A HEMATOLOGICAL STUDY OF SNOW, BLUE, AND CANADA GEESE*

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A HEMATOLOGICAL STUDY OF SNOW, BLUE, AND CANADA GEESE*

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Abstract: Hematological values, including erythrocyte counts, hematocrit and hemoglobin values, and total and differential leucocyte counts, were measured at approximately 30-day intervals during a calendar year in adult snow (Chen caerulescens), blue (Chen caerulescens) and Canada goose (Branta canadensis interior). Blood samples from approximately 10 birds (range 3-14) of each type of goose were examined at each bleeding period. Erythrocyte counts for snow and blue geese were very similar and slightly higher than those recorded for Canada goose. Seasonal trends were evident for erythrocyte, hematocrit, and hemoglobin measurements. The highest erythrocyte counts occurred during the winter and spring; the lowest during the summer. Hematocrit and hemoglobin values were highest in the winter and early spring and at their lowest level in the fall. Total and differential leucocyte counts revealed no obvious species or seasonal variations. There were no hematological differences detected between males and females. This is the first report of a detailed hematological study of snow, blue, and Canada goose.

Wild geese constitute a significant segment of wild waterfowl populations in North America. If these populations are to be successfully managed, basic knowledge of the bird including its physiology is important. Although considerable information is available concerning certain aspects of the wild goose, little is recorded on its physiological parameters, such as hematology.

Although hematological data for several anseriform species are available in the literature, they are generally lacking for wild geese. Contributions by Dukes and Schwarte, Hanson, and Lucas and Jamroz provide the only available hematological information on the Canada goose, and a literature review failed to reveal any hematological data on the snow or blue goose. Most ornithologists consider the blue and snow goose to be color phases of a single species. In this study, however, they are referred to as distinct species to simplify the reporting and discussion of data.

This study was undertaken to provide baseline hematological data for three species of wild geese during a calendar year, and to determine if hematological differences existed between species, sexes, or seasons of the year.

MATERIALS AND METHODS

Sixty wild adult snow, blue, and Canada geese were obtained from the Sand Lake National Wildlife Refuge, Colombia, South Dakota, through the cooperation of R. A. Hunt, Wisconsin Department of Natural Resources, Research Bureau. Twenty birds of each species (10 of each sex) were banded, wing clipped and sexed prior to release in a 5-acre, fenced pen at the Wilkie Brothers Foundation in southeastern Wisconsin. The geese had access to a small pond, were free to graze on available vegetation, and were provided ad libitum a diet of corn and commercial duck ration throughout the course of the study.

* Research supported by the College of Agricultural and Life Sciences, University of Wisconsin, Madison, and by the Wilkie Brothers Foundation, Des Plaines, Illinois.
** Present address is Wisconsin State University, Stevens Point, Wisconsin 54481.
Beginning in May 1969, approxi-
mately 10 birds of each species were
bled at monthly intervals for 1 year. The
actual number of blood samples tested
per month varied from 3-14 due to diffi-
culty in capture, breakage of tubes, etc.
Due to losses resulting from predation
and escape, the number of Canada geese
was substantially reduced during the
second half of the study. In an attempt
to keep the number of blood samples per
species similar, Canada geese (Branta
canadensis interior) held at the Charmany
Research Center, University of Wiscon-
sin, Madison, were bled and specimens
substituted for the last five bleeding
periods. All blood samples were collected
from the brachial vein during the late
morning (10-11:00 AM). Blood smears
were immediately prepared from each
sample for total and differential leuco-
cyte counts, and blood to be used for
other measurements was mixed with
ethylenediamine tetraacetic acid (EDTA).

Within 5 hours of collection, labora-
tory determinations of the hematological
values were carried out at the Wisconsin
Alumni Research Foundation, Madison,
Wisconsin, using the following methods:

Erythrocytes

An electronic Coulter counter* was
used to determine erythrocyte counts.2
Two-fold dilutions, starting with 20
lambda of blood in 10 ml of Isoton*,
were prepared. The number of erythro-
cytes in the second dilution was read
directly on the counter.

Hematocrit

Microhematocrit methods, employing
75 mm microhematocrit tubes, were used
to determine hematocrit percentages.
Each tube was centrifuged for 5 to 7
minutes after which a direct reading of
sediment (PCV) was taken from the
column.2

Hemoglobin

Hemoglobin concentrations were de-
termined by cyanmethemoglobin meth-
ods, utilizing a Coleman spectropho-
tometer.10 Twenty lambda of blood was
added to 6 ml of Drabkin solution and the
optical density of the solution was
then recorded on the spectrophotometer
at a wavelength of 540 m. This value
was then multiplied by a factor of 31.6
to convert the value of hemoglobin to
grams/100 ml.

Total leucocytes

The number of leucocytes in each
sample was measured by an indirect
method described by Coles.2 Acidophilic
cells in each sample were stained with a
1:200 dilution of phloxine stain and then
counted directly on a hemocytometer.
The total percent of eosinophils and
heterophils were counted from the blood
smear. These values were then incorpo-
rated into a formula to determine the
total number of leucocytes present in the
sample.

Differential leucocytes

Blood smears stained with Wright’s
stain were used to determine differential
leucocyte counts.2 A total of 100 cells/slide
were examined to determine the per-
cent of heterophils, eosinophils, lympho-
cytes and basophils.

RESULTS

A summary of the hematological data
for the snow, blue, and Canada geese in
this study is presented in Table 1. Based
on erythrocyte counts, species differences
were significant (P < 0.05) when tested
by analysis of variance.3 Erythrocyte
values for Canada geese were significantly
lower than those for either snow or blue
gleese; however, snow and blue geese
differences were similar to each other. This
apparent species difference was not de-
tected when comparing other hematologic
parameters in this study.

