Robin	54	28.3 grams
Eastern Hermit Thrush	44	11.5 grams
Eastern Cardinal	23	18.6 grams

Range is the mathematical difference between the maximum and the minimum for the species.

Among the causes of variability may be listed immaturity, sex differences, malnutrition and glandular disturbances. Since the distribution of weights was of the normal type, the range may be due largely to individual characteristics. Since it was impossible to fully determine immature individuals, no assumption can be made on the effect of immaturity on weight range.

Table II gives the average, maximum and minimum temperatures of the species observed. It should be noted that temperatures fluctuate. Other observers have found that a bird's temperature may vary as much as ten degrees over the period of a single day.

The following ten species give some indication of the ranges in temperatures of birds.

Species	*Records*	*Range*
Slate-colored Junco	368	9.6 degrees
White-throated Sparrow	245	6.5 degrees
Mississippi Song Sparrow	64	10.0 degrees
Bronzed Grackle	128	5.8 degrees
Eastern Cowbird	38	3.5 degrees
Northern Blue Jay	26	3.9 degrees
White-crowned Sparrow	39	4.9 degrees
Eastern Robin	48	10.6 degrees
Eastern Hermit Thrush	28	6.6 degrees
Eastern Mourning Dove	18	4.2 degrees

This variability may be a character inherited from the bird's reptilian ancestors. This, however, remains to be proven. The studies made for this paper were not broad enough in scope to attribute the variation to any one factor or group of factors. The variation found in the data presented may possibly be due to inclusion of immature individuals not having reached the age of temperature control. However, since immature individuals can be determined in many of the species studied which have a decided variability in temperature, this factor can hardly be considered as important in all species.

In computing the correlation between average weight and average temperature of the ten representative species of birds giving a normal range from small to the large birds found in the following paragraph, a coefficient of $-.30-.186$ is obtained. This coefficient is low and is not statistically significant, but it suggests there may be a tendency for larger birds to have a lower body temperature than smaller birds. The above data fail to demonstrate this point.

The ten species studied in obtaining the coefficient of correlation

for weight and temperature are.

Species	*Average Weight*	*Number of Records*	*Average Temperature*	*Number of Records*
Slate-colored Junco.....	19.5 grams	597	109.2 degrees	368
White-throated Sparrow....	27.2 grams	375	109.7 degrees	245
Mississippi Song Sparrow...	20.6 grams	77	109.6 degrees	64
Bronzed Grackle.....	105.2 grams	143	110.4 degrees	128
Eastern Cowbird.....	46.0 grams	41	110.2 degrees	38
Northern Blue Jay.....	84.0 grams	30	109.6 degrees	26
White-crowned Sparrow....	32.1 grams	48	109.0 degrees	39
Eastern Robin.....	74.1 grams	54	109.5 degrees	48
Eastern Hermit Thrush....	29.0 grams	44	109.2 degrees	28
Eastern Mourning Dove...	130.8 grams	21	107.6 degrees	18

TABLE III

DIURNAL VARIATION IN WEIGHT

Band Number	*Time of Day*	*Average Weight*	*Number of Records*
	SLATE-COLORED JUNCO		
C30788	A.M.	16.4	1
	P.M.	17.4	7
C30793	A.M.	16.7	3
	P.M.	17.0	8
C30796	A.M.	16.8	5
	P.M.	17.3	9
C30810	A.M.	16.9	7
	P.M.	17.5	18
C30827	A.M.	16.4	1
	P.M.	17.8	10
C30838	A.M.	16.9	3
	P.M.	17.8	9
C30967	A.M.	19.6	3
	P.M.	19.7	8
C30999	A.M.	20.0	9
	P.M.	20.4	3
F78026	A.M.	15.6	8
	P.M.	15.9	8
F78044	A.M.	18.2	9
	P.M.	18.5	13
F78122	A.M.	15.6	19
	P.M.	15.7	19
A182132	A.M.	17.7	5
	P.M.	19.8	8
F78422	A.M.	18.7	2
	P.M.	19.8	8
B90438	A.M.	19.5	3
	P.M.	20.5	2
	WHITE-THROATED SPARROW		
C30744	A.M.	21.5	4
	P.M.	21.1	6
C30749	A.M.	17.8	5
	P.M.	19.6	9
C30799	A.M.	19.0	4
	P.M.	20.4	5
C30815	A.M.	21.6	4

