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A HEMATOLOGIC SURVEY OF CAPTIVE WATERFOWL[1]

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Abstract: Hematologic parameters were studied in giant Canada geese (*Branta canadensis maxima*), mallard ducks (*Anas platyrhynchos platyrhynchos*) and various species of diving ducks at seasonal intervals throughout the year. Highest values for packed cell volume, hemoglobin content and erythrocyte counts were found in the winter and pre-nesting periods. Mean corpuscular volume and mean corpuscular hemoglobin varied inversely with these values.

INTRODUCTION

As waterfowl management practices become more precise, there is increasing interest in physiologic values. Status of health is an important population factor in birds that congregate in large numbers on refuges. Hematologic parameters can act as indicators for the state of health of an animal, since many diseases and other abnormal situations are accompanied by changes in the hemogram. However, normal seasonal variations may be confused with disease-associated changes. This study was undertaken to determine seasonal changes in hematologic parameters of geese and ducks.

MATERIALS AND METHODS

Captive flocks of waterfowl are maintained at the Northern Prairie Wildlife Research Center, Jamestown, North Dakota. Giant Canada geese (*Branta canadensis maxima*), 10 males and 7 females, represented the tribe *Anserini*. Common mallard ducks (*Anas platyrhynchos platyrhynchos*), 4 males and 7 females, represented tribe *Anatini*. A total of 14 diving ducks represented the tribes *Aythini* and *Oxyurini*. These included two male and two female canvasbacks (*Aythya valisineria*), one male and one female greater scaup (*Aythya marila*), two female redheads (*Aythya americana*), one female lesser scaup (*Aythya affinis*), one female ringneck (*Aythya collaris*), and two male and two female ruddy ducks (*Oxyura jamaicensis*). The mallards, lesser scaup and redheads had been hatched in captivity from wild eggs. The remaining birds were from stock that had been in captivity no more than two generations. All were adults. Diving ducks in this study were maintained throughout the year in a flock situation in an outdoor pen; they had access to a pond and indoor protection during cold weather. Geese and mallards were kept in low metal sheds during winter, with no extra heat source. At other seasons pairs were placed in outside, fenced enclosures with concrete pools. Mallards and geese were successful breeders; diving ducks were only partially successful. The waterfowl were maintained on a custom pelleted ration and water *ad libitum* throughout the study period. The composition of the ration was calculated to be 18.0% protein, 3.8% fat, 3.8% fiber, 55.3% nitrogen free extract, and 6.4% ash.

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Blood samples were taken from ducks and geese during the winter (January), the pre-nesting period (March), the post-nesting period (June for geese, July for ducks), and the migratory period (October). Samples were drawn between 1000 and 1300 hrs to eliminate diurnal variations. Two ml of blood were withdrawn from the brachial vein into tubes containing 1 drop of 10% EDTA. Blood smears for differential counts were made immediately. Due to the distance from the Research Center to the laboratory, there was a 24 hr delay in all other tests; therefore, blood tubes were chilled until tested.

Erythrocytes were counted with a Coulter Counter, Model F. Packed cell volume (PCV) was determined by centrifuging blood 5 min in capillary tubes in a micro-hematocrit centrifuge. The hemoglobin values in grams % were determined by adding 20 microliters of blood to 6 ml of Drabkin's solution, centrifuging at 1300 rpm for 10 min, reading the optical density of this solution at 540 nm on a spectrophotometer, and multiplying the results by 31.6.[6] Leukocytes were counted using the phloxine method of Wiseman.[7] The percentage of various leukocytes was determined by counting 100 cells on blood smears stained with Wright's stain. Statistical significance was determined by the *t* test[5] at the 95% confidence level.

RESULTS

Leukocyte and differential counts were erratic; however, there seemed to be a trend toward lower leukocyte numbers in the summer and fall, accompanied by an increase in heterophils. Due to the extreme variability, and questionable validity, these values were not tabulated.

