The weight of a bird has been shown by numerous authors to be influenced by such factors as age, sex, and time of day of the capture. Since the distribution of weights presented here is obviously not bimodal, there is no evidence for sexual or age differences in this small population. The fact that there was fair and warm weather prior to the dates of capture indicates that the mean weight recorded here is probably close to that of normal healthy birds in the spring near the end of their migration period. This belief is further strengthened by the close correspondence of these and Stewart's data.

The fact that Poole's bird weighed nearly 4 grams less than the minimum recorded by either Stewart or myself would indicate that Poole must have unfortunately selected either a bird which was emaciated or one which had been dead for some time prior to weighing. Assuming that the wing area is the same for all swifts (obviously not necessarily a valid assumption), the following comparison shows how far off one may go in basing calculations on a single specimen:

Author	No. of birds	Wt. of bird	Wing area	Wing area per gram
Poole (1938)	1	17.3 gm.	104 $cm.^2$	6.00 $cm.^2$
Stewart (1937)	47	23.3	104*	4.46†
Present data	72	24.9	104*	4.18†

*assumed value, based on Poole's single specimen.
†calculated using assumed value for wing area.

This, then, is just one more example showing that extreme caution must be exercised in the interpretation of data based on few specimens or observations, especially when such observations run counter to previously published data.

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THE CLOACAL PROTUBERANCE—A MEANS FOR DETERMINING BREEDING CONDITION IN LIVE MALE PASSERINES

BY ALBERT WOLFSON

Ornithologists have always been interested in the breeding seasons of birds and have recorded their occurrence in numerous species. With Rowan's discovery (1929) that day length influences the reproductive cycle in birds, these observations took on new significance, and further intensive studies were stimulated. These studies have been of two types: experimental, laboratory studies designed to elucidate the role of day length and other environmental factors, and careful studies of breeding seasons in nature in relation to latitude and climate. In experimental studies the usual method for determining the response of the reproductive organs is to autopsy the birds and examine the testes. This method has certain obvious disadvantages, the most important being that it precludes the possibility of following the duration of reproductive activity in individual birds. In field studies, the breeding season for a species is usually defined by the occurrence of fresh or incubated eggs. When concomitant studies of the male gonadal cycle have been made the birds have been collected to determine the size and condition of the testes. Again, this necessitates the sacrifice of individual birds, which may be disadvantageous in certain kinds of studies. Moreover, as has become clear from our studies, testis size or condition by itself is not a valid indicator of readiness to breed.

The object of this paper is to call attention to the cloacal protuberance, which we have found to be a reliable criterion of breeding condition in males of some passerines, and to describe a method for determining the occurrence of motile sperm.

During the course of our studies of captive passerines we noted an enlargement of the cloacal region in some males during the breeding season. No particular attention was paid to this observation until some males were observed in which the cloacal region was so well developed that a scrotum seemed to be present. Close examination of the surface of the protuberance revealed in fact two small, nodular bodies which were quite distinct, and whose finely tubular nature could be seen through the skin of the cloaca. The analogy with the mammalian condition was indeed striking!

Figure 1 shows the fully developed cloacal protuberance in the male Swamp Sparrow. Note especially the bulging of the posterior wall which is caused by the nodules. Dissection of the protuberance revealed two pear-shaped bodies composed of tightly coiled tubules. These bodies were connected with the ducts of the testes, the vasa deferentia, and each had also a small duct which entered the urodeum, a chamber in the cloaca (Figures 2 and 3). Examination of the contents of these bodies under the microscope demonstrated their function. They stored sperm. They also appeared glandular and capable of secreting a medium for the transport of sperm, as the seminal vesicles do in mammals. In mammals, however, the sperm are not stored in the seminal vesicles. It was interesting to note that with the cloaca so greatly distended, the vesicles were actually outside of the body cavity. It seemed possible that the sperm were being stored at a lower temperature than that of the body, again, as is the case in most mammals. (Studies of the temperature of the protuberance later confirmed this supposition.)