	P.M.	20.7	3
C30825	A.M.	24.8	13
	P.M.	25.1	29
C30828	A.M.	27.1	4
	P.M.	28.8	3
C30304	A.M.	26.4	13
	P.M.	28.0	15
C30352	A.M.	26.9	5
	P.M.	26.5	2
A173829	A.M.	23.3	3
	P.M.	22.3	7
	MISSISSIPPI SONG SPARROW		
F78003	A.M.	19.6	5
	P.M.	19.7	6
	EASTERN COWBIRD		
A256781 (Male)	A.M.	47.2	5
	P.M.	47.0	7
	NORTHERN BLUE JAY		
107829	A.M.	90.0	5
	P.M.	87.9	3

TABLE III (continued)

Band Number	*Time of Day*	*Average Weight*	*Number of Records*

DIURNAL VARIATION IN WEIGHT

One determination of weight or temperature for an individual bird tells us nothing about its diurnal variation. Hence it is desirable to study the data for repeaters, i.e., those which were captured ten or more times. Records taken from 8–10 A.M. are considered as morning records and those from 4–6 P.M. are considered as afternoon records in this discussion. The selection of these two periods with an interval between of six hours eliminates any chance of confusing the data, since it was possible that some birds caught in the morning might not have been weighed until early afternoon and this confinement would affect the data. There is no overlapping of morning and afternoon records with the interval selected in this work.

From a study of Table III it can be seen that all of the Slate-colored Junco repeaters show a gain in weight in the afternoon over the morning record. The gains range from a minimum of .1 gram to a maximum of 2.1 grams. One possible explanation for this gain may be that the afternoon records were taken after feeding.

The White-throated Sparrows show a great deal of variability, some birds showing a gain in weight and others a loss in the afternoon records as compared with those of the morning. This loss may possibly be accounted for by the small number of records obtained. It would be interesting to secure a large number of records on repeaters and determine the actual state that exists in the case of the White-throated Sparrows.

Table III has the Mississippi Song Sparrow showing a slight gain

in weight and the Eastern Cowbird and Northern Blue Jay showing a loss in the afternoon records as compared with those of the morning. With a small number of records it is inaccurate to draw any definite conclusions. A larger number of records should be taken to determine whether there is a gain or loss in the afternoon as compared with the morning records.

Bird numbered C30825 is an interesting case since it repeated 57 times from October 11, 1931 to December 1, 1931. This bird had a growth covering one-half of its right eye and one of its legs was paralyzed. These physical handicaps explain why it depended on going into the traps for food. It was very quiet, when handled, and did not seem excited at any time. Its weight seemed quite constant on the records obtained throughout the day.

Variation might possibly depend on kind and amount of food eaten by the bird during the day and the activity of the bird.

TABLE IV

DIURNAL VARIATION IN TEMPERATURE

Band Number	*Time of Day*	*Average Temperature*	*Number of Records*
	SLATE-COLORED JUNCO		
C30788	A.M.	109.0	1
	P.M.	109.9	7
C30793	A.M.	111.5	3
	P.M.	110.0	8
C30796	A.M.	110.4	5
	P.M.	111.0	9
C30810	A.M.	110.2	7
	P.M.	110.7	18
C30838	A.M.	110.4	3
	P.M.	110.1	9
C30967	A.M.	110.5	3
	P.M.	110.3	8
C30999	A.M.	109.7	9
	P.M.	110.5	3
F78026	A.M.	110.0	9
	P.M.	111.2	7
F78044	A.M.	110.3	11
	P.M.	110.7	13
F78122	A.M.	110.0	17
	P.M.	111.0	19
A182132	A.M.	110.7	5
	P.M.	110.6	6
B90438	A.M.	110.6	3
	P.M.	111.3	2
	WHITE-THROATED SPARROW		
C30744	A.M.	109.0	4
	P.M.	109.9	6
C30749	A.M.	109.1	5
	P.M.	110.7	9
C30799	A.M.	109.1	3