Table 1 presents a summary, by season, of hematologic values for Canada geese. Values for males and for females did not vary significantly. Winter and pre-nesting averages for PCV, hemoglobin, erythrocyte count, and mean corpuscular hemoglobin concentration (MCHC) were higher than the post-nesting and fall averages. Post-nesting mean corpuscular hemoglobin (MCH) was higher in the fall. Post-nesting mean corpuscular volume (MCV) was higher than in the winter or pre-nesting periods.

A summary, by season, of hematologic values for mallards (Table 2) indicates there were no significant differences between values for males and for females. As with the geese, winter and pre-nesting averages for PCV, hemoglobin, erythrocyte count and MCHC were higher than post-nesting and fall averages. Fall averages were higher than post-nesting. MCV and MCH were higher post-nesting and in the fall. Winter MCHC values were highest of any period.

Due to insufficient numbers in any one species of diving ducks for statistical evaluation, hematologic values for 6 species were grouped (Table 3). As would be expected, greater variations were found here than in the mallards and geese, due to the heterogenicity of the group. Females had higher PCV values pre-nesting and higher PCV, hemoglobin and erythrocyte counts post-nesting than males. Winter and pre-nesting PCV and erythrocyte counts for all the diving ducks were higher than post-nesting or in the fall, while post-nesting and fall MCV and MCH were higher.

Significant variations existed between species (Fig. 1). In the winter, mallards had higher erythrocyte counts than divers. During the pre-nesting period, mallards had higher erythrocyte counts and PCV values, while divers had higher MCV and MCH values. During the post-nesting period divers had higher PCV, hemoglobin and MCHC values. In the fall, divers had higher MCHC values and mallards had higher PCV values. In winter, both groups of ducks had higher erythrocyte counts than geese while geese had higher MCV and MCH values. During pre-nesting, geese had higher hemoglobin, MCV and MCH values than the ducks.

DISCUSSION

Hanson[2] evaluated the physical condition of Canada geese at various periods by determining body weight and weights of various tissues. He found the highest weights at or near the end of spring

TABLE 1. Hematologic values for Canada geese.

	January	March	June	October	January	March	June	October
	PCV (%) (means ± standard dev.)				MCV (u^3)			
10 Males	51±3.1	52±2.1	46±3.7	45±2.1	197.4±16.2	194.1±22.6	209.2±19.2	199.6±18.5
7 Females	51±3.1	52±6.1	46±3.1	45±4.0	187.5±16.6	180.6±14.8	211.3±21.0	197.8±17.4
Both Sexes	51±3.1	52±4.0	46±3.5	45±3.3	193.3±16.6	188.5±20.4	210.1±19.4	198.8±17.5
	Hemoglobin (gm%)				MCH (uug)			
10 Males	16.2±1.0	17.1±1.4	13.8±1.3	13.5±0.6	62.4±5.2	63.8±7.3	63.9±3.7	58.6±6.2
7 Females	16.2±1.1	17.1±0.6	14.2±1.1	13.7±1.4	59.3±5.2	60.0±7.6	65.2±7.8	60.4±5.2
Both Sexes	16.2±1.0	17.1±2.0	14.0±1.2*	13.6±0.9*	61.1±5.3	62.3±7.4	64.4±5.6	59.4±5.7
	RBC ($X10^6/mm^3$)				MCHC (%)			
10 Males	2.62±0.3	2.70±0.3	2.16±0.2	2.32±0.2	31.6±0.1	32.9±1.5	30.7±1.4	29.4±2.1
7 Females	2.75±0.3	2.88±0.4	2.20±0.2	2.28±0.3	31.7±0.1	33.2±1.9	30.8±1.4	30.6±2.5
Both Sexes	2.67±0.3	2.78±0.4	2.18±0.3*	2.30±0.2*	31.6±0.1	33.0±1.7	30.7±1.4*	29.9±2.3*

* Significantly different from mean March values, $p < 0.05$.