Observations on the nature and function of the protuberance were incidental in our experimental studies, but a method was developed for obtaining sperm in live birds. This permitted us to follow the reproductive activity of individual birds over long periods of time and became an important tool in our studies. The method is described below. Our incidental observations and a review of the literature will be presented later, but it may be noted here, that despite the fact that Fatio (1864) was just as impressed as we were with this remarkable structure almost a hundred years ago, little is known about it. Collectors and banders (Mason, 1938), to be sure, are familiar with it, and have used the con-

Figure 1. Cloacal protuberance in an adult male Swamp Sparrow *(Melospiza georgiana).* (Anterior is toward the right.) Note the outline of the nodules on the posterior wall and the relative displacement of the cloacal opening (not visible, but surrounded by anal tuft of feathers) toward the anterior wall of the cloaca. Normally, the opening is centrally located. Photographed on June 23, 1952, enlarged approximately 5 times. Reduced 2 times. Actual measurements in the living bird were as follows: Height of anterior wall: 6.2 mm. Height of posterior wall: 6.7 mm. Largest diameter (near top): 7.0 mm. This bird was caught the previous fall and he.d in captivity under natural conditions of day length.

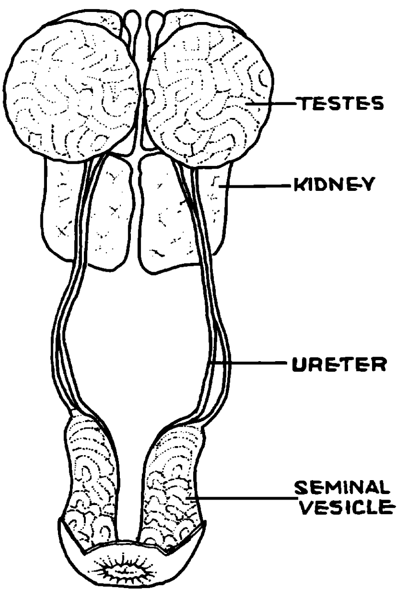

Figure 2. Diagram of the reproductive organs of a male Slate-colored Junco *(Junco hyemalis)* in breeding condition. Ventral view, diagrammatic, with protuberance pulled posteriorly. Enlarged about 4½ times. Reduced 2 times. Specimen autopsied June 8, 1951. This bird was caught April 6, and was exposed to 20-hour day lengths until autopsied. The right seminal vesicle measured about 8 mm. long, 3.5 mm. wide and 5.5 mm. deep; it weighed 43.2 mg. The left vesicle was about the same size and weighed 40.4 mg.

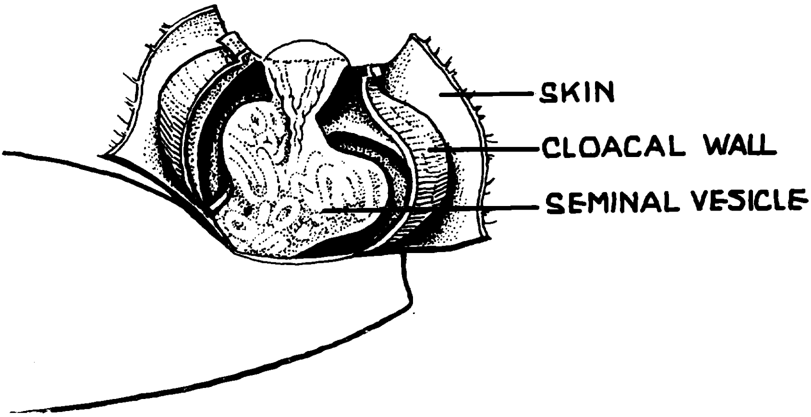

Figure 3. Dissection of the protuberance in lateral view in a White-throated Sparrow *(Zonotrichia albicollis)* in breeding condition. Diagrammatic, anterior to left, enlarged about 5 times. Note: the conical area, near the top of the cloaca, which appears to be attached to the seminal vesicle, is the outer surface of the proctadeum. The V-shaped structure on it is either a tendon or muscle which supports the cloaca. The urodeum, into which the seminal vesicle opens, is median to the distal part of vesicle and cannot be seen. Specimen autopsied June 4, 1951. Bird was caught during spring migration and was held in captivity under natural conditions of day length.