TABLE IV (continued)

Band Number	*Time of Day*	*Average Temperature*	*Number of Records*
	P.M.	109.8	5
C30815	A.M.	109.1	4
	P.M.	109.2	3
C30825	A.M.	110.6	13
	P.M.	110.8	29
C30828	A.M.	109.7	4
	P.M.	109.4	3
C30304	A.M.	109.2	2
	P.M.	110.3	3
	MISSISSIPPI SONG SPARROW		
F78003	A.M.	109.2	5
	P.M.	110.9	6
	EASTERN COWBIRD		
A256781 (Male)	A.M.	111.2	5
	P.M.	111.7	7
	NORTHERN BLUE JAY		
107829	A.M.	110.7	5
	P.M.	110.5	3

DIURNAL VARIATION IN TEMPERATURE

From a study of the diurnal variation in temperature of the Slate-colored Junco in Table IV it can be seen that some individuals show a gain and others a loss in the afternoon records as compared with those of the morning. This statement also holds true in the case of the White-throated Sparrow. The single records of the Mississippi Song Sparrow and the Eastern Cowbird both show gains in the afternoon period. The single record of the Northern Blue Jay shows a slight loss in temperature in the afternoon records as compared with those of the morning. Temperature has already, in this paper, been noted to be highly variable, so the only possible conclusion is that some birds show a loss and others a gain in the afternoon temperature records as compared with the morning records.

Simpson and Galbraith (1905–1912) and Baldwin (1932) found the temperatures to be at a maximum in the afternoon. As in the case of weights, in order to secure conclusive results, it would be necessary to make records frequently during the day on the same individuals over a long period of time. This is not possible under natural conditions since the birds do not re-enter the traps regularly. Baldwin (1932) and Wetmore (1921) have found that an individual's temperature may vary several degrees during the day.

TABLE V

AVERAGE WEIGHTS AND TEMPERATURES OF REPEATS
SLATE-COLORED JUNCO

TABLE V (continued)

Band Number	*Average Weight*	*Number of Records*	*Average Temperature*	*Number of Records*
C30788	16.9 grams	13	109.9 degrees	13
C30793	16.8 grams	15	110.5 degrees	14
C30796	17.3 grams	16	110.8 degrees	16
C30810	17.2 grams	31	110.4 degrees	31
C30827	17.4 grams	14	110.8 degrees	13
C30838	17.6 grams	15	110.2 degrees	15
C30869	16.8 grams	10	....	..
C30967	19.6 grams	16	110.1 degrees	16
C30968	21.9 grams	21	110.4 degrees	20
C30999	20.1 grams	13	109.9 degrees	13
F78026	15.7 grams	16	110.5 degrees	16
F78044	18.3 grams	23	110.6 degrees	25
F78122	15.6 grams	38	110.6 degrees	36
A182078	18.4 grams	11	....	..
F78289	18.0 grams	10	....	..
A182132	19.0 grams	24	110.9 degrees	18
F89442	19.3 grams	21	110.9 degrees	12
B90438	20.6 grams	10	110.4 degrees	9
	WHITE-THROATED SPARROW			
C30744	21.4 grams	13	109.3 degrees	13
C30749	19.1 grams	21	110.0 degrees	21
C30799	19.5 grams	13	109.5 degrees	12
C30815	21.5 grams	10	109.1 degrees	10
C30825	24.6 grams	57	110.6 degrees	56
C30828	28.4 grams	12	109.8 degrees	12
C30304	27.1 grams	35	110.0 degrees	6
C30352	25.2 grams	13	....	..
A173829	23.2 grams	11	....	..
	MISSISSIPPI SONG SPARROW			
F78003	19.7 grams	11	110.1 degrees	11
B90414	20.0 grams	10	110.9 degrees	10
	EASTERN COWBIRD			
A256781 (Male)	47.1 grams	12	111.5 degrees	12
	NORTHERN BLUE JAY			
107829	90.3 grams	13	110.4 degrees	13
	BLACK-CAPPED CHICKADEE			
C30930	10.9 grams	12	109.5 degrees	12

CONSIDERATION OF AVERAGE WEIGHTS AND TEMPERATURES OF REPEATERS

Table V shows the average weights and temperatures of repeaters (those caught 10 or more times). The majority of the Slate-colored Junco and White-throated Sparrow repeaters show a weight average less than the average determined for the whole species record. The sample of the whole species includes birds caught one or more times, so for this larger group a different average weight might be expected.

The Mississippi Song Sparrow repeaters are also both under the average weight determined for the sample of the whole species. The Eastern Cowbird, Northern Blue Jay and Black-capped Chickadee have higher average weights in repeaters than in the sample for the entire species.

The writers are unable to explain why repeater average weights are, in general, lower than those of the whole species sample. The variation in number of records of repeats as compared with the whole species sample may possibly be a factor. Possible preponderance of one sex in either sample may also be a factor.

In considering the temperatures in Table V, we find in the case of the majority of the birds of each species that the repeater average temperature is higher than the sample for the whole species. Since temperature has already been noted to be highly variable, the writers are unable to explain the variation other than possibly being due to the variation in the number of records of the repeater and whole species sample.

TABLE VI

COMPARISON OF WEIGHTS WITH OTHER OBSERVERS

Species	*Number of Records*	*Average Weight*	*Observer*
Brown Creeper	3	8.7 grams	Becker and Stack
	1	6.6 grams	Maurice Broun
Black-capped Chickadee	19	10.3 grams	Becker and Stack
	1	10.0 grams	Maurice Broun
	58	11.1 grams	Mrs. Wetherbee
Eastern Golden-crowned Kinglet	9	6.5 grams	Becker and Stack
	1	7.3 grams	Maurice Broun
Eastern Ruby-crowned Kinglet	5	6.4 grams	Becker and Stack
	1	5.8 grams	Maurice Broun
Red-eyed Towhee	6	40.7 grams	Becker and Stack
	1	36.97 grams	Maurice Broun
	14	40.6 grams	Mrs. Wetherbee
Eastern Tree Sparrow	3	16.6 grams	Becker and Stack
	2	17.4 grams	Maurice Broun
	48	19.59 grams	Mrs. Wetherbee
Eastern Chipping Sparrow	19	13.0 grams	Becker and Stack
	4	12.8 grams	Maurice Broun
	97	12.53 grams	Mrs. Wetherbee
	14	13.00 grams	Whittle
White-throated Sparrow	375	27.2 grams	Becker and Stack
	1	22.5 grams	Maurice Broun
	10	29.9 grams	Whittle
	4	27.26 grams	Mrs. Wetherbee
Swamp Sparrow	2	16.9 grams	Becker and Stack
	1	15.7 grams	Maurice Broun
Northern Downy Woodpecker	5	27.1 grams	Becker and Stack
	1	27.0 grams	Whittle
	3	28.1 grams	Mrs. Wetherbee

TABLE VI (continued)

Species	*Number of Records*	*Average Weight*	*Observer*
Northern Blue Jay	30	84.0 grams	Becker and Stack
	2	95.0 grams	Whittle
	44	89.22 grams	Mrs. Wetherbee
Eastern Cowbird	41	46.0 grams	Becker and Stack
	9	42.76 grams	Whittle
White-crowned Sparrow	48	32.1 grams	Becker and Stack
	3	30.8 grams	Whittle
	7	31.27 grams	Mrs. Wetherbee
Eastern Fox Sparrow	5	39.5 grams	Becker and Stack
	6	40.2 grams	Whittle
	16	40.28 grams	Mrs. Wetherbee
Eastern Robin	54	74.1 grams	Becker and Stack
	2	83.5 grams	Whittle
	16	76.6 grams	Mrs. Wetherbee
Slate-colored Junco	597	19.5 grams	Becker and Stack
	13	21.0 grams	Whittle

COMPARISON OF DATA WITH THOSE OF OTHER OBSERVERS

Table VI gives the average weights of 16 species observed by Maurice Broun, Mrs. Wetherbee, Charles Whittle and the writers. The average weights of the other observers vary from the same reading to as much as 11 grams as compared with the writers averages. Since the scales used in the data records of this paper were accurately checked by standard weights this difference can not be accounted for by any inaccuracy of the writers' scales.

From a study of Table I it is noted that all species are somewhat variable in their weights, in some cases reaching a range of 53.5 grams. These variations in the average weights of the previously named observers as compared with the writers could easily be explained as within the possible range for the species. The small number of records in some cases would give more importance to that particular average than it deserved. Only by the use of a large number of records can an accurate average be found.

It is interesting to note the difference in weight between the subspecies of the Song Sparrow.

Subspecies	*Number of Records*	*Average Weight*	*Observer*
Eastern Song Sparrow (*Melospiza melodia melodia*)	29	22.52 grams	Whittle
	94	21.88 grams	Mrs. Wetherbee
Mississippi Song Sparrow (*Melospiza melodia beata*)	77	20.6 grams	Becker and Stack

The eastern form of Song Sparrow has from 1.28 to 1.92 grams higher weight than the form of the Mississippi Valley region. Whether this difference is statistically significant or not cannot be determined since Whittle, and Mrs. Wetherbee neglected to state

the probable error of the mean in their data.

The differences between the weight averages listed by the various observers may be due to variations in the abundance and types of food in the localities where the birds were captured, differences in the sex ratios of the samples, or differences in the number of records of the observers.

TABLE VII

COMPARISON OF TEMPERATURES WITH OTHER OBSERVERS

Species	*Number of Records*	*Average Temperature*	*Observer*
Eastern Bob-White	6	107.9	Becker and Stack
	7	107.95	Wetmore
	1	111.2	Baldwin
Eastern Fox Sparrow	5	109.1	Becker and Stack
	5	109.3	Wetmore
Eastern Hairy Woodpecker	1	106.6	Becker and Stack
	4	108.45	Wetmore
Northern Downy Woodpecker	3	107.3	Becker and Stack
	9	107.75	Wetmore
	3	108.25	Baldwin
Northern Flicker	1	104.7	Becker and Stack
	2	109.1	Wetmore
	2	108.35	Baldwin
Red-headed Woodpecker	4	108.4	Becker and Stack
	2	108.3	Wetmore
Eastern Phoebe	1	107.9	Becker and Stack
	2	110.45	Baldwin
Eastern Cowbird	38	110.2	Becker and Stack
	6	108.15	Wetmore
Baltimore Oriole	3	107.1	Becker and Stack
	2	109.1	Wetmore
Bronzed Grackle	128	110.4	Becker and Stack
	1	109.6	Wetmore
White-crowned Sparrow	39	109.0	Becker and Stack
	6	108.95	Wetmore
White-throated Sparrow	245	109.7	Becker and Stack
	5	110.2	Wetmore
Eastern Chipping Sparrow	15	109.5	Becker and Stack
	2	108.75	Wetmore
Slate-colored Junco	368	109.2	Becker and Stack
	11	108.7	Wetmore
Red-eyed Towhee	3	109.7	Becker and Stack
	3	110.0	Wetmore
Eastern Cardinal	14	109.7	Becker and Stack
	9	109.3	Wetmore
Mississippi Song Sparrow	64	109.6	Becker and Stack
	15	109.1	Wetmore
Lincoln's Sparrow	4	108.3	Becker and Stack
	2	107.8	Wetmore
Swamp Sparrow	2	110.2	Becker and Stack
	4	108.9	Wetmore
Eastern Mourning Dove	18	107.6	Becker and Stack
	13	108.35	Wetmore

TABLE VII (continued)

Species	*Number of Records*	*Average Temperature*	*Observer*
Magnolia Warbler	2	109.1	Becker and Stack
	9	107.85	Wetmore
Oven-bird	3	108.5	Becker and Stack
	3	107.4	Wetmore
Catbird	7	109.0	Becker and Stack
	3	108.65	Wetmore
	1	108.4	Baldwin
White-breasted Nuthatch	7	108.7	Becker and Stack
	6	107.7	Wetmore
Red-breasted Nuthatch	1	102.7	Becker and Stack
	8	107.9	Wetmore
Tufted Titmouse	2	108.2	Becker and Stack
	5	109.1	Wetmore
Black-capped Chickadee	11	108.1	Becker and Stack
	4	108.3	Wetmore
Olive-backed Thrush	18	109.8	Becker and Stack
	4	109.35	Wetmore
Eastern Hermit Thrush	28	109.2	Becker and Stack
	7	108.45	Wetmore
Eastern Robin	48	109.5	Becker and Stack
	9	109.75	Wetmore
	5	109.55	Baldwin

Table VII gives the average temperatures of 30 species as observed by Baldwin, Wetmore and the writers. In no instance does the average vary more than 4 degrees. It has previously been noted that a bird's temperature is subject to a great variability, therefore the writers have no proof that the variations are not those to be expected as a result of natural conditions. Only birds whose temperatures were taken by means of clinical thermometers are considered in this discussion. Where Baldwin and Wetmore indicated sex differences, the average of the male and female were secured for comparative purpose. Mr. Wetmore secured the majority of his records from birds immediately after killing, while the writers records were obtained entirely from living birds.

Some of Baldwin's records secured by the use of the thermocouple are.

Species	*Number of Records*	*Average (in degrees)* *Male*	*Female*
Eastern Chipping Sparrow	9	104.84	104.0
Eastern Robin	2	104.5	104.6
Northern Downy Woodpecker	1	104.3	....
Eastern Hairy Woodpecker	1	....	105.0

These records are noticeably lower than the averages secured by the writers through the use of the clinical thermometer. The writers by use of the thermometer secured the maximum temper-

ature within the first three minutes of taking temperature of each bird. Baldwin by the use of the thermocouple was able to record any drops in temperature. It might be expected that thermocouple readings would be lower than those of a clinical thermometer since it records any drop in temperature after reaching a maximum. It was impossible to secure this reading with a clinical thermometer.

Possible factors which may be involved in temperature variation of the readings of the observers are.

1. Differences in the sex ratios of the groups investigated.
2. Differences due to diurnal variation.
3. Differences in the number of records of the various observers.
4. Pathological conditions.

TABLE VIII

SEASONAL VARIATION WITHIN SPECIES

Season	*Records*	*Average*	*Minimum*	*Maximum*	*Standard Deviation*
		WHITE-THROATED SPARROW			
		Weights			
Fall 1931	30	25.6 ± .2	21.5	29.5	1.8
Fall 1932	111	25.0 ± .1	19.1	31.5	2.2
Spring 1932	102	29.3 ± .1	24.5	34.5	2.0
Spring 1933	132	27.8 ± .1	22.4	34.2	2.1
		Temperatures			
Fall 1931	29	109.0 ± .2	106.2	111.2	1.2
Fall 1932	61	110.1 ± .1	108.1	111.6	.9
Spring 1932	100	109.8 ± .1	106.5	112.7	.9
Spring 1933	55	109.5 ± .1	107.7	111.3	.7
		SLATE-COLORED JUNCO			
		Weights			
Fall 1931	141	18.6 ± .1	15.2	22.1	1.3
Fall 1932	233	18.8 ± .1	14.7	23.9	1.5
Spring 1932	102	21.2 ± .1	15.3	26.8	2.2
Spring 1933	97	20.5 ± .1	16.4	27.6	1.8
		Temperatures			
Fall 1931	133	108.9 ± .1	104.0	112.1	1.5
Fall 1932	36	109.7 ± .1	107.0	113.6	1.2
Spring 1932	99	109.7 ± .1	106.9	112.2	1.0
Spring 1933	82	108.8 ± .1	104.3	111.0	1.2
		MISSISSIPPI SONG SPARROW			
		Weights			
Fall 1931	9	21.2 ± .4	19.2	24.1	1.7
Fall 1932	11	20.1 ± .2	19.2	22.3	.7
Spring 1932	34	20.9 ± .1	18.6	23.6	1.2
Spring 1933	23	20.2 ± .3	17.3	25.2	1.8
		Temperatures			
Fall 1931	8	107.9 ± .6	102.0	110.8	2.6
Fall 1932	6	109.4 ± .3	108.2	111.5	.9
Spring 1932	30	110.2 ± .1	107.7	111.8	1.1
Spring 1933	20	109.6 ± .2	106.5	111.0	1.2

COMPARISON OF SEASONAL VARIATION IN WEIGHT WITHIN THE SPECIES

Three species are to be considered in this discussion: the White-throated Sparrow, Slate-colored Junco, and Mississippi Song Sparrow, since only the number of their records warrants the formulation of conclusions. Table VIII gives the records of seasonal variation to the species studied.

WHITE-THROATED SPARROW

Fall 1931	25.6 grams average weight
Spring 1932	29.3 grams average weight
difference	3.7 grams

Since this gain in the spring is more than three times the probable error of the difference of .23 grams it is statistically significant.

Fall 1932	25.0 grams average weight
Spring 1933	27.8 grams average weight
difference	2.8 grams

The difference is significant since it is more than three times the probable error of the difference of .18 grams.

SLATE-COLORED JUNCO

Fall 1931	18.6 grams average weight
Spring 1932	21.2 grams average weight
difference	2.6 grams
Probable error of the difference	.168 grams

The gain is significant.

Fall 1932	18.8 grams average weight
Spring 1933	20.5 grams average weight
difference	2.3 grams
Probable error of the difference	.141 grams

This gain is significant.

MISSISSIPPI SONG SPARROW

Fall 1931	21.2 grams average weight
Spring 1932	20.9 grams average weight
difference	.3 grams
Probable error of the difference	.41 grams
Fall 1932	20.1 grams average weight
Spring 1933	20.2 grams average weight
difference	.1 grams
Probable error of the difference	.296 grams

There is no significant gain or loss.

The fall records are those taken from October 1st to December 31st and the spring records are those taken from March 1st to June 30th.

In the case of the White-throated Sparrow and Slate-colored Junco there is a decided gain in the spring season over the record

of the preceding fall season. The Mississippi Song Sparrow retains about the same weight in the fall and spring despite migration, nest building, and rearing of the young in the spring.

The following factors should be considered in drawing definite conclusions concerning weight variation in the different seasons.

1. Sex ratios in the records.
2. Varying number of records in each season.
3. Abundance of food in the different seasons.
4. Individuality of weight difference.
5. Pathological conditions.
6. Number of adults and immature birds in records.
7. Migration.

However, in this study it was impossible to isolate these factors to study their effect on the weight of the bird.

COMPARISON OF SEASONAL VARIATION IN TEMPERATURE WITHIN THE SPECIES[1]

WHITE-THROATED SPARROW

Fall (1931)	109.0 degrees average temperature
Spring 1932	109.8 degrees average temperature
difference	.8 degree
Probable error of the difference	.161 degree

This gain is significant.

Fall 1932	110.1 degrees average temperature
Spring 1933	109.5 degrees average temperature
difference	.6 degree
Probable error of the difference	.101 degree

This loss is significant.

SLATE-COLORED JUNCO

Fall 1931	108.9 degrees average temperature
Spring 1932	109.7 degrees average temperature
difference	.8 degree
Probable error of the difference	.114 degree

This gain is significant.

Fall 1932	109.7 degrees average temperature
Spring 1933	108.8 degrees average temperature
difference	.9 degree
Probable error of the difference	.168 degree

The loss is significant.

MISSISSIPPI SONG SPARROW

Fall 1931	107.9 degrees average temperature
Spring 1932	110.2 degrees average temperature
difference	2.3 degrees
Probable error of the difference	.634 degree

This gain is significant.

[1]Table VIII also gives the seasonal temperature variations in the species studied.

Fall 1932	109.4 degrees average temperature
Spring 1933	109.6 degrees average temperature
difference	.2 degree
Probable error of the difference	.317 degree

There is no significant gain or loss.

The White-throated Sparrows and Slate-colored Juncos show a gain in temperature in the first spring and a loss in the second spring over the preceding fall seasons. The writers are unable to account for this variation. There seems to be a good deal of variation in seasonal temperature records, in some cases showing a gain and in others a loss. Keeping in mind that temperature is apt to vary greatly during 24 hours, the only conclusion which these data warrant is that season has little if any effect on temperature.

Data concerning other species observed are too scant to justify any discussion.

DISCUSSION

The discussions in this paper have considered several facts concerning bird weights and temperatures. Since the writers obtained their records under approximately natural environmental conditions there was no control on the factors involved or any determination made of the relative importance of each. A study should be made of weights and temperatures throughout the day with a control placed on the factors and, also, to ascertain the factors involved and the importance of each in affecting weight or temperature. We have definitely proven that there is a large range in weight and temperature within the species. The factors directly responsible have not been determined. Baldwin (1932) and Wetmore (1921) have found that an individual bird may vary as much as ten degrees in temperature during 24 hours. Could this variation possibly show some tendency toward an inherent characteristic received from the bird's poikilothermic, reptilian ancestors? Mammals do not have this wide fluctuation in temperature.

It has been noted that larger birds show a slight tendency to have a lower average weight than the smaller species. Possibly the larger birds may have a slower rate of metabolism than smaller birds. This has not been determined. In general it is found that birds show a heavier weight in the afternoon records than those taken for the morning. This may be due to a heavier feeding between the morning and afternoon records. It is not possible to draw any conclusion concerning diurnal variation in temperature from the data in this paper. We find that average weights for repeaters seem to average lower than the average sample of the whole species, while the average temperature of repeaters seem, in general, to

average higher. Records of the various observers discussed seem to approximate a similarity considering the possible variation due to natural conditions.

White-throated Sparrows and Slate-colored Juncos seem to be affected by seasonal changes in showing a gain in weight in the spring over the preceding fall records. Seasonal changes apparently have no effect on temperature. The Mississippi Song Sparrows retain approximately the weight and temperature in both the fall and spring seasons.

It will be necessary to carry out experiments under controlled conditions to determine the causes of variation in weight and temperature.

GENERAL CONCLUSIONS

1. There is a decided variation in bird weights and temperatures.
2. There is a slight indication that larger birds have a lower average body temperature than the smaller species.
3. Repeater weights average lower and their temperatures average higher than the average sample of the whole species.
4. The Slate-colored Junco and the White-throated Sparrow show a gain in weight in the spring from the preceding fall.
5. There is no seasonal effect on temperature variation in the data.

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CAPTURING BARN SWALLOWS AND CHIMNEY SWIFTS AT NIGHT

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READERS of *Bird-Banding* will recall E. A. McIlhenny's fascinating account of capturing birds at night, which appeared in the January, 1942, issue. The present writer was especially interested in that paper, for he, too, has been a confirmed night hunter for several years.

While vacationing in the Catskills in 1939, I discovered the thrills which await every night hunter. One night I chanced to walk through a barn, near our place, in which a pair of Barn Swallows (*Hirundo erythrogaster*) had nested earlier in the season. Something prompted me to flash my light up at the old nest as I passed under it, and there sat one of the adult swallows. I returned to our cottage, where I fastened my trout landing net to a short pole, provided myself with a powerful flashlight, and then sallied forth. Quietly entering the barn, I walked to a spot directly beneath the nest, which was plastered to a beam about eight feet above the floor. I was amazed at how easily this swallow was captured—I merely snapped the light on the bird and quickly slipped the net