TABLE 2. Hematologic values for mallards.

	January	March	July	October	January	March	July	October
	PCV (%) (means ± standard dev.)				MCV (u^3)			
4 Males	50±2.1	51±3.0	38±5.6	46±4.6	156.4±14.1	144.5±12.3	217.8±30.6	177.6±4.75
7 Females	49±2.7	49±2.8	40±5.1	45±2.6	143.8±13.5	129.9±21.2	189.2±21.5	191.7±27.6
Both Sexes	49±2.5	50±2.9	39±5.1*	45±3.3*	148.4±13.7*	135.2±15.3	199.6±27.7*	186.6±23.7*
	Hemoglobin (gm%)				MCH (uug)			
4 Males	15.9±0.7	15.2±0.5	10.6±0.9	13.0±0.8	49.5±3.6	43.4±3.9	62.0±12.5	51.2±7.8
7 Females	15.4±0.8	15.0±1.0	11.9±1.7	13.8±0.5	45.5±2.4	39.4±3.1	56.0±4.6	58.6±17.0
Both Sexes	15.6±0.8	15.0±0.9	11.4±1.6*	13.5±0.7*	46.9±4.4	40.9±4.3	58.2±8.3*	55.9±11.7*
	RBC ($X10^6/mm^3$)				MCHC (%)			
4 Males	3.23±0.3	3.53±0.3	1.78±0.4	2.74±0.8	31.6±0.0	30.0±0.7	28.3±1.6	28.6±2.7
7 Females	3.42±0.4	3.81±0.4	2.14±0.4	2.38±0.3	31.6±0.1	30.4±2.2	29.7±2.1	30.7±1.9
Both Sexes	3.35±0.3	3.71±0.4	2.01±0.4*	2.51±0.5*	31.6±0.2*	30.3±1.8	29.2±2.0	29.9±2.3

* Significantly different from mean March values, $p < 0.05$.

TABLE 3. Hematologic values for diving ducks.

	January	March	July	October	January	March	July	October
	PCV (%) [a]				MCV (u^3)			
5 Males	49±5.1	44±3.6	42±2.2	42±3.6	176.1±23.0	178.0±28.1	214.6±29.0	204.6±41.8
9 Females	48±6.2	48±3.3	46±4.1	42±2.9	160.2±33.4	171.0±21.0	189.5±27.9	188.0±25.3
Both Sexes	48±5.7	46±3.9	44±4.0	42±3.0	165.8±30.2	173.5±19.6	198.5±29.9	194.0±31.6
	Hemoglobin (gm%)				MCH (uug)			
5 Males	15.4±1.6	14.7±0.9	12.5±1.5	14.6±1.3	55.6±7.3	59.8±7.9	63.8±5.0	61.1±11.3
9 Females	15.2±2.0	14.8±1.4	15.2±1.6	14.0±1.6	50.7±10.6	53.9±11.0	62.8±8.9	63.7±13.2
Both Sexes	15.3±1.8	14.7±1.2	14.2±2.0	14.2±1.5	52.4±9.5	55.6±10.2	63.2±7.5	62.8±12.2
	RBC ($X10^6/mm^3$)				MCHC (%)			
5 Males	2.80±0.4	2.49±0.4	1.97±0.3	2.12±0.4	31.6±0.1	32.6±0.1	30.0±2.9	34.5±2.0
9 Females	3.07±0.4	2.81±0.4	2.45±0.3	2.24±0.3	31.7±0.1	31.0±3.2	33.3±3.6	33.8±5.0
Both Sexes	2.98±0.4	2.71±0.4	2.28±0.4	2.20±0.3	31.6±0.1	31.5±2.7	32.1±3.6	34.1±4.0