dition of the cloaca for sexing birds during the breeding season, but those I have spoken to were not aware of its significance. The most extensive study we know of is that of Salt (1948), whose studies were concurrent with ours. Our findings are almost identical, and I am indebted to Mr. Salt for permission to read and cite his studies before their publication.

METHOD FOR OBTAINING SPERM

The bird is placed in the hand with its bill toward the observer and the ventral side up. The fifth finger is then placed over the neck and the forefinger over the tail. The legs are held down by the thumb. A slight curling of the third and fourth fingers restricts the wings and body of the bird (Figure 4). No force is applied at any point. The bird is immobilized by restricting it, and it will usually lie quietly after lying in this position for a few moments. The next step is to shift the thumb and forefinger so that they are applied to the anterior and posterior faces of the cloaca (Figure 5). Before the protuberance is squeezed, the head of the bird is brought to rest against the body of the observer. Gentle pressure will cause the eversion of the outer (distal) chamber of the cloaca, the proctadeum. When everted, the posterior wall of this chamber forms a short conical papilla about 1.5 mm. long. A microscope slide is brought into contact with this papilla as further pressure is applied and the exudate collected (Figure 5).

Under ideal conditions, when no excrement is extruded, a "pin-point" of semi-fluid exudate (usually less than 1 mm. in diameter) will adhere to the slide. A drop of warm-blooded Ringer's solution (or normal saline) is added to the exudate to prevent its drying out. Without add-

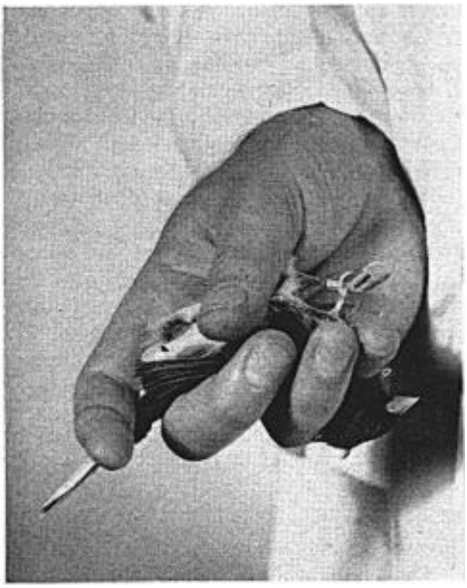

Figure 4. Initial position of bird prior to obtaining sperm.

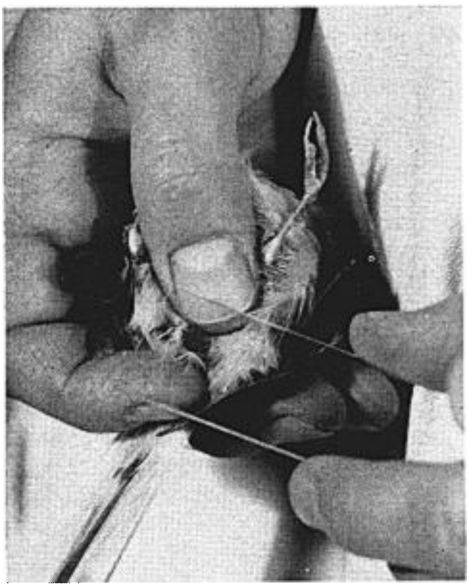

Figure 5. Position of bird and microscope slide while obtaining sperm. Note protuberance between thumb and forefinger.