Based on the results of the hematol-
ogical measurements in this study there
were no differences in sex-specific hema-
tologic values within a given species of
goose (Table 1).

*Coulter Electronics Co., Hialeah, Florida.
All three species of geese had similar leucocyte values; therefore, to eliminate the presentation of duplicate data only leucocyte data for the blue geese were recorded (Table 3).

In all three species of geese, erythrocyte, hematocrit, and hemoglobin measurements varied with the season of the year (Table 2). These seasonal tendencies did not exist for total or differential leucocyte counts. An increase in the number of erythrocytes in each species occurred during the winter, peaked in March, and declined during the summer with the lowest values recorded in September (Fig. 1a). Hematocrit (Fig. 1b) and hemoglobin values (Fig. 1c) had similar seasonal patterns with the highest values recorded in the spring and the lowest in the fall.

The least variability in values was recorded for hematocrit and hemoglobin measurements, while basophil, eosinophil, and monocyte counts had the largest coefficients of variability.

DISCUSSION

Some of the apparent differences in hematological values recorded in this study are of interest and may be related to other physiological changes of the geese. As noted above, seasonal patterns in erythrocyte counts were recorded for snow, blue, and Canada geese. Similar seasonal tendencies have been reported in other avian species such as doves, pigeons, chickens and canaries.8,11,12,16 The high erythrocyte counts observed during the spring may have been due to increased metabolic processes and hormone levels associated with reproductive behavior and migratory activity. It has been reported that hormones such as thyroxin,

| TABLE 1. A summary of grand mean hematological data, including average values for both sexes and the range of monthly means for snow, blue, and Canada geese. |
|-------------------------------------------------|-------------------|-------------------|-------------------|
| Measurement                                    | Snow              | Blue              | Canada            |
| Erythrocytes (10⁶/mm³)                         |                   |                   |                   |
| Grand mean                                     | 2.24              | 2.25              | 2.01              |
| Male                                           | 2.24              | 2.26              | 1.98              |
| Female                                         | 2.25              | 2.24              | 2.06              |
| Hematocrit (percent)                           |                   |                   |                   |
| Grand mean                                     | 45.7              | 46.0              | 45.4              |
| Male                                           | 45.6              | 46.6              | 45.1              |
| Female                                         | 46.1              | 45.8              | 46.0              |
| Hemoglobin (gm/100 ml)                         |                   |                   |                   |
| Grand mean                                     | 14.5              | 14.0              | 14.3              |
| Male                                           | 14.2              | 14.7              | 14.1              |
| Female                                         | 14.6              | 13.8              | 14.4              |
| Total Leucocyte (10⁹/mm³)                      |                   |                   |                   |
| Grand mean                                     | 20.1              | 19.3              | 20.8              |
| Male                                           | 19.7              | 18.8              | 20.4              |
| Female                                         | 21.0              | 20.7              | 21.8              |
TABLE 2. A summary of monthly mean erythrocyte, hematocrit and hemoglobin values of snow, blue, and Canada geese.

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** ( ) = one standard error.
* RBC = erythrocytes, PCV = hematocrit, and HB = hemoglobin.
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<td>(40)</td>
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* WBC = 10³/mm³, differential counts = percent.
** ( ) = one standard error.
FIGURE 1. Seasonal variations of erythrocyte (a), hematocrit (b), and hemoglobin (c) values of snow, blue, and Canada Geese.
estrogen, and androgens influence hematological measurements. The second increase in the number of erythrocytes in all three species that occurred during October, may be the result of changes in the physiological state of the geese associated with fall migratory behavior.

In general, the hematological measurements recorded in this study for all three species were similar; although, Canada geese had a significantly lower mean erythrocyte value than either snow or blue geese. This relationship was the same for the Canada geese held at the Wilkie Brothers Foundation and for the substituted Canada geese kept at the Charmany Research Center. Since larger species normally have larger erythrocytes, it is conceivable that Canada geese have larger cells than snow or blue geese, thus accounting for the higher hematocrit and hemoglobin values recorded for Canada geese.

Based on a number of anatomical and behavioral characteristics, most ornithologists consider the blue and snow goose to be color phases of a single species. The hematological results of this study support this single species contention.

Although it is commonly reported in other avian species that males have higher erythrocyte counts than females, there were no obvious sex differences detected in this study. A partial explanation for this lack of sexual dimorphism may involve diurnal erythrocyte cycles. Such a cycle exists in chickens and males have lower values at noon than at any other time of the day. The geese in this study were bled in the late morning, a time when males may have had the lowest numbers of circulating erythrocytes, possibly resulting in low counts.

The hematological values recorded for Canada geese in this study are comparable to limited data available. Hemoglobin concentrations are similar to those reported for several Canada geese by Dukes and Schwarte. Heterophil and basophil percentages are comparable with those of Lucas and Jamroz, while lymphocyte counts were approximately 30 percent higher and eosinophil and monocyte values are nearly 80 percent lower. Hematological data for snow and blue geese were not available for comparison.

The limitations of this hematological study both in sample size and environmental conditions are appreciated, but the results do provide valuable baseline physiological data which adds to our basic knowledge of the snow, blue, and Canada goose.

Acknowledgements

The authors express their appreciation to Dr. M. Friend for his statistical advice; to R. A. Hunt for providing the geese used in the study; and to K. Sheetz of the Wilkie Brothers Foundation and to personnel of the Wisconsin Alumni Research Foundation for their technical assistance.

LITERATURE CITED


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