[a] All values are mean ± standard deviation

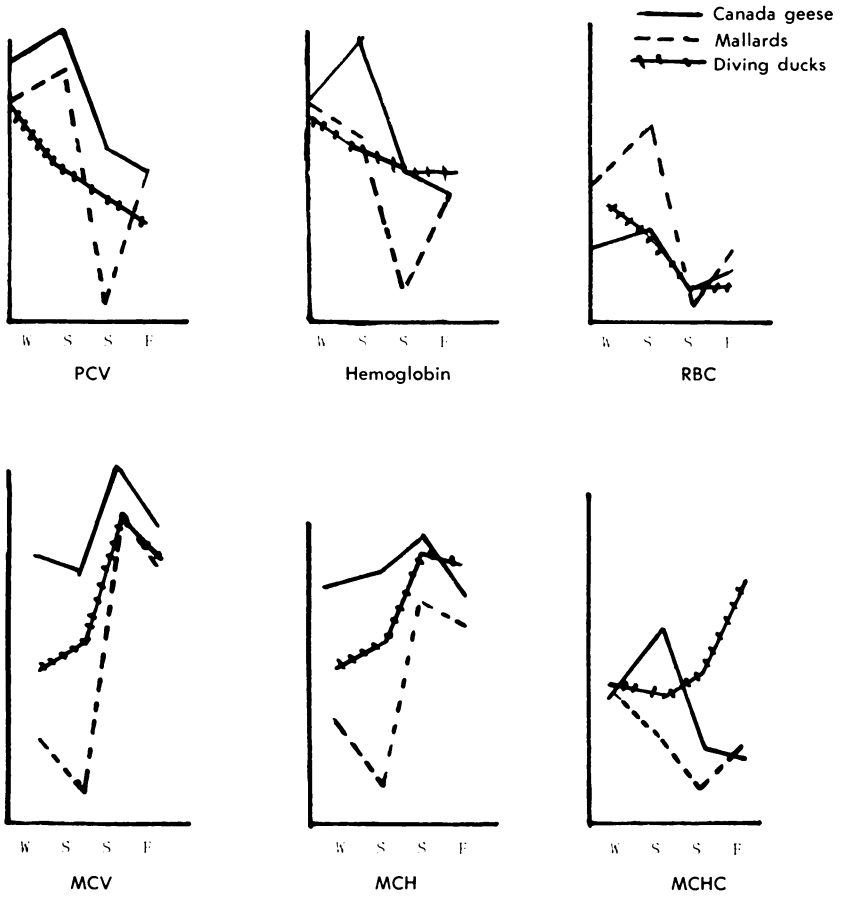

FIGURE 1. Seasonal variations in hematologic values of mallards, diving ducks and geese.

migration and during the fall migration period. Although the birds in this study did not migrate, presumably they were under the same hormonal stimuli as migrating birds. Hanson found that minimum body weight was obtained during the non-flying stages of the molt. Body weights of wintering geese depended on management, food supplies and population size. The hematologic values determined in this study correlate with Hanson's findings. The lowest oxygen carrying capacity occurred post-nesting, while the highest values occurred pre-nesting. The high winter values would indicate that the birds were under little stress.

Hemm and Carlton,[3] in reviewing publications concerning duck hematology, noted that varying methods and small numbers of specimens yielded widely divergent results in early publications. According to Bond and Gilbert,[1] higher erythrocyte counts occur in dabbling ducks and slightly higher hemoglobin values in diving ducks. This study found the same correlation during the winter and pre-nesting periods.

Kocan[4] studying winter blood values of diving ducks, found a tendency toward higher PCV values and erythrocyte counts for female canvasbacks and scaup. This tendency was found only during the post-nesting period in this study.

Williams and Trainer[6] studied hematologic parameters of captive Canada geese at monthly intervals throughout a year. Their findings are corroborated by this study; in addition they found a peak in hemoglobin values during early summer.

The present work involved captive birds under controlled conditions. The actual stresses of migration, having to search for food and safety, and other factors faced by birds in the wild are not reflected. However, certain seasonal fluctuations are evidenced that are helpful in evaluating the physiological status of waterfowl.

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