ing a coverslip it is examined under the microscope as soon as possible. Low power (100X) is adequate. If the bird is in breeding condition, there will be a dense concentration of sperm, most of them highly motile, and swimming away radially from the center of the original "pin-point" of exudate. Most attempts, however, are not ideal, and some excrement is usually extruded when pressure is applied to the cloaca. When that occurs, the excrement is collected on one end of the slide (or removed) and the cloaca is squeezed again. The second exudate is collected on the slide adjacent to the first. If necessary, a third exudate is collected, and so on until a reasonably uncontaminated one is obtained. Ringer's solution is usually added to the last exudate obtained since it will usually be the driest. Motile sperm can be seen readily even in contaminated material and under low power. High power (400X) is difficult to use unless the sample is flat.

We have not made a systematic study of the length of time the sperm remain motile, but it varies with the amount of contamination and the amount of dilution with Ringer's solution. We have had some samples remain active for as long as 10 minutes with no particular care.

Even when the cloaca is not fully developed it has been possible to obtain sperm. In such cases, when the cloaca is only slightly elevated, the thumb and forefinger are pressed dorsally first before the cloaca is squeezed, and while squeezing, pressure is applied more to the lateral walls at the base of the cloaca, rather than to the posterior wall. This modification is also useful when the bird is excessively fat, as occurs frequently in experimental birds, or in spring migrants.

Using this method we have followed the reproductive activity of many birds, some for over a year, and have been able to follow the rapidity of reproductive development, the duration of sperm formation, and the onset of regression under different experimental conditions. Day-length has been found to be an important factor in the regulation of these events (Wolfson, 1952). The cloacal protuberance can also be used, of course, as an indicator of breeding condition in freshly collected birds.

In field studies, where time is an important factor, a smear can be made and the slides stained and studied later in the laboratory. The slides need only be dried in the field. The same procedure can be followed for freshly collected birds, or the seminal vesicles can be removed and preserved for later study. However, we have found the size of the seminal vesicles alone, and hence the cloacal protuberance, to be a valid indicator of breeding condition in most instances. One must, however, be familiar with the "inactive" as well as the "active" conditions of the cloaca. This may not be possible when one collects a species only during the breeding season.

A method for collecting sperm in domesticated birds like the fowl and turkey was developed by Burrows and Quinn (1937) and has proved useful in studies of fertility and factors affecting semen production (see Jull, 1952, chapter 2, for review and bibliography).

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A POPULATION BALANCE FOR THE BLACK-CAPPED CHICKADEE

BY CHARLES H. BLAKE

As an illustration of a method of examining the annual balance of a bird population and to look for evidence of short period cyclic change I have surveyed my records of the Black-capped Chickadee for the past five years. Some tentative conclusions may be drawn from an attempt to balance the variations in number during the year against the calculated number of deaths. On tallying the birds known to be alive and banded on five specific dates, 1 February, 1 May, 1 July, 1 September, and 1 December of each year, one very striking fact emerged: the population was essentially constant from year to year on 1 July, varying only between 11 and 13 birds. There may be a question as whether the data for 1951 are actually all in, but except for the September records it must be very nearly all in and, in any event, would tend to make the July account more uniform rather than less. The figures that I obtained are set out in Table 1, together with the average figure for each date. It is evident that mathematically the plus and minus changes in the average must balance giving an amplitude of 11.2 birds. They need not, however, balance within any one year. If we turn our attention for the moment to the first day of July it would appear that the population comes to a constant level at this time. It has been nearly constant in

TABLE I

Numbers known to be banded and alive on dates shown

	1 Feb.	1 May	1 July	1 Sept.	1 Dec.
1946	—	—	—	—	29
1947	26	14	12	14	21
1948	19	13	12	15	15
1949	12	13	11	18	31
1950	20	11	13	18	20
1951	16	11	12	22	—
Average	18.6	12.4	12.0	17.8	23.2
Amplitude as % of Average	75	24	17	